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Biocultural Importance of the Chiuri Tree [*Diploknema butyracea* (Roxb.) H. J. Lam] for the Chepang Communities of Central Nepal

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Abstract: Major socio-economic changes over the last few decades have reduced Indigenous peoples' engagement in cultural practices, such as harvesting of forest resources. Nevertheless, some species remain important for culture, subsistence and livelihood, such as the chiuri tree (*Diploknema butyracea* (Roxb.) H. J. Lam) to the Chepang people of Central Nepal. Using the cultural keystone species framework, we conducted interviews within Chepang communities to assess the biocultural importance of the chiuri tree. It is central to the Chepang culture, and no other species could provide the same benefits. It also provides food and habitat for a number of wildlife species, including bats, which are themselves culturally important. Strictly observed tree ownership rules, as well as a cultural ban on tree cutting and branch lopping, have so far contributed to chiuri conservation. However, these rules are increasingly less adhered to. Other threats to chiuri sustainability are excessive flower foraging by bees (reducing pollen production) and bat hunting (reducing pollen transport). Further studies are needed to quantify these threats and to adjust forest and wildlife management practices so that the cultural landscape continues to provide multiple benefits to the Chepang people. Our study of the chiuri case attests to the usefulness of the cultural keystone species framework in landscape assessment for management and conservation.

Keywords: cultural salience; butter tree; Indigenous peoples; socio-ecological system; forest management

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1. Introduction

Trees are valued for the many tangible and intangible benefits they provide in rural, as well as in urban landscapes throughout the world [1–5]. Some tree species have special importance for Indigenous peoples, as they are associated with cultural and spiritual practices [1,6–10]. Indeed, although Indigenous peoples generally value all species equally within a holistic worldview [11,12], particular species can be more prominent in certain circumstances. Indigenous peoples protect such culturally salient species by means of customary regulations, thus contributing to biodiversity conservation [13,14]. Indigenous practices are often regarded as more effective than the presence of protected areas for biodiversity conservation [3,15–18].

Rapid socio-economic changes over the last few decades have caused a marked decrease in the proportion of Indigenous peoples engaging in cultural practices and knowledge transmission, hence threatening biodiversity conservation [19–22]. Globally, it has been found that when cultural diversity is lost, biological diversity is also lost, as cultures and ecosystems are closely linked [23]. In Nepal, increased market access due to rural road expansion, outmigration, foreign employment, and land use changes have resulted in socio-economic changes, causing a loss of cultural practices over the last 20 years [24–27]. For example, the Chepang people, a marginalized Indigenous group living in central Nepal [28,29], are now less dependent on forests, and their main livelihood sources are

agriculture and wage labor rather than hunting and gathering [30,31]. Nevertheless, the Chepang still use various forest resources for subsistence and income generation [32], including the chiuri tree (*Diploknema butyracea* (Roxb.) H. J. Lam; synonym, *Aesandra butyracea* (Roxb.) Baehni), which bears high importance for culture and livelihood [29,32–36]. Native to the sub-Himalayan region, the species has been recorded in 46 districts, totaling 10.8 million trees, including 5.6 million at the flowering stage [37]. In ancient literature, the chiuri tree was said to be a *kalpabriskha* (literally, "world tree", i.e., a wish-fulfilling sacred tree) [38]. Chiuri has always been well protected by the Chepang people, even in times of high deforestation [39] and dominance of slash-and-burn cultivation practices [40]. Because of the importance of chiuri for cultural practices [37,41], the Chepang do not fell a tree or cut its branches [38]. Chiuri also has a high value for subsistence and livelihood, and it is often planted by community forest user groups. Most Chepang households use several chiuri parts for various purposes (food, medicine, construction, fuelwood, etc.) [33]. A high percentage of Chepang people also obtain income from selling chiuri parts, such as bark, leaves, wood, seeds and fruits, as well as chiuri-derived products, such as honey, soap, wine and butter [37,42]. About 40 metric tons of butter can be produced annually in Nepal, worth almost USD 40 million [37].

