



NURSERY MANUAL

Nagaland Forest Management Project (NFMP)





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Nagaland Forest Management Project**



**CHIEF MINISTER
NAGALAND
KOHIMA
MESSAGE**

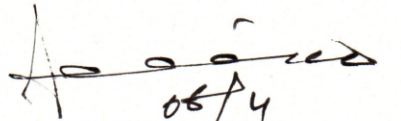
6th April, 2021

I am happy to know that the Nagaland Forest Management Project (NFMP), a Japan International Cooperation Agency (JICA) assisted program under Department of Environment, Forest and Climate Change, Government of Nagaland, is bringing out manuals which will ensure dissemination of knowledge and effective implementation of the project.

I am confident that these Manuals will facilitate proper execution of the project activities in a transparent and participatory manner and help guide all stake-holders, ranging from officials to village communities as well as the field NGOs and SHGs.

The Nagaland Forest Management Project (NFMP) is a process driven and result oriented approach through the use of modern scientific technologies including GIS and MIS for planning, implementation and monitoring of various activities and it is being implemented by the Communities in Villages. The concept of implementation is laudable, and I am sure that this will go a long way in improving forest ecosystems, support income generation through rehabilitation of Jhum areas and enhance the livelihood opportunities.

I wish the Nagaland Forest Management Project a grand success.


(NEIPHIU RIO)

FOREWORD

Nagaland have more than 3/4th of its geographical area under forest cover. Being a rural and tribal dominated society the dependency of a large population on forest resources is undeniably evident. Importantly, about 2/3rd of total work force of the state depends on agriculture and allied activities. Jhum cultivation in different forms is the most dominant farming system in the state, although facing productivity related challenges at multiple levels. Nagaland Forest Management Project (NFMP) aims to rejuvenate about 79,000 ha area of forest and jhum lands through different forestry and agroforestry plantation models.

For the common public, tree planting is the most direct and visible activity under NFMP. There is a growing awareness of the environmental and economic benefits of maintaining multipurpose trees in jhum as well as in forest areas. This created widespread support and generate participation in afforestation projects like NFMP. More importantly, such large-scale afforestation program creates employment opportunities for local people. NFMP works on this agenda through village level Joint Forest Management Committees (JFMC).

Under NFMP, the provision of quality planting materials to village communities is planned through decentralized JFMC Nurseries. This manual on nursery development and production and handling of saplings is an attempt to standardize the nursery operations in project areas.

It is with high hope this manual will create enough operational capabilities in all who are part in the process of arresting the depleting forest resources and restoring jhum areas of the State. I am sure that this manual will also be quite handy to plantation work of State Forest Department.

**Dharmendra Prakash, IFS
PCCF & HOFF
Chief Project Director and CEO**

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PREFACE

The 'Manual for Development of JFMC Nurseries' is a timely prepared document which may facilitate rejuvenation of jhum and forest areas of the State, one of the important components of Nagaland Forest Management Project (NFMP). This is planned through five different plantation models specifically designed for different typologies of jhum & forest areas of the State.

Production of large number of quality tree saplings from decentralized, community-owned JFMC nurseries is an ambitious component of the project. Thus, transfer of technical know-how of systematic raising of saplings in nurseries to the local people, is essential. This manual aims to provide technical and operational details to create a workable nursery and also enable the production of quality tree saplings.

The manual is prepared for the field use by JFMC members and concerned front-line forest department personnel who supervise the nursery related activities in field. The manual provides two levels of guidance for field implementors. First, providing in brief, key steps needed to develop and operate nurseries as checklist of tasks. These Standard Operating Procedures (SoPs) may find usefulness in day to day functioning and monitoring of nursery related operations. Second, giving the detailed operational tips for development of JFM nurseries and raising different types of saplings in these nurseries. Among the topics covered are the nursery establishment, tending, handling and safe transporting of saplings and the maintaining the nursery register.

Section A. Background

1. About NFMP

The poverty ratio in Nagaland had increased by 10% from 2004 to 2011 unlike other States. This percentage is also higher compared to other North-Eastern States. The high increase in poverty among rural population is due to geographical remoteness, inaccessibility and lack of infrastructure. In such a situation, 60% of the total population in the State relies on natural resources (agriculture and forest) for their living. Forests constitute about 75% of the total geographical area, and within this jhum- farming is the predominant land-use.

The Nagaland Forest Management Project (NFMP), with the financial assistance from Japan International Cooperation Agency (JICA) is being implemented to strengthen the forestry sector of the State, with long term goals of environmental conservation and poverty alleviation. The project will be implemented in 10 years¹.

NFMP Objectives

- Strengthening conservation regime through community participation
- Livelihood opportunities for enhanced household incomes through convergence
- Institutional strengthening

The project aims to improve the forest ecosystem by promoting sustainable jhum and forestland management and biodiversity conservation. These are planned to achieve through Joint Forest Management (JFM) approach with harmonized socio- economic development of local communities.

NFMP proposes to undertake forest and biodiversity management work in 185 villages of 11 forest divisions and 22 forest ranges / beats. The project targets to cover 79096 ha. area under five different forestry and biodiversity conservation models, focusing jhum lands, forest lands and community conservation areas (Table 1).

Table 1: Matrix showing application of forest & biodiversity models across land-use types

Model Type	Active Jhum Block	Discontinued Jhum Block	Open/ Degraded Forest	Forest Reserves & Conservation Block
Jhum Agroforestry (JAF)	✓			
Jhum Fallow Forestry (JFF)	✓			
Jhum Conversion to Forestry (JCF)		✓		
Jhum Conversion to CCA (JCC)		✓		
Protection & Expansion of CCA (PEC)			✓	✓

Based on the objective of management like harvesting of benefits and/or conservation of forests and biodiversity, NFMP proposes maintenance of varying tree densities in five different models through methods of (i) Artificial Regeneration (AR) or new plantation and (ii) Assisted Natural Regeneration (ANR).

In case of AR, new plants will be made available from two major sources: saplings raised in the nursery and collecting naturally available wildlings, cutting etc. In the nursery, two types of saplings will be raised for plantation purpose (i) naked root and (ii) container, preferably in 50:50 ratio.

Thus, the project requires about 16.5 million saplings are required to facilitate plantations in five forestry and biodiversity models (Table 2). Considering the fact that plantation work will be

¹ Project period is from 2017-18 to 2026-27, with clearly distinguished phases of implementation viz. preparatory phase, implementation phase and consolidation and exit phase.

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Undertaken in three batches spread over the three years, the average yearly requirement of saplings will be around 5.5 million.

Model	Target Area (ha)	Proposed Tree Density (No. per ha)	New Plants to be Raised (No. per ha)				Total Polybag & Naked Root Sapling to be Raised (including 20% mortality replacement (No. in Lakhs))
			Total ²	Sapling (Polybag)	Sapling (Naked Root)	Other Planting material (like cutting, suckers, wildlings, bamboo culms etc)	
JAF	10325	800	400	200	200	0	49.6
JFF	4594	1250	625	156	156	313	17.2
JCF	4594	625	625	156	156	313	17.2
JCC	3697	625	625	156	156	313	13.9
PEC	55886	200	200	50	50	100	67.1
Total	79096						165.0

1. User of Manual

This manual aims to provide details of different aspects of nursery establishment and development and provide specific guidelines on technical issues for field implementation. Thus, this manual aims to guide JFMC members, frontline staff of Forest Department and technical staffs under NFMP, who will be engaged in planning, establishment and management of nurseries in project villages.

2. Organization of the Manual

Manual is divided into five sections. Section A provides the background of the project and need of planting materials for different forestry models. Section B provide Standard Operating Procedures (SoP) for nursery establishment and tending of sapling raising operations. Section C describes the availability and management of quality seeds for raising the nursery plants. Section D details out the principles and methods of development and management of nurseries with respect to NFMP. Section E provides nursery management of some important tree species of Nagaland.

² Remaining tree density will be raised through ANR methods (like coppicing, etc.)

Section B: Standard Operating Procedures (SoP)

1. Nursery Development

- Step 1:** Measuring the demand of Saplings for all the Forestry Models for one year (including up to 20% casualty replacement).
- Step 2:** Based on the demand, estimate the area need for nursery.
- Land Total Area = Production Area (75%) + Facilities /Supporting Areas (25%)
- Step 3:** Selection of appropriate site, based on given criteria (*refer Section D-1.1*)
- Step 4:** Once nursery site is allocated, prepare a layout map keeping in view the orientation of east west directions (to avoid shade effect)
- Step 5:** Preparation of site for nursery purpose (clearing, levelling, terracing, pitching to harden the land)
- Step 6:** Arrange year-round watering source or water storage facilities in nursery site
- Step 7:** Testing of nursery soil to check the pH (ideally it should be between 5.5 to 6.5) and other essential nutrients and minerals.
- Step 8:** Construction of mother beds for germination and construction of raised transplanting beds for naked root saplings, container beds for placing containers. The germination bed or raised bed follow uniform size (*refer Section D-4*)
- Step 7:** Construction of shade-house over the mother bed, raised beds and container beds to protect seedlings from sun-heat, frost, wind and rains.

2. Sapling Raising Operation

- Step 1:** Measuring the species-specific demand of Saplings for all the Forestry Models for next year's plantation cycle, during the micro-plan preparation time
- Step 2:** Measure the species-specific demand of different types of planting materials like naked root, container, wildling or stem-cutting
- Step 3:** Identification of Plus Trees of selected species (*refer Section C-1*)
- Step 4:** Collection of required quantity of seeds from Plus trees (whenever the seeding happened) (*refer Section C-2*). Alternatively, JFMC can borrow/purchase seeds from local seed collectors other nearby JFMCs of earlier batch. Avoid borrow/purchase of old seeds.
- Step 5:** Procurement of required numbers of planting containers (polybags, cloth, bamboo etc). Size of the container for small saplings 15 -20cm x 23-27 cm and for larger saplings 35 cm x 40 cm (*refer Section D-4.2*)
- Step 6:** Testing of nursery soil to check the texture, pH and other essential nutrients and minerals. Prepare potting/ sowing soil by using soil testing results. If needed, add sand, FYM, Pig-dung manure, lime, etc. to make the growing medium (soil) suitable to use in nursery beds and filling the containers (*refer Section D-5*)
- Step 7:** Conduct pre-germination test with appropriate seed treatment to break the dormancy (*refer Section E-Table 6*)
- Step 8:** Seed sowing in mother beds (germination bed) and containers (*refer Section D-6*)
- Step 9:** Check status of germination every 2nd or 3rd day so that to assess the need for more germination beds to prepare.
- Step 10:** Start maintaining nursery register and record the saplings raised (*refer Section D-9*)
- Step 11:** Undertake Tending Operations:
- Check saplings for their vertical position, every week for first 8 weeks
 - Weed control in naked root nursery beds, every month (*refer Section D-7.1*)
 - Singling in container, once after 3-5 weeks of seed germination (*refer Section D-7.2*)
 - Pruning of saplings, if necessary, every 2 weeks) (*refer Section D-7.3*)
 - Watering of saplings, at every 2nd or 3rd day depending upon the weather condition and stage of growth; avoid over watering; need special care during the months of January and March, when there is water scarcity.
 - Examination of pest and disease at every week and control measure (*refer Section D-7.5*)
- Step 12:** Transfer of seedling from mother bed or germination bed to containers; check if the roots are not coiled or bent too much.
- Step 13:** Assess the mortality of saplings every week and ensure the replacement.
- Step 14:** Grading of saplings. Avoid using inferior quality (or grade 3) saplings for planting purpose. Grade 3 saplings can be allowed to grow in nursery so that they can be used as mortality replacement (*refer Section D-7.4*)
- Step 15:** Arrange the bags, boxes and wrapping materials for transportation of saplings
- Step 16:** Transporting of saplings to planting sites; saplings need to be moistened, properly packed especially naked-root plants; (*refer Section D-8*)

