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# Local Users and Other Stakeholders' Perceptions of the Identification and Prioritization of Ecosystem Services in Fragile Mountains: A Case Study of *Chure* Region of Nepal

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**Abstract:** Forest-based ecosystem services (ES) play a vital role in improving people's livelihoods, the environment, and the economy. Prior studies have focused on technical aspects of economic valuation such as biophysical quantification through modeling and mapping, or monetary valuation, while little attention has been paid to the social dimensions. Taking case studies of two dominant community-based forest management systems (community forestry—CF and collaborative forestry—CFM) in the *Chure* region of Nepal, we investigate how local users and other stakeholders perceive the valuation of forest-based ecosystem services based on proximity (nearby vs. distant users), socio-economic class (rich vs. poor users), and forest management modalities (CF vs. CFM). We found that local users and other stakeholders in the *Chure* region identified a total of 42 forest-based ecosystem services: 16 provisioning, 15 regulating, and 11 cultural services. While all local users prioritised firewood, water quality improvement, and bequest values as the top three services, genetic resources, hazard protection, and hunting services were valued as having the lowest priority. The priorities placed on other services varied in many respects. For instance, rich users living near a CF showed a strong preference for fodder, grasses, and soil conservation services whereas users living far from forests prioritised timber, fresh water, and flood control services. In the case of CFM, rich users adjacent to forests preferred timber, soil conservation, and carbon sequestration services but those living far from forests chose timber, poles, and flood control as their top priorities. Differences in rankings also occurred among the regional managers, national experts, and forest users. The reasons for these differences and their policy implications are discussed, and ways of reaching consensus between the users are suggested.

**Keywords:** forests; valuation; community-based forest management

## 1. Introduction

The concept of ecosystem services (ES) first appeared in the 1980s [1] and gained increased recognition following a seminal paper by Costanza and his team [2]. Costanza et al. [2] first estimated the worth of the world's ES at US \$33 trillion, almost 1.2 times more than the total global gross domestic product in 1995. In their 2014 update, this estimate increased to US \$145 trillion [3]. Other groundbreaking works on ES include the Millennium Ecosystem Assessment in 2005 [4] and The Economics of Ecosystem and Biodiversity (TEEB) [5]. The concept of ES has now entered the discourse of many disciplines including natural resource management, biodiversity conservation, and environmental policy and accounting [1,6].

Forest-based ES play a vital role in enriching people's livelihoods, enhancing the environment, and developing the economy [7,8]. Valuation research in forest-based ES increased at an exponential rate from 2014 onwards [9,10]. Prior studies explored how forest-based ES contribute to generate value or benefits for people's livelihoods [11,12], the environment, and the economy [13]. However, these studies were constrained by their disproportionate focus on the technical aspects of economic valuation such as biophysical quantification through modelling and mapping [14–17], or by employing purely monetary valuation, of the forest-based ES [18–21]. Little research has been carried out that demonstrates how social dimensions, for example people's perceptions or preferences, affect or play important roles in the identification and prioritization of forest-based ES. Studies have called for urgent action to incorporate the views of broader stakeholders when carrying out forest-based ES valuation research [22–26].

The forest-based ES contribute in both developed and developing nations, although their contributions vary. The contribution to the livelihood of resource-poor rural people, particularly those in developing countries, is critically important [27,28]. Recent statistics show that forest-based ES provide approximately 20% of the income of rural households both through cash and by meeting subsistence needs [29]. About 75% of poor people in developing countries are heavily dependent on forest-based ES [8]. However, despite their significant contributions to large populations, the actual social contributions of forest-based ES to different categories of users have not been adequately assessed.

The community based forest management (CBFM) system is the dominant forest management regime in developing countries. In this system, local people play a vital role in planning, decision-making, implementation, and benefit sharing [30,31]. About 511 million hectares of global forests (almost 15.5%) are either owned or managed by such communities [32]. The trend for adoption of these systems is increasing in developing countries (22% in 2006, 27% in 2010, and >30% in 2015) [30,32]. The CBFM system comprises different users of a forest, both living nearby and distant from the forest and with different socioeconomic backgrounds [33]. Their perceptions of the forest-based ES vary significantly according to their livelihood outcomes [34]. The users are the real managers but are victims of ecosystem degradation, and therefore, there is a need to understand their perceptions and take their views into account for effective implementation of forest policy and plans [35]. Knowing the local people's attitudes, considering the needs of the local context of forest-based ES is imperative since this can create three-fold benefits. First, this will create awareness among different sub-groups at the local level of the identification and prioritization of critical forest-based ES. Second, identification and prioritization of forest-based ES will help policy makers and managers assess the needs and aspirations of the different sub-groups involved so that they can formulate practical and applicable forest-based ES management plans. Such an understanding would also help prioritize scarce resources for the successful implementation of forest and natural resource conservation plans. Third, the international community will gain insights into how forest-based ES vary among the sub-groups in the CBFM under consideration and how these ES can be assessed through reaching a consensus in a complex situation.

Nepal is considered a pioneering country in adoption of the CBFM system and its modality has been replicated in many developing countries around the world [30]. There are two major CBFM systems in Nepal, community forestry (CF) and collaborative forest management (CFM). These two CBFM systems manage over 32% of the total forests in Nepal [36]. The National Forest Strategy Plan 2016–2025 aspires to increase this figure to 39% (6.6 million ha) by 2025 [36]. Taking a case study of these two CBFM systems, we assess how local users and other stakeholders perceive the importance of forest-based ES based on proximity (nearby vs. distant users), socio-economic class (rich vs. poor users), and forest management modalities (CF vs. CFM).

The significance of this study is further enhanced by the selection of case studies from the Siwalic region, locally known as *Chure*, which comprises the youngest mountains ranging from 93–1955 metres above mean sea level (masl), and extends over four developing countries: Pakistan, India, Nepal, and Bhutan [37]. In Nepal, it extends over 36 districts and its ES are critically important to large populations in Nepal and in the Bihar and Uttar Pradesh provinces of India. Given its importance to peoples'

livelihoods and socioeconomic development, the Government of Nepal (GoN) has placed high priority on its conservation and management through its US \$2.49 billion “President Chure-Tarai Madhesh Conservation and Development Programme” [38,39]. The programme is gathering information on how different types of forest users and other stakeholders perceive and prioritise forest-based ES in order to prepare a master plan for the region [40].

