Ecosystem Services Certification Document (ESCD) for Charnawati Landscape, Nepal

Introduction

FSC-STD-60-004 *International Generic Indicators* (IGI) specifies that when a certified forest management organization makes FSC claims regarding the maintenance and/or enhancement of ecosystem services, Annex C is followed regarding additional requirements, including the development of a publicly available Ecosystem Services Certification Document.

In the Ecosystem Services Certification Document, the certified forest management organization shall list the declared ecosystem service(s), state the desired ecosystem service(s) claim and describe: the status and management of, and threats to, the declared ecosystem service(s); the methodology used to evaluate the impacts of management activities on the declared ecosystem service(s); the results of impact assessment; a list of those involved in activities related to the declared ecosystem service(s); and a summary of culturally appropriate engagement with Indigenous Peoples and local communities.

The Ecosystem Services Certification Document, along with FSC claims for the maintenance and/or enhancement of ecosystem services, can be used to improve market access to ecosystem service payments by increasing the confidence of potential buyers or investors.

The Ecosystem Services Certification Document is subject to assessment as part of a forest management evaluation by certification bodies.

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Ecosystem Services Certification Document (ESCD) for Charnawati Landscape, Nepal

Part I: Information regarding the demonstration of impact

Declaration of the ecosystem services for which a claim is being or will be made
Please state the ecosystem service(s) for which you are making or plan to make FSC claims for the maintenance and/or enhancement of ecosystem services. You can choose more than one option. ☒ Carbon sequestration and storage ☒ Watershed services ☒ Biological diversity conservation ☒ Soil conservation ☐ Recreational services

1. Core information regarding the demonstration of impact

Declared ecosystem service (ES)	FSC ecosystem service claim (from Annex I of FSC-PRO-30-002 – ForCES field testing draft)	Associated impact indicator for the claim (from Annex I of FSC-PRO-30-002)	Baseline level of the impact indicator	Verifiable target for the impact indicator	Key management activities and strategies to reduce threats and maintain and/or enhance the ecosystem service	Results of impact assessment (see section 6)
Watershed Services	Protect water (buffer zones around water sources)	Number of water sources protected	No baseline required	100% of water sources protected	• Identified perennial water sources and developed spatial distribution map (in each community forest) • Revised the forest management plan, including detail of water sources conservation • Maintain forest cover around the water sources	247/247 water sources protected

					• Protect water source and a buffer area of at least 10 metres radius • Control disturbance (open grazing, damaging water supply systems, illegal harvesting) in and around water sources • Keep water sources pollution free • Fenced water sources (only in places that needed it) • Identified users and/or affected people of selected ES within and outside the management units • Discussed and assessed the scale and intensity and potential risks to each ES in a participatory way.	
Biological Diversity Conservation	Protect biodiversity (natural forest cover)	Area of natural forest (no baseline required)	No baseline required	100% of natural forest cover maintained	• Identified and mapped the natural forest area (in each community forest) • Revised the management plan • Trained community forest user groups (CFUGs) to implement the management plan • Controlled open grazing and promoted rotational grazing and stall feeding • Collected leaf litter from forest before the dry season • Maintained or constructed forest fire lines to control forest fire, including use of road, streams, and trails as forest fire lines • Control illegal harvesting and logging • Promoted planting of native species in degraded areas	100% of natural forest maintained

					• Carried out thinning, pruning, and cleaning to assist natural regeneration • Identified users and/or affected people of selected ES within and outside the management units • Discussed and assessed the scale and intensity and potential risks to each ES in a participatory way.	
	Protect biodiversity (conservation areas)	Area of high conservation value (HCV), intact forest landscape (IFL), and conservation areas (no baseline required)	No baseline required	At least 10% of total forest is conserved	• Identified and mapped the area of HCV covering at least 10% of total forest area under group certification • Promoted sustainable harvesting and use of non-timber forest products (NTFPs) • Carried out awareness-raising activities on biodiversity conservation for local communities • Controlled invasive species by clearing and allowing households to collect them for bedding materials • Biodiversity conservation given special attention during silvicultural activities in HCV areas • Control grazing, hunting, poaching, and illegal harvesting • Increased awareness of forest management units (FMUs) and local communities about impacts of forest fire and fire control systems	The total forest area is 7,835 ha and 1,080 ha area has been conserved, i.e. 13.79%

					• Identified users and/or affected people of selected ES within and outside the management units • Discussed and assessed the scale and intensity and potential risks to each ES in a participatory way.	
Soil Conservation	Protect soil (maintain forest cover)	Area of natural forest cover (no baseline required)	No baseline required	100% of natural forest cover maintained	• Identified and mapped the natural forest area (in each community forest) • Controlled open grazing and promoted rotational grazing and stall feeding • Collection of leaf litter from the forest before the dry season • Maintained or constructed forest fire lines to control forest fire • Control illegal harvesting, logging, and unsustainable harvesting practices • Promoted assisted natural regeneration • Promoted planting of native species in degraded areas • Educated local people on reduced-impact logging in the forests • Promoted natural regeneration and planting in landslide-affected areas • Discouraged use of chemical fertilizer and pesticides in forest area including plantation • Identified users and/or affected people of selected ES within and outside the management units	100% of natural forest conserved

					• Discussed and assessed the scale and intensity and potential risks to each ES in a participatory way.	
Carbon Sequestation and Storage	Mitigate climate change (enhance forest carbon)	Forest carbon storage (tonnes of CO_2)	2010 baseline: 209.12 t/ha	Increase in forest carbon stock by 10% in 10 years and 5% in five years	• Studied drivers of deforestation and forest degradation • Identified key areas prone to forest fire and illegal logging, and highly degraded areas (in each community forest) • Assessed NTFPs, estimated total stock and annual allowable harvest (AAH) • Revised forest management plan • Facilitated CFUGs to delineate and protect HCV areas, to conduct development activities with minimum impacts on forests and important biodiversity habitats • Made provision for NTFP management and utilization in forest management plan, so that local people can sustainably collect and sell NTFPs, and generate NTFP-based income to reduce pressure and illegal logging activities in the forests • Identified and incorporated management activities in the forest management plan to reduce the threats to declared ES, discussing them with local communities and other potential users and affected stakeholders • Provided orientation training to forest managers about implementation of forest management plan	Carbon stock increased by 2.09% per annum in last five years

					• Facilitated implementation of forest management plan and record-keeping • Maintained forest fire lines inside forests; collecting leaf litter at the beginning of the forest fire season • Developed awareness on control of forest fires • Controlled open grazing and promoted rotational grazing • Conduct silvicultural operations such as thinning, pruning, climber cutting, and bush clearing to enhance regeneration and growth of forests • Established baseline of forest carbon and monitored it annually and periodically • Continued community monitoring system to control illegal logging and encroachment in collaboration with district forest office and district police • Promoted assisted natural regeneration and carried out tree planning in some FMUs • Introduced alternative income-generation activities to reduce dependency on forests • Developed and piloted carbon payment distribution mechanism • Identified users and/or affected people of selected ES within and outside the management units and involved them in management planning and implementation process	

					• Discussed and assessed the scale and intensity of, and potential risks to, each ES in a participatory way • Coordinated and facilitated local development agencies in eco-friendly development activities.	

