Impact of Operational Plans on Forest Cover Area: A Comparative Study of Community Forests in Nepal

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Abstract

Within the middle hills of Nepal, operational plans (OPs) were found to prescribe the same operations, irrespective of species composition, forest conditions, and forest management objectives. It is not clear how, and to what extent, the OPs play a role in practical forest management, or whether they are followed by the members of the community forest user groups (CFUGs) and how this affects the forest cover area. This study assesses whether differences in forest cover area between two community forests can be explained by differences in their OPs and their implementation by the respective CFUGs. To achieve this, three methods were applied: forest cover area measurements using annual landcover data, a directed content analysis of the OPs, and ground truthing through interviews and Likert scale questionnaires. Results revealed a significant difference in the forest cover area: Machhedanda CFUG showed more fluctuation compared to Baluwa Bhanjyang CFUG. The CFUGs differ in OP focus, with Machhedanda more focused on socio-economic development and Baluwa Bhanjyang prioritising forest conservation. Both CFUGs faced communication challenges and struggled to fully implement their OPs. These findings suggest that forest cover area outcomes are not solely influenced by written plans, but also by how CFUGs engage with and implement them.

Keywords: Forest cover area, operational plan, community forest, likert scale

INTRODUCTION

The community forest program has shown a remarkable success in forest cover growth over the last 30 years (Acharya *et al.* 2022); however, it is still in development. The Nepalese government implemented community forest programs since 1978, with 28 per cent of forest areas now managed by Division Forest offices (DFO, formerly District Forest Offices) and community forest user groups (CFUGs) (DOF 2017). Operational plans (OPs) have been in use by the CFUGs across Nepal since then. They serve as legitimate sources for executive committees and as agreements between DFOs and CFUGs. However, Baral *et al.* (2020) found that OPs in Nepal's middle hills prescribed identical operations regardless of species composition or forest conditions. OPs often fail to match ground realities as the implementations focus mostly on harvesting, neglecting silvicultural activities. Despite their importance, OPs prescribe uniform activities regardless of ecological variations, leading to sub-standard implementation (Ghimire *et al.* 2022; Toft *et al.* 2015).

Baral *et al.* (2020) conducted their research in only one district (of which the name is kept anonymous) within the middle hills, where 10 per cent of the amount of CFUGs were randomly selected to give a picture of the OPs and their relevance. Ghimire *et al.* (2022) aligned with Baral *et al.* (2020) by showing that most CFUGs only implement harvesting related activities and neglect silvicultural practices. They highlight a disconnection between what is written in OPs and what is implemented; they point to implementation as the main weakness and not just the content by emphasising that OPs are rarely updated to reflect changing forest conditions or CFUG needs. According to Toft *et al.* (2015), inventory-based forest management plans were often unused in daily decision making by the CFUGs; the OPs are just formalities to satisfy bureaucratic requirements and do not inform management decisions on ground level. Therefore, it is difficult to make a generalisation of whether OPs are the same across all middle hill districts of Nepal, as variations in topography, ecological conditions, and socio-economic contexts may influence community forest management.

Nepal is a cultural mosaic and changes in land use are the result of interactions of multiple factors (such as diversities in ethnic, caste, linguistic and religious communities) where migration from uphill to low land and towards roads and urban places contributed to both loss and gain of forest and changed land-use patterns in the middle hills of Nepal (Bhawana *et al.* 2017; Pradhan and Visweswaran 2011).

After the government forest was handed over to community members as a management system, factors related to increasing forest cover were emigration, occupation shift, agroforestry practices, as well as particularly by plantation on barren lands, awareness among forest users, and conservation activities conducted by local inhabitants (Bhandari *et al.* 2019). To address a wide variety of resource management problems, including the assessment of forest cover change and its causes, a combined use of remote sensing and Geographic Information System (GIS) technologies can be invaluable (Tripathi *et al.* 2020).

It is unknown to what extent the OPs are followed by the members of the CFUGs and if this affects the forest cover. Ground truthing and geospatial analyses are therefore necessary to improve the current OPs and their implementation so forest cover can sustain or grow further.

Therefore, this study aims to assess whether differences in forest cover area between two CFUGs can be explained by differences in their OPs and how these are implemented by the CFUGs.

