Conservation Governance of Ecosystem Goods and Services obtained from Red Panda Habitats in Western Nepal

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A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

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Declaration

I, Manoj Bhatta, declare that the work herein, now submitted as a thesis for the degree of Doctor of Philosophy at Charles Darwin University (CDU), is the result of my own investigations unless otherwise referenced or specifically acknowledged.

I hereby certify that the work embodied in this thesis has not already been accepted in substance for any degree, and is not being currently submitted in candidature for any other degree. To the best of my knowledge, the thesis contains no material that has been written or published by a third person. I acknowledge that the copyright of the published work (Chapter 2) contained within this thesis remains with the copyright holder of the work.

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August, 2021
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Dedication

I want to dedicate my PhD to my Grandma late Belu Devi Bhatta who taught me to be humble, dedicated, and honest. To my parents Padam Raj Bhatta and Parvati Devi Bhatta, my true source of inspiration, who always believe in me, and encourage me to pursue my dreams. To my beautiful wife Mandira Dahal who walked together toward the successful accomplishment of the degree. And to all the conservationists globally who tirelessly working for the conservation of the nature and betterment of humanity.
List of publications and submissions

Chapters 2, 3, 4 and 5 of this thesis have been written as scientific peer-reviewed papers. Their status is as follows:

Chapter 2 – Published


This chapter identifies the services provided by red panda habitats that contribute to the quality of life and wellbeing of the remote communities living in and around a protected area in western Nepal. It also suggests that understanding the value of the services provided to local communities could allow the development of policy that would also help conserve red pandas. The chapter has been published in full in *Mountain Research and Development*. Changes have been made to the formatting and the referencing style to ensure it is consistent with the rest of the thesis; the published text is included in the Appendices.

PhD Candidate contribution:

MB conceived the ideas, designed the analysis, and wrote the manuscript. STG and KKZ helped in the conceptualisation, design and execution of the analyses. STG, KKZ, and BJA contributed to writing, reviewing and editing the manuscript.

Chapter 3 – Submitted

This chapter describes the current use and availability of ecosystem goods and services from red panda habitat in and around a protected area in western Nepal, as well as trends over the last 20 years, and the factors driving those trends. It identifies how information on trends in the use and availability of ecosystem goods and services from the panda’s forest habitats could contribute to the development of policy instruments that concurrently improve local livelihoods, reduce degradation in natural resources and conserve biological diversity. Changes have been made to the formatting and the referencing style to ensure it is consistent with the rest of the thesis.

**PhD Candidate contribution:**

MB designed and conceived the ideas, perspectives and methodology with guidance from STG and KKZ. MB collected the data and wrote the manuscript. KKZ assisted with data analysis and STG contributed to writing, reviewing and editing the manuscript.

**Chapter 4 – Submitted**


This chapter determines the willingness of local people to participate in a potential PES-like scheme to help the conservation of the red panda habitat through reduced use of forest resources. The results could be used to the design and implementation of a PES-like scheme concurrently managing the nexus between effective conservation, sustainable
resource utilisation and livelihoods improvement. Changes have been made to the formatting and the referencing style to ensure it is consistent with the rest of the thesis.

**PhD Candidate contribution:**

MB conceived of the ideas and perspectives, selected the methodology, and analysed the data with assistance from KKZ. MB wrote the manuscript with KKZ and STG helping by reviewing and editing the manuscript.

**Chapter 5 – Submitted**


This chapter describes the governance regime for forests in the study area, then uses best-worst scaling to reveal which aspects of good governance are most preferred by local residents. Policy changes are suggested to the governance regime that may increase local control of outcomes and reduce corruption.

**PhD Candidate contribution:**

MB conceived of the ideas and perspectives, selected the methodology, and collected the data with assistance from KKZ. MB led the analysis of the data and writing of the manuscript in collaboration with KKZ and STG.
Abstract

Mountain ecosystems in north-western Nepal provide habitats for the endangered red panda (*Ailurus fulgens fulgens*) as well as satisfying the daily livelihood requirements of local communities. I explored how panda conservation could be advanced by managing sustainably the ecosystem goods and services derived from their habitat.

I used a mix-methods research approach to i) identify the ecosystem goods and services provided by the panda’s habitats (iii) assess trends in their use, availability, and condition (iv) determine whether local people would agree to be compensated for reduced use of the habitat and (v) explore ways of habitat governance could be improved.

The most important of the 51 provisioning and cultural ecosystem goods and services villagers obtain from red panda habitats were seasonal grazing in upland pastures, plant materials for medicines and food, wild plants for energy, transhumance culture, and religious interactions with nature. Of these, use of medicinal plants had increased but their availability had declined; bamboo use had remained steady although was becoming harder to obtain; there was less traditional transhumant pastoralism to upland pastures than previously but pasture availability had also declined; use of sacred religious sites had declined inside but not outside the park but the reverse was true for recreational tourism. The choice experiment indicated that a large majority of respondents were willing to accept compensation in return for reducing forest resource use, preferably receiving a mix of communal and personal payments. Best-worst scaling revealed that villagers prioritized participation in decision-making over other aspects of governance, which is probably the most effective means of reducing the impact of systemic corruption that currently prevents effective delivery of environmental policy in the region.
The research provides the basis for introducing incentive-based governance approaches (designing PES or PES-like schemes) in red panda habitats in Nepal which will strengthen existing governance regimes, conserve the panda and support local communities. However, the work also uncovered a widespread belief that existing forest management is impeded by corruption and rapid changes in the ways in which the habitat is used that may benefit the panda.
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Chapter 1. Introduction

Red panda (Ailurus fulgens fulgens) in the Mountain habitats of eastern Nepal. Photo: Damber Bista, 2019)
1.1. Governance, conservation governance, and good governance

There is no simple or commonly acknowledged definition of ‘governance’. The concept is widely debated in current policy science literature, which has resulted in a wide spectrum of concepts being applied (Arnouts et al., 2012, Kersbergen and Waarden, 2004). In general, governance is the ‘process of decision making and the process by which decisions are implemented’ (Sheng, 2009), inclusive of formal and informal actors responsible in decision making and implementation (Pokharel & Tiwari, 2013). Some authors argue that it is the process of developing, encouraging, and sustaining special collaboration between governmental and non-governmental actors in the governing process (Howlett et al., 2009). Others claim that governance is all about governing by, with and without the state (Arts, 2014). Overall, governance is the interaction between government, other social organizations, and citizens to make important decisions in a complex world (Graham et al., 2003). Collectively, these definitions focus on how decisions are made and how they are implemented for effective governance.

Governance of forestry and the environment evolved gradually during the twentieth century from a state-based ‘top-down’ model to one in which other actors, including local communities and the private sector, were able to participate in the governance process (Lemos & Agrawal, 2006; McDermott et al., 2010; Kozová et al., 2018). Globally, forest conservation governance has been in limelight due to the tactical and economic importance of forests (Rayner et al., 2010). The actors have included local government authorities, community-based organisations, rural communities, informal and traditional structure are influentially involved in forest governance worldwide (Tucker, 2010). The concept has progressively become a key to achieve conservation governance goals, primarily for forest preservation and restoration in the last decade (Carter, 2009; Guariguata & Brancalion, 2014). It is usually noticed that poor conservation governance
and weak institutions lead to the limited implementation of the policy in natural resource conservation and management (Child, 2019). In general, community participation, accountability, transparency and pro-poor policy change can be critical to effective conservation governance.

Endorsed by the United Nations at the end of the 1980s, ‘good governance’ has become imperative for the decision-making process globally (Pomeranz & Stedman, 2020). Good governance is considered essential to meeting development objectives (Abrams et al., 2003) with the overall objective of achieving positive social services, economic development and environmental management (Davis et al., 2013). The principles of good governance should inform all decision-making in policy implementation (van Doeveren, 2011) and many authors have recognized principles that replicate good governance practices (Pomeranz & Stedman, 2020).

1.2. Conservation governance in Nepal

Nepal has tried various means of conserving its rich biological resources, with participatory biodiversity conservation now considered the most likely to be successful in the development of effective conservation and governance (Khatri, 2010). During the 1970s, to mitigate the rapid loss of wildlife and their natural habitats, the Government of Nepal established strictly protected areas (PA) including national parks, wildlife reserves and conservation areas in various part of the country. At the start of the 21st century, strict protection started to be replaced by more community contributory practices. This shift from strict protection to a more integrated and participatory approach involving sustainable use has improved conservation and management of natural resources, a greater appreciation of local communities towards conservation and a sense of ownership of the PAs (Khatri, 2010). Such participatory conservation governance paradigms
including community managed buffer zones and conservation areas are widespread across
the country (DNPWC, 2015).

The 20 PAs in Nepal - including ten National Parks, three Wildlife Reserves, six
Conservation Areas and one Hunting Reserve - were patronized and directly controlled by
kings and their allies until the end of the monarchy in 2008. Currently, the Department of
National Parks and Wildlife Conservation manages 16 PAs, three are managed by the
National Trust for Nature Conservation and one by a local Council (Api Nampa
Conservation Area Management Council). To promote integrated and long-term
conservation management by improving co-operation among PAs and surrounding
communities, 13 buffer zones have been declared in the country. The PAs and buffer
zones collectively represent 23.4 % of the land area of Nepal (DNPWC, 2015). The PAs
and buffer zone programs have been vital for the effective conservation governance of
natural resources for many reasons. Among them are the significant contribution made by
partnerships between governmental and non-governmental organizations (NGO),
conservation line agencies, and local communities, the expenditure of the revenue
generated by the PAs on rural infrastructure and livelihood support programs, tourism and
eco-tourism promotion and enhancement, and community engagement through
community-based organization formation (such as buffer zone management committees,
buffer zone user groups, buffer zone community forest user groups), which are
responsible for managing the forest for sustainable use, monitoring wildlife and
controlling related crimes (Thakali et al., 2018).

According to the Department of Forest Research and Survey (DFRS) report
(2015), forest covers 5.96 million ha (40 %) of the total area of the country (14.7 million
ha). Of this, 4.9 million ha (83%) lies outside PAs. Under the Forest Act, 2076 (2019), the
forest outside the PAs are under two forest management regimes: private forest and
national forest. The former category is the forest area on the legally owned private land (23 km²). The latter includes all forests that belong to the government other than private forest. The second category is further divided into the government-managed forest (managed solely by the government; 39,000 km²), protected forest (protected in consideration of their environmental, scientific, and cultural importance; 7,110 km²), community forest (conserved, managed and utilised by the community; 12,000 km²), leasehold forest (leased for the specified purposes; 147 km²) and religious forest (entrusted to a religious entity, group or community; 5.43 km²). The Forest Act formalized community forestry and provided community user groups with an opportunity to be independent and self-governing organizations with their own constitution and guidelines for sustainable use and management of forest resources. The country now a leading example among South Asian countries for its decentralized forest governance system. The system is regulated by a comprehensive plan between the Division Forest Office and the forest user groups and aims to achieve the twin goals of forest protection and poverty reduction.

While community-based management to support the conservation of ecosystems and landscapes are becoming increasingly popular in Nepal (Bhatta et al., 2014a), the Government of Nepal is also involved in a landscape management strategy with the main purpose of conserving biological diversity and enhancing local livelihoods outside the PA (MoFSC, 2014b; MoFE, 2018) — a reason being that PAs are not large enough to support the high biodiversity value outside their boundaries. Six landscape conservation programs have been recognized and declared in Nepal covering over 88% of the area nationwide, four of them having the broader aim of strengthening north-south connectivity, maintaining biodiversity corridors, and enhancing livelihoods in the region (MoFE, 2018).
1.3. Gaps in conservation governance and biodiversity management

In international conservation, the centralised state control of forests and other ecosystems in the form of national parks and other PAs has historically been a dominant conservation paradigm (Brockington et al., 2008). However, the concept of governance became a major part of the international conservation discourse when the Fourth World Park Congress 2003 highlighted community participation, NGOs, and the private sector in the establishment and management of PAs (Dearden et al., 2005). In Nepal, participatory conservation has also been a hallmark of conservation initiatives over the past decade. The necessity of participatory conservation in Nepal is due to the substantial dependency of rural people for their livelihoods on natural resources and their intimate cultural connection with nature. Policy and practices relating to the management, institutional arrangements and park-people relationships in Nepal have changed greatly in recent decades (Paudel et al., 2010). In the 1990s the focus was on protecting megafauna (Heinen & Yonzon, 1994) but this has gradually expanded to the conservation of ecosystems and landscapes. Various Governmental Organisations and NGOs working in the field of biodiversity conservation, livelihoods, and human empowerment, have been created inside and outside PAs. The participation of local people has been prioritised in different conservation and development activities and provisions for benefit sharing have been institutionalised particularly in conservation areas and in buffer zones. However, there continue to be gaps between rhetoric and the reality of implementing procedures and participatory conservation approaches (Paudel et al., 2010). These changes in governance have assisted in the building of local capacity through increasing community participation but research to determine the impacts of such governance changes on conservation of biological diversity is warranted and has relevance to the development
and implementation of future conservation policy within the country that has much consideration on principles of good governance.

In Nepal, insufficient knowledge and understanding of ecosystems, poor conservation governance, lack of long-term vision, and inadequate financial resources and technical capacity are some of the major gaps and constraints which limit the potential to sustainably utilise and manage resources in the red panda habitats. Despite several commitments to change, current legal and institutional spaces within the participatory conservation modalities limit the capacity of local people to express their views and influence conservation plans and programmes. As a result, the Government of Nepal is facing increasing community pressure from local and indigenous people for an increased role in conservation decision making and questioning the relevance of participatory policies to local people. This thesis is intended to understand the conservation governance effectiveness in the red panda habitats of Nepal to see why such difficulties are arising.

1.4. Ecosystem Services value and valuation

The world’s human population depends entirely on the Earth’s ecosystems and the services they provide, including food, water, disease management, climate regulation, spiritual fulfilment, and aesthetic enjoyment. Many of these ecosystem services (ES) have direct (e.g. food, water, timber, fuel) or indirect (e.g. climate regulation, air quality) benefits to humans and many people, especially those depending on natural resources and agriculture for their livelihoods, heavily use these ES (MEA, 2005). However, as population pressure increases, land availability declines and climate changes, the provision of ES become under severe threat (Brickhill, 2015).

Many working definitions and description of ES have evolved over the last three decades (Ojea et al., 2010) and a more recent report, The Economics of Ecosystem and
Biodiversity (TEEB) adjusted to these categories. In the TEEB, “Supporting Services” were replaced by “Habitat Services” and “Ecosystem Functions”, and defined as “a subset of the interactions between ecosystem structure and processes that underpin the capacity of an ecosystem to provide goods and services” (TEEB, 2010). Similar to the TEEB classification, the Common International Classification of Ecosystem Services (CICES) from 2012 does not include “supporting services” as proposed by (MEA, 2005), but merges “habitat services” with regulating services in a category called “regulating and maintenance services” (Haines-Young & Potschin, 2012; La Notte et al., 2017). For identification and categorisation of ecosystem goods and services from the red panda habitats, I employed the CICES framework (detail is provided in section 1.10.1).

The limited provision, exploitation and unequal distribution of ES make it necessary to value them (TEEB, 2010). The value of ES can be obtained from the values people hold for them which is a measure of their utility from these services and the importance people place on them for their livelihoods. ES are vital for people’s well-being, but an equal and efficient distribution is difficult because they are not traded in conventional markets, so they do not fall under neoclassical demand and supply rules. Quantifying ES in monetary terms can help to show their ‘true’ value to people and to improve their distribution, provision, and most importantly their conservation. In other words, because markets fail to incorporate the full economic value of ES or allocate appropriate value or price, they often come up as having zero value and are therefore not well protected (Conniff, 2012).

There are various methods of valuating ES which fall into two main approaches i.e. revealed preference (e.g. market price method) and stated preference approach (e.g. choice experiment; Carson & Bergstrom, 2003). This thesis employed a market price method for determining the monetary value of certain goods and services derived from
the red panda habitats and choice experiment to estimate the peoples’ willingness to accept the cash compensation to reduce the resources used from red panda habitats. The details on the choice experiment approach are provided in Section 1.11.5.

1.5. Payments for ecosystem services

There is increasing interest that novel modes of state interference are necessary to introduce more neo-liberal approaches to conservation governance (Potter & Wolf, 2014). Several environmental incentives based concepts and mechanisms ranging from voluntary agreements to market-based contract mechanisms (Kosoy et al., 2007), has been discussed and deliberated to promote and sustain environmental services (Wunder, 2015; Aryal et al., 2019). Such mechanisms include integrated conservation and development projects (Simpson & Sedjo, 1996); payment of ecosystem (or environmental) services (PES; Wunder, 2005); compensation and reward mechanisms for environmental services (Van Noordwijk et al., 2007); “PES-like” schemes (Porras et al., 2008); and incentives for ES (Patterson et al., 2017). These concepts/schemes unlikely to be similar, may not always pursue a market-based mechanism (Wunder et al., 2008) but have common goals of internalizing negative environmental externalities and promoting and sustaining the positive ones (Aryal et al., 2019).

In this regard, PES defined as, “voluntary transactions between service users and service providers that are conditional on agreed rules of natural resource management for generating offsite services” (Wunder, 2015) -- are progressively powerful mechanism of local conservation governance in both developing and developed nations (Wunder et al., 2008; Potter & Wolf, 2014; McElwee, 2012; Higgins et al., 2014). This mechanism is widely considered as an effective and efficient than other non-market-based means of action because of its flexible and result driven quality (Lockie & Tennent, 2010; Engel et al., 2008).
People living in or around the red panda habitat use the resources, such as timber and non-timber forest resources, in their daily lives. For the conservation of the red panda, it would be better if they don’t or reduce the use. One way to ‘persuade’ them not to exploit the red panda’s habitat is to compensate them for income foregone or for providing the service of protecting the red panda. But what is an appropriate level of compensation? Using economic valuation helped this thesis to answer this question and guide decision-makers to set appropriate incentives for local people to help to protect the red panda and its habitat. This mechanism can not only improve conservation outcomes but also increase income generation in rural areas, food security and sustainable conservation.

1.6. Red panda: a charismatic species

1.6.1. Species description

The red panda (*Ailurus fulgens fulgens*, Cuvier 1825) is the sole species of the monotypic family Ailuridae, and includes two sub-species *Ailurus fulgens fulgens* and *Ailurus fulgens styani* (Glatston, 1994; Roberts & Gittleman, 1984). They are solitary animals except during the mating season when they may sometimes be observed as a pair or a group of three. They are generally considered to be nocturnal or crepuscular and are usually sedentary, though may travel a linear distance of at least 1.8 km during the breeding season (summer in Nepal) in June to August (Yonzon, 1989). They primarily eat leaves and shoots of bamboo species supplemented with berries, fruits, mushrooms, acorns and lichens (Pradhan et al., 2001). Globally, red pandas are found throughout the Himalayan Mountains (Fig. 1.1) of Nepal, India, Bhutan, Myanmar and China between 2200 and 4800 m altitude (Glatston et al., 2015; Roberts & Gittleman, 1984). They are
charismatic animals and ideal as flagship species for harnessing public support for natural

In Nepal, red pandas are distributed within a narrow elevational range 2500 –4200
m in the northern part of the country which includes 24 districts and seven PAs covering
approximately 24,000 km² (Fig. 1.2), with the majority (nearly 70%) of habitat lying
outside the PA networks of Nepal (Bista et al., 2016; DNPWC & DFSC, 2018).
1.6.2. Red panda conservation actions and initiatives in Nepal

The red panda has been listed as “Endangered C2a(i)” in The Status of Nepal’s Mammals: The National Red List Series 2011 (Jnawali et al., 2012), a status also accorded the species as a whole in the International Union for Conservation of Nature Global Red List of threatened species. It was also listed in Appendix I of the Convention on International Trade in Endangered Species of Wild in the early 1990s, which bans any international trade. The species is a top priority threatened species facing the threat of extinction listed under the National Parks and Wildlife Conservation Act 1973. The National Biodiversity Strategy and Action Plan 2014-2020 has focused on conservation of the endangered species like the red panda and a red panda conservation action plan (2019-2023) has been developed and implemented in Nepal. Thus, red panda is well represented in different conservation laws, acts, and regulations in the country.

The country has established numerous PAs in the mountains of Nepal which are contributing to the conservation of the threatened species including red panda. Some fine-
scale collective red panda conservation efforts have been initiated through the buffer zone management committees and division forest offices within red panda habitats (DNPWC & DFSC, 2018). Red panda habitats inside these mountain PAs are conserved to some extent but the majority (70%) of these habitats fall outside the PAs (Bista et al., 2016). Outside the PAs, a conservation intervention by the Red Panda Network in red panda habitats of eastern Nepal has been a major step towards community-based red panda conservation (Williams et al., 2011; MoFSC, 2014b). The program has recently been introduced to western Nepal (DNPWC & DFSC, 2018). In addition to this, Nepal has initiated a community-based management landscape-level approach to conserve the mountain ecosystems that support numerous threatened species, including red panda. Along with these conservation actions, the country conducted the first national survey of red panda (Bista et al., 2016), a protocol on species survey and monitoring has been designed (MoFSC, 2015), and various community-based red panda population monitoring programs have been conducted (Mahato et al., 2011; Williams et al., 2011) in eastern Nepal.

1.6.3. Forest resources utilization from red panda habitat

Biological diversity in Nepal is closely connected with the livelihoods and economic status of the rural population. Almost 80% of Nepalese people live in rural areas and their livelihoods are entirely dependent on subsistence farming (Pokharel, 2015). The same proportion of rural people also depends on forest resources for their livelihood (Shrestha et al., 2020), usually for household use, food security and income generation.

In the habitat of the red panda, seasonal livestock grazing (mostly yak, goat and sheep) and the cutting of edible parts of bamboo to provide additional food to livestock
decreases the availability of the leaves and the shoots of bamboo species that are the major part of the panda’s diet (Pradhan et al., 2001; Yonzon, 1989). The leaves and shoots of *Drepanostachyum* spp., the most important bamboo species, are also exploited for domestic use with young shoots of this species consumed as a vegetable and occasionally in making pickles. *Drepanostachyum* spp. are used for house and cattle shed roofing, walls, fencing, chicken coops (*chrungo*) and bedding while *Drepanostachyum falcatum* (*malingo*) is favoured for making baskets, brooms, *suppo, Haludo, mandro, chapro, syaku* and other kitchen utensils, some of which are sold (Bhatta et al., 2014b, Williams, 2003).

The rate of collection of NTFPs, especially *Drepanostachyum* spp. and medicinal herbs that also supplement the panda’s diet such as *Cordyceps sinesis* (*Yarsagumba*), *Morchella esculenta* (*Ghuchhi chyau*), *Asparagus filicinus* (*Kurilo*), *Valeriana jatamansii* (*Samayo*), *Pleurospermum dentatum* (*Ganaino*), is highest at the upper end of red panda habitat while the most important tree species for red panda, including *Quercus semecarpifolia, Abies spectabilis, Tsuga dumosa, Picea smithiana, Pinus wallichiana*, are felled to meet local demand for timber and fuelwood (Acharya et al., 2018).

