Research article

Assessment of sustainability in collaborative forest management (CFM): A case study from Nepal

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Abstract: A study was conducted in Buddha Shanti Collaborative Forest Management (BSCFM) of Parasi district to assess the sustainability of the collaborative forest management approach based on existing socio-economic and ecological conditions. The sustainability index was calculated by using Criteria and indicators method. A household questionnaire survey (n=115) and Focus Group Discussion was conducted among the collaborative forest management user group (CFMUG) members to collect socio-economic data. Ecological data was collected through forest inventory. The results found that the overall sustainability index of BSCFM was 0.76 with the overall socio-economic and ecological sustainability index to be 0.75 and 0.77 respectively. This value indicates that the BSCFM is medium in condition socio-economically as well as ecologically with 75% and 77% likelihood of sustainability in social and ecological terms respectively. There is room for improvement in both the socio-economic and ecological aspects of BSCFM. In addition, the study also shows that criteria and indicators are useful tools for monitoring the efficiency and effectiveness of collaborative forest management programme.

Keywords: Collaborative forest management - Criteria and indicators - Sustainability.

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INTRODUCTION

The word 'Sustainability' stands for the ability to exist constantly. Sustainability includes three core principles; social acceptability, economic viability and ecological integrity (Bebarta 2004). Sustainable forest management (SFM) is the management of *forests resources* according to the principles of *sustainable development*. While the concept of sustainable development was adopted at the United Nations Conference on Environment and Development (UNCED) in 1992 where sustainable forest management has been considered as a key component of global sustainable development (Bebarta 2004, ITTO 2005). Ecological, economic and socio-cultural factors are the three primary pillars that SFM must maintain balance between. Therefore, SFM offers a holistic approach to ensure forest activities deliver social, environmental and economic benefits, balance competing needs and maintain and enhance forest functions now and in the future (SFI 2012).

Community-based forest management has approach been globally recognized as an innovative and successful approach to forest resource management (Acharya 2002, Shrestha & McManus 2007). Nepal is the pioneer country in implementing community-based forestry worldwide (Pokharel 2009) and now is recognized as a world leader in community-based forest management programme (Shrestha & McManus 2007, Ghimire & Lamichhane 2020). At present, Nepal has been managing its forest resources under six different community-based forestry models namely: community forest, leasehold forestry, buffer zone community forestry, collaborative forest management, religious forest, and protection forest supported by various policies and programs (Pokharel *et al.* 2015, Ghimire & Lamichhane 2020). Collaborative forest management (CFM) is a concept of participatory approach to forest management where forests are managed by the government and stakeholders collaboratively according to the approved forest management plan to improve livelihoods, economic opportunities and other multipurpose benefits such as maintaining ecological balance (MoFSC 2011). The CFM modality was introduced as a mechanism to address the management issues of large block forests of

Terai and inner Terai that may secure conservation, livelihood welfare of local forest users and a regular flow of revenue part of the government (MoFSC 2000, Ghimire & Lamichhane 2020). Presently, CFM modality is the second largest community-based forest management program in the country after the community forestry programme and the government of Nepal has emphasized CFM as a focal management modality for sustainable management of Terai forest to fulfill the country's demand for timber and other forest products (Ghimire & Lamichhane 2020).

Community-Based Forest Management is considered as one of the successful models in sustainable forest management in Nepal (Pokharel & Tiwari 2018, Ghimire & Lamichhane 2020). The sustainability of community-based forestry can be understood as the condition of conservation, development and utilization of forest resources under which the social-cultural, economic, and ecological needs of the present and future generations of the local community are maintained and enhanced (Pokharel *et al.* 2015, Paudel *et al.* 2019). Even though, SFM is a globally accepted approach, many countries have been facing challenges in implementing the SFM. It is even more challenging, especially in a country like Nepal where people rely heavily on forest resources for their livelihoods. Community-based forestry model involves local people in different levels of forest management which varies with place and context. More importantly, community-based forestry invites local people to join their hands in the management of forest resources and encourages them to be involved in different levels of management (Pokharel *et al.* 2015, Pokharel & Tiwari 2018). In this context, the present study aims to assess whether the collaborative community forest management approach is sustainable or not using criteria and indicators.