Study areas

Baluwa Bhanjyang CFUG and Machhedanda CFUG were selected from FECOFUN's database based on the availability of complete GIS data and their similar forest cover in 2019 (FRTC 2022). The CFUGs are located in Makawanpur, in the southern parts of the middle hills (Figure 1), but in different municipalities and thus coordinated by different DFOs. Baluwa Bhanjyang CFUG falls under the DFO located in Rapti and Machhedanda CFUG falls under the DFO located in Hetauda. The southern middle hills of Nepal are characterised by a subtropical to temperate climate, with a distinct monsoon season lasting from June until September, during which approximately 80 per cent of the annual rainfall occurs (Sharma and Awal 2013).The region's ecological characteristics are further influenced by elevation gradients, land use, and human activities (Bhandari *et al.* 2019; Bhawana *et al.* 2017). Both study areas are influenced by these, but in different proportions.

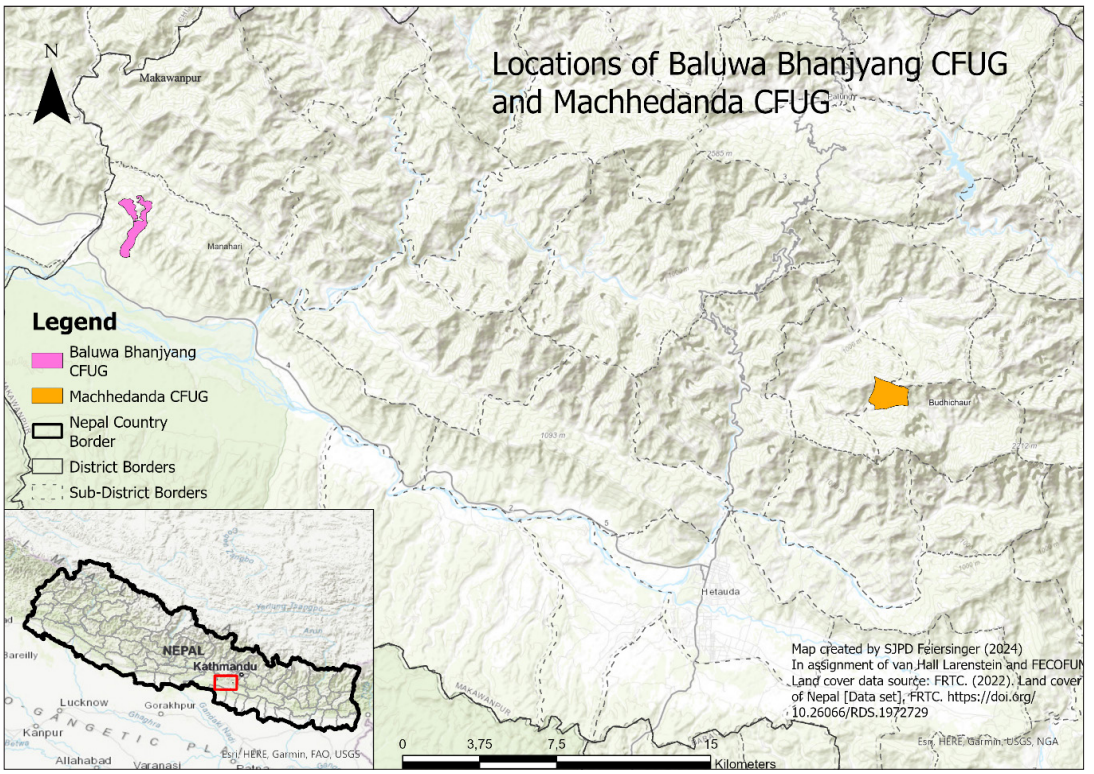

Figure 1: The location of two selected community forests: Baluwa Bhanjyang in purple, Machhedanda in orange. The CFUGs are located in the district Makawanpur. Baluwa Bhanjyang CFUG is located in sub-district, Manahari and Machhedanda CFUG is located in sub-district, Budhichaur

Machhedanda CFUG has a total population of 318 residents, of which 151 are women and 167 are men, living in 98 households. The altitude ranges from 1215 meters to 2106 meters above sea level. In the 201.9 hectares sized area, the forest cover in 2019 was 177.14 ha (87.7%) and the average growing stock is 106.41 m3/ha. The plant species khote salla (*Pinus roxburghii*), chilaune (*Schima wallichii*), bajh (*Quercus* spp.), dale katus (*Castanopsis indica*), guras (*Rhododendron arboretum*) and kafal (*Myrica esculenta*) are the most prominent tree species in the CFUG. Baluwa Bhanjyang CFUG has 298 residents, of which 158 are women and 140 are men, living in 71 households. The altitude ranges from 700 meters to 1300 meters above sea level. The community forest has a total area of 180.16 hectares with a forest cover of 161.63 hectares (89.5%) in 2019 and an average growing stock of 153.20 m3/ha. In this subtropical forest, one can find plant species such as the sal tree (*Shorea robusta*), asna (*Terminalia elliptica*), sandan (*Ougeinia oojeinensis*), chilaune (*Schima wallichii*) and bahera (*Terminalia bellirica*). These demographic characteristics may influence how forest management practices are carried out. For example, male outmigration, common in the mid-hills, can reduce available labor for forest activities, leaving women more involved in daily forest use and decision-making (Bhawana *et al.* 2017; Bhandari *et al.* 2019; Bista *et al.* 2021). Such dynamics, as well as differences in elevation and plant species, may affect how OPs are being implemented across the two CFUGs.

