# Managing tropical Sal forests (*Shorea robusta)* of Nepal in short rotations: findings of a 12-year long research

K. P. Acharya[1], P. R. Tamrakar[1], G. Gautam[1], R. Regmi[1], A. Adhikari[1] and B. Acharya[1]

In the past, tropical Sal (*Shorea robusta*) forests of Nepal's were heavily exploited either to generate state revenue or to fulfil the forest product demand of increasing population, which resulted in formation of large tracts of degraded forest. Realising the extent of the problems, the government recognises forest user groups as the managers of the community forests and such degraded forests were handed over to local communities for management. There is a growing demand for information from local communities as well as forestry field staff on how forests could be managed to meet the demand for daily subsistence of the rural livelihood.

Department of Forest Research and Survey established study plots of Tropical Sal Forests to inform the local managers of identifying management practice/s that could maximise fodder and firewood production from these forests. The study was based on research plots established at Chaukibari of Sunsari district in Eastern Nepal. A single block forest was established with 16 different treatments. Of these treatments, four were designed for fodder and fuelwood production in a short rotation. Analysis for the four treatments of simple coppice management option was done. It was found that 1 shoot per stool was better for earlier foliage production and 3/2/1 shoots per stool was the best treatment to produce maximum fuelwood in a short rotation.

**Key words:** Sal forests, regeneration, biomass, management practices, Nepal

Tropical Sal Forests are most widely distributed and occupy largest area of forests in lowland region of Nepal. The country mainly depends on this forest to meet its timber requirement. Sal is the most prized wood in Nepal. Tropical Sal Forests have been heavily exploited either to generate state revenue or to meet the forest product demand of ever increasing population and for resettlement programmes. Many of such forests have either become degraded or converted into agricultural land. In present days, such forests are protected and felling of any kind is prohibited. However, due to lack of planned management, despite being put under total protection, such forests are degrading in quantity and quality (Acharya 2000).

Well-established regeneration is believed to be the first step for a successfully managed forest. Natural forest management research programme in the country has a greater focus on regeneration establishment. Long-term research plots were established in the 1980s when the national focus in forestry sector was on rejuvenation of degraded sites. The government of Nepal then had a single most important programme to establish plantations on such sites in the country.

These research plots were established in two forest types: Tropical Sal (*Shorea robusta*) Forest Type and *Schima castanopsis* Forest Type. Tropical Sal (*Shorea robusta*) Forest Type is distributed in the Terai Region and *Schima castanopsis* Forest Type in the Middle Hill Region of the country. Both types of forests are most important, as they serve wide variety of forest product needs of rural people in the Hills and Terai. Through Community Forestry Development Programme, substantial area of forests has been handed over to Forest User Groups (FUGs) for their management and to meet their subsistence requirement. Of the handed over forests, largest share is that of Tropical Sal and *Schima castanopsis* forests. An estimate has shown that a total of 3654 million ha of forest area is available for improved management. Out of which Sal occupies 132,000 ha and *Schima castanopsis* occupies 1090,000 ha of forest area in Nepal (Sowerine 1994).

[1] Department of Forest Research and Survey, PO Box 3339, Kathmandu, Nepal.

There is a growing demand for information from local community as well as forestry field staff on how forests could be managed to meet the demand of forest products that is essential to sustain rural livelihood.

### Objectives of the study

The main objective of the research were:

- to investigate best management practice to establish the natural regeneration through coppice management.
- to identify best management practice that can maximise fodder and firewood production from degraded Terai forests of Nepal.

However, the aim of this paper is to provide information on management options for Sal simple coppice management that maximises total biomass production.

### Distribution of research sites

Forest Research Division (FRD) of the Department of Forest Research and Survey (DFRS) initiated research in the Tropical Sal Forest Types since 1988. In 1988, first research was established in Jogikuti of Butwal of Rupandehi district. Following on, Chaukibari, Dharan of Sunsari district was established in 1989. Other two sites in Ratomate, Hetauda of Makawanpur district and Anekot, Panchkhal of Kavrepalanchok district were also studied (Annex 1).

In studying the potentials of the regenerative potentials of the Tropical Sal Forests, research plots were established in the Tropical Sal Forest of various parts of the country.

### Description of the study sites

Chaukibari is situated in the Bhabar Terai, and the plots are at an altitude of 400 m.a.s.l. The soil texture is sandy loam with gravel. Basically, the climate is subtropical with regular monsoon in June - August. Frost occurs seldom and the annual average number of days with minus temperature is 0 (Jackson 1994). Climatic data of the study site are presented in Annex 2.

