Regeneration promotion and income generation through scientific forest management in community forestry: a case study from Rupandehi district, Nepal

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Community forestry is the most popular programme of forestry sector in Nepal. Previously community forest management was protection oriented and nowadays it has become production oriented due to implementation of scientific forest management plan. Recent forest policy promotes the application of scientific management of all productive forests and now it becomes a novel programme in forestry sector. This study highlights the outputs of the first year of implementation of scientific forest management plan in seven community forests (CF) of Rupandehi district, Nepal. Both bio-physical and socio-economic data were collected and analyzed. Regeneration survey was carried out before and after one year of regeneration felling. Similarly data related to income generation and employment opportunities were collected and analyzed. The results showed that 6.4 times increase in seedlings and 3.4 times increase in saplings after one year of regeneration felling operation. Similarly, the average production of timber and fuel wood was 1,086 cft and 4.5 chatta per ha. during regeneration felling in studied CFs. Average income from the intensive managed area of CF was found to be NRs. 884,059.8 and local employment generation of 910 man-days per ha. This indicates scientific forest management is one of the best options for improving forest condition through promoting regeneration of the forest for future generation and generating income and employment opportunities for the users.

Key words: Community forestry, employment, income, regeneration, scientific forest management

Forest is one of the major natural resources and an integral part of the farming system of Nepal. So forest management is always a high concern of local people (Kanel *et al.*, 2005). However, there was no effective people's participation in forest management activities until 1990s. The first policy document that realised the importance of peoples' participation in forest management was the National Forest Plan of 1976 which highlighted people's participation as its fifth objective (Kanel *et al.*, 2005). The Master Plan for the Forestry Sector (1989) prioritized community forestry as a major forestry programme and is widely implemented after the enactment of Forest Act, 1993 and Forest Regulation, 1995.

According to the Forest Act, 1993, community forests are national forests handed over to the local user groups for protection, management and utilization. The forests are managed according to the operational plan prepared by community forest users groups (CFUGs), approved by the District Forest Office (DFO). According to the Act, the CFUGs have to be formulated and registered at the DFO before handing over of the forests and they are self-sustained institutions (Kanel, 1993). The CFUGs can act as self-governing entities to generate, utilize and sell the forest products as per the approved management plan. Procedural details of the community forests are explained in the Forest Rules, 1995 and community forestry guidelines and directives.

The concept of scientific forest management (SFM) is not a new concept; its principles had originated from the present-day Germany in the early 19th century and have been adopted by forest training institutions and forest bureaucracies throughout the world (Kumar, 2002; Rutt *et al.*, 2014). The SFM requires statistically sound forest inventories that determines the growing stock as well as annual increment with sufficient

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accuracy to ensure harvesting does not exceed re-growth over the longer-term while maintaining environmental services such as erosion control, watershed protection, wind protection, species habitat and carbon storage (Rutt *et al.*, 2014).

In Nepal, the concept of forest management was initiated in 1960s by preparing working plans of different forest divisions of terai[3]. However, these plans became ineffective due to lack of site specific plan, lack of political commitment and not addressing the local socio-economic issues and they were never implemented (Gautam *et al.*, 2004). Similarly, in 1990s the government initiated the management of productive forests of terai region with financial and technical support from Finnish International Development Agency (FINNIDA) by preparing operational forest management plan. But this programme also became ineffective due to not involving local people and their concerns (Bampton *et al.*, 2007).

Formulation and implementation of the scientific forest management plan in the community based forest management system has gained momentum only after the formulation of revised forest policy, 2000 in Nepal. The Government of Nepal (GoN) has given emphasis on scientific management of forest resources to increase productivity so that more revenue can be generated from existing productive forest. Further, GoN not only formulated policies and guidelines in favour of SFM but also incorporated SFM programmes in periodic and fiscal year plans. According to the guideline "scientific forest management is the systematic application of forestry science knowledge for the management of forests based on the correct assessments of attributes of forest crop to maximize and sustain benefits (including indirect benefits such as environmental and ecosystem services) accruing from the forest. Scientific forest management essentially follows silvicultural systems" (MFSC, 2014). Application of SFM helps to create better forest condition, improve environmental services, sustainable supply of forest products, improve local and national economy and development, increase local employment opportunities (MFSC, 2014).

