

# **Training Manual**

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## Maintenance and Protection of Plantations

Haryana Community Forestry Project

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# Introduction

Haryana has a tradition of village common lands, where communities use such land for common purposes, e.g. cultivation for agriculture, grazing (gochar land), village Bani (fuelwood, fodder and shade provider) and other common purposes (village fair, play ground, public utility, crematorium, religious gatherings, etc). Haryana Community Forestry Project (HCFP) has tried to develop such land resources under the village woodlot component. Plantations have been raised on such lands with active support from Village Resource Management Committees (VRMCs), and grass seed sowing has also been carried out. Plantation of different tree species has been established over such common lands during the project period. By and large the most unproductive land has been used for raising plantations to increase land productivity.

HCFP has implemented different components/models to address the need of land resource development. Village land resources are either owned by the community (Panchayat) or by individuals. Village resource management pertaining to plantation comprises:

- i) Village Woodlots (VWL) on Panchayat/Shamlat Land;
- ii) Circular Tree Grooves (TG) on Community Land;
- iii) Linear Tree Grooves (LTG) on Roadsides;
- iv) Sand Dune Fixation (SDF) Plantations on Private Land;
- v) Farm Forestry Plantations (Multi-species and Poplar);
- vi) Kitchen Garden Homestead Plantation.

Common land plantations require proper management practices to manage these resources in an effective and sustainable manner. After project exit, villagers in general and VRMCs in particular have to manage the plantations using the Village Resource Management Fund created with support from HCFP. Experience has shown that in the absence of proper institutional arrangements to protect, manage and utilise the common resources such as village woodlots, more often than not the efforts and the resources are wasted and the objective of creating the plantation remains unfulfilled.

## Purpose and Objective

The purpose of this manual is to orient the executive body members of the VRMC, which is responsible for management of the community plantations, and the private farmers, who have created Sand Dune Fixation Plantations on private land, on various technical and institutional issues related to protection, maintenance, management and utilization of the plantations.

The specific objectives of the training are to discuss issues related to:

- protection and management of community plantations
- maintenance of community and private plantations
- utilisation, harvesting and marketing of products
- management of the Resource Management Fund for protection and management of plantations
- information on species specific care and management

## Organisation of the Manual

The manual is organised into following six training sessions – each dealing with a major issue related to protection and sustainable management of plantations:

Session No.	Session Title	Session Details	Duration (hr.)
	Introduction: Objectives of Training		½
1	Management Principles and Systems	Discuss principles and options related to management of plantations.	¾
2	Protection and Maintenance of Community Plantations	Discuss issues, options and mechanisms related to Protection and Maintenance of Community Plantations. Discuss the need and method for cultural operations in various types of community plantations.	3 – 4
3	Management of Funds	Discuss utilisation of Resource Management Fund (RMF) for protection and maintenance of the community plantations.	1.5 – 2
4	Harvesting and Marketing of Produce	Inform VRMC members and SDF Farmers on harvesting procedures. Discuss process and procedure for marketing the produce.	1.5
5	Equity Issues in Management of Plantations	Sensitising the VRMCs to the need, difference in priorities and importance of managing different interest groups and incorporating the concerns of poor and women in decisions related to management of plantations.	2
6	Management of Private Land Plantations	Discuss species specific management operations.	2
	Evaluation & Closing		½

Ideally all the issues can be addressed in a two-day training programme. If required the training can be divided into two main parts – Part one would include session 2, 3 and 5 specifically targeting the VRMCs, whereas session 1, 4 and 6 would also include Sand Dune Fixation farmers.

# Session 1: Management Principles and Systems for Block Plantations

***Purpose:***

Discuss principles and options related to management of block plantations

***Time needed:***

45 minutes

***Material needed:***

Blackboard or flipchart, chalk or marker pens

***Method:***

Lecture

By good management, in which we choose our treatments carefully, we can improve the condition of a plantation. Sustainable management and use of the plantation must be based on the type and condition of the plantation, the needs and preferences of users for different products, and silvicultural practices that ensure sustainable use.

It is important to remember that silvicultural operations that involve removing trees and other plants by e.g. weeding, thinning and harvesting is not inherently bad for the ecosystem – these actions done carefully can in fact help restore and enrich the biodiversity and ecosystem health of a plantation. In other words, restoration of an ecosystem and its sustainable, productive use should go hand in hand.

## **Information needed for silvicultural management decisions**

- type, structure, and species composition of the plantation
- productive capacity of the plantation in terms of small timber, fuelwood, fodder, fencing material, other Non-Timber Forest Products (NTFP), etc
- risks posed by fire, grazing etc
- needs and preferences of all user groups
- past and present harvesting systems and ideas suggested by different user groups
- effects of specific silvicultural treatments on structure, species composition and capacity to regenerate
- knowledge of silvicultural options for harvesting and treating different species
- range of products and the relative quantity of each product type that may be provided by each silvicultural option over time

## Handout

<b>Forest Management Strategy</b>	<b>Definition</b>	<b>Type of Situation</b>
Forest Resource Creation	Establishing and maintaining plantations to create new resources	<ul style="list-style-type: none"> <li>• Very degraded areas where planting is the only means of re-establishing forest</li> <li>• When there are existing plantations</li> <li>• When there is a demand for forest products</li> <li>• Where growth rates are likely to be good</li> </ul>
Forest Resource Utilisation	Harvesting products to meet local and/or commercial needs	<ul style="list-style-type: none"> <li>• When the plantation condition is such that harvesting can take place without causing degradation</li> <li>• When the growing plantation needs thinning to develop NTFP production and biodiversity values</li> <li>• When there is a demand for forest products</li> </ul>
Forest Resource Management and Conservation	Managing an existing forest to improve or conserve its different values (productive values, ecosystem functions, biodiversity values, cultural and spiritual values)	<ul style="list-style-type: none"> <li>• In areas where biodiversity is high or potentially high</li> <li>• In degraded areas where ecosystem functions need to be restored</li> </ul>
Forest Resource Protection	Controlling illicit activities to prevent damage to a forest	<ul style="list-style-type: none"> <li>• In degraded areas where ecosystem functions need to be restored</li> <li>• Areas where there is a high pressure from destructive use</li> <li>• Areas where there is a good potential that protection activities will work</li> <li>• Sacred groves where protection needs to be upheld or strengthened</li> </ul>

(Adapted from Peter Branney)

Depending on the chosen forest management strategy or combination of strategies, a number of forest management options or actions may be needed. Again, these management options may need to be combined, depending on the needs of the different user groups, the particular site and its ecological status. Examples of forest management options are given below.