## 2. A Brief Snapshot of Community Forestry (CF) and Collaborative Forestry (CFM) in Nepal

Although CF and CFM both adopt a CBFM modality, many differences—such as coverage, access to forest ES, use rights, management modalities, exclusion of other users, and alienation of forest areas—exist between them (see Table A1 in Appendix A for details). CF applies to national forests handed over to local forest users for protection, utilization, and management with the objective of fulfilling the forest product and services demands of local communities [41]. About one-third of Nepal’s total forest area has been handed over to 22,000 community forest user groups (CFUGs); the National Forest Strategy 2016–2015 aims to add an additional 600,000 hectares by 2025 [36]. CFM, on the other hand, is a partnership model involving the Department of Forests, local governments and local communities for the management of a patch of national forest to fulfil local needs [42]. So far, 28 CFM groups, comprising 3.4 million households, manage nearly 71,000 hectares of forests. By 2025, the Government of Nepal aims for an additional area of 265,000 hectares of forests to be under CFM [36].

CF users can collect and harvest all provisioning ES, whereas CFM users can gain access only for basic forest ES [43]. CF users, through a general assembly, can make all decisions about forest utilization and management, whereas in CFM, mostly the forestry officials and an executive committee make such decisions [43]. In the case of CFM, 50% of forest product revenue goes to the governments (40% to the national government and 10% to the local government) but in the case of CF, all revenue goes to local users. It is widely claimed that although a large percentage of CFM income goes to government, the contribution from the government is inadequate for managing collaborative forests [44]. Similarly, in the case of CFM, 40% of the total community income is allocated to forest management, 50% to poor people and 10% to community development, whereas in CF, these values are 25%, 35%, and 40%, respectively [36]. Although 50% income allocation to poor people seems high in the case of CFM, it is in fact 20% of the total income. Furthermore, in the case of CFM, there is no right to alienate forestland to the poor, whereas in CF, some areas of forest can be allocated to poor people for leasing [36]. Therefore, compared to the CFM model, the CF is a more pro-poor forest management model.

## 3. Materials and Methods

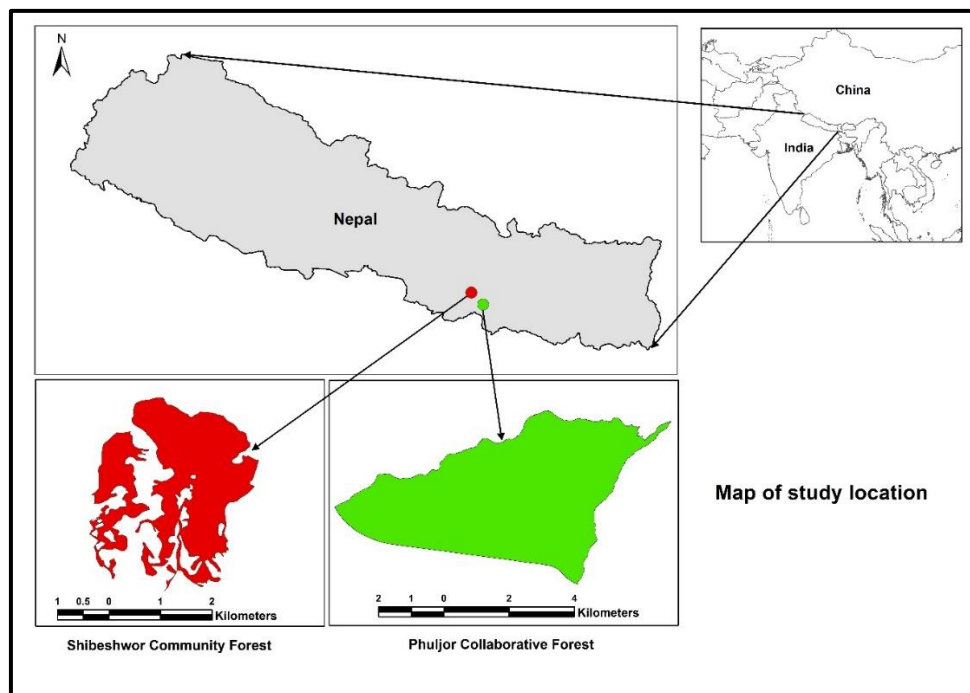
### 3.1. Study Area

This study was conducted in *Sarlahi* District. The district hosts both community and collaborative forests with nearby and distant users. The *Sarlahi* district is in the central part of Province No. 2, 350 kilometres southeast of Kathmandu, the capital city. The district covers 125,948 hectares, of which 15.5% are *Chure* ranges and rest is the *Bhawar* and the *Tarai* regions [45]. The elevation of the district ranges from 60 metres above sea level (masl) to 659 masl [46] and consequently it is diverse in climate, vegetation, and land use patterns [37,47].

In the district, the sub-watersheds of the Lakhandehi and Banke rivers were selected for study. The total area of the two watersheds is 15,930 hectares [47]. Cultivated land constitutes almost two-thirds of the area (66.57%) followed by forests (23.31%) and sand/gravel (4.31%) [46,47]. CF and CFM have been implemented in the watershed since the early 2000s with the support of the Biodiversity Sector Programme for Siwalik and Tarai (BISEP-ST), funded by the Government of The Netherlands.

The study investigated two community-based forest management models (one CF and one CFM). These were *Shibeshwor* CF in the *Hariyon* municipality, and *Phuljor* CFM in the *Ishworpur* municipality, which cover a total area of 3121 hectares of forested area (the CF covering 711 hectares, and CFM

2419 hectares) (see Figure 1). The *Shibeshwor* CF comprised 719 households with a population of 4496, while *Phuljor* CFM consisted of 27,953 households with 161,730 residents [48]. Local users were living both nearby and far from the forests. The nearby users in both the CF and CFM live in the foothills. Agriculture and animal husbandry are the mainstays of their livelihoods. The distant users in the CF live in the semi-urban area and have multiple livelihood options including commercial agriculture, services, and small shops. The distant users in the CFM live some distance away from the forest (>5–20 kilometres) and also depend on agriculture and animal husbandry for their livelihoods [48]. The reasons for selecting these two CBFMs are: (1) both of them have both nearby and distant users; (2) they have a long history of community participation in forest management; (3) the areas are endowed with rich ecosystems [49]. The outcomes of the study are highly applicable to the wider *Chure* region and to the CBFM model globally.



**Figure 1.** Location map of case study sites (CF and CFM) in Nepal.

### 3.2. Assessment and Prioritisation of Ecosystem Services

#### 3.2.1. Identification of Ecosystem Services

A list of potential ES was prepared after reviewing the relevant forests and wetland ecosystem literature, particularly studies conducted in and adjacent to the *Chure* region [50–53]. We started with Bhandari et al. [50] for a preliminary list—which included 14 provisioning services, 9 regulating services, and 3 cultural services—since their research site is similar to our site and then expanded the list based on other literature. This list was then further augmented through consultation with 29 national experts (an ‘expert’ is a person with extensive knowledge or ability in ecosystem-based research, experience, or occupation and in particular, having publications in ES and resource management), 17 regional managers (‘regional managers’ are provincial and district forest officials working in the *Chure* area directly involved in managing ecosystem services in the *Chure* region), and eight focus group discussions (FGD).