The Ministry of Forests and Soil Conservation (MFSC) has endorsed the Forest Policy, 2015 (MFSC, 2015) which envisioned for the sustainable and scientific forest management to increase the productivity of the forest and has strategy and action plan for adopting proper silvicultural systems in prescribed operational plan for the forest management. The MFSC has also developed and approved scientific forest management guideline, 2014 for proper implementation of the policy. Now, scientific forest management activities are in practice under the collaborative and community forest management system of terai and mid hill regions of Nepal.

The GoN is implementing SFM to improve forest condition, generate employment opportunities, regular supply of forest products and increase local and national income and it is now at the initial stage. So it is too early to study the impacts of SFM on these aspects. So, this study tries to assess the initial effects of implementing SFM activities in community forestry in terms of regeneration promotion, forest products production, income, and employment generation.

Rupandehi district was selected for this study because it is one of the pioneer districts for implementing SFM in Nepal. DFO Rupandehi initiated SFM in Lumbini collaborative forest and Baunnakoti community forest since 2013 (Khanal and Jnawali, 2014). Till 2016, 17 CFUGs are implementing SFM plans in Rupandehi district (DFO Rupandehi, 2016). So this case study is based on the preliminary effect of the first year implementation of scientific forest management plans in seven community forests of the district.

Silviculture system and irregular shelterwood system

Silviculture system is a method of silvicultural procedure worked out in accordance with accepted sets of silvicultural principles by which crops constituting matured forests are harvested, regenerated, and tended and replaced by new crops of distinctive forms (Khanna, 2004). In the past, silvicultural systems have been designed to maximize the production of timber crops. However, more recently additional ecological considerations and resource objectives have also been included. On the basis of mode of regeneration, silviculture system can be classified as high forest and coppice forests. Similarly high forest system is further classified on the basis of pattern of felling affecting the

[3] Terai: It is one of the physiographic regions of Nepal and consists of gently sloping alluvial deposits and is bordered by the Indian Gangetic plain to the south and the Churia region to the north

concentration or diffusion of regeneration as clear felling, shelterwood, selection and accessory systems (Khanna, 2004). Shelterwood system can further classified into uniform shelterwood, group shelterwood, strip shelterwood, irregular shelterwood and one cut shelterwood system. Irregular shelterwood system is a method of shelterwood system in which, few mother/shelter trees will be kept and remaining trees will be removed in regeneration felling operations and existing regeneration and poles will be kept for future crops resulting in a irregular crop, which is why it is known as a irregular shelterwood system. Irregular shelterwood system is one of the prescribed silviculture system for Sal (*Shorea robusta*) forest management in Nepal (MFSC, 2014; Awasthi *et al.*, 2015). Those saplings and poles grown already in the forest are kept as future trees to reduce the risk of regeneration and use the already grown crops in the future which make the resultant crops uneven-aged.

Regeneration felling is the major management intervention in irregular shelterwood system. Generally 80 years rotation with 10 years of regeneration period is used for Terai Sal forest. As a result, there are eight periodic blocks in each community forest. The regeneration felling operation has been carried out in first periodic block (PB) of each community forest for 10 years. Because of the use of area control method of yield regulation, the first periodic block was divided into 10 equal annual sub blocks for regeneration felling. So for the first 10 years, regeneration felling operation has to be carried out in PB I and thinning of different intensities, seeding felling and climber cutting or improvement felling activities have to be carried out in other periodic blocks. Similarly, species, diameter, height, class, health condition and location (X, Y co-ordinate) of each individual tree of PB I are recorded and map of tree location is prepared, which is called as stem mapping. Similarly, in each hectare of forest, 15—25 trees with medium age, medium crown, solid and straight boles with good health condition are selected as mother trees and remaining trees are felled during regeneration felling operation. Majority of the mother trees are Sal and its associated species. Efforts are made for selecting uniformly distributed mother trees.