METHODS

As the two community forests with a similar forest cover area were chosen, the forest cover change from 2000 to 2019 was determined by using the annual land cover data of each year provided by FRTC (2022) in GIS. The dataset (FRTC 2022) provides consistent national land cover data for those exact years with a spatial resolution of 30 meters. As this study was conducted in cooperation with FECOFUN, it utilised the same dataset used for their ongoing projects, including biomass change assessments, which aligns with their data needs and supports comparability.

Shapefiles of the two CFUGs were provided by FECOFUN. According to Puyravaud (2003), the following formula should be used to ease comparisons between sites of annual rates of forest change, the forest area and time of measurements:

$$P = \left(\frac{100}{t_2 - t_1}\right) * \ln\left(\frac{A2}{A1}\right)$$

Where, A1 and A2 are the forest cover in hectares at time t1 and t2 in years, respectively, and P is the percentage of forest cover loss or gain (Tripathi *et al.* 2020). This was done for each following years, giving 18 annual growth rates of forest cover area from 2000 until 2019 per CFUG. In addition to forest cover area, the analysis included other land cover classes from FRTC (2022): shrubland, grassland, and other wooded land (OWL).

A directed content analysis by Hsieh and Shannon (2005) was applied to the two OPs to examine their contents, using the *Community Forest Development Guideline* (2014), developed by the Department of Forest, as a reference document. This document comes with a framework for forest management plans and offers a set of activities and prescriptions that should be described in the OPs. The reason for using this document was that the same criteria can be applied to both OPs and allow pinpointing specific areas where the OPs vary or align with each other. Based on this guideline's framework, a coding scheme was developed by listing each prescribed activity and assigning a score from 0 to 3 for its presence and level of detail in the OPs: 0 = not mentioned, 1 = mentioned without details, 2 = some detail (what, where, when), and 3 = fully detailed including timeframes, consequences, and examples.

Both Machhedanda CFUG and Baluwa Bhanjyang CFUG were visited for interviews to assess to what extent they follow and implement their OPs and whether this influences the forest cover area. Participants were selected using a purposive sampling approach to ensure both committee and non-committee members were included. A total of 32 participants per CFUG were interviewed, representing over 10 per cent of the population, which meets the criteria for community-level surveys. The structured questionnaire included 15 statements scored on a 5-point Likert scale to measure perceptions on the implementation of OP objectives and activities. These answers were backed up with qualitative data obtained from the interviews and focus group sessions. The questions were derived from the Community Forestry Development Programme (1995), a framework used by the DFO to evaluate CFUG performance. To reflect varying levels of relevance to change in forest cover area, some questions were weighted from 0.5 to 1.5, with 1 representing a neutral weight.

The outcome of the forest cover area analysis is further explained with the results from the content analysis of OPs and the Likert scale data and interview analysis in the discussion to establish a link between OPs and forest cover area.

RESULTS

Forest cover area analysis

The forest cover area analysis revealed significant differences between Baluwa Bhanjyang CFUG and Machhedanda CFUG over the period from 2000 to 2019. Figures 2 and 3 illustrates the comparison of land cover of both years of the CFUGs, where both CFUGs show a partially gained forest cover area in 2019. In both cases, most forest cover was gained from shrubland. Table 1 presents the detailed land use transitions, quantifying how much area changed from one land cover type to another over the 20-years period. Agricultural areas remained outside the CFUG boundaries, consistent with forest policy that restricts agricultural use within community forests (FECOFUN, personal communication, September 2023). Machhedanda CFUG showed a greater fluctuations in forest cover