MATERIALS AND METHODS

Study area

The study was conducted in Buddha Shanti Collaborative Forest Management of Parasi district of Gandaki Province, Nepal (Fig. 1). Topographically, this district entails 27° 30' to 27°40' latitude and 83° 35' to 83°40' longitudes. BSCF is situated in the south-west part of some wards of Sunaul municipality (7, 8, 9), Ramgram municipality (6, 10, 14, 15, 16) and Palinandan rural municipality (4, 5, 6) of Parasi district. The forest cover 1781.32 ha of area with natural broad-leaved forest dominated by *Shorea robusta* Gaertn. (Sal) forest with other associated species such as *Terminalia tomentosa* Wild. (Saj), *Adina cordifolia* (Roxb.) Brandis, *Terminalia bellirica* (Gaertn.) Roxb., *Semecarpus anacardium* L. f., *Syzygium cumini* (L.) Skeels etc. The area is characterized by tropical climate and thè altitudinal range varies from 200 to 300 m above mean sea level (amsl). The annual average temperature ranging from 15°C to 35°C while annual rainfall is recorded to be 2145 mm in average. The Buddha Shanti Collaborative Forest Management User Group (BSCFMUG) benefits 11, 422 households (BSCFMG 2014).
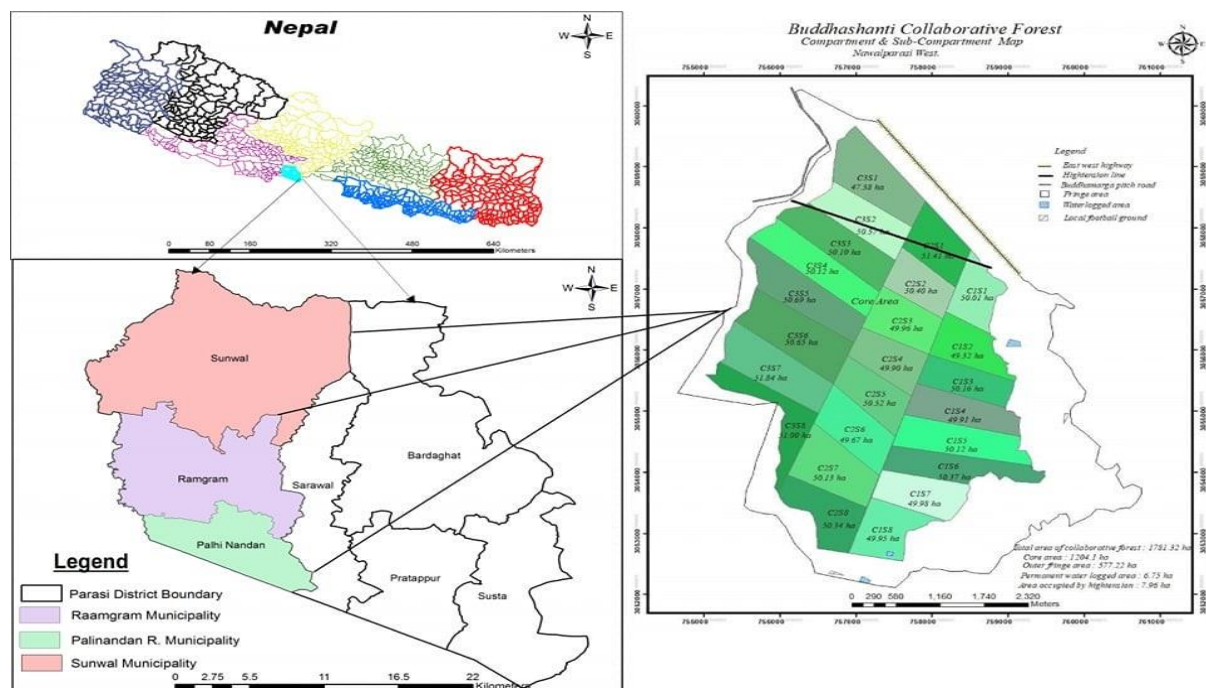

Figure 1. Figure showing map of the study area.