1.7. Necessity of good conservation governance in red panda habitat

In Nepal, all known and most potential habitats of red pandas lie in the Middle to High Mountains (2000-5000 m) physiographic zone. This zone consists of forests, rangelands, wetlands, farmlands and snow and rock covered landscapes that support and sustain a large number of plant and animal species. Many endangered species of flora and fauna inhabit this zone, which contains 84% of the country’s PAs, as well as about half of the country’s global priority eco-regions. However, these valuable mountain ecosystems and the services they provide are increasingly at risk due to deep-rooted poverty, degradation of natural resources and the adverse impacts of climate change (MoFSC,
A particular threat to mountain biodiversity is overexploitation of non-wood and wood products, which results from weak conservation law enforcement and inefficient control over the resources in the mountains (Bhatta et al., 2014b; Ojha et al., 2019). Millions of people residing in the rural areas of Nepal directly depend on forest biodiversity to meet their daily subsistence requirements. The rich diversity of plants and animals in Nepal provide a wide range of goods and services as well as income-generating opportunities for the local people, which includes many ethnic groups (Sharma et al., 2010). The Ministry of Forest and Soil Conservation estimated that the rural people of Nepal use about 1,463 species of valuable herbal medicinal plant (Chaudhary, 2009). However, poor conservation governance and a lack of appropriate forest management have resulted in unsustainable harvesting of these resources and reduced the productivity of forests (He, 2018). This shows the necessity of research to improve the sustainability of ES and good governance over the resources in the suitable red panda habitat of Nepal.

Although the benefits of ecosystem function to humans have become more apparent (MEA, 2005) and the conservation spotlight has shifted away from individual species, some questions remain which can only be addressed at the species level because the long-term functioning of ecosystems depends on the stability of species in their communities, as these ensure the functioning of the entire system (Blüthgen et al., 2016). Similarly, many species will require specific and targeted interventions to persist in the face of climate change and increasing rates of land conversion worldwide (McLachlan et al., 2007). Improvement in the governance of red panda habitat in Nepal has the potential not only to conserve this endangered species but also to help to preserve its unique habitat, which also provides habitat for a range of other threatened species. In addition, despite the Government and NGOs spending increasing sums of money on conservation policies and programs, there is a lack of scientific assessment of their effectiveness in
meeting conservation objectives. Additional research regarding the effectiveness of the conservation governance and successful implementation of conservation policies is therefore essential in contemporary conservation management (Ferraro & Pattanayak, 2006).

An action plan from the Species Survival Commission of the IUCN, “Status Survey and Conservation Action plan for Procyonids and Ailurids”, recommended conducting surveys to determine the status and distribution of red panda throughout its range (Glatston, 1994). Yonzon et al. (1997) also stated that conservation of the red panda in Nepal has been constrained by a lack of reliable information regarding the status, distribution, and habitat. However, in the last decade, there has been remarkable work done to explore the status and distribution and threats to the red pandas in their potential habitat (DNPWC & DFSC, 2018). The Government of Nepal, in collaboration with the World Wide Fund for Nature-Nepal and the Red Panda Network-Nepal, has conducted a nation-wide survey to identify all habitats used by the red panda (Bista et al., 2016). However, corresponding information on the governance of that habitat and the extraction and utilization of resources from the red panda habitat in Nepal is lacking, which implies the importance of further scientific research to conserve this species in the wild.

The species is facing intense pressure for survival due to various human-induced activities such as habitat fragmentation and destruction and there is a need to ameliorate existing threats (Acharya et al., 2018; Panthi et al., 2019). Among the actions needed is improvements to the species conservation governance and implementation of conservation policies designed to protect red panda habitats. Research on how the conservation governance of the red panda habitat can be improved has not been carried out. Hence, this research project: “Conservation governance of ecosystem goods and services obtained from red panda habitats in Western Nepal” will provide an important
addition to the existing database of knowledge regarding the status of governance of the red panda habitat and help in the design and implementation of the conservation and management activities undertaken in the country.

1.8. Significance of the study on ecosystem services for red panda conservation

Ecosystem services research has highlighted the role of biodiversity in maintaining essential services in human-modified landscapes. Biodiversity is not regarded as an ES itself, but rather as a pre-requisite to sustaining each of them with complex links between the presence of diversity and the capacity of an ecosystem to provide services. Changes to and the loss of biodiversity can also directly influence the capacity of an ecosystem to produce and supply essential services and can affect the long-term ability of ecological, economic and social systems to adapt and respond to global pressures (Close et al., 2009). Much remains to be learnt by measuring, modelling, and mapping ES, and assessing how changes in their delivery affect human welfare (MEA, 2005).

Nepal is richly endowed with a variety of natural ecosystems that provide invaluable ES to local people, the nation as a whole, and indeed, the world. Forests, grasslands, wetlands, and the high mountains are all important habitats for Nepal’s spectacular wildlife and provide a range of ES that are integral to the livelihoods of the population, most of whom live in rural areas. However, the National Biodiversity Strategy and Action Plan: 2014–20 (MoFSC, 2014a), and a technical report published by the International Centre for Integrated Mountain Development (Rasul et al., 2011), which defines a Framework for Valuing Ecosystem Services in the Himalayas, identified major deficiencies in understanding of the country’s biodiversity, a lack of awareness of the importance of ecosystems services among users, a lack of economic valuation of ES, inadequate understanding of climate change impacts on species and ecosystems, inadequate research and knowledge of non-timber forest products, and weak linkages
between research and policy. Improved policy formulation can deliver not only more effective biodiversity conservation but also sustainable livelihoods and poverty reduction (DNPWC & BCN, 2012) with policy decisions made and management actions taken now having implications for biodiversity, ES and people well-being far into the future.

Red panda habitat in Nepal includes many places with high levels of biodiversity and which deliver a range of other important ES. These areas can tell us a lot about the state of biodiversity in the mountainous region of the country, how habitats and ecological systems are linked to the provision of services and who benefits from their provision. Answering these questions can inform decision-making at both small and large scales. Given that the entire red panda range is facing intense pressure from human disturbance, habitat fragmentation and overexploitation of resources, decision-makers need clear information on how biodiversity underpins these services, the demand for them, the capacity of ecosystems to provide them and the pressures impairing that capacity (Brickhill, 2015). This thesis explores the gap of knowledge in the sector of ES and their governance in the red panda habitat of Nepal.

One overarching question is why we need to value ES and biodiversity. Valuation, if done well and robustly, can positively influence policy at local, regional, national, and international levels (Brickhill, 2015). Ecosystem valuation is important for unravelling the complexities of socio-ecological relationships, making clear how decisions would affect ES values and for expressing value changes in a monetary form that allows their integration into public decision-making processes (Mooney et al., 2005). Valuing ES and incorporating those services into decision-making processes can help in evaluating the impacts of development policies and policy interventions that alter the condition of an ecosystem and consequently in human well-being (NRC, 2005). Another reason for conducting valuation studies is to understand alternative uses for some biodiversity goods
and services. Valuation also helps to identify impending insecurity in demand and supply of natural resources and compensation for damage to natural capital as well as providing a stronger basis for more inclusive and effective ecosystem-based management (TEEB, 2010). Thus, the valuation of ES can be useful for providing a way to validate and set priorities for programs, policies, or actions that preserve or restore ecosystems and their services.

Overall, the sustainable management of red panda habitats is possible if policymakers appreciate the root causes and impacts of the unsustainable use of resources, line agencies implement comprehensive and targeted policies effectively, and communities understand and embrace the reasons for policy change both outside and inside PAs. Thus, this thesis is expected to inform science, policy, and society in general, which could therefore drive more equitable and sustainable policies, plans, and regulations, and help to conserve red pandas. Simultaneously, it will improve the sustainability of resource management by local people, thus building a positive nexus between preservation of mountain habitats, species conservation, and sustainable livelihoods of deprived communities. This approach of linking biological diversity, ecosystem services, and livelihoods may be useful in other red panda habitats and equally applicable in the conservation of other threatened and flagship species throughout Nepal.

1.9. Study area and context

The study was conducted in six administrative wards (consisting of 11 localities) nearest to known red panda habitats (Fig. 1.3): three in Rara National Park (RNP) and the adjacent buffer zone in Mugu district (Jnawali et al., 2012), and an additional three in Jumla district outside both (Bhatta et al., 2014b). These two remote mountain districts are in Karnali province, the largest of Nepal’s seven federal provinces with an area of 24,453 km² but having the smallest population (1.6 million).
We purposefully selected the nearest villages to the known red panda habitats in and around the PA as our study sites. Secondly, these locations have two distinct forms of forest governance. Forests inside the PA are managed by both buffer zone management committees and the RNP authority, which is part of the Department of National Parks and Wildlife Conservation. Community and leasehold forests outside the PA are managed by the district office of the Department of Forests and Soil Conservation. Lastly, these communities support their livelihoods through a high dependency on red panda habitats.

Figure 1.3. Location map of Rara National Park, the associated buffer zone and Jumla district.

The study region is located in the highly mountainous north-western corner of Nepal, with a diverse climate that includes warm and wet summers, slightly cold and dry winters and warm and dry springs (Ichiyanagi et al., 2007; Putkonen, 2004). The RNP is Nepal's smallest PA (106 km$^2$) and is situated in both Mugu and Jumla districts. The adjacent buffer zone (198 km$^2$) consists of one Municipality and two Rural Municipalities of Mugu and one Rural Municipality of Jumla district. The forest area in Jumla and Mugu
district is approximately 1,210 km\(^2\) and 1,200 km\(^2\) respectively (DFRS, 2015). A significant proportion of the mountains are grasslands and rangelands which contribute as grazing lands for sheep, mountain goats, yaks, and horses. These highland meadows are also rich in medicinal herbs. The high-altitude landscapes of the study area are also the habitat of diverse flora and fauna including several globally threatened species, such as red panda \((Ailurus fulgens)\), snow leopard \((Panthera uncia)\), Himalayan musk deer \((Moschus chrysogaster)\) and Himalayan thar \((Hemitragus jemlahicus; RNP, 2019)\). Forests of these mountain habitats are characterised by temperate and subalpine (inferior) bioclimatic zones which are dominated by \(Quercus semecarpifolia, Abies spectabilis, Acer sp., Rhododendron spp., Betula utilis, Picea smithiana, Pinus wallichiana\) etc. (Bhuju et al., 2007). Overall, these habitats constitute core resources for both local communities and endangered species such as the red panda.

Despite being bio-culturally diverse, the study area is the most impoverished, geographically isolated, and least developed region of the country. Jumla and Mugu possess a human development index (geometric mean) of 0.409 and 0.397, a human poverty index of 42.1 and 45.2, a life expectancy index of 0.636 and 0.676, and an adult literacy index of 0.444 and 0.393 respectively, with overall human development ranking near the bottom of the table for the country (NPC, 2014). Most people in the area depend on agricultural activities for their livelihood but face acute food shortages for much of the year because the little arable land available is not very productive. Traditionally the economic activities in the villages are limited to a combination of agriculture (mostly millet, barley, maize, potato cultivation), animal farming (large herds of sheep and mountain goats), the collection of medicinal herbs and high-value forest products, home trade industries, and seasonal outmigration for employment.
1.10. Conceptual frameworks

1.10.1. Common International Classification of Ecosystem Services

(Chapter 2)

The Common International Classification of Ecosystem Services (CICES) is a commonly used ES classification framework (Haines-Young & Potschin-Young, 2018), specifically for ‘mapping, ecosystem assessment, and natural capital ecosystem accounting’ after the first version was disseminated in 2013 (Haines-Young & Potschin, 2013). It has been updated to version 5.1 (for an overview of the revised structure of the framework visit, www.cices.eu) which provides a way of classifying ES as well as acting as a cross-reference classification that allows translation between various existing ES classification systems, for example, that used by the Millennium Ecosystem Assessment (MEA; Leemans & De Groot, 2003), The Economics of Ecosystems and Biodiversity (TEEB; Sukhdev et al., 2008) and the Intergovernmental science policy Platform on Biodiversity and Ecosystem Services (IPBES; Díaz et al., 2015), with its notion of nature’s benefits to people. (Haines-Young & Potschin, 2018). The CICES is a more comprehensive classification system than the common alternatives that uses a hierarchical structure and is applicable at different geographical and thematic scales (Haines-Young & Potschin, 2012). This kind of structure divides three major categories (‘sections’) of provisioning, regulating and cultural services into more precise ‘divisions’, ‘groups’, and ‘classes’ (Fig. 1.4; Potschin & Haines-Young, 2016; Czúcz et al., 2018). This systematic framework allows users to place the services in which they are interested in classes with no sub-divisions at the bottom of the hierarchy below class level (Czúcz et al., 2018).
Figure 1.4. Illustration of the hierarchical structure of CICES V5.1 using cereals (figure adapted from Haines-Young & Potschin-Young (2018)).

1.10.2. Framework for Assessing and Monitoring Forest Governance

(Chapter 5)

There have been numerous frameworks for assessing governance proposed by developmental aid donor organizations, working groups and scholars through books and peer-reviewed literature (van Doeveren, 2011) that cover the principles of good governance, criteria, indicators, methodologies, and operational tools focused on the governance quality measurement (Secco et al., 2014). These frameworks have been designed to assess the quality of forest governance at the national level, primarily for developing countries, but each has shortcomings (Secco et al., 2014).

To assess the quality of conservation governance of red panda habitat (Chapter 5), this thesis used, Framework for Assessing and Monitoring Forest Governance (PROFOR
and its users’ guide (Kishor & Rosenbaum, 2012) developed by the Program on Forests (PROFOR) and the Food and Agriculture Organization (FAO) of the United Nations. This framework has been designed with the intention of improving general insights into forest governance and to encourage progress towards best practice in the processes and application of good governance. The framework consists of six governance principles (accountability, effectiveness, efficiency, fairness/equity, participation, and transparency) which can be assessed using indicator questions about the current state of forest governance. The principles of the PROFOR governance framework have drawn on various approaches and frameworks developed by different organizations working in the sector of forest governance related process, actions, and monitoring systems (PROFOR & FAO, 2011). For each principle, PROFOR proposes a definition that can be useful to understand the clear and concise meaning of good governance. In this thesis (Chapter 6), I adapted these definitions and designed indicator interview questions for each principle, which are most relevant and likely to be understood by the local communities in and around the red panda habitats.

1.10.3. Flagship species centric assessment of ecosystem services and conservation governance

Ecosystem services are projected globally at USD $125 trillion per year (Costanza et al., 1997; Costanza et al., 2014). Similar estimations at national and regional levels replicate how these goods and services sustain our livelihoods (Bateman et al., 2013). There is also strong evidence that biodiversity, which is globally in continuous decline, is essential to sustaining these services (Butchart et al., 2010). The red panda epitomises flagship species in the Himalayas (Yonzon & Hunter, 1991). This charismatic mammal is an ideal flagship species for harnessing unrivalled public support for practical
conservation funding, as well as decision making. The species is an indicator species of the mountain forest (Roka et al., 2020). Assessment of its role as a flagship species, however, has yet to be explored (Karki et al., 2021).

Many paradigms persist in nature conservation. Lately, species based (flagship species) and ecosystem based (ecosystem services) conservation paradigms have appeared as an increasing dichotomy (Sergio et al., 2003; Thompson and Rog, 2019), which have a greatest impact in framing conservation policies, decision making process and research activities (Schröter et al., 2014). Both views substantially debate the worth of each paradigm among the conservationist, practioners and decisionmakers (Ducarme et al., 2013), with both having strengths and shortcomings (Senzaki et al., 2017; Thompson, 2019).

In this context, this thesis predominantly uses two conceptual elements – conservation governance and ecosystem services – to articulate the conceptual contribution of a flagship species centric approach for conservation governance of mountain red panda habitats, biodiversity conservation as a whole, and the sustainable flow of ecosystem services.

1.11. Methodological approaches

A systematic data collection process is necessary as it ensures that the data gathered are both clear and accurate and that subsequent decisions based on the findings are valid (Sapsford & Jupp, 1996). The research methodology is the general research strategy that outlines the way in which research was undertaken and, among other things, identifies the methods used (Howell, 2012). This thesis used both qualitative and quantitative research approaches to attain the aims of the research.
1.11.1. Mixed method approach (qualitative and quantitative research method)

Qualitative research uses a naturalistic approach that seeks to understand phenomena in context-specific settings, such as the "real world setting [where] the researcher does not attempt to manipulate the phenomenon of interest" (Patton, 1990). Quantitative research uses the systematic empirical investigation of observation phenomenon via statistical, mathematical, or computational techniques (Given, 2008). This means qualitative research recognises the socially constructed nature of reality, including that there is a relationship between the researcher and subject(s), as well as situational constraints that shape enquiry (Denzin & Lincoln, 2011). Unlike quantitative researchers who seek causal determination, prediction, and generalization of findings, qualitative researchers seek instead illumination, understanding, and extrapolation to similar situations (Hoepfl, 1997). Thus, qualitative research is used to gain insight into people’s attitudes, behaviour’s, value systems, concerns, motivations, aspirations, culture, or lifestyles (Joubish et al., 2011), whereas quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon. Qualitative research methods are often employed to answer the whys and hows of human behaviour, opinion, and experience which are difficult to obtain through more quantitatively-oriented methods used to quantify attitudes, opinions, behaviours, and other defined variables (Sitorus, 2012).

In this thesis, qualitative research methods including Focused Group Discussions (FGDs) and Key Informants Interviews (KIIs) were used to understand respondents’ viewpoints regarding ecosystem goods and services derived from red panda habitats, trends in use and availability of these goods and benefits and the current state and effectiveness of conservation governance in and around these mountain habitats. For
quantitative information, the thesis also employed the household questionnaire survey for in-depth information on thesis objectives using a semi-structured questionnaire. The core of the questionnaire was a choice experiment (CE), a multi-attribute elicitation method designed to elicit each respondent’s preferences for red panda habitat conservation and thereby indirectly assessing the economic value the red panda habitats has to local people and what would the local peoples’ willingness to accept (WTA) compensation to reduce the use of the forest resources from these habitats. In addition, Best-worst scaling (BWS) was used to identify desired improvements in the governance within the red panda habitats.

1.11.2. Focus Group Discussions (Chapter 2, 3, 4 and 5)

A focus group is a group discussion on a particular topic organised for research purposes (Kitzinger, 1994). The advantage of focus groups is that they present a more natural environment than that of the individual interview because participants are influencing, and are influenced by, others just as they are in real life (Krueger, 2014). This social context offers an opportunity to see how ideas and languages emerge in a more naturalistic setting than in an in-depth interview, and how they are shaped through conversation with others (Ritchie et al., 2013). Thus, focus groups are effective in eliciting data on the cultural norms of a group and in generating broad overviews of issues of concern to the cultural groups or subgroups represented (Mack, 2005).

The researcher, who is called the ‘moderator’ or ‘facilitator’, guides, monitors and records the discussion (Morgan & Krueger, 1998). FGDs may vary in group size and duration depending on the target population, research objectives and the topic under discussion, but a typical format in social research includes a group of six to eight people who meet once for a period of around an hour-and-a-half to two hours (Ritchie et al.,
This research project included eight to ten participants for around two hours. A group of this size is considered ideal because smaller groups may limit the amount of discussion occurring, while large groups can be chaotic, hard to manage for the moderator and either frustrating for participants who feel they get insufficient opportunities to speak or intimidating for those not used to speaking in large groups (Bloor, 2001).

Participants in FGDs were selected carefully to increase the likelihood of obtaining reliable information relevant to the research questions with members of the group expected to be familiar with the research aims, known for their ability to share their opinions respectfully, and willing to volunteer at least two hours of their time for the discussion. The discussions were undertaken with Forest User Groups, women’s groups (Aama Samuha), a herders group, etc. Key individuals in the village also nominated people they thought would make good participants. During this process, information relevant to the research project aims was collected either by taking notes or through digital recordings.

1.11.3. Key Informant Interviews (Chapter 2, 3, 4 & 5)

The method most frequently used to generate data in qualitative research is interviews, which may be defined as structured, semi-structured or unstructured. I used semi-structured interviews, the most commonly used approach (Holloway and Galvin, 2016), as a primary method of data collection during KIIIs which involved asking predetermined questions, but following which the researcher is free to seek clarification (Doody & Noonan, 2013). The flexibility of the semi-structured interview allows the asking of open-ended questions exploring issues that arise spontaneously (Lune & Berg, 2017). This allows information to be discovered and elaborated on that is important to
participants but may not have previously been thought of as pertinent by the research team (Gill et al., 2008).

Key Informant Interviews are qualitative in-depth interviews conducted with people who have detailed knowledge of factors relevant to the research question in their local community. This type of interview is mainly used to collect information from people such as community leaders, professionals or residents who have first-hand knowledge about the community and can provide insights into the nature of problems and give recommendations for solutions (Burgess, 2003). For this thesis, the Key Informants (KI) were selected based on an informant’s intimate knowledge and experience regarding the subject on which they were interviewed. Such knowledge was based on their special social positions, professional expertise or experience in the sector of research interest. The KIs were government officials, particularly Division Forest Officers, forest rangers, Village Development Committee officials, representatives from NGOs working in the conservation sector, local school teachers, local leaders, herders, and representatives of women’s groups. The KIIs were transcribed as field notes and digitally recorded where permission was granted to do so.

1.11.4. Household questionnaire survey (Chapter 3, 4 & 5)

The questionnaire (Appendix 1) used in the survey included both structured and semi-structured questions, a segmented structured questionnaire being accompanied with open-ended follow-up questions. The household survey questionnaires aimed to build on the information collected from KIIIs and FGDs and were piloted before finalization. Participants in the survey were purposively sampled (also termed as judgmental sampling; (Kerlinger & Lee, 2000; Klar & Leeper, 2019). This non-random sampling technique was adopted with chosen respondents being experienced and knowledgeable
with the subject we were studying. In addition to participants’ knowledge and comprehension, their availability and willingness to participate to communicate their opinion in thoughtful ways were considered. The survey involved a single-visit household questionnaire.

1.11.5. Choice Experiment (Chapter 4)

Economic valuation methods fall broadly into two major categories: revealed preference (RP) and stated preference (SP) methods (Freeman III et al., 2014). RP methods rely on the observation of individual choices in actual markets related to the ES that is subject of the valuation (TEEB, 2010), SP methods, on the other hand, use hypothetical markets and elicit individual’s preferences for given changes in the provision of ES through the survey (Defra, 2007). The main SP methods are contingent valuation (CV) and choice modelling, also known as Choice Experiment (CE). Some of the commonly used valuation methods to quantify or estimate the different value components of the Total Economic Value are shown in Fig. 1.5.
The CE involves the repeated selection of the environmental attributes from the hypothetical experiment consisting of the multiple sets of attributes while CV simply estimates overall environmental benefits (Chaikaew et al., 2017; Zander et al., 2010). This attribute based method has been demonstrated to deliver a powerful evaluation of values of non-market goods and services specifically when estimating changes in the quality of the environment (Boxall et al., 1996).