<b>Forest Management Strategy</b>	<b>Forest Management Options (examples)</b>
Forest Resource Creation	<ul style="list-style-type: none"> <li>• plantation establishment</li> <li>• sowing and dibbling</li> <li>• plantation tending operations</li> </ul>
Forest Resource Utilisation	<ul style="list-style-type: none"> <li>• thinning</li> <li>• timber and fuelwood extraction</li> <li>• bamboo management</li> <li>• green leaf manure harvesting</li> <li>• dry leaf litter collection</li> <li>• NTFP collection</li> </ul>
Forest Resource Conservation and Management	<ul style="list-style-type: none"> <li>• NTFP management</li> <li>• natural regeneration management</li> <li>• enrichment planting</li> <li>• eco-tourism development</li> <li>• soil and water conservation</li> </ul>
Forest Resource Protection	<ul style="list-style-type: none"> <li>• fire protection</li> <li>• grazing protection</li> <li>• protection from illicit harvesting of boles, timber or fuelwood</li> <li>• protection from encroachment</li> </ul>

(Adapted from Peter Branney)

# Session 2: Protection and Maintenance of Community Plantations

## *Purpose:*

1. Discuss issues, options and mechanisms related to Protection and Management of Community Plantations.
2. Discuss the need and method for cultural operations in various types of community plantations.

## *Time needed:*

Three to four hours

## *Material needed:*

Chart paper & sketch pens

Sketch map of the village woodlot & other plantation sites (if available)

Pruning scissors

## *Process:*

Discuss various issues related to future maintenance and management of community plantations such as Tree Groves (TG) and Village Woodlots (VWL).

Ask them to prepare a sketch map of the VWL plantation site and its surrounding areas, and ask them to show areas of slow growth, open areas, grazing problem, other problems related to protection, etc.

Accompany the VRMC members on a transect walk to the Tree Groves and the VWL sites. On the site, discuss issues related to:

- Growth of trees
- Protection from grazing, theft and physical damage
- Replanting in blank areas
- Need for cultural operations
- Protection from termites and other insects & pests
- Protection from encroachment by neighbouring farms
- Other issues related to protection and management

Ask the VRMC members as to how would they rate the plantations on a scale of 1 to 10 (where 10 is for best). Discuss how they can further enrich their plantations.

Ask VRMC members about the different species that are planted and their potential use/benefits.

Ensure that all members of the VRMC, including women members, accompany you.

Discuss systems and options related to protection, maintenance and management, grazing after coming back to the training venue.

## **Note for the Trainer**

The second half of the session when you come back from the transect walk can be divided into three separate sessions dealing with protection of VWL, cultural operations of VWL, grazing management in VWL and management of *other* community plantations (TG) respectively. The emphasis (time given to a particular subject) would depend on the nature of the issue faced with respect to the specific community plantation.

### ***Discussion related to Protection***

Discuss the following questions to generate discussion on protection issues and to help the VRMC come to a common understanding of the best way to deal with the issue:

- What is the source and reason for pressure, theft or illegal cutting or physical damage to trees in the VWL?
- What can be done to resolve it? What steps has the VRMC taken up till now? Has it helped?
- What should you do if you detect theft from the plantation?
- What should you do if you catch hold of an offender?

Share different practices adopted by the village communities for protection of their common resource and discuss their advantages and disadvantages/limitations in the context of the village.

### ***Discussion related to Pruning and Thinning***

Discuss at the plantation site when and where pruning is needed. Ask which species should be pruned and which should not be pruned. Discuss the way a tree has to be pruned. Show how a tree can be pruned with the help of pruning scissors. Discuss ‘dos’ and ‘don’ts’ in pruning and thinning.

Guidelines for pruning and thinning are given in the handout ‘Cultural Operations in Village Woodlots’ below. Further guidelines on pruning/thinning are also provided in the handout ‘Management of Private Land Plantations’ and a separate handout on species specific management practices under Session 6.

### ***Discussion related to Grazing Management***

Discuss the need for fodder and grazing in the village. Discuss when and how grazing can destroy or help. Discuss the system, advantages and organisation of rotational grazing.

## **Handout: Cultural Operations in Village Woodlots**

### **Why should you do pruning and thinning?**

- Woodlot plantations have been raised at 4 x 2.5 m spacing.
- These plantations will require regular pruning and thinning operations to enhance clear bole formation.
- Excessive congestion in crop will cause hindrance to proper growth of trees and reduce the timber formation in trees.
- Thinning will provide VRMC/ beneficiaries some kind of intermittent revenue by way of such removals. Full details for these operations are available in management practices for individual tree species.

### **When and where is pruning required?**

- Pruning in Acacia species (Kikar, Israeli Kikar, Ronjh etc.) will be required in 2nd year when the seedling has attained a height above one meter and looks bushy.
- Though pruning in Shisham, Ailanthus, Ber, Farash, Toon, Amla, Bakain and Neem is not a common practice, keeping in mind the Haryana conditions and tree management by villagers, we recommend regular pruning of these species, so that in the plantation different species are not allowed to take the shape of bushes. Even small branches coming out at collar level and on many occasions causing damage to the leading shoot, make it more necessary to carry out pruning, so that the leading shoot takes the leading role in bole formation. Such pruning is recommended during 2/3rd and 5/6th year.
- No pruning should be carried out to Jand and Roheda during initial years of establishment. Wait till the leading branch starts taking the shape of bole formation/ developing from the bush. Once bole formation is clearly visible and more than 2 meters in height, then only will pruning be allowed to support bole formation. In case of early pruning these plants get damaged and growth gets stunted. Risks of physical damage to these species are higher in the early stage when the root system tries to stabilize. In that stage, any kind of injury may damage the plant.
- No pruning should be done in Anar and Citrus fruit plants. Pruning increases the chances of fungal attack in these species and a die back process starts in them.

### **How to prune the Acacia species plantations?**

- Very light pruning (one third above ground) may be carried out with pruning scissors. When plantations attain a height above 3 meters or during 4th or 5th year when the bole crop is having a lot of branches in the lower part, pruning can be carried out at one third of the height above ground level. One must look out for unnecessary branches and remove them by a sharp axe during the 7th year to facilitate clear bole formation. It is accepted that most of the Acacia species adopt self-pruning, but that is such a slow process that it hampers the growth of the tree and bole formation in tree stands.

### **Important to remember**

- Any decision for pruning cannot be taken as thumb rule decision. One must inspect the plantations and after visualising the ground realities, decision for pruning must be taken according to growth need of that tree crop.
- Adequate care must be taken that pruning is carried out close to the tree trunk and fungicide is applied to avoid fungal attack in future.
- You must ensure that while going for pruning only 1/3 from bottom of ground surface be covered and no pruning above 1/3 height of the plant be allowed to be carried out.
- FD must visit each site and approve the cultural operations due in woodlots. Extent of pruning and thinning must be approved by the FD and they must guide VRMC regarding how much money will be required to carry out such operations. VRMC can withdraw and spend funds accordingly.

### **Why is it required to take up thinning of plantations?**

- Close canopy tree stands do not allow seasonal grasses to grow, which is an essential part of the desert eco-system. In desert conditions there is serious competition for moisture.
- Close canopy does not allow timber formation in trees due to low moisture regime. Close canopy retards growth and there is small incremental gain in trees for long periods and for years together trees remain the same.
- Available space in plantation of 2.5 or 4 m is so small that desired crown formation and expansion cannot take place.
- Thinning will provide some space and light for grasses to grow. These grasses are essential for the desert conditions, which will provide fodder to cattle wealth and food for wildlife.
- Availability of space in canopy will also help in growing of seasonal medicinal plants, which will supplement the VRMC income.