2. Management objectives related to maintenance and/or enhancement of declared ecosystem services

- Maintain and protect pristine forests and landscapes through application of FSC standards including Annex C requirements for delivering ecosystem services – namely, recreational services, biodiversity conservation, hydrological, and soil conservation.
- Restore, maintain, and enhance forest cover and forest carbon storage and sequestration in community forests through application of FSC standards including Annex C requirements and access national and international carbon markets and funds through national REDD+ (reducing emissions from deforestation and forest degradation) programme.
- Contribute to improved local livelihoods through accessing market for FSC-certified NTFPs with claim on verified ecosystem services on biodiversity conservation.
- Establish payment for ES (hydrological and soil conservation) at local and national level, promoting sustainable forest management with application of FSC standards including Annex C requirements.

3. Description of the current condition of the declared ecosystem service(s), areas within and outside the management unit that contribute to the declared ecosystem service(s)

The Charnawati landscape is spread over 21,500 ha covering three bio-climatic zones (sub-tropical, temperate, and sub-alpine) and at least 18 vegetation types from riverine forest to alpine juniper scrub. Altogether, 37% of the land is covered by forest, about 10% by shrub land, 1.24% by grassland, and the rest by agricultural land, barren land, rocky areas, and water bodies. A total of 73 CFUGs and 12,647 households (63,235 people) are managing 7,835 ha of biodiversity-rich forests for obtaining various ecosystem goods and services, such as timber, NTFPs, forest carbon sequestration, biodiversity conservation, water quantity and quality enhancement, and soil conservation. The status of these ecosystem services is given below.

Forest carbon sequestration: The baseline of forest carbon for Charnawati landscape was established in 2010 and monitoring was done in 2013 and 2016. The forest carbon assessment included three major pools (aboveground carbon, below-ground carbon, and soil carbon) and the result showed that the carbon stock reached 235.37 t/ha in 2016, having risen from 221.44 t/ha in 2013 and 209.12 t/ha in 2010. The carbon increment was

significant (*P* = 0.007). The Forest Certification for Ecosystem Services (ForCES) project supported the monitoring of forest carbon in 2016 and analysis is in progress.

Hydrological services (water): Water is an important resource in the landscape due to increased population and demand. At the same time, the water sources are depleting: unmanaged grazing, illegal logging, prolonged drought, and disturbance of water sources by surrounding inhabitants were the major risks that reduced the water quality and quantity.

The CFUGs of Charnawati landscape have managed their forest considering hydrological services as one of the major services. A total of 73 CFUGs have identified, delineated, and protected 247 perennial water sources and identified areas of ephemeral sources. The main objective of conserving water sources is to have a sustainable supply of clean water.

Two CFUGs, namely Charnawati and Suspa (covering about 1,400 ha of mountain forests), are managing their forests and water sources against payments for watershed services. A total of 35 perennial water sources were counted in these two CFUGs. The service buyer is Charikot Drinking Water and Sanitation Users Association (CDWSUA), which agrees to pay USD1.2 per drinking-water tap per annum to the CFUGs for sustainable management of the forest and maintaining water sources. CDWSUA represents users of Charikot city and surrounding areas of Bhimeshowr Municipality. Now, the CFUGs are controlling fires, reducing grazing impacts, improving timber harvesting practices, and involving local people in the process.

Biodiversity conservation: The Charnawati landscape has three climatological zones, 18 vegetation types, and numerous flowering and non-flowering plants, including economically important timber and NTFPs species. Major tree species of the area are blue pine (*Pinus wallichina*), chir pine (*Pinus roxburghii*), chilaune (*Schima wallichii*), utis (*Alnus nepalensis*), sal (*Shorea robusta*),*Quercus* species, *Rhododendron* species, and a number of *Ficus* species. Major NTFPs are Chiraito (*Swertia chiraita*), Lokta (*Daphne bhulua*), Argeli (*Edgeworthia gardneri*), Machhino (*Gultheria fragrantissima*), Allo (Himalayan nettle, *Girardinia diversifolia*), and Majito (*Rubia manjith*). The forest and NTFPs are one of the income sources for poor people. Similarly, this area has rare and endangered species that are listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), namely *Catreus wallichii*, *Taxus wallichiana*, *Dioscorea deltoidea*, *Juglans regia*, and orchids (*Orchidaceae*). The area also harbours various mammal, bird, and reptile species, including the following rare, endangered, and threatened species: Alpine musk deer (*Moschus chrysogaster*), leopard (*Panthera pardus*), Asian black bear (*Ursus thibetanus*), Assam macaque (*Macaca assamensis*), Himalayan goral (*Naemorhedus goral*), and Chinese pangolin (*Manis pentadactyla*).

The major threats to biological diversity identified are forest fire, over-grazing, illegal logging, poaching, and unsustainable management and harvesting of timber and NTFP species. The CFUGs identified appropriate habitat within their forests for those wild flora and fauna, listed and prioritized the threats, and incorporated mitigation measures in forest management plans to maintain and enhance their habitat.

Soil conservation: The forests in Charnawati landscape are situated in a mountainous area with very gentle to very steep slopes up to 90°. Improper and mismanagement of forests, soil erosion, landslides, soil nutrient loss, and degradation were common phenomena in the area. Thus, to mitigate or reduce these effects, the CFUGs have identified soil conservation as a major function of the responsibly managed forest. Each CFUG has identified such soil-erosion- and landslide-prone areas and developed measures to prevent and reduce the incidence of landslides and soil erosion. In addition,

the CFUGs have made provision to participate in and generate income through establishing payment for environmental services (PES) with potential service buyers, but that has not happened yet.