This thesis (Chapter 4) used questionnaire-based CE to discover individual preferences for a reduction in the use of ES as part of the red panda habitat conservation. Participants from the study area were presented with different combinations of attributes and asked to choose their preferred combination or rank the alternative combinations. Each combination of attributes had a monetary attribute associated with it meaning that respondents revealed their WTA for changes in the given attributes. The CEs are most
commonly applied to understanding the service users willingness to pay (WTP) or providers WTA payments in hypothetical markets (Soto et al., 2018). In applied economics, these two limbs of DC are used as the survey techniques intended to measure the value of non-market goods or services. WTP and WTA compensation measure a unit change in an attribute in monetary value (Grutters et al., 2008). These two models estimate how much respondents are willing to pay or would like to be paid to avoid/accept a positive/negative environmental outcome (Ginsburgh, 2017). The detailed design of the CE was finalised after the KII and FGDs because information obtained through the qualitative data collection method was necessary to inform the choice model design, with the model also being piloted before finalization.

1.11.6. Participatory three-dimensional mapping (Chapter 3)

This thesis (Chapter 3) used Participatory 3D Mapping (P3DM), a tool that helps participants convert local geographical knowledge into a map. The use of physical 3D models has been commonly applied to facilitate broader community participation in participatory Geographic Information System (GIS) mapping activities (Brown and Kyttä, 2018, Fisher et al., 2019, Joshi et al., 2016, Ramirez-Gomez et al., 2017). For this thesis, the value of the 3D printed models was their ability to reproduce a detailed representation of the topography of the study landscape. Light weight 3D printed tiles were easy to transport to remote communities and did not require extensive preparation before the models could be used to assist discussion. Study participants used their local spatial knowledge to depict land use, land cover, and other physical features including natural formation such as mountains, hills, rivers, and rangelands. The information about the features depicted in the model was photographed.
1.11.7. Best-worst scaling for good governance assessment (Chapter 5)

The BWS model, a novel substitute to the CE (Flynn et al., 2007), provides respondents with an opportunity to choose both the best (most important) and worst (least important) items in the subset of all the items (Louviere et al., 2015), unlike rating scales (e.g. Likert or numeric rating) which have a single attribute to select (Flynn, 2010). This thesis (Chapter 5) employed the BWS approach to identify the aspects of governance they considered most important for improving the sustainable use of the red panda habitats. The BWS method was used because the model used in this thesis consists of only six different preferences (indicator questions) of good governance and I believed that BWS with this number of attributes would have less cognitive difficulties than other approaches such as direct ranking.

1.12. Research aims objectives and thesis structure

Conservation governance seeks to balance human dependency on resources and the needs of economic development and conservation of biological diversity. There is an urgency to recognising, incorporating and supporting the need for biodiversity conservation and decision making processes because the conservation of endangered species like red panda will not be possible without good governance of the resources it requires.

The overall aim of this research project is:

To understand the effectiveness of conservation governance in the range of the red panda in western Nepal, to explore and value the ecosystem services provided by the red panda habitat and to develop practical measures for sustainable management of those services in a manner that enables conservation of the species.
To achieve these aims I endeavoured to answer the following research questions:

**What are the services provided by red panda habitats that contribute to the quality of life and human wellbeing in western Nepal? (Chapter 2)**

**What are the values of the ecosystem services obtained from red panda habitats for local communities and what are the trends in their use, availability, and condition? (Chapter 3)**

**How willing are local people to enter into an agreement to be compensated for use of the ecosystem services obtained from red panda habitats? (Chapter 4)**

**How can the governance of ecosystem services produced from the red panda habitat be improved and regulated more effectively? (Chapter 5)**

To do this I have published, or submitted for publication, the following research papers. The accepted/submitted version of each paper is included in the Appendices.

Because chapters have been written as stand-alone bodies of publishable work, there is inevitably some repetition in the introduction and method sections of each chapter).

**Chapter 2: Societal recognition of ecosystem service flows from red panda habitats in western Nepal**

This chapter describes the reports on focus group discussions, key informant interviews, informal interactions, and participant observations to identify and categorize the goods and services provided by red panda habitats.

**Chapter 3: Trends in ecosystem goods and services obtained from red panda habitats in north-western Nepal**

In this chapter I used a mixed methods research approach was used to assess the current use of red panda habitat in and around a PA in western Nepal, trends over the last
20 years, and the factors driving those trends with the expectation that information on trends in the use and availability of ecosystem goods and services from these habitats could allow the development of policy instruments that concurrently improve local livelihoods, reduce degradation in natural resources and conserve biological diversity.

Chapter 4: Willingness of local people in western Nepal to accept compensation in return for reducing exploitation of red panda habitat

In this chapter, I report on a survey among villagers in the region to determine their willingness to participate in a potential PES-like scheme to help the conservation of the red panda habitat through reduced use of forest resources with the aim of informing the design and implementation of a PES-like scheme that concurrently manages the nexus between effective conservation, sustainable resource utilisation and livelihoods improvement.
Chapter 5: The state of governance of forest resource use in western Nepal and community preferences for governance principles that would improve sustainability

In this chapter, I describe the current state of governance of ecosystem goods and services derived from red panda habitat and report the results of Best-worst Scaling on which forms of governance local residents of the region think should be emphasised if the sustainability of resource use is to be improved.

Chapter 6: Discussion and Conclusions

This chapter synthesises the results and explores the policy implications arising from the four papers, if implemented, that should help the conservation of red panda, its habitat, associated biodiversity, and habitat dependent communities within red panda habitats.
1.13. References


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https://doi.org/10.1016/B978-1-4377-7813-7.00022-7


Focus Group Discussion participants of Ripi village, Jumla. Photo by Dipesh Acharya (Research Assistant of the project).
Societal Recognition of Ecosystem Service Flows from Red Panda Habitats in Western Nepal

Manoj Bhatta*1, Kerstin K. Zander2, Beau J. Austin1, and Stephen T. Garnett1

2.1. Abstract

The biologically and culturally diverse mountain habitats of the red panda (Ailurus fulgens) produce numerous ecosystem goods and services of global significance, as well as satisfying the daily sustenance requirements and well-being of poor and vulnerable local communities. Most studies of ecosystem services conducted in Nepal have investigated community forest management and protected areas, largely in the lower hills and plains of the country. However, to conserve red pandas and associated biodiversity, knowledge is needed of the services instrumental to the livelihoods and well-being of people living in and around their Himalayan mountain habitats. Using case studies of 6 remote villages nearest to known red panda habitats inside and outside a protected area in western Nepal, this study reports on key informant interviews, focus group discussions, informal interactions, and participant observations to identify and categorize the goods and services provided by these habitats. Among the provisioning and cultural ecosystem goods and services obtained from red panda habitats, local people prioritized seasonal grazing in high-altitude pastures, plant materials for medicines and food, wild plants for energy, transhumance culture, and religious interaction with nature.

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Their dependence on these services varied with season and location, with greater reliance on the services outside the protected areas. Some services used for valuing ecosystems, such as carbon storage, improved air and water quality and biodiversity, were only ever mentioned in a manner that would characterize them as cultural services provided by mountain deities. They only appear to be acknowledged as services with a use value by people from outside the region. This study suggests that understanding the value of the services provided to local communities could allow development of a policy that would also help conserve red pandas, particularly if income can be obtained for providing services to outsiders who have no perceived local economic benefit.

**Keywords:** mountain habitat; livelihoods; transhumance culture; highland rangeland; traditional medicinal herbs; governance.

### 2.2. Introduction

Although mountains cover only about 22% of the Earth’s land surface area and are home for only about 13% of the population (Romeo et al., 2015), well over half of all humans rely directly or indirectly on mountain resources (Rodríguez-Rodríguez et al., 2011; Maselli, 2012). Mountains provide provisioning services like food, timber, fibre, and medicine, regulating and supporting services including water purification, climate regulation, nutrient cycling and soil formation, and cultural services such as aesthetic, symbolic, and religious values (MEA, 2005; Macchi & Team, 2010; Molden & Sharma, 2013; Hamilton 2015). They are also biologically diverse—home to 25% of global terrestrial biodiversity (Sharma et al., 2019).

Among the species relying on mountain habitats are the red panda (*Ailurus fulgens*). Red panda habitats are found between 2500 and 4800 m asl across the mountains of Bhutan, China, India, Myanmar, and Nepal (Glatston et al., 2015). In Nepal,
of which three-quarters is mountainous (Thapa 1996), potential habitats of red panda cover 24,000 km² in 24 districts (Bista et al., 2016; DNPWC and DFSC 2018) in which there are numerous threatened plant and animal species (Måren et al., 2015). Red panda habitats also sustain local livelihoods (Chaudhary et al., 2009), based on livestock and non-timber forest products (NTFPs; BPP 1995). However, population growth, overexploitation, and land fragmentation are all altering traditional practices of resource usage and degrading these mountain habitats (Adhikari et al., 2007; Tiwari and Joshi 2015; Everard et al., 2019). Current policies, regulations, and practices, and demand for goods and services also tend to overlook or undervalue the benefits obtained from nature and lead to suboptimal investment in conservation and management of ecosystems (MEA 2005; Rasul et al., 2011).

While people have long obtained services from mountain ecosystems, the articulation of ecosystem services (ES) as an idea is comparatively new. Quantifying, classifying, and understanding ES has now become a significant field of investigation (Fisher et al., 2009), and several frameworks, approaches, tools, and research (Leemans and De Groot 2003; Sukhdev 2008; Rasul et al., 2011; Peh et al., 2013; Haines-Young and Potschin 2011, 2018; Bennett et al., 2015; Diaz et al., 2015; La Notte et al., 2017) have been proposed to gain insight into the goods and services that nature produces, how they should be categorized and classified, how their value should be quantified, and how the linkages between ES, livelihoods, and well-being can be understood (Carpenter, DeFries et al., 2006; Tallis et al., 2008). However, apart from studies of community forest management systems and lower-altitude protected areas (Lamsal et al., 2018), there is little understanding of ES instrumental to the livelihoods and well-being of people living in mountainous Nepal or how those services benefit the many animals, such as the red panda, with which mountain communities coexist.
This study identifies the services provided by red panda habitats that contribute to the quality of life and well-being of the remote communities living in and around a protected area (PA) in western Nepal. First, we categorize the benefits derived from red panda habitats using a recent ES framework, the Common International Classification of Ecosystem Services (CICES; Haines-Young and Potschin 2018). Then we analyse the ecosystem goods and services obtained from red panda habitats that local people value the most, the services people use, and their interdependencies. In doing so, we aim to improve understanding of nature–human interactions in the region to help develop a policy that will potentially improve local livelihoods and well-being but also ensure sustainable management of ES derived from red panda habitats.

2.3. Materials and methods

2.3.1. Study area

The research was undertaken in Jumla and Mugu districts, 2 remote, mountainous districts of Karnali province in the northwest corner of Nepal (Fig. 2.1). Karnali province is the largest (24,453 km²) of Nepal’s seven federal provinces but has the smallest population (1.6 million). Jumla district (2500 km², population 109,000; CBS 2012) ranges from 2100 m to 6400 m asl (DDC, 2013), annual temperature is generally between 1.3°C and 13.0°C, and receives about 860 mm of rain annually (DHM, 2017). Mugu district to the north (3500 km², 55,000 people; CBS; 2012) is equally mountainous (1200–6600 m; DDC, 2016) but a little cooler (−0.1°C to 10.8°C) and slightly drier (800 mm; DHM, 2017).
The study was conducted in the six villages nearest to known red panda habitats in Rara National Park (RNP), the adjacent buffer zone of Mugu district (Jnawali et al., 2012), and an additional area in Jumla district outside both (Bhatta et al., 2014b). Most people in the area depend on agriculture for their livelihoods but are often short of food because there is little arable land and agricultural productivity is low. Economic activity in the villages is largely limited to traditional occupations such as agriculture, animal husbandry, the collection of medicinal herbs and high-value NTFPs, home trade industries, and seasonal outmigration for employment. Within this traditional economy, the mountains of the study area constitute core resources for both local people and globally threatened species, such as red panda, snow leopard (*Panthera uncia*), musk deer (*Moschus chrysogaster*), and Himalayan tahr (*Hemitragus jemlahicus*).
2.3.2. Data collection

Data were collected from November 2017 to January 2018 using qualitative
research methods including Key Informant Interviews (KIIs; Holloway & Galvin, 2017),
Focus Group Discussions (FGDs; Morgan & Spanish, 1984), informal interactions, and
participant observation (Kawulich 2005; Musante & DeWalt 2011). Participants in KIIs
and FGDs were selected on the basis of their intimate knowledge and experience in the
region and its environments. Informants’ knowledge was based on their social role,
professional expertise, or experience in the sector of our research interest. KIIs (n=15)
were conducted with the Division Forest Officer of Jumla district, the rangers of RNP,
members of the RNP buffer zone management committee and community forest user
groups, the customary village chief (Mukhiya) of each of the study villages,
representatives from the mothers’ groups (Ama Samuha), school teachers, senior citizens,
and herders. A total of 6 FGDs, 3 inside and 3 outside the PA, were also carried out in the
study area. For most FGDs, village leaders nominated people they thought would increase
the likelihood of obtaining reliable information relevant to the research questions. A
discussion with 8 to 10 participants was then conducted for a period of around 2 hours.

Relevant information was also collected from various governmental administration
bodies, line agencies, and nongovernmental organizations and international
nongovernmental organizations. Informal community consultation was first established
with customary village heads, elders, and other local leaders who further facilitated KIIs
and FGDs.

The purpose of the research project was explained to all groups with a description
of the methods to be employed and the affiliations of the researchers. Information during
the individual interviews and group discussions was gathered by using a semistructured
questionnaire (Longhurst, 2003; Baumbusch, 2010) that had been designed to elicit
information on the ecosystem goods and services being provided by red panda habitats that contribute to the livelihoods and well-being of the local people. The FGD participants then ranked the 5 main ES perceived as most important to their livelihoods and well-being. Relevant information was collected by taking notes and through digital recordings in the local language.

2.3.3. Data presentation and analysis

The information was transcribed, translated into English, imported in a Qualitative Data Analysis (QDA) software NVivo 11, and then categorized and classified using CICES, version 5.1 (www.cices.eu). The CICES classification allows translation among various alternative ES classification schemes (Haines-Young & Potschin, 2018). Such schemes include the Millennium Ecosystem Assessment (MEA; Leemans & De Groot, 2003), The Economics of Ecosystems and Biodiversity (TEEB; Sukhdev, 2008), and the Intergovernmental science policy Platform on Biodiversity and Ecosystem Services (IPBES; Diaz et al., 2015). Under CICES’ hierarchical structure, the 3 major categories (“sections”) of provisioning, regulating, and cultural services are divided into more precise “divisions”, “groups”, and “classes” (Haines-Young & Potschin, 2012; Potschin & Haines-Young, 2016; Czúcz et al., 2018) into which users can place the services they are assessing (Czúcz et al., 2018). In contrast, the MEA, the first large-scale ecosystem assessment framework (EC, 2013), had no structured classification at lower levels. To aid interpretation of the information (Miley & Read, 2011), a visual representation of the responses from the FGD participants inside and outside RNP was encapsulated in word-clouds using the online word-cloud generator WordArt (https://wordart.com), based on those words that occurred with highest frequency (Heimerl et al., 2014) after they had been translated.
2.4. Results

2.4.1. Major benefits obtained from red panda habitats

The ES provided by remote red panda habitats were categorized into 4 sections, 6 divisions, 9 groups, and 17 classes (Table 2.1), according to CICES version 5.1 (Haines-Young & Potschin, 2018). Consumptive uses included terrestrial wild plants, animals, and surface water, for nutrition, materials, or energy, and seasonal transhumanism; productive uses included direct use goods such as medicinal herbs, bamboo products, and the products of beekeeping; goods and services with non-consumptive uses identified were recreational activities, research, aesthetic experiences, and symbolic and religious interactions with nature. Non-use ES were also recognized in the red panda habitats including existence, option or bequest values, and cultural abiotic services in the form of religious sites, caves, and high-altitude rangelands.
Table 2.2. Categories of key ecosystem goods and services from red panda habitats; the classification typology including sections, divisions, groups, and classes was adapted from CICES version 5.1 proposed by Haines-Young and Potschin (2018).

<table>
<thead>
<tr>
<th>Ecosystem goods and services categories (modified from CICES version 5.1)</th>
<th>Services / goods and services from red panda habitats</th>
<th>Use of services&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Services locations&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provisioning (biotic)</strong></td>
<td>Terrestrial wild plants for nutrition, materials, or energy</td>
<td>Edible wild fruits and flowers, bamboo shoots, mushrooms, green leafy vegetables</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Terrestrial wild plants, including fungi, algae used for nutrition</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fibers and other materials from wild plants for direct use or processing (excluding genetic materials)</td>
<td>Medicinal plants / herbs, wood and wood products, roofing slate, bamboo species and products, handmade paper, forage, fodder and bedding for animals, flowers for religious offerings</td>
<td>C &amp; P</td>
</tr>
<tr>
<td></td>
<td>Terrestrial wild plants used as a source of energy</td>
<td>Firewood, pine sticks</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Wild animals (terrestrial and aquatic) for nutrition, materials, or energy</td>
<td>Birds, fishes</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Terrestrial and aquatic wild animals used for nutritional purposes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other types of provisioning service from biotic sources</td>
<td>Beekeeping, highland pastures</td>
<td>C &amp; P</td>
</tr>
<tr>
<td><strong>Provisioning (abiotic)</strong></td>
<td>Surface water used for nutrition, materials, or energy</td>
<td>Potable water through pipelines, spouts, brooks, spring</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Surface water for drinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surface water used as a material (non-drinking purposes)</td>
<td>Water for domestic uses, agricultural uses, traditional mill</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Freshwater surface water used as an energy source</td>
<td>Micro-hydropower, pico-hydropower</td>
<td>C</td>
</tr>
<tr>
<td><strong>Cultural (biotic)</strong></td>
<td>Physical and experiential interactions with natural environment</td>
<td>Characteristics of living systems that enable activities promoting health, recuperation, or enjoyment through active / passive or immersive / observational interactions</td>
<td>Traditional walking routes, roads, tourist activities hiking, horse riding, boating and other recreational activities in and around Rara Lake inside the red panda habitats</td>
</tr>
<tr>
<td>Ecosystem goods and services categories (modified from CICES version 5.1)</td>
<td>Services / goods and services from red panda habitats</td>
<td>Use of services</td>
<td>Services locations</td>
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<td><strong>Section</strong></td>
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<td><strong>Division</strong></td>
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<tr>
<td><strong>Group</strong></td>
<td><strong>Class</strong></td>
<td><strong>Characteristics of living systems that enable scientific investigation, education, and training</strong></td>
<td>Research/studies on biological diversity; forest resources; bird watching; mammal inventory; fishery research; educational tours</td>
</tr>
<tr>
<td><strong>Class</strong></td>
<td><strong>Characteristics of living systems that are resonant in terms of culture or heritage</strong></td>
<td>Seasonal transhumance culture</td>
<td>C&amp;P</td>
</tr>
<tr>
<td><strong>Class</strong></td>
<td><strong>Characteristics of living systems that enable aesthetic experiences</strong></td>
<td>High altitude rangelands; picturesque landscapes; Rara Lake (“the queen of lakes”)</td>
<td>NC</td>
</tr>
<tr>
<td><strong>Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting</strong></td>
<td><strong>Spiritual, symbolic, and other interactions with natural environment</strong></td>
<td>Elements of living systems that have symbolic meaning</td>
<td>Himalayan monal (“national bird of Nepal”); Rhododendron (“the national flower of Nepal”); endemic fish species</td>
</tr>
<tr>
<td><strong>Elements of living systems that have sacred or religious meaning</strong></td>
<td>Presence of temples, holy sites, lakes, caves, inside the red panda habitats</td>
<td>NC</td>
<td>O &amp; I</td>
</tr>
<tr>
<td><strong>Elements of living systems used for entertainment or representation</strong></td>
<td>Documentaries and films</td>
<td>NC</td>
<td>I</td>
</tr>
<tr>
<td><strong>Other biotic characteristics that have a nonuse value</strong></td>
<td><strong>Characteristics or features of living systems that have an existence, option, or bequest value</strong></td>
<td>Threatened flora and fauna, biological diversity inside the RNP</td>
<td>NU</td>
</tr>
<tr>
<td><strong>Cultural (abiotic)</strong></td>
<td><strong>Direct, in-situ and outdoor interactions with natural physical systems that depend on presence in the environmental setting</strong></td>
<td><strong>Physical, experiential, intellectual and representative interactions with abiotic components of the natural environment</strong></td>
<td>Presence of caves, lakes, religious sites, temples, scenic views, mountains</td>
</tr>
</tbody>
</table>
2.4.2. Contribution of ES from red panda habitats to local communities

The main source of income for all villagers was the collection and sale of traditional medicinal herbs and seasonal transhumant pastoralism. FGD participants described how most villagers depend on red panda habitats, although the level of dependency varies. Some villagers rely primarily on transhumant sheep and goat pastoralism, others on medicinal herbs harvesting, and some on both. After herb collection and grazing on highlands in summer, villagers generally look for alternative sources of income during winter including short-term employment in India, weaving baskets using bamboo collected from the forest, making wool rugs, etc. The men were responsible for transhumant pastoralism and for picking medicinal herbs while women undertook household (domestic) work and collected firewood, fodder, and bedding for animals.

2.4.2.1. Provisioning contributions

The FGD participants identified edible wild fruits, flowers, mushrooms, green leafy vegetables, wild birds, and freshwater fish as supplementary sources of nutrition derived from red panda habitats.

Red panda habitats also supplied medicinal and aromatic plants used directly by villagers in traditional remedies, conventional therapies, and income generation. Medicinal plants were used for traditional health benefits and generated relatively high financial returns. FGD participants described how leaves, shoots, flowers, fruits, seeds, bark, resin, tubers, roots, rhizomes, or whole plants were all utilized to prepare traditional medicine and for trade.

Plant resources from red panda habitats also provided forage and bedding for domestic stock. Forests supported beehives for honey production, flowers were used in
religious and traditional rituals, and the fibrous inner bark of lokta bushes (Daphne spp.) provided raw materials for handmade lokta paper. Some species had many uses: for example, bamboo (Drepanostachyum spp.) was used for fencing, roofing, construction of cattle sheds, weaving of mats and baskets, and fodder for animals. A major forest good was firewood, the primary means of energy for cooking and heating with timber also used for household construction and creation of agricultural implements. Slates from these habitats were used as a roofing material. Red panda habitats also supplied potable water through pipelines, brooks, and springs, as well as for various other domestic uses, for crop irrigation, and to operate traditional mills. Streams and rivulets were also used to generate micro and pico-hydropower.

