FOREST MANAGEMENT

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Understanding Forest Dynamics for Active Management: Results from Participatory Trial Plots in the Hills of Nepal

Participatory action research plots were laid in 1997 in 3 purposively selected community forests in 3 middle hills districts in Nepal. These plots were subjected to various silvicultural treatments and monitored with active participation of FUGs. The findings revealed that the prescribed harvesting levels are far below the increment potential. This justifies more intensive use of forest, and this should be considered while preparing or revising operational plans.

Introduction

Since the implementation of Community Forestry in Nepal, most of the forest user group (FUG) Operational Plans (OP) were prepared without conducting a systematic measurement of the forest products. The decisions about the harvesting intensity and harvesting season were solely based on personal judgement of the rangers from the District Forest Offices. Meanwhile, guidelines have been developed and implemented for the assessment of the forest condition and to develop prescriptions for sustainable management of the forest. The guidelines are based on several "conservative" assumptions about the dynamic of the forest. This article analyzes the participatory experimental data to evaluate the assumptions related to growth and dynamics of forest stands under community management.

In order to acquire more knowledge about the dynamic of the forests in the mid hills of Nepal and use this knowledge to improve the prescriptions for the management of the forests, since 1997 the Nepal Swiss Community Forestry Project (NSCFP) has established and monitored several "Forest Management Action Research Plots" with the active participation of selected FUGs in the districts of Dolakha, Ramechhap and Okhaldhunga. The objectives of such experimental plots were to test silvicultural options in different forest types, to monitor the development of the forests (in terms of species composition, growth rates and regeneration) and to have places for field demonstration.

The present article is not meant to describe all the details concerning the Forest Management Action Research Plot activities, but rather to present some of the main findings about the development of the forests, under different conditions and treatments in 3 selected FUGs. These could be helpful to all concerned forest technicians, while preparing forest management plans in the hill districts of Nepal.

TABLE 1:Definition of the development stages of the plants and the size of the plots for the measurement.

Development stage	Plant dimension	Data recorded	Size of inventory plot
Young regeneration	0.25 m < Height < 1.00 m	Frequency (number of plants per species)	Circular plot of 10 m^2
Established regeneration	1.00 m < Height < 2.00 m	Frequency (number of plants per species)	Circular plot of 50 m^2
Big thicket	More than 2.00 m Height and less than 10 cm DBH	DBH, light condition, crown form and bole quality	Circular plot of 100 m^2
Trees	More than 10 cm DBH	DBH, Height, light condition, crown form, bole quality	Rectangular plot of (25 x 25) m^2

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Methodology

The establishment and monitoring of Forest Management Action Research Plots is based on participatory approaches, involving FUG members in the process. The selection of the FUGs was done based on the interest and demand from the FUGs as well as on forest type and condition (to cover different representative forest types). Several simple silvicultural treatments are defined by the users and applied in different forest plots (25 x 25 m^2). The monitoring of the forest is done through regular measurements in one-year interval. The results are visualised and shared with the concerned users as well as with other interested actors. The inventory of the forest is done separately for plants of different development stages, as shown in TABLE 1.

For the purpose of analysis, three conditions of young and established regeneration were identified: Good (young - 5000 plants/Ha and Established - 2000 plants/Ha), Fair (Young - 2000-5000 plants/Ha and Established - 800-2000 plants/Ha) and Poor (Young - < 2000 plants/Ha and established - < 800 plants/Ha).

Forest condition, management treatments results

A short description of three community forests, management treatments applied and results are summarised in Table-2.

In Bhakunde, four different silvicultural treatments have been tested in the forest to improve the forest condition (giving priority to Castanopsis sp. and Schima wallichii) and to fulfil the demand of forest products of the members of the CFUG (giving first priority to fodder and second priority to timber, fuelwood and other products). No changes in the species composition took place between 1999 and 2000. The analysis showed that there have been only little changes in the condition of the

TABLE 2: Summary description of community forests, management treatments and results