Materials and methods

Study area

Rupandehi district lies in the western Terai region of Nepal (Fig. 1). The total area of the district is 130,522 ha. It has 25,105 ha. of forest area, in which 6,512 ha. lies in Terai and 18,593 ha. in Churiya[4] region (DFRS, 2015). This district has 163,916 households (HHs) and the population is 880,196 (CBS, 2011). Out of the total HHs, 34% HHs are primarily dependent on fuel wood for cooking purpose (CBS, 2014).

In this district 15,820 ha. of national forest has been handed over to 97 community forest user groups benefitting 64,410 households. Similarly, 2084 ha. of national forest has been managed as two collaborative forests, and 24.8 ha.of national forest has been handed over as three religious forests in the district (DFO Rupandehi, 2016).

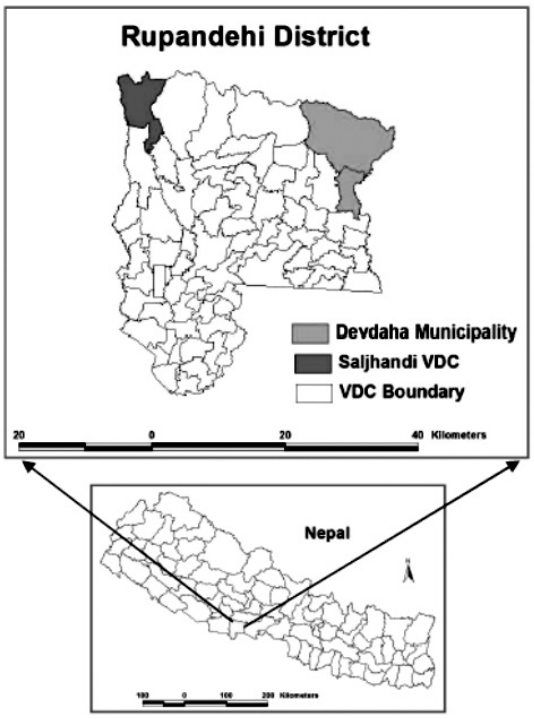

Fig. 1: Location map of study area

So far, 15 community forest user groups have prepared and implemented SFM plan in 2,910 ha. This case study is based on the five community forests of Sainamaina Municipality (previously, Saljhandi Village Development Committee) and

[4] Churiya, also known as the Siwalik, is the youngest mountain range in the Himalayas and just north of the Terai, it runs the entire length of southern Nepal, from east to west, skirting the southern flanks of the Himalayas.

two community forests of Devdaha Municipality of Rupandehi district. The forests in Saljhandi and Bhaluhi (Devdaha) area are one of the most productive forest areas in the district. Out of the 25 community forests in these areas, seven community forests were selected based on: forests handed over at least seven years before so that institutional capacity is developed in CF, SFM plan implemented before two years and regeneration survey completed and recorded prior to the implementation of SFM plan. Sal is the dominant forest species in the study area. These community forests are adopting SFM on individual CF basis.

Data collection and analysis

Both bio-physical and socio-economic data were used for this study. Data regarding regeneration status were collected through systematic sampling in the same plot for two time period. Likewise, other data related to production of forest products, income and employment generation as well as expenditure pattern were collected from respective CFUGs along with their annual and audit reports. Collected data were also triangulated through discussions with committee members and office assistant of respective CFUGs.