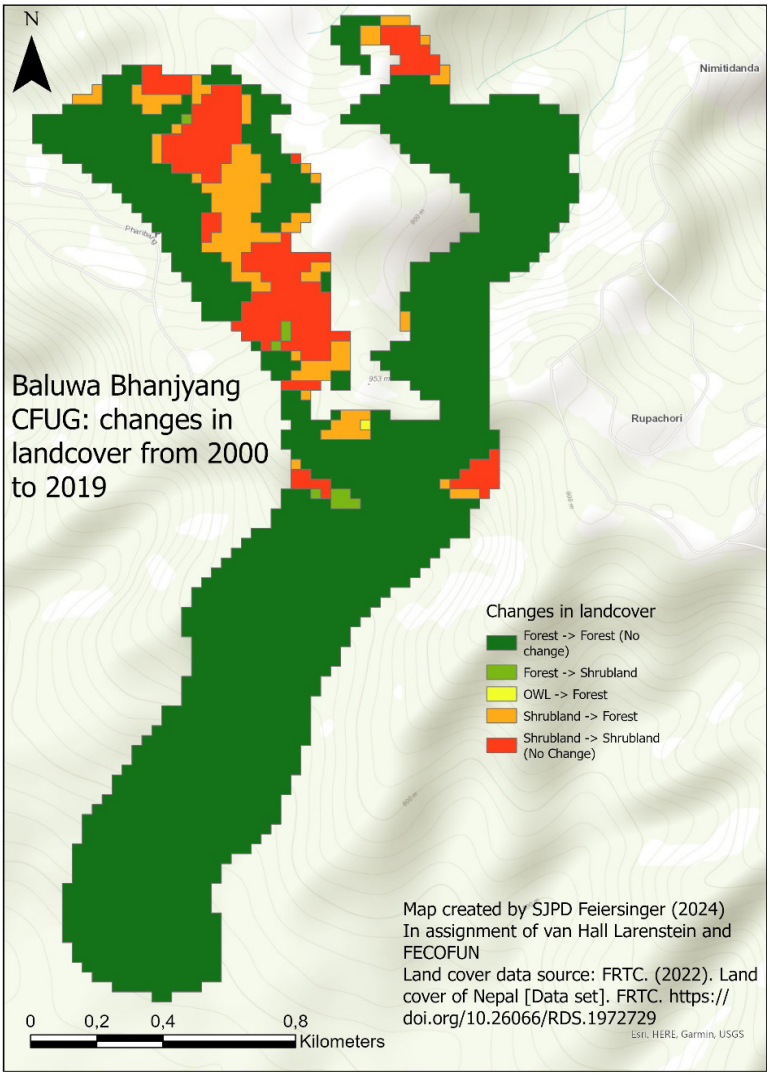

Figure 2: The landcover remained the same for the greatest part; mostly shrubland turned into forest and in a few parts, forest turned into shrubland

area over the period compared to Baluwa Bhanjyang CFUG; however, it showed a higher net increase in forest cover area by 2019 (Figure 4). Also in Figure 4, a slight decrease in forest cover in Baluwa Bhanjyang CFUG can be seen. Over the period from 2000 until 2019, Machhedanda CFUG had a total forest cover growth of 22.6 hectares (11.2%), whereas Baluwa Bhanjyang CFUG had a total forest cover growth of 11.36 hectares (6.3%). A difference of 11.24 hectares (4.9%) between the two CFUGs is visible. A Mann-Whitney U Test revealed a significant difference in the annual forest cover percentages between the two CFUGs ($n = 18$, $df = 19$, $p = < 0.001$) over these 20 years.