4. Threats to the declared ecosystem service(s) within and outside of the management unit

Forest carbon sequestration: Charnawati landscape has high potential to maintain and enhance the forest carbon stock. Forest degradation is a major threat, but deforestation is rare and at a small scale. The major drivers of deforestation and forest degradation are unsustainable management and harvesting practices, infrastructure development, illegal logging and extraction of forest products, lopping, firewood collection, forest fire, grazing, and encroachment. These drivers have been contributing to forest degradation and carbon emission.

Hydrological services: The Charnawati River is a tributary of the Saptakoshi (Kosi) River, and this small river supplies water for drinking, irrigation, electricity generation, operating water mills, maintaining freshwater ecosystems, and improving dependent livelihoods in the area. This hydrological service (water) has been threatened on a daily basis by a lack of proper assessment and management, grazing and illegal logging around the water sources, throwing non-degradable waste into and around the water sources, climate change and its effects including prolonged drought and drying up of natural springs, increased demand for water, and lack of ownership by and incentives for the service providers (e.g. forest management groups).

Biological diversity: This area comprises good habitat for wild animals, including rare, threatened, and endangered species. Forest fire, illegal poaching and trade, lack of identification and conservation of wildlife habitat, and lack of awareness about biodiversity conservation among the local people are major threats to maintain appropriate habitat for wildlife.

Soil conservation: Having gentle to steep slopes, soil erosion and landslides have been frequent in various places within the landscape and at different scales due to lack of appropriate management of water sources. The area was also the epicentre of an earthquake (6.7 on the Richter scale) on 12 May 2015, which had many aftershocks. In addition, inappropriate harvesting and transportation of timber, forest fire, and grazing have been contributing to the reduction of the soil productivity in the area.

5. Description of the methodology used to demonstrate the impact for each selected claim (including more information on baseline if necessary)

The ForCES project has applied the following methods to evaluate the status of the declared ES.

ES 1: Forest carbon sequestration

The project carried out a forest carbon assessment in 2010 to establish a baseline, and monitored carbon in 2013 and in 2016 at landscape level. The following methods were used to measure and monitor the carbon stock in Charnawati landscape.

Delineation of community forest boundaries and stratification: Individual CFUGs mapped the forest area with the support of GIS experts and forest technicians (participatory mapping). GPS tracking (GPS Map 60CSx, Garmin) was performed to delineate the boundaries of the community forests where the natural boundary was not clearly observable. Forest stratification was carried out using high-resolution remote sensing imagery with ERDAS Imagine, Definiens Developer, and ArcGIS software. Forest with more than 70% canopy cover was considered 'dense' and that with less than 70% as 'sparse'.

Pilot inventory for optimal sampling intensity: A preliminary inventory was conducted to estimate the variation of the carbon stock in each forest stratum and to provide a basis for calculating the number of permanent plots required for detailed inventory. It was carried out by laying 10 circular plots randomly in each stratum. Altogether, pilot measurements were carried out in 20 temporary circular plots. As random selection is important to cover the natural variability present within the different strata, all the plots were randomly distributed using Hawth's Analysis Tool for ArcGIS developed by Beyer (2004) (www.spatialecology.com). Hawth's Analysis Tool creates random points at ecological and landscape levels. Centre points of the plots generated were loaded in a GPS and located in the field.

After classification by canopy cover, a total of 205 composite plots (Figure 1) – 41 plots under sparse canopy and 164 under dense canopy – were established to enable inventory of estimated forest biomass changes in 2010, 2013, and 2016. A subplot of 0.56 m radius was established in the centre for litter (dry fallen leaf litter and twigs) collection for the first year and shifted 5.64 m from the centre to magnetic north and then 5.64 m to the east for second and third years, respectively. The same plots were used to collect samples of other living materials (all plants other than tree seedlings, saplings, and trees) and to estimate biomass. Similarly, a plot of 5.64 m radius from the centre was established for recording the plant species and measuring diameter at breast height (DBH) of sapling-sized plants (with DBH 1–5 cm), and a plot with a radius of 8.92 m was used for measuring height and DBH of trees (with DBH > 5 cm) and recording names of all tree species. Aboveground biomass, below-ground biomass, leaf litter, and soil organic carbon were measured to estimate total carbon stock in the landscape.