It is a tropical Sal forest having more than 80 percent Sal (*Shorea robusta*). Other associated tree species in this forest are Asna *(Terminalia alata)*, Amala *(Phyllanthus emblica)*, Barro *(Terminalia belerica)*, Bhalayo *(Semicarpus anacardium)* Botdhairo *(Lagestroemia parviflora)*, Harro *(Terminalia chebula)*, Jamun (*Syzygium cumini)*, Kalikath *(Myrsine semiserrata)*, Karma *(Adina cordifolia)*, Raj Briksha *(Cassia fistula)* and Sindure *(Mallotus philipinensis)*.

### Methods and tools

The block has been divided into four different management prescriptions: i) simple coppice, ii) high forest, iii) coppice with standards 50% and iv) coppice with standards 25% (Figure 1). Each of these management prescriptions has four treatments. This report analyses the simple coppice option only having the shortest rotation of four years. The simple coppice plot is divided into four plots, each of 30m X 15m. The Simple coppice management option and the treatments within the option are described below and more details of all options and the treatment within them are explained in Tamrakar (1994).

### Simple coppice management option

The treatment is the simplest of all the option tested which maximises productivity through capitalising on the quick growth of the early coppice from the harvested stumps. Coppices are either annually harvested or protected. The entire crop is harvested (clear felled) as soon as the rotation is reached. The treatments of the option are as follows.

**Plot No: 1 3-shoots treatment**
In the first year, the multiple shoots originated from the stump after clearfelling were singled to three best shoots per stump and the rest were harvested. These three shoots were maintained in the following years and new shoots are removed if there are any. Clearfelling was carried out in the fourth year. The cycle was repeated for 3 rotations.

**Plot No: 2 1-shoot treatment**
This treatment involved singling to one shoots per stump in the first year. Harvesting any new shoots were carried out every following year until the canopy closes and complete harvesting (clearfelling) is made in four years.

**Plot No: 3 3-2-1 shoots treatment**
This treatment maintained three best shoots per stump for the first years. These were reduced to two

shoots per stump in the second year and further reduced to one shoot per stump in the third year. The canopy closed at four years when the crop was clearfelled.

**Plot No: 4 Control plot, no treatment**

In this treatment only weeding is done to facilitate coppice growth for initial three years. The plot was harvested (clearfelled) on the fourth years and similar cycle was repeated for 3 rotations.

## Results and discussion

The total biomass output of Sal forests under simple coppice management option for a period of 12 years is presented in Table 3. The table clearly shows that management intervention increases biomass production.

For the first rotation, the results clearly show biomass production increases if management prescriptions are applied. The highest biomass is obtained with 3 s/s treatment applications. The biomass production in second rotation was significantly higher in comparison to first rotation. A biomass increase of more than 80 percent (3/2/1 treatment) was observed. However, there was no such significant increase or decrease between the second and third rotations.

The lowest biomass production in first rotation compared to second and third rotations could be due to unfavourable growing condition available at the beginning of the first rotation. These degraded forests areas were under severe stress due to high level of grazing, forest fire and human disturbances. Moreover, the development of root system with time may also have played important role for this trend. However, future productions with increased number of rotations, and more studies in time and space could provide better information.

Overall, the treatment 3-2-1 has produced higher biomass in comparison with other treatments in all three rotations. This finding shows that for maximum biomass production (more wood biomass), 3/2/1 s/s is the best treatment. The findings are similar with that of Butwal research site (Tamrakar 1993; 1994).

The study also indicates that in all cases for each rotation the production of wood biomass was significantly higher compared with foliage biomass production. However, the yearly production rate varies and high quantity of foliage production was observed in 1 s/s treatment in early years while in the same period high quantity of wood products was observed for rest of the treatments. About 80 percent of the foliage produced was in the form of fodder. Similarly, 3/2/1 s/s produces maximum fuelwood.