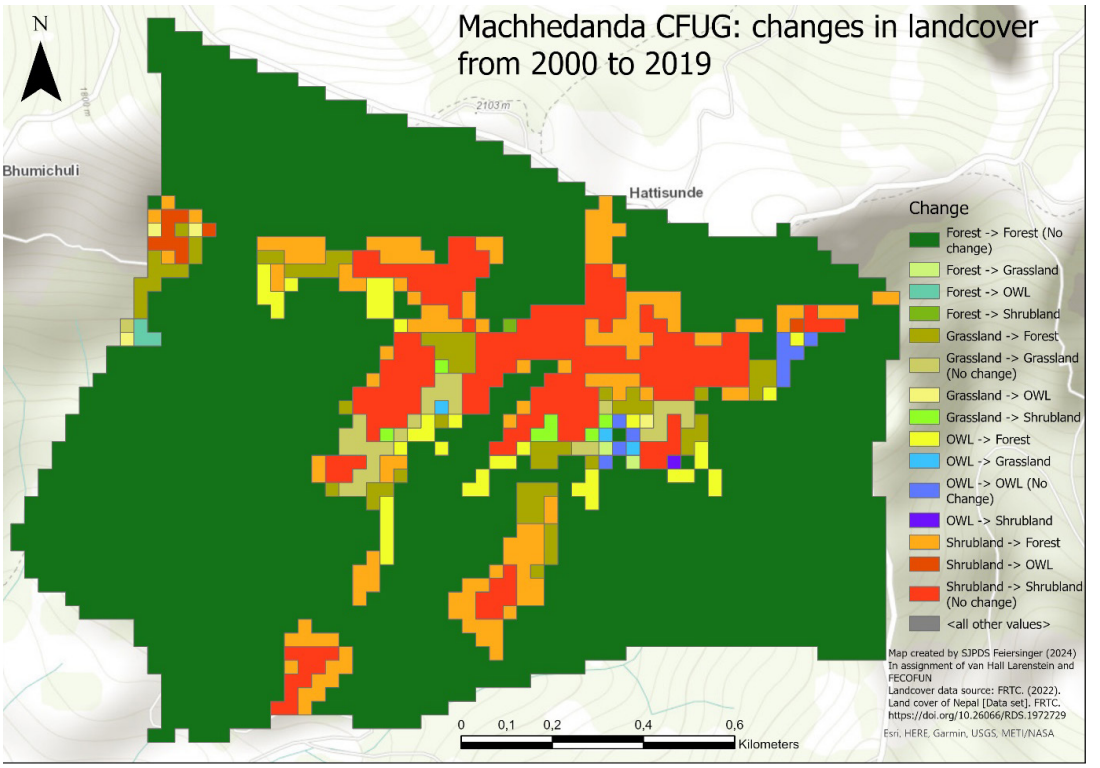

Figure 3: The map shows, in 15 categories, how the land cover changed from 2000 until 2019. Mainly the shrubland, grassland and OWL turned into forest, increasing in a net increase in forest cover

Table 1: Quantification of the changes in land cover from 2000 to 2019

Type of Change	Machhedanda CFUG		Baluwa Bhanjyang CFUG	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Summary regarding forest gain/loss:				
Forest → Other landcovers	0.54	0.26	0.9	0.5
Other landcovers → Forest	23.67	11.73	13.14	7.29
Detailed land Cover Changes:				
Forest → Forest (No change)	153.90	76.27	149.22	82.73
Forest → Grassland	0.18	0.09		
Forest → OWL	0.27	0.13		
Forest → Shrubland	0.09	0.04	0.9	0.5
Grassland → Forest	6.03	2.99		
Grassland → Grassland (No change)	2.88	1.43		
Grassland → OWL	0.36	0.18		
Grassland → Shrubland	0.63	0.31		
OWL → Forest	3.87	1.92	0.09	0.05
OWL → Grassland	0.27	0.13		
OWL → OWL (No Change)	0.9	0.45		
OWL → Shrubland	0.09	0.04		
Shrubland → Forest	13.23	6.56	12.15	6.74
Shrubland → OWL	0.81	0.4		
Shrubland → Shrubland (No change)	18.27	9.05	18	9.98
Total Area and percentage (100%)	201.78	100	180.36	100

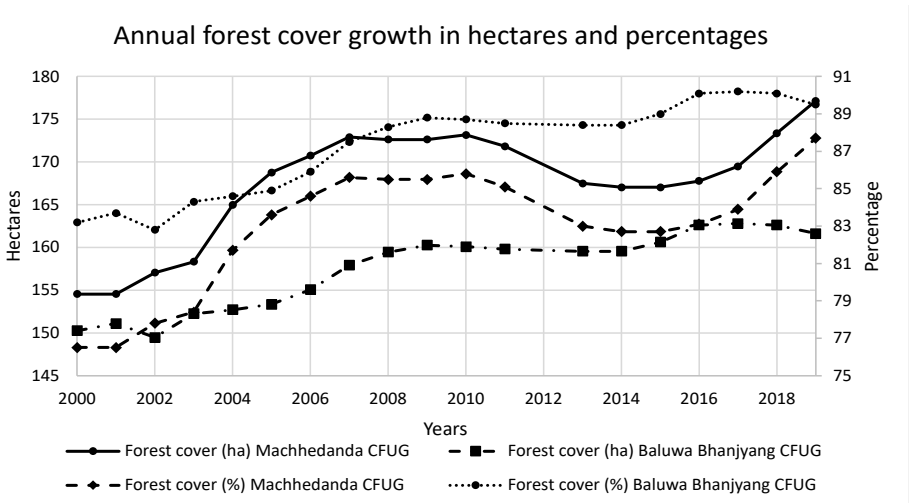

Figure 4: Reflection of the annual forest cover change (in hectares and percentages) of both CFUGs

Content analysis of OPs

In general, the objectives stated in the OPs were different; the Machhedanda CFUG, focused more on socio-economic development and status through sustainable forest management, controlling poaching, achieving crop self-sufficiency and engaging low-income members in income-generating activities. Whereas, Baluwa Bhanjyang CFUG had their focus on efficient utilisation of forest products, meeting consumers' needs, while conserving the forest and addressing landslides and erosion and implementing adaptation programs to combat climate change effects.