### **Where should thinning be undertaken?**

- In VWL, except for Eucalyptus and Poplar, all other species require sufficient space for crown formation which is related to the bole formation.

### **When should thinning operations be undertaken?**

- In desert conditions, thinning is essentially required at specific intervals as specified in management practices for different species.
- Plantations carried out at close spacing can be felled at short interval, i.e. after 7/8 years for firewood, which will provide low biomass production.
- First mechanical thinning must be carried out when plants attain a height above 3 m (may be during 4<sup>th</sup> or 5<sup>th</sup> year or earlier) and alternate plants be removed to make plantation at 4 x 5 m spacing.

### **How to undertake thinning operations?**

- During first thinning care must be taken to remove weak, malformed, diseased, too much branched, top broken plants/boles.
- When plants attain 6 m height (may be during 7<sup>th</sup> to 9<sup>th</sup> year of plantation), alternate plants in each row may be removed during 2<sup>nd</sup> thinning.
- While keeping in mind the purpose of plantations and health of trees to be removed, efforts may be made to make plantation at 8 x 10 or 10 x 10 m spacing. In extreme desert conditions growth is very slow and suitable height may be attained after 10 years also. VRMC can use available space for raising of medicinal plants/Jatropha plantations in between the lines.
- Third thinning will be improvement/selection thinning to remove suppressed, top broken, dry, diseased, weak boles, so that good quality timber is harvested from the Panchayat land. Selection thinning must be carried out after proper approval from forest expert in FD.

### **Important to remember**

- Thinning should not be carried out only on the basis of the year of plantation, but it should be based on the height of crop and health of the crop.
- If growth is so fast that wider openings are required, then heavier thinning should be carried out at an early stage or age. In case growth is slow, then thinning schedule may be reworked accordingly.
- Thinning has to be carried out with full technical knowledge; otherwise it can be harmful to the crop also. Some people can misuse the thinning process as a tool to destroy the tree crop.
- The quantum of thinning has to be decided in consultation with forest experts from FD, who will visit each and every site and communicate all technical decisions in writing to VRMC, clearly indicating up to what extent thinning should be carried out. In special cases, experts may get it done under their direct supervision also.

## Handout: Options for Protection of Village Woodlots

Rural communities in various parts of the country adopt different mechanisms for protection of their forests and plantations. Some of the practices adopted by them are given below:

**Rotational Patrolling:** All the households or members of the committee take turns to go for patrolling in the plantation area. The group going for patrolling depends on the size of the plantation/forest and the extent or nature of pressure on it. It could be daily when the pressure is high or at irregular intervals or seasonal, depending on pressure from outsiders on the plantation. The mechanism works in situations where the capacity of some sections of the community to contribute fees for employment of paid watchers is low. At many places the mechanism is employed in combination with 'paid watcher' to deal with high pressure in certain seasons. In case some households are not able to fulfil their duty on the specified date, they either mutually adjust their dates with other households or pay a specified sum to the committee, which is normally the prevailing wage rate in the area.

**Paid Watcher:** Paid watcher(s) are employed at places where the community is financially capable. The number of watchers depends on the size of forest/plantation and the extent of pressure. The watchers are paid in cash or kind or both. Mostly the poorest and physically capable persons are selected with consensus. The duties and powers of the watcher are specified and read out in a community meeting. At some places, the watchers are employed seasonally instead of regularly.

**Social Fencing or general watch:** This practice is employed at many places where the community or committee is confident that it would be able to enforce the rules related to protection and where detection of offence is relatively easy. This is easier to practice where the members of the community regularly visit the area near the plantation and the pressure on plantation is relatively low. This mechanism is also easy to adopt when the trees grow big in size and are difficult to carry away without being detected.

**Involvement of women in protection duties:** Practice where the women have taken over the management responsibility – mostly when the men are found to be careless about the protection related issues, where women perceive significant benefits for themselves from the plantation (easing the firewood or fodder situation), where women normally go to the plantation area for collection of fodder or firewood or where there is a significant number of women offenders.

### Important to note

- Identify the source of the problem (pressure for illegal felling). Treat the root cause, instead of dealing with symptoms.
- Be more careful and vigilant at the time of Panchayat elections.
- The VWL belongs to the whole village and can be protected with the involvement of all. Avoid taking individual credit for the asset created (VWL), which invites jealousy and politicking.
- Maintain the 'fence'.

## Handout: Grazing Management

Cattle and small animals may be an important part of the community's livelihood, and it may be the base for livelihoods of nomadic graziers. Grazing is not inherently bad or damaging to ecosystems, but it needs to be managed sustainably. When there is a high grazing pressure and periodic nomadic grazing, sustainable management may be difficult. Careful planning and a lot of negotiations between different user groups may be needed, both within the community and between the community and user groups outside the community.

**The following are some of the options for sustainable livestock management that may be considered by the community (and negotiated with outside user groups such as graziers coming from Rajasthan):**

- identification of all user groups
- allowing all user groups to participate in planning
- introduction of rotational grazing
- protection from grazing in areas where trees should be allowed to regenerate
- increased stall feeding
- increased fodder production on private land
- increased fodder production on common land
- reduction of number of livestock
- introduction of improved breeds
- introducing mechanisms for sharing grass and grazing (e.g. by tradable grazing/ grass harvesting rights)
- monitoring the health of grazing areas

### Potential benefits of rotational grazing

Both overgrazing and total or partial rest of a grassland may lead to capped and eroding soils with dead grass. Periodic animal impact in the form of intensive grazing and trampling by a cattle herd during a brief period, together with periods of rest, may improve water, mineral and energy flows in many ecosystems. Trampling during a brief period can break up sealed soil surfaces and trample dead grass and other plant tissue into the soil to help start the decomposing of organic matter. If a period of rest follows, plants will regenerate and dormant seeds may germinate.

**Changing grazing practices to rotational grazing with high animal impact and minimal overgrazing can have the following effects:**

- Improvement of grassland health through greater diversity, deeper root systems, and more porous soil
- Restoration of water cycles
- Reduction of noxious weeds
- Reduction of breeding sites of pest organisms and stabilisation of populations through greater diversity of species
- Reduction of capital and supplemental feed demands

(Adapted from Allan Savory, Holistic Resource Management)

## **Handout: Management of Tree Groves**

### ***Management of Tree Groves (TG) on Common Places:***

Most of tree groves have been planted at places of community use, e.g. ponds, school, cattle ground etc. Most of the tree groves do not require thinning etc, because care has been taken to plant at wider spacing.

- VRMC must ensure that these plants are protected from damage by stray cattle and human beings (specially in case of neem).
- The whole village must adopt these TGs as their own and must ensure protection.
- Dead dry trees may not be removed except for commercial species such as Shisham; standing trees will provide shelter to birds.
- In case of TG at a village pond, VRMC has to put extra efforts for protection of these trees.
- Traditionally villagers used to protect such groves for common use such as resting place for cattle during summer. Graziers frequently use such shades for cattle gathering.