2.4.2.2. Cultural contributions

Red panda habitats in the study area provided biotic and abiotic cultural benefits on a local, regional, and global scale. Seasonal transhumance culture has been practiced in these habitats for as long as any of the FGD participants could remember with livestock—mainly sheep and goats—being taken to high-altitude rangelands where NTFPs were also collected. Not only does this generate income but it is also seen as integral to local culture.

FGD participants also explained how deities were worshiped every year following traditional rituals at religious temples, holy sites, lakes, and caves inside the red panda habitats. These places also provided active or passive interactions with nature through their aesthetic value to both local people and visitors while endangered flora and fauna in the region provided a range of existence, option, or bequest values.

The cultural values also provide economic benefits to local communities through provision of services to tourists including homestay, horse riding, boating, tourist guides, etc. Scientific investigation on the status and biology of mammals, birds, fish, and forests
regularly occurred inside the PA. These areas also provided a venue for local and regional educational opportunities through field excursions and research training. Study sites were also used for making films and documentaries.

2.4.3. ES important to the local communities

Participants preferences for the “5 goods and services from red panda habitats most important for your livelihood?” were consistent among the 6 FGDs but their priority varied according to the respondents’ accessibility and availability of resources and services. Respondents outside the PA gave highest priority to the seasonal grazing highland pastures and plant materials, with transhumance culture next and wild plants for energy and religious interaction with nature as the least important (Fig. 2.2a). Respondents inside the PA, however, put greater emphasis on plant materials, with less importance to the other 4 attributes (Fig. 2.2b).
Figure 2.2. Word clouds illustrating the priority given to ecosystem goods and services among the local users of red panda habitats (A) outside and (B) inside RNP. The larger the word size, the higher the priority given to the service and vice versa.
As shown in Fig. 2.3, key ecosystem goods and services identified by focus group discussants in all 6 villages were those that contributed directly to their livelihoods (e.g. wild plants for energy, seasonal grazing highland pastures, and plant materials) and cultural values (e.g. transhumance culture, religious interaction with nature, and recreation activities and ecotourism). Participants outside the PA prioritized seasonal grazing highland pastures while plant materials were more important to respondents inside the PA (Fig. 2.3a & b). The FGD in one community inside the PA identified recreational activities and ecotourism in the top 5 ES from red panda habitats (Fig. 2.3b).
2.5. Discussion

The novelty of this study lies in its identification and categorization of the major goods and services that people living in the locality obtain from the remote mountain
habitats of the red panda. The study demonstrates the important contribution of these services to sustaining the livelihoods of the communities residing inside and outside the mountain PA. Most research in Nepal relevant to red pandas has so far focused on the status, distribution, habitat preferences, diet, diseases, conservation threats, and ecology of the species (Yonzon, 1989; Bhatta et al., 2014b; Sharma et al., 2014; Lama et al., 2015; Panthi et al., 2015; Panthi et al., 2017; Acharya et al., 2018; Thapa et al., 2018; Bista et al., 2019). To date, no research has focused on how these habitats are contributing to the daily needs of the human communities with whom the pandas coexist, both inside and outside PAs. ES-related studies in Nepal, which could have covered this gap, have largely neglected the mountainous parts of the country (Lamsal et al., 2018). Our work has showcased the people’s understanding of services that they obtain from these mountain areas. Determining the dependency of villagers on the diverse resources from these habitats can inform development of relevant policies and plans, and can help to conserve red pandas simultaneously improving the sustainability of resource management by local people.

2.5.1. Identifying contributions of ecosystem goods and services from red panda habitats

In this study, we identified 51 types of ES from 17 different classes that were recognized by people as being provided by the panda’s mountain habitats (Table 2.1), including 23 provisioning and 28 cultural goods and services. By way of comparison using a categorization broadly similar to our own, 42 ES were identified in the Chure region in central Nepal (Acharya et al., 2019), 37 in the Panchase mountain ecological region of western Nepal (Adhikari et al., 2018), 10 from the Chure region of western Nepal (Bhandari et al., 2016), 24 in Jagadishpur reservoir catchment area of western Nepal (Bhandari et al., 2016), 24 in Jagadishpur reservoir catchment area of western Nepal.
Nepal (Baral et al., 2016), 15 from the Koshi Tappu wildlife reserve of eastern Nepal (Sharma et al., 2015) and 19 from the community-managed forests in central Nepal (Paudyal et al., 2015). The higher diversity of services provided by red panda habitats may be because the communities who provided the information have a greater reliance on the diverse mountain resources and stronger cultural interconnections with nature than at other sites, as there are few alternatives to support their livelihoods. Respondents also claimed more cultural benefits than provisioning services from red panda habitats, possibly because people living in and around red panda habitats consider these places as holy sites bearing spiritual power, a belief common to many of the religions practiced in the area (Bernbaum, 2006). The ancient practice of seasonal transhumant pastoralism also draws on a wide range of services that are then transformed into economic goods—in Nepal’s western mountains a herder can make about US$200 a year from this custom (Gentle & Thwaites, 2016).

Communities near Rara Lake inside the National Park also engaged in tourism activities such as homestay, horse riding, and boating and were aware that the red panda habitats inside the park are providing platforms for scientific research, guided tours, films, and documentaries. Overall, the panda habitats inside the PA tended to provide more cultural services while those outside offered more provisioning services. This may be because park regulations limit access to the resources, so people have started seeking alternatives sources of livelihood. For some people, cultural services, specifically ecotourism in the effectively managed region, are progressively being accepted as a substitute for traditional livelihoods (Fleming & Fleming, 2009).

Our study presents the understanding of the use and non-use ES obtained from mountain red panda habitats that are crucial for the welfare of local communities. Respondents stated that, in keeping with many rural communities in developing nations
(Vira & Kontoleon, 2012), there is significant reliance on forest ES with productive uses including medicinal herbs, bamboo products, transhumant practices, and ecotourism still being the major source of income for them. Indeed, forest ecosystems are critical to the national Nepalese economy, providing food, fibre, freshwater, and medicine to 80% of the Nepalese population and contributing almost 90% of all the energy usage (DNPWC & BCN, 2012).

2.5.2. High value ES

The top 5 ES for livelihoods and cultural significance are similar to those identified from the community-managed forests in central Nepal (Paudyal et al., 2015) but they are influenced by local context (Daw et al., 2011; Chaudhary et al., 2018). Thus, as noted by He et al., (2018) in southeast China, proximity to a PA limited access to the forest resources but provided opportunities to draw on other services such as ecotourism and associated recreational activities. Likewise, in the Chure region of Nepal (Acharya et al., 2019), proximity to the forest, socioeconomic status, and forest management systems influenced ES priorities. Although local communities in our study area needed to travel a whole day to reach the important high-altitude rangelands, these areas were still valued highly. Such preferences may be because of a greater reliance on these services for livelihoods than others. This may also be because of the priority given to religious sites—temples, holy sites, etc. inside the red panda habitats—as also noted in China (He et al., 2018). Firewood from these forests was also vital as a source of energy regardless of the distance, in keeping with many rural communities (Muhamad et al., 2014; Ahammad et al., 2019). About 64% of houses in Nepal use firewood as the primary means of energy for cooking (CBS, 2012), and globally, around 2.4 billion population use firewood for cooking, heating, and boiling water (FAO, 2018).
2.5.3. Gaps in the identification and classification of ES

We broadly categorized the ES described in the FGDs and KIIs according to the CICES. However, some services listed could not readily be described while some services known to be produced by the panda habitats were never mentioned. The two gaps are related. The CICES classification categorizes religious services, cultural services, and spiritual services as potential ES but does not spell out what might be included, or excluded, from these categories. As in the study of the Panchase mountain ecological region of western Nepal (Adhikari et al., 2018), we found it difficult to find concordance between the CICES classification and what was described in the FGDs and KIIs as being included within these categories. On the other hand, FGDs and KIIs universally omitted mention of regulating and maintenance services as use values.

We think this was at least partly because of the ontological framing of the concepts. It became evident in the FGDs and KIIs that many aspects of nature are not considered separately from the gods and goddesses who are embodied in the mountains. These deities regulate and maintain the services western science has categorized as climate control, carbon storage, natural hazard reduction, and maintenance of air, water, and soil quality. If the environment is thought of as sentient, which seemed to be the case from the way in which people spoke of the mountains, then people have little control of the services provided even if, to outsiders, the ongoing provision of many of these services is critical to wellbeing and livelihoods beyond the mountains. This means that many regulating and maintenance services can be categorized most readily as cultural and spiritual services rather than use services. This finding is consistent with other research exploring the application of the ES framework to spiritual services provided by natural environment (Cooper et al., 2016), particularly where there are interrelationships between people and nature (Pascua et al., 2017). It highlights a need to explore more deeply ways
in which these different worldviews can be accommodated into the largely utilitarian ES framework (Sangha et al., 2019).

2.5.4. Management implications

Identification and classification of ES benefits accruing to local communities from red panda habitats provides an evidence base and the first step towards supporting more sustainable resource management. There are 5 steps that logically follow this exercise. The second step will be to quantify the goods and services that we have identified as being required to support local livelihoods, including ways of incorporating cultural and spiritual values (Sangha et al., 2019). The third is to estimate their value to different sectors of the community, including to communities beyond the region that draw on the regulating and maintenance services provided by the panda habitats. The fourth is to assess the status and trends in the availability of the ES, identifying factors that might lead to negative trends. The fifth step is to explore the policies, regulations, and governance regimes that will be most effective in sustaining provision of the ES from red panda habitats at healthy levels.

Understanding the level and trends in resource use and the distribution of benefits among the stakeholders would help reveal the extent to which these habitats address poverty and equity issues in the region. Research on trends in the availability of resources is required to explore not just current uses but also how future service provision is likely to be affected by a range of drivers such as climate change and changes in socioeconomic trends. Assessments of ES can help to accumulate a knowledge base on the benefits from ES which, in turn, can promote sustainable biodiversity conservation and help raise community awareness, build local capacity, engage communities and line agencies in
decision-making processes, and ensure alignment of management with national conservation policies (Thapa et al., 2016).

Trade-offs between current and prospective uses of the same ES (Carpenter, Bennett et al., 2006; Rodríguez et al., 2006), as may happen in our study area from overharvesting of medicinal herbs or the excessive extraction of Himalayan bamboo species (the sole food for red panda), need not always have negative consequences (Bennett et al., 2009; Turkelboom et al., 2016). This is apparent in RNP, and elsewhere in the red panda’s range (Bista, 2018), where reduction in delivery of one ES (transhumant pastoralism) is resulting in an increase in another (ecotourism), as has happened in other areas where there have been synergies between improving wildlife habitats and enhancing prospects of recreation and ecotourism (Lindsey et al., 2007; Baral et al., 2017).

A thorough assessment of the values and trends of ES in red panda habitats can also potentially form the basis for development of a payments for ecosystem services (PES) scheme (Bhatta et al., 2014a; Baral et al., 2017). However, carefully planned and locally defined incentive-based mechanisms for maintaining ES (Jack et al., 2008; Patterson et al., 2017) can often be more effective than a market-based PES mechanism (Sydee & Beder, 2006). This, however, requires an effective governance system, particularly of the ES that are being overexploited. The national policy environment for such governance is already in place. As a party to the Convention on Biological Diversity (CBD), Nepal has formulated a National Biodiversity Strategy and Action Plan (NBSAP) 2014–2020 as a policy instrument focusing on effective conservation of biological diversity, sustainable utilization of natural resources, and mainstreaming biodiversity into policies and plans (MoFSC, 2014b). Realizing the gaps and major constraints in sustainable mountain ecosystem management and the urgency of incorporating the values of mountain ES into governmental planning and decisions, the NBSAP has addressed
mountain biodiversity as a separate thematic area for the purpose of strategic planning. The declaration of PAs can also help safeguard the future delivery of ES (Thapa et al., 2016). Nepal has already satisfied Aichi Target 11, which requires conservation of at least 17% of terrestrial areas, by gazetting 23% of the country as PAs (MoFSC, 2014a), including 84% of mountain areas (MoFSC, 2014b). However, deep-rooted poverty-induced human pressure and human-induced climate change means protected mountain sites are not yet improving the status of Nepal’s biological diversity (Bhattarai & Kindlmann, 2013). Also, many areas with high biodiversity value, including 70% of red panda habitats, fall outside the PAs (MoFSC, 2014b). This suggests that a community-based, landscape-level approach (Lindenmayer et al., 2008; Sayer, 2009; Arts, 2017) to ES governance is needed to build a positive nexus between preservation of mountain habitats, species conservation, and sustainable livelihoods of deprived communities.

While community-based management approaches to strengthen ecosystems and conserve landscapes are gaining popularity in Nepal (Bhatta et al., 2014a), and a conservation intervention by the Red Panda Network in red panda habitats of eastern Nepal underpins community-based red panda conservation (MoFSC, 2014a), if these initiatives are to succeed there is a need to focus on sustainability both of ES from these habitats and of the ways in which use of the ES supports societal livelihoods and wellbeing. Similarly, policy instruments targeted at red panda conservation should include detailed habitat-level studies focusing on identification, quantification, valuation, and the interrelationship between ES obtained, human disturbance, and alternatives to reducing the human pressure. The information obtained could drive more equitable and sustainable policies. Thus, conservation of this charismatic priority species could simultaneously safeguard the wellbeing and sustainability of associated biodiversity, ecosystems, and local communities.
2.6. Conclusions

This study describes provisioning and cultural ecosystem goods and services perceived by local people as supporting rural livelihoods in the habitats of the red panda in the mountains of western Nepal, including their significance for local subsistence. Identification of ecosystem goods and services from these mountain landscapes provides an evidence base that may inform policy reform for the sustainable conservation of biodiversity and equitable management of ES in the region. Understanding the nature and scale of such services can help to emphasize the need for effective ES governance. Overall, knowledge of ES flowing from the mountain habitats of the panda can help to regulate their use and management for the current and future delivery of needed and desired goods and services.

2.7. Acknowledgments

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2.8. References


Chapter 3. Trends in ecosystem goods and services obtained from red panda habitats in north-western Nepal

A villager from Jumphai village, Mugu Knitting a basket from bamboo. Photo: Manoj Bhatta
3.1. Abstract

Most research on Nepal’s endangered red pandas has been autecological, describing the species’ habitat, ecology, distribution and threats. An alternative, complementary lens through which to evaluate pressures faced by the pandas is to consider the flows of ecosystem goods and services from the panda’s habitat. Understanding human dependency on the goods and services provided by the red panda’s habitat and trends in the sustainability of their use can potentially provide an avenue to reduce pressure on the species. Here we have applied a mixed methods research approach to assess the current use of red panda habitat in and around a protected area in western Nepal, trends over the last 20 years, and the factors driving those trends. We found that more ecosystem goods and services were obtained from the red panda habitat outside the protected area than inside except for fodder and bedding for animals, recreational activities and ecotourism. However, people inside the protected area had a higher income than those outside, who had to travel further to access ecosystem benefits. Of the seven main services investigated: i) the use of medicinal plants had increased but their availability had declined; ii) bamboo use had remained steady, although bamboo was becoming harder to obtain; iii) there were no perceived trends in firewood use or availability; iv) there was less traditional transhumant pastoralism to upland pastures than previously but pasture availability had also declined; v) less fodder and bedding for animals was being collected inside the park than outside, but the availability was unchanged; vi) use of sacred religious sites had declined inside but not outside the park; vii) the reverse was true for recreational tourism. Perceived direct drivers were changes in weather patterns, the need to trade-off ecosystem goods and services and market fluctuation; indirect drivers were institutional governance and regulation, population growth, literacy, poverty, and infrastructure development. Information on trends in the
use and availability of ecosystem goods and services from these habitats could allow the development of policy instruments that concurrently improve local livelihoods, reduce degradation in natural resources and conserve biological diversity.

**Keywords:** sustainable livelihoods, mountains, tourism, transhumant pastoralism, bamboo

### 3.2. Introduction

Nearly 13% of the human population lives in 22% of the Earth’s surface that is montane (Romeo et al., 2015). Many of those people rely directly or indirectly on mountain resources (Rodríguez-Rodríguez et al., 2011; Maselli, 2012), particularly poor and vulnerable local communities (Chaudhary et al., 2009). However, while mountain ecosystems face increasing levels of environmental degradation through human interference (Price, 2015) and climate change (Peters et al., 2019), mountain ecosystem goods and services are often given low priority in conservation decision making processes and policies (Costanza et al., 1997) because of the high opportunity costs incurred by mountain ecosystem conservation (de Groot et al., 2010; Rasul et al., 2011).

Mountain ecosystems also support a quarter of global terrestrial biological diversity and encompass almost one-half of the world’s biodiversity hotspots (Sharma et al., 2019). Among the 20 most important hotspots is the Himalayan biodiversity hotspot (MoFSC, 2014a) at the heart of which is Nepal. Mountains cover about three-quarters of the country (Thapa, 1996) but many of the species occurring in these mountains are threatened (Måren et al., 2015). Among them is the red panda (*Ailurus fulgens*), a species confined to an elevational range of 2500 and 4800 m asl in Nepal (Glatston et al., 2015) where it has a range of about 24,000 km² across 24 districts (Bista et al., 2016, DNPWC and DFSC, 2018). The species also occurs in India, China, Myanmar and Bhutan.
The mountain red panda habitat in Nepal is integral to the livelihoods of the many poor and vulnerable local communities (Chaudhary et al., 2009; Bhatta et al., 2020) that primarily rely on non-timber forest products such as medicinal and aromatic plants and transhumant grazing (BPP, 1995). However, many people depend on many of the goods and services produced by mountain ecosystems, for which the ecosystem is a common-pool resource (Gentle & Maraseni, 2012). As such, unsustainable use and resource depletion are highly likely (Ostrom, 2007), leading to depletion of both red panda populations and the goods and services needed by the region’s human inhabitants.

To date most research on red pandas has been autecological, describing the species’ habitat, ecology, distribution and threats (DNPWC & DFSC, 2018). Such studies provide a biological context for red panda conservation but do not capture the socio-ecological pressures on its environment. An alternative way to understand these pressures is to consider the trends in the goods and services derived from the panda’s habitat. However, there is a dearth of knowledge about these services, with most studies of ecosystem service provision in Nepal being from the mid-hills and lowlands of the country (Lamsal et al., 2018). However, such knowledge is essential for the development of policy and practice that not only relieves the pressures and reduces the threats to the species but also provides benefits for the people using the panda’s habitat and for the many species with which the panda coexists. The aims of this study are therefore to explore the perceived use, availability, and provision trends in ecosystem goods and services that contribute significantly to local livelihoods. Strengthened knowledge of the availability of resources in the panda’s habitat and their use will help policymakers mainstream the conservation of mountain ecosystems and biodiversity into policies aimed at increasing the sustainability of rural livelihoods.
3.3. Materials and methods

3.3.1. Study area

The study was carried out in Jumla and Mugu, the two most remote districts in Karnali province — the largest (24,453 km$^2$) but least populated (1.6 million people) among the seven federal provinces of Nepal (Fig. 3.1). The study districts are mountainous (Jumla 2,100 m - 6,400 m asl.; DDC, 2013, Mugu 1,200-6,600 m asl.; DDC, 2016) with Mugu is larger, cooler, drier, less populous and less vegetated (3,500 km$^2$, 0.1°C to 10.8°C, 800 mm, 55,000 people, bare area 40%, forests 21%, shrub/grassland 17%, agriculture 8%; Shrestha et al., 2019) than Jumla (2,500 km$^2$, 1.3°C to 13.0°C, 860 mm, 109,000 people; bare area 19%, forests 37%, shrub/grassland 32%, agriculture 10%; Shrestha et al., 2019). Within the two districts, we selected six administrative wards as the study area including the 11 localities (Fig. 3.1) closest to known red panda habitat in Rara National Park (RNP), the contiguous Buffer Zone of Mugu district (Jnawali et al., 2012) and an additional area in Jumla district (Bhatta et al., 2014) outside both where local communities rely on mountain habitats for their daily subsistence and retain strong cultural ties to the area (Bhatta et al., 2020).
3.3.2. Research design

This study used a mixed-methods research approach (Morse, 2003; Denscombe, 2008), a social research approach that combines components of both the qualitative and quantitative research approaches (Patton, 1990; Tashakkori et al., 1998). Social research tools used to attain research objectives (Fig. 3.2) included Focus Group Discussions (FGDs; Morgan & Spanish, 1984, Schaafsma et al., 2017), Key Informant Interviews (KII; Holloway & Galvin, 2016), semi-structured questionnaire surveys (Mukherjee, 1997; Longhurst, 2003), Participatory 3D Mapping (P3DM; Fisher et al., 2019; Joshi et al., 2016), and participant observation (Kawulich, 2005, DeWalt & DeWalt, 2011). These techniques were designed to elicit the respondent’s perceptions of ES provision, use, and availability of livelihood resources and the drivers of change in resource flows from north-western red panda habitats in Nepal. We provided research participants with a copy
of a Plain Language Project Information sheet and also explained in the local language the research aims, methodology, the background of the investigators and the research ethics principles being followed. The necessary information was then recorded digitally, by taking notes, and in survey questionnaires. All the research respondents signed an informed consent form before the research proceeded further. Human research ethical clearance was obtained from the Human Research Ethics Committee of Charles Darwin University (H17030). Study permits were also obtained from the relevant line agencies in Nepal.

Figure 3.2. The methodological approach used in this study for assessment on changes in livelihoods resources derived from red panda habitats. Acronyms: FGDs – Focus Group Discussions, KIIs – Key Informant Interviews, ES – Ecosystem Services, CICES – Common International Classification of Ecosystem Service, P3DM – Participatory 3D Mapping.
3.4. Research methods

3.4.1. Data collection and sampling strategy

We started by holding informal discussions with the traditional village chiefs, local leaders and village elders who then nominated people they thought would participate constructively and provide reliable and relevant information. All data were collected with the help of locally hired co-researchers. Most of the qualitative data were collected from November 2017 to January 2018 in FGDs, KIIs and through participant observation (Fig. 3.2). We conducted a total of six FGDs (56 participants: 68% M, 32% F), three outside and three inside the Protected Area (PA), and 15 KIIs (67% M and 33% F; Table 3.1).

Quantitative data were collected from August to October 2019 through a semi-structured household questionnaire. Additionally, six workshops (three inside and three outside the PA, 56 participants, 64% M, 36% F) with participatory 3D mapping were conducted.