3. Costing of Nursery Development

#	Item of work of Material	Unit [#]	Container Sapling	Naked Root Sapling
1	Making of nursery bed (10 m x 1.22 m) including soil work, manuring & edging the bed	Man Days	2	2
2	Cost of Compost/ Soil Conditioners/ Manures/Insecticides/Fungicides, Hormones	INR	2000	2000
3	Provision of shade over nursery bed			
3.1	Cost of Polythene sheet/ thatching leaves/Toko leaves	INR	700	700
3.2	Bamboo poles - 15 nos.	INR	900	900
3.3	Labour charge for making nursery shed	Man Days	2	2
4	Collection / procurement of seeds for one bed	INR	1000	1000
5	Sowing of seeds	Man days	1	1
6	Cost of Polythene bags (12.5 x 18 cm) (1600 Nos)	INR	600	NA
7	Preparation of soil mixture & filling of 1600 Polybags	Man Days	10	NA
8	Transplantation of sapling- germination beds to polybags	Man Days	2	NA
9	Naked Root Sapling- Up-rooting and packing	Man Days	NA	1
10	Weeding and watering of Nursery beds as needed	Man Days	45	23
11	Shifting of Container Sapling (two times)	Man Days	8	NA
12	Total Number of Man Days	Man Days	70	29
13	Total Material Cost	INR	5,200	4,600
14	Total Cost for raising 1440 Saplings (in INR)	INR	18,430	10,081
15	Cost per Sapling	INR	12.80	7.00
16	<i>Material cost per sapling</i>	<i>INR</i>	<i>3.61</i>	<i>3.19</i>
17	<i>Labour cost per sapling</i>	<i>INR</i>	<i>9.19</i>	<i>3.81</i>
# Wage Rate considered in this calculation is Rs. 189.2/- per day				

4. Plan of Operation for JFMC Nursery Development

Table 3: Key nursery related actions at quarterly levels for three year of nursery running (for 2 years of planting cycle and mortality replacement)

#	Key Nursery Related Action	Year-1				Year 2				Year 3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	JFMC Formed	✓											
2	Nursery site selection including request to VC, site evaluation team formation and checking the potentials sites based on criteria.	✓											
3	Physio-chemical testing of nursery soils	✓											
4	Procurement of required numbers of planting containers (polybags, cloth, bamboo etc), FYM, Lime etc.	✓											
5	Prepare potting/ sowing soil using soil testing result & adding FYM/ Lime etc.		✓										
6	Ensure, arrangement of water for nursery activities	✓	✓										
7	Nursery layout finalization and development including land clearing, levelling, hardening, nursery beds making, shade-hut above nursery beds)	✓	✓										
8	Micro-plan ready with measurement of demands of different species for different forestry models		✓				✓						
9	Seed collection/ procurement of different species	✓	✓										
10	Conduct pre-germination test & seed treatment tests for better germination	✓	✓										
11	Start maintaining the Nursery register (every month)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11	Sapling raising operations continue (depending upon the species and planting cycle including casualty replacement)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12	Required number of saplings of different species is ready for planting	✓				✓				✓			
13	Arrange the bags and boxes for transportation	✓											
14	Transporting of ready saplings to field		✓				✓				✓		

5. Responsibility and Accountability

Table 4: Matrix indicating individual responsibility and accountability for completion, monitoring and reporting of different nursery related activities

Nursery related Activities	Completion Accountability	Monitoring & Reporting Responsibility
Assessment of species wise naked root and container sapling to be raised	JFMC Chairman & Forester	RFO
Identification of Plus Trees of different species	Forester & experienced JFMC members	RFO
Collection of seeds from Plus Trees or purchase of seeds	JFMC Chairman & Forester	RFO
Conduct germination test & seed treatment tests	JFMC Chairman & Forester	RFO
Nursery Site Selection	JFMC Chairman & Forester	RFO
Soil testing of nursery soils	Forester	RFO
Procurement of containers, FYM, Basic nursery equipment, bamboo poles, green-shade cover etc.	JFMC Chairman & MS	DFO
Prepare right kind of potting soil with FYM/Lime etc. and filling the container	Nursery In-charge, Forester	RFO
Ensure water / irrigation system	JFMC Chairman & MS	DFO
Nursery development including land clearing, levelling, hardening, nursery beds making, shade-hut above nursery beds	Nursery In-charge & Forester	RFO
Raising of naked root and container saplings of different species and their maintenance (seed sowing, weeding, pest control, pruning, timely watering etc)	Nursery In-charge, Forester	RFO
Maintaining the Nursery register (every month)	JFMC Chairman and MS	DFO
Assessment of mortality of saplings and their replacement (every week)	JFMC Chairman & Forester	RFO
Ensure required number of saplings of different species for planting	Forester & RFO	DFO
Safe transportation of Saplings to plantation site	JFMC Chairman & Forester	RFO

Section C. Seed Management

1. Selection of Plus Trees

The identification and selection of the best trees, also known as 'Plus Trees', which are the source of good quality planting stock, is critical.

Concept of selecting Plus Trees for propagation purpose is to hasten the natural selection of important tree traits to improve next generation crops.

Plus-tree can be described as a tree that appears distinctly superior to the average but, due to its long maturity period, yet not tested for its genetic superiority. The phenotypic superiority can be described in terms of growth, form, productivity, wood density, disease and pest resistance, etc.

While the criteria for selection of plus trees vary with the purpose of raising the plantation like for timber or fodder or fruit, some of the common features of an ideal plus tree may include (Fig. 1):

- Age: Medium aged trees, not very old one
- Height: at least 5-10% superior in height than other comparison trees
- Stem: straight, cylindrical, non-forking, non-twisting, at least 15-20% superior GBH
- Branches: number, not very thick branches, wide branch-angles
- Crown: narrow crown (for timber), high foliage density
- Wood: high wood density, long fiber length (especially for timber species)
- Reproductive capacity: good capacity of flowering and fruiting
- Adaptation: resistance to pests and diseases and water stress

As a thumb rule, selection of a Plus Tree nearer to proposed plantation site may have a better chance of raising a good plant, few other preferable conditions are:

- Selection from natural stands than from plantation areas
- Natural forests without selective felling history
- Site conditions are similar to plantation site
- Select at least 10-15 trees from each forest division

The selection of plus trees can be done at two stages. At first, a greater number of candidate trees can be identified and marked. At second, out of these shortlisted candidate trees, identify only few final candidate trees and marked them with two-red rings on their stem.

Follow the principle of '*no bad trees get selected, let few good trees get discarded*'.

2. Seed Quantity and Collection

Based on the total demand of the saplings, quantity of seed will be determined. Following three factors are critical in estimating the quantity of seeds required:

- ratio of seedlings to viable seeds
- viability of seeds
- purity of seeds

Using the above, the total quantity of seeds to be collected can be computed for different tree species. An example is presented in Table 5 below:

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Table 5: Computation of seed requirement for species (For example of Gomri -Gmelina arborea)

Question	Example Value	Computed quantity of seeds needed	Estimated Requirement Value
What is the average number of plants per ha to be planted?	50	-	-
What is the total area to be covered under plantation each year?	200	-	-
How many plants are to be planted each year?	10,000	-	-
How many batches of plantation under project?	2	-	-
How many saplings need to be produced?	-	10,000 x 2	20,000
What is the germination rate of seeds?	25%	-	-
Total number of seeds needed to provide required number of saplings	-	20000*(100/25)	80,000
How many seeds are there in one kg	2500	80,000 ÷ 2,500	32 kg
What is the purity of seeds?	90%	32 ÷ 0.9	35.5 kg
What is the total seed (in weight) to be collected?	-	-	35.5 kg

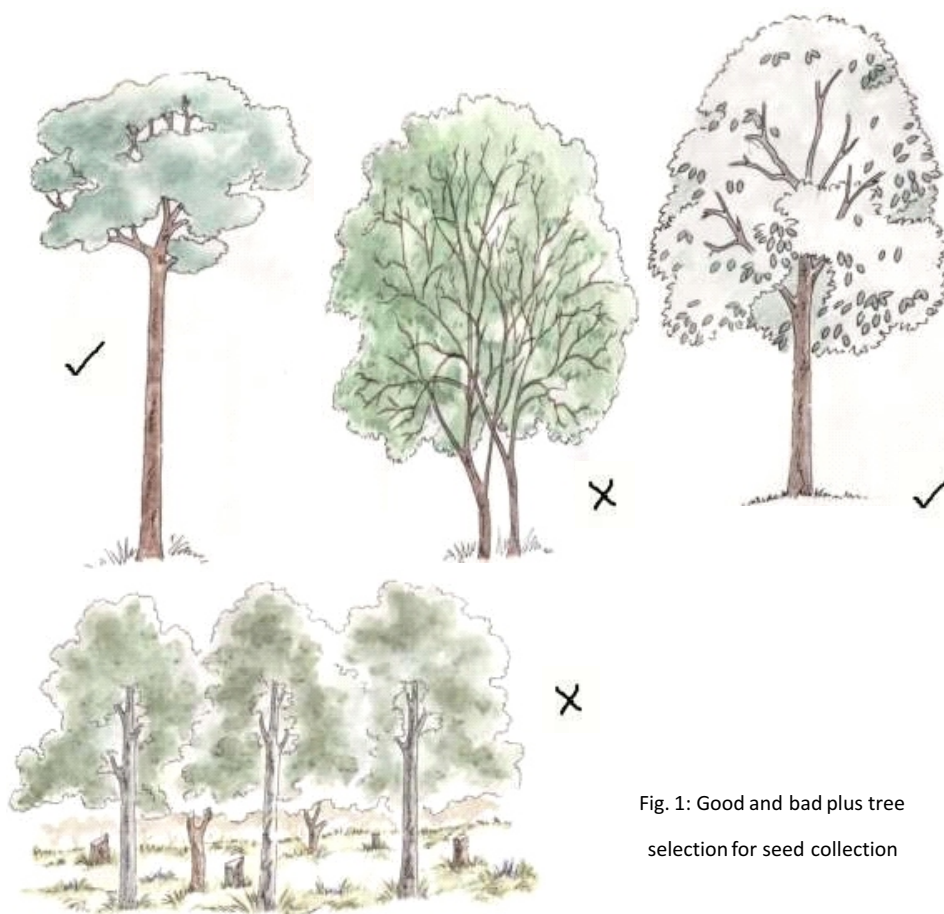


Fig. 1: Good and bad plus tree selection for seed collection

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Some of the key considerations while collecting seeds are:

- Collect a few seeds from as many individual plants of the species as possible. A good rule of thumb is to collect from at least 30 individuals.
- Leave enough seeds as a food source for animals and to ensure the natural reproduction of the plants (Fig. 2)
- Leave an area to rest for at least two growing seasons between collections. Keep in mind that longer periods may be needed for some plant species.