The multiple benefits provided to the Chepang people by the chiuri tree point to the species' cultural salience. This concept was popularized by Eugene Hunn, who referred to it as "the particular importance of a plant or animal that can be understood only in terms unique to [a] culture" [43]. The cultural salience of a species can also be understood as "an emergent property of the history of human interactions (both positive and negative) with wild/captive individuals, derived products (e.g., skins, meat) and/or representations (words, images, videos). These interactions emerge when a species affords (...) purpose, actions and emotions to humans" [44]. In an effort to "measure" a species' cultural salience, the cultural keystone species (CKS) concept has emerged over the last two decades [45,46]. CKS are essential to the identity and cultural stability of cultural groups [45,47]. As such, they are deemed irreplaceable, as the various benefits they provide cannot be derived from other species [48]. Hence, the loss of a CKS can severely affect the cultural integrity of an Indigenous people. Even if the approaches to evaluate CKS status have been criticized [46], the concept still provides a useful framework for assessing the consequences of environmental change on a group of people and their way of life [45,49,50], and to identify socially acceptable conservation, management and restoration activities [51–53].

Using chiuri as a case study, we evaluated the usefulness of the CKS framework to assess biocultural importance and to identify the need for culturally relevant management and conservation activities. The interviews we conducted with the Chepang people showed that chiuri is central to their culture, as it provides multiple benefits that no other species could provide. We also showed that socio-economic changes have led more people to ignore cultural rules, such as prohibiting branch lopping, which threatens chiuri sustainability. Additional threats to chiuri in this cultural landscape are excessive flower foraging by bees (reducing pollen production) and bat hunting (reducing pollen transport). The CKS framework allowed us to highlight the difficulty of balancing the various benefits the Chepang people obtain from the cultural landscape, calling for specific management measures. The CKS framework could be used in other socio-ecological systems to identify species of interest measure their cultural salience, and to identify conservation, management and restoration needs.

2. Materials and Methods

2.1. Study Setting

The study was conducted in the Makwanpur, Chitwan, Dhading and Gorkha districts of central Nepal (Table 1; Figure 1), in the Chepang territory. Inhabiting mostly the Chure and Mahabharat mountain ranges, the Chepang people are an Indigenous people of Tibeto-Burman origin [28]. The Chepang population totals around 50,000 (0.23% of Nepal's population) and is scattered mainly across the districts of Chitwan (40%), Mak-

wanpur (29%), Dhading (20%) and Gorkha (5%) [54]. The Chepang have long lived a nomadic lifestyle [55], practicing shifting cultivation [56], but have recently settled in their traditional territories as they engage in subsistence agriculture. Despite socio-economic changes, the Chepang people have preserved their identity by maintaining their traditional knowledge system [36].

Table 1. General characteristics of the study sites in central Nepal.

Village(s) (District)	Households	Distance from National Highway (km)	Walking Time to Nearby Forest (min)
Hanglang (Makwanpur)	27	1	5–10
Pipaltar (Chitwan)	70	5	5–10
Siddhi and Tindovan (Chitwan)	404 and 160	16	5–10
Laitak (Dhading)	<50	1	5–10
Thumka and Ghyalchok (Gorkha)	49 and 127	1	20–30