Regeneration survey was carried out in March, 2015 and 2016. Regeneration was categorized into seedlings (height <1.3 m) and saplings (dbh <10 cm and height >1.3 m). Systematic sampling method with nested plot design was used. At least six sample plots in the sub-block, where regeneration felling operation was carried out in 2015, of each community forest were laid out and measured before and one year after regeneration felling operation. The size of the sample plot was 5 m × 5 m for saplings and 2 m × 5 m for seedlings. Sample plots were laid out on the map using ArcGis 10.2.1 software. The point location of the plot was navigated through Garmin GPS and the identified point was used as the south west corner point of the main plot. The 2 m × 5 m plot was established in west corner of the main plot.

All the data were entered in MS Office Excel spreadsheets. Descriptive statistics like summation, mean and percentage were calculated and interpreted accordingly.

Results and discussion

Basic information of selected community forests

All the studied community forests were handed over to the CFUGs at least seven years before. The summary of the basic information of selected community forests is given in table 1. These CFs consist of matured Sal (*S. robusta*) dominated forest, and irregular shelterwood system has been applied as silvicultural system for forest management. The SFM plans of all these community forests were approved in fiscal year 2013/14.

Regeneration status of the forests

The major objective of the regeneration felling operation was to promote regeneration in the forest. Since, Sal is a light demanding species, regeneration felling operations open up the forest canopy and the sunlight can reach up to forest floor easily. During late summer the Sal seeds ripe and fall on the forest floor and starts germination with pre-monsoon rain. During the monsoon season, there is vigorous growth of Sal seedlings. If the forest is protected from fire and grazing the regeneration will establish within

Table 1: Basic information of selected community forests

Name of CF	Address	Area (ha)	Handed over as CF (year in AD)	Households benefitted	SFM plan approved (Fiscal Year in AD)
Kanchan	Saljhandi 3	131.6	2009	278	2013/14
Shaljhandi	Saljhandi 4	149.1	2002	193	2013/14
Shanti	Saljhandi 6,8,9	165	2003	599	2013/14
Singhadarja	Saljhandi 2 3	75.22	2001	166	2013/14
Rajapani	Saljhandi 5	270.6	2001	381	2013/14
Pragati	Devdaha	284.73	2009	350	2013/14
Janapriya	Devdaha 10	237.16	2009	428	2013/14
Total		**1313.41**		**2395**	

5 to 10 years. The table 2 shows the status of regeneration in terms of seedlings and saplings before and a year after regeneration felling. There is significant change in number of seedlings and saplings before and after regeneration felling.

From table 2, it seems that there was significant increase in number of seedlings in Shanti CF before and one year after regeneration felling. The least number of seedlings was increased in Janapriya CF after regeneration felling. Among the studied CFs, the most significant increase in

Table 2: Regeneration status before and after regeneration felling (r.f.)

Name of the community forest	Area of the sub-block (ha)	Number of seedlings per ha		Number of saplings per ha		Change in number (in multiplication)	
		Seedlings before r.f.	Seedlings after 1 yr of r.f.	Saplings before r.f.	Saplings after 1 yr of r.f.	Seedlings changed	Saplings changed
Kanchan	1.22	7833	34833	1533	2800	4.4	1.8
Saljhandi	1.7	5333	21833	200	1760	4.1	8.8
Shanti	1.99	1200	28800	1360	1520	24.0	1.1
Singhadarja	0.68	7600	34600	300	2240	4.6	7.5
Rajapani	3.16	1666	7834	800	1333	4.7	1.7
Pragati	3.18	13000	19600	2880	4640	1.5	1.6
Janapriya	3.15	17800	21000	4400	5760	1.2	1.3
Average	2.15	6804	21063	1434	2507	6.4	3.4

Before regeneration felling, the highest number of seedlings per ha. was found in Janapriya community forest and the lowest in Shanti community forest whereas the highest number of seedlings per ha. was found in Kanchan community forest and the lowest at Rajapani community forest after one year of regeneration felling. The average number of seedlings per ha. was 6,804 and 21,063 before and after regeneration felling, respectively (Table 2). Awasthi *et al.* (2015) found 16,555—21,000 seedlings per ha. after regeneration felling of Sal forest under irregular shelterwood system in similar site of Rupandehi district.