Sampling design and forest measurement

A simple random sampling method was applied to carry out both socio-economic and ecological surveys. Sample plots were laid out as per the Community Forestry Inventory Guideline of the Government of Nepal (DoF 2004). Concentric circular plots were established systematically to measure forest vegetation ecological data. Trees, poles and regeneration conditions are the major data for ecological sustainability assessment. A total of 45 sample plots (with sampling intensity 0.5%) were laid out and forest inventory was carried out in circular plots of radius 12.61 m for Trees, 5.64 m for Poles, 2.82 m for Sapling and 1.78 m for regeneration respectively. The diameter at breast height (dbh) of each tree and pole was measured within 21 plots using diameter tape and height of each tree and pole was estimated using Range Finder. ArcGIS 10.3 was used to delineate the study area and sample plots. Similarly, a total of 115 total Households were surveyed for socio-economic data. Semi-structured questionnaire survey, key informant and focus group discussion were conducted to collect the socio-economic data of forest user group.

Selection of criteria and indicator (C& I)

For this study criteria & indicator (C& I) method developed by Pokharel *et al.* (2013) were adopted. Altogether 60 indicators under 4 criteria were selected for socio-economic and ecological sustainability assessment. Four criteria for sustainability assessment were: i. Extent of forest resources (C1); ii. Social and economic benefits from forest (C2); iii. Forest management practices and its implementation (C3); and iv. Institutional framework and governance (C4). Among these four criteria, C2 and C4 represent the Socio-economical sustainability whereas C1 and C3 represent the ecological sustainability. The criteria and indicators used for this study are shown in Appendix I.

Sustainability Index (SI)

For sustainability assessment, sustainability index were generated for individual criterion and based on that overall sustainability index was determined. The following formula as suggested by Singh (2017) was used to determine the sustainability index for individual criteria (SIIC) and overall sustainability index (OSI):

$$\text{SIIC} = \frac{\text{Sum of average score of all indicators within a criterion}}{\text{Number of indicators in each criterion}}$$

$$\text{OSI} = \frac{\text{Sum of scores of all criteria}}{\text{Number of criteria}}$$

Then, the sustainability condition was categorized and interpreted into good, medium and poor based on calculated index value. If the index value lies in between 81–100%, 50–80% and less than 50% then it is interpreted into good, fair and poor categories respectively (Pokharel *et al.* 2013). Empirical data were analyzed with the help of Statistical Package for Social Science (SPSS).

RESULT AND DISCUSSION

Socio-economic sustainability assessment

The concept of CFM modality has emerged as a mechanism to sustainably manage the forests in Terai and inner Terai that could improve livelihoods, economic opportunities and other multipurpose benefits such as maintaining ecological balance (Ghimire & Lamichhane 2020). The socioeconomic upliftment of forest users is one of the major objectives of the implementation of CFM programme in Terai and inner Terai in Nepal. Therefore, the evaluation of socio-economic conditions also forms an important part of assessing the sustainability of collaborative forests.

Criteria for socio-economic sustainability

Criteria 2 (Socio-economic benefits from forest) assesses the participation of local users in CFM development work, access to benefit sharing and distributions, mobilizing fund for CFUGs development and employment generation through CFM. This criterion has an average score of 2.21 which is very good while the sustainability index is 0.74. Similarly, Criteria 4 (Institutional framework and governance) assess the institutional planning, decision-making, transparency as well as legal framework of the CFM user groups and indicates the extent of commitment from forest users to sustainable forest management. This criterion has an average mean criteria of 2.30 while the sustainability index is 0.77 (Table 1).

Table 1. Socio-economic sustainability indices.