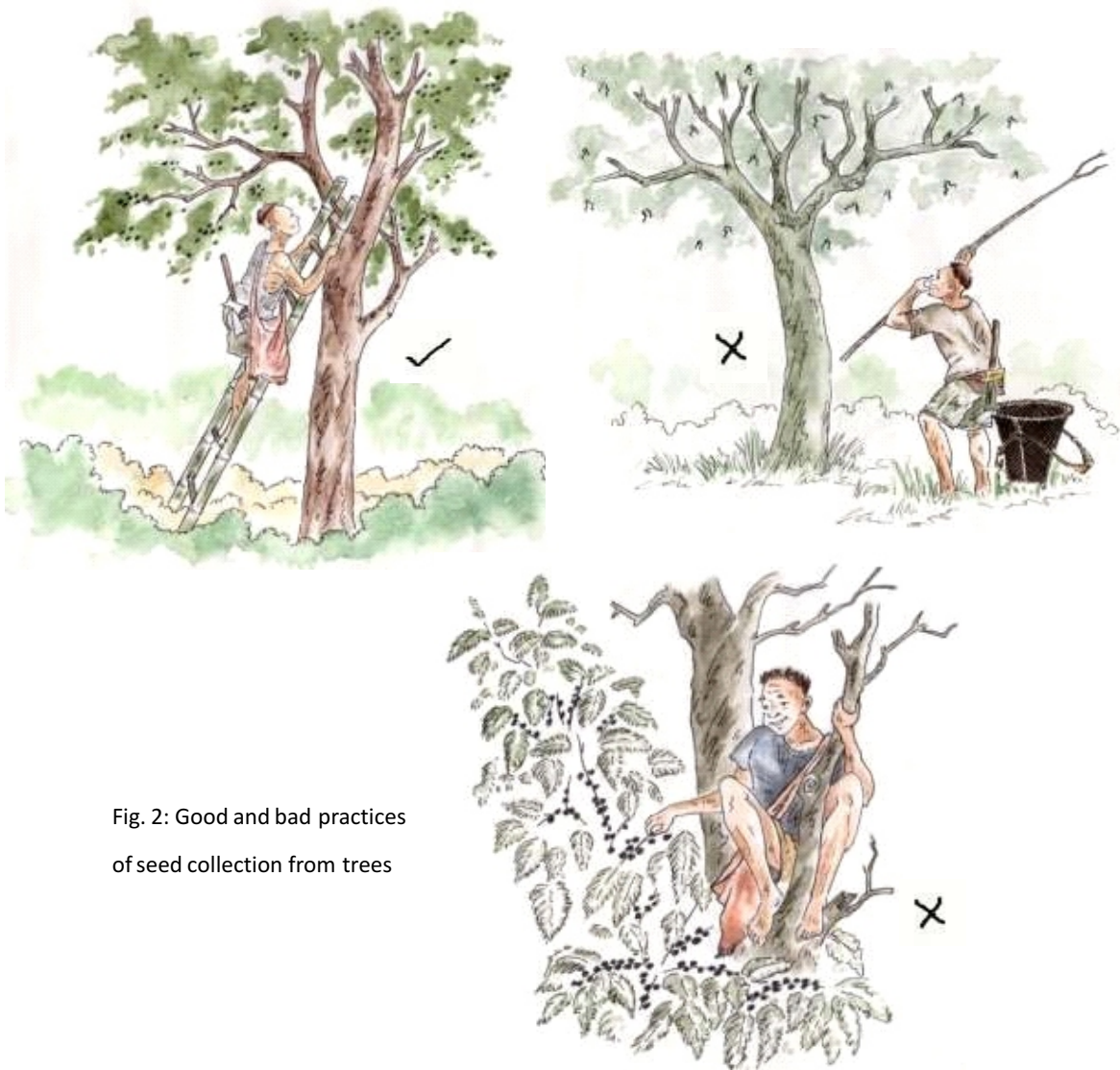


Fig. 2: Good and bad practices of seed collection from trees

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While seed collection from Plus-trees is ideal situation, in natural conditions few other areas from where the seeds can be collected include³:

- Dung or pellet piles of wild animals and birds, like bats, hornbills, bear etc. (Fig. 3).
- Naturally formed trenches and depressions, especially for those seed that disperse through wind. These seeds need to be collected before monsoon sets-in.



Depressions &
trenches in forest
floor



Dungs and pellets
of animals & birds



Shaking the branches and
collect seeds on sacks/clothes

Fig. 3: Different sources of collection of seeds

3 Source: Sharma, S.K. 2019. Van Paudhshala. Sthapna Evam Prabandhan. Himanshu Publication. Udaipur

3. Seed Dormancy and Treatment

Generally, the seeds are ready to germinate in next immediate growing season. However, there are seeds of many species that go for dormancy period and germinate at appropriate times for survival and growth. While the reasons for dormancy varies from one species to other, the impermeable, hard seed-coat is one of the most common which force seeds to pass through dormancy period. Some common seed treatment methods include:



Fig. 4: Different traditional methods and processes of Seed treatment

Soaking. Soaking of seeds in water for a few hours up to several days often gives good results.

Stratification. Many dormant seeds require a cold, moist period before they germinate. One of the easy methods of treatment is called 'sandwich stratification', wherein one layer of seed is placed on moist paper towels / napkins, folded and placed in a plastic zip-lock bag and put in a refrigerator.

Scarification. To treat hard and impermeable seed coats Mechanical (scratching, piercing, chipping), soaking in hot water and in sulphuric acid are three common methods (Fig.4).

Method of treatment of seeds to overcome dormancy and thus facilitating the germination of some of the tree species of Nagaland is described in **Section E**.

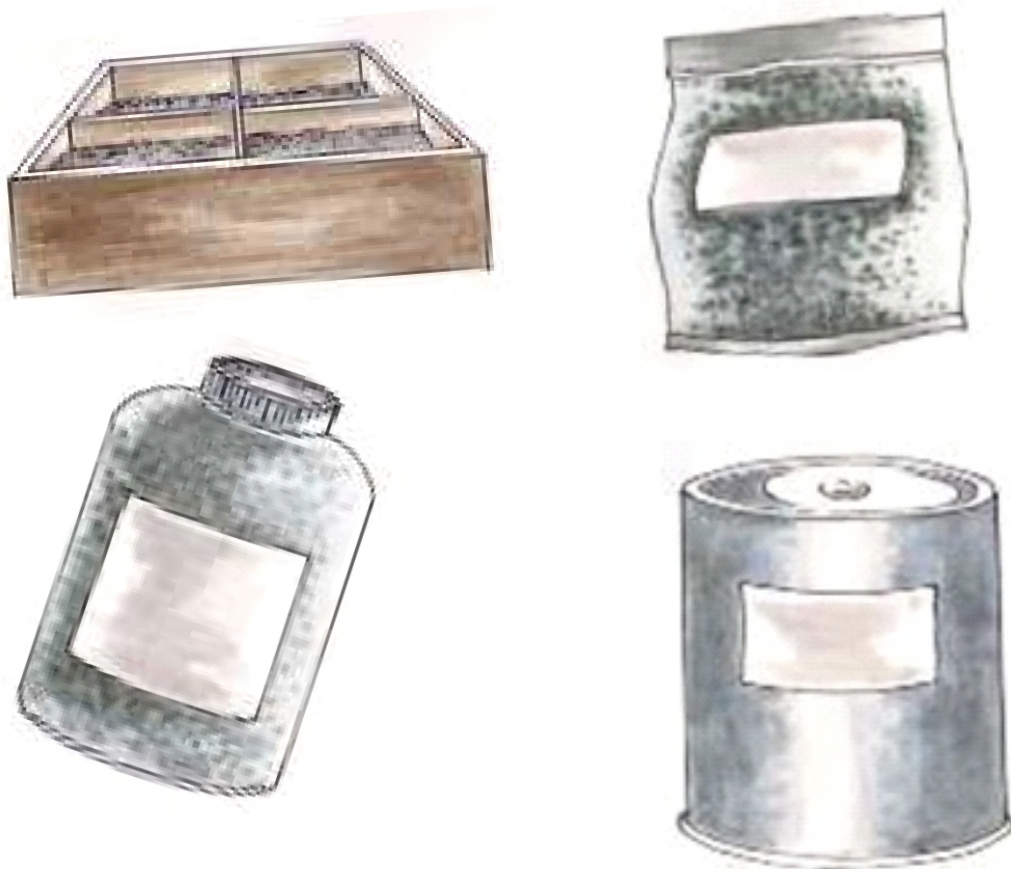


Fig. 5: Different seed storage containers

Section D. Forest Nursery Development

As discussed earlier, about 14 million saplings will be required for plantation in different forestry and biodiversity improvement models in NFMP. One way to achieve this is by promoting decentralized nurseries in the rural areas, through project funding. Thus, NFMP proposes to create 185 JFMC Nurseries, one in each project village. Thus, on an average each nursery needs to raise 90 thousand saplings⁴ during the entire planting years i.e. about 2-3 years. Most importantly, these nurseries will also be one of the means for active involvement and participation of the village community in forest regeneration programmes.

This section describes basic principles of nursery development and key operational settings.

1. Nursery Designing

1.1. Site Selection Criterion for Nursery Development

Some of the factors to be considered for site selection may be:

1. Physical accessibility. All weather road or trails are important to make easy transportation of materials to develop the nursery.
2. Proximity to forest offices (beat or range) will help JFMC members and forest staffs to mobilize labour and other services including the monitoring of plant growth and physical activities. Nearness to planting sites is also important for transportation of saplings.
3. Water availability. Sites near the permanent water source e.g. spring, river, well or piped water, will make water available all the time.
4. Topography and slope. Flatter areas with less than 5% slope are preferred site. Otherwise, wider terraces need to be made. Being in high rainfall zone, sites need good natural drainage to avoid water logging.
5. Surface Soil. The soil of nursery site needs to be deep and firm. Sites with heavy clay soil, and pebbles and stones need to be avoided.
6. Access of sun light. The nurseries must be located on sites with good sun light exposure, Both in daily and growing season terms.
7. Land area. Nursery must be large enough (about 0.5 ha) to have seedling/sapling production area and also to support storage infrastructure & movement of equipment and materials.
8. Frost and Wind. Avoid sites which are subjected to high frosts and high wind which may damage the tender saplings.
9. Insect damage. Avoid sites with termite infestation.
10. Weed. Avoid sites infested with exotic weeds (like Lantana camara, Parthenium etc.).
11. Legal status. Avoid sites having long pending legal or administrative disputes.

Table 6: Assigned weightage to site selection criterion

#	Site Selection Criteria	Criteria Weight
1	Physical Accessibility	10
2	Proximity	10
3	Water Availability	10
4	Access of solar energy	9
5	Topography and Slope	8
6	Frost and Wind	8
7	Land area	7
8	Legal status	7
9	Surface soil	5
10	Weeds	4
11	Insect damage	3

Based on the relative importance in selecting the nursery site in the hilly regions, these criteria are given a weightage (Table 6).

⁴ Total sapling need will be around 74000. Also, 20% saplings (i.e. 15-16000) may also be needed to cover losses at two levels - inferior quality of saplings in nursery and 20% mortality replacement in plantation area. Thus, for a safer side 90000 saplings can be targeted for each nursery.

1.2. Process of Site Selection

- JFMC may send a formal request letter to Village Council (VC) for granting lands for nursery, along with list of site selection criteria.
- For nursery site selection, Member Secretary (MS) of JFMC, who is Range Forest Officer (RFO), must constitute a team of experienced JFMC members and Forester.
- The team must examine all the potential sites for their suitability using all the criterion, and assign an importance score to each, on a scale from one to 10.
- For each site, the importance score given to each criterion will be multiplied by the weight assigned to criteria.
- For each site, the weighted score of all the criteria will be added. The site with highest summed-up score may be considered for nursery development.
- In case, two sites secure same score, then the weighted score of only top 6 criteria should be added to decide the ranking of sites (Fig. 6).
- If VC fails to provide land, JFMC may take suitable land on a rental basis.