Name and Description of the community forests	Management Treatments	Key comparative results
Bhakunde CFUG, Okhaldunga: The Forest Management Action Research Plot in Bhakunde has been established in 1999. The forest is located at an altitude of 1550 m on a slope of 30 degree with S/E aspect. The vegetation type is a mixed broadleaves forest, mainly of Schima wallichii and Castanopsis sp. at pole stage, with approximately 70% crown coverage and mostly good natural regeneration.	High intensity harvesting (every 5x5 m^2 the best tree has been selected and all the remaining trees were cut); Low harvesting intensity (every 5x5 m^2 the two best trees were selected and only those trees which were competing with them were cut); Harvesting intensity according to the "Guidelines for the simple participatory forest inventory and data analysis" (C. Rai, R. aus der Beek, S. Dangal, 2000). No harvesting.	Regeneration: Little changes in the condition of the natural regeneration in all treatments Regeneration from coppice is more numerous than from seeds. In high intensity harvesting improved young regeneration Thickets In all the harvested plots, the number of plants went down between 1999 and 2000. Trees The annual volume increment of the forest can be estimated between 20% (low intensity treatment) and 38 % (high intensity treatment).
Chaletropakha CFUG, Dolakha: The Forest Management Action Research Plot in Chaletropakha has been established in 1997. The forest is located at an altitude of 1730 m, on a slope of 40 degree with S/E aspect. The vegetation type is a 14 years old plantation of Pinus roxburghii, with approximately 60% crown coverage and no natural regeneration.	Pruning of trees up to 1/3 of their crown; Removing of banmara to improve the natural regeneration; No intervention.	Regeneration removing banmara results in some improvement in regeneration Big thicket Retention of banmara may hamper big thickets Trees The absolute figures show an annual increment between 12.5 m^3/Ha (removing of banmara) and 19.2 m^3/Ha (pruning).

Name and Description of the community forests	Management Treatments	Key comparative results
Bhudhikhoriya CFUG, Ramechhap: The Forest Management Action Research Plot in Bhudhikhoriya has been established in 1997. The forest is located at an altitude of 1325 m, on a slope of 35 degree with S/E aspect. The vegetation type is a mixed forest with broadleaves and some pines at pole stage mixed with some elder trees, with approximately 60% crown coverage and predominantly good natural regeneration.	High intensity thinning (approx. 70% of the trees); Low intensity thinning (approx. 25% of the trees); No intervention.	Regeneration In most cases the natural regeneration is good and particularly abundant in the form of coppice. No major changes took place between 1997 and 2000. Big thicket The number of big thickets has increased in the forest where the high intensity thinning took place. This is probably due to the appropriate site condition (more light and less competition) created through the strong opening of the canopy. Trees The trees with more than 10 cm DBH are very few and also quite mature. Therefore their annual productivity is comparatively lower, reaching from 1.8 m^3/Ha (high intensity thinning) to 11.5 m^3/Ha (low intensity thinning). This corresponds to an annual increment between 5% and 19%, which even in this case is still higher than what assumed in most Operational Plans of FUGs.

natural regeneration; the abundance of the regeneration from coppice is higher than from seeds, high harvesting intensity improves young regeneration.

The most abundant species forming the big thicket is Castanopsis sp., while Schima wallichii, Eurya acuminata and Myrica esculenta were found in much less abundance. No difference has been observed in the species composition between 1999 and 2000 and between each treatment. In all the harvested plots, the number of plants went down between 1999 and 2000, not only because of the death of plants, but also because some plants counted as big thicket in 1999 just entered the higher level of classification (trees with more than 10 cm DBH) and others were cut by the users during the year.

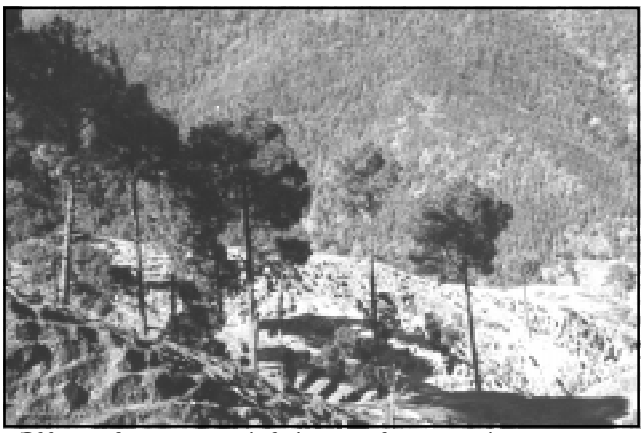
Based on these data, the annual volume increment of the forest can be estimated between 20% (low intensity treatment) and 38 % (high intensity treatment). The absolute figures show an annual increment between 9.5 m^3/Ha (high intensity treatment) and 22.5 m^3/Ha (unharvested forest). Similarly the Basal Area of the forest has increased between 8 % (low intensity treatment) and 27 % (high intensity treatment).

Although there is big heterogeneity between the results of the different treatments and although one-year measurement might not be reliable enough to predict the growth of the forest, the obtained results are far higher than the assumptions made for the preparation of the Operational Plans.