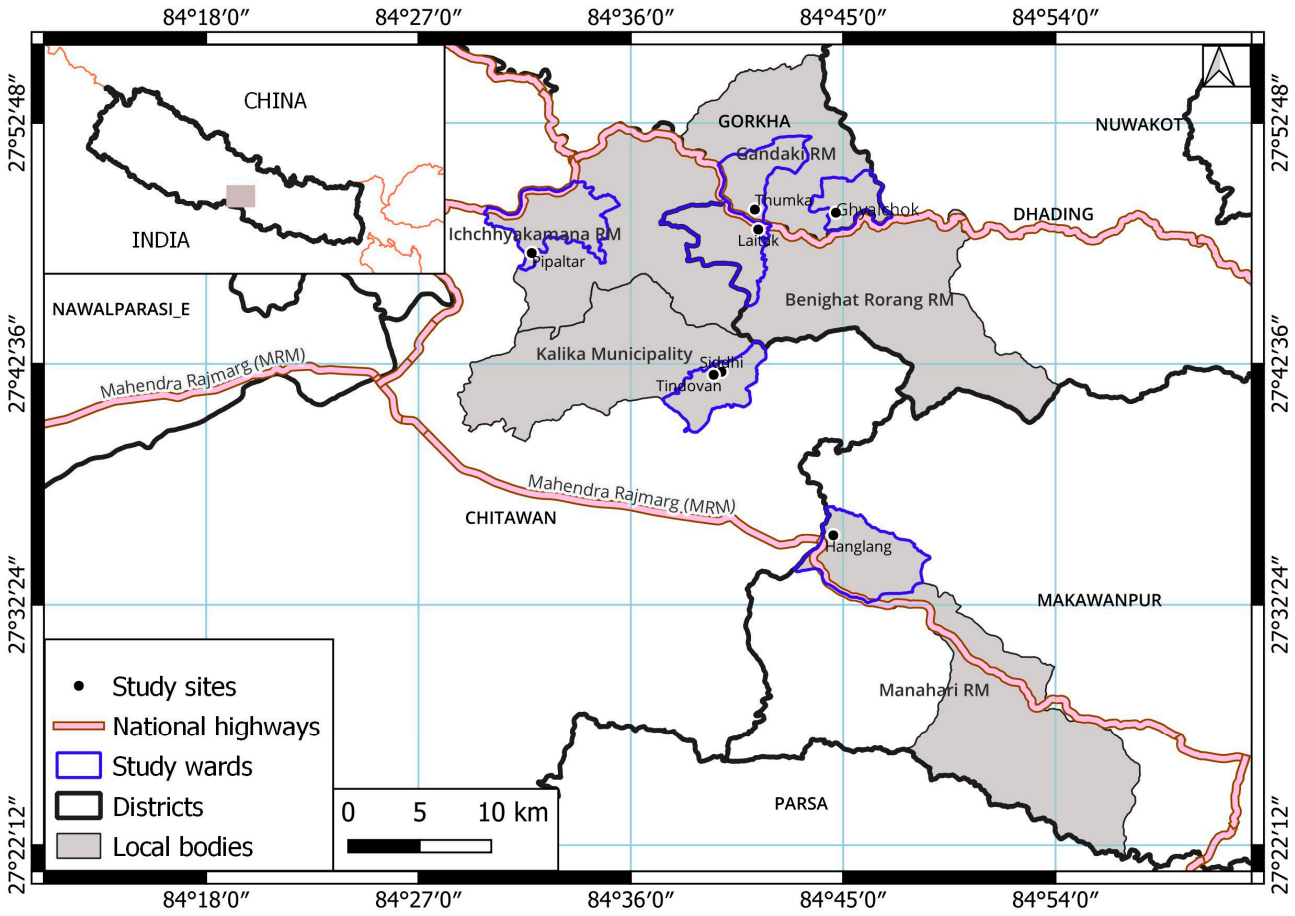

Figure 1. Location of the study area and study sites in the Makwanpur, Chitwan, Dhading and Gorkha districts of central Nepal. Each district includes several local bodies, such as municipalities or rural municipalities (RM), which are further divided into wards that include villages, such as those considered in this study (study sites).

The Chepang use various forest resources to support their livelihood [57]. Apart from fodder, timber and fuelwood, they collect wild vegetables and fruits that are used as dietary supplements and play a significant role in food security, as crop production is not sufficient for year-round sustenance [32]. Various medicinal plants are also used to treat different diseases and ailments [29,36,58].