A directed content analysis was done based on the framework of activities found in the Community Forest Development Guideline (2014), with the code scheme in Table 2 as a result. The coding scheme was used to assess whether the activities outlined in the framework were included in the OPs and to what extent they were described. A higher total score indicates that the OP places greater emphasis on activities related to forest cover management. The total score of Machhedanda CFUG was 18, whereas Baluwa Bhanjyang CFUG scored 26.

The main difference was that Machhedanda CFUG had a tabular format with activities (without descriptive detail of the activity itself), including a budget, a time frame and frequency for each activity which was similarly written in the Community Forest Development Guideline (2014). Whereas, Baluwa Bhanjyang CFUG had a descriptive version of all their activities, where only the activities, their reasons, and consequences for (not) implementing them were explained. No budget, time frame, or frequency of each activity was seen here.

Table 2: Score explanation for activity mention: 0 = no mention of activity, 1 = basic mention of activity, but without details, 2 = activity mentioned with some details (what, where and when can be answered), 3 = activity mentioned and completely detailed with time planning, consequences, and examples. It is notable that Baluwa Bhanjyang CFUG mentions more activities, especially forest conservation activities

Activity regarding forest cover	Mentioned in OP of Machhedanda CFUG?	Mentioned in OP of Baluwa Bhanjyang CFUG?
Forest Conservation Activities (Marking)		
Theft and illegal harvest Control	0	2
Forest Fire Control	0	2
Animal Grazing Control	0	2
Encroachment Control	0	2
Forest Promotion Activities		
Nursery Establishment / Maintenance	2	0
Plant Production Wood Species	1	0
Plant production - non-timber species	1	1
Wire Fence / Biological Fence	0	1
Plantation	2	1
Replanting	0	0

Weeding and Cleaning	2	1
Bush cleaning	0	2
Pruning	2	2
Thinning	2	2
Singling	0	0
Reproduction Management	0	1
Herb/non-timber forest products Management	2	0
Forest Path Construction / Maintenance	1	2
Construction / Maintenance of fire protection line	2	1
Actions related to soil conservation	0	2
Wildlife Conservation and Biodiversity Conservation	1	2
Total score	**18**	**26**

Likert scale data and interview analysis

The weighted Likert scale scores are shown per question in Figure 5. Each CFUG shows scores of the average responses of 32 participants, including one DFO representative and one local FECOFUN member. In Figure 5, the variables labeled "O1" to "O5" match to the five objectives of the Community Forestry Development Programme (1995): promoting forest conservation (O1), implementing approved forest management activities (O2), maintaining financial transparency (O3), monitoring effectiveness (O4), and enhancing user group autonomy (O5). The variables labeled "A1" to "A10" represent ten specific forest management actions derived from the same programme, including problem identification, forest inventory, management plan preparation, resource mobilisation, capacity building, and monitoring activities.

Higher scores on the Likert scale represent a greater level of agreement with the positive impact of the CFUG on the aspects mentioned in the questions. An independent samples t-test was used to compare people's opinions about the general development regarding forest cover between the Machhedanda CFUG and Baluwa Bhanjyang CFUG. It showed no significant difference, $t(62) = 0{,}374$, $p = 0{,}711$. However, a significant difference was found between the scores given by the committee and the non-committee members (Figure 6). This was the case for both CFUGs: Machhedanda CFUG: $t(30) = 2{,}213$, $p = 0{,}035$; Baluwa Bhanjyang: $t(30) = 3{,}286$, $p = 0{,}003$.