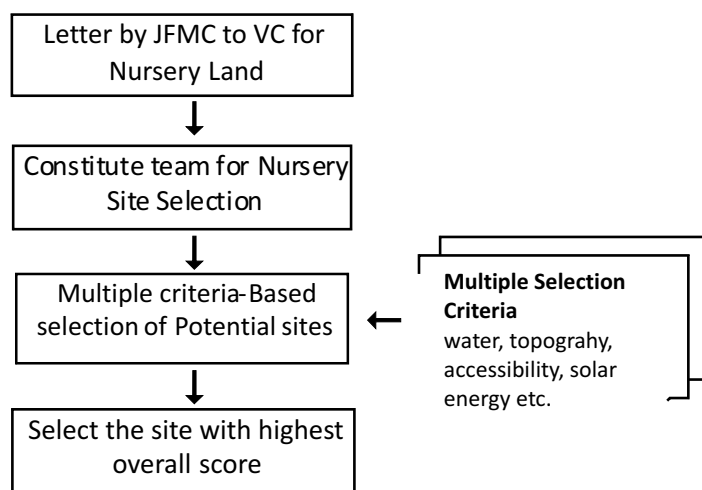


Fig. 6: Important steps in selection of nursery sites

2. Nursery Infrastructure & Layout

The nursery layout is important to manage the seedling production units for making an easy and smooth production process. In general, a nursery should have:

- Water storage facility
- Shed for storing of seeds, tools, containers, bags, compost/fertilizers etc
- A separate working area for preparation of planting medium (soil mixed with compost/fertilizer) and filling the containers (e.g. bags, root trainers, bamboo stems)
- Nursery beds with pathways in between (Fig. 7).
- Size of nursery beds need to be uniform, so that counting & other calculations get easy



Fig. 7: General schematic layout of a nursery

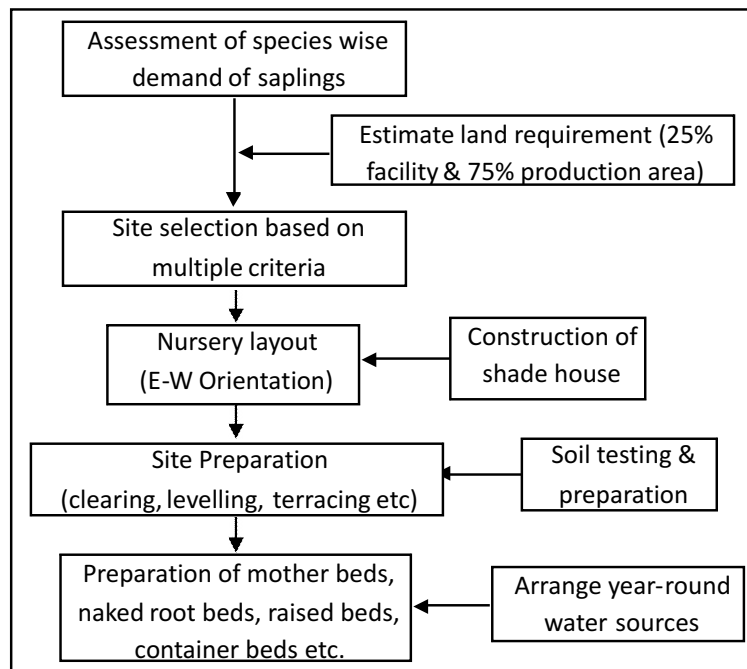


Fig.8: Diagram showing key steps in developing JFM nurseries

3. Raising Plants in Nursery

In terms of method of raising plants, nurseries produce two types of planting stocks: (i) Naked-root (or bare root) saplings, and (ii) Container saplings.

Other planting materials like wildlings and stem cuttings can also be prepared for plantation purpose.

3.1. Naked Root Nursery

- In naked-root nurseries, plants are grown directly in specially designed nursery beds. Two types of naked-root plants can be raised: those grown from seeds or grown from stem cuttings.
- At the time of planting, saplings along with the roots are carefully extracted from the soil, and root-shoot cuttings of about 6-8 inch are prepared, and transported to plantation site.
- Naked-root saplings are planted without soil-ball around roots, so need special attention.

3.2. Container Nursery

- In container nurseries, seedlings are grown in a single container or in multi-cavity trays.
- Containers need filling with potting- mixture of soil, farm yard manure & sand in 3:1:1 ratio.
- Saplings growing in small containers often face the problem of forming a dense root mesh or roots come out from the holes at the bottom or from the side walls of the container, and need proper management.



3.3. Wildlings

Wildlings are the seedlings which are germinated naturally near mother trees, and are extracted to be raised in nurseries. Wildlings are useful for those species which do not shed seeds regularly or seeds have short viability period.

Generally, wildlings are collected in an *ad hoc* manner, but a carefully designed collection strategy is essential to ensure quality control.

- In areas of high rainfall, wildlings can be collected and planted immediately in the target area. In some cases wildlings need to be collected and raised in nursery till they get ready for plantation.
- Collect wildlings when the soil is moist. Rather, watered the area first and then collect wildlings after 10-12 hrs.
- Rainy season is the best season for collecting wildlings.
- Avoid extracting the wildlings by pulling, it can damage the plant. Rather extract those with the help of khurpi (trowel).
- Avoid collecting all the wildlings from a given location. Leave sufficient number of wildlings in the area to grow naturally.
- Collect younger seedlings of 2 to 4 leaves stage when tap roots are not penetrated deep into the soil. Avoid collecting those wildlings which already have deep tap roots.

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- It is important to have some soil attached with the roots of wildlings. Generally, soil carries with them the beneficial mycorrhiza, which help establishment and growth of wildlings.
- In nursery, transplant collected wildlings in adequately large containers without much delay.
- While planting wildlings in the container, it is important to avoid bending of roots in the container.

3.4. Stem Cuttings

As planting material, the stem cuttings are quite

Distinct because:

- They are genetically identical (=clones) to their mother tree, thus maintain the key traits of the mother tree.
- They grow faster and establish quickly than seed-based plants

Some of the important aspects of raising stem cutting in the nursery include:

Moisture. Stem cuttings tend to lose water rapidly, especially through the cut ends. Therefore, maintaining high humidity by frequent spraying of water is essential.

Polarity. Polarity is the inherent orientation in the plants. Typically, the upper end of the plants forms shoot system while lower end the root system. The flow of different plant materials (like carbohydrates, growth hormones, water, minerals etc) follows the 'polarity'. Thus, ascertaining and maintaining the polarity of the cut stem is important. Two simple rules can help identify polarity of stem cuttings⁵:

- In naturally grown plants, the diameter of lower side of the stem is always more than the upper side (Fig. 9).
- The nodes in the stems are always oriented upwards (Fig. 9). Feeling by finger touch the orientation can be determined.

4. Nursery Beds

Beds are required to be made for three purpose:

- for seed germination
- to prepare naked-root saplings and
- to arrange container saplings.

Fig. 9: A stem cutting.
N= narrow end; B= Broad end, P= Nodes



Generally, these beds are made with either 5 m x 1 m or 10 m x 1 m dimensions, depending upon the requirements and size of nursery. The beds need to be made on a straight plane.

4.1. Nursery Beds for Naked Root Plants

Depending upon the seeds to be planted and soil and rainfall conditions, three main types of planting beds can be designed for naked root plants. Three different types of nursery beds are useful: flat, raised and sunken (Fig. 10). As per needs, these beds can be prepared in open or under natural shade or under green screen shade.

⁵ Source: Sharma, S.K. 2019. Van Paudhshala. Sthapna Evam Prabandhan. Himanshu Publication. Udaipur

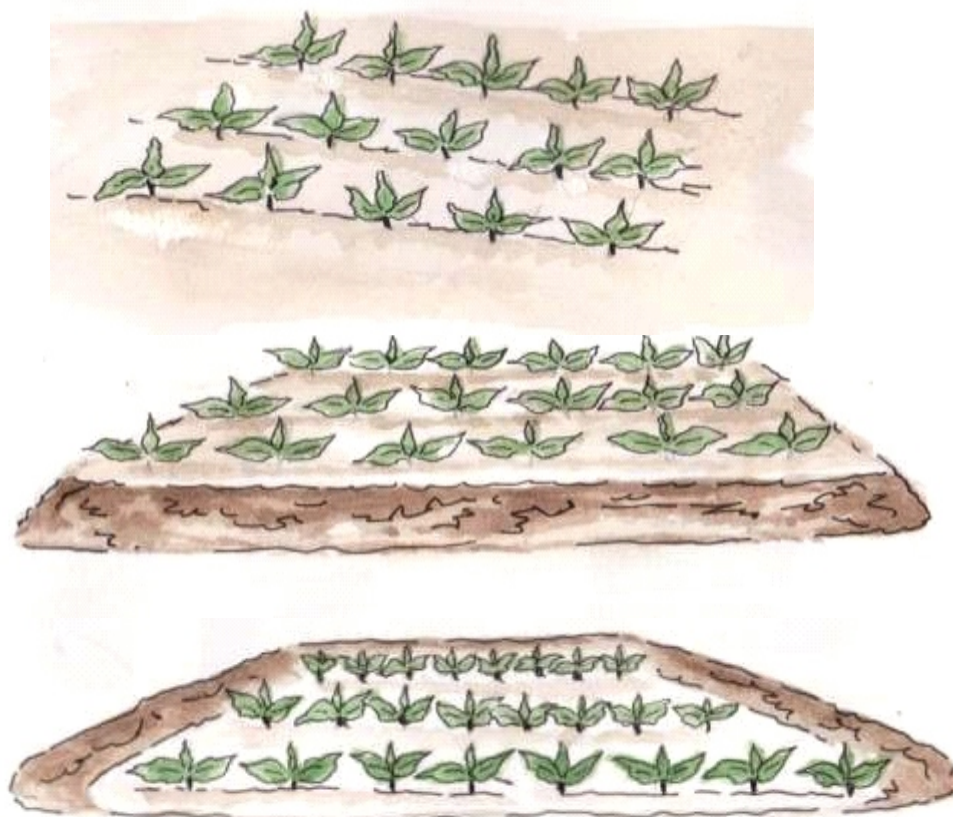


Fig. 10: Schematic drawing showing:
(a) Flat-bed nursery
(B) Raised bed nursery
(C) Sunken bed nursery

4.1.1. Flat Nursery Bed

It is the simplest form of nursery bed, because it does not alter the land architecture, much (Fig. 10). These are mainly prepared in areas which receive less rainfall and where the soil is light sandy to sandy loam, restricting the problem of water stagnation.

4.1.2. Raised Nursery Bed

In relatively high rainfall zone, where stagnation of water becomes a problem, raised nursery beds will be more useful for raising saplings (Fig. 4b). Raised beds are made parallel to each other and located side by side (Fig. 11). Each raised bed *will be rectangular* in shape with standard dimension of 5m x 1m. These raised nursery beds will be of 12 to 15 cm height from ground level. In between two beds, a space of 30 cm is left so as to carry out cultural practices (weeding and hoeing) easily (Fig. 12). The seeds are sown in lines in the bed.

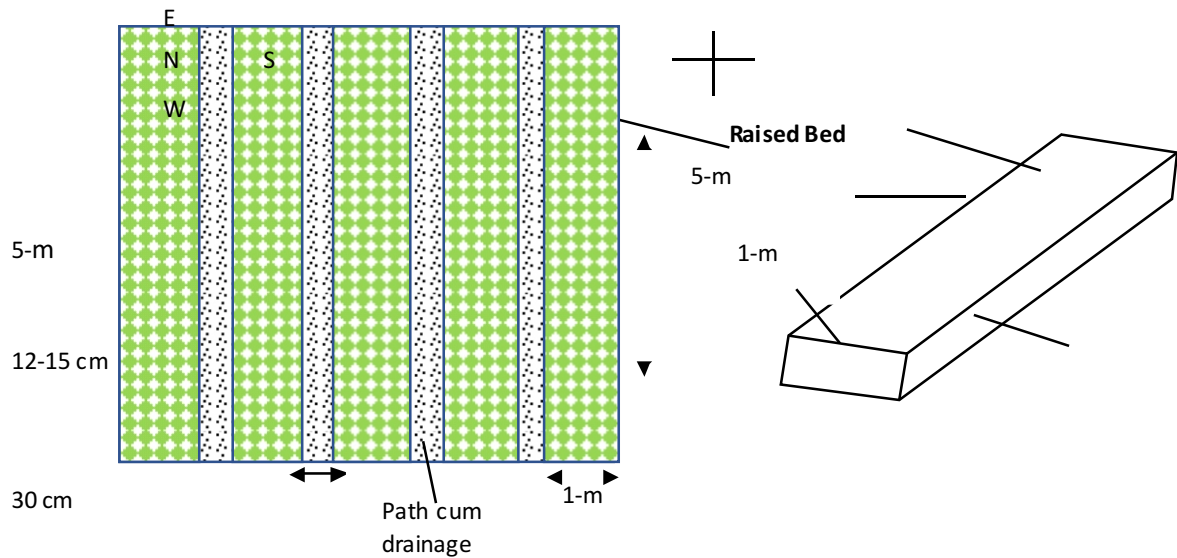


Fig. 11: Dimension of raised beds and their arrangements

4.1.3. Sunken Nursery Bed

The sunken beds (Fig. 10c) are used for raising the moisture loving plants and is useful in the areas where rainfall is less. Although, in most of the NFMP project area rainfall is sufficient, in some rain-shadow pockets, sunken nursery beds may be useful. In such beds, rain or irrigated water are collected, ensuring moisture to the growing plants for longer period. Nursery beds are prepared at a depth of 10 to 15 cm below the ground by digging the soil. The removed soil can be used in filling the containers

