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Minimizing the Cost of Overstocking: Towards a Thinning Regime for Community - Managed Pine Plantations in the Central Hills of Nepal

The authors assess the impact of stocking levels on the growth of Pinus Roxburghii and Pinus Patula which were planted in the two central hill districts of Nepal over the past two decades, and are generally overstocked due to conservative thinning practices. An analysis of more than 150 tress at different stocking levels showed that overstocking has reduced volume growth, and if thinning is delayed, this will be equivalent to a loss of over USD 200 per hectare per anum. To maximize income from such plantations, thinning regimes for the two species are also suggested.

Introduction

The Nepal Australia Community Resource Management Project (NACRMP) and earlier project phases have been working in the two districts of Sindhu Palchok and Kabhre Palanchok since 1978. During this time the Projects have supported the establishment by local communities of more than 22,000 ha of plantations. The predominant species planted have been *P. patula*, *P. roxburghii* and *P. wallichiana* and a range of broadleaf species. *P. patula*, a native of Mexico, thrives in the Mid Hills of Nepal at altitudes from 1,400-2,200 m, while the local species of *P. roxburghii* and *P. wallichiana* do best at altitudes of 600-1,600 m and 1,800-2,800 m respectively. As such, the three species form a good combination for plantation establishment throughout this altitude range. Unfortunately, due to the exposed nature of many of the plantation sites, the survival of broadleaf species has been less successful.

While the survival and condition of some of these plantations has been poor, particularly with broadleaf species, more than half of the forests are in reasonably good condition and constitute viable plantation forests. Hence, many of the plantation forests handed over as community forests are of good quality, and these have been established, maintained and nurtured by the Forest User Groups¹ (FUGs) themselves.

With few exceptions, these community plantations have been very conservatively managed and the emphasis of FUG Operational Plans² (OPs) has largely been on protection and conservation over the last 2 decades. Harvesting is generally limited to pruning for fuelwood, leaf litter collection for livestock bedding and fodder

collection. Round poles and sawlog harvesting are generally limited to stunted, dead and dying trees only. As a result many of the stands are overstocked and growth is stagnating, and this appears to be most severe where stocking exceeds 1,000 stems/ha.

Traditional use of sawn timber in the rural areas is relatively low by international standards. A recent Project consultancy (NACRMP 1999) estimated that up to 80% of the yield from pine plantations would be surplus to user requirements. Many of these forests therefore have the potential to fulfil the subsistence needs of the users, and to produce surplus products for commercial sale outside of the user group.

To gather further data on this problem, a study to examine the impact of stocking and age on the growth of *Pinus* plantations was completed in 2000/01. This note outlines the results of this study, and describes thinning regimes developed for similar accessible plantation forests in the Mid Hills of Nepal.

Study Methodology and Results

Both *P. roxburghii* and *P. patula* trees were sampled over a range of stockings, ages and site qualities. Because of the small area of *P. wallichiana* planted in the Project districts, it was not included in the sample. Due to variation in the original planting densities and mortality, the actual stocking around individual trees varies throughout each forest. To obtain a measure of this, "stocking" for each tree was determined by counting the number of trees within a 100 square metre circle (see Figure 1).

Core samples of more than 150 trees of both *P. patula*

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¹ A Forest User Group is a legally autonomous body approved under the Forest Act 1993. It is generally made up of a group of rural people who agree to use and manage a community forest to support their farms and households.

² Operational Plans contain a forest management plan of the FUG's community forest, and in some cases also include a community development plan for the user group.



Regeneration in government controlled forest waiting for opening of upper storey crown in western hills of Nepal.

and *P. roxburghii* were collected using a HAGLOF brand 30 cm increment borer. Each core was taken directly through the centre of each tree to ensure the pith was included in the core. The borer removes a core of 0.5 cm diameter. The core samples were soaked in an alcohol solution to improve the contrast of growth rings, and a caliper was used to measure increment for each year's growth.

The results are summarised as follows:

- There is an inverse impact of stocking density on growth, i.e. as stocking increases, growth decreases.
- There is also an inverse impact of age on growth, after 5-7 years, growth reduces with age.
- The growth of *P. roxburghii* is less than *P. patula*.

Discussion

1. Volume Loss

The results clearly demonstrate that the annual increment of the older stands is stagnating due to their high stocking densities. A common trend was apparent within stands up to 20 years of age where diameter growth has averaged up to 1.0cm/annum to around 5 to 7 years, but this then drops to between 0.2 - 0.4 cm/annum by around 10 years of age. As expected, this growth decline was greater in stands of higher stocking. This suggests that these stands reach full site occupancy at about age 6 years, and without thinning, growth increment reduces substantially. Thus, leaving these plantations unthinned results in an overall loss of sawlog volume and a loss of potential income generation to the FUGs.

Crockford (1995) reported similar results with yield predictions for *P. patula* in Zimbabwe. Predicted yields for unthinned stands at 26 years were 15% to 27% less than stands undergoing three thinning, and the reduction in growth was directly proportional to site quality.