The highest number of saplings was found in Janapriya CF and the lowest number of saplings in Saljhandi CF before regeneration felling whereas the highest number of saplings were found in Janpriya CF and the lowest number of saplings in Rajapani CF after one year of regeneration felling (Table 2). The average number of saplings before and after regeneration felling was found to be 1,434 and 2,507, respectively. Awasthi *et al.* (2015) found comparable results in similar sites of Rupandehi district. They recorded 1,644 saplings per ha. after one year and 3,022 per ha. after two years of regeneration felling operation, while 1,055 saplings per ha. in no regeneration felling area.

saplings number was found in Saljhandi CF and the least in Shanti CF after one year of regeneration felling. On an average there was 6.4 times increase in seedlings and 3.4 times increase in saplings number after one year of regeneration felling.

Species composition of seedlings before and after one year of regeneration felling operation is shown in Fig. 2. On an average, the share of Sal seedlings before regeneration felling operation was 65% and increased to 86% after one year of regeneration felling. It indicates the goal of attaining at least 80% stems of Sal in SFM plan can be achieved. Troup (1986) also observed better shoot and root development of *S. robusta* in open space rather than under shade

Species composition of saplings before and after one year of regeneration felling operation is shown in figure 3. On an average the share of Sal saplings before regeneration felling operation was 78% and increased to 86% after one year of regeneration felling. As Sal is a light demander species, it requires a complete overhead light in most cases from earliest stage of development (Champion and Seth, 1968). Opening of canopy in the forest stand promotes regeneration and the growth of under storey seedlings and saplings (Troup, 1986). Hence, the regeneration of *S. robusta* in the study CFs was found higher after

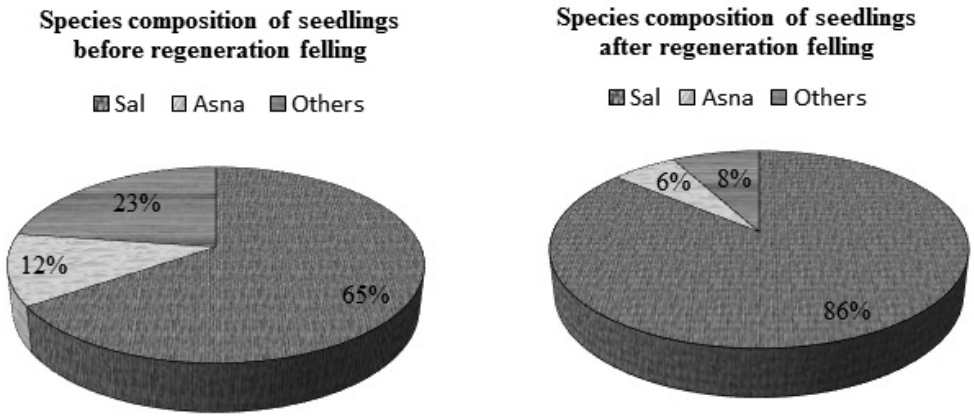

Fig. 2: Species composition of seedlings before and after regeneration felling operation