The household survey questionnaires aimed to build on the information collected from the first field trip and improve understanding of the use and availability of ecosystem goods and services from the red panda habitat. They were piloted with 12 households before finalization. Participants in the survey were purposively sampled (also termed as judgmental sampling; Kerlinger & Lee, 2000; Klar; Leeper, 2019; Tongco, 2007; Topp et al., 2004), a non-random sampling technique, was adopted with chosen respondents being experienced and knowledgeable with the subject we were studying. In addition to participants’ knowledge and comprehension, their availability and willingness to participate to communicate their opinion in thoughtful ways were considered. The survey involved a single-visit household questionnaire. In total, 243 out of 334
households (145 out of 220 within and 98 out of 114 outside the PA) in six administrative wards (11 settlements) were sampled for the survey. Where possible we interviewed the oldest members of the family in the household survey but, if they were unavailable, we included other senior household members.

Participants in FGDs, KII s, and P3DM were chosen based on their in-depth understanding and experience in the local landscape with respondents selected on the basis of their position within the village governance structure and their traditional and professional experience. The FGDs and the P3DM exercise involved interaction for approximately two hours with eight to ten participants (Table 3.1).
<table>
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<th>Research activities</th>
<th>Research goals</th>
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<th>Participants / Respondents</th>
<th>Number of participants</th>
<th>Research methods</th>
<th>Timing</th>
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<td>5 M 3 F 5 M 2</td>
<td>Key Informant Interviews</td>
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<td>22 M 4 F 16 M 14 F</td>
<td>Focus Group Discussions</td>
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<td>Document the local spatial knowledge of their territory; Depict the areas of livelihoods resources use</td>
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<td>Participatory 3D Mapping</td>
<td>August to October 2019</td>
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<td>98 M 47 F 53 M 45 F</td>
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</tbody>
</table>

Table 3: Summary of the methods employed to collect the information on changes in livelihoods ecosystem goods and services obtained from red panda habitats in western Nepal.
3.4.2. Design of Focus Group Discussions

We asked participants in FGDs to discuss the changes in ES provision from red panda habitats in the past two decades. The information gathered from FGDs was then triangulated with information from the KIIs and from field observations. Using a five-point Likert scale (Likert, 1932), perceptions on changes described in the FGDs were scaled as: greatly declined (1); declined a little (2); about the same (3); increased slightly (4); and greatly increased (5). The information from the Likert scale was analysed (using Microsoft Excel 2016) to assess the opinion of respondents on trends in ES provision from red panda habitats.

3.4.3. Survey design

The questionnaire consisted of two parts. We first asked about the quantity (in local units) of ecosystem goods and services harvested annually from red panda habitats. Based on Bhatta et al. (2020), the ecosystem goods and services assessed included bamboo, medicinal plants, firewood, fodder and bedding for animals. We then collected information on the local market unit price (Appendix 2) of these provisioning services to enable the calculation of the annual monetary return from these services. We also asked the household respondents for the annual income they had been generating from transhumance and ecotourism activities in and around red panda habitats. Income from transhumance was derived from selling goats, sheep, their wool and associated products. Ecotourism income was derived from tourist guiding, boating, horse riding and provision of accommodation.

In the second part of the questionnaire, we collected the opinions of the household survey informants on the importance of these ecosystem goods and services to the daily requirements of the community in and around the red panda habitats and how their use
(demand) and availability (supply) has changed in the last two decades. Opinions on changes were assessed using scales with three categories: changes in use (more/increase, no change/stable, less/decrease); changes in availability (more abundant/increase, no change/stable, less abundant/decrease).

During the FGDs and the P3DM exercise, we gathered information on the drivers of change in ES demand and supply from red panda habitats. The participants also discussed the implications of such changes to local livelihoods.

3.4.4. Data analysis

We used information on income to calculate the mean, standard deviation, minimum and maximum economic value of ecosystem goods and services from mountain habitats of red panda both inside and outside the PA. We tested for differences between the inside and outside the PA using the Kruskal-Wallis rank-sum test (Kruskal & Wallis, 1952), a non-parametric statistical analysis test.

To assess perceived changes in ES use and availability, we calculated the percentage of responses in each category of the scales. Responses on trends in the last 20 years were only included for respondents of age 35 or above as they would have been at least 15 years old when the trend period began. As with income, we tested differences between inside and outside the PA using the Kruskal-Wallis rank-sum test (Kruskal & Wallis, 1952).

3.4.5. Participatory three-dimensional mapping

We used a P3DM tool to help convert local geographical knowledge to a map. The use of physical 3D models has been widely used to facilitate discussion by community members about their use of landscape (Brown & Kyttä, 2018; Fisher et al.,
The mountainous terrain in the study area, reproduced by the 3D models, meant that people using this landscape are highly attuned to the topographic detail through daily experience. The light-weight 3D printed tiles were easy to transport to remote communities for discussion and required little preparation before they could be used as the basis of discussion.
Two 3D printed landscape models (nine tiles each) were created for red panda habitats, one for inside the PA, one for outside. The tilesets represented an area of about 33 km x 28 km inside the PA and 35 x 29 km outside the PA. The technical aspects of the model and its significance to the current project were explained to the stakeholders. The participants (Table 3.1) then used their local spatial knowledge to depict land use, land cover, and other features in relation to the formations shown in the landscape models such as mountains, hills, rivers, and rangelands (Fig. 3.3). The informants used multi-color pushpins (points) and Blu Tack (lines) to show the areas from which they derived ecosystem goods and services of livelihood significance, the routes used for transhumance, the religious sites in and around the red panda habitats, and the places attractive to tourists. The participants also marked the core habitats of the red panda and walking paths to the nearest local roads and highways. The information about the features depicted in the model was photographed. Photographs of the landscape models were subsequently digitized and a georeferenced map of local land-use created. We then used the map to calculate the time required to reach the areas from which key ecosystem goods and services were being obtained.

3.5. Results

3.5.1. Sample description

Of the 243 respondents interviewed to determine which ecosystem goods and services were perceived as important to the community (Section 3.2) and the monetary returns from ecosystem goods and services (Section 3.3), the average age was 42 years with a male bias (62%; Appendix 3). Of these, 176 were included in analyses of
perceived trends in the use and availability of ecosystem goods and services (97 inside, 79 outside the PA; Section 3.5) because they were older than 35 years so had personal experience of change in their lifetime. This group had an average age of 47 years of whom 68% were men and 65% had not completed any formal education.

Most FGDs participants (Section 3.4) were 46-60 years old (41%) and identified as male (≈68%). Similarly, most participants of the P3DM (Section 3.6) were 46-60 years old (39%), and men (≈64%; Appendix 3).

3.5.2. Ecosystem goods and services perceived as important to the communities

All communities relied on wild plants from red panda habitats for materials or energy—particularly firewood (all households, both inside and outside the PA), fodder and bedding for animals (91% households, inside 97%, outside 84%), bamboo (84%, 81%, 89%), and medicinal plants (79%, 70%, 92%). About 23% (inside 19%, outside 29%) of households used upland pastures for seasonal transhumant grazing and around 68% (61%, 78%) of households said that they perform religious practices in and around these habitats. Almost 36% households inside the PA were involved in tourism and recreational activities but only 3% of households were active in such activities outside the PA (Fig. 3.4).
3.5.3. Monetary returns from ecosystem goods and services

Our survey indicated that households inside the PA generated greater annual economic value from ecosystem goods and services (USD $2718) than those living outside the PA (USD $2538). Households inside the PA derived more income from recreation, seasonal grazing, and fodder and bedding for animals, but less for medicinal plants and firewood (Table 3.2).
Table 3.2. Monetary value of key ecosystem goods and services obtained from red panda habitats inside and outside a PA in western Nepal. (Significant values $p \leq 0.05$ in bold, exchange rate: USD $1 = \text{NPR} 114; \text{N inside 145, outside 98}; \ast$only three household survey respondents from outside the PA actively pursued ecotourism as a source of income).

<table>
<thead>
<tr>
<th>Key ecosystem goods and services</th>
<th>Mean quantity per annum</th>
<th>Monetary value per annum (USD)</th>
<th>Kruskal-Wallis rank-sum test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inside</td>
<td>Outside</td>
<td>Mean value</td>
</tr>
<tr>
<td>Bamboo (pieces)</td>
<td>49</td>
<td>41</td>
<td>18</td>
</tr>
<tr>
<td>Medicinal plants (kg)</td>
<td>9</td>
<td>21</td>
<td>90</td>
</tr>
<tr>
<td>Firewood (Bhari)</td>
<td>120</td>
<td>143</td>
<td>526</td>
</tr>
<tr>
<td>Fodder and bedding for animals (Bhari)</td>
<td>191</td>
<td>171</td>
<td>670</td>
</tr>
<tr>
<td>Seasonal grazing</td>
<td>-</td>
<td>-</td>
<td>698</td>
</tr>
<tr>
<td>Recreational activities and ecotourism</td>
<td>-</td>
<td>-</td>
<td>716</td>
</tr>
<tr>
<td>Total</td>
<td>2718</td>
<td>2538</td>
<td></td>
</tr>
</tbody>
</table>

3.5.4. Perceived trends in the provision of ecosystem goods and services flowing from red panda

In the last 20 years, FGD participants had perceived declines in the availability of bamboo parts and products, medicinal plants, upland pastures, Himalayan monal, rhododendrons and threatened flora and fauna in and around red panda habitats but had noticed little change in the availability of firewood, fodder and bedding for livestock, edible wild fruits, flowers, green leafy vegetables, their religious and spiritual interaction with holy sites, traditional walking routes or areas of aesthetic attraction (picturesque landscapes, high-altitude rangelands, lakes, mountains, caves, temples; Fig. 3.5). In contrast, the availability of hydropower, roads, scientific research and education had increased in and around the red panda habitat. Most trends were the same inside and outside PAs, although the tourist and recreational activities and film making had only increased within the PA.
3.5.5. Perceived trends in use and availability of ecosystem goods and services of livelihoods significance

Household survey respondents believed there had been strong declines in the use of upland pastures for grazing and in the interaction with religious sites, many of which are visited when travelling to and from the pastures (Fig. 3.6a). There had been a less general decline in the collection of bamboo, firewood and of fodder and bedding for animals and the collection of medicinal plants had increased greatly. Only for only
recreational opportunities was there a significant difference between inside and outside the PA, with use greatly increased within the PA (Table 3.3).

a. Use

![Bar chart showing trends in use inside and outside the PA for various ecosystem goods and services.]

b. Availability

![Bar chart showing trends in availability inside and outside the PA for various ecosystem goods and services.]

Figure 3.6. Trends in the use and availability of ecosystem goods and services of livelihoods significance in red panda habitats in western Nepal.

Survey participants considered that the supply of bamboo, medicinal plants and seasonal grazing had declined greatly, though views on grazing were slightly more mixed (Fig. 3.6b). Most thought that religious site availability was unchanged, though some thought it had declined. There was a range of views on the availability of fodder/animal bedding and firewood, with no clear trend, and virtually no trend in the availability of recreational/ecotourism opportunities. No differences between inside and outside the PA.
were significant except for recreational and ecotourism activities inside the PA (Kruskal-Wallis rank-sum test, P<0.05; Table 3.3).

Table 3.3. Change in use and availability of ecosystem goods and services from red panda habitats inside and outside a PA in western Nepal. Significant values p ≤ 0.05 in bold.

<table>
<thead>
<tr>
<th>Ecosystem goods and services</th>
<th>Use values</th>
<th>Available values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P-value</td>
<td>Chi²</td>
</tr>
<tr>
<td>Bamboo</td>
<td>0.955</td>
<td>0.003</td>
</tr>
<tr>
<td>Medicinal Plants</td>
<td>0.487</td>
<td>0.483</td>
</tr>
<tr>
<td>Firewood</td>
<td>0.884</td>
<td>0.021</td>
</tr>
<tr>
<td>Fodder and bedding for animals</td>
<td>0.298</td>
<td>1.084</td>
</tr>
<tr>
<td>Seasonal grazing upland pastures</td>
<td>0.542</td>
<td>0.373</td>
</tr>
<tr>
<td>Recreational activities and ecotourism</td>
<td>&lt;0.001</td>
<td>69.603</td>
</tr>
<tr>
<td>Interaction with religious sites inside the red panda habitats</td>
<td>0.249</td>
<td>1.330</td>
</tr>
</tbody>
</table>

3.5.6. Participatory mapping of ecosystem goods and services

3.5.6.1. Distribution of ecosystem goods and services in and around the red panda habitat

The participants identified 104 locations (inside the PA 46, outside the PA 58; Fig. 3.7a & b), in and around known red panda habitats, providing ecosystem goods and services perceived as vital to their livelihoods. The P3DM exercise participants revealed that the land tenure of the sites comprised of national forest, community forest, leasehold forest, national park, and buffer zone. The national forests were the major land tenure used to obtain ES for the communities outside the PA whereas RNP and buffer zone was most used by communities inside the PA.
Figure 3.7. Maps showing ecosystem goods and services locations and travel time to these locations a) inside and b) outside the PA.
3.5.6.2. Travel time to access the ecosystem goods and services from red panda habitats

The average elevation and the time taken to reach places where ecosystem goods and services provided by red panda habitats could be obtained were similar inside and outside the national park apart from recreational services, with the single site outside the park being higher than inside the park (Fig. 3.7a & b, Table 3.4).

The villagers outside the PA appeared to travel further than insiders. For example, the maximum elevation and travel time to reach some ecosystem goods and services including bamboo (3600m asl, 8.8 hrs), medicinal plants (3600m asl, 9.6 hrs), and upland pastures (4000 m asl, 10.0 hrs) is greater than insiders (bamboo-3400 m asl, 6.4 hrs); medicinal plants (3500 m asl, 6.7 hrs); and upland pastures (3500 m asl, 5.7 hrs).
Table 3.4. Elevation of and travel time to ecosystem goods and services provided by red panda habitat inside and outside the PA in western Nepal.

<table>
<thead>
<tr>
<th>Elevation (m asl)</th>
<th>Inside the PA</th>
<th>Outside the PA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Bamboo</td>
<td>3093</td>
<td>207</td>
</tr>
<tr>
<td>Medicinal plants</td>
<td>3211</td>
<td>165</td>
</tr>
<tr>
<td>Firewood, fodder and bedding for animals</td>
<td>3215</td>
<td>313</td>
</tr>
<tr>
<td>Seasonal grazing upland pastures</td>
<td>3226</td>
<td>115.51</td>
</tr>
<tr>
<td>Recreational activities and ecotourism</td>
<td>3348</td>
<td>383</td>
</tr>
<tr>
<td>Interaction with religious sites</td>
<td>3301</td>
<td>357</td>
</tr>
</tbody>
</table>

| Travel time (hrs)                               |      |     |     |     |      |     |     |     |
| Bamboo                                         | 2.48 | 1.71 | 0.70 | 6.35 | 2.74 | 2.92 | 0.41 | 8.83 |
| Medicinal plants                               | 3.23 | 1.70 | 1.25 | 6.69 | 3.70 | 2.95 | 0.51 | 9.55 |
| Firewood, fodder and bedding for animals        | 1.43 | 0.67 | 0.70 | 2.57 | 1.48 | 0.49 | 0.86 | 2.19 |
| Seasonal grazing upland pastures                | 3.67 | 1.26 | 1.73 | 5.72 | 5.51 | 2.56 | 2.4  | 9.95 |
| Recreational activities and ecotourism          | 1.72 | 0.58 | 1.22 | 2.22 | 3.89 | -   | -   | -   |
| Interaction with religious sites                 | 3.06 | 1.61 | 0.91 | 5.27 | 4.49 | 2.44 | 1.59 | 8.65 |

3.5.7. Drivers of change in livelihood ecosystem goods and services from red panda habitats

A total of 26 (13 each for use and availability) underlying reasons for the change in the use and availability of key ecosystem goods and services were identified during the FGDs and P3DM exercise (Fig. 3.8). Three drivers of change - ecosystem goods and services trade-offs, common-pool resources (upland rangelands) and transformation in transhumance - were perceived as responsible for the change in both use and availability of resources from red panda habitats. Some perceived drivers of change in conditions of ecosystem goods and services differ between the respondents inside and outside the PA,
but the drivers shown in Fig. 3.8 were common to all red panda habitats. Many drivers of change are linked and result in “ecosystem goods and services trade-offs”, for example, development activities, connectivity, and accessibility lead to the decline in transhumance culture but an increase in ecotourism activities specifically inside the PA.

![Image of diagram](image)

*Figure 3.8. Drivers of change in the use and availability of ecosystem goods and services from red panda habitats in western Nepal.*

The participants believed that any decline in the availability of bamboo was mainly due to unsustainable harvesting of bamboo, forest fire and a mass flowering event among bamboo in the region (a natural occurrence at intervals of many decades after which all bamboo dies before re-growing from seed; Tewari 1993). One respondent
considered the transformation of transhumance culture to be responsible for what he saw as a decline in bamboo availability.

“Decline in bamboo availability is also due to uncontrolled onsite stall feeding of our cattle. In the past, we used to take our cattle to the lowlands [down to Dailekh district and Surkhet district]. Now we are not allowed to graze there due to the formation of community forests in most of those areas and we are compelled to keep our cattle near our villages which creates pressure on local resources and the upland pastures.”

The respondents suggested that one of the main reasons for the increase in demand (use) of medicinal plants was a “boom and bust” pattern of demand for medicinal plants in and around the red panda habitats. A respondent inside the PA stated that:

“We were unaware of the high economic value of medicinal plants from red panda habitats but, in the last 10 years, this has changed drastically. Every year local middlemen, vendors, and dealers come to our village and demand a large volume of medicinal plants (sometimes we get money in advance as well). The demand for individual medicinal plants fluctuates from year to year and the price accordingly. Sometimes they show us photographs of plants not collected for commercial purposes before and ask us to collect that particular species. Demand for that species peaks that year—we get good money for that.”

The respondents indicated that drivers such as unsustainable and conventional harvesting practices, overharvesting, and illegal harvesting of medicinal plants caused a decrease in the availability of the resources. In addition, respondents thought that the
inexperience of some harvesters, poor governance, weak collection control and a lack of monitoring were key factors in the declines.

A respondent from outside the PA revealed that:

“People from other villages and even from adjoining districts illegally collect medicinal plants in large volumes from our areas. Medicinal herb traders seek permission from local authorities but collect beyond the permitted amount. There are inefficient and weak law enforcement mechanisms in and around the red panda habitats.”

A respondent from inside the PA stated:

“Illegal harvest of medicinal plants existed even after the establishment of the national park. It was under control during Maoist insurgency because outsiders were afraid of entering the park and buffer zone for illegal collection of plants but it increased after the end of Maovadi dwandakaal (Maoist strife period) in 2006.”

One respondent claimed that the upland pastures had also been depleted because they were common pool resources with people coming from various parts of the district to use the same pastures. They also believed that in the past, when they used to graze their cattle in the lowlands during winter, the grasses in the uplands had a greater chance to recover but now they must spend longer in the higher pastures, putting them under greater pressure, a process that had been exacerbated by the inclusion of non-traditional domesticated animals such as buffalo, mules, and horses.

However, most FGD participants discussed the decline or abandonment of transhumance, attributing it primarily to road construction which had improved access to the market. One respondent described what had been happening.
“We used to take our cattle (mountain sheep and goats) to the lowlands during the winter season, selling and exchanging goods including wool and its products, goat and sheep for meat, traditional medicines, and obtaining groceries. We would then return to our upland pastures in summer. The cattle were our means of transport. New roads made access to the market, transportation, and other daily requisites easy, altering the transhumant lifestyle or leading to its abandonment.”

The other main reason given for the decline or abandonment of transhumance was a lack of labour because many younger people were unwilling to continue the culture, being attracted instead to cash crop farming, mainly tree fruits such as apples, as well as goat farming in the village, education, ecotourism, and national and foreign employment opportunities. Only one FGD participant outside the PA thought young people in their village were interested in continuing, but with modifications such as using modern techniques to improve the breed of animals.

Other reasons given for the decline in transhumance were disease among the cattle and that regulations in the RNP and buffer zone had so restricted their grazing of cattle in the upland pastures that they opted to abandon it.

Most respondents agreed that a consequence of the decline in transhumance was less religious interaction with nature, although they still managed to perform major religious rites or ceremonies. One respondent described how

“We have hundreds of religious / holy sites on the transhumance routes where our rituals show honour and reverence for our god and goddess for the betterment of herds, a safe trip, and continuing security and health
Other drivers of change mentioned in FGD were the extension of the national road network to near the PA, which had increased recreational and ecotourism activities inside the PA, population growth, poverty, and changes in weather patterns, particularly an increased frequency of extreme weather such as exceptionally high snowfall, flooding rains and drought.

3.6. Discussion

The wellbeing of both red pandas and the people amongst whom it lives have traditionally been inseparable. An earlier study (Bhatta et al., 2020) identified, categorized and prioritized the ecosystem goods and services currently derived from the red panda habitats by local communities in and near RNP in western Nepal. In this study on the significance of the contribution of these goods and services to local livelihoods, and trends in their use and availability over the past two decades, we show that human use of the red panda habitats of western Nepal is changing rapidly with implications for both the panda and the people who rely on the ecosystem goods and services provided by its habitat. Our study complements the increasing knowledge of the ecological requirements of the panda itself (DNPWC & DFSC, 2018) and will allow important refinements to the interventions, community-based conservation initiatives and other species-based monitoring and conservation programs and approaches currently practiced (Bista, 2018; Bista et al., 2016; MoFSC, 2015).

3.6.1. Provision of ecosystem goods and services from red panda habitats

In the hills and mountains of Nepal, agriculture, forests and livestock farming are three closely interlinked and inseparable elements of rural livelihoods (Mahat, 1987;
Gilmour and Fisher, 1991) that are critical from social, economic and cultural perspectives (Acharya, 2002). Communities obtained firewood, medicinal plants, bamboo, fodder and bedding for domestic animals from the red panda habitat, and use the habitat while ascending with their flocks of livestock to upland pastures. The habitat also provides recreational activities for tourists and is embedded in religious practice (Bhatta et al., 2020). Of these, we found that firewood, fodder and bedding for animals created the greatest value for communities both inside and outside the PA. Such reliance of rural communities on the natural environment is common in developing nations (Vira & Kontoleon, 2012) with 80% of the population in Nepal obtaining food, fibre, freshwater and medicine from the forest (DNPWC & BCN, 2012) and about 64% of households using firewood as the main source of energy for cooking (CBS, 2012). For cash income, however, communities outside the PA relied primarily on medicinal plants and those inside the PA on tourism. Both are important to Nepal more generally: in 2014 Nepal traded more than ten thousand tons of medicinal and aromatic plants with a total value estimated at US$ 60 million to over 50 countries (Ghimire et al., 2015); in 2018, the country created more than US$2 billion in tourism revenue which supported over one million jobs (WTTC, 2019). And, just as in the country as a whole, tourism was providing more income at the time of the study than plants, and, was gradually replacing conventional sources of income (Fleming & Fleming, 2009; He et al., 2018). However, in our study area, such reliance of local communities on key ecosystem goods and services derived from red panda habitats inside and outside the PA may depend on several factors, including the area of habitats, distance from the villages, socio-economic and topographic factors, scarce services demand, benefit sharing access, ownership status and governing rules, and regulations. This is comparable with the communities’ priorities as seen in
other empirical studies (Acharya et al., 2019; Chaudhary et al., 2018; Muhamad et al., 2014; Murali et al., 2017) and concurs with their findings.