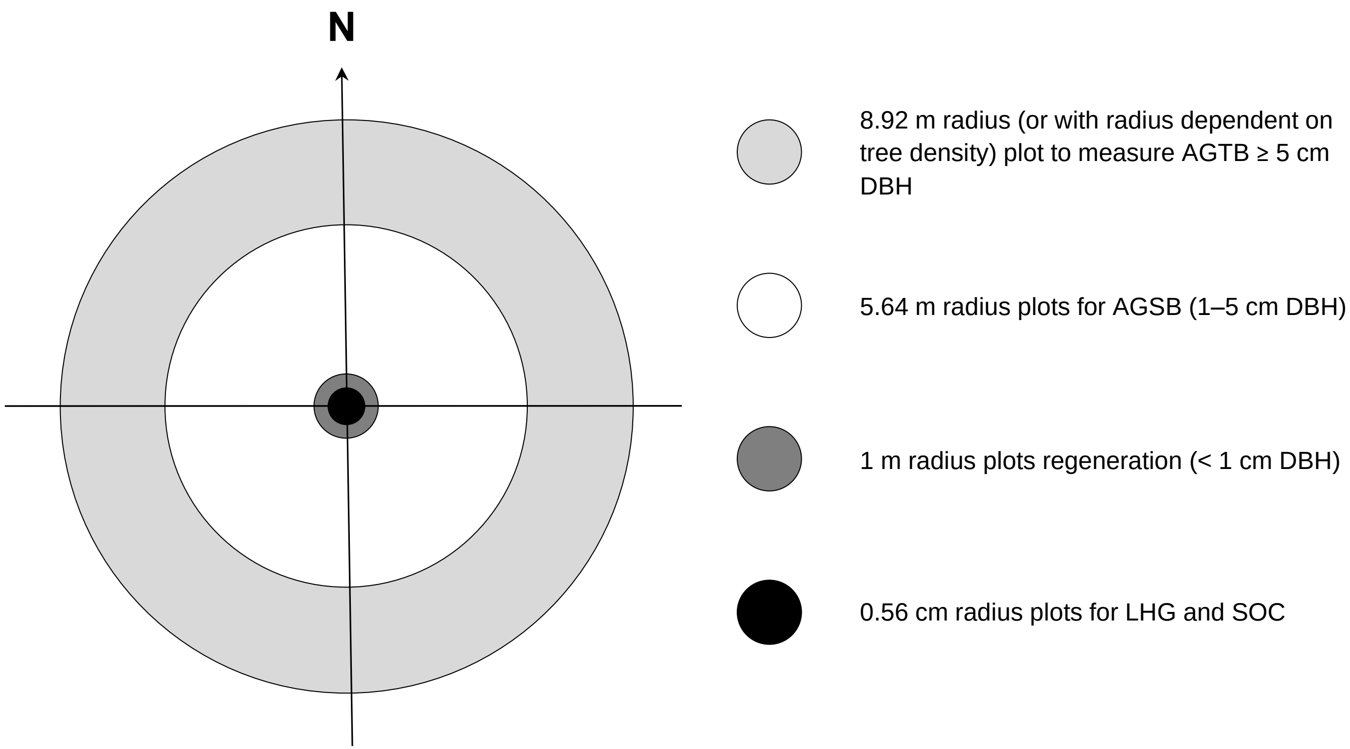

Figure 1. Sampling design of circular plot

AGTB: aboveground tree biomass; AGSB: aboveground sapling biomass; DBH: diameter at breast height; SOC: soil organic carbon; LHG: leaf litter, herbs, and grasses.

Aboveground tree biomass: Since Nepal-specific allometric equations to estimate aboveground tree biomass (AGTB) are not available, an equation proposed by Chave et al. (2005) for moist forest type (Eq. (1)) is used to estimate AGTB, which includes three predictive variables (wood density, tree height, and DBH), and was tested in a variety of climatic situations. The Charnawati landscape lies in a moist climatic zone with an average annual rainfall of 1,999–2,177 mm, and precipitation occurs across all months (fewer than three months are completely dry in the case of Dolakha) (ANSAB, 2010). Chave et al. (2005) used a large dataset of trees (DBH > 5 cm) across different climatic conditions of global sites to develop equations for different climates and various authors have used that dataset to estimate AGTB. Eq. (1) is used for AGTB (Chave et al., 2005):

$$AGTB = 0.0509 * \rho D^2 H \text{……………………………………Eq. (1)}$$

where:

AGTB	=	aboveground tree biomass (kg);
ρ	=	wood density (kg/m^2);
D	=	tree diameter at breast height (DBH) (cm); and
H	=	tree height (m).

After taking the sum of all the individual biomass weights (in kg) of a sampling plot and dividing it by the area of a sampling plot (250 m^2), the biomass stock density was obtained in kg/m^2. This value was then converted to t/ha by multiplying it by 10. Since the project areas are part of the tropical and sub-tropical region, the biomass stock density was converted into carbon stock densities by multiplication with the IPCC (2006) default carbon fraction of 0.47.

Aboveground sapling biomass: Saplings were measured in nested subplots of 5.64 m radius. Saplings with diameter > 1 cm to < 5 cm were measured at 1.3 m above ground level (diameter at breast height, DBH). To determine the aboveground sapling biomass (AGSB) (DBH < 5 cm), national allometric biomass equations were used. These tables are developed by the Department of Forest Research and Survey (DFRS) and the Department of Forest, Tree Improvement and Silviculture Component (TISC) (Tamrakar, 2000). The following regression model (Eq. (2)) was used for an assortment of species to calculate biomass.

$$\log(AGSB) = \alpha + b \log(D) \text{ …………………………………… Eq. (2)}$$

where:

log	=	natural log (dimensionless);
AGSB	=	aboveground sapling biomass (kg);
α	=	intercept of allometric relationship for saplings (dimensionless);
b	=	slope allometric relationship for saplings (dimensionless); and
D	=	over-bark diameter at breast height (measured at 1.3 m above ground) (cm).

Used variables (i.e. α and *b*) for all tree species are presented in forest carbon measurement guideline by ANSAB (Subedi, 2011). Biomass stock density was converted to carbon stock density using the IPCC (2006) default carbon fraction of 0.47.

Below-ground biomass (BGB): Below-ground biomass was estimated as root-to-shoot ratio value of 1:5 that is 20 per cent of aboveground tree biomass (MacDicken, 1997).

Leaf litter, herbs, and grasses: One circular subplot of 1 m^2 (0.56 m radius) was established at the centre of each nested plot. All leaf litter (dead leaves, twigs, etc.) and live components (herbs and grass) within each subplot were collected separately in a destructive manner. Fresh samples were weighed in the field with 0.1 g precision. A well-mixed subsample of about 100 g was then placed in a marked bag. Subsamples were taken to the laboratory and oven dried to constant weight to determine water content to determine oven-dry-to-wet mass ratio to convert the total wet mass to oven-dry mass.

For herbs, grass, and litter, the amount of biomass per unit area was calculated by:

$$LHG = \frac{W_{field}}{A} \times \frac{W_{subsample,dry}}{W_{subsample,wet}} \times \frac{1}{10,000} \quad \text{…………… Eq. (3)}$$

where:

LHG	=	biomass of leaf litter, herbs, and grass (t/ha);
W_{field}	=	weight of the fresh field sample of leaf litter, herbs, and grass, destructively sampled within an area of size *A* (g);
A	=	size of the area in which leaf litter, herbs, and grass were collected (ha);
$W_{subsample,dry}$	=	weight of the oven-dry subsample of leaf litter, herbs, and grass taken to the laboratory to determine moisture content (g); and
$W_{subsample,wet}$	=	weight of the fresh subsample of leaf litter, herbs, and grass taken to the laboratory to determine moisture content (g).

The carbon content in LHG, C(LHG) was calculated by multiplying LHG by the IPCC (2006) default carbon fraction of 0.47.

Soil organic carbon: Soil organic carbon was determined through samples collected from the default depth of 30 cm prescribed by IPCC (2006). Near the centre of the plot, a single pit of about 30 cm depth was dug. For the purpose of estimating bulk density, three individual soil samples of approximately 300 cm^3, one each from three depths (0–10 cm, 10–20 cm, and 20–30 cm) were collected with the help of a standardized 300 cm^3 metal soil sampling corer. Similarly, one composite sample of approximately 100 g was collected mixing soils from all the three layers for determination of organic carbon concentration. The composite soil samples collected in the field were prepared by removing stones and plant residues (> 2 mm) and grinding. All material collected in the cores and composite soil sample were placed into appropriately labelled sample bags. Subsequently, samples were transported to the laboratory and oven dried (105°C) to constant weight to determine water content. The carbon stock density of soil organic carbon was calculated as given by Eq. (4) (Pearson et al., 2007, p. 30):

$$SOC = \rho \times d \times \%C \qquad \text{………………………. Eq. (4)}$$

where:

SOC	=	soil organic carbon stock per unit area (t/ha);
ρ	=	soil bulk density (g/cm^3);
D	=	the total depth at which the sample was taken (cm); and
%*C*	=	carbon concentration (%).