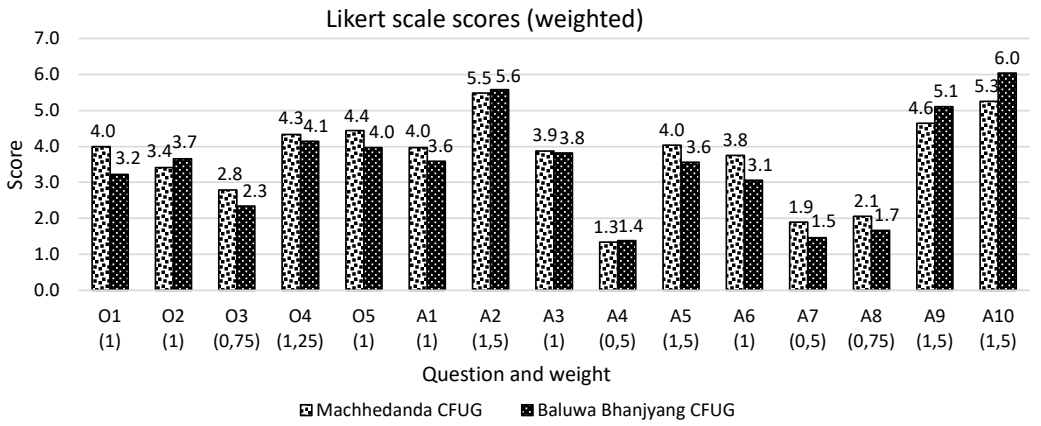

Figure 5: Average weighted Likert scale scores. O1 stands for question Objective 1 and A1 stands for question Action 1. Some interview questions were more linked to changes in forest cover area, the reason why all questions were weighted from 0,5 to 1,5, where 1 is neutral

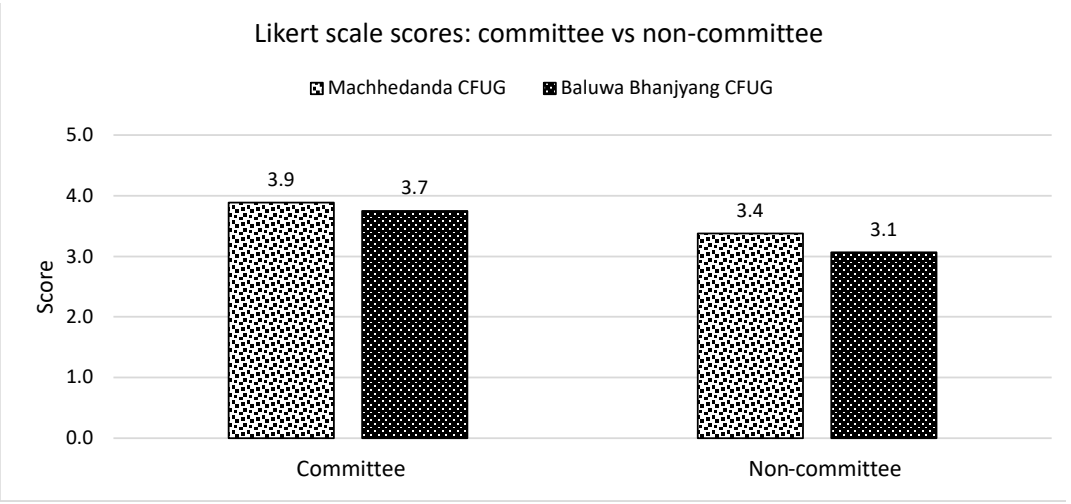

Figure 6: The difference in responses between committee and non-committee members among the two CFUGs

The committees were comprised of 13 members, with key positions equally split between genders. The committee members of both CFUGs showed more insight than the non-committee members did, and a communication gap was prevalent as non-committee members could only join meetings once per year. Machhedanda CFUG has not held a yearly meeting with the whole CFUG since the issue of the OP (2021). As only the harvest programs from the OP were followed, there was not much to communicate regarding the status of the forest. Baluwa bhanjyang CFUG mentioned having more communication with their DFO than Machhedanda CFUG. While Machhedanda CFUG linked forest cover

decrease to forest fire and road construction, Baluwa Bhanjyang CFUG emphasised forest fires and landslides to be the reason for loss in forest cover area, along with the delay in implementing programs. Similarly, Machhedanda CFUG focused on wood extraction and income-generating activities like resin tapping and medical herbs, while Baluwa Bhanjyang CFUG solely focused on wood extraction. Both CFUGs struggle with starting an enterprise as problems arise on policy levels, and they have a lack of resources to implement these programs. It was found out that Machhedanda CFUG utilised the forest in a more productive way, while Baluwa Bhanjyang CFUG focused more on the conservation aspect of the forest.