### 3.2.2. Prioritisation of Ecosystem Services

The primary data was collected from July to October 2018. The names of potential experts and regional managers were obtained from the President Chure-Tarai Madesh Conservation and Development Board and the District Forest Office *Sarlahi*. After that, we consulted some of them for suggestions on selecting case study sites to meet our objectives. Subsequently, we carried out multistage sampling, first selecting the district and then the CBFMs and venues for discussions, after ascertaining that the users' participation was high.

Local users' preferences among the range of ESs were identified through FGD which is considered as a suitable tool for assessing people's perceptions of a particular area of interest [54]. As noted, in order to serve our objectives, users were stratified into different strata (rich and poor and nearby and distant users) (Nearby/distant: In collaborative forest management: users living within 5 km of forests are considered nearby and beyond 5 km as distant users; in CF living within 3 km is considered distant. Rich/Poor: CBFM classifies users into four categories (Well-off, Medium, Poor and Very poor). This study includes the first two as Rich and the other two as Poor). The databases for forming these strata were obtained from the constitutions and operational plans of both CBFMs. These databases were further verified through consultations with executive committees. Eight FGDs were conducted, addressing proximity (nearby and distant) and the socio-economic classes (rich and poor). The FGD were conducted in a local language and between 11 and 18 participants took part in the FGD. The main demographic features of the participants are listed in Table 1. A long list of potential ES—developed through the literature review and preliminary consultations with users, experts and forest managers—for each service type was provided to all participants. ES Concept, types (i.e., provisioning, regulating and cultural), importance of various ES to their livelihoods, and the implication of ranking priorities were also discussed. The discussion also addressed the question of how respondents could reach a consensus if there were any misalignments of priorities. Then, adopting the principles set out in Shoyama and Yamagata [55], participants were asked to discuss and unanimously rank all ESs on within services types on the basis of their importance to their livelihoods. The final list of identified forest-based ES suggested 16 provisioning, 15 regulating, and 11 cultural services. Therefore, in case of provisioning services, regulating services, and cultural services, the ranking goes from 1–16 (1 is the least important and 16 is the most important), 1–15 (1 is the least important and 15 is the most important), and 1–11 (1 is the least important and 11 is the most important), respectively. The respondents agreed that if there is any misalignment among user's priorities, the differences could be settled by a democratic process through a majority vote. They also discussed why they assigned the top score to the particular services in that particular fashion.

## 4. Results

### 4.1. Assessment of Ecosystem Services from the Community-Based Forest Management System of Chure Forests

Local users, regional managers, and experts from the national level identified a total of 42 different ES throughout the region. These were classified based on the Common International Classification of Ecosystem Services (CICES) [56] into three categories: provisioning (16), regulating (15), and cultural (11) services (Figure 2A–C; Appendix B: Table A2). ES are either from extractive uses such as timber, firewood, grasses, sand, boulders, and gravel or non-extractive uses such as regulating climate and water related services as well as being linked to social and cultural values of the local communities such as cultural or religious values or landscape beauty.

**Table 1.** Socio-demographic features of the respondents.

Demographic Features	CF Nearby		CF Distant		CFM Nearby		CFM Distant		Regional Manager ( <i>n</i> = 17)	National Experts ( <i>n</i> = 29)
	Rich ( <i>n</i> = 11)	Poor ( <i>n</i> = 16)	Rich ( <i>n</i> = 18)	Poor ( <i>n</i> = 18)	Rich ( <i>n</i> = 12)	Poor ( <i>n</i> = 12)	Rich ( <i>n</i> = 15)	Poor ( <i>n</i> = 17)		
Gender	M = 8 F = 3	M = 6 F = 10	M = 13 F = 5	M = 7 F = 11	M = 8 F = 4	M = 9 F = 3	M = 12 F = 3	M = 12 F = 5	M = 14 F = 3	M = 25 F = 4
Median age (years)	41 (19–75)	40 (18–80)	48 (24–79)	48.50 (21–74)	39 (22–68)	45 (20–75)	51 (20–84)	45 (25–77)	46 (31–57)	53.5 (29–69)
Education level	I = 2 P = 4 S = 3 T = 2	I = 3 P = 10 S = 2 T = 1	I = 1 P = 3 S = 7 T = 7	I = 8 P = 3 S = 5 T = 2	I = 1 P = 4 S = 6 T = 1	I = 2 P = 5 S = 3 T = 2	I = 2 P = 4 S = 5 T = 4	I = 4 P = 7 S = 5 T = 1	T = 17	T = 29
Ethnic composition	UC = 8 LC = 3	UC = 2 LC = 14	UC = 16 LC = 2	UC = 4 LC = 14	UC = 5 LC = 7	UC = 3 LC = 9	UC = 11 LC = 4	UC = 10 LC = 7	UC = 10 LC = 7	UC = 17 LC = 12
Religion	H = 9 B = 2	H = 12 B = 4	H = 18	H = 16 M = 2	H = 9 B = 2 M = 1	H = 7 B = 4 M = 1	H = 15	H = 17	H = 14 B = 3	H = 25 B = 4

Data in parentheses denotes a range; Gender: M = Male, F = Female; Education level: I = Illiterate, P = Primary/lower secondary, S = High school educated, T = College & above; Ethnic composition: Higher Caste = Bahun/Kshetri/Dashanami/Madeshi, Lower Caste = Janajati, Janajati/Madhesi, and Dalit; Religion: H = Hindu, B = Buddhist, M = Muslim.