2.2. Chiuri Tree

The chiuri (often called butter tree in English) is a medium- to large-sized broadleaved tree species belonging to the Sapotaceae family. It appears individually or in small clumps in broadleaved forests (state forests, as well as unregistered and registered private lands), and as scattered individuals in wastelands and cultivated fields near villages [59]. It is a shade-intolerant species which grows at elevations between 400 m and 1500 m, often on steep slopes, narrow shady valleys or gorges, and cliffs [32,59,60]. The tree can reach 25 m in height, starts producing fruits at 6–10 years, and yields fruits for about 50–60 years [33,37,41]. It plays a key role in soil protection and stabilization [35,37]. Flowering occurs in April or November, depending on the region, and fruit ripening occurs between June and December, also depending on the region [41]. Fruits and seeds (Figure 2) are eaten by many wildlife species, including birds, bats, jackals and wolves, and the trees are a habitat for many animal species [59]. Bats play an important role in chiuri pollination [61].

2.3. Data Collection

The objective of the research and its implications for the preservation of biocultural diversity were first discussed with Ward Presidents in the four districts where fieldwork was to take place. Wards include villages, and they are local level administrative units within the government of Nepal with various responsibilities, including cultural preservation and the conservation and promotion of forest resources and biodiversity. General consent was obtained from the Ward Presidents, who agreed for the research to take place within the area under their responsibility.

Data were collected from September to December 2021. Two focus group discussions in each site were conducted with six to eight participants. In addition, four or five key informants were interviewed in each site to validate the interpretation of the information gathered from the focus group discussions. The key informants were suggested by participants of the focus groups. Prior informed consent was obtained orally from the participants. Local interpreters, suggested by the Ward Presidents, were present at each focus group discussion and interview so that participants could speak their native language. The participants were chosen by non-probabilistic sampling [62] from the most knowledgeable community members, including elders and village leaders. Participant selection was thus based on age, knowledge about the chiuri and the Chepang culture, and willingness to participate in the study. Knowledge proficiency was assessed by peer recognition. Data collection was conducted until information saturation was reached, i.e., when further data collection would not allow elicitation of new information [63].

Each focus group interview was facilitated by using an interview guide (Appendix A) adapted from the CKS framework [45,46]. The participants were asked to attribute a score from zero to five for each criterion used to evaluate CKS status (0 = "no, not used", 1 = "yes, although low or infrequent", 2 = "yes, low", 3 = "yes, moderate", 4 = "yes, high", and 5 = "yes, very high"). The sum of their answers corresponds to the Identified Cultural Influence (ICI) index [45].

The use value (UV) was also calculated [64]. Use reports were obtained from the key informants and were used to calculate the UV as follows:

$$UV = \Sigma Ui/n, \quad (1)$$

where, Ui is the number of uses mentioned by each informant for a given species and n is the total number of informants.

(**a**)

(**b**)

(**c**)

Figure 2. Chiuri fruits shown in a tree (**a**) and up close (**b**), and chiuri seeds (**c**).

The CKS framework has been criticized, as it depends on the ability of the researcher to subjectively assign the appropriate ratings to the criteria used to assess CKS status, hence paving the way for judgment errors [46,48]. To avoid this shortcoming, we explained the objectives of the research to the participants and asked them to provide the ratings. One question in the interview guide (Q.2) was asked to determine if there are specific gender roles or practices associated with chiuri use (Appendix A). The interview guide also included questions to determine the local perception of the ecological value of the species.

The focus group discussions lasted for about two hours and were recorded and transcribed verbatim. Each session ended with a discussion of the cultural importance of tree species in other societies [10,62]. This form of reciprocity was taken positively, as the sharing of cases from other societies was deemed interesting and inspiring. The individual interviews lasted about 1.5 h and were also recorded and transcribed verbatim. Data were subject to thematic analysis, i.e., they were coded and categorized into major themes, following a mixed deductive and inductive approach [65]. Some themes were derived from the interview guide, while others emerged during analysis.

The main findings of the study were shared with the communities in June, July and November 2022.