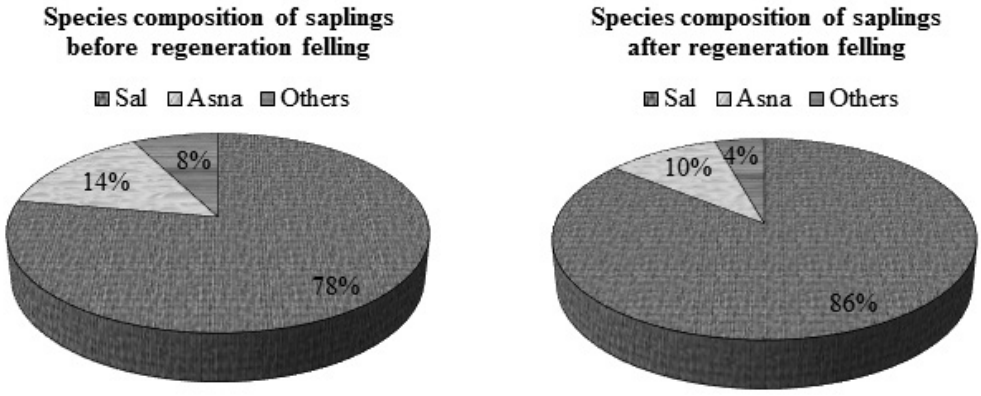

Fig. 3: Species composition of saplings before and after one year of regeneration felling

regeneration felling operation. Awasthi *et al.* (2015) also found higher number of Sal saplings after regeneration felling than no regeneration felling area.

Production of forest products, income and employment generation

Forest products especially timber and fuel wood available during regeneration felling operation of each community forest are tabulated in table 3. The highest volume of timber and fuel wood per unit area was produced in Kanchan community forest whereas the lowest volume of timber was produced in Rajapani community forest and the lowest volume of fuel wood was in Shanti community forest. On an average, the production of timber and fuel wood was 1086.6 cubic feet and 4.5 Chatta per ha. from regeneration felling in the studied CFs. Similarly, Kanchan community forest, which had the highest volume of timber and fuel wood, had gained highest income per

Table 3: Forest products production, income and employment generation

Name of community forest	Production per ha		Income (NRs.) per ha	Investment (NRs.) per ha	Employment generation (man-days/ha)
	Timber (cft)	Fuel wood (chatta)			
Kanchan	1,677.8	8.2	1,527,844.3	951,400	1,492
Shaljhandi	1,053.7	3.5	823,243.5	516,291	1,162
Shanti	808.0	3.0	723,119.1	494,066	813
Singhadarja	1,088.2	5.1	879,329.4	453,182	1,219
Rajapani	755.2	4.7	714,656.6	272,214	612
Pragati	1,253.2	3.2	1,039,369.8	299,563	565
Janapriya	970.4	3.3	480,856.2	358,182	503
Average	**1,086.6**	**4.5**	**884,059.8**	**477843**	**910**

ha. Average income from the studied community forests was found to be NRs. 884,059.8 per ha.

Community forest user groups were investing NRs. 477,843 per ha. for forest protection, utilization, management and implementation of silvicultural operations in regeneration felling areas. Most of the activities like tree felling, trimming of logs, loading, unloading, piling, debarking, and numbering were carried out manually. However, the forest products were transported by tractors. Therefore, all these activities require human resource which ultimately creates employment opportunities to local poor and forest dependent people. Further, implementation of silvicultural operations especially weeding, cleaning, bush cutting, thinning and others also require forest labour which also create local jobs to users. On an average, 910 man-days were created while managing one hectare of community forest as per the SFM plan. Khanal and Jnawali (2014) found 800 man–days per ha. which is slightly lower than this study. This may be due to very few labour required for post harvesting and cleaning operation in Teak (*Tectona grandis*) forests in the absence of other species and shrubs in Baunnakoti CF.

Trend in expenditures of community forest user groups

Community forest user groups act as a node for local development through the funds generated from their forest management activities and other sources in order to respond to a range of both public and private demands. These include the ongoing management of the forest resource, financing community development activities such as construction of schools, road, water supply and other small infrastructure. These activities were carried out mainly through the development of enterprise, support to private individuals' income generation activities, training and provision of small grants particularly for educational purposes (MFSC, 2013). The CF operational guidelines, 2014 has prescribed at least 25% of CFUGs total budget should be spent on activities related to forest management and 35% on pro-poor programmes (DoF, 2014). However, it has not seen at all.