### ***Management of Linear Tree Groves (LTG):***

LTGs have been planted along village approach roads and village-to-village kachha paths. These paths/roads traditionally used to have shady trees, but due to continuous negligence shady trees have been destroyed. There is a felt need that these paths be provided shade to travellers.

- Biggest cooperation is required from owners of farms on both sides of the path/road.
- VRMC has to own the responsibility to mobilise and convince all such farmers to protect these trees.
- Ownership of land of these paths lies with the village Panchayat. So, it will be appropriate that VRMC also mobilises the village Panchayat. Panchayat and owners of land adjacent to such paths share final harvest on 50:50 basis, so that any kind of loss to agricultural crop is compensated to farmers, and in turn farmers protect these trees.
- In case of metalled roads, ownership of such land is with the PWD/Forest Department. In that case, we have to mobilise territorial staff for effective protection of these LTGs.
- These single line plantations only require pruning during initial 4 years; later not much is required except protection from physical damage.
- In some parts, LTGs have been planted along canal/water channels. Such LTGs can be protected with the cooperation from farmers, and later on territorial staff will protect and take charge of such linear plantations.
- Enumeration must be carried out of such strips for effective protection.
- Thinning will be carried out by the co-sharer/future owner of these strips.

# Session 3: Management of Funds

***Purpose:***

Discuss utilisation of Resource Management Fund (RMF) for protection and maintenance of the community plantations.

***Time needed:***

One and a half to two hours

***Material needed:***

Chart papers, marker pens

***Method:***

Group discussion and exercise

***Process:***

Divide the VRMC members in three groups of four to five persons each. One group could be of office bearers, the second could be of landless and SC members and the third group could be of women members.

Discuss the RMF objective and possible utilisation. Help the participants to calculate the amount of funds they have in the RMF and the amount of fund that would be available to the VRMC in a month.

## **Group Exercise**

- Ask the groups to discuss various areas/activities for which money would be needed after the withdrawal of HCFP for protection and maintenance of the plantation and functioning of the VRMC.
- Ask them to classify the activity in three categories based on its necessity – high, medium and low. They should also assess whether the activity would require regular or one-time expense.
- The groups should estimate the expense related to that activity. If the activity is monthly they should calculate the monthly expense. If it is one-time, they should accordingly specify the total amount.
- Ask them to assess whether the existing funds would be sufficient to cover the expenses. If not, they should identify the source from where they can make up the shortfall or ways in which they would be able to manage with the existing funds.
- The outputs by each group can be summarised on a chart in the format provided in the handout.
- The groups present their outputs and differences are discussed.

## Handout for group exercise

<b>Activity / Task Expenditure Head</b>	<b>Necessity (High, Medium, Low)</b>	<b>Nature of expense (Regular – monthly, quarterly, half- yearly, annually); One-time (Need based)</b>	<b>Expected amount of expenditure (Rs.) per month/year</b>	<b>Source of fund</b>
Watch & Ward				
VRMC Meetings				
Maintain linkage with Forest Department (travel, postage, stationery, phone)				
Pruning				
Thinning				
Gap planting				
Harvesting				
Marketing				

## **Handout: Management of Funds**

- HCFP has provided a fixed deposit of Rs. 30,000 as Resource Management Fund (RMF) plus Rs. 500 per hectare additionally for woodlot areas above 10 ha.
- Incentive money of Rs. 300 + Rs. 400 per hectare (in 2<sup>nd</sup> and 3<sup>rd</sup> year of plantation) has been provided to the respective VRMCs, for successful VWL plantations.
- VRMCs have collected membership fee from the villagers. Moreover, the VRMCs can collect some funds by donation/voluntary contributions from local villagers or outside agencies.
- RMF was provided in the form of a 3-year fixed deposit. After maturity, this money has been reinvested in another fixed deposit. It is expected that towards the end of the project period, this amount will be around Rs. 60,000. If we add to it incentive money and additional RMF, the total will be a reasonable amount. Those villages which have VWL plantations above 40 ha will not face much problem to continue with one of the link workers or someone else as plantation watcher, and payment (Rs. 600 per month) can be made from the annual interest accrual on RMF and other existing deposits.
- Some of the VRMCs with a larger chunk of common land have built up reasonable financial resources with them. By using interest accrued from that money, the VRMC can sustain future management of common land plantations up to the rotation period.
- For maintenance and protection of woodlots, the VRMC can spend money in following order according to area covered:
  - Rs. 600 per month for plantation area up to 20 ha,
  - Rs. 1000 per month for area up to 30 ha,
  - Rs. 1500 per month for area up to 50 ha,
  - Rs. 2000 per month for areas exceeding 50 ha.

### **What should you do if you do not have enough money in your RMF?**

- Use the RMF judiciously. Reduce the monthly honorarium to link worker/ plantation watcher to such a level that it can be managed within interest accrual on existing deposits or an additional amount can be collected from the village.
- Consider the possibility of rotation patrolling combined with effective general watch and ward without employing the watcher.
- VRMC can try to get financial support from the village Panchayat, which they can adjust at the time of final harvest. In case no other financial resource is available, Rs. 500 per month can be drawn from the RMF deposit and can be paid to plantation watcher/link worker. This will ensure maintenance of plantations up to the rotation period.
- Generate some income from the non-timber produce. A large number of non-timber produces are removed from common lands e.g. Tint, Kachari, Grasses, Munja/pulla, medicinal plants (herbs/shrubs grow seasonally), fruits, fodder, dead/dry/fallen lops and tops from trees, etc. VRMCs can generate some funds either by charging a nominal fee from collectors or auctioning them to interested buyers/collectors. This will generate small amounts only, but on a sustainable basis.
- Generate annual financial contribution from community members. Some of the VRMCs have demonstrated ability to collect part of funds for management from villagers by way of donations.

# Session 4: Harvesting and Marketing of Produce

***Purpose:***

1. Inform VRMC members and SDF Farmers on harvesting procedures.
2. Discuss process and procedure for marketing the produce.

***Time needed:***

One and a half hours

***Material needed:***

Flipchart or blackboard, marker pens or chalk

***Method:***

Lecture and group discussion

***Process:***

Introduce the details of the procedures related to harvesting of NTFPs and final produce.

After listing the process and procedures, discuss the elements that may cause difficulty and suggestions on how to overcome them.

Ask if the VRMC and farmers would like information about other aspects of harvesting and marketing the produce. Clarify their queries to the best of your ability or suggest to them sources for more information.