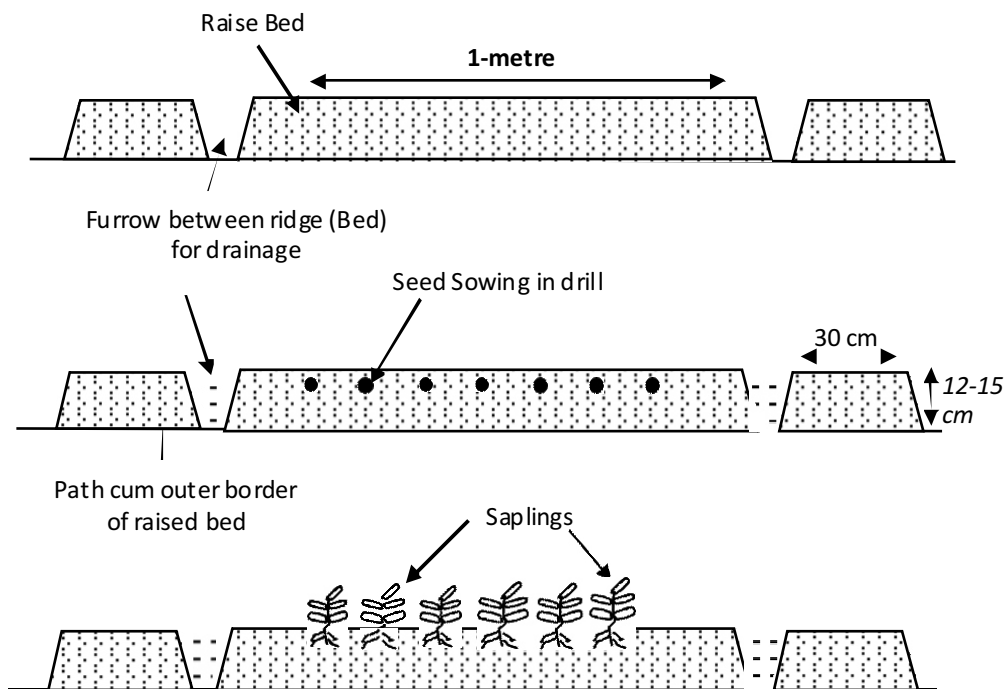


Fig. 12: The diagrammatic representation of growing plants on raised bed

4.2. Container Plant Nursery

Container saplings are raised in relatively much controlled and isolated environment. Each sapling is growing in its own container. This limits the competitions among the seedlings. Although it demands efficient management, large number of container saplings can be raised in less time.

The containers used for raising the saplings are of different types.

- Polybags are most widely used containers in nurseries. However, their use is stopped due to ban on plastics. However, due to lack of other viable options, polybags can be used. But it needs to follow safe disposal of the polybags after extracting the saplings.
- Cloth bags are used in many nurseries. But being porous in nature, soil in the bag loses its moisture quickly, and thus need regular watering. Also, often the cloth bags degrade quickly.
- Preferred sizes of the container for small saplings 15 -20cm x 23-27 cm and for larger saplings 35 cm x 40 cm.
- In Nagaland many nurseries use containers made from hollow bamboo stems. This is useful if the diameter of bamboo stem and the inter-node length are sufficient to raise the saplings. Bamboo containers also face the challenge of easy extraction of sapling with intact soil-ball, at the time of plantation.
- An innovative solution can be tried out. Cut the bamboo containers vertically and tightly tied the two halves by threads. Add soil mixture in this pot and seeds can be sown. Once the sapling is ready for plantation, threads can be removed so that two halves of bamboo container get separated. Sapling with soil mass will be available ready for plantation (Fig. 13).

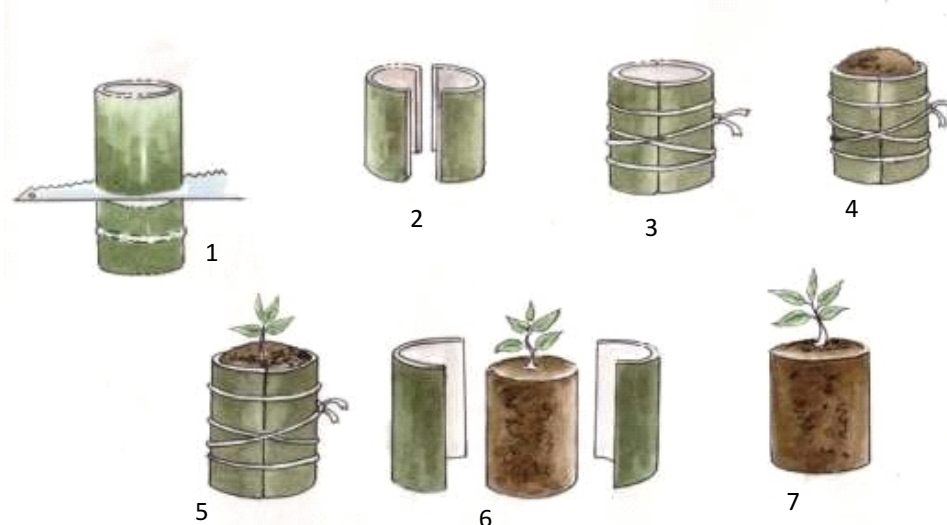


Fig. 13: Method of using bamboo containers for raising saplings. (1. A hollow bamboo container. 2.

Container is cut into two equal halves, vertically. 3. The two cut halves will be joined and tied tightly by threads (rubber bands); 4. Filled Potting mixture (soil + sand + FYM in 3:1:1 ratio) and seed sowing; 5. Sapling raised. 6. Remove the thread (or rubber bands) and separate the two halves of the bamboo container. 7. Plant sapling with soil mass are ready for planting)

4.2.1. Sapling Raising in Containers

There are two possible ways for raising sapling in containers (Fig. 14):

1. The potting mixture are filled in containers and seeds are directly sown in the pots.
2. Seeds are sown in a separate naked-root bed and once the seedlings reach to 3-5 leaves stage, they can be transplanted in the containers.

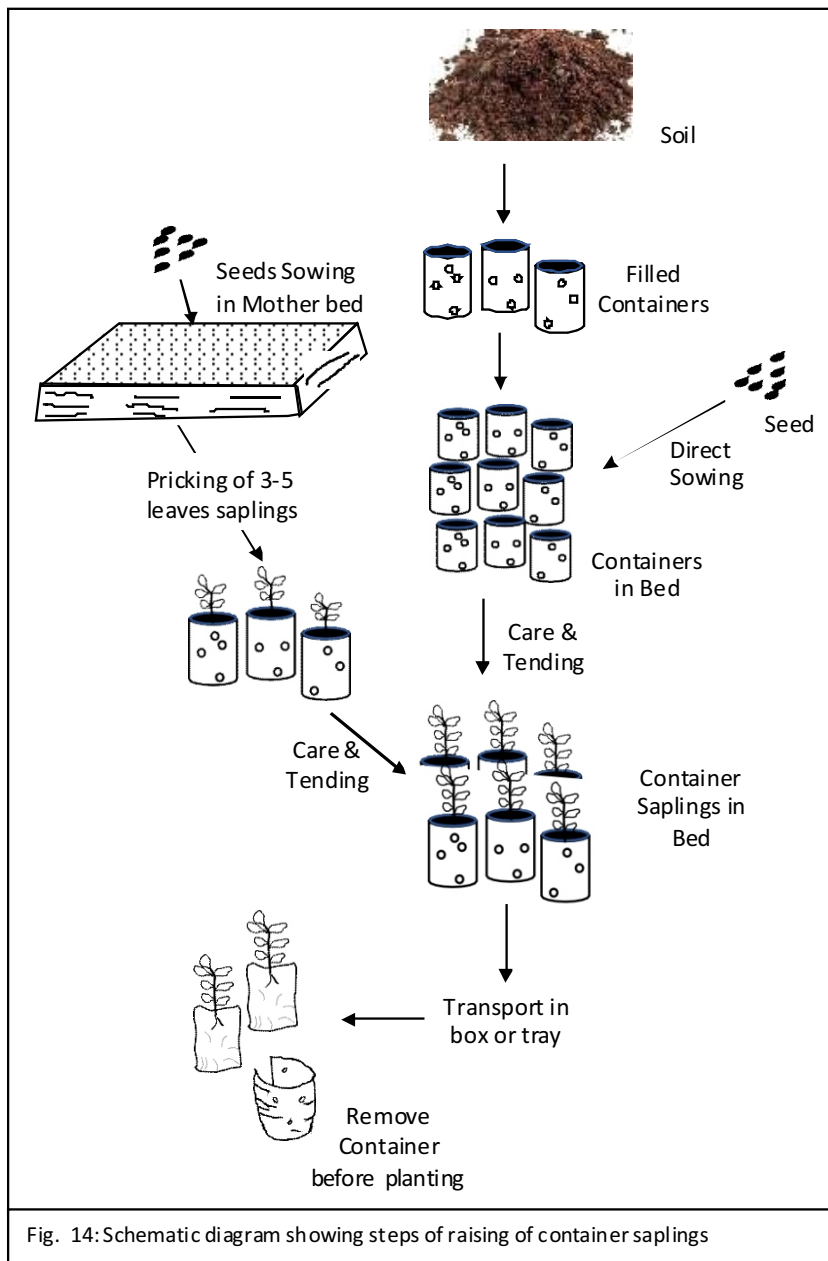


Fig. 14: Schematic diagram showing steps of raising of container saplings

In a nursery, the containers should be arranged in container beds of 10 m x 1m dimension. Between two beds a path is made for tending operations (Fig. 15). In order to hold the containers up-right, the container bed may be bounded by thin bamboo sticks.

The terrace beds, prepared on slopes, also need to follow the standard size of the beds i.e. 10 x 1 meter. If space for more length is available, the two beds need to be separated by bamboo logs. The orientation of beds needs to follow east-west direction for longer sunlight duration (Fig. 16).

5. Soil composition for nursery bed & containers

- The soil is the main growing medium in the nurseries and influence the growth of saplings.
- Preparation of good soil medium is critical for growth and quality of the saplings.

- Test soil for pH with portable kits. Soils with pH below 7.0 are considered 'acidic' while those above 7.0 are considered 'basic'
- In general, light soil of sandy loam texture (i.e. higher percentages of sand and lower percentages of silt and clay) with slight acidic nature (pH 5.5 to 6.5) are suitable soil.
- The soil conditions can be manipulated: texture by adding sand; nutrients by adding different types and quantity of farm yard manures (including the pig excreta); acidity by adding lime. Adding FYMs and other fertilizers in different quantity can also manipulate the soil acidity.
- Generally, in NFMP project area, best potting mixture may be a mix of top soil or native soil with less clay content, sand and FYM in the ratio of 3:1:1.