In this study, administration costs covered mostly the costs of office such as stationeries, electricity, drinking water and communication charges, salary of office assistant, audit charge, monthly allowances of chairman, secretary and treasures, etc. Similarly, the costs of institutional development included meeting fees, cost of training, workshops, educational tours, and annual general assembly. Forest management costs covered the costs of forest protection, forest development and forest products utilization. The costs of forest protection included salary of forest watcher, fire line construction and maintenance costs, forest fire control activities, fencing, etc. Forest development activities are plantation, weeding, thinning and regeneration promotion. Forest product utilization activities include tree marking, product harvesting, transportation and selling. Community development activities include development and maintenance of infrastructures like road, irrigation canal, water pond, drinking water supply, street light, supports to school, play ground maintenance, etc. Livelihood improvement activities are support for income generating activities such as goat/pig/buffalo/poultry farming, vegetable cultivation, shop keeping, support for biogas plant installation, support for disables, etc. The expenditure of fiscal year 2015/16 of selected community forest user groups is shown in figure 4..

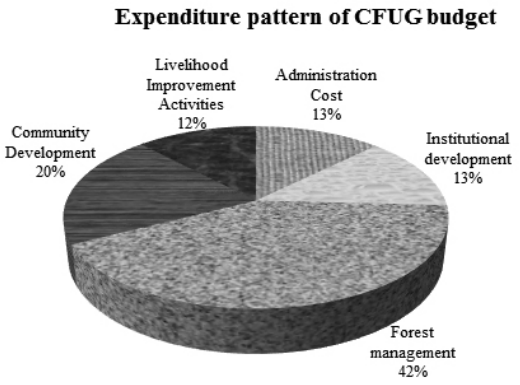

Fig. 4 : Expenditure pattern of community forest user group budget

It indicates that the CFUG had invested more than 40 per cent in forest management activities which is more than the prescription made in CF operational guidelines, 2014. It is assumed that in the initial years of SFM implementation, CFUGs have to invest more on forest protection measures such as construction of fire line and fencing and such investment will be reduced later. Similarly CFUGs had invested only 12% in livelihood improvement programmes for the pro-poor users

which is less than the prescription made in CF operational guidelines, 2014. However, the percentage sharing of activities varied from one CF to another.

The expenditure pattern in this study was quite different from Kanel and Niraula (2004) and Pokharel (2009). Kanel and Niraula (2004) found that CFUG, spent 36% in community development activities, 28% in forest management activities, and 3% in pro-poor programmes, whereas Pokharel (2009) found 55% in community development activities, 22% in pro-poor programmes and 17% in forest management activities, among others. During implementation of SFM plan in initial years, CFUGs had to invest more on forest protection *i.e*. forest watcher, fencing, fire line construction and maintenance, as well as management activities like post harvesting operations, weeding, cleaning, singling which make higher investment on forest management activities than that of previous years. All these activities generate employment for local forest users and assist in uplifting their livelihood directly but these costs were listed in other than livelihood improvement activities.

Conclusion

This study was based on Sal dominated community forests which were handed over to the community forest users groups about seven years ago and now they have managed as per the approved scientific forest management plans in Rupandehi district. Regeneration felling was the major intervention carried out in the forest due to which more light has reached on the forest floor, among others. The results showed 6.4 times increase in seedlings number and 3.4 times increase in saplings number after one year of regeneration felling. The share of Sal seedlings and saplings also increased significantly after regeneration felling operation. The productivity of Kanchan CF was found to be the highest in both volume of forest products and income per unit area. Similarly, investment per unit area was also found the highest in Kanchan CF, as a result this CF had more employees per unit area. Similarly, the CFUGs had invested 40% of their total expenditure on forest management activities especially forest protection, forest products collection and tending operations whereas only 12% was spent on livelihood improvement of the pro-poor users in fiscal year 2015/2016. Detailed study on impact of scientific forest management on community forest and forest user group is recommended for near future.

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