## Handout: Harvesting and Marketing of Produce

### Procedure for Removal of Non-Wood/Timber Products:

- (a) **Grasses:** Fodder grass seeds have been sown in woodlot areas. Mainly Cenchrus grass is indigenous to this area.
- VRMC will regulate removal of grasses by cutting as head loads and keeps a record of the same in prescribed manner.
  - VRMC will announce the date, time and period for collection of grasses from the plantations. It will preferably be July-August.
  - VRMC will allow grass collection to all societal groups; at the same time landless may be given preference in grass cutting.
  - Every household will be given equal opportunity; VRMC will not discriminate on any ground.
  - VRMC can, in a general body meeting, fix a nominal price per head load removal and that money will be shown in VRMC records. Link worker/Secretary will maintain such records. Annual report will be sent to the FD.
  - VRMC will not allocate any part of the area to any person or group of persons. But for the sake of uniformity grass cutting will be allowed from one end to the other as decided by the VRMC.
  - Grass cuttings will be allowed up to second week of September or till flowering starts in Chenchrus and other grasses. After flowering, no grass cutting will be allowed.
  - Grass seeds will be collected through VRMC or allowed to fall in the area, according to need of the area, so that grasses continue to regenerate in the area.
  - It will be allowed to cut dry grasses after ensuring that all seeds have fallen in the ground (during November-December) and record will be maintained for that.
- (b) **Other Products:** Some seasonal products such as Tint, Kachari, Medicinal Plants and local Fruits can be collected from the woodlots.
- VRMC will assess the extent of crop depending on rainfall and prevalent weather conditions.
  - Depending on the ground realities, VRMC will assess the quantum and reserve price for auction of such products in a general body meeting.
  - Auction notice will be issued with clear 15 days time and one copy will be pasted on the Chetna Kendra wall.
  - While auctioning such products preferences must be given to people of the same village. If no one is willing to buy in that village, then the product may be auctioned to neighbouring villages.
  - It must be ensured that while removing such products, no damage is caused to plantations and the tree crop.
  - Only auctioned material will be removed. VRMC will not allow removal/ collection of other than specified items.

- It will be the duty of Chairperson and Secretary of the VRMC to regulate and control such removal.
- Day-to-day record of removal will be maintained by the Secretary. Entry of such removals will be made in VRMC registers.
- Process of removal of a particular product will be allowed after deposit of 100% advance amount in the VRMC account.
- Executive body of VRMC will keep constant watch on such removal. In case of any damage or violation, they can stop/ cancel such collection. Any kind of refund of money will not be allowed on violation of terms and conditions by the contractor.

(c) ***Final Harvest:***

- Final harvest of different tree species will be according to the rotation period of a particular species subject to proper growth in that area.

Rotation age or girth, whichever is less, for major tree species can be used as:

*Kikar: 15 years or 90 cm*

*Ailanthus: 10 years or 120 cm*

*Israeli Kikar: 10 years or 90 cm*

*Eucalyptus: 8 years or 60 cm*

*Shisham: 40 years or 150 cm*

*Khair: 30 years or 90 cm*

*Poplar: 7 years or 90 cm*

*Ronjh: 15 years or 90 cm*

*Jand: Has been included in list of protected trees; removal of dead and dry trees only*

- Again, only rotation age cannot be kept as a single criterion for harvesting a crop. It is the local site, edaphic factors, irrigation facilities, interest taken by villagers in protection of the tree crop, growth of a particular species, market demand, market price etc. that will influence the final decision.
- Purpose and object of the plantation will also decide the time of final harvest of a particular species.
- Keeping different parameters in mind, the FD team of technical experts will help the VRMC to decide about harvest time period/ rotation.
- VRMC will carry out enumeration of trees proposed for harvest and send it to FD. VRMC will make written request to the FD for final harvest.
- FD will communicate in writing its permission for harvest along with reserve price and list of probable buyers, whom VRMC can contact for sale of their product.
- Then VRMC will issue 30 days notice for selling of a tree crop. A copy of this notice will compulsorily be posted outside the Chetna Kendra, village Panchayat building, bus stand and government school of that village.
- Preference will be given to buyers from the same village if other conditions are the same. Second preference will be given to persons from other HCFP villages.

- The buyer has to deposit full amount and respective share will be deposited in VRMC account and Panchayat account. When village Sarpanch and VRMC Chairperson furnish a certificate for this, the felling process will be allowed. As per prevalent arrangements 70% of the harvest will go to Panchayat for development and 30% will go to VRMC for replanting the same area.
- All sale proceeds have to be reflected properly in the VRMC accounts and the PME team must help in verification of records.
- Again FD has to play the role of mediator to VRMC and Panchayat. FD on one hand provides technical expertise to VRMC, at the same time motivates villagers and VRMC in such a way that they can raise plantations successfully after harvest of crop.
- FD will work as facilitator for effective and economical disposal of the tree crop. FD will help in fixing reserve price at appropriate time.
- FD will also help in locating the proper buyer.
- Permission for felling of tree crop from Panchayat land has to come from different agencies. FD will provide necessary guidance for that also.
- In case HFDC does not provide proper price, then FD can communicate with different agencies for sale of forest crop from such Panchayat land.
- When the forest crop is mature, it will be auctioned jointly by village Panchayat and VRMC after due approval from FD. FD will assess plantations due for final harvest and fix the reserve price along with revenue sharing mechanism. FD must clearly spell out at that time how that money will be used by the VRMC. First preference must be given for re-forestation of the felled area. Part of the funds can be diverted to other development activities as decided by the VRMC in consultation with FD.

### **Important**

There could be problems in sharing of the sale proceeds from forest crops with the Panchayat on final harvest. In case the Panchayat agrees to give 30% to the VRMC, the VRMC can use those funds for raising future plantations. In case the village Panchayat backs out from the tripartite agreement, the VRMC will not be sustainable. The VRMC has to be vigilant that the tripartite agreement is honoured.

# Session 5: Equity Issues in Management of Plantations

**Time needed:**

Two hours (Part 1 - one hour; Part 2 – one hour)

**Material needed:**

Chart paper and sketch pen

**Process:**

The process can be divided into two main parts.

**Part 1**

**Purpose:**

Sensitising the VRMCs to the need and importance of managing different interest groups and incorporating the concerns of poor and women in the planning and implementation

Organise a discussion with the trainees with reference to Panchayat Land. Identify different Interest Groups, and discuss their nature of interest in the Panchayat land. Such groups could be of graziers, potters taking soil from the land, stone mine workers, encroachers, lease holders of Panchayat land, farmers having fields neighbouring the Panchayat land, Panchayat, people using the land for storing cow dung cakes, poor and women. Discuss how the existing VWL, the species planted under VWL and the rules being applied for its management affect different interest groups. Also discuss the ways in which a “win-win” solution can be evolved with respect to groups which are losing.

Group	Nature of Interest	Strength of the Group	Does the VWL benefit or harm their interest? How?
Poor			
Women			
Landless			
Graziers			
Panchayat			
Neighbouring farmers			

## **Part 2: Deciding on management strategy for Village Woodlots**

**Purpose:** To highlight priorities and differences between different interest groups and emphasise the need for sensitivity to the needs of poor and women.

The activity begins by identifying the different types of products that could be available from a Village Woodlot.

Starting with the first product, compare whether men or women use the resource more. The group could be asked to give points from one to ten. Each point can be represented by a X, to indicate the relative importance of the resource to each group. Continue with the next product until the entire gender column has been completed. Then continue with the wealth column, comparing the uses of resources by richer, average and poorer people.