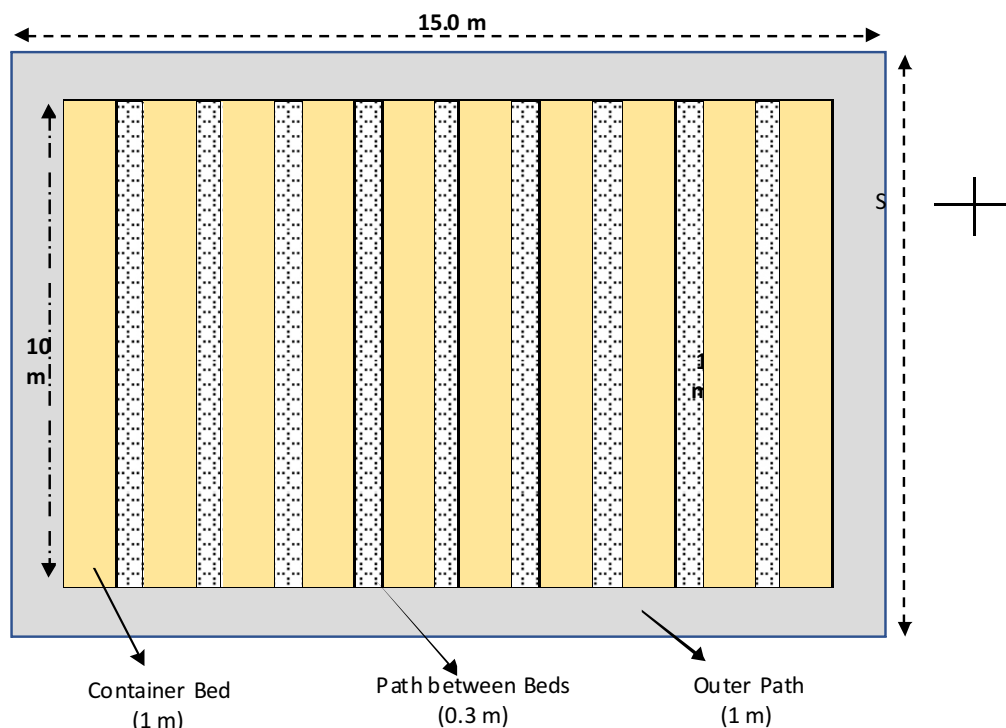


Fig. 15: The schematic diagram of arrangement of container beds in a nursery

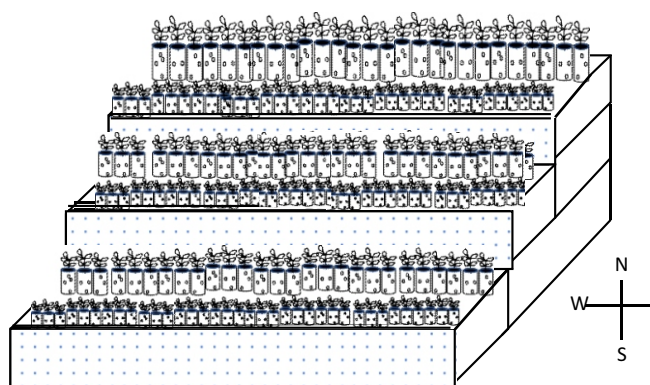


Fig. 16: The scheme of arrangement of containers in a step-bed nursery

6. Seed sowing methods

Sowing in the mother bed (or nursery beds) can be done in three broad manners: by random spread (broadcasting), putting in holes (dibbling) or putting in rows (drill) (Fig 17).



Fig. 12: Seed sowing methods

6.1. Broadcasting

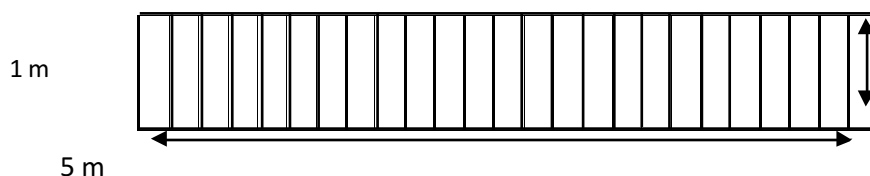
- Broadcasting is the process of random manual scattering of seed on the surface of seedbeds.
- Suitable for small to medium sized seeds.
- In manual broadcasting, the major issue is the uneven seed spread making patches of high and low density of seed on the mother bed. By dividing the mother bed into 5-10 equal segments and broadcast the seeds separately in each segment, may resolve this issue.
- Tiny seeds can mix with equal part of dry, fine sand & spread using nets of right mesh size.
- Because of random spread of seedlings, extraction of weed and saplings need extra care.

6.2. Dibbling

- Dibbling is the process of placing seeds in holes made in seedbed and covering them by soil.
- In this method, seeds are placed in holes made at definite depth at fixed spacing. Small hand dibblers of conical shape can be used for the purpose.
- This method is suitable for medium to large seeds.

6.1. Drill -sowing

- Drilling consists of dropping the seeds in rows and covered with ½ cm of soil.
- For most species, the rows can be about 6 inches apart.
- The rows will be oriented parallel to smaller size of the bed.
- In a mother-bed of 5m x 1m dimension, 20- 25 rows can be made (Fig. 18).



18: Arrangement of rows in drill sowing.

6.4. Seed Sowing in Container

- In the containers, seeds will be sown by dibbling method.
- For small seeds, 2-3 holes can be made in the container and seeds put in such holes.
- For large size seeds, one seed is enough per container.

7. Tending and Management of Nursery Plants

7.1. Weed Control

- In the nurseries grasses and sedges are major weeds which need to be removed manually.
- Avoid use of any herbicide/ weedicide.

7.2. Singling

- Often, more than one seed is planted in the container. This affects the growth of the seedlings
- All the weak looking seedlings should be removed & only one seedling will be allowed to grow.
- The removed seedlings, however, may be planted in other blank containers.

7.3. Pruning

- In nurseries, maintaining shoot: root ratio of saplings is critical. A healthy sapling means shoot-root ratio of 1: 1 or 1:2.
- Since shoots are visible, they draw attention of nursery management. The root system, being underground, often miss the attention.
- A good quality sapling must have straight & compact roots with many succulent fibrous roots.
- Pruning of extra roots is one of the important tending activities of nursery plants.
- It is an *in-situ* process of trimming the roots of nursery raised saplings (both naked-root and container ones).
- Root pruning helps in developing fibrous root system rather than long and thin roots, and thus maintain healthy shoot-root balance. Thus, pruning is a method of hardening of saplings, so that they can survive the harsh natural planting conditions.
- As a thumb rule, pruning needs to be repeated every two weeks or as per requirement. There should be enough gap (2-3 weeks) between the last pruning and final planting date, so that plant grows new lateral roots.

7.3.1. Root Pruning of Naked bed Plants

- In naked-root nursery, pruning can be done efficiently if the seeds are sown in rows.
- It is very difficult to do root pruning in broadcast sown saplings.

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- Efficient way of pruning the root underground is by making vertical incisions between the seedlings, either straight or at an angle, using a sharp tile spade. The cut may be made in both directions. (Fig. 19 and 20)^{6,7}.
- The pruning depth should be between 10 to 30 cm below the soil surface depending on the species.

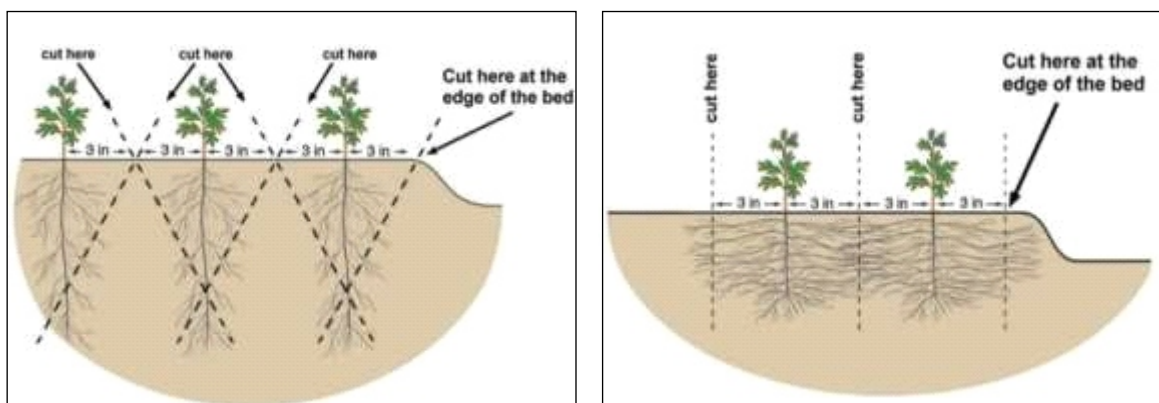


Fig. 19: Method of Vertical pruning (left) and Lateral pruning (right)

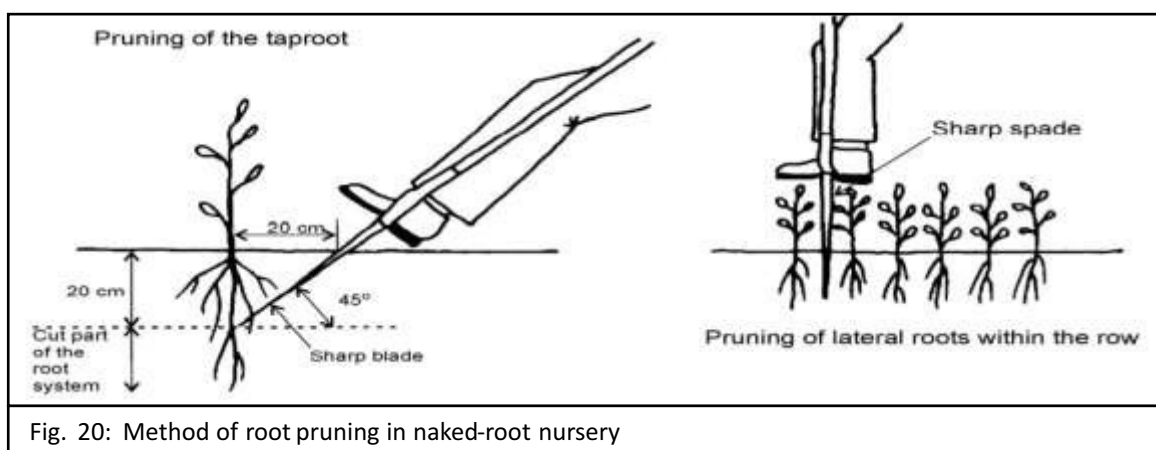


Fig. 20: Method of root pruning in naked-root nursery

7.3.1. Root Pruning of Container Plants

- Roots of container sapling grow within and often comes out from the sides and bottom holes, and even goes into the soil.
- The pruning of these protruding roots is essential.
- First root pruning needs to be done as soon as the roots appear through the bag and enter the ground
- In container plants, root pruning can be done by lifting each container and cut the roots.
- In case of containers on raised stand/platform, pruning can be done by inserting the trowel between the surface and container bottom (Fig. 21)⁵.

⁶Source: Dumroese, R. K., Landis, T. D. and Luna, T. 2012. Raising native plants in nurseries: basic concepts. USDA, Rocky Mountain Research Station. 84 p.