Criterion	Index value	Overall Scio-economic sustainability index value
C2	0.74	0.75
C4	0.77	

Overall Socio-economic Sustainability Index (OESI)

$$\text{OSSI} = \frac{\text{Sustainability Index for Individual Criteria}(C2 + C4)}{\text{Number of criteria}} = 0.75$$

Overall socio-economic sustainability index was reported as 0.75 which means that the forest has medium sustainability in terms of existing socio-economic settings of the forest users.

Ecological sustainability assessment

Forest ecosystem health and vitality; and ecological productivity should not be overlooked while ensuring long-term benefits to the people. Forest management and utilization have a considerable impact on the ecological stability and sustainability of forest ecosystems. Hence, ecological criteria also need to be assessed for sustainability assessment.

Criteria for ecological sustainability

Criteria 1 (Extent of forest resources) gives combined information on the forest conditions; forest growth and harvest, and change in forest resources over time. The average mean of criteria was found to be 2.45 and the individual sustainability index recorded was 0.82 which is good. Likewise, criteria 3 (Forest management practices and its implementation) provides the overall silvicultural operations, block division, plantation activities, and provision of biodiversity conservation in the CFM. The average mean of criteria was found to be 2.16 and the individual sustainability index was found to be 0.72 which is medium in condition (Table 2).

Table 2. Ecological sustainability indices.

| Criterion	Index value	Overall Ecological sustainability index value
C1	0.82	0.77
C3	0.72	

Overall Ecological Sustainability Index (OESI)

$$\text{OSSI} = \frac{\text{Sustainability Index for Individual Criteria}(C1 + C3)}{\text{Number of criteria}} = 0.77$$

The overall ecological sustainability index is 0.77 which means that the forest has medium sustainability in terms of ecological integrity of forest resources. This means that the forest is self-sustaining ecologically in medium condition.

Overall sustainability of BSCFM

From the above results, it is revealed that Buddha Shanti Collaborative Forest Management is 76% sustainable. The forest is more or less equal in socio-economic and ecological sustainability. Its socio-economic sustainability is 75% and ecological sustainability is 77% (Fig. 2). The result of the study is in line with Dhungana (2010) who reported medium level of sustainability index in Buffer Zone Community Forests of Chitwan district Nepal. Pokharel *et al.* (2015) documented an overall sustainability index of 0.49 and 0.46 in Halkhoria CFM and Sahajnath CFM in Bara district of Nepal. It is observed that Buddha-Shanti CFM was more sustainable than Halkhoria CFM and Sahajnath CFM showing improved socio-economic and ecological performance. However, there is also room for improvement in both the socio-economic and ecological aspects
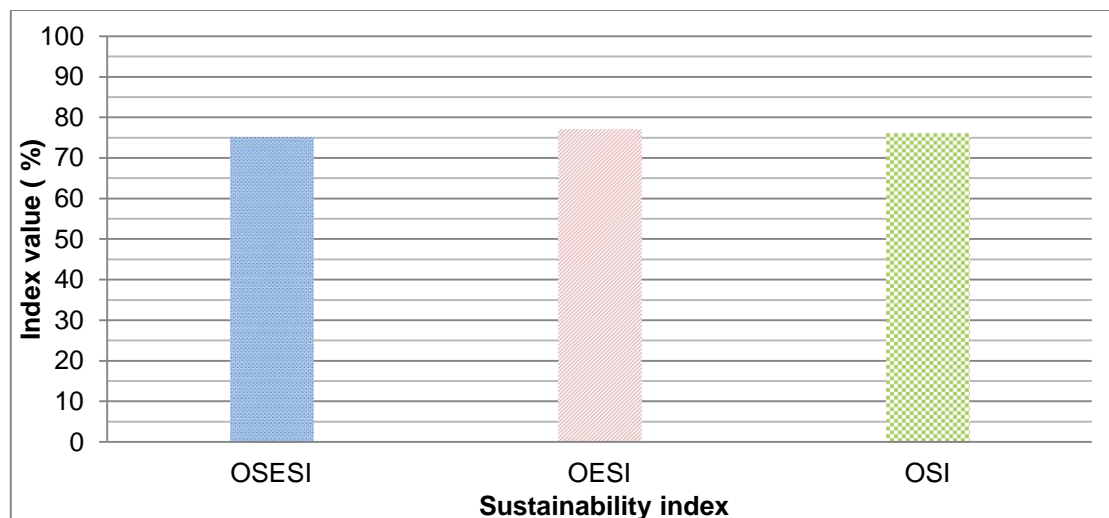
Figure 2. Figure showing values of OSSI, OESI and OSI of BSCFM.