Most of the resources were extracted from government forest. In 1957 forests were nationalized and traditional use regulation and dispute resolution was abandoned (Adhikari, 1990; Bhatta et al., 2010). Since then there has been little local participation in management (Poudyal et al., 2020) and regulation of use has been ineffective (Chaudhary et al., 2016; Shrestha, 1999; UNEP, 2001) resulting in a “tragedy of commons” (Hardin, 1968). Because people felt that their use of resources was more constrained within the PA, as has also been found in Bardia National Park in south-western Nepal (Shova & Hubacek, 2011), there was an increase in the illegal extraction of resources from the government forests by natural resource dependent underprivileged and vulnerable groups who gained little from biodiversity protection within the PAs (Acharya et al., 2008; Bhatta et al., 2010). More recently there has been a shift in the management of the PAs from the nature-centric “fine and fence approach” (Baral, 2005; Bhattarai et al., 2017; Heinen & Kattel, 1992) to more participatory human-centered paradigms (Jones, 2007; Paudel et al., 2007; Spiteri & Nepal, 2008). Recent examples of participatory policy initiatives linking conservation and livelihoods in and around PAs are the management of buffer zone and community forests. Similarly, the collaborative approach to forest management and governance (Acharya, 2002; Pathak et al., 2017; Paudyal et al., 2017; Shrestha & Shrestha, 2010) practiced in the communal forests, which include the participatory forest management regimes undertaken under community, collaborative and leasehold forestry management systems, in conservation areas and in buffer zones (Poudel, 2019) have been demonstrably more effective than government forests since their formalization in the 1980s (Gilmour & Fisher, 1991). These differences in governance may explain why we found that communities outside the PA travelled further
and to areas of higher elevation than those inside the PA to receive the ecosystem benefits. However, it was apparent the participatory approaches had not prevented all over-exploitation. The weak legal and organizational capacity of local institutions, heavy emphasis on infrastructure development, and the limited participation of deprived populations and marginalized groups have reduced the effectiveness of participatory governance elsewhere in Nepal (Acharya et al., 2008; Paudel et al., 2007; Thing & Poudel, 2017) and in our study medicinal plants continued to be collected from within the PA, apparently without constraint; often communities close to the park boundaries are regularly pressured to collect illegally (Karanth et al., 2006; Thapa & Chapman, 2010).

3.6.2. Changes in ecosystem goods and services from red panda habitats

3.6.2.1. Trends in ecosystem goods and services

Of the 53 provisioning and cultural ecosystem goods and services identified as being obtained from red panda habitats, seven were considered particularly important to local livelihoods: bamboo, medicinal plants, firewood, fodder and bedding for animals, transhumance, recreational activities and ecotourism, and interactions with religious sites (Bhatta et al., 2020). The greatest contrast between demand and availability over the last two decades has been for medicinal plants, some of which are probably being over-exploited. For bamboo demand was thought to have stayed the same but availability had declined whereas the condition of upland pastures had declined despite a reduction in usage. Little change in the availability of the other services had been noted but there had been changes in the use of the landscape within the national park as people shifted from transhumance and pastoralism to tourism as a source of income. The picture painted by the FGD’s and household survey is of a society in transition, particularly within the PA, as transhumance is replaced by other forms of income. The trends noticed are in keeping
with regional (e.g., Wester et al., 2019; IPBES, 2018) and global assessments (e.g., 
IPBES, 2019; MEA, 2005) of the demand for medicinal plants and nature-based tourism 
and for national trends for services like firewood and fodder (Panchase mountain 
ecological region of western Nepal, Adhikari et al., 2019; central mid-hills of Nepal, 
Paudyal et al., 2015). They also apply to the other 46 ecosystem goods and services noted 
in Bhatta et al. (2020), such as the ongoing decline in the abundance of Himalayan 
monals and rhododendrons, Nepal’s national bird and flower respectively, the increasing 
rarity of many threatened mountain species (MoFSC, 2014a, 2014b) and the rapid 
depletion of many mountain resources, particularly those affected by the development of 
infrastructures such as rural roads and hydropower (Shrestha, 2017; DoR, 2010). Often 
such development is unplanned and non-regulated (MoFE, 2018), threatening mountain 
ecological systems (DoF, 2012; Wilkie et al., 2000) and traditional livelihoods.

3.6.2.2. Impacts of change on local livelihoods and the red panda

Until recently, income from ecotourism in Nepal had been growing rapidly 
(DNPWC, 2012), benefiting people living in PA buffer zones (Acharya et al., 2008) 
although not those outside the immediate vicinity of the parks (MoFSC, 2017). Even near 
parks, the greatest benefits were in places receiving international tourists (Paudel et al., 
2007); that people in communities around RNP continued to rely on the park for many 
goods and services may be because most tourists were Nepalese who had lower spending 
power. Nevertheless, there was a marked decline in transhumant pastoralism which has 
consequences not only for the ways in which mountain communities earn their living but 
potentially also on their traditional and cultural identity (Gentle & Thwaites, 2016; Negi, 
2007; Bhatta et al., 2020) since fewer people are visiting shrines and continuing the 
religious practices associated with the journeys to and from the mountain pastures.
How these social changes are affecting the red panda population is unclear. Transhumant grazing including attacks by livestock guard dogs have been considered threats to red panda both in our study locations (Bhatta et al., 2014; Sharma et al., 2014a) and elsewhere in Nepal (Williams, 2003; Yonzon, 1989) so potentially a decline in the practice of transhumance could benefit the panda. However, the ongoing loss of bamboo, the panda’s sole food source, and disturbance that may arise from medicinal plant collection, which occurs largely during the spring breeding season of the panda (Roberts & Gittleman, 1984), could have a negative effect depending on whether trends in panda populations are driven by food availability or predation.

3.6.3. Key drivers of change in ecosystem goods and services from red panda habitat

Many of the drivers of change identified in the FGDs are common to poor rural communities in the broader region (IPBES, 2019; Wester et al., 2019; IPBES, 2018; MoFE, 2018; MEA, 2005). Until recently there has been limited opportunity to substitute reliance on ecosystem goods and services (Roe, 2008) with poverty driving declines in natural resources (Squires, 2014). Where opportunities arise to make additional money, such as for high-value medicinal plants, the collection tends to be unsustainable because those collecting the plants receive a small fraction of their market value (Olsen & Bhattarai, 2005; Ghimire et al., 2008). Similarly, the opportunities now becoming available from infrastructure development, particularly the roads that improve access to markets, are poorly regulated leading to environmental damage that can offset the short-term advantages (Chaudhary et al., 2016; MoFE, 2018). Underpinning the negative effects of these drivers of change is the weakness in institutional arrangements that means resources are harvested without constraint or monitoring (Barnes & van Laerhoven, 2015;
Fleischman, 2014), compromising the sustainability of traditional resource use and degrading biodiversity, habitats and the viability of rural livelihoods (Squires, 2014, Uprety et al., 2016). In particular, the replacement of traditional forms of governance, such as the Mukhiya system (village head) that traditionally managed the use of upland pastures (Aryal et al., 2013), with poorly-administered state governance has meant resources like grasslands and medicinal plants have become common pool resources with little or no control on their exploitation (Ojha et al., 2019). Exactly the same process has happened in places like Inner Mongolia (Briske et al., 2015) and elsewhere in mountainous regions of the Asia-Pacific (ADB, 2017) where conventional livelihoods and cultures are transformed (Dutta & Bilbao-Osorio, 2012). In the process, traditional bonds between people and nature have been removed (Negi, 2012; Oviedo & Jeanrenaud, 2007) compromising rich biological and cultural diversity (Dudley et al., 2010) as new cultural influences become pervasive (IPBES, 2018; Parrotta et al., 2009).

3.6.4. Research implications and recommendations

Three main questions arise from the research concerning the sustainability of the use of red panda habitat in western Nepal. The most important highlights the need for much greater knowledge of the demand and supply, distribution and abundance, consumption patterns, trade, and threats involved in the industry surrounding medicinal plants (Ghimire et al., 2008). Existing legislation, plans, and policies to regulate and manage these plants are ineffective in mountainous parts of the country (Larsen et al., 2000; Olsen and Helles, 1997) leading to their rapid over-exploitation. There is a strong need for local involvement in this research as well as in the regulation and monitoring of harvesting (Poudyal et al., 2020). Such research would need to consider the individual medicinal plant species, as some harvest may be more harmful or sustainable than others.
From the perspective of red panda conservation, the research would also need to consider which aspects of the medicinal plant industry are likely to have the greatest impact on panda conservation.

A second area of research is the interaction between bamboo use by pandas and people given that all bamboo dies after flowering (Tewari, 1993). Despite red panda having survived both periodic loss of a food that constitutes more than 80% of its diet (Panthi et al., 2012; Panthi et al., 2015; Pradhan et al., 2001; Sharma et al., 2014b; Thapa & Basnet, 2015; Yonzon, 1989; Yonzon & Hunter, 1991) and traditional use of bamboo by many mountain communities (Bhatta et al., 2014; Bhatta et al., 2020), bamboo flowering is now considered a threat to the red panda (Bista et al., 2017; Williams et al., 2011). The research question thus concerns the extent to which human take of bamboo exacerbates existing shortages as well as whether the declines in bamboo noted in this study are primarily driven by a mass flowering event in recent years of a bamboo species with long periodicity or by some other factor given the use of bamboo by the communities sampled was not thought to have changed.

Thirdly, changes in and around the study region to improve the accessibility and connectivity of remote communities are likely to be having multiple flow-on effects that need to be fully understood. Modifications to improve the provision of a single service usually have consequences to multiple services delivered by the ecosystem (MEA, 2005). However, rarely it is possible to optimize all ecosystem benefits so trade-offs are necessary (King et al., 2015; Polasky et al., 2008; Smith et al., 2012). While trade-off assessment can be complex (IPBES, 2018; McShane et al., 2011), policymakers need the analysis to allow evidence-based decision making (de Groot et al., 2010; Rasul et al., 2011). While trade-offs between existing and future use of the same ecosystem goods and services (Carpenter et al., 2006; Rodríguez et al., 2006) do not necessarily always have
negative impacts (Bennett et al., 2009; Turkelboom et al., 2016), there needs to be a full understanding of the scope of influence that changes can bring to a community. In our example, a positive impact could be argued for RNP (Bhatta et al., 2020), and for other red panda habitats of Nepal (Bista, 2018), because seasonal transhumant grazing is being replaced as a livelihood by nature-based tourism with potential benefits for biodiversity conservation (Baral et al., 2017; Lindsey et al., 2007). However, the same loss of transhumance as a livelihood and lifestyle could be considered to be a negative outcome as it is a practice that annually reaffirmed cultural and religious ties to the red panda habitat. But nor should the change in practice be attributed solely to the rise of tourism as a livelihood as it is also being driven by changes in access to lowland pastures in winter, an unintended consequence of novel communal forest management (Gentle & Thwaites, 2016) that has replaced traditional governance institutions that allowed visiting pastoralists to graze in forests, and may have benefitted both pastoralists and local communities (Singh et al., 2015).

This three set of research questions highlights the need for studies aiming to further red panda conservation not only to expand in their breadth to consider more than distribution, habitat requisites, and threats but also to be geographically specific given that the social and cultural milieu within which the panda exists will vary from place to place (DNPWC & DFSC, 2018), just as we found to be the case inside and outside RNP. Understanding the values of ecosystem goods and services from habitats then allows the development of management interventions that are appropriately targeted for the communities and threats at each location. This is particularly true for red panda habitat that falls outside PAs, as is the case for nearly 70% of red panda habitats in Nepal (MoFSC, 2014b).
The sustainable management of ecosystem goods and services from the red panda habitat is possible if policymakers appreciate the root causes and impacts of unsustainable usage, line agencies implement comprehensive and targeted policies effectively and communities understand and embrace the reasons for policy change both outside and inside PAs. Similarly, PA management plans should address the local contexts to ensure they have support from communities around the park. Our approach of linking biological diversity, ecosystem services, and livelihoods may be useful in other red panda habitats and equally applicable to the conservation of other threatened and flagship species in the mountains and elsewhere in Nepal.

3.7. Conclusions

This study provides a synopsis of perceived trends in supply and demand for ecosystem goods and services obtained from red panda habitat and considered significant to the livelihoods inside and outside a PA in the north-western mountains of Nepal. Assessment of variation in use and availability of the ecosystem goods and services from these mountain landscapes in the past two decades provides an understanding of drivers of change in the habitat and likely trends if these drivers persist. Understanding changes in the flows of ecosystem goods and services from red panda habitat and the factors underlying those changes may be relevant simultaneously to the protection of the red panda, its habitat and associated biodiversity to the sustainability of the use of ecosystem goods and services, and to the improvement of local livelihoods. In this context, this study provides a cornerstone for formulating holistic red panda habitat governance approaches and strategies at the nexus of biological diversity, ecosystem services and livelihoods.
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Chapter 4. Willingness of local people in western Nepal to accept compensation in return for reducing exploitation of red panda habitat

A glimpse of research assistants conducting the household survey, first in Budha Bada, Jumla, and second in Jhyari, Mugu. Photo: Manoj Bhatta.
4.1. Abstract

Mountain ecosystems in western Nepal provide critical habitats for the endangered red panda. These habitats also need to satisfy the daily livelihood requirements and economic wellbeing of local communities. A high level of resource dependence and unsustainable resource use are creating pressure on the provision of ecosystem services in the region. Understanding the views of local residents about their willingness to constrain the use of forest resources is the first step towards helping them realise sustainable environmental management. We conducted a survey among villagers in the region to determine their willingness to participate in a potential PES-like scheme to help the conservation of the red panda habitat through reduced use of forest resources. Choice experiment results indicate that a high proportion of respondents are willing to accept payments in return for reducing forest resource use with a strong preference for a high conditionality and long-term contracts. People living inside a protected area were willing to accept a lower compensation than those outside. Respondents indicated that they would prefer communal compensation payments over personal payments. The findings could allow successful design and implementation of a PES-like scheme that concurrently manages the nexus between effective conservation, sustainable resource utilisation and livelihoods improvement.

Keywords: payment of ecosystem services, choice experiment, medicinal plants, transhumance, bamboo, willingness to accept

4.2. Introduction

About one-third of the global population depends on forests and forest products (FAO & UNEP, 2020). Although deforestation constitutes the main threat to forests worldwide (Wade et al., 2020), the overexploitation or unsustainable use of non-timber
forest products is also a global problem, leading to changes in ecological community structure and processes (Ndangalasi et al., 2007; Toledo-Aceves et al., 2014; Shackleton et al., 2018; Diaz et al., 2019), alteration in ecological community composition, interactions and organization (Moegenburg & Levey, 2002), declines in forest biodiversity (IPBES, 2019; Secretariat of the Convention on Biological Diversity, 2020), and degradation of the habitats of forest specialist species (IPBES, 2019; Leaver et al., 2019).

Pressures on global forests also compromise the provision of ecosystem service (ES) flows and ecosystem functioning (Brockerhoff et al., 2017) which negatively impacts livelihoods and human well-being, primarily of forest-dependent communities (MEA, 2005). Despite considerable global conservation effort, forest ES are continuously declining (Diaz et al., 2019). To meet the Aichi Biodiversity targets $5^3$, $7.3^4$, $12.2^5$ and $14^6$, and Sustainable Development Goal $15.2^7$ and $15.5^8$, conservation management must extend beyond protected areas (PAs; FAO & UNEP, 2020). This can result in a conflict over land use between local people and conservation managers (e.g. Robinson et al., 2013). Therefore, successful and socially acceptable conservation of forest ES can rarely

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3 By 2020, the rate of loss of all-natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
4 By 2020, areas under forestry are managed sustainably.
5 By 2020, conservation status of threatened species, particularly of those most in decline, has been improved and sustained.
6 By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.
7 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species.
8 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.
be achieved without the voluntary involvement of local people (Agrawal et al., 2008; Mace, 2014; Soe & Yeo-Chang, 2019).

A prominent policy instrument aiming to achieve more effective and fair conservation approaches is payments for ecosystem services (PES; Engel et al., 2008; Wunder et al., 2008, 2020). This scheme, or variations on it referred to as PES-like schemes, are market-based instruments intended to enhance both livelihoods and conservation (Wunder et al.; 2008; Chan et al., 2017). Such schemes are designed to provide incentives for people in exchange for the conservation and sustainable use of natural resources (Engel et al. 2008; Muradian et al., 2010; Wunder et al., 2020). For the conservation of forest ES, one approach is to pay local people for a reduction in forest resource usage, timber products and non-timber forest products (e.g., Muñoz-Piña et al., 2008; Wunder et al., 2008; Leimona et al., 2015; Grima et al., 2016; Ruggiero et al., 2019). This requires appropriate direct compensation payments (Paudyal et al., 2018).

However, who should get paid, for what and how much is context specific (Pagiola et al., 2010; Adhikari & Agrawal, 2013) and depends on peoples’ initial level of extraction, the value of the extracted services and the level of commitment to reduce extraction. It is also important to consider the preferences of those providing the services about how they would like to provide them (Petheram & Campbell, 2010; Zander et al., 2013), ensuring that the PES scheme satisfies the local socio-cultural conditions of those involved (Jack et al., 2008; Swallow et al., 2009; Kaczan et al., 2013). Apart from understanding the social context, it is equally important to consider the local ecological system and services such as the biophysical nature of the ES, the spatial distributions of the ES and trade-offs and synergies among different services; actors in PES programs including ES users, providers, intermediaries and donors; and PES scheme design and governance which includes the governance of funding arrangements and their
distribution, target recipients, contract length, payment type, amount, method, frequency and timing (Prokofieva, 2016).

In this paper, we present a case study from a mountainous region of north-western Nepal in and around Rara National Park (RNP), which also supports populations of the Endangered red panda (*Ailurus fulgens fulgens*; Glatston et al., 2015). The red panda is an arboreal habitat specialist that primarily consumes leaves and bamboo shoots (Glatston, 1994; Wei et al., 1999; Yonzon & Hunter, 1991). The mountain habitats of this species are also essential to the livelihoods of poor and vulnerable communities (Chaudhary et al., 2009) who extract bamboo from the forest, which can compete directly with the red panda for food. Their tradition of transhumance, which is the seasonal movements of livestock to upland pastures, and the increasingly commercial but unsustainable collection of medicinal plants, can also degrade the panda’s habitat (Bhatta et al., 2020) or disturb them during their spring and summer breeding season (Roberts & Gittleman, 1984).

However, community members are also concerned about environmental degradation and are exploring new sources of income (Chapter 3; Bhatta et al., submitted) so we wished to know to what extent they would be receptive to accepting compensation in return for constraining resource use. We therefore worked with them to assess 1) the extent to which people are willing to accept participation in a PES-like scheme to help the conservation of the red panda through reduced use of forest resources, 2) the level of compensation required for such participation, 3) how such compensation might differ among different groups of potential participants and 4) preferences for different modes of compensation.

To do so we undertook a survey among local forest users within the habitat range of red panda inside a buffer zone adjacent to a protected area (PA, Rara National Park) and adjacent to the buffer zone but outside the PA. We purposefully selected research
areas inside and outside the PA because of differences in governance and rule enforcement, as well as a high level of dependency among these communities on core red panda habitats with few alternative income sources. We used a choice experiment (CE), a multi-attribute stated preference method that is commonly used to value services for which market values are not universally available (Faccioli et al., 2020). The reasons we chose a stated preference method was that, while some of the products people collect from the forests do have market values, many don’t, and we aimed to assess preferences for behaviours in anticipation of restrictions in forest resource extraction that does not yet occur.

To date, the existing red panda conservation interventions and initiatives (MoFSC, 2015) poorly reflect the interrelatedness of goods and services provided by the mountain habitats that contribute to the livelihoods and wellbeing of local communities. The results of this study can help to shed light on the level of interdependency and how to compensate people equitably. The results are expected to provide insights into potential PES and PES-like policies in and around the habitat of the red panda in Nepal. In particular, we provide information about the value of the supply side of potential PES programs which is needed to find potential buyers of such services, i.e. to match supply with demand for ES (Müller et al., 2020). This has rarely been done in Nepal apart for a few community-based watershed management schemes (Bhatta et al., 2014a; Bhatta et al., 2018; Paudyal et al., 2018; Rai et al., 2018).

4.3. Background and methods

4.3.1. The use of choice experiments in conservation

Choice experiments (CE), together with contingent valuation (CV), are the two most widely applied stated preference methods in environmental economics. CEs are
based on random utility theory (Thurstone, 1927) and are now commonly used to understand preferences since originally being developed and employed during the early 1980s (Louviere & Woodworth, 1983). The method is effective for assessing behavioural changes in hypothetical for the conservation of wildlife (Hanley & Czajkowski, 2019). For conservation decision-making, the use of CE has had two important applications: 1) the evaluation of threatened species for setting conservation priorities and 2) the assessment of potential designs of conservation approaches involving people (e.g. PES or PES-like schemes).

As examples of threatened species valuation, CEs were employed to determine the economic value of charismatic threatened species (e.g. Zander et al., 2014), biodiversity in general (e.g. Czajkowski et al., 2009) or ecosystems that are home to threatened species (Shoyama et al., 2013). Sometimes, multiple species are evaluated in one study to provide a ranking for investment decisions (Tisdell & Wilson, 2004; Subroy et al., 2018; Lundberg et al., 2020). Evaluations are mostly based on peoples’ willingness-to-pay (WTP) for conservation in the form of an additional tax or a one-off donation into a conservation fund.

The second contribution of CEs, of most relevance to our study, has been the assessment of preferences for participation in PES programs with different contract designs through participants willingness-to-accept (WTA) compensation payments or WTP for participation. One example is that of farmers delivering ecosystem services by participating in agri-environmental schemes (e.g. Latacz-Lohmann & Breustedt, 2019; Mamine et al., 2020). Examples from low-income countries includes providing wages as an alternative to illegal hunting of wildlife (Moro et al., 2013) and compensating farmers in return for environmentally friendly agronomic practices (Mulatu et al., 2014; Geussens et al., 2019). We applied a CE in a similar context to assess the willingness of Nepalese
mountain villagers to extract fewer forest resources so there is less competition with red panda for food (such as bamboo) and to protect the red panda habitat by limiting transhumant practices and the commercial collection of medicinal plants.

To the best of our knowledge, no studies have applied CE to assess local peoples’ willingness to engage in conservation practices for threatened species in Nepal, although a few studies have used CV to determine the WTP to support the conservation of threatened species (e.g. Schutgens et al., 2019). Our study is expected to contribute to new knowledge about local peoples’ attitudes towards changing their behaviour, i.e. reducing the use of forest resources, to support the conservation of threatened species and their habitat in Nepal. Our results can also help target participants should a PES or PES-like scheme be established to conserve the red panda.