⁷Hall, K.C. Manual on nursery practices. Forestry Department, Jamaica

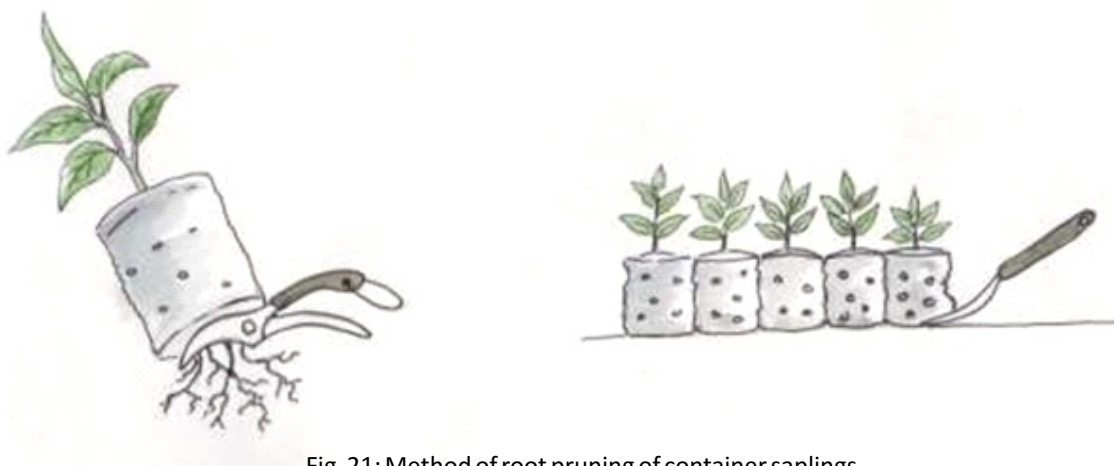


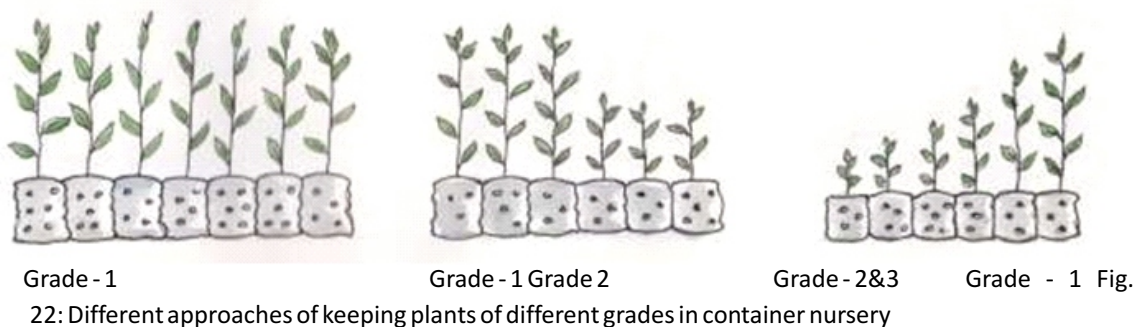
Fig. 21: Method of root pruning of container saplings

7.1. Quality Assurance and Grading of Saplings

- Only those saplings which fits to the criteria of 'good quality' should be considered for planting.
- In standard plantation protocols, the sapling must have a minimum height and stem thickness. Saplings with height and collar-diameter⁸ ratio of 80 cm: 1 cm are considered good quality. With such height -diameter ratio a sapling can withstand field condition after planting out.

Grading is essential to segregate the saplings based on their growth variations.

- Generally, in a single bed, saplings raised in containers show variations in their height.
- As a principle, for the plantation, each planting site, must use saplings of the same growth/ size.
- Thus, in a nursery bed, the container saplings should be graded based on their size e.g. small (Grade 3), medium (Grade 2) and large (Grade 1). Generally, the Grade 3 plants can be avoided for plantation.
- Three different types of grading methods can be adopted (Fig. 22)⁹:
 - Container saplings of different height classes are kept in separate beds.
 - The small and large size saplings are kept in same bed but in different groups
 - The small, medium and large size sapling are kept in same bed in increasing or decreasing order



⁸ A 'collar' in plant sapling is the point where the root and shoot get differentiated and used as the location for measuring stem diameter and the reference base for measuring the height of the sapling.

⁹ Source: Sharma, S.K. 2019. Van Paudhshala. Sthapna Evam Prabandhan. Himanshu Publication. Udaipur

7.5. Disease and Pest Control

The nursery attendants must spot the abnormalities in the saplings, using two stage examination:

- At nursery level: to locate the problem (which beds? which species?).
- At seedling level: to find the problem parts and causing agents (insects, fungus or virus?). In case the entire shoot part of the seedlings is getting wilted or drying, problem can be traced in root system.

For solution, there are many pest controlling chemicals available. Some of the commonly used chemicals are: Endosulfan, Chloropyrifos, Mailathian, Monocrotokas, Captan, Dithene, Drassicol etc. Before using chemicals, check if they are approved by competent authorities.

8. Transportation of Saplings

Transportation of sapling from nursery to plantation site is very critical stage. If not done properly, entire effort of raising seedlings gets wasted. Some of the common problems during transportation of saplings to plantation sites are:

- The seedlings are pulled by the shoots, thereby breaking them
- Container saplings are not transported upright and the soil-balls around the roots break up
- Seedlings are stored too long before planting
- Seedlings are not adequately protected against wind and sun-light, and even against livestock to minimize the risks during handling, saplings should be transported directly to planting site.

The handling and transportation of container and naked root saplings from nursery to plantation site and from the plantation site to plantation plots is diagrammatically explained (Fig. 23, 24 and 25).

8.1. Container Saplings

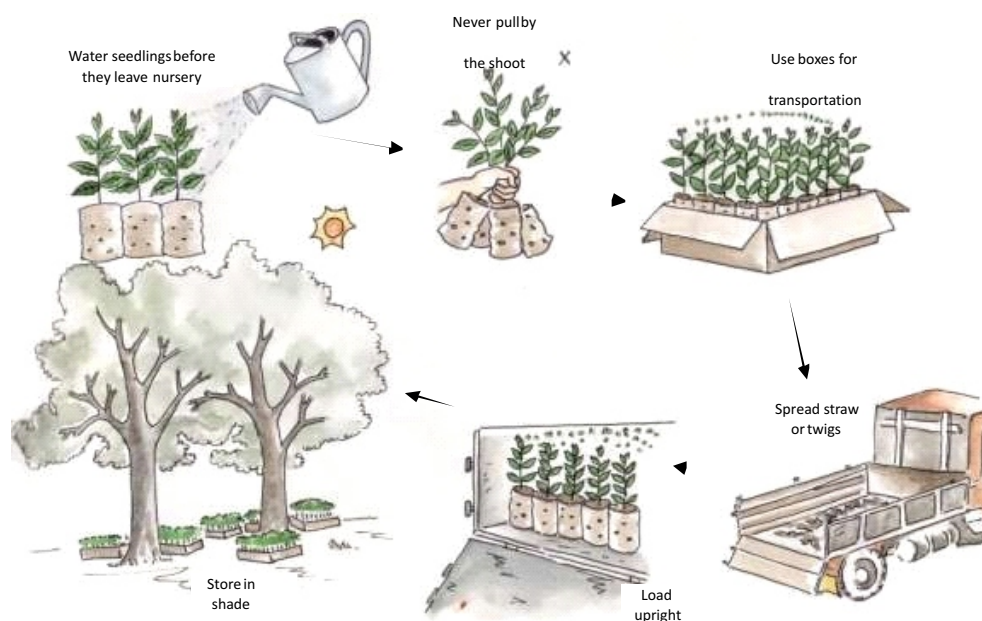


Fig. 23: Important steps in transportation of container plants

8.2. Naked Root Saplings

- In case of naked root plants, the time between the sapling extraction from nursery bed and their transportation and plantation, need to be as short as possible.
- The saplings need to be properly wrapped and put into bags and boxes (Fig. 24)
- They must be protected from strong light, heat and drying out.
- Saplings should be thoroughly moistened before leaving the nursery.

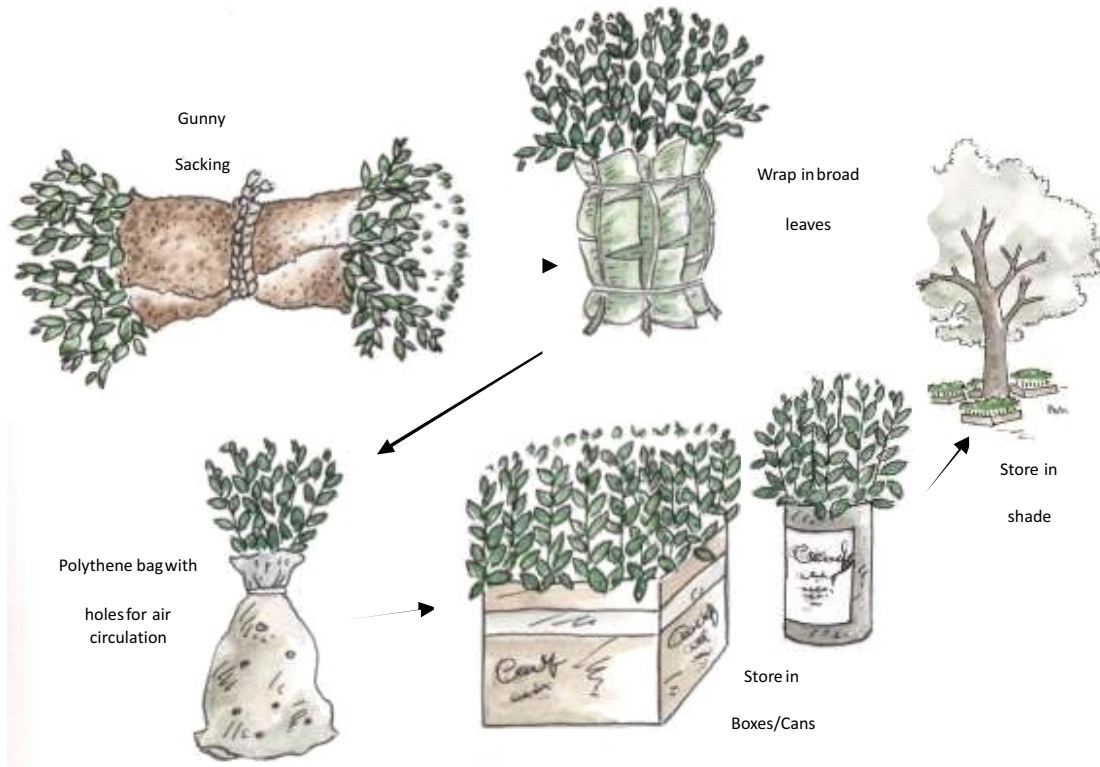


Fig. 24: Important steps in transportation of naked-root plants



Fig. 25: Carrying saplings to plantation plots

9. Nursery Register

For smooth functioning of nursery, it is important to maintain a nursery stock register, which broadly record the species wise, sapling type wise stock at a given period of time. A sample of nursery register is given below:

Nagaland Forest Management Project (NFMP)									
Nursery Register									
Name of the JFMC:			Name of the Village:			Name of the FMU:			
Name of the DMU:			Net Nursery Area (Ha):			Reporting Month:			
S.N.	Local / common Name of the Species	Botanical Name of the Species	Sapling Type: Naked Root/ Poly Bag/ Bamboo Container	Saplings available at the start of the month (Number)	New Saplings Added in the current month (Number)	Sapling Mortality during the Month (Number)	Total Saplings Ready for Plantation in the Month (number)	Saplings transported to plantation sites (Number)	Saplings available at the end of the Month
a	b	c	d	e	f	g	h = (e + f - g)	i	j = (h-i)
1	Alder	<i>Alnus nepalensis</i>	Poly bag	1250	200	50	1400	600	800
2	Bonsum	<i>Phoebe goa pa rensis</i>	Naked root	500	150	0	650	150	500
3									
4									
5									

Some of the important aspects of filling up the Nursery Register include:

- This register shall be filled in at the end of each month by the Asst. Member Secretary of the JFMC and Chairperson of the JFMC.
- The opening balance for the reporting month shall match with the closing balance of the previous month.
- The number are to be written based on the physical counting of the saplings.
- Both local/ common name and botanical name of the plants shall be mentioned in the format.
- The net nursery area is the total area of production area under poly houses and open bed.
- The Nursery Register shall be produced before the JFMC during the monthly meeting and approved by the JFMC Executive Committee.