It is important to follow up the matrix with discussion in greater depth about why use patterns differ, how access rules affect different groups, what conflicts there may be between groups.

Use should be carefully defined and agreed – for example use could mean the person who actually harvests the resource, or the person who is the end user.

**Examples to show differences between women and men, rich and poor, local and external: priorities for different products (numbers in brackets indicate how many X were allocated to each product)**

	Gender		Wealth		
	Men	Women	Richer	Average	Poorer
Firewood		xxxxx (5)	xx (2)	xxx (3)	xxxx (4)
Green manure	xxxx (4)		xxxx (4)	xxx (3)	
Fence posts	xxxx (4)		xx (2)	xxxx (4)	x (1)
Timber for ploughs	xxxx (4)		xx (2)	xxxx(4)	xx (2)
Timber for house construction	xxxx (4)		xx (2)	xxxx (4)	xxx (3)
Medicinal plants		xxxxxx (5)	x (1)	xxx (3)	xxxxxx (5)
Grasses		xxxxxx (5)	x (1)	xxxx (4)	xxxxxx (5)
Income from sale of firewood					
Income from sale of timber					

**If we summarise this table we can see which product is of greatest importance to which group**

Product	Gender	Wealth
Firewood	Women	Poorer
Green manure	Men	Richer
Fence posts	Men	Average
Timber for ploughs	Men	Average
Medicinal plants	Women	Poorer
Grasses	Women	Poorer

From this summary it becomes clear that management decisions will have very important consequences on particular groups. It is also clear that the majority of users are poor people, but that rich people also have an important interest in the woodlot that could conflict with some of the other uses – for example over-cutting of green manure can lead to a serious reduction in medicinal plants due to an alteration in shade levels. This exercise is very important when determining how an area is going to be managed for what products and for whom.

## Handout for group exercise

	Gender		Wealth		
	Men	Women	Richer	Average	Poorer
Firewood					
Green manure					
Fence posts					
Timber for ploughs					
Timber for house construction					
Medicinal plants					
Grasses					
Income from sale of firewood					
Income from sale of timber					

**Summary: Which product is of greatest importance to which group**

Product	Gender	Wealth
Firewood		
Green manure		
Fence posts		
Timber for ploughs		
Medicinal plants		
Grasses		

# Session 6: Management of Private Land Plantations

## **Purpose:**

Discuss issues, options and techniques for management of plantations on private land

## **Time needed:**

Two hours (with break of 10 minutes)

## **Material needed:**

Blackboard or flipchart, chalk or marker pens

## **Method:**

Lecture and group discussion

HCFP has raised plantation on private lands under the Sand Dune Fixation (SDF/MSDF) and Poplar plantation models. SDF/MSDF has been implemented in Hisar Circle and poplar plantation in Ambala Circle. Besides, farmers have planted seedlings at their own under the Multi-Species Farm Forestry (MSFF) model. HCFP has provided incentive money of Rs. 2 and Rs. 4 in first and third year for surviving plants in MSFF.

For effective management we can classify trees on private land under 4 categories.

- Short rotation tree crops.
- Long rotation tree crop
- Fruit/plant crop.
- Medicinal plant plantations.

HCFP has provided tree species with short to moderate rotation (<15 years rotation) such as Eucalyptus, Ailanthus excelsa, Poplar, Khair (Acacia catechu), Bakain (Melia azedirachta), Fransh (Tamarix aphylla), etc. etc.

Long rotation tree species (>15 years rotation) are Shisham (Dalbergia sissoo), Kikar (Acacia nilotica), Israeli Kikar (Acacia tortilis), Jand (Prosopis cineraria), Roheda (Tecomella undulata), etc.

Fruit Plantation: Ber (Ziziphus mauritiana), Amla (Emblca officinalis), Amrood (Psidium guajava), Citrus spcs, Anar (Punica granatum), Papita (Caraca papaya), Bel pathar (Aegle marmalose), etc. etc.

Medicinal Plants Plantation: Jatropha curcus (Ratanjot), Emblica officinalis (Amla), Emblica amrus, Andragraphis paniculata, Baecopi monnieri, Commiphora weightii, Asparagus racemosus, Asparagus adscendens, Chlorophytum tuberosum, Plantago ovota, Digitalis purpuria, Cassia augustifolia, Glycyrrhiza glabra. Ocimum basilicum, Rauwolfia serpentine and Spilanthus acemella, etc.

Apart from this session's handout on Management of Private Land Plantations, guidelines for pruning and thinning are also provided in the handout 'Cultural Operations in Village Woodlots' (under Session 2), which may be shared with tree growing farmers. Species specific management practices are given in a separate handout.

# **Handout: Management of Private Land Plantations**

## **Important things to note and remember**

- The tree crop/canopy is to be managed in such a way that the agricultural crop continues to get enough sunlight for proper production.
- Thinning in farm forestry can be managed in such a way that finally the plants are at 8 x 5 or 8 x 10 meter spacing.
- Farmers can raise medicinal plants as inter-crop on their private land to increase their income.
- In general short rotation tree crops require regular irrigation. If farmers can provide one irrigation every month it will give better results in growth.
- Similarly, if the farmer after irrigation carries out regular weeding and hoeing operations, performance of the trees will be better.
- All these tree species give best results when fields are tilled and ploughed regularly. Ploughing boosts the growth of trees. It is advisable to keep the field free from weeds and grasses, which hamper the growth of these species.
- These plants can manage with irrigation in alternate months. If water is not available for regular irrigations then two irrigations are a must, one during April/May another before winter.
- After the 3rd year, plants can survive without any irrigation, but growth will be adversely affected.
- Pruning and thinning must be carried out according to compatibility with agricultural crops raised in the fields. Without proper pruning these trees have a tendency to increase their crown size, which may hamper agricultural crops.
- In block plantations thinning must be executed, particularly in Ailanthus and Bakain crops, because these have large crowns. Best way is to keep these species at 6 x 6 or 5 x 8 m spacing when they cross ten foot height. Once the height is about 20 to 25 ft (6 to 8 m) trees must be spaced at 10 x 10 or 10 x 8 m. Later on the farmer can retain a number of stems as per future purpose of the tree crop.

## **How to manage and develop different species?**

- Ailanthus and Israeli Kikar have been planted mostly on sand dunes where chances of irrigation are minimal. Where cultivation of agricultural crops is remote, in such areas Israeli Kikar can be retained up to its rotation period. Pruning has to be carried out in 2nd, 4th and 6th year. Thinning has to be carried out twice, first mechanical thinning in 4th/5th year. When the plantation is about 4-5 m high, this mechanical thinning will remove alternate plants to make a spacing of 5 x 4 m. Then in 7th/8th year, again thinning will make spacing at 10 x 8 m. Last thinning should be selective to remove any kind of congestion, which hampers bole formation in trees. This can be done in 11th/12th year. Farmers can then get good size trees and during thinning removed fuelwood can provide intermittent income to farmers.
- Removals through thinning will also provide space for cultivation of medicinal plants/agricultural crops as inter-crop.