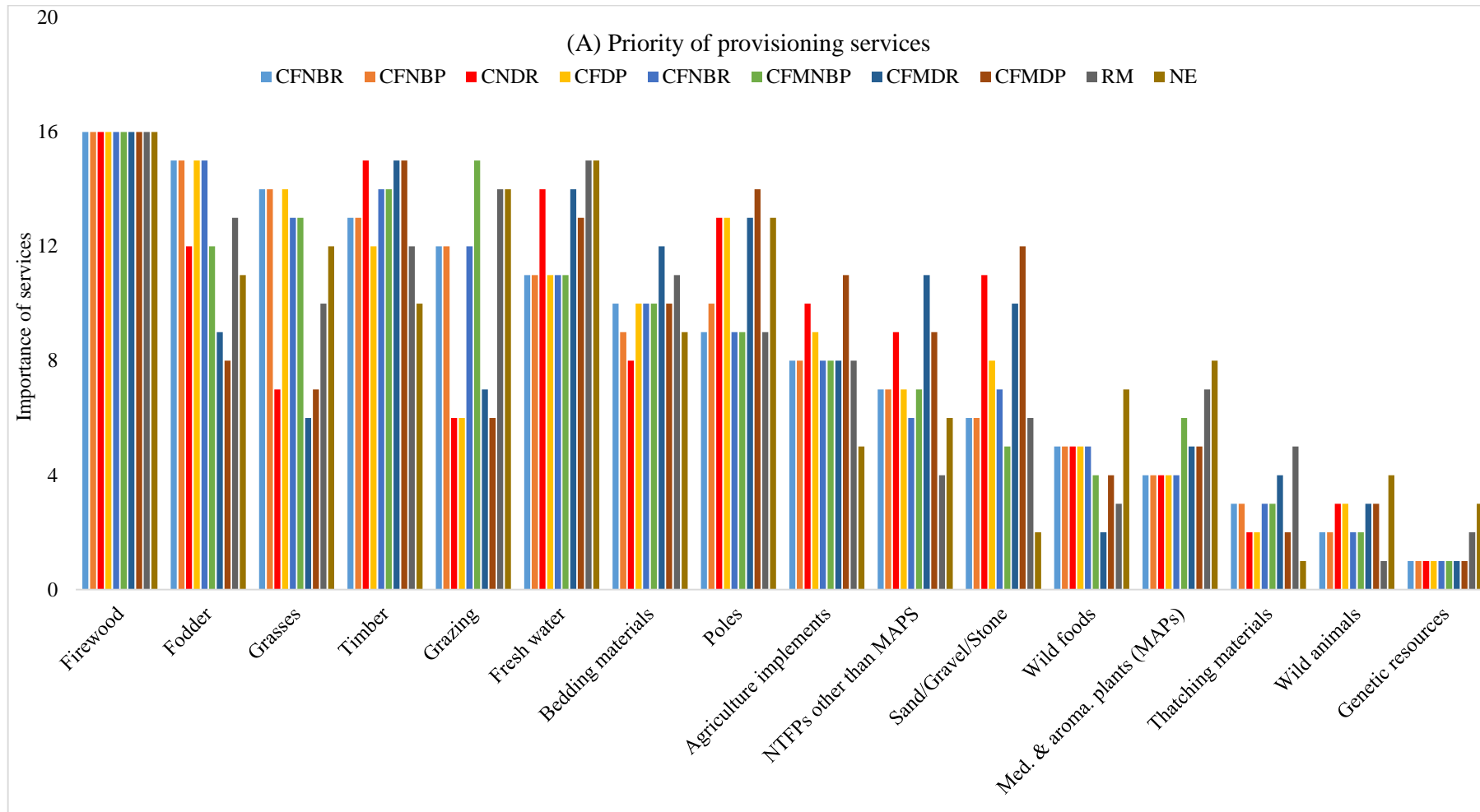


Figure 2. Cont.

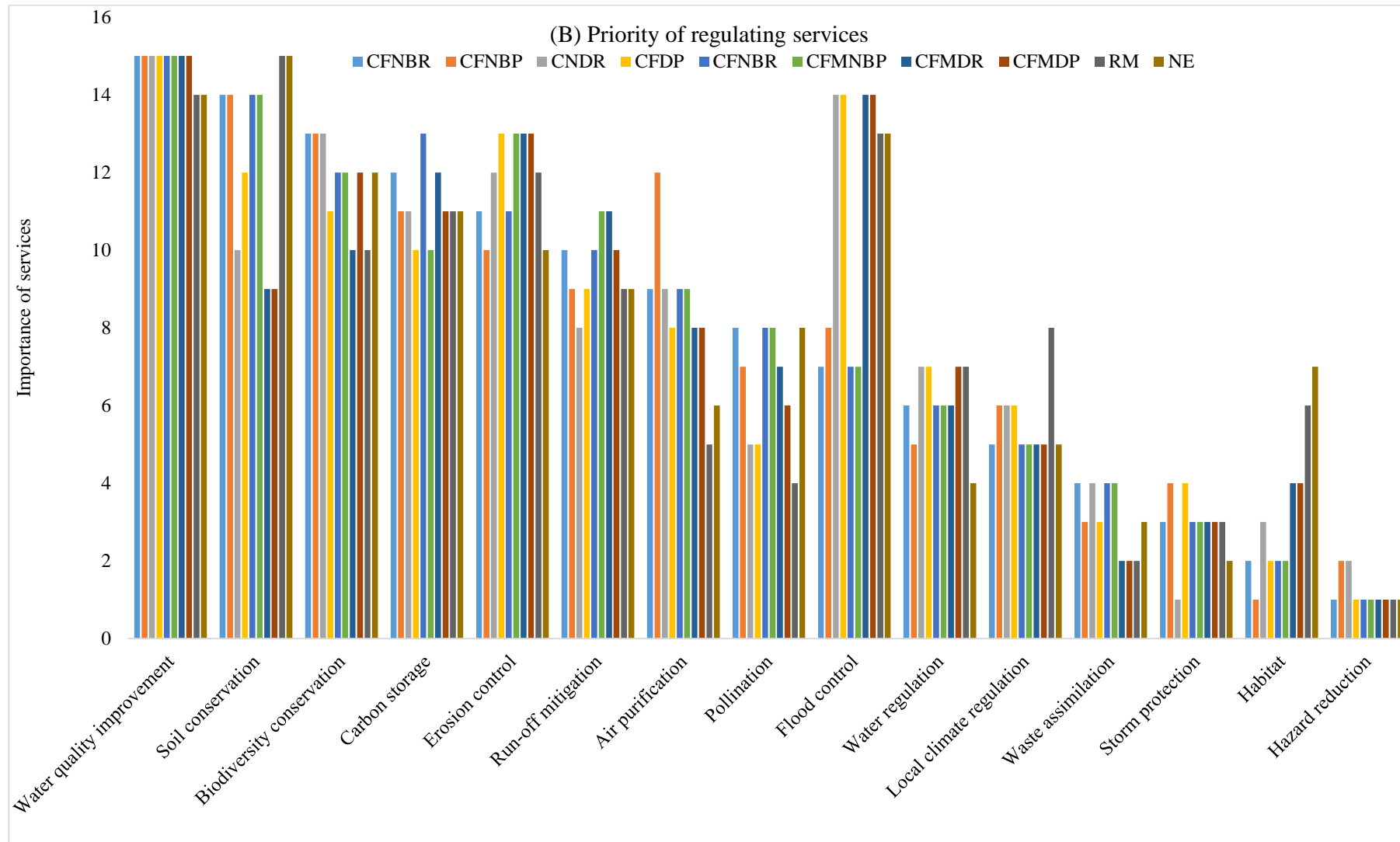
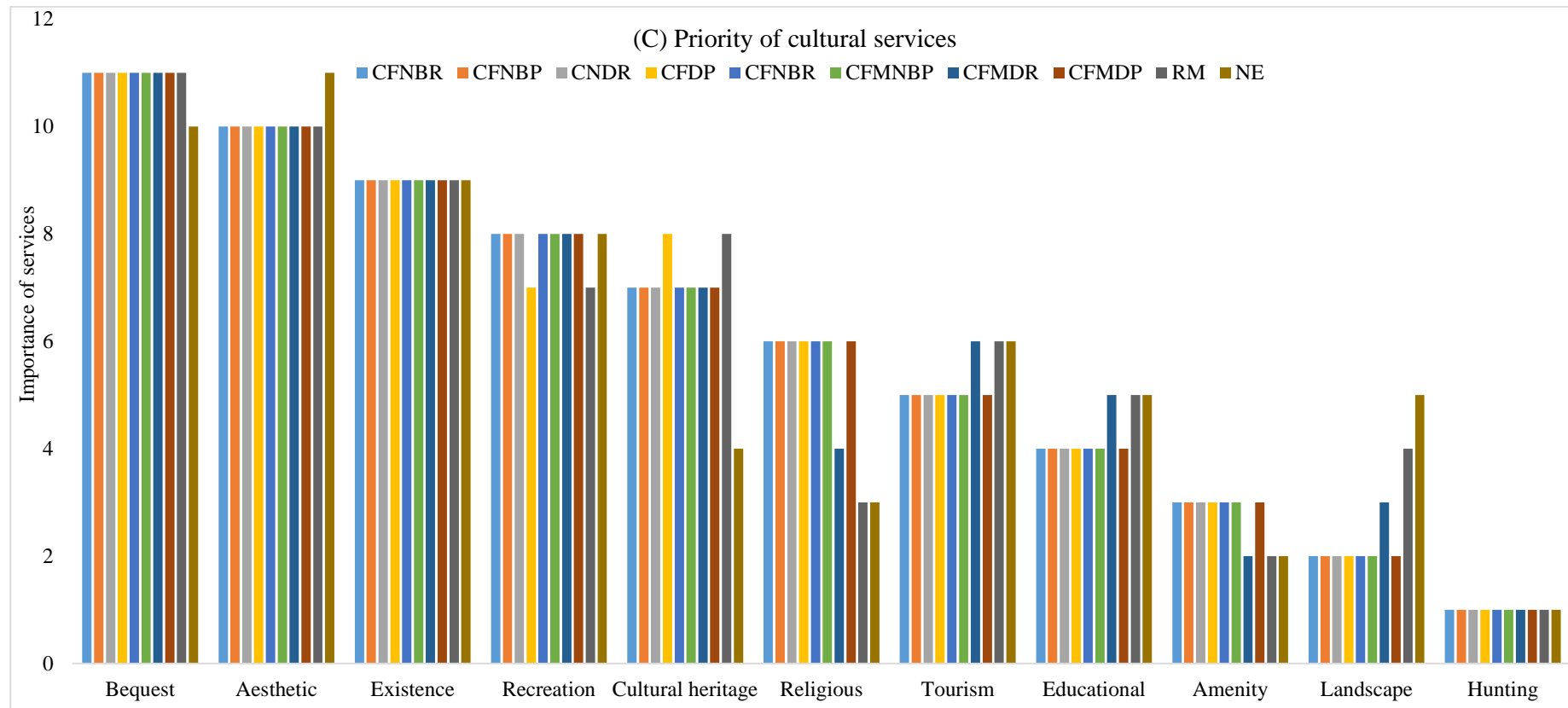