For quick reference, the entire process of nursery development and raising the plants in these decentralized JFMC nurseries is presented in Fig. 26

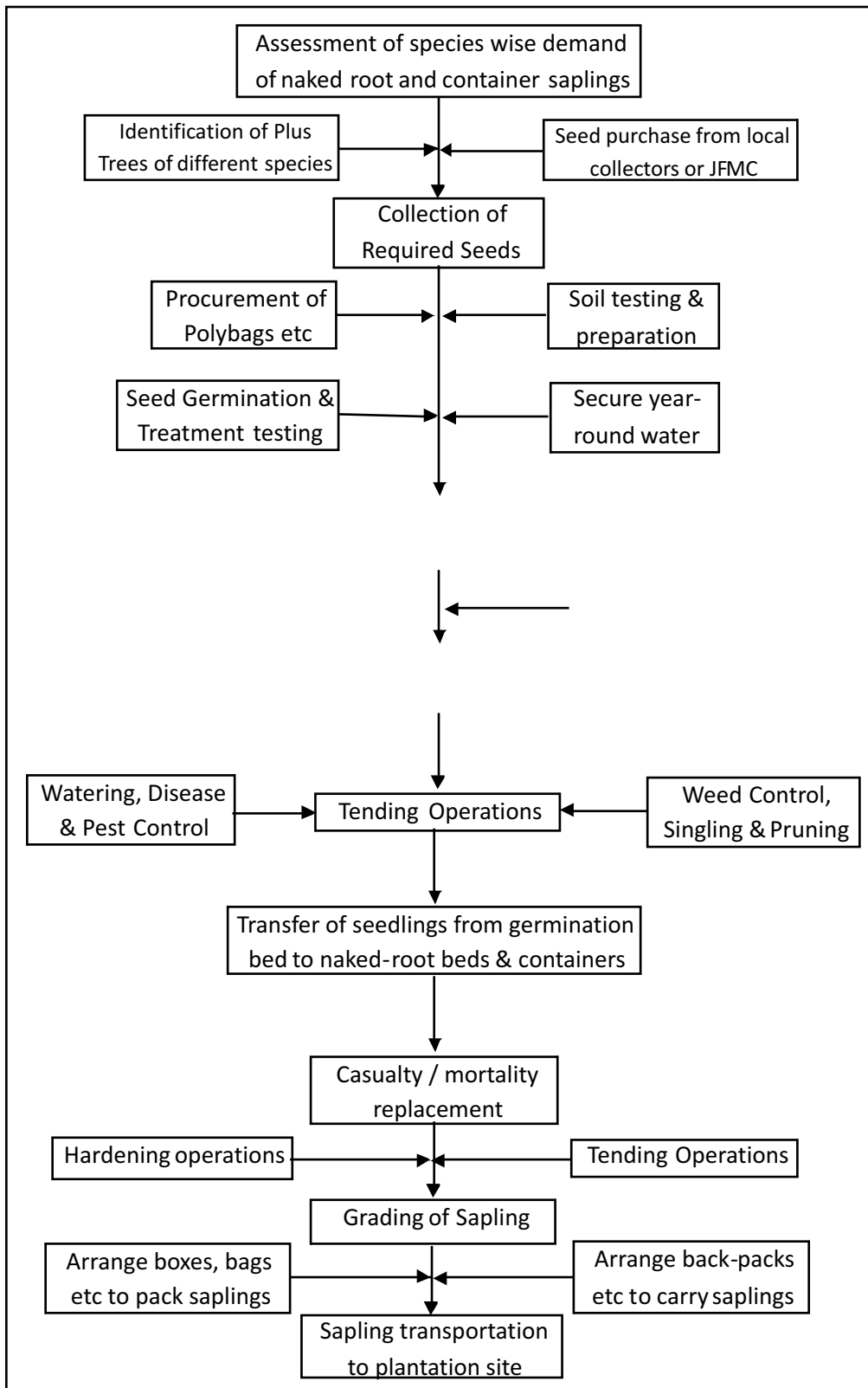


Fig. 26: Diagram showing key steps to be taken in raising saplings in nursery

Section E. Nursery Management of Important Species

In the context of Nagaland, species-specific details such as seed collection period, seed are not readily available. However, in this manual, some species-specific information is presented. Table 7 presents a summary of key nursery related characteristics of some of the important tree species found in Nagaland¹⁰.

¹⁰ The information is collated from following two main sources: 1. Bisht, N.S., Ahlawat, S.P. and Singh, U.V. (undated). Nursery techniques of local tree species. SFRI, Itanagar, Arunachal Pradesh. 2. Singh, U.V., Ahlawat, S.P. and Bisht, N.S. (2003). Nursery technique of Local Tree Species II. SFRI, Itanagar, Arunachal Pradesh

Table 7: Key nursery related features of important tree species of Nagaland

Species	Seed collection period	Number of seeds/Kg.	Seed viability (month)	Germi. %	Seedlings per kg seeds	Pre-sowing treatment	Sowing method	Germination period	Nursery management
Agar (<i>Aquilaria agallocha</i>)	Jun-Jul	1,500	1	60	900	Not required	Sowing in mother beds	7-25 days	Seed starts germinating immediately after falling on the ground and it is quite likely that 50 % of the seeds might have started germination at the time of collection, therefore, sowing should be done immediately.
Amari (<i>Amoora wallichii</i>)	Jun - Jul	150-230	2	60	100-150	ML	Direct sowing in container	15-50	Sowing must be done in Shaded beds to obtain good germination
Bogipoma (<i>Chukrasia tabularis</i>)	Jan-Mar	90,000	6	90	76,500	Overnight soaking in cold water	Sowing in mother beds	7-35 days	It is better to cover mother beds with thatch and care is taken during watering so that young seedlings are not damaged.
Bhola (<i>Morus laevigata</i>)	Apr-May	3,50,000	6	40	1,40,500	Not required	Sowing in mother beds	10-45 days	Care should be taken at the time of sowing of seeds and watering the beds as there are chances of damage due to very light weight of the seeds.
Bonsum (<i>Phoebe goalparensis</i>)	Oct-Nov	950	3	70	650	Overnight soaking in tap water	Sowing in mother beds	25-90 days	Removal of thin mesocarp is essential before the sowing of the seeds. Seeds are sown immediately after drying in the month of November
Borpat (<i>Ailanthus grandis</i>)	Feb-Mar	1720	7	85	1300	Not required	Direct sowing in container	25-120 days	Remove the wings before sowing and seeds are sown flat/horizontal in the beds. Shade is necessary in the initial stages of seedling development. Naked root transplanting has not given good result
Dhuna (<i>Canarium strictum</i>)	Nov-Jan	300	18	90	270	Hot water treatment	Sowing in mother beds	26-140 days	Sowing in mother beds is more fruitful because in many seeds one to three seedlings \ emerge from a single stone/fruit which can be separated and transplanted into the container.
Hollock (<i>Terminalia myriocarpa</i>)	Dec-Jan	5,00,000	3	60	2,50,000	Not required	Line sowing in mother beds	10 to 35 days	Providing a cover of thatch over the beds in the initial stages enhances the germination.
Hollong (<i>Dipterocarpus retusus - D. macrocarpus</i>)	Feb-Mar	64	0.5	70	45	Not required	Direct sowing in container after removing the wings	8-21 days	10 cm thick layer of freshly collected seeds is made over a layer of sand in a sunken bed. Seeds are then covered by sand or jute and moistened by regular sprinkling of water until radicle emerges. The germinated seeds are immediately transferred to the container.
Jutulii (<i>Altingia excelisa</i>)	Dec-Feb	8,00,000	4	40	3,00,000	Not required	Sowing in mother beds	10 to 70 days	Due to very small size of seeds mulching is essential after sowing until the emergence of seedlings. This is done to keep the beds humid and care is taken at the time of watering so that seedlings are not damaged.
Kadam (<i>Anthocephalus chinensis</i>)	Jan-Feb, Oct- Nov	16,00,000	12	60	9,50,000	Overnight soaking	Mother beds/trays	10-30 days	Watering should be done carefully with a fine sprayer in the initial stages, because seeds are very minute and improper watering may wash away seeds as well as the seedlings. Seeds

Species	Seed collection period	Number of seeds/Kg. (approx.)	Seed viability (month)	Germi. %	Seedlings per kg seeds	Pre-sowing treatment	Sowing method	Germination period	Nursery management
									should be cleaned properly as seeds with pulp give very low germination.
Khokan (<i>Duabanga grandiflora</i>)	Mar-May	50 million (approx.)	3	30	15,00,000	Not required	Sowing in mother beds	10-40 days	Young seedlings are very minute, therefore, requires proper care during watering. Excessive watering is harmful and may lead to damping-off of seedling. Mixing with sand ensures even spread and prevent washing away of seeds while watering
Mandhani (<i>Acrocarpus fraxinifolius</i>)	Apr- May	29,300	27	40	12000	Overnight soak in hot water	Sowing in mother beds	10-45 days	2 to 3 minutes soaking in concentrated sulphuric acid gives better germination.
Mekai (<i>Shorea assamica</i>)	Mar- Apr	600-1000	1	35	350	Not required	Direct sowing in container	10-25 days	10 cm thick layer of freshly collected seeds is made over a layer of sand in a sunken bed. Seeds are then covered by sand or jute and moistened by regular sprinkling of water until radicle emerges. The germinated seeds are immediately transferred to the container.
Nahar/Nagkesar (<i>Mesua ferrea</i>)	Aug - Sep	230	4	70	160	Not required	Direct sowing in container	15-90 days	Shade is necessary in the initial stage, as the species is extremely sensitive to drought
Titasopa or Champ (<i>Michelia champaca</i>)	Aug - Sep	12,000	1	70	8,400	Not required	Sowing in mother beds	10 to 45 days	The red pulp (aril) around the seeds should be removed before sowing because de-pulped seeds give significantly higher percentage of germination compared to seeds sown with pulp
Alder (<i>Alnus nepalensis</i>)	Nov - Dec	18,00,000	3	58	10,40,000	stratification	Broadcasting in open mother beds	8 to 30 days	After sowing seeds are covered by a thin layer of soil or straw to maintain the moisture and temperature. Beds are watered twice daily.
Sam-kathal (<i>Artocarpus chaplasha</i>)	Jun - Aug.	1,235	2	65	800	Overnight soaking in water	Direct sowing in container at a depth of 2 cm	5 to 20 days	Seedlings are kept in shaded beds to protect them from rain. Seedlings become ready for planting in the field by the next planting season. Root and shoot pruning is useful in case of over grown seedlings or entire transplanting.
Mecho (<i>Schima wallichii</i>)	Feb - Mar	2,00,000	4	45	90,000	Not Required	Direct sowing in raised mother bed	10 to 25 days	Mother beds in shaded area. Seeds are sown either by broadcasting or in furrows at a depth of 0.4 to 0.6 cm. Natural seedlings collected from the forests are equally successful. The tree is moderate light demanded
Gomri (<i>Gmelina arborea</i>)	May - Jun	2500	6	15-25	375	Soak in cold water for 24 hours	Sowing in mother beds	7 to 15 days	It grows 8 feet tall in 30x45 cm size bags in 4 to 6 months

Disclaimer:

The contents of this document have been prepared by Nagaland Forest Management Project Society (NFMPs) for use under JICA supported Nagaland Forest Management Project (NFMP) implementation. This document has been prepared with reasonable skill, care and due diligence and information based on the observations, field visits and interviews with stakeholders. The views expressed in this document are primarily to be used for NFMP implementation. Neither NFMPs nor any shareholder undertakes any responsibility arising in any way whatsoever to any person or organization in respect of information set out in this document, including any errors or omissions therein arising through negligence or otherwise however caused.

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ABOUT NAGALAND FOREST MANAGEMENT PROJECT

The Project is an Externally Aided Project supported by an International Agency i.e. Japan International Cooperation Agency (JICA) aiming to improve forest ecosystem and support income generation by rehabilitation of Jhum area and provision of livelihood support, thereby contributing to sustainable forest and environmental conservation and livelihood improvement in the target villages in Nagaland State. The project has a target to cover 185 villages involving all Districts of the state and 22 Forest Range & Beats and will be spread over a period of 10 years.

This project has following three components:

- * Forestry interventions and biodiversity conservation
- * Livelihood improvement and community development &
- * Institutional strengthening