- Shisham, Jand, Roheda and Toon are long rotation trees with reference to Haryana conditions. Jand cannot tolerate pruning in early stage. But once bole formation is clear, then pruning and pollarding can be carried out.
- In SDF areas plantations at 4 x 2.5 m spacing may be converted to 4 x 5 m spacing during 4th/5th year and 10 x 8 m spacing during 8/9th year by carrying out thinning operations.
- Jand is highly friendly with rainfed agricultural system. It can grow well at 5 x 8 m spacing, but due to large scale use of tractors, 10 x 8 m is a better option for farmers to adopt in agricultural practices. Secondly during winter it is heavily pollarded (chhangai) for fodder and fuelwood, which makes it the least harmful tree to agricultural crops.
- Shisham must be pruned in 2nd, 4th and 6th year. First mechanical thinning will be carried out in 4/5th year to make 5 x 4 or 8 x 5 m spacing. Then during 12th year spacing may be made at 10 x 8 m. Third thinning must be selective to remove dead, dry, diseased, broken, malformed trees from crop or to provide sunlight to agricultural crops, as and where required according to farmer needs according to compatibility with agricultural crops.
- Fruit plant plantations require intensive and regular care. Weeding/hoeing and irrigation must be carried out every month. In case of any kind of damage by insect/pest, insecticides/pesticides must be used well in time. Proper care must be taken to provide irrigation after fruit formation; dry spell may induce falling of fruits in initial stage. Similarly excessive irrigation at the time of flowering may reduce profuse setting of flowering in plants. Fruits must be harvested in time, otherwise they get damaged. In case of Anar, Amrood and Amla no pruning is required. In case of grafted fruit plants, care must be taken to remove any shoot coming below the grafted portion.

### **How to Manage Farm Forestry Plantations?**

These plants have been planted by farmers at their own choice. In spite of all efforts, farmers have not planted these plants at regular intervals. There are local variations in the spacing and combination of different species at the same place. Most of the farmers in the dry zone have planted plants along the farm boundary. But Eucalyptus have been planted in block plantations also. HCFP has already paid Rs. 2 + Rs. 4 for every surviving plant as incentive money. After exit of HCFP, farmers should continue to maintain and carry out new plantations mostly in linear strips.

- Thinning is not very necessary, but pruning is required every year in these plants after winter season.
- In case of Ailanthus, Shisham and Bakain, plants are planted at closer spacing. Farmers should remove some plants to provide enough space for growth and bole formation of such trees.
- In case of some pest/insect attack, ask for advice from FD to spray insecticides/pesticides.

## **How to manage Kitchen Garden (KG) Plants?**

High value quality grafted fruit plants have been provided and planted under the KG component. These five plants have been planted in close vicinity of houses, where the womenfolk can play a crucial role in maintaining them. These plants are highly susceptible to damage and require frequent post-plantation care.

- Every week the owner must provide irrigation to these plants.
- Every month hoeing and weeding (if any) must be carried out.
- Initially every week the owner must look out for fresh shoots coming below the grafted portion.
- In case you do not look after grafted plants regularly at the initial stage and then after a gap of some months, you may find that a number of shoots have come out at collar level. Then it becomes difficult for them to differentiate between shoots coming out from the grafted portion and shoots that have sprouted from the seed origin portion. Then ultimately the grafted fruit plant becomes of seed origin.
- Once in a quarter owners must carry out deep hoeing also to control growth of secondary roots.
- A common problem is the termite attack. Villagers can use tobacco solution, which is very effective to control termite attacks. As it is not possible to purchase insecticides/pesticides for 5 plants, the best way to protect them is to spray tobacco solution or neem paste solution or to apply neem cake etc, which are the indigenous methods. In the roots portion farmers can apply solution extract from Aak/Bakain/Aksand plants.
- Another problem is the lack of proper irrigation. Neither excessive irrigation nor low/scanty irrigation will do for these plants. Next irrigation must be provided when upper soils are dry.
- Another problem with Pomegranate/Citrus is the inflicting wounds by cuttings/pruning, which cause fungal attack and plants start dying. In case of pomegranate, pruning must be avoided at any stage. In case it is carried out, fungicide must be used on such portions. In case of citrus and pomegranate, removal of secondary roots (called jaala) from the roots is essential, otherwise flowers do not get set up.

# Handout: Management Practices for Different Species

## 1. Shisham

In case of good growth it gives lots of lateral branches, which gives it a bushy shape. In such conditions pruning must be carried out at one-third height from the ground. Pruning must be carried out with pruning scissors or cutter. Farmers are advised not to use local blunt instruments (drarti or kulhari). First thinning is a must after attaining a height of about 4 m, when plants must be spaced at 5 x 4 or 8 x 5 m. Second thinning will be carried out when the bole is 6 to 8 m high and spacing be made at 10 x 8 m or 12 x 12 m. Yield at about 15 years will be about 40 tonnes of firewood, and at about 20 years about 100 cum. of timber can be obtained. Rotation of about 40 years is recommended for Shisham for timber production. External injuries to trees may increase the chances for fungal attacks, which spoil the timber quality. Any kind of wound inflicted at an early age may cause hollowness of timber at maturity due to fungal attacks of the wounds. Villagers use Shisham as timber for doors and windows, also for cabinet making and carving. Lops and tops are used as small timber for agricultural implements and firewood.

## 2. Eucalyptus (Safeda)

It is a short rotation crop; in Haryana conditions people like to sell 7 to 10 years old trees. Eucalyptus carries out self-pruning through shedding of branches. In case of retaining trees for timber, spacing has to be more than 3 m.

## 3. Khair

Pruning during third year helps in clear bole formation. Rodents do a lot of damage to young seedlings; the tree also suffers from certain insects. To control rodents rat poison is mixed in soil, while against insects the use of thiodine 30 E.C. is recommended. In old plantations *Ganoderma lucidum* causes serious root rot. Sites having earlier history of fungal attack should be avoided.

## 4. Kikar, Bari Babul

It is a medium sized tree and generally attains a height of 10 to 15 meters. It has a perfect umbrella-like crown and its roots go deep in search of water. It is a thorny species with bright yellow scented flowers.

In case the plant looks bushy, light pruning can be carried out during second/third year and a second pruning if required during 6/7th year. Thinning is essential to induce bole formation. First thinning will be carried out in third/fourth year when the plant is more than 3 m high, at 4 x 8 m spacing. Second thinning will be carried out when trees are about 6 m in height, to make spacing at 8 x 8 m. It is a good nitrogen fixer and poor coppicer in young boles mainly. In average areas it is expected to produce about 400 quintals of firewood after 6 years. Trees, at the age of 10 years, may produce about 250 gms. of gum per tree. For timber production rotation can be 20 years. It dies early when raised in areas having *kankar* pan.