3. Results

Based on the respondents' understanding and interpretation of the six criteria used to assess CKS status, the ICI of chiuri to the Chepang was found to be 34, i.e., one away from a perfect score (Table 2). Additionally, the UV was found to be 5.72 (126 uses reported by 22 key informants).

Table 2. Participants' ratings of chiuri with regards to the six criteria used to assess cultural keystone species status.

Criteria Indicating Cultural Keystone Species Status	ICI Rating	Related Question(s) in the Interview Guide
Intensity, type, and multiplicity of use		Q1
• Is the species used intensively (routinely and/or in large quantities)?	5	
• Does the species have multiple uses?	5	
Naming and terminology in the language, including use as seasonal or phenological indicators, names of months or seasons, place names		Q4
• Does the language incorporate names and specialized vocabulary relating to the species?	5	
Role in narratives, ceremonies, or symbolism		Q3–6
• Is it prominently featured in narratives and (or) ceremonies, dances, songs, or as a major crest, totem, or symbol?	5	
Persistence and memory of use in relationship to cultural change		Q3–6
• Is the species ubiquitous in the collective cultural consciousness and frequently discussed?	5	
Level of unique position in culture		Q7
• Would it be hard to replace this species with another available native species?	5	
Extent to which it provides opportunities for resource acquisition from beyond the territory.		Q9
• Is this species used as a trade item for other groups?	4	

3.1. Traditional Uses of Chiuri

Because of its wide range of uses and values to the Chepang, the participants awarded chiuri the highest possible ranking (5) for the first criterion used to assess CKS status (Table 2). All participants agreed that there is no other tree like chiuri. It is a multipurpose species that provides various provisioning and cultural services. The chiuri tree has been used for time immemorial, according to the participants, and it is highly valued for its fruits. Ripe fruits are edible and are considered flavorful and nutritious. Elder participants recalled their childhood and said that they would rely on chiuri fruits when there was a lack of food. One participant said he planted a chiuri tree near his house so that his children can eat the fruits easily.

The Chepang people have specific names in their language for the chiuri tree (*yoro* or *yoshi*) and for different parts of the tree (e.g., *yusi* or *yosae* for the fruit, *sae* for the flower, *irlung* for the seed), which led participants to give chiuri a perfect score for the second criterion used to assess CKS status (Table 2). When a chiuri tree is located near someone's house, that person is named after the tree. For example, if the house of the second son of a family is located near a chiuri tree, then his name will be "*Chiuri bote maila*" (second son near the chiuri tree). There are also places which are named after the chiuri tree, such as *Chiuri tar* (a plain area located near a chiuri tree), *Chiuri dhunga* (a big stone beside a chiuri tree), *Chiuri bisaunu* (a place beside a chiuri tree where people can stop and rest), and *Chiuri ghar* (a house beside a chiuri tree).

All participants mentioned that chiuri is for them what cows and buffalos are for other people, as it is a source of butter extracted from the seeds and used for different purposes, such as cooking, and to treat health problems, such as muscle spasms or skin infections. Sick people are allowed to eat food cooked in chiuri butter, compared to other types of vegetable oil and animal fat, which are not eaten during a sickness episode. Chiuri butter is used to light religious lamps. It is also used to treat toe infections, which originate from the mud during the rainy season. Chiuri butter can be sold for income generation. As the money received from selling chiuri butter can be used to buy various things, numerous participants highlighted that chiuri is "everything" to them.

The residue left after extracting butter from the seeds (referred to as "cake" by the Chepang people) is used as fish poisoning, to kill lice in goats and to treat dermatitis in buffalo. Cake is used as a fertilizer, notably in organic agriculture, to turn unfertile red soil into fertile black soil. It is also used as a pesticide in paddy to prevent damage by the yellow stem borer (*gawaro*) and other fungal diseases. Cake is also used as a leech repellent during the rainy season.