## Conclusion

The study reveals that simple coppice management option is potentially the best one to produce fuelwood and fodder from Tropical Sal Forest in short rotation. If fodder requirement is the management option,

**Figure 1: Block layout of the research**

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| | | | |
|---|---|---|---|
| 3 shoots per stool | Control | Early selection of Standards | Clipping |
| 1 per stool | Ground and Crown Thinning | Pollarding | Late Selection of Standards |
| 3/2/1 shots per stool | Ground Thinning | Late Selection of Standards | Pollarding |
| Control | Crown Thinning | Clipping | Early selection of Standards |
| *Simple Coppice* | *High Forest* | *Coppice with Standard 50%* | *Coppice with Standard 25%* |

**Table 3: Total biomass output for 12 years (3 rotations) of the study for Simple Coppice Management Option**

| Treatment | Forest Product | First rotation | | | | Total/ha | Second rotation | | | | Total/ha | Third rotation | | | | Total/ha |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1990 | 1991 | 1992 | 1993 | | 1994 | 1995 | 1996 | 1997 | | 1998 | 1999 | 2000 | 2001 | |
| | | Forest Product in green weight in kg | | | | | Forest Product in green weight in kg | | | | | Forest Product in green weight in kg | | | | |
| Control | foliage total | 0.0 | 0.0 | 0.0 | 406.4 | 9.0 | 0.0 | 0.0 | 0.0 | 421.9 | 9.4 | 0.0 | 0.0 | 0.0 | 118.5 | 2.6 |
| | wood total | 0.0 | 0.0 | 0.0 | 1704.0 | 37.9 | 0.0 | 0.0 | 0.0 | 2992.5 | 66.5 | 0.0 | 0.0 | 0.0 | 3293.0 | 73.2 |
| | Total | | | | | 46.9 | | | | | 75.9 | | | | | 75.8 |
| 3 s/s | foliage total | 43.6 | 36.0 | 13.2 | 447.6 | 12.0 | 36.2 | 18.1 | 0.8 | 471.3 | 11.7 | 31.2 | 2.4 | 3.4 | 130.5 | 3.7 |
| | wood total | 15.0 | 29.9 | 11.5 | 1993.9 | 45.6 | 37.0 | 10.3 | 1.2 | 3128.3 | 70.6 | 31.6 | 2.0 | 4.0 | 3410.5 | 76.6 |
| | Total | | | | | 57.6 | | | | | 82.3 | | | | | 80.3 |
| 3-2-1 s/s | foliage total | 31.8 | 70.5 | 135.3 | 439.7 | 15.1 | 35.5 | 49.4 | 75.4 | 540.8 | 15.6 | 34.2 | 41.0 | 75.4 | 219.0 | 8.2 |
| | wood total | 14.0 | 100.2 | 182.2 | 1520.8 | 40.4 | 50.1 | 47.6 | 532.8 | 3159.2 | 84.2 | 43.8 | 12.0 | 371.6 | 3590.8 | 89.3 |
| | Total | | | | | 55.4 | | | | | 99.8 | | | | | 97.5 |
| 1 s/s | foliage total | 73.9 | 89.7 | 49.4 | 390.7 | 13.4 | 110.3 | 63.1 | 6.5 | 274.8 | 10.1 | 103.5 | 72.0 | 5.4 | 157.5 | 7.5 |
| | wood total | 14.0 | 115.7 | 31.7 | 1480.0 | 36.5 | 139.2 | 38.5 | 76.2 | 3180.0 | 76.3 | 136.3 | 315.0 | 70.0 | 3129.6 | 81.1 |
| | Total | | | | | 49.9 | | | | | 86.4 | | | | | 88.7 |

*S/S stand for stems per stump*

earlier years of the rotation needs to be best managed. Similarly, 3/2/1 s/s is the best treatment for fuelwood production. This management option is not suitable to produce timber, except some weaving materials (*Bhata*) that can be used for house construction. The yields of different products for each of the options give an indication of the productivity that can be expected by Forest User Groups following different management options in degraded Tropical Sal Forests.

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Annex 1: Distribution of Sal regeneration establishment studies

| S N | Research Sites | Location | Established year |
|---|---|---|---|
| 1 | Jogikuti, Butwal, Rupendhi District | Western Terai | 1988 |
| 2 | Ratomate, Hetauda, Makwanpur District | Central Terai/inner Terai | 1991 |
| 3 | Chaukibari, Dharan, Sunsari District | Eastern Nepal | 1989 |
| 4 | Anekot, Panchkhal, Kabhre Palanchok District | Central Middle Hills | 1994 |

Annex 2: Climatic data from the meteorological station at Dharan

| | |
|---|---|
| Mean precipitation | 2401 mm |
| Maximum precipitation | 3316 mm |
| Minimum precipitation | 1505 mm |
| Mean temperature of warmest month | 28.2° C (June and August) |
| Mean temperature of coldest month | 17.1° C (January) |
| Absolute maximum temperature | 41.0° C |
| Absolute minimum temperature | 5.0° C |
| Number of days/year with minus temperature less than 0°C. | 0.0 |