DISCUSSION

The annual forest cover growth graphs (Figure 4) of both CFUGs shows a decrease in forest cover area in Machhedanda CFUG from 2010 until 2015 and in Baluwa Bhanjyang from 2009 to 2014 and 2017 to 2019. Machhedanda CFUG had a greater decrease in forest cover from 2010 until 2015 than Baluwa Bhanjyang CFUG had from 2009 until 2014. During the interviews, the committees of both CFUGs mentioned that the reasons for the long period of forest cover decrease were mainly due to forest fires, however, the interviewees of Baluwa Bhanjyang CFUG strongly emphasised that they had more forest fires. Looking at the location and weather of Baluwa Bhanjyang CFUG, it is annually warmer and hotter in the pre-monsoon as it lies closer to the border of the Siwalik (Talchabhadel *et al.* 2019).

Regarding the objectives and activities in the OPs of both CFUGs, Baluwa Bhanjyang CFUG clearly stands out regarding forest fire control measures. However, implementation appears limited due to practical challenges, such as difficult terrain and increase in forest fires, as mentioned in the interviews. These challenges could be a reason for the forest cover area decline from 2017 to 2019, showing how the gap between documented OP priorities and real-world execution is a broader issue.

Baral *et al.* (2020) stated that the OPs in the middle hills of Nepal lack the level of detail necessary for effective implementation while being largely identical across CFUGs. They argued that many of the prescriptions are copied from one plan and pasted into another. This does not appear to be the case in this research, as the OPs of the two CFUGs list different activities used to achieve their objectives. Additionally, the way in which the activities are explained differs greatly, with one OP presenting them in a tabular format and the other in a descriptive format. This difference could be explained by the fact that the two CFUGs are located in different sub-districts and are therefore supported by two different DFOs.

Ghimire *et al.* (2022) stated that the implementation status of OPs was often found to be sub-standard, with most CFUGs focusing mainly on harvesting activities while neglecting essential silvicultural practices. This observation is applicable to the two CFUGs in this research as well. The content analysis revealed that Baluwa Bhanjyang CFUG achieved a higher total score in the OP evaluation, suggesting a stronger emphasis on forest management activities. However, the forest cover trend showed a relative decline in recent years, whereas Machhedanda CFUG, with a lower content score, showed an increase in forest cover (Figure 4). This contrast may reflect a gap between the written objectives and actions in the OPs and their actual implementation as well, as this is a phenomenon that has been observed in community forestry in Nepal before (Ghimire *et al.* 2022; Toft *et al.* 2015). The significant division between committee and non-committee members in both CFUGs, shown by the Likert scale data, may explain this contrast as well.

The CFUG's development orientation is another aspect worth considering. Machhedanda CFUG's socio-economic focus and income-generating activities, such as Non-Timber Forest Products (NTFPs) cultivation and tourism development, may have motivated the CFUG members to actively manage their forest (Acharya *et al.* 2022; Bhandari *et al.* 2019). In addition, natural regeneration dynamics and differing ecological conditions between the two CFUGs may have influenced forest cover outcomes independently of the content of the OPs (Bista *et al.* 2021).

Only Baluwa Bhanjyang CFUG mentioned the DFO visiting them regularly to check on the status of the CFUG. This was not mentioned during the interviews in Machhedanda CFUG and it aligns with what Toft *et al.* (2015) state: the community-level manager (chairperson) appears knowledgeable about forest conditions and the management plans are not used in practical forest management since most of the activities are done superficially without looking through the OP. This is because the forestry officials (DFO) takes no action even if the prescriptions are not implemented.

CONCLUSION

This study compared two CFUGs in the middle hills of Nepal to examine how differences in OPs and their implementation affect the forest cover area. Despite both CFUGs increasing in forest cover between 2000 and 2019, Machhedanda CFUG showed a greater net gain, even though its OP received a lower content evaluation score. This suggests that written plans alone are not sufficient, as actual implementation, local engagement, and socio-ecological factors significantly influence outcomes. Among these, differences in DFO management, fire vulnerability, internal group dynamics, and the varying levels of knowledge and interest between committee and non-committee members appear to shape how OPs are implemented in practice, highlighting a need for improved communication and knowledge sharing within the CFUGs.

The challenges faced by Machhedanda CFUG and Baluwa Bhanjyang CFUG can be resolved by improving communication and aligning OPs more closely to realities in the field. With that in mind, differences in forest cover area of the two CFUGs can be explained by differences in how the OPs were implemented. Further research may be needed to better understand how a stronger connection between OP, OP implementation and forest cover change can be established.

RECOMMENDATIONS

More training and better communication and transparency could help the CFUGs to implement activities other than harvesting. The DFO could help with these two issues for better development of the CFUGs and therefore a conservation or increase in forest cover area. In agreement with Baral et al. (2020), a closer fit between the OPs and social, economic, and ecological realities is needed as the OPs in community forests in the middle hills in Nepal do not match the reality on the ground.

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