Figure 2. Cont.





**Figure 2.** Prioritisation of 16 provisioning (A), 15 regulating (B), and 11 cultural (C) ecosystem services. In the case of provisioning services, regulating services and cultural services, the ranking goes from 1–16 (1 is the least important and 16 is the most important), 1–15 (1 is the least important and 15 is the most important) and 1–11 (1 is the least important and 11 is the most important), respectively. Note: CFNBR = Community Forest Nearby Rich Users, CFNBP = Community Forest Nearby Poor Users, CFDP = Community Forest Distant Rich Users, CFDP = Community Forest Distant Poor Users CFMNBR = Collaborative Forest Management Nearby Rich Users, CFMNBP = Collaborative Forest Management Nearby Poor Users, CFMDR = Collaborative Forest Management Distant Rich Users, CFMDP = Collaborative Forest Management Distant Poor Users, RM = Regional Managers, NE = National Experts.

In the case of CF, the top priorities of all subgroups were found to be: firewood, fodder, grasses, timber, fresh water, water quality improvement (WQI), soil conservation (SC), biodiversity conservation (BD), flood control (FC), erosion control (EC), bequest, aesthetic, and existence. In the case of CFM, top priorities were firewood, fodder, timber, grazing, fresh water, poles, WQI, SC, BD, FC, EC, bequest, aesthetic, and existence ES.

#### *4.2. Prioritisation of Various Ecosystem Services from Community-Based Forest Management by Local Users*

Different subgroups had different priorities. Considering all subgroups within the CF, the top three provisioning services were firewood, fodder, timber, grasses, and fresh water. Similarly, the top three regulating and cultural services were WQI, SC, FC, bequest, aesthetic, and existence values.

CFM users, on the other hand, assigned highest priority to firewood, timber, and fresh water as provisioning services, and WQI, carbon, FC, and EC as regulating services. Irrespective of the different management modalities, users placed high priority on bequest, aesthetic, and existence values as cultural services.

Forest users' priorities on ES differed in relation to their spatial distance from forests. In CF, users living near forests prioritised fodder, grasses, and grazing provisioning services while distant users chose timber, fresh water, and poles. In the case of regulating services, nearby users placed highest priority on SC, and BD services, whereas distant users from the same category placed strong priority on FC and EC services. For cultural services, both nearby and distant users preferred bequest, aesthetic, and existence services and prioritised amenity, landscape, and hunting services least. In the case of CFM, nearby users gave high priority to firewood, fodder and timber while distant users selected firewood, timber, and fresh water provisioning services. Users living adjacent to a forest selected WQI, SC, and carbon sequestration/storage, whereas distant users from the same category nominated WQI, FC, and EC regulating services. Users both nearby and distant from a forest favoured similar cultural services to those selected by the CF users.

Users' priorities differed between higher and lower socioeconomic status groups for many services in the CF. For example, rich users from nearby forests ranked fodder as the second most important service while those of the same status living far from the forest area preferred fresh water. Regarding regulating services, both categories placed WQI in the top rank; however, their priority differed regarding SC. SC was ranked in second position by rich nearby users, whereas the same wealth category living far away ranked this service as sixth priority. In the case of CFM, wealthier users living next to the CFM area preferred fodder, timber, grasses, and grazing services while rich users residing far from forests selected timber, poles, and fresh water services. In terms of regulating services, the priorities of the wealthier users living near the CFM area were similar to those living nearby the CF area, whereas wealthier users at a greater distance prioritised FC and EC (Figure 2A–C; Appendix B: Table A2).