All participants said that the chiuri tree is beautiful and provides greenery in winter, when other trees have shed their leaves and look "naked". This makes people feel relaxed and at peace. A local alcohol made from chiuri fruits is considered as medicine. Chiuri leaf cups are used to drink the local alcohol, and chiuri leaf plates are used to eat and for religious practices. Bark paste, juice or extract is used to treat various ailments, such as gastritis. An exudate released by the tree is collected, cooked and made into a glue used to trap birds in trees. The juice made from their flowers is sweet and nutritious. The twigs and leaves are used as fodder. The dried branches are used as fuelwood. The bark juice is used to expel leeches from the nose of cattle. The seeds are given during *deusi bhailo* (a local festival), while cash and rice are given in other cultures.

3.2. Cultural Importance of Chiuri

Concordant with the third criterion used to assess CKS status (Table 2), the Chepang respect chiuri, and the species is conspicuous in all discussions within or related to the Chepang culture. All participants agreed that having chiuri trees is a matter of prestige. For them, it is a legacy from their ancestors, and they have the responsibility to preserve chiuri trees for their descendants. Both genders are involved in collecting and using chiuri. The species is associated with the ancestors, and various songs and stories mention it. For example, in the village of Pipaltar (Chitwan district), people believe that the Chepang

people owe their existence to the chiuri. This story was, however, little known in other villages, where people had heard only fragments. A 70-year-old woman participant from Pipaltar narrated the story as follows:

> "A long time ago there were a father and his son living in the village. A Chinglang (an animal eating humans) once visited the house when the son was alone. The Chinglang wanted to eat his father, but the son was so smart that he was able to make the Chinglang confused about where to search for his father. The son pointed to the South when actually his father had gone to the North to harvest tarul (*Dioscorea* sp.). One day the Chinglang was tired of searching for the father and thought that the son had lied about his location. The Chinglang went to the direction opposite to that which the son had suggested and caught the father. The Chinglang took the father's dead body (to the son) and asked if he had anything to say. The son asked for his father's little finger. As soon as the Chinglang left, the son went to the river bank and planted the finger. The next day he went to the site and saw a big chiuri tree with golden ripen fruits. He knew that Chinglangs would visit the village again to eat people, so he called all the Chinglangs to visit the site where the chiuri tree had grown. He suggested them to taste the fruits. The Chinglangs found them tasty and jumped on the tree. The twigs were set in such a way that when the Chinglangs jumped the twigs broke and all the Chinglangs fell in the river. This is how our existence continues. This was all possible because of chiuri."

According to the participants, everyone within the Chepang communities can identify the chiuri tree, justifying the attribution of a perfect score to the fourth criterion used to assess CKS status (Table 2). The felling of a chiuri tree is considered a sin. In the past, even the lopping of branches was a sin. The Chepang used to give a Chiuri sapling to their daughters as a dowry when they married, because chiuri gives everything, and thus daughters could sustain themselves and their husband with only that tree. Some community members do not want to use the term "dowry" as it has a negative connotation in the society. They would rather call it a gift. Dowry is not practiced anymore, as other livelihood options have become available.

In the past, all the chiuri trees within a community would be divided among the households equally. Individual ownership rights to wild chiuri trees have existed for a long time and are strictly respected by the communities. For example, picking up someone else's fruits without permission is not allowed. If someone is deprived of chiuri, then there is a quarrel between the villagers for the tree. If there are not enough trees for everyone within a household, the branches of a tree can be divided among family members.

When asked if any other species can provide similar cultural, provisioning and ecological services to the Chepang people, all the participants clearly said that no species could replace the value of chiuri for their people. Chiuri is said to be even more valuable than sal (*Shorea robusta* Gaertn.), which is a high-value timber-yielding tree that is available in the region. One participant said, "Chiuri is everything for us and nothing can replace it. If there is no chiuri, then we cannot survive". Another participant said, "we give two hundred over one hundred for your question" (see Appendix A, question #7). All other participants in the discussion group agreed and collectively awarded the highest possible ranking for the fifth criterion used to assess CKS status (Table 2).