In Chaletropakha, three slightly different treatments have been tested in the forest to improve the forest condition. In most of the plots no regeneration was found. Pinus roxburghii was found in the regeneration stage in one plot. No changes in the species composition took place between 1997 and 2000. If the promotion of natural regeneration of broadleaves species is attempted, strong thinning operations and probably even some planting are required. Removing banmara was found to result in some regeneration.

The only species observed in the big thicket is Pinus roxburghii, with no changes between 1997 and 2000. The result indicated that retention of banmara may hamper big thickets. The only species encountered beneath trees with more than 10 cm DBH is Pinus roxburghii.

Since there was not a clear difference between the silvicultural treatments (at least in terms of harvesting/ thinning intensity), analysed figures show the potential of the productivity of the forest, according to a given initial growing stock. Based on these data, the annual volume increment of the forest can be estimated between 26 % (removing of banmara) and 40 % (pruning). The absolute figures show an annual increment between 12.5 m^3/Ha (removing of banmara) and 19.2 m^3/Ha (pruning). Similarly the Basal Area of the forest has increased between 10.9% (removing banmara) and 21.6 % (pruning). Being a homogeneous plantation, there is less heterogeneity between the results of the different plots. Since there have not been big differences between the results of the measurement done every year, the given results are quite reliable. Once more they show that the productivity of the forest, in this case a pine



Effect of institutional failure in forest ecology - a severly degraded government controlled pine forest in western Nepal.

plantation, is much higher than what is assumed during the formulation of Operational Plans.

In Budhikhoria, three slightly different silvicultural treatments have been tested in the forest to improve the forest condition without changing its composition. The main species forming the natural regeneration is Shorea robusta. Other species such as Schima wallichii, Syzygium cumini, Phadil, Lyonia ovalifolia are also found, but in much lower abundance. No major changes in the species composition took place between 1997 and 2000. The analysis showed that in most cases the natural regeneration is good and particularly abundant in the form of coppice, and that no major changes took place between 1997 and 2000.

The most abundant species forming the big thicket is Shorea robusta, followed by Schima wallichii, Syzygium cumini, Phadil and Kyamuna. Other species encountered are Emblica officinalis, Badkaule, Lyonia ovalifolia, Swasnikat, Botdhangero, and Maesa macrophylla. No major changes of the species composition took place between 1997 and 2000. It is surprising how drastically the number of big thickets has increased in the forest where the high intensity thinning took place. This is probably due to the appropriate site condition (more light and less competition) created through the strong opening of the canopy. Although at this stage the trees can still not be used as timber, it is interesting to observe that also big thickets contribute considerably to the biomass productivity of the forest with an annual increment of the stem volume between 4.7 m^3/Ha (no intervention and high thinning intensity) and 9.4 m^3/Ha (low thinning intensity).

The main species encountered beneath trees with more than 10 cm DBH are Shorea robusta, Schima wallichii and Pinus roxburghii. The different thinning intensities have shown considerable impact on the growing stock of the forest. In comparison with the forests of Bhakunde and Chaletropakha, in Bhudhikhoriya trees with more than 10 cm DBH are very few and also quite mature. Therefore their annual productivity is comparatively lower, reaching from 1.8 m^3/Ha (high intensity thinning) to 11.5 m^3/Ha (low intensity thinning). This corresponds to an annual increment between 5% and 19% which even in this case is still higher than what assumed in most Operational Plans of CFUGs. The decreased average DBH is due to the "coming in" of new trees with smaller diameters.

Conclusions

Based on the results observed in the different Forest Management Action Research Plots, following main conclusions and recommendations can be given:

Most of the forests have shown a relatively high productivity. However this productivity is not always reflected in the quality of the trees for timber purposes.

The productivity of the forest is higher than assumed while defining management prescriptions in most of the Operational Plans. This ranges from a lowest 5% (under low thinning treatment of mature forest to 40% (under pruning only treatment of Pine plantation). It is clear that there must be some rethinking of the harvesting prescriptions in Operational Plan to promote effective utilisation of forest resources.

Natural regeneration in pine plantation is very poor. Therefore, if broadleaves have to be promoted (for a better production of fodder and fuelwood), high harvesting intensities are required. These interventions are justified even being far beyond the annual increment of the forest.

The results in terms of abundance of natural regeneration (particularly young regeneration), are often contradictory year by year. This shows that it's difficult to assess the condition and the dynamic of the natural regeneration by counting plants in plots of 10 m^2.

The silvicultural treatments applied in the forests didn't have impact on the species composition. Particularly in pine plantations, higher intensity of treatments is required for the promotion of broadleaves.

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