#### *4.3. Prioritisation of Various Ecosystem Services by Regional Managers and National Experts in the Chure Region*

The priorities placed on ES by regional managers and national level experts were also mixed. Regional managers assigned fresh water and SC services as their top priorities. The national level experts, on the other hand, placed the highest priority on firewood, SC and aesthetic values. Regional managers and national experts also placed high priority on genetic resources, habitat, landscape beauty, amenity services, and hunting, whereas local forest users prioritised these services least (Figure 2A–C; Appendix B: Table A2).

## 5. Discussion

### 5.1. Identification of Ecosystem Services

Forest users and other stakeholders identified 42 different ES in the study area which are important to local people's livelihoods and that also contribute to the regional and national economy. These results are comparable with some other studies, both within and outside Nepal. Previous studies have enumerated 19 to 37 different ES from similar localities focusing on forests [35,41,50,53,57–59] and wetlands [51,52].

It has been a challenge to the researchers to explain the high numbers in the results occurring in ES types. For example, a similar study conducted in *Panchase* area in Nepal acknowledged the landscape mosaic as an important factor [58]. Our study site does not comprise the same mosaic, however it still resulted in a high number of ES identified, probably because of the involvement of a large number of diverse forest stakeholders. Moreover, the *Panchase* study was based only on CF while our research covers both CF and CFM systems. Furthermore, their case study site was hilly terrain, whereas our study area is a lowland landscape with diverse flora and fauna, and high ethnic and cultural diversity. Our study site has more than 20 different ethnic groups with resulting diversified demands on forest ES [48]. Similarly, about 1308 species of flora and fauna are found in the *Chure-Tarai* landscape alone [38,60]. The higher the number of species and ethnic and cultural groups, the greater the diversity of all ES [61].

Our study revealed a high number of provisioning ES (16) in comparison to regulating (15) and cultural services (11). The findings of our study both coincide with and contradict other studies. For example, Bhandari et al. [50] documented 14 provisioning and 11 regulating services, which is similar to our findings while Adhikari, Baral, and Nitschke [58] identified 19 regulating services in Nepal. Similarly, Chaudhary et al. [41] identified eight provisioning, four regulating, and seven cultural services in *Mai Pokhari* Ramsar site, Nepal. A study conducted in Sweden in private forests also reported a high number of provisioning services ( $n = 23$ ) [22]. The difference between cases might be due to differences in landscape and ethnicity. The first case study site is similar to our site and revealed similar findings, whereas the second and third study sites have different landscapes and different management modalities. In addition, our study site comprises production forests while the other two sites studied (i.e., *Panchase* and *Mai Pokhari*) comprise protection forests with limited use of provisioning services.

### 5.2. Differences in Priority of Ecosystem Services among Forests Users, Regional Managers, and National Experts

#### 5.2.1. Differences among Different Sub-Groups of Community Forests and Collaborative Forest Management

The findings revealed that, irrespective of management modalities, all users ranked firewood, water quality improvement (WQI), and bequest values as top priority. Some of the possible reasons behind these preferences could be similarity in the use pattern, an increased need for these services as well as the socio-cultural beliefs of those sub-groups. More than 80% of the households in the *Chure* region use firewood for cooking [38] and the total demand for firewood in both CBFMs is 403,112 (35,512 *bhari* required by CF and 367,600 *bhari* by CFM) *bhari* (*Bhari* is a local unit of measurement. One *bhari* is a head load carried by an individual, approximately equivalent to 25 kg) [48]. Rich-distant users employ an energy mix such as liquefied petroleum gas (LPG) and bio-gas, however, most of the population regardless of their economic status rear cattle and firewood is necessary for cooking cattle feed, locally called *Khole*. In addition, all sub-groups use firewood for heating in winter. According to FAO about 2.4 billion people make use of fuelwood for cooking, boiling water, and heating globally [8]. In the case of developing countries, fuelwood is the prime source of energy. Our case study sites concur with the findings of others studies [8,35,62]. Likewise, both water quality and quantity are of serious ongoing concern for inhabitants of *Chure* and *Tarai*, mainly due to the influx of hill migrants

and increased water use coupled with the fragile topography and the low water holding capacity of the landscape [37,38,63]. Similar results have been recorded in other parts of the world e.g., in the dry northern region of Kenya [61] and the Chittagong Hill Tracts in Bangladesh [62]. Similarly, bequest value is categorised as a non-use value, which is a special case of option value that represents the value (to current users) of being able to bequeath the forest to future generations [64,65]. As the local users of the study area strongly believe in reincarnation and saving for future generations, forest users may have prioritised bequest services for their children and grandchildren [66]. Therefore, all sub-groups ranked these services amongst their top priorities.

Regardless of their economic status and management modalities, all users from both CBFMs regarded many critical services, for example genetic resources, hazard protection, and hunting services as least priority. The reason for this might be associated with the level of awareness of the importance of many ES. Although the landscape approach in the Tarai-Arc Landscape (TAL) programme was implemented in the Chure and Tarai regions in 2004, their focus has only been on 13 western districts [63]. The TAL excludes the eastern Tarai region, where our study area is located. Furthermore, both CBFM have completely prohibited the hunting of any wild animals [48,67]. This could be why hunting services were given lowest priority.

The findings indicated a clear difference in the priority rankings among nearby and distant users in CFM; such difference might be influenced by number of factors, primarily the benefits accruing from the forests [26,41]. In general, local users from the CFM placed highest priority on the ES based on the benefits that they would have to their individual livelihoods. For example, the nearby users of both socioeconomic groups prioritised grasses 4th while distant users in same category placed grasses 8th and 10th. This is comparable with communities' priorities in other empirical studies [35,68,69]. Nearby forest users, show a greater preference for direct use services as they receive higher benefits from these as compared to more distant users. Hence, the level of tangible benefits received by the users could be one of the primary determinants of prioritising the ES.

In our study, proximity to a forest area also influenced the prioritisation of the ES. Users living nearby forests under CF preferred daily use services such as fodder, grasses, and grazing, whereas users living farther from the forest area prioritised timber and fresh water. The possible reasons for variation in priority among these sub-groups might be differences in location, occupation, demand, price, and use pattern of the services. For instance, as previously mentioned when discussing our methodology, the nearby users in CF live in the hills and rely solely on agriculture and animal husbandry for their livelihoods. About three quarters of these households raise cattle ranging in number from one to seven head and total demand for fodder and grasses is almost 21,256 *bhari* [67]. The more distant users of a CF, on the other hand, live in semi-urban areas and have multiple livelihood options including cash crop cultivation, government and other jobs, and small businesses. They prioritised timber and poles, since the market price of timber in the semi-urban area is high. Comparable findings were reported in Java, Indonesia, where location of residents and livestock holdings determined the selection of forest-based ES [35]. Purchasing timber and poles from the market is almost 10 times more expensive than obtaining these services from the CF. In addition, fresh water is of special interest for distant rich users since large farmers cultivate sugarcane [70] and irrigate their sugarcane farms. These might be key reasons behind the differences in priority placed on provisioning services among CF users.