of Buddha-Shanti CFM. Specifically, more attention has to be given in socio-economic upliftment, institutional framework and governance, and forest management activities. Jafari *et al.* (2018) also reported poor level of sustainability in community forest management in Iran. This type of study could be useful to provide information and guidance to local forest management entities to identify key issues that need attention to enhance the sustainability of their forests. The information generated could be very important for monitoring the efficiency and effectiveness of forest management practices.

CONCLUSION

The study concluded that the overall sustainability index of Buddha Shanti Collaborative Forest Management was found as 0.76 which means that the forest has 76% chance of sustainability if the prevailing socio-economic and ecological condition continues. This value indicates that the forest is in medium condition socio-economically as well as ecologically. The extent of forest resources was good in condition however, institutional framework and governance, socio-economic benefits and forest management aspect need to be improved in the future.

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Appendix I: Criteria and indicators used for the study.

Criterion 1 - Extent of forest resources		
Indicators	**Verifiers**	**Scoring**
Forest condition	Tree species	Poor = one tree species in the forest
		Fair = 2-3 tree species in the forest
		Good = >3 tree species in the forest
	Regeneration	Poor = <2000 seedlings/ha
		Fair = 2000-5000 seedlings/ha
		Good = >5000 seedlings/ha
	Trees with different classes	Poor = one age class trees(matured/young/pole)
		Fair = two age class (either matured and young; young and pole; matured and pole)
		Good = all age classes(matured/young/pole)
	Canopy cover	Poor = < 39 % of canopy cover
		Fair = 40-70 % of canopy cover
		Good = >70 % of canopy cover
	Good shape trees	Poor = <20% of good shape trees
		Fair = 20-40 % of good shape trees
		Good = >40% of good shape trees
	Area with destructive weeds and climber	Poor = > 40% of forest area
		Fair = 20-40% of forest area
		Good = < 20 % of forest area *
Forest growth and harvest	Amount of timber and fuel wood harvested in a year	Poor = > harvestable amount in a year
		Fair = equal to harvestable amount in a year
		Good = < harvestable amount in a year **
Greenery	Number of springs in forest	Poor = no spring in the area
		Fair = one spring in the area
		Good = > one spring in the forest
	Vegetation in the area	Poor = <20% of vegetation in the area
		Fair = 20-39 % of vegetation in the area
		Good = 40% and higher of vegetation in the area
Coverage in forest ground	Open area in forest floor	Poor = > 50 % of forest floor open
		Fair = 25-50% of forest floor open
		Good = < 25 % 0f forest floor open
Changed forest area over time	Changed forest area into other land use over time	Poor = >10% changed in forest area
		Fair = 10% and lower changed in forest area***
		Good = No changed in forest area
Wildlife in forest	Occurrence of wildlife	Poor = never appeared
		Fair = 10 times and less appeared in a year
		Good = >10 times appeared in a year
	Livestock killed/attacked	Poor = never attacked / killed
		Fair = attacked/killed occasionally(3 times/yr or less
		Good = attacked/killed frequently(> 3 times/yr)

Note: Poor = 1, Fair = 2, and Good = 3; * = 80% of forest coverage is considered as good; ** = inventory in Nepal is less likely to be accurate; *** = manageable.