3.3. Trade of Chiuri Products

Chiuri fruits, butter and "cake" are exchanged for other goods, and traded within communities and in the market. However, all the participants said that the extent to which chiuri is traded is negligible compared to what it was in the past. A participant explained:

> "We would prepare 50–60 kg of chiuri butter and go to Kathmandu (the capital city of Nepal) by foot. It took 6–7 days to return from Kathmandu. We would make some money and buy sugar, salt, and food sufficient for some months".

Cake is still sold as a fertilizer to other communities and exchanged for rice. In the past, the fruits were exchanged extensively for food crops. Trade decreased by about 90% compared to the past because only about 5% of the Chepang people extract and use chiuri butter, currently. For this reason, the participants agreed to give a score of 4 for the sixth criterion used to assess CKS status (Table 2).

3.4. Ecological Values

When asked which wildlife species are dependent on the chiuri tree, most of the participants (92%) were able to mention more than three wildlife species. They mentioned that monkeys, bats, squirrels, wolves, foxes, wasps and most birds feed on chiuri fruits. Likewise, honeybees extract nectar from chiuri flowers. An elder said that "because bats eat only chiuri flowers and fruits, they are pure and healthy, therefore we eat bat meat". Forty percent of the participants said that birds that were seen in previous flowering and fruiting seasons would come back during the next flowering and fruiting seasons. Other ecological values of the chiuri tree include it being a nesting site for birds, providing shade to other plants, as well as animals and humans, and protecting against landslides and soil erosion.

3.5. Threats to Chiuri

Most of the participants (70%) said that people are less careful about the species nowadays, as a result of major socio-economic changes. Hence, the majority of the participants (60%) were worried about the loss of chiuri on their territory. As one of them said, "chiuri is getting lost, please save it". Participants were asked to rank the availability of chiuri on their territory based on abundance ranking (4 = Dominant, 3 = Common, 2 = Less common, 1 = Rare). Most of the participants (80%) agreed that the abundance of chiuri has decreased to the point that the species is now less common (abundance score = 2). They were deeply concerned and calling for improved management and restoration of the species. They observed that the trees have produced less fruits in recent years and they said that one possible reason for this is honeybee foraging on the pollen and nectar, which resulted in lower seed production and production of low-quality fruits. In addition, they mentioned that, even though the lopping of chiuri branches used to be considered a sin, some people are now doing it to produce fodder. Another reason for declining availability of chiuri could be bat hunting, preventing the species from fully playing its role in pollen dispersal.

In contrast, 20% of the participants said that the availability of chiuri has increased and ranked chiuri abundance as common (3). They explained that chiuri seeds are no longer collected in the wild (to produce butter), but rather bought from the market. Moreover, they estimated that only 5% of the Chepang people still use chiuri butter.

4. Discussion

The objective of this study was to assess the status of chiuri as a cultural keystone species to the Chepang people in central Nepal. The very high ICI value (34/35) attributed to chiuri by the participants confirms its CKS status. Indeed, the ICI values previously reported for CKS were usually in the 26–35 range [10,45,66,67]. Likewise, the use value (UV) indicates that participants knew on average 5.72 uses of the chiuri tree, which is among the highest UV values reported (0–6) [68–70]. The cultural importance of chiuri is particularly reflected by the fact that, according to most participants, it could not be replaced by another native tree species.

The traditional uses, economic value and livelihood contribution of chiuri to the Chepang people have been documented in Nepal [32,36,59,71] and in India [38]. However, none of these studies used the CKS framework to assess the cultural importance of the species. The CKS framework could be useful for assessing the biocultural importance of other tree species that are reported as culturally salient in Nepal, but without a strong methodological basis, such as the banyan (*Ficus benghalensis* L.), bodhi (*Ficus religiosa* L.) [72], as well as the mauwa (*Madhuca longifolia* [Koenig] MacBride) [73].