2. Income Loss

The districts of NACRMP are relatively close to Kathmandu and have an above average road network for hill districts in Nepal. While not all of the plantation resources have road access, a substantial area of the resource is adjacent to or within reasonable portage distance of a roadhead. With market demand for sawlogs and sawn timber high in Kathmandu, these forest resources could be readily sold into this market. A number of sawlog buyers have indicated their desire to enter into fixed term supply contracts with FUGs. Current 2001 prices paid for plantation sawlogs vary from Rs 70 to Rs 120 /cuff (USD 1 to 1.8). This figure is paid for sawlogs picked up from the roadside in the Districts.

Hence, there is a lost opportunity cost of delaying thinning to these stands through the reduction in annual increment, and this equates to between Rs 15-20,000 / ha/annum. This amount does not include the loss of additional potential benefits associated with local employment and value added processing. Hence, to reduce these losses, it is necessary to apply thinning regimes, especially for those plantation stands accessible to outside markets.

Recommendations

The following thinning regimes were developed by the DOF and Project staff for implementation in the plantations of Sindhu Palchok and Kabhre Palanchok. These are based on the results of the growth impact study combined with prescribed regimes for these species from other studies (Crockford 1995). The tables (see Tables 1a, 1b, 2a, and 2b) prescribe stockings for both *P. patula* and *P. roxburghii*, and for established stands over 15 years of age (i.e. where thinning has been delayed) and younger stands under 15 years of age, where thinning can start reasonably on time.

The distinction between established and young stands while recommending thinning schedule is to avoid dramatic thinning reductions with older, established stands. The young stands are those less than 15 years of age at the time of first thinning. The "established" stands are those over 15 years of age at the time of first thinning. The main distinction is between those stands that are suffering from delayed thinning (established) and those stands that are younger and not yet under delayed thinning stress.

In practice, a number of FUGs have thinned their plantations in stages to avoid this. One example was a 22 year old stand at Chaubas VDC thinned from 1400 to 900 trees/ha, and three years later a further thinning was applied down to 500 trees/ha. Most FUGs prefer to be conservative and carry out a number of thinnings rather

Table 1a. Thinning regimes prescribed for established *P. patula* plantations (where thinning has been delayed).

Age (year)	Stocking (trees/ha)	Minimum spacing (m)
15 to 20	800	3.50x3.50
20 to 25	500	4.25x4.25
25 to 30	350	5.75x5.75
30 to 35	150	8.00x8.00

Table 2a. Thinning regimes prescribed for established *P. roxburghii* plantations (where thinning has been delayed).

Age (year)	Stocking (trees/ha)	Minimum spacing (m)
15 to 25	800	3.50x3.50
25 to 35	500	4.50x4.50
35 to 45	350	5.75x5.75
45 to 55	150	8.00x8.00

Table 1b. Thinning regimes prescribed for young *P. patula* plantations.

Age (year)	Stocking (trees/ha)	Minimum spacing (m)
0 to 5	1600	2.50x2.50
5 to 10	1200	3.00x3.00
10 to 15	900	3.30x3.30
15 to 20	600	4.00x4.00
20 to 25	300	5.70x5.70
25 +	150	8.00x8.00

Table 2b. Thinning regimes prescribed for young *P. roxburghii* plantations.

Age (year)	Stocking (trees/ha)	Minimum spacing (m)
0 to 5	1600	2.50x2.50
5 to 15	1200	3.00x3.00
15 to 25	900	3.30x3.30
25 to 35	600	4.00x4.00
35 to 45	450	4.70x4.70
45 to 55	250	6.30x6.30
50 to 60	150	8.00x8.00

than a first thinning down to the recommended stocking. Such step-wise repeated thinnings also allow the stands to stabilise between thinnings and may help to avoid windthrow in the event of heavy windstorms.

Application of Thinning Regimes

In early 2000, the Department of Forest issued new directives for the development of new and the revision of existing Operational Plans. These require the forest management prescriptions for community forests to be based on inventory data. These directives also set royalty charges for the sale of forest products surplus to FUG member needs. As such, the directives provide clear guidelines to encourage FUGs to actively manage their community forests for both the subsistence needs of the members, and to sell surplus forest products to generate income for the FUG.

In Sindhu Palchok and Kabhre Palanchok, the Project and DOF staff have worked together with several FUGs to develop simple inventory methodologies for the users to carry out the bulk of the data collection work themselves. In contrast to natural forests, the inventory

data collected for pine plantations can be analysed relatively easily, and management prescriptions for each block prepared, based on the above tables. By June 2001, more than 20 FUGs had revised OPs based on these prescriptions, and almost half of these had commenced thinning operations.

References

- Crockford, K. J. (1995) Yield Models and Tables for *Pinus patula*, *Pinus elliotii* and *Pinus taeda* in Zimbabwe. The Zimbabwe Bulletin of Forestry Research No. 12.
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