Criterion 2 - Socio-economic benefits from forest

Indicators	Verifiers	Scoring
Awareness of people towards the importance of forestry	Households showed up voluntarily to participate in forest related works	Poor = upto 25% of the HHs
		Fair=26-50 % of the HHs
		Good= >50% of the HHs
	Number of meeting conducted	Poor = no awareness meeting in a year
		Fair= one awareness meeting in a year
		Good= > one awareness meeting in a year
	Trees on private land	Poor = 10% and less HHs planted trees
		Fair=11-30 % HHs planted trees
		Good= >30% HHs planted trees
Participation of people in forestry works	Households showed up in general assembly	Poor = upto 50% of the HHs
		Fair=51-75 % of the HHs
		Good= >75% of the HHs
	Households in forest management activities	Poor = upto 25% of the HHs
		Fair=26-50 % of the HHs
		Good= >50% of the HHs
Access to benefits	Households obtained benefits	Poor = upto 25% of the HHs
		Fair=26-50 % of the HHs
		Good= >50% of the HHs
Distribution of benefits	Poor / marginalized households received benefits	Poor = upto 25% of the poor HHs
		Fair=26-50 % of the poor HHs
		Good= >50% of the poor HHs
	Wood received by forest dependent people	Poor = up to 25% of the HHs
		Fair=26-50 % of the HHs
		Good= >50% of the HHs
Motivational works towards forestry	Welfare funds/allowance through forestry funds	Poor =No funds for welfare allowance
		Fair = >5% of the annual income
		Good = up to 5% of the annual income
	Financial support through forestry funds to forest dependent people for IGA	Poor = up to 25% of forest dependent households
		Fair = 26-50% of forest dependent households
		Good = >50% of forest dependent households
	Subsidy received through forestry funds for alternative energy	Poor = up to 25% of the HHs
		Fair=26-50 % of the HHs
		Good= >50% of the HHs
	Scholarship through forestry funds	Poor = no forestry funds for scholarship
		Fair= up to 5% of the annual income
		Good= >5% of the annual income
Employment through forestry	Local people hired as labors or staffs	Poor =upto 25 %of required employees/labors
		Fair =25-50% of required employees/labors
		Good = > 50% of required employees/labors
	Received skill oriented training	Poor =upto 10 % of the users' households
		Fair =11-20% of the users' households
		Good = > 20% of the users' households
	Households involved in IGA through forestry funds	Poor =upto 10 % of the users' households
		Fair =11-20% of the users' households
		Good = > 20% of the users' households
Generating common funds through forestry	Amount of income generated through forest products	Poor =upto NRs. 25000 per year
		Fair = NRs. 25001-50000 per year
		Good = > NRs. 50000 per year
	Amount of income generated through other sources	Poor =upto 20 % of the yearly income
		Fair =21-40% of the yearly income
		Good = > 40% of the yearly income
Mobilization of forestry funds	Investment through forestry funds	Poor = Investment in RI only
		Fair = Investment in RI and FI
		Good = Investment in RI,FA and PPP

Note: Poor= 1, Fair=2, and Good=3; RI= rural infrastructures; FI= forest improvements; PPP= Pro-poor programmes.