We only had one composite sample of soil (0–30 cm) for carbon concentration analysis, so, for the purpose of soil organic carbon (SOC) analysis, the bulk density was also derived for the depth of 0–30 cm by averaging the bulk densities from the available layers (0–10 cm, 10–20 cm, and 20–30 cm).

Total carbon stock and CO_2 equivalent (CO_2e): Total carbon stock per hectare and total carbon stock in the forests were calculated by summing the aboveground biomass (trees, saplings, herbs and grasses, leaf litter), soil carbon, and below-ground biomass. The total CO_2e was calculated by multiplying the carbon stock value by 44/12 or 3.67 (Pearson et al., 2007).

ES 2: Hydrological services (water)

The CFUGs have each identified perennial and ephemeral water sources through participatory mapping with key informants and local forest users. The number of water sources, discharge, and quality of two water sources were measured in 2015. To determine the number of sources in the area, participatory resource mapping was carried out in each CFUG.

Identification of the number and location of perennial water sources was done using participatory mapping with following steps.

1. The CFUG gathered key informants who know about water resources distribution over the forest management unit.
2. The group (CFUG and key informants) identified a suitable place (area of ground) for mapping from where the whole forest and village was visible.
3. The CFUG explained the purpose and process of participatory mapping with the key community members.
4. The group gathered the material (e.g. sticks, stones, wood ash, flowers, leaves, and other material that was available locally) to develop the participatory resource map.
5. The facilitators asked the group to select one or two persons to draw the map.
6. Symbols were used to indicate different size (flow) of water sources.
7. The group identified the total number of water sources – river, stream, and small natural water spring – over the forest management unit.
8. The participatory resource map was sketched and prepared, showing the forest and water sources.
9. The group identified at least one source of each type for sample study.
10. Water discharge measurement was carried out.

The forest management group categorized the selected water sources of three types based on the flow size (i.e. river, stream, and small natural water spring) and used salt dilution method, float methods, and bucket methods, respectively, to quantify the water discharge.

Bucket method: The team used a small bucket (1 litre capacity) and a stopwatch to measure the discharge of the small natural water spring. The total discharge of water from the small water spring was estimated.

Floating method: For the small stream, the team used floating method. In this method, discharge is calculated as the product of velocity and cross-sectional area. To measure these variables, the team identified a section of stream situated on a gentle slope. On that section, the team measured the velocity of moving water (V in m/s) and the cross-sectional area of the water (A in m^2) with a floating object, stopwatch, measuring tape, and stick. After the measurement, the team estimated the total discharge of the stream (Q) in volume per unit time using the equation:

$$Q = V * A \qquad \text{Eq. (5)}$$

Salt dilution method: This was used to measure the discharge in high-flow streams and the river. For this, the team leader first oriented the team members, including community people, about the process and equipment used for estimating discharge of water. Major pieces of equipment used are:

- conductivity meter
- 20-litre bucket
- stopwatch
- adequate number of bags of salt
- data input sheet.

Measurement:

1. Dissolved an appropriate amount of salt in the bucket (2–5 kg) and the amount of dissolved salt (mg) noted on the data input sheet.
2. Fix the conductivity meter's sensor in the main line of flow of the stream.
3. Turn on the conductivity meter.
4. Place the conductivity meter ideally at mid-depth of the stream.
5. A bucket of heavily salted water is thrown into the stream upstream.
6. Salt conducts electricity and conductivity is measured by the probe.
7. As soon as the salt cloud is seen to reach the measurement point, note down the time that has passed since introducing the salt and note down the measured value from the conductivity meter on the data input sheet. Repeat measurements every five seconds.
8. Continue taking measurements every five seconds until the value returns to the base level conductivity.
9. The total discharge is estimated using the equation:

$$Q = \frac{Msalt}{K\int \mu dt} \quad \text{.. Eq. (6)}$$

where *Msalt* is the mass of salt in kg, *K* is the constant equal to 1.8, and $\int \mu dt$ is the area under the curve.

The discharge was measured in m^3 per second to estimate total water discharge (water quantity) in 2015. Ephemeral water sources were only counted. Detailed quality analysis was done for those sources selected for establishing PES.

Defining buffer area around water sources: After identifying the water sources, the group decided on a buffer area of at least 10 metres radius depending on specific size of water flow for protecting the water sources and included this provision in the forest management plan after discussing with local people and endorsement by the group.

ES 3: Biological diversity

The CFUGs carried out participatory resource mapping, forest inventory, and group discussion to identify effective forest cover, natural forests, biodiversity habitat, and HCV areas.

Participatory resource mapping: This is a tool used to identify and sketch spatial distribution of natural forests, biodiversity habitats, and HCV areas. Between 7 and 15 people with good knowledge of the forests and habitat were invited to participate. Based on their knowledge, the CFUGs identified the resources and sketched the participatory resource map. This mapping tool provided the number, area, and location of the natural forests, specific habitats, and HCV areas.

Similarly, the team carried out forest inventory with sampling survey on 1–2% of the total area using a random sampling method. The team established composite plots of 500 m^2, 100 m^2, 25 m^2, and 1 m^2 for mature forests, forest dominated by pole-sized trees, NTFPs, and regeneration, respectively. The team recorded tree species, the number of trees and pole-sized trees, regeneration, and NTFPs; and the height, diameter, and weight as per need. Based on the information noted and variables measured, the team identified and estimated the status of species, their distribution, and composition.

ES 4: Soil conservation

The CFUGs identified soil-erosion-prone areas applying a participatory resource mapping tool. Based on the mapping and discussion in the group, the forest area having steep slope, degraded forests, bank of the rivers and streams, and the area already affected from landslide and soil erosion were identified to conserve the erosion-prone area. The data obtained from inventory sampling plots, spatial distribution mapping of landslides, and household questionnaire survey after the earthquake were used to design mitigation measures in the landscape to conserve soil-erosion- and landslide-prone areas.

Similarly, ANSAB and CIFOR monitored the incidents of landslides in the landscape. Household survey, focus group discussions, and key informant interviews elicited the incidents of soil erosion and landslides, causes of landslides, and control measures applied. Similarly, a GIS tool was used to determine the number of landslides, their spatial distribution, and to identify the most affected areas in the landscape.