In the case of CFM, the nearby users favoured fodder, timber, and grasses while distant users selected timber, poles and fresh water services. Access to benefit sharing, distance to the forest area, and demand for scarce services could be potential reasons for selecting these services. As noted, CFM is a partnership model among national and local governments and local communities for the management of a block of national forest to fulfil the needs of local people [42]. In CFM, the level of access to benefit sharing by users distant to a forest area is different to that of CF [43]. In the case of CFM, 50% of forest product revenue goes to the governments (40% to national government and 10% to the local government) but there is no such provision in CF [43,44]. CF users reside near forests (nearby users live adjacent to the forest area and distant users live almost two to three km from a forest)

while under CFM, distant users reside over five km away [33]. As the nearby users raise livestock (average of four to eight head of cattle per livestock-keeping household (HHs)) and require substantial amounts of forage, their priority is fodder and grasses. Likewise, as many users in the CFM system live 5–20 kilometres away from the forest area [48], they cannot collect daily use services such as fodder and grasses [33]. A study conducted in Tanzania reported contrasting findings [71], suggesting that most of provisional ES were utilized within one km radius of the forest, but in our case, many ES such as timber, poles and firewood are used up to 20 km away from the forests. Users do, however, consider forests as the source of timber, poles, and the fresh water and therefore prioritise these services accordingly.

Likewise, socio-economic and topographic factors play important roles in prioritising regulating services. The wealthier users adjacent to both CBFMs assigned top priority to SC, BD, and carbon sequestration services while users within the same wealth group living far from forests assigned high priority to FC and EC services. The *Chure* region is highly susceptible to soil erosion [39,72] and the *Dun* and *Tarai-Madesh* regions are susceptible to flooding [38,40]. Users living nearby the *Chure* forests face acute soil loss problems in the region [38–40]. On average, 16 to 64 tonnes of soil are lost every year [72,73]. The *Tarai/distant* region, on the other hand, faces frequent flooding: in 2017 flooding caused severe losses in 18 *Tarai* districts worth US \$584.7 million [74]. Due to experiencing recent flood damage, distant users might have been influenced to select FC services as the top priority.

As presented in the study results, all sub-groups in both management modalities recognised the benefits of carbon storage and sequestration services (CSS) and ranked these fourth to sixth. Surprisingly, they currently receive no benefit from CSS though still choose this as a high priority. However, they have heard about the Reducing Emissions from Deforestation and Forests Degradation (REDD+) pilot projects implemented in nearby districts (*Chitwan*, *Dolakha*, and *Gorkha* districts). These projects have provided many financial benefits to the local users in accordance with their contribution to social and environmental safeguards [31,75]. Similarly, the Nepalese government, along with World Wildlife Fund for Nature (WWF) recently initiated REDD+ projects in 12 TAL districts, adjacent to our study site [36,76]. With a total budget of US\$ 177.1 million, 14 metric tonnes of carbon dioxide equivalent (MtCO<sub>2</sub> e) (A metric measure used to compare the emissions from different greenhouse gases based upon their global warming potential. The carbon dioxide equivalent for a gas is derived by multiplying tons of the gas by its associated global warming potential) will have been credited to the World Bank Carbon Fund [36]. Although users in our research site have not received any carbon benefits so far, these initiatives in nearby districts may have created some awareness about them and users might have been more optimistic at the time of the study about the carbon benefits coming in the near future.

### 5.2.2. Differences between Regional Managers and National Experts

Regional and nation stakeholders share many similarities, although they have slightly different priorities for bequest services. Regional managers regard bequest value as the top priority, whereas the national stakeholders ranked this in second position. Regional managers stayed longer in the region and have a more in-depth understanding of the current field situation than national stakeholders. Studies conducted in Israel and Slovenia concur with this finding [77,78]. Practical and field experience can enhance identification and better prioritization of the ES. Consistent with this, regional managers tend to see with the eyes of local users whereas the national experts' input reflects national perspectives. The national experts, however, have more international exposure and have more knowledge of the global literature, which might have influenced their perceptions.

### 5.3. Policy Implications of the Study

This study identified and prioritized a wide range of forest-based provisioning, regulating, and cultural ecosystem services. Many of these services are not documented in the operational/management plans of both forests management systems [79]. Considering the increasing tendency toward valuing such services, it is essential to document them in management plans for CBFM projects. Furthermore,

our study revealed the differences in priorities between sub-groups in both CF and CFM, however, up until now the plans of CBFM have not internalized these issues. In the CF, for instance, users living nearby prioritised fodder and grass services as highest priority but the current management plans do not incorporate ways of optimizing the values of these services. In the case of CFM, the operational plan largely focuses on timber production, while high priority is placed on firewood by distant users. Moreover, poor users living nearby also need a substantial amount of fodder, grasses, and grazing services but the management plan does not consider these pertinent issues. Users acknowledged that it is not possible to include all prioritized ecosystem services from all sub-groups in the management plans but it is crucial to consider at least the top five priorities from each sub-group. This provision would make all users feel that their interests and priorities are included. As a result, they will be motivated for to act for conservation and sustainable management of their forests. At the same time, mismatches of different groups should be equally considered for managing potential areas of conflict in the long run.

How we can include the provision of forest-based ecosystem services in an operational plan could raise some issues. As noted, in the CBFM system, part of the national forest is legally handed over to the local community for protection, management and utilization [80]. The process is supported by government policies, rules, and regulations. In the case of Nepal, Forest Act 1991, Forest Regulations 1995, and National Forest Strategy Plan 2016–2025 provide a roadmap and clearly specify the possible roles, responsibilities and inputs of communities, government, and non-government facilitators [36,81]. Once the user group's constitution and working plan are negotiated and signed by the users and government department—in the case of Nepal, the Divisional Forest Officer (DFO)—a given patch of national forest legally becomes a community forest. The operational plan of a CBFM system must be renewed at regular intervals for its perpetuity. The process and provision of securing prioritized forest-based ES could be incorporated into the revised operational plan for full-fledged implementation.