Criterion 3 - Forest Management Practices and its implementation

Indicators	Verifiers	Scoring
Silvicultural operations	Silvicultural operations conducted regularly	Poor = no regular silvicultural operations
		Fair = silvicultural operations in a regular basis
		Good = Silvicultural operations in a regular basis and also prescribed it in forest operational plan
	Promoting valuable tree species	Poor = not favored the valuable tree species
		Fair = favored valuable tree species
		Good = favored valuable tree species & also prescribed it in forest operational plan
Plantation activity	Conducted Plantation activity	Poor = no Plantation activity
		Fair = Conducted Plantation activity regularly
		Good = Conducted Plantation activity regularly & also prescribed it in forest operational plan
Incidence of forest fires	Occurrence of forest fires in forest areas	Poor = artificial and deliberate forest fires
		Fair = artificial and accidental forest fires
		Good = more natural and controlled forest fires only
	Fire lines in forest	Poor = no fire lines in the forest
		Fair = existence of fire lines in the forest
		Good = existence of fire lines in the forest & also prescribed it in forest operational plan
Block divisions	Block divisions in the forest	Poor = no block divisions in the forest
		Fair = divisions of forest into blocks
		Good = block divisions in the forest & also prescribed it in forest operational plan
Wet land in forest	Prevalence of wet land in the forest	Poor = no wet land in the forest
		Fair = Prevalence of wet land in the forest
		Good = Prevalence of wet land in the forest and maintained it regularly
	Pond created artificially	Poor = no pond created artificially in the forest
		Fair = Pond created artificially in the forest
		Good = Pond created artificially in the forest and maintained it regularly
Grass land in forest	Prevalence of Grass land in forest	Poor = no grass land in forest
		Fair = Prevalence of grass land in the forest
		Good = Prevalence of grass land in the forest with clear guidelines
	Grass land created artificially	Poor = no grass land created artificially in forest
		Fair = grass land created artificially in forest
		Good = grass land created artificially in forest with clear guidelines
Recreation area in forest	Forest area allocated or created for recreation	Poor = no forest area allocated for recreation
		Fair = forest area allocated for recreation
		Good = forest area allocated for recreation and developed facility as well in the area

Note: Poor= 1, Fair=2, and Good=3

Criterion 4 - Institutional framework and governance

Indicators	Verifiers	Scoring
Policy	Existence of policy	Poor = no national policy for CBFM
		Fair=existence of national policy in CBFM
		Good= existence of national policy and put it into practices
	Rules exist for collection	Poor =no rules for forest products collection
		Fair= rules exist for forest products collection
		Good= exist forest products collection rules and put it into practices
Leadership	Punctuality	Poor =less punctual in pre-determined programmes
		Fair= some punctual in pre-determined programmes
		Good= highly punctual in pre-determined programmes
	Democratic mindset	Poor =less democratic and credible
		Fair=some in democratic style and credible
		Good= highly democratic and credible
	Performed activities	Poor = Performed activities without approved plan
		Fair= Performed activities with approved plan
		Good= Performed activities with consensus and approved plan
	Knowledge on forest policy	Poor =no Knowledge on forest policy
		Fair=little Knowledge on forest policy
		Good=good Knowledge on forest policy
	Sensitive on OP and constitution	Poor =not Sensitive towards OP and constitution
		Fair=little Sensitive towards OP and constitution
		Good=very Sensitive towards OP and constitution
	Healthy	Poor =not healthy to walk around the forest
		Fair= healthy to walk around the forest
		Good= healthy and ready to walk around the forest as needed
Nature of EC	Inclusive (gender and marginalized people)	Poor = not inclusive
		Fair= representative in terms of gender and marginalized people
		Good= representation from marginalized people & also balanced equally from gender perspective
Transparency	Citizen charter	Poor = no citizen charter
		Fair= Citizen charter with poor visibility
		Good= Citizen charter with high visibility
	Public notice	Poor =no public notice circulated
		Fair= public notice circulated in limited place
		Good= public notice circulated widely
	Public hearing	Poor =no public hearing held
		Fair= public hearing held regularly
		Good= public hearing held regularly and timely
	Performed activities	Poor= activities performed without approved plan
		Fair= activities performed with approved plan
		Good= performed activities with prior notice and approved plan
	Sub-committee	Poor =no sub-committee for financial activity
		Fair= sub-committee exists for financial activity
		Good= sub-committee exists for financial activity and prescribed it in OP and Constitution
Office management	Office building	Poor =no office building
		Fair=own office building exists
		Good=own office building with communication facility
	Office outlook	Poor = office not good looking
		Fair= office good looking
		Good= good looking office with meeting hall

Office assistant	Poor =no office assistant
	Fair= office assistant in the office
	Good=office assistant with good responsibility bearing
Meeting held	Poor =no regular meeting of the executive committee
	Fair= regular meeting of the executive committee
	Good= regular meeting of the executive committee with full members

Note: Poor= 1, Fair=2, and Good=3