6. Detailed results of impact assessment and monitoring

Monitoring results

Biological diversity:

- The CFUGs have maintained species composition of 10 to 40 tree species in their forests depending on the community forests.
- The CFUGs have conserved 7,158.6 ha of natural forests which represent 100%.
- The CFUGs in the group allocated 1,080 ha area as HCV areas for regulating environmental services, and protecting biodiversity and their habitats.
- The CFUGs have maintained at least three seed trees per hectare to promote natural regeneration, at least one old growth tree, dead and dying tree per hectare, and a certain volume of course woody debris to maintain wildlife habitat where applicable.

Soil conservation: The CFUGs have identified, mapped, and conserved the landslide- and erosion-prone areas. This was also supported by GIS analysis done by CIFOR. The analysis showed that there was no landslide except in two places covering 0.54 ha in total in Charnawati landscape after earthquake due to regular conservation effort in the community forests.

The CFUGs have maintained species composition and natural forests as mentioned under ‘biological diversity’.

Water: The CFUGs have protected 100% of water sources identified which are in use.

Forest carbon: The CFUGs were able to increase the carbon stock by 26.25 t/ha (2.09%), from 209.12 t/ha in 2010 to 221.44 t/ha in 2013 and 235.37 t/ha in 2016.

Part 2: Management information

1. Name of the Organization
Federation of Community Forest Users Nepal (FECOFUN) Group Manager

2. Location of the management unit
The Charnawati landscape is in Dolakha District in the central development region of Nepal. The landscape is approximately 133 km east of Kathmandu, capital city of Nepal. Geographically, the landscape has hills, mid-height mountains, and high mountains (Figure 2). The landscape is inhabited by mixed communities representing Bramin/Chhetri, ethnic/indigenous, and socially excluded communities. The geographical location, altitudinal range, and climatological information of the landscape are presented in Table 1.

Table 1. Climatological information of Charnawati landscape

Landscape	Geographical location		Altitude (masl)	Average temperature (°C)	Average rainfall (mm/year)
	Latitude (N)	Longitude (E)			
Charnawati (Dolakha)	27°35'16.12" to 27°44'47.92"	85°56'18.41" to 86°03'56.92"	850–3,500	19.9 (max), 8.3 (min)	2,232.1

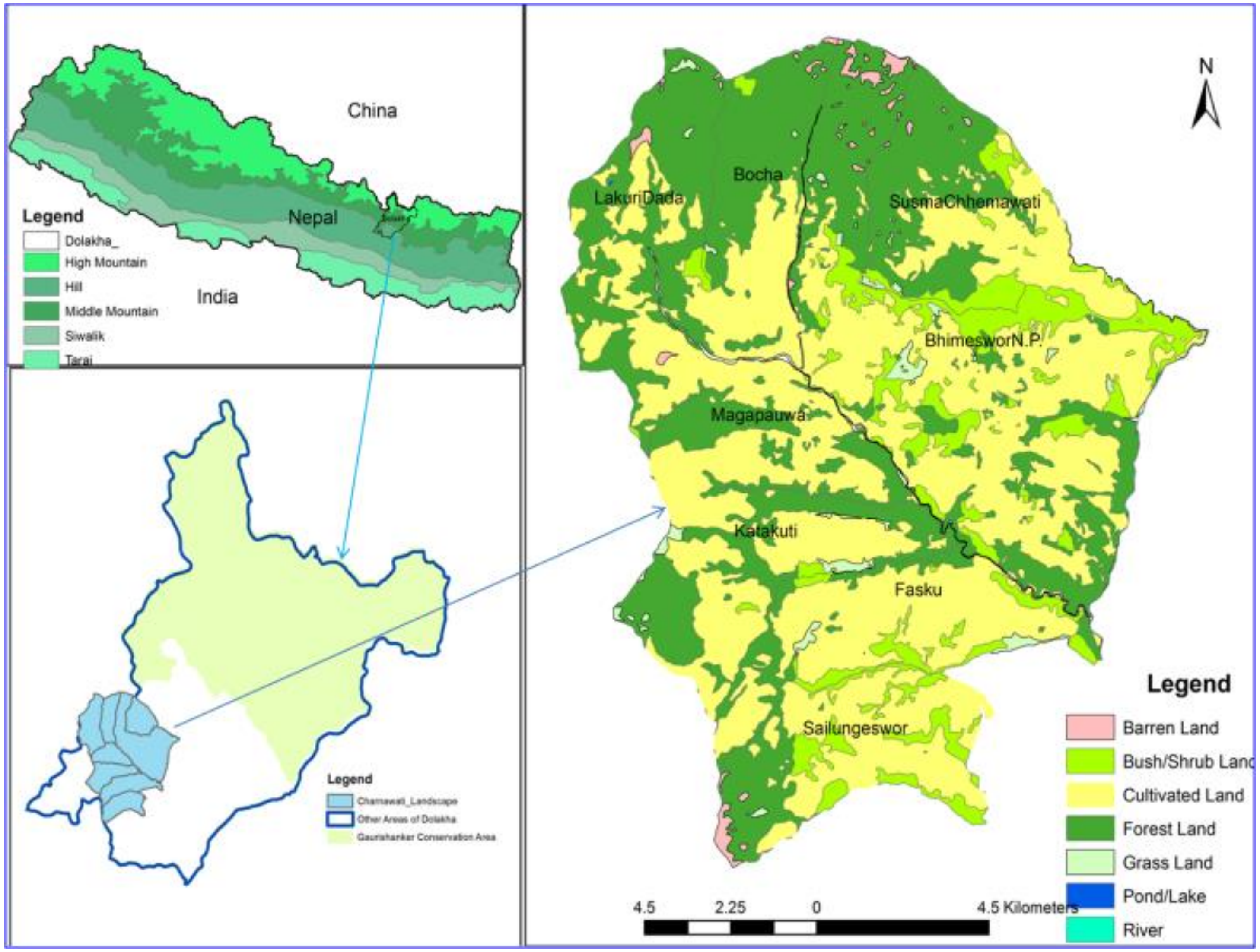

Figure 2. Land use map of Charnawati landscape by location and Village Development Committee

3. Type of certification

Please tick all the options that apply to the management unit:

Size:

☒ Large scale ☐ Conventional ☒ SLIMF(small and low-intensity managed forest)

Type of organization certified:

☐ Individual ☐ Private company ☒ Public organization ☐ Indigenous Peoples☐ Local communities ☒ Management group

4. Characteristics of the certificate

Please give the following information:

Management unit area (in hectares): 7,835

Number of members (if applicable): 73

FSC Certificate Code: SW-FM/COC-001438

First issue date: 22 February 2005

Last issue date: 20 May 2010

Expiry date: 19 May 2015

5. Organization contact information

Please provide relevant contact information:

Email: gnkarki@gmail.com, fecofun@wlink.com.np

Postal address: FECOFUN, G.P.O. No. 8219, Duwakot, Bhaktapur

Telephone number: +9771 6616408, 6616421

Contact name: Ganesh Karki, Chairperson, FECOFUN

6. Legal tenure to manage and/or use the forest, or other legal right to receive payments for declared ecosystem services

The Forest Act of 1993 and several amendments, and the Forest Regulation of 1995 provided a framework for the ownership and tenure of forests. This act has provided full authority and responsibility to the locally organized community groups to restore and upgrade the local forests. The government authority may hand over part of national forests to a user group in the form of Community Forest, entitling the group to develop, conserve, use, and manage the forest, and to sell and distribute the forest products by independently fixing their prices, though the land tenure remains with government. As per the recently amended Forest Act (1993), Water Regulation Act (1998), and other policies, strategies, and guidelines, the CFUGs can establish PES and generate income from their forests and ES.

7. List of communities and other organizations involved in activities related to the declared ecosystem service(s)

- 73 Forest Management Sub-Committees (FMSCs)
- District Forest Office, Dolakha
- Department of Forests
- Department of National Parks and Wildlife Conservation
- Ministry of Forest and Soil Conservation
- Community-Based Forestry Supporters Network (COFSUN)
- Nepal Foresters Association
- Federation of Community Forest Users Nepal (FECOFUN)
- Asia Network for Sustainable Agriculture and Bioresources (ANSAB), Kathmandu
- International Center for Integrated Mountain Development (ICIMOD)
- District Soil Conservation Office, Dolakha
- District Development Committee (DDC), Dolakha
- Nepal Federation of Indigenous Nationalities (NEFIN), Dolakha

8. Summary of culturally appropriate engagement with Indigenous Peoples and local communities, related to the declared ecosystem service(s) – including ecosystem services access and use, and benefit sharing – consistent with FSC Principles 3 and 4

The community forest management or steering committee identified hamlets and other interest groups, including indigenous communities. In support of the ForCES project, they conducted training and organized meetings at hamlet level and for forest-dependent groups, including indigenous communities, and discussed forest and ecosystem-service resources and their territory, results of forest and ecosystem-service assessment, major threats, management activities, harvesting methods and season, major impacts and mitigation measures, and access to benefit sharing, and noted their views and thoughts. With all the views and thoughts available, the CFUGs designed the management activities and drafted the forest management plan. The draft plan was presented, discussed, agreed, and endorsed by the general assembly of CFUGs, in which local communities and indigenous groups actively participated.

Water sources: The drinking water users and Charikot Drinking Water and Sanitation Users Institution (CDWSUI) agreed to pay for verified ecosystem services at the rate of NPR120 per domestic water tap per annum for restoring, maintaining, and enhancing water quality and quantity through the application of FSC standards of sustainable forest and ecosystem services management. This fee can be revised periodically. The contract is going to be signed very soon. As agreed between the two parties, the benefit-sharing model will be as given in Figure 3.

NTFPs products considering biodiversity: In Charnawati landscape, a total of 63 community forests produce various NTFPs, of which 30 species are included under the scope of sustainable forest management certification. The Himalayan Bio-Trade Limited (HBTL), an FSC-certified chain of custody company of Nepal, is exporting FSC-certified products to US and European markets. AVEDA company of the USA has been importing FSC-certified Nepalese handmade paper and has shown an interest in paying a premium price for sustainable forest management (SFM) and biodiversity conservation while buying FSC-certified NTFPs. The company has agreed to pay 1–2% of the total revenue as a premium to the CFUGs who supply the NTFPs. The premium revenue will be distributed to CFUGs based on the volume of FSC-certified NTFPs harvested and traded.

The CFUGs will consider as revenue: royalties, grants, PES (water, carbon, biodiversity, etc.), and selling the forest products (i.e. timber and NTFPs). All the revenue generated through the forests and ecosystem services will be used mainly in three areas: (1) sustainable forest management, 25%; (2) enhancing livelihoods of local people and poor people, 35%; and (3) community development activities, 40%. As each CFUG has identified ultra-poor forest-dependent households through well-being ranking, the ultra-poor are the first priority to benefit from PES.