## 6. Conclusions

This study assesses and prioritizes key forest-based ecosystem services in community and collaborative forests in the *Chure* region of Nepal. The findings show that the *Chure* landscape provides approximately 42 ecosystem services for local, regional, national, and international users. This high number of ecosystem services is attributed to the high diversity of flora and fauna, and to the cultural and ethnic diversity in the study areas. Results also show both similarities and differences in the prioritization of the ecosystem services among different user groups, largely influenced by their forest management modalities (community forests and collaborative forests), proximity to forest area (nearby and distant) and socio-economic status (rich and poor). The similarities can determine common areas of interest among larger stakeholders, while the differences can indicate potential areas of conflict when implementing the management plans.

The mismatches in prioritization of ecosystem services among the subgroups of users generates complexities for forest management. Although obtaining consensus among different subgroups is not possible in such a large and socio-economically and culturally diverse landscape, it is imperative for better management of forest resources. Considering the priorities of regional managers and national experts is equally important, despite adding further complexity. Therefore, promoting the culture of multi-stakeholder consultation process towards achieving consensus among them is necessary. Once the interests of all stakeholders are negotiated and agreed upon, the process and provision of securing those ecosystem services should be included in the forest operational plans during their revision.

The outcomes of this research could be useful for a number of purposes: (1) two ongoing large programmes in Nepal—“President Chure-Tarai-Madhesh Conservation and Development Programme” and “Tarai Arc Landscape Programme”—could consider the users’ priorities for channeling and prioritizing their scarce resources; (2) the priority of ecosystem services for different users may change over time. This study provides benchmark data for change assessment; and (3) the research-sampling framework developed in this study can be applied in any community-based forest management (CBFM) system in developing countries.

Due to the scarcity of resources, this study was not able to cover all forest user groups. Therefore, more research across a larger number of community and collaborative forests is required to determine whether these results are indicative of the entire *Chure* region.

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**Conflicts of Interest:** The authors declare that there is no conflict of interest.

## Appendix A

**Table A1.** Difference between Community Forests and Collaborative Forest Management in Nepal.

Features	Community Forests	Collaborative Forests
Concept	CF are national forests handed over to forest users for protection, utilisation and management of forests with the objective of fulfilling forest product and services demands of the local communities	CFM is a partnership model between Department of Forests (DoF), local government and local communities for the management of a patch of national forest to fulfil the local needs (both nearby and distant users) of many ecosystem goods and services such as timber, firewood and other non-timber forest products
History	Initiated in late 1980s	Initiated after 2000s
Coverage	1.81 million hectares of forests among 19,361 CFUG groups across Nepal Tarai, Chure, Midhills, and High Mountain regions	0.071 million hectares of forests area managed by 28 CFM groups (3.4 million HHs) in <i>Tarai</i> and <i>Chure</i> regions
Access	Each member has access rights as per the prescribed management plan	Forest users have rights to enter the forest within specified times and months
Use/management right	Users can decide and extract, collect and harvest all provisioning ES	Users can get regular access only for basic forest services such as fodder, grasses, and other non-timber forests products
Exclusion of non-users	Users have rights to include and exclude users, and utilisation of forests services	Forestry officials and executive committee mostly decide about the users, utilisation and management of forest services
Sharing of Revenue	100% of income goes to local users but 15% of revenue from commercial transactions of <i>Acacia catechu</i> and <i>Shorea robusta</i> goes to central government.	50% of all timber income goes to central and local governments and another 50% to the local government.
Provision on forest management	Allocation of 25% of total income of CF for forest management	Allocation of 40% of total income of CFM for forest management
Alienation of land forest land	CF can decide to allocate a piece of land to poor groups	There is no such provision in CFM

## Appendix B

**Table A2.** Relative importance of different forest-based ecosystem services to sub-groups and other stakeholders.

Service Types	Category	CF Nearby		CF Distant		CFM Nearby		CFM Distant		Regional Managers	National Experts
		Rich	Poor	Rich	Poor	Rich	Poor	Rich	Poor		
Provisioning Services	Firewood	16	16	16	16	16	16	16	16	16	16
	Fodder	15	15	12	15	15	12	9	8	13	11
	Grasses	14	14	7	14	13	13	6	7	10	12
	Timber	13	13	15	12	14	14	15	15	12	10
	Grazing	12	12	6	6	12	15	7	6	14	14
	Fresh water	11	11	14	11	11	11	14	13	15	15
	Bedding materials	10	9	8	10	10	10	12	10	11	9
	Poles	9	10	13	13	9	9	13	14	9	13
	Agriculture implements	8	8	10	9	8	8	8	11	8	5
	NTFPs other than MAPS	7	7	9	7	6	7	11	9	4	6
	Sand/Gravel/Stone	6	6	11	8	7	5	10	12	6	2
	Wild foods	5	5	5	5	5	4	2	4	3	7
	Med. & aroma. plants (MAPs)	4	4	4	4	4	6	5	5	7	8
	Thatching materials	3	3	2	2	3	3	4	2	5	1
	Wild animals	2	2	3	3	2	2	3	3	1	4
Genetic resources	1	1	1	1	1	1	1	1	2	3	
Regulating Services	Water quality improvement	15	15	15	15	15	15	15	15	14	14
	Soil conservation	14	14	10	12	14	14	9	9	15	15
	Biodiversity conservation	13	13	13	11	12	12	10	12	10	12
	Carbon storage	12	11	11	10	13	10	12	11	11	11
	Erosion control	11	10	12	13	11	13	13	13	12	10
	Run-off mitigation	10	9	8	9	10	11	11	10	9	9
	Air purification	9	12	9	8	9	9	8	8	5	6
	Pollination	8	7	5	5	8	8	7	6	4	8
	Flood control	7	8	14	14	7	7	14	14	13	13
	Water regulation	6	5	7	7	6	6	6	7	7	4
	Local climate regulation	5	6	6	6	5	5	5	5	8	5
	Waste assimilation	4	3	4	3	4	4	2	2	2	3
	Storm protection	3	4	1	4	3	3	3	3	3	2
	Habitat	2	1	3	2	2	2	4	4	6	7
	Hazard reduction	1	2	2	1	1	1	1	1	1	1
Cultural Services	Bequest	11	11	11	11	11	11	11	11	11	10
	Aesthetic	10	10	10	10	10	10	10	10	10	11
	Existence	9	9	9	9	9	9	9	9	9	9
	Recreation	8	8	8	7	8	8	8	8	7	8
	Cultural heritage	7	7	7	8	7	7	7	7	8	4
	Religious	6	6	6	6	6	6	4	6	3	3
	Tourism	5	5	5	5	5	5	6	5	6	6
	Educational	4	4	4	4	4	4	5	4	5	5
	Amenity	3	3	3	3	3	3	2	3	2	2
	Landscape	2	2	2	2	2	2	3	2	4	5
	Hunting	1	1	1	1	1	1	1	1	1	1

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