4.3.2. Study area

The red panda habitat covers approximately 24,000 km² across 24 districts of Nepal, the majority of which (nearly 70%) lies outside PAs (Bista et al., 2016; DNPWC & DFSC 2018). Although listed as a protected priority species under schedule I of the Nepal Government’s National Parks and Wildlife Conservation Act 1973 and the subject of various conservation programs and legal provisions, the population, already small (237–1061 individuals; Jnawali et al., 2012), is declining in its range countries: Nepal, India, China, Myanmar and Bhutan (Glatston et al., 2015). The species has already been extirpated from some former habitat in Nepal (Bista et al., 2017). One of the most suitable but least explored habitats of the red panda is in and around RNP (Sharma, 2008; Bhatta et al. 2014b).

The study locations were in and around RNP and its buffer zone. The national park (IUCN category II) was gazetted in 1976 and is the smallest PA in Nepal (106 km²).
The buffer zone of 198 km² surrounding the park was designated in 2006. The buffer zone was established according to the Nepal National Parks and Wildlife Conservation Act, 1973, to support and inspire the participation of local communities in biodiversity conservation. The Himali National Park Regulation, 1979, allows local people to graze livestock and undertake subsistence extraction (for personal use) of minor forest resources including bamboo, and medicinal herbs, but not for commercial purposes. The Buffer Zone Management Regulation, 1996, commits to providing 30-50% of total park revenue to the buffer zone communities. The park and the buffer zone are part of two districts in Karnali Province: Mugu and Jumla districts (Fig. 4.1). A significant proportion of the mountains in the RNP and buffer zone covers grasslands and rangelands used as grazing by sheep, mountain goats, yaks, and horses. These highland meadows are also rich in medicinal herbs.
Figure 4.1. Study area map for a study of a potential PES-like scheme in and around red panda habitats in western Nepal

The people in the research area, inside and outside the PA, rely to different degrees on forest resources, such as medicinal plants, bamboo, and transhumant grazing
(Bhatta et al., 2020). However, a high level of resource dependency combined with population growth has altered traditional resource usage, and led to unsustainable practices (Adhikari et al., 2007; Tiwari and Joshi, 2015; Everard et al., 2019), creating pressure on the red panda habitat. In particular, illegal trade in mountain forest resources has increased, particularly medicinal plants, reducing benefits to local communities because there has been little compliance with a national governance system and disempowerment of traditional and community-based resources governance (Larsen, 2014).

4.3.3. Data collection and sampling

The study area comprised six administrative wards of which three were located in the buffer zone of the RNP in Mugu district and three were outside the PA in Jumla district (Fig. 4.1). These wards and the villages within them were selected because they were the nearest villages to the known range of the red panda (Jnawali et al., 2012; Bhatta et al., 2014b).

Exploratory research was conducted from November 2017 to January 2018 and included key informant interviews with the Division Forest Officer of Jumla district, the rangers of RNP, members of the RNP buffer zone management committee and community forest user group, the customary village chief (Mukhiya) of each of the study villages, representatives from the mother’s group (Ama Samuha), school teachers, senior citizens, and herders (see Bhatta et al., 2020). The questionnaire, designed based on these interviews, had three parts: 1) questions about the socio-economic background and income sources of respondents, 2) the CE including follow-up questions regarding how choices were made, and 3) questions about preferences for alternative compensation.

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9 Wards comprise villages and are the smallest administrative unit in Nepal.
modes such as personal payments, communal payments, or livelihood support programs. Respondents were also presented with a short introduction to the project explaining its objectives.

The questionnaire, including the CE, was tested in the Mugu district during August 2019. The purpose of piloting the survey was to review and refine the chosen attributes, to ensure that the concepts made sense and that the levels of different attributes in the CE were appropriate. This exploratory process involved twelve face-to-face interviews and two Focus Group Discussions (FGDs) with 16 participants.

The final household questionnaire survey was conducted during September and October 2019 with 243 households (145 inside and 98 outside the PA) of the six wards (three inside and three outside the PA) consisting of 11 villages in and around the red panda habitat (Appendix 4). We applied purposive (also known as judgemental sampling; Kerlinger, 1973), a non-random sampling technique composed of a single-visit household questionnaire survey. The study involved 334 households (220 inside and 114 outside the PA) and, in doing so, sampled roughly 86% of people inside and 66% outside. Elder members of the family, or, in absence of such members, other senior members of the family were selected for the survey.

Five experienced enumerators (research assistants) were recruited for the survey. These were university students, the majority of whom came from the study region and were familiar with the local language, culture, conservation practices and livelihood conditions. The enumerators were trained in the use of the questionnaire and CE. The survey was conducted in Khas bhasa, the local language. The enumerators explained in detail the attributes and levels used in the CE, and how to read the choice sets. The enumerators informed the survey respondents that participation in the scheme was entirely voluntary. All necessary research permissions were obtained from the relevant
authorities in Nepal. Human research ethics approval was also obtained from the Human Research Ethics Committee of Charles Darwin University (H17030).

4.3.4. Design of the choice experiment

Respondents were presented with six so called choice sets. Each choice sets included three alternatives from which respondents chose one (Fig. 4.2). Each alternative differed in terms of characteristics (attributes) and their levels. Respondents were asked to treat each of the six sets independently and to choose their preferred alternative out of the three alternatives in each choice set. For each choice set, respondents were asked to assume that a conservation organisation administering conservation programs would compensate them to reduce the use of resources from red panda habitats. Each choice set comprised two scenarios that described a restriction in forest resource extraction and a status-quo (SQ) alternative, describing the current situation with forest resource usage.

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a cash monthly</td>
<td>0</td>
<td>3000 ($26.32)</td>
<td>2000 ($17.54)</td>
</tr>
<tr>
<td>compensation of a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>6 to 10 years</td>
<td>3 to 5 years</td>
</tr>
<tr>
<td>Seasonal grazing on upland</td>
<td>Yes, no restriction</td>
<td>No more grazing on upland</td>
<td>Yes, restrictions in terms</td>
</tr>
<tr>
<td>pastures</td>
<td></td>
<td>pastures</td>
<td>of the number of animals (fewer</td>
</tr>
<tr>
<td>Taking of other forest</td>
<td>Yes, no restriction</td>
<td>Restrictions on only bamboo</td>
<td>medicinal plants (little</td>
</tr>
<tr>
<td>resources</td>
<td></td>
<td>(little amounts for self-use)</td>
<td>amounts for self-use)</td>
</tr>
</tbody>
</table>

I prefer                     [ ] [ ] [ ]

\(^4\) Based on the exchange rate during the time of the survey (USD $1=NPR 114)

*Figure 4.2 An example of a choice set used in a survey among local people in and around red panda habitats in western Nepal.*

The attributes and level section for the CE was based on the exploratory research phase, as well as on published literature describing similar CE applications (e.g.
Espinosa-Goded et al., 2010; Kaczan et al., 2013; Mulatu et al., 2014; Hansen et al., 2018; Geussens et al., 2019). We included five attributes in the final design (Table 4.1).

Table 4.1. Choice experiment attributes and levels.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Description</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seasonal grazing on upland pastures</td>
<td>The limited or restricted grazing on the upland rangelands.</td>
<td>No more grazing on upland pastures, grazing allowed with fewer animals, grazing allowed for fewer months</td>
</tr>
<tr>
<td>Use of medicinal plants and bamboo</td>
<td>The limited and restricted use of medicinal plants and bamboo.</td>
<td>Restrictions on only medicinal plants, restrictions on the only bamboo, restrictions on both medicinal plants and bamboo (Note: all three levels permit little amounts for self-use)</td>
</tr>
<tr>
<td>Level of compliance (conditionality)$^a$</td>
<td>Three different levels of contract conditionality that needs to be accepted.</td>
<td>Low, moderate, high</td>
</tr>
<tr>
<td>Length of contract</td>
<td>Amount of time that limits or restricts the use of specified ES from red panda habitats.</td>
<td>3 to 5 years, 6 to 10 years</td>
</tr>
<tr>
<td>Level of compensation</td>
<td>The monthly payment in Nepalese Rupee (NRP)$^b$. Amount of monthly cash payment that a villager will receive.</td>
<td>2000 ($17.54), 3000 ($26.32), 4000($35.09), 5000 ($43.86)</td>
</tr>
</tbody>
</table>

$^a$ At the low level of conditionality, community members are required to keep a logbook documenting how they use the ES from the red panda habitat. No inspection is needed for this level but the logbook may be audited.

At the moderate level of conditionality, a local villager would be hired by the local administrative body to inspect (annually) the proper extraction and use of ecosystem goods and benefits from the habitat.

At the high level of conditionality, a forestry officer nominated by administrating body would inspect (at least twice every year) the goods and benefits obtained from red panda habitats to keep a balance between availability and supply of resources.

$^b$ Based on the exchange rate during the time of the survey (USD $1=NPR 114)

In order to elicit the amount needed by local people as compensation for extracting fewer forest resources, we aimed to evaluate their WTA compensation, as done previously (e.g. Mulatu et al., 2014; Geussens et al., 2019; Haile et al., 2019). The levels for the monetary attribute, a personal monthly compensation payment, were based on the average monthly earnings in the research area and their range.

Two attributes described how compliance with these restrictions would be enforced and for how long the compensation would be paid (length of contract). Three
levels of contract conditionality (low, moderate and high) were used and the definitions shown to respondents (Table 4.1). The remaining two attributes concerned the behaviours that have the greatest impact on the red panda habitat but are also the most important source of forest ecosystem services: medicinal plants, bamboo and transhumance\(^{10}\) (Bhatta et al., 2020). The first attribute considered restrictions on seasonal grazing of animals (transhumance) including the number of animals or length of grazing season; the second specified potential restrictions in the quantity of medicinal plants, bamboo, or both, that could be taken (Table 4.1).

Because of the high number of attributes with their levels, there would have been 216 (=3*3*3*2*4) ways to combine them. To reduce the number of choice sets to a reasonable number that can be administered in a survey, we used the software Ngene (ChoiceMetrics, 2012) to create 18 choice sets using D-efficiency criteria (see Scarpa & Rose, 2008). The use of efficient designs has recently become prevalent (Haile et al., 2019) and are particularly useful for studies with small sample sizes because they lead to smaller standard errors in model estimation (Rose & Bliemer, 2013). The D-efficiency criteria is the most commonly used efficiency measure because it leads to the smallest generalized variances of the parameter estimates (Louviere et al., 2008). Our final design had a D-error of 0.206. These 18 choice sets were blocked into three blocks and with one block of six choice sets randomly used for each respondent, ensuring that each block was used about the same number of times.

\(^{10}\) Firewood, and fodder and bedding for animals were also ranked among the main services, but are collected from nearby forest, mostly out of the core habitats of red panda, and for self-consumption, hence not included in the choice experiment. Choice experiments have to be limited in the number of attributes that can be shown to respondents without overburdening their cognitive capacity to make sound choices.
4.3.5. Data analysis

We started the analysis with a basic multinomial logit (MNL) model to check for significant attributes and signs of the coefficients. A negative coefficient signified that a respondent did not prefer the particular level of an attribute, compared to the reference level, a positive sign that they preferred it. For the dummy variable ‘length of contract’, which had only two levels, we included a variable for one of the two levels (Table 4.1), for ‘6 to 10 years’ which was coded 1, meaning that the other level, ‘3 to 5 years’, was coded 0 and was treated as the reference level. All other non-monetary attributes had three levels, which meant that, to avoid perfect collinearity (Hensher et al., 2015), we had to create two variables for two of the levels and treat one level as the reference level. For seasonal grazing on upland pastures, we used the level ‘no more grazing’ as the reference level, for the use of medicinal plants and bamboo ‘restrictions on both, the extraction of medicinal plants and bamboo’ and for the level of compliance ‘moderate’.

While useful for checking attributes and signs, the MNL model has known shortcomings, such as the problem of independence of irrelevant alternatives (IIA) and the assumption that every respondent has the same preference. We, therefore, estimated random parameter logit (RPL) models which are more flexible in their assumptions and which can detect unobserved preference heterogeneity across the sample and allow for respondents making repetitive choices (panel data; Hensher et al., 2015). We estimated a basic RPL model and one which aimed at explaining what type of respondents preferred the SQ alternative. This was done by including interaction terms between socio-economic variables (gender, age, education, location (inside/outside PA) and whether or not respondents were engaged in any transhumance) and the choice of the SQ alternative.

We included all attributes and levels in the MNL model, but for the RPL model, we excluded those that were insignificant. For the RPL model with interaction terms, we
included relevant socio-demographic variables and only kept those that had significant effects on the choice of the SQ alternative. All RPL models were estimated using 2,000 Halton draws.

The WTA estimates were derived from the basic RPL model through simulations and the 95% confidence intervals (CI) were derived through the Krinsky and Robb (KR) procedure (Hensher et al., 2015) with 10,000 simulations.

4.4. Results

4.4.1. Sample description

The average age of respondents was 42.6 years (SD: 11.9; median: 40) and 62% of the sample was male (Table 4.2). About 57% of the respondents had not completed any formal education, while very few (about 3%) had attended or completed a university degree. About 60% lived inside the PA and BZ in Mugu district, the remaining 40% outside both in Jumla district. Most of the respondents collected bamboo (84%) and medicinal plants (79%) as part of their livelihoods; 23% practiced seasonal transhumance.

Table 4.2. Socio-economic characteristics of participants who completed the choice experiment in a survey among local people in and around red panda habitats in western Nepal (n=243: inside protected area = 145, outside protected area = 98).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondents inside the PA (%)</td>
<td>60</td>
</tr>
<tr>
<td>Average age (SD; median)</td>
<td>42.6 (11.9; 40)</td>
</tr>
<tr>
<td>Male (%)</td>
<td>62</td>
</tr>
<tr>
<td>Level of education (%)</td>
<td></td>
</tr>
<tr>
<td>Not completed any formal education</td>
<td>57</td>
</tr>
<tr>
<td>Completed primary / elementary school</td>
<td>21</td>
</tr>
<tr>
<td>Attended secondary school (Years 8,9,10)</td>
<td>12</td>
</tr>
<tr>
<td>Attended or completed high school (Years 10,11,12)</td>
<td>7</td>
</tr>
<tr>
<td>Attended or completed university</td>
<td>3</td>
</tr>
<tr>
<td>Actively collecting bamboo (%)</td>
<td>84</td>
</tr>
<tr>
<td>Actively collecting medicinal plants (%)</td>
<td>79</td>
</tr>
<tr>
<td>Engaged in transhumance (%)</td>
<td>23</td>
</tr>
</tbody>
</table>
4.4.2. Acceptance of compensation payments to reduce forest resource use

Out of all 243 respondents, less than 13% (31; 16 inside and 15 outside the PA) chose the SQ, the current practice of forest usage, in all six choice tasks. In doing so they rejected the idea of participation in a PES-like scheme and of being compensated for restricting their use of forest resources to conserve the red panda habitat. There was no significant difference in the rejection rate among respondents inside and outside the protected area (X-squared = 0.96; df = 1, p-value = 0.3275). Respondents who always choose the SQ were more likely to be older and male with low levels of education (Appendix 5). Reasons for always choosing the SQ (Table 4.3) included that they considered the payments would not be enough to compensate for their loss (61%), that they liked the traditional lifestyle and did not want to stop going into the forest (61%), that they lacked alternatives to their existing lifestyle (35%), or that they did not like the monitoring and compliance (19%).

Table 4.3. Results of multiple value response analysis (frequency distribution analysis) among local people in and around red panda habitats in western Nepal showing respondent reasons for always choosing the current situation (SQ) in all six presented choice tasks.

<table>
<thead>
<tr>
<th>What is the reason for always choosing ‘current situation’?</th>
<th>Frequency</th>
<th>Percent of responses</th>
<th>Percent of cases (n=31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The payments were never enough to compensate my loss</td>
<td>19</td>
<td>35</td>
<td>61</td>
</tr>
<tr>
<td>I like the traditional lifestyle and do not want to stop going into the forest</td>
<td>19</td>
<td>35</td>
<td>61</td>
</tr>
<tr>
<td>I would not know what else to do with my time then</td>
<td>11</td>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td>I do not like the monitoring and compliance</td>
<td>6</td>
<td>10</td>
<td>19</td>
</tr>
</tbody>
</table>

4.4.3. Preference for a potential PES-like scheme to conserve the red panda habitat

The MNL results including all attributes and levels (Appendix 6) showed that three variables were insignificant: ‘low conditionality’, ‘grazing allowed with fewer animals’ and ‘restrictions on bamboo only’. This means that respondents preferences for
the proposed levels did not differ from the respective reference levels. Otherwise, respondents preferred a contract with a high level of conditionality over a contract with low and moderate levels, and that a contract lasting 6-10 years was preferred over one of 3-5 years. Respondents preferred restricting extraction of medicinal plants and bamboo together or only bamboo over restricting only the extraction of medicinal plants. Respondents preferred ‘no more grazing’ and restricting the number of animals allowed to be taken to the upland rangelands for grazing over restricting the number of months grazing was allowed.

The Basic RPL model (Table 4.4) showed a reasonable fit with a McFadden $R^2$ of 0.21. Significant standard deviations for both RPL models showed that the significant attributes left in the model varied greatly between respondents. This indicated a great deal of unobserved heterogeneity within the sample which we aimed to examine further by including the interaction terms. The McFadden $R^2$ slightly increased (to 0.22) when interaction terms between attributes and the SQ alternative were introduced (RPL model with interaction terms; Table 4.4).

Both RPL models confirmed the results of the MNL model with the expected signs. The coefficient for the SQ alternative was significant and positive for the basic RPL model, signifying that respondents, in general, prefer the SQ and need compensation to participate. In the RPL model with interaction terms, the SQ constant became insignificant, while four socio-economic characteristics had a significant influence on the choice of the SQ.

Women, those who were engaged in grazing and those living outside the PA were more likely to choose the SQ alternative and would require greater compensation than men, those not practising transhumance and those inside the PA. Younger respondents were less likely to choose the SQ and would need lower compensation payments.
Education and whether or not respondents lived inside or outside the PA had no significant impact on the choice of the SQ alternative.

Table 4.4. Results of RPL (random parameter logit) models describing the preferences of local people in and around red panda habitats in western Nepal without and with the interaction of variables with the choice of the status-quo (SQ) implying non-participation in a PES-like scheme and no restrictions on the extraction of forest resources by local people.

<table>
<thead>
<tr>
<th>Basic RPL model</th>
<th>RPL model with interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compensation (in USD)</td>
<td>(0.081^{***}) 0.006</td>
</tr>
<tr>
<td>High conditionality</td>
<td>0.349** 0.140 0.883***</td>
</tr>
<tr>
<td>Length of contract 3-5 years</td>
<td>-0.698*** 0.137 1.294***</td>
</tr>
<tr>
<td>Restriction on months of grazing</td>
<td>-0.678*** 0.162 1.228***</td>
</tr>
<tr>
<td>Restriction on medicinal plants collection</td>
<td>-0.417*** 0.134 1.314***</td>
</tr>
<tr>
<td>Constant for SQ alternative</td>
<td>0.674*** 0.208</td>
</tr>
<tr>
<td>SQ x Engaged in transhumance</td>
<td>0.933*** 0.213</td>
</tr>
<tr>
<td>SQ x Age</td>
<td>0.026*** 0.008</td>
</tr>
<tr>
<td>SQ x Male</td>
<td>-0.562*** 0.213</td>
</tr>
<tr>
<td>SQ x Inside PA</td>
<td>-0.400** 0.197</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1458</td>
</tr>
<tr>
<td>AIC</td>
<td>2560.3</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-1270.1</td>
</tr>
<tr>
<td>Mc Fadden R²</td>
<td>0.21</td>
</tr>
</tbody>
</table>

SE = Standard error
SD = Standard deviation for random parameters
*** p < 0.01, ** p < 0.05, * p < 0.1.

4.4.4. Willingness-to-accept compensation

Respondents were willing to accept a monthly compensation of around USD 8.36 to change from their current practices to participating in a PES-like scheme aiming to reduce forest resource extraction (Table 4.5). Respondents would need another USD 8.42 monthly if they had to restrict the time (months) they could take their animals to the rangelands, all else being equal, and another USD 5.17 if medicinal plant extraction was restricted. For short term contracts (3 to 5 years) they were willing to accept a monthly
payment of USD 8.67 (or vice versa, if the contract was for 6 to 10 years, they would need USD 8.67 less). For a high conditionality, respondents would accept less compensation (USD 4.33 per month), and vice versa, if conditionality was low or moderate, they would need another USD 4.33 per month.

Respondents engaged in transhumance would require USD 11.50 more per month than those not practicing transhumance, women USD 6.92 more than men and those outside the PA USD 4.92 more than those living inside. Respondents would need USD 0.33 more per year of age, i.e. while a person who is 60 would require USD 19.8 per month for participation, a person who is 25 years would require USD 8.25, i.e. USD 11.55 less per month.

Table 4.5. Willingness-to-accept (WTA) compensation (in USD) by local people in and around red panda habitats in western Nepal for participating in a PES-like scheme in and for specific attributes of such a scheme.

<table>
<thead>
<tr>
<th>From Basic RPL model</th>
<th>From RPL model with interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTA</td>
<td>95% CI</td>
</tr>
<tr>
<td>For participation (change from SQ)</td>
<td>8.36</td>
</tr>
<tr>
<td>High conditionality</td>
<td>-4.33</td>
</tr>
<tr>
<td>Length of contract 3-5 years</td>
<td>8.67</td>
</tr>
<tr>
<td>Restriction in months of grazing</td>
<td>8.42</td>
</tr>
<tr>
<td>Restriction on medicinal plants collection</td>
<td>5.17</td>
</tr>
<tr>
<td>Engaged in transhumance</td>
<td>11.50</td>
</tr>
<tr>
<td>Age</td>
<td>0.33</td>
</tr>
<tr>
<td>Male</td>
<td>-6.92</td>
</tr>
<tr>
<td>Inside PA</td>
<td>-4.92</td>
</tr>
</tbody>
</table>

CI = Confidence interval
ns = not significant

4.4.5. Acceptance of alternative types of compensation payment

Approximately 84% (122 inside and 83 outside the PA) of the respondents were willing to reduce the use of forest resources if there were communal compensation payments instead of personal payments. Nearly all (95%; 145 inside and 86 outside the
PA) were willing to reduce the use of forest resources if the compensation payment was in the form of livelihood support programs, instead of personal payments. Respondents preferences for the open-ended question “What else would you accept as compensation to stop transhumance and/or stop collecting bamboo and medicinal plants for commercial purposes?” were consistent among respondents inside and outside the PA except for some location specific compensation suggestions such as ecotourism and homestay promotion support which were repeatedly mentioned by respondents inside the PA.