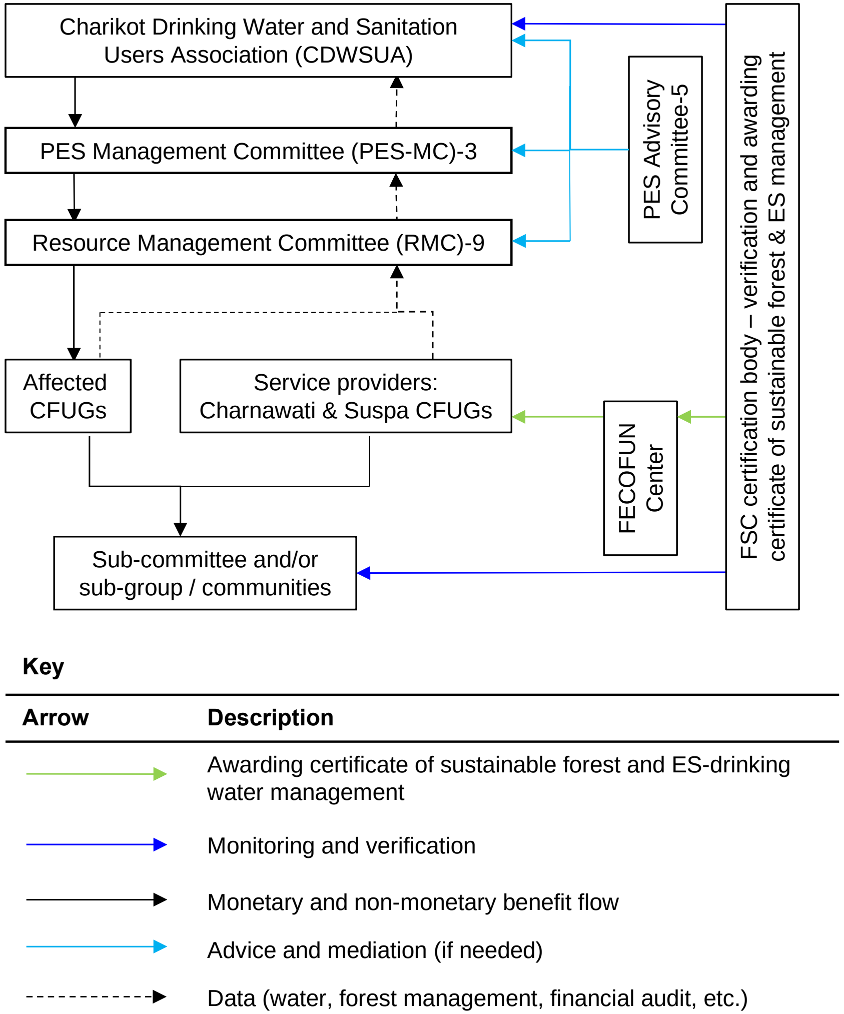

Figure 3. Drinking water service payment model

Numbers represent number of members in the committee.

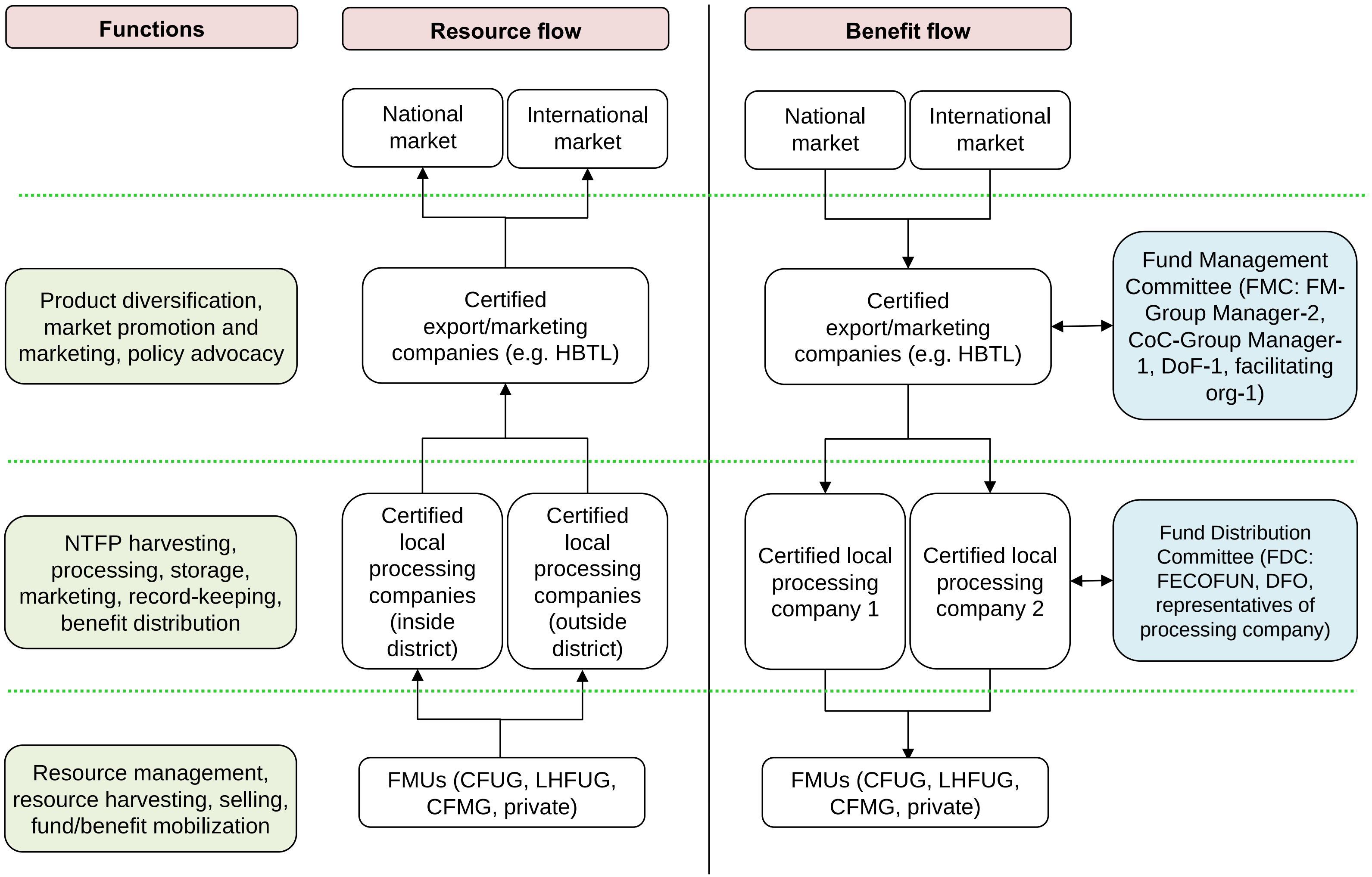

Figure 4. NTFP premium payment model

CFUG: community forest user group; CoC: chain of custody; CFMG: Collaborative Forest Management Group; DFO: District Forest Officer; DoF: Department of Forestry; LHFUG: leasehold forest user groups; FM: forest management; HBTL: Himalayan Bio-Trade Limited. Numbers represent number of members in the committee.

References

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Tamrakar, P.R. (2000) *Biomass and Volume Tables with Species Description for Community Forest Management*. Ministry of Forest and Soil Conservation, Kathmandu.

The following referenced documents are relevant for the application of this document. For references with specific version, only the edition cited applies. For other references, the latest edition of the referenced document (including any amendments) applies.

FSC-STD-01-001 Version 5-2 *FSC Principles and Criteria*

FSC-STD-01-002 *Glossary of Terms*

FSC-STD-50-001 *Requirements for use of the FSC Trademarks by Certificate Holders*

FSC-STD-60-004 *International Generic Indicators*

FSC-PRO-30-002 *Demonstrating the Impact of Forest Stewardship on Ecosystem Services* (under development)

FSC-PRO-60-006 *Development and Transfer of National Forest Stewardship Standards to the FSC Principles and Criteria Version 5-1*

Terms and definitions

For the purposes of this ESCD, the terms and definitions given in FSC-STD-01-002 *Glossary of Terms*, FSC-STD-01-001 *FSC Principles and Criteria for Forest Stewardship*, and FSC-STD-60-004 *International Generic Indicators* are used.