A number of wildlife species depend on chiuri for habitat and food. Among them, bats return the favor by playing an important role in chiuri pollination. As revealed by the participants, bats are considered pure as they only eat chiuri flowers and fruits. They are therefore hunted and eaten as a delicacy. The Chepang people are known as the "bat hunting tribe" [61]. Bat meat has been increasingly sold in markets [61], partly explaining the declining abundance of chiuri, according to the participants. Hence, one benefit (bat meat) can be obtained at the expense of another (chiuri fruits). Increased bat-hunting control would improve chiuri sustainability, while reducing the risk of zoonotic disease propagation [74,75].

The participants mentioned another example of the difficulty of balancing between two benefits (chiuri fruits and chiuri honey). An increasing number of Chepang families engage in beekeeping and production of chiuri honey as a source of additional income [33,34]. However, the participants mentioned that excessive bee foraging of chiuri pollen and nectar reduces fruit production. Improved monitoring of beekeeping is therefore necessary to keep the balance between both benefits (chiuri fruits and chiuri honey).

The participants mentioned that respect and care for chiuri have declined over the years. In addition to the abovementioned indirect effects of bat hunting and beekeeping, branch lopping has also increased. Again, there is a balance to find between two benefits (leaving the branches on the trees to produce fruits or cutting the branches for fodder). Thus, socio-economic changes have altered cultural practices, which are now threatening the fragile balance of the Chepang–chiuri socio-ecological system. Culturally-sound management measures are needed to allow local people to continue benefitting from all the services provided by the chiuri tree and associated wildlife. Such management measures need to be developed and implemented in a partnership between the Chepang communities and state authorities, thus sustaining local culture and ecosystems [76,77]. Chiuri has recently been identified as one of the top-priority non-timber forest products for livelihood support and soil protection [78] in the Chure hills, one of the most fragile and vulnerable landscapes in Nepal [79].

5. Conclusions

The very high ICI and UV values we found for chiuri in this study confirm its cultural keystone species status for the Chepang people. The species provides multiple benefits and has a unique place in Chepang culture. However, socio-economic changes in recent years have caused changes in cultural practices, with more people engaging in chiuri branch lopping, beekeeping and bat hunting. These practices have shifted the balance of different benefits that the Chepang obtain from chiuri, either directly (fruits, branches) or indirectly (honey from bees, bat meat). Additional studies are needed to quantify the different threats to chiuri, and to identify appropriate forest and wildlife management practices.

Our study of the chiuri case shows that the CKS framework is useful for identifying species of interest and measuring their cultural salience, and for identifying conservation, management and restoration practices needed to preserve the benefits the species provide. The CKS framework could thus be used in other socio-ecological systems where local people's culture, subsistence and livelihood depend on the benefits they obtain from plant and animal species.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A Interview Guide (Translated from Nepali)

Date:
Locality:
Name of the participant:
Age:
Gender:
Occupation:
Education level:

1. What are the uses of chiuri in your community? (Identify species use values, i.e., intensity, type, and multiplicity of use)
    a. Characteristics of the species
    b. Parts used
    c. Used for
    d. Methods of use
    e. Time(s) and method(s) of harvesting
    f. Areas of collection
2. Which groups of the community commonly collect and use chiuri (gender and age)?
3. Is chiuri prominently featured in narratives or ceremonies/rituals, dances, songs, or as a major crest, totem, or symbol?
4. Does the Chepang language include names and specialized vocabulary about chiuri, including place names, name(s) for the tree itself or some of its parts, names of products created with chiuri, names of ceremonies conducted with chiuri or within forests where it is found, etc.?
5. Is chiuri frequently discussed among Chepang people?
6. Does chiuri have a story associated with the ancestors? Does it have a spirit of its own?
7. Could chiuri be replaced with another available native species that would fulfil the same functions/uses?
8. What is the availability (past and present trends) of chiuri?
9. Is chiuri sold in markets or exchanged for other products with other groups?
10. What other species are dependent on chiuri? (e.g., habitat, food).

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