## **5. Israeli kikar, Bhundhaly kikar**

It yields about 40 tonnes of wood per ha at the age of 10 years, if it is growing well. Compared to indigenous arid zone tree species its growth rate is four to five times more. In the Indira Gandhi Canal Project, Rajasthan its productivity was recorded as 6 m<sup>3</sup>/ha. An excellent species for refractory sites including shifting sand dunes. In case the plant looks bushy, light pruning can be carried out during second/third year. Thinning is essential to induce bole formation. First thinning will be carried out in third/fourth year when the plant is more than 4 m high, at 4 x 8 m spacing, second thinning when trees are about 6 m in height to make spacing at 8 x 8 m.

## **6. Ulloo Neem, Ardhoosa, Maharukh, Ailanthus**

It is a medium sized tree attaining a height of up to twenty meters. It is a fast growing species and has good crooked stem. After rainy season young leaves have a bad odour; due to that leaves are not eaten by animals. However, it is a good fodder for the animals of Rajasthan or once cattle develop a taste for it. It is a strong light demander, fast growing and a good coppicer. 4 irrigations during first year, 3 during second year and 2 during third year can sustain the plant in sandy soils. The tree cannot withstand excess watering; it should never be over-watered. Right from sowing to planting in the field it needs regular watering, but it should always be done sparingly. Too much moisture leads to damping off disease. Grasses and weeds hamper its growth; removal of grasses and hoeing are highly beneficial to plant growth. If harrowing is done in between plantation lines, it boosts the growth. It gives good fodder for camels. Farmers can get some income from leaf fodder. It yields 5-7 quintals of green fodder twice a year. Leaf fodder can be dried and stored. It is rich in calcium and crude protein. Timber is used in match and sports goods industries. When mature the tree is large, 18-25m high, with a straight trunk of 60-80 cm diameter. Defoliator attack can be controlled by spraying 0.2% Endosulphan solution.

## **7. Jand or Jandi**

Crop is usually harvested at a rotation of 40 years. It is a very good coppicer and even coppice comes up from roots cut deep in the ground. Growth rate in bole stage is relatively faster than that in seedling or sapling stages, as during the earlier stages a strong root system develops and establishes itself. Thereafter shoot growth is accelerated. When young it coppices well and freely reproduces good suckers. It is a medium sized tree and grows up to 18 meters high. It is a thorny tree and is at ease in sandy and hot areas. Its roots go deep into the soil in search of water. It is a very good agro-forestry species. Leaves are used for fodder (on an average complete lopping of a full grown tree yields 59 kg green forage; crude protein of leaves range from 13.9 – 15.3). The bark is used for medicinal purposes, green fruit pods are used as vegetable, dry fruit pods are relished by goats. Its branches provide fencing material and good firewood for cooking food. The wood, apart from being good fuel (5,000 kcal/kg), is also used for house building, agriculture implements and small timber.

## **8. Roheda, Marwar teak**

It is a deciduous or nearly evergreen tree of arid and semi-arid regions. It is fire and drought hardy. No pruning is required, rather it dislikes pruning during initial years. When the plant is about 2 meters high, then only will unnecessary branches be pruned and the main stem must not be touched. Any injury or wound in the stem increases the risk for fungal attack, which destroys its timber value. It is harvested at an early stage to avoid hollowness or fungal attacks inside the trunk. Farmers harvest it 20 years onward depending on requirement.

## **9. Ber**

It is a fast growing evergreen tree that grows up to 15 meters high. It is a thorny plant and the leaves are good quality fodder. The fruits are rich in many nutrients. Pruned/lopped branches are used as fencing material. Fruits are a rich source of vitamin C. The wood is a good firewood (4878 kcal/kg) and is also used for making charcoal. Its bark yields tannin (4-9%). This species is planted mainly for its fruits. A number of cultivars have been developed and there is variation in time of fruit ripening from cultivar to cultivar. Cultivars 'Gola' and 'Seb' ripen in February, while 'Kaithali' and 'Baramasi' ripen in the second fortnight of February and March. Cultivar 'Uran' ripens in late March and April. To maximize fruit yield, ber plants need to be nurtured well. The plant has to be properly pruned and treated with specific chemicals. There are chemicals that can produce more flower buds per unit length of a branch, then there are chemicals that help flowers stay on the tree and not fall off prematurely. Certain chemicals help increase fruit size, and others help the fruit to ripen properly. Plants retained for fruit plantation are thinned to make 8 x 10 or 8 x 8 m spacing.

## **10. Neem**

Leaves provide excellent fodder and are used for extraction of azadirachtin used as insect-repellent. Fruits are used for extracting neem oil or moringa oil used in soap, disinfectant drugs and as a lubricant. Seed cake is an excellent manure. Bark contains tannin. Wood is used for furniture, carts, axles, yokes, packing cases and boat building etc. In arid regions wood is used as firewood. Fruits, when ripe, are yellow in colour and fall from trees in June-July. Healthy fruits can be collected from the ground. Fruits are de-pulped and then dried. Trees start fruiting at about 5 years. Besides, a mature tree will also yield about 400 kg of leaves. On good soils crop will yield about 4-10 cum. of wood per annum of its age.

## **11. Bakain**

It is a strong light demander. It grows very fast and also coppices extremely well. Leaves are lopped for fodder and the wood is used for a variety of purposes in rural areas. Its life is short and it needs to be replaced every 20 years or so. It is a very good shady tree and is largely liked, especially in desert and semi-desert areas. It tolerates frost and is not generally browsed by animals. Planted as avenue tree. The wood is used as firewood and oil is extracted from its seeds, which is suitable for lightening.

## **12. Pahari Papri**

This tree is used for small wood for agricultural purposes, so it is felled according to need by the farmers. Farmers plant this tree along farm boundaries as a farm forestry species also. It is a moderate coppicer. It is not a frost hardy species. Papri is a large tree with an offensive smell. The wood is light and yellow and is used for building construction, carts and carvings. Leaves are used as fodder during scarcity. Leaves and fruits are eaten by cattle. It gives an excellent firewood (5,258 kcal/kg). The wood is also used for veneering, packing cases, shoe-heels, bobbins, matchboxes, etc.

## **13. Amla**

It is a medium sized tree and grows up to 20 to 30 meters high. Its branches are soft and the leaves look like the feathers of birds. The species grows in dry to moist tropical areas. Its fruit is full of vitamin C and is used for making pickles and preservatives. The tree is also used as a fodder source. The bark is used for tanning and dyeing. The wood is used as firewood (5,200 kcal/kg) and gives an excellent quality charcoal. Cultivated varieties like Kanchan, ND 5 and ND 7 are heavy bearers with big size fruits. Planting stock of these varieties can be obtained from the Horticulture Department, Acharya Narendra Development University of Agriculture Technology, Faizabad.

## **14. Bel**

Attains best growth in well-drained loamy soils with sufficient moisture. It also occurs in gravelly and poor soils, but growth is poor. It is a good coppicer. It is frost and drought hardy. Grows in hot climate with rainfall varying from 500 mm to 1500 mm. Spacing suggested for this species is 4 x 4 m. The fruit has great medicinal value; leaves are a good fodder; the bark yields tannin (11.6%); timber is used for agricultural implements.