Respondents also indicated a variety of community programs that they would like to see implemented in return for reducing their forest resource use, such as: skill enhancement and training programs, agriculture-based livelihoods programs, community-based conservation initiatives, and the provision and training of innovative and modern agricultural tools and techniques. They also wished for alternative allocations for grazing areas and other specific locations for fodder and bedding for animal collection outside the core red panda habitats. Some respondents also indicated that they would appreciate support for substituting their bamboo use and wool and woollen products, although the production of essential storage and transport equipment (e.g. Doko, Chhapro, Dalo, Namlo, Kokro, Naglo), fencing and roofing materials, seasonal cattle shed (Goth) construction, knitting mats, and vegetable and pickle from young bamboo shoots still require the processing of bamboo. Some respondents further suggested receiving financial aid to construct animal sheds near villages instead of having to take the animals up to highland rangelands, while others preferred a medicinal herb plantation program in and around the villages, modern goat and sheep farming methods, advice and assistance with commercial vegetable and fruit growing and market access, and irrigation facilities.
4.5. Discussion

4.5.1. Addressing a significant research gap

In Nepal, most research on the threatened red panda has been autecological, providing a biological context for red panda conservation (DNPWC & DFSC, 2018) but not capturing the linkages between ES benefits derived from red panda habitats, livelihoods and wellbeing, and socio-ecological pressures on these habitats. Previous related research (Bhatta et al., 2020) identified, categorized, and prioritized the ecosystem goods and services obtained from the mountain habitats of the red panda inside and outside the RNP in Western Nepal. It showed the significant dependence of local people on the extraction of forest resources. Our study assessed pathways for including local people in the conservation of the red panda. It fills an important research gap since conservation of threatened species must often be targeted indirectly through conserving their habitats (Beatley, 2014) and when direct conservation strategies, such as excluding local people through a ‘Fine and Fence approach’ to PA management, is socially unacceptable and unsuccessful (Heinen, 1996). Following successful applications worldwide, we designed a PES-like scheme that would pay compensation to local people if they participate and reduce their extraction of forest resources in the red panda habitat. This type of study is the first to be designed for the red panda, and our results can be useful for similar locations where conservation of threatened species is ineffective due to conflicts of resource use between humans and animals (see also Loomis & White, 1996; Zander et al., 2014; Gong et al., 2020). Our study can thus constitute the basis for developing a PES or PES-like scheme in Nepal for forest ES and the conservation of forest specialist species and compliments recent PES studies (Bhatta et al., 2018; Paudyal et al., 2018). As such our paper also contributes to a growing body of research on the
application of PES to the conservation of threatened species in low-income countries where resource governance and compliance are often weak (Chaudhary et al., 2016).

### 4.5.2. Acceptance of participation and preferred restrictions

Generally, acceptance of the idea of being paid for a reduction in use of forest resources was very high (87%). This suggests that local people are aware that their increasing extraction of resources from the red panda habitats cannot be sustained and that most people do not mind reducing this usage if they are compensated for their loss. This also indicates that the local people might have been aware that this species will be conserved by reducing their forest resource use. We are also confident that the applied CE included plausible alternatives with appropriately chosen attributes and levels sufficient to incentivize villagers to conserve the red panda habitats.

We were surprised that respondents preferred high conditionality over low or moderate levels. High conditionality was explained to respondents as: a forestry officer nominated by an administrating body will inspect (at least twice every year) the goods and benefits obtained from red panda habitats to keep a balance between availability and supply of resources. This result is comparable to the findings from a previous study conducted in the East Usambara Mountains, Tanzania where the respondents opted for high conditionality with physical inspection and compliance (Kaczan et al., 2013). Our result can be interpreted in two ways. One is that local people realise the need for higher compliance and standards in their effort to reduce forest resource overexploitation, especially as the increased resource extraction, sparked by high demand from China and India for medicinal plants, is increasingly being undertaken by people from outside the area such as commercial collectors from other cities in Nepal. A second, non-exclusive,
interpretation is that respondents saw opportunities for employment for community members as local officers to be hired to check compliance.

That respondents preferred to be bound by a longer contract contrasts with findings from similar studies where shorter contracts were preferred (Torres et al. 2013; Haile et al. 2019). This could be because compensation payments as described would constitute a steady income stream when direct resource-based incomes tend to vary from year to year and are deficient in bad years. Alternatively, respondents may not want to return to a livelihood relying on forest resource usage, preferring instead to change gradually to other income streams, hence the preference for a long-term commitment from both sides, themselves and those who provide the contract.

We were also surprised that people preferred restrictions on the extraction of both medicinal plant and bamboo extraction, or of bamboo alone over restrictions on medicinal plant extraction alone. We expected that respondents would focus on restricting medicinal plant harvest given the lack of local benefit, as described above. However, in the CE posed to respondents, collection for self-consumption would still be permitted under all levels of forest resource extraction, so the broader restrictions preferred would limit large-scale commercial extraction of any kind. How commercial extraction would be limited was beyond the scope of the survey since people from outside the villages who extract medicinal plants for commercial use were not surveyed. Further work is required on the appropriate instruments for reducing their extraction of resources from red panda habitat.

The results for restrictions in transhumance were ambiguous and offered the most interesting results. We found that respondents strongly disliked restricting the time they are allowed to take their animals to the upland rangelands. Given the time and effort required to take animals up the mountains in summer, respondents either wanted to leave their animals there for as long as possible or not take them at all. We would have
expected the same preference for the proposed restriction in the number of animals allowed for grazing, but respondents were indifferent towards this level, as compared to the reference level, and both were preferred over the time restriction. It could be that many people do not hold many animals or have reduced their herd size already (Gentle & Thwaites, 2016), and that the restriction in animal numbers would not greatly affect them. Also, local people are in the process of shifting from transhumance to alternative livelihoods consistent with a gradual shift from pastoral livelihoods to non-pastoral sectors elsewhere in mountainous Asian countries (Banerjee, 2009; Kerven et al. 2012; Namgay et al., 2014), and most people may be little affected by a total ban on the highland grazing. This was reflected in the sample of respondents of whom only 23% were actively involved in transhumance. Those continuing the practice, however, required more compensation (USD 11.50 more per month more than those not taking animals to upland rangelands) consistence with a reluctance to change this lifestyle, or perhaps a lack of alternative income sources since those continuing to practice transhumance may not be engaging in other forms of income generation.

4.5.3. Alternative payment modes in PES schemes

The CE used a personal monthly payment as its monetary attribute but the result of follow up questions suggests that respondents would prefer a communal compensation payment. A similar result has been found in some other community settings (Kerr et al., 2012; Zander et al., 2013), including in Asia (Leimona et al., 2009); in Mexico, the national PES scheme was more equitable where there were community incentives (García-Amado et al., 2011). Respondents in other studies in developing nations, however, have opted not to support a community payment strategy for PES contracts (Kaczan et al., 2013; Costedoat et al., 2016; Geussens et al., 2019).
Respondents also preferred forms of compensation other than cash, a preference also noted elsewhere (Robertson & Wunder, 2005; Huang & Upadhyaya, 2007; Asquith et al., 2008). One reason for such a preference may be because small cash payments would be spent quickly with few long-term livelihood benefits in contrast to other forms of compensation. Another reason may be that the cash payments may not be adequate on their own to offset the opportunity costs incurred by ceasing resource consumption (Huang & Upadhyaya, 2007), especially for high return items like medicinal herbs. Instead, respondents wanted cash payments to be complemented with community-based livelihood support and enhancement programs (such as skill enhancement and training programs), agriculture-based livelihoods programs, community-based conservation initiatives, and the provision of and training in innovative and modern agricultural tools and techniques, and alternative forest resources benefits (such as allocation of alternative grazing and resource collection areas). This is consistent with the findings from many developing countries and contexts across Asia (see Leimona et al., 2009 for detailed review).

4.5.4. Transhumance culture in transition

Many of the results are consistent with broader social change in the region with the low percentage of respondents involved in transhumance suggesting that there has already been a cultural transformation from traditional livelihoods. This has been driven by three major demographic and social trends. The first is outmigration by young people, particularly young men, to educational opportunities or national and foreign employment outside their villages (Ghimire et al., 2020). For those remaining, agricultural production has intensified over the last two decades with cash crop farming, mainly tree fruits such as apples, widely adopted (Pandey et al., 2017) and people have also taken up goat
farming (Neupane et al., 2018) and commercial beekeeping (Aryal et al., 2015) to provide a regular income. Some people, particularly from inside the PA, have also invested in homestay businesses for eco- and cultural tourism, a practice promoted heavily by government (Acharya & Halpenny, 2013) with proven welfare benefits (Yergeau, 2020).

For the conservation of red panda habitats, this transformation could have positive consequences because it has the potential to decrease competition for food and to reduce disturbance during the breeding season. Already there is evidence from some parts of Nepal of reforestation in mountain areas where populations have declined (Oldekop et al., 2018). For the people living in the region, the changes are likely to be substantial: highland transhumance has been practised for so long that it was central to the traditional and cultural identity of many mountain people (Negi, 2007; Gentle & Thwaites, 2016). The rapid change is likely to lead to a rapid loss of traditional knowledge since older people are less likely to take children with them on transhumant expeditions during which they shared stories and knowledge about the land and resources. While respondents said they take their children into the forests near the villages to educate them about forest resources and share stories when collecting medicinal plants, bamboo or firewood, knowledge of the more distant highland areas can be expected to decline. Transhumance is also connected to religious rituals and ceremonies but many of the holy sites along the transhumance routes are no longer visited and so site-specific rituals to seek help from deities to improved herds, safe travel, continued security and ongoing health of families back home have been abandoned. The impact of this on the wellbeing of villagers is unknown - when asked, respondents said they practise the same religious ceremonies in the villages.
4.5.5. Design of a potential PES-like scheme for red panda habitat

The design and execution of a sustainable PES program in a developing country like Nepal needs to be underpinned by principles of equity and fairness (Leimona et al., 2015), especially if there is to be adherence at the grass-roots level. It will be particularly important to include poor and vulnerable resource-dependent households in any scheme (Börner et al., 2017) to ensure the sustainable conservation of biodiversity and an efficient flow of ecosystem benefits (Muradian et al., 2010). Ultimately, however, compensation needs to satisfy at least as many people as needed to reduce the forest resource extraction to a level that is not harmful to the red pandas, which will potentially be all those wanting to participate (87%). Thus, not only the poorest sector of the community needs to be included but also those people generating substantial value from natural resources, such as commercial harvesters of medicinal plants. Failure to satisfy this sector of the community, or to compete with alternative land uses at a fair market price (Nielsen et al., 2018), may lead to unintended consequences given that pressures to supply the medicinal plants market may drive up prices in the illegal market, driving non-compliance in the PES scheme and a need for greater investment in the enforcement of conditionality. However, the results suggest some awareness of these issues with a lower level of compensation needed when there is a high level of compliance, with compliance being identified as one of the most important challenges facing PES schemes over the last 15 years (Wunder et al., 2020).

Knowing who needs the least compensation is helpful for cost-effective PES schemes (see Zander et al., 2013) and the results of the RPL model with interactions offer some useful insights. For example, offering a long-term contract (at least 6 years) for a PES scheme means that less compensation needs to be paid. There are also increasing calls to make PES context specific (Aguilar-Gomez et al., 2020; Wunder et al., 2020). In
our study area, the respondents considered that in-kind rewards would be particularly
beneficial for younger people as they will gain most from training in new skills that will
allow them to generate income from alternative sources and reduce dependency on
ecosystem goods and services from the red panda habitats. Similarly, people inside the
PA were willing to accept less compensation than those outsides, as they were more
likely to be involved in eco-tourism and homestay businesses. In such cases, the amount
paid in compensation could reasonably be expected to decline as forest income sources
are replaced or, in the case of tourism, increase as forest quality and the probability of
encountering target biodiversity improves.

   Given the large discrepancy in livelihoods between those few actively practicing
transhumance and those who commercially collect medicinal plants, the PES scheme
could usefully be tailored to the needs of each group including the specific restrictions
with which those practising each activity have to comply. It is inefficient to pay
somebody to reduce transhumance or limit medicinal plant collection if they do not
practice it. Even if different payment amounts to different people is not desired among the
community, compliance conditions could vary.

   Overall, governance of the ecosystem goods and services derived from the
mountain habitats of the red panda needs to improve given the serious concerns for
resources sustainability, biodiversity conservation, habitat management, and rural
livelihoods. A PES scheme that is designed and implemented successfully has the
potential to support effective conservation, sustainable resource utilisation and rural
livelihood development. A key research question is how such a scheme can be governed
in a manner that complies not only with national laws and policies but also with local
custom and practice.
4.6. Conclusions

This study provides the basis of a potential PES-like scheme that would compensate local communities in and around the red panda habitats if they agree to reduce the use of habitat resources. The results demonstrate a high level of willingness to participate in such a scheme, possibly because fewer resources are now being extracted than previously. They also shed light on the levels of compensation required and the form it should take. The assessment is a novel contribution to PES literature in Nepal and also offers a fresh approach to conserving the red panda, its mountain habitats and associated biodiversity without penalising the livelihoods and well-being of local communities. In this context, our study provides a basis for designing a PES or PES-like scheme in the red panda habitats of Nepal and other range countries.
4.7. References


Chapter 5. The state of governance of forest resource use in western Nepal and community preferences for governance principles that would improve sustainability

Explain the purpose of the research project to the villagers of Imilcha, Jumla. Photo: Dipesh Acharya (Research Assistant of the project)
5.1. Abstract

Improved governance of natural resource use is critical to the sustainability and maintenance of environmental quality. In western Nepal, unsustainable resource extraction is seen by the local community as a major threat to forest sustainability. While most respondents to a survey of 243 households inside and outside a protected area thought the laws for managing resource use were adequate and appropriate, a far smaller proportion thought they were achieving their objectives. Disenchantment with the existing governance regime was strongest outside the protected area (PA), probably because there was greater investment in community engagement within the PA. The most likely reason for this failure is the deeply embedded corruption within the forest governance system. To improve governance, respondents strongly favoured increased governance participation when preferences for six good governance principles were tested using best-worst scaling, with effectiveness, accountability and transparency also important and likely to be favoured by higher levels of participation. Devolution of power to local communities by increasing governance participation is one of the most likely means of containing corruption.

5.2. Introduction

Globally, mountain ecosystems are being degraded primarily by climate change (Peters et al., 2019) and the over-exploitation of natural resources (Price, 2015). A response to climate change requires global collaboration, with little local agency possible, but over-exploitation could be contained were it not for failures in resource use governance (Arun & Ritu, 2017). Governance, generally understood to be a system of rules, norms or strategies for guiding or regulating the actions of the governed (Robichau 2011), has long been appreciated as critical to effective societal function (Pomeranz &
Stedman, 2020) and biodiversity conservation (Baynham-Herd et al., 2020). Improving governance is therefore one of the keys to improving natural resource management.

An example of resource governance inadequacy is a forest biodiversity hotspot in the mountains in western Nepal, which contains 84% of the country’s protected areas (PA) and half of the country’s global priority eco-regions. Although forests in the region provide numerous ecosystem services for the local community (see Bhatta et al., 2020, Chapter 2), as well as supporting substantial biodiversity, such as the endangered red panda (*Ailurus fulgens fulgens*), weak enforcement of the law and inadequate regulatory mechanisms are undermining biodiversity conservation (GoN, 2014).

The problem is not new – Nepal has tried various means of improving the governance of its rich biological heritage. Currently, governance of forest resources in Nepal has elements of all three main categories of governance, which differ in the way decision-making power is distributed and coordinated (Kim, 2020). For most of its history, forest governance in Nepal was fragmented, with individualised systems of governance applying to specific sectors or groups (Zelli & van Asselt, 2013). A monocentric approach was adopted when forests were nationalised in 1957 and PAs established with power emanating from a central government (Termeer et al., 2010; Kim, 2020). However, with the advent of community forestry, from 1978 on (Gronow & Shrestha, 1991), some governance has become polycentric, with different overlapping units of authority each having individual approaches to a given problem but taking each other into account where necessary (Marshall, 2009; Pokharel and Tiwari, 2013). However, although participatory conservation governance paradigms are widespread across the country (Khatri, 2010; DNPWC, 2015), fragmented governance remains common and gaps remain between rhetoric and the reality of implementing procedures and participatory conservation approaches (Paudel et al., 2010).
In western Nepal, monocentric approaches are particularly challenging given the remoteness and comparative inaccessibility of the mountain terrain, the socio-economic status of local communities, and traditional and cultural beliefs (Arun & Ritu, 2017). As a result of the loss of traditional regulation of resource use and a failure to enforce national policy and legislation (Bhatta et al., 2014), forest resources such as medicinal plants, highland pastures and the main food of panda, bamboo, are being over-used and are becoming less available (Chapter 3). While local communities are willing to accept compensation for using fewer forest resources, they want conditions placed on the provision of such compensation to be strongly enforced (Chapter 4). However, any attempt to introduce incentive-based governance approaches (Kjaer, 2004), will mean that existing governance regimes must be substantially strengthened (Ferraro & Pattanayak, 2006), while taking account of local culture and the ecological context (Ojha et al., 2019).

The first step in achieving such an aim is to determine the views on governance of those whose resource use is being governed, particularly given their enthusiasm for strongly enforced compliance (Chapter 4).

This study aims first to assess the views of people in six communities across two districts inside and outside a protected area in north-western Nepal in which threats to the forest are most in need of improved governance. Secondly, we sought community members views on the current state of that governance as it related to forest resource use. Finally, we assessed their preferences for good governance principles that might be adopted in the development of governance arrangements in the future using a stated preference method, Best-Worst-Scaling (BWS), which allows the evaluation of hypothetical policy settings to identify which features of any improved governance system they thought most important, and which the least. To the best of the author’s
knowledge, there are no other studies that have analysed the status, effectiveness and potential improvements to conservation governance at the community level.

5.3. Methods

5.3.1. Study area

The study area is located in the Jumla and Mugu districts in the Karnali Province of north-western Nepal, approximately 365 km from the country capital (Fig. 5.1). The study area comprises of six administrative wards (a ward, which is comprised of multiple villages, is the smallest administrative unit in the federal structure of the Government of Nepal) consisting of 11 localities: three wards are part of the buffer zone of the Rara National Park (RNP) in Mugu district and three outside the park in Jumla district.
These sites were selected because they are the nearest villages to the known red panda habitats in and around the PA. The second reason is that these locations have two distinct forms of forest governance. Forests inside the PA are managed by the RNP authority, which is part of the Department of National Parks and Wildlife Conservation, and buffer zone management committees; community and leasehold forests outside the PA are managed by the district office of the Department of Forests and Soil Conservation. The third reason for site selection is the high dependency of these communities on red panda habitats to support their livelihoods.
5.3.2. Data collection and sampling

Data were collected through household surveys using structured questionnaires (Appendix 5.1). To inform the questionnaire design, including the BWS, exploratory research was conducted from November 2017 to January 2018, including key informant interviews with the members of the RNP buffer zone management committee, community forest user group, the customary village chief (Mukhiya) of each of the study villages, representatives from the mother’s group (Ama Samuha), school teachers, senior citizens, and herders. The questionnaire subsequently developed consisted of three parts: 1) questions about the socio-economic background of respondents, 2) questions about the main threats to red panda habitats and the current state of governance, and 3) the BWS used for ranking good governance principles. Respondents were also presented with a short introduction to the project explaining the aims and prospects of the current study.

The questionnaire, including the BWS, was tested in the Mugu district during August, 2019 to review and refine the chosen good governance attributes and to ensure that the concepts of indicator questions made sense. This exploratory process involved twelve face-to-face interviews and two Focus Group Discussions (FGDs) with 16 participants.

The final household questionnaire survey was conducted between September and October, 2019 with 243 households (145 inside and 98 outside the PA) in the six wards (3 each inside and outside the PA) consisting of 11 villages in and around the red panda habitat. We applied purposive (Kerlinger, 1973); a non-random sampling technique composed of a single-visit household questionnaire survey. The study area consisted of 334 households (220 inside and 114 outside the PA) and we sampled roughly 86% of people inside and 66% outside the PA. Elder members of the family, or, in absence of such members, other senior members of the family were selected for the survey.
Five experienced enumerators (research assistants) were recruited for the survey. These were university students, the majority of them belonging to the same region and familiar with the local language, culture, conservation practices and livelihood conditions. The enumerators were trained in the use of the questionnaire and the BWS approach. The survey language was the local language, *Khas bhasa*. The enumerators explained in detail the good governance principles and indicator questions used in the BWS exercise and other related questions, and how to read the BWS blocks. The enumerators informed the survey respondents that participation in the scheme was entirely voluntary. All necessary research permissions were obtained from the Department of Forest, Jumla Division Forest Office, Department of National Parks and Wildlife Conservation and Rara National Park in Nepal. Human research ethics approval was also obtained from the Human Research Ethics Committee of Charles Darwin University (H17030).

5.3.3. Best-Worst Scaling design and analysis

Best-Worst-Scaling, developed in the late 1980s (Finn & Louviere, 1992; Louviere et al., 2015), is increasingly being used to rank preferences, including in the field of natural resource conservation and management (Kreye et al., 2016; Louviere et al., 2015; Soto et al., 2016, 2018; Tyner and Boyer, 2020). The BWS model provides respondents with an opportunity to choose both best and worst items (or most and least important attributes) in the subset of all the items (Louviere et al., 2015). In our case, the items represented the good governance principles (Section 2.2). Although BWS requires the inclusion of multiples choice sets, which respondents may consider repetitive and confusing (Jaeger & Cardello, 2009, Mueller-Loose & Lockshin, 2013), it is less cognitively challenging for respondents to complete than the direct ranking of multiple
items because respondents only have to select two items in any choice set, the best and the worst (Flynn et al., 2007).

The items consisted of six principles of good governance of forest resources from the PROFOR governance framework (PROFOR & FAO, 2011; Kishor & Rosenbaum, 2012) which consider Accountability, Effectiveness, Efficiency, Fairness, Participation and Transparency (Table 5.1). For each principle, selected from substantial literature on measurement criteria, indicators, methodologies and operational tools to assess the quality of governance (Abrams et al., 2003; van Doeveren, 2011; Secco et al., 2014), PROFOR provides a definition of good governance that we used to design questions relating to forest governance in our study area. Alternative tools developed for assessing national performance, such as the Framework for Assessing and Monitoring Forest Governance (Kishor et al. 2009) and the Assessing Forest Governance Toolkit (Davis et al., 2013), are not necessarily at an appropriate scale to be applied at the local level (see Secco et al., 2014 for a detailed review).

Table 5.1. Description of good governance principles based on PROFOR and FAO (2011), and indicator interview questions related to each governance principle.

<table>
<thead>
<tr>
<th>Good governance principles</th>
<th>Indicator concepts used in best-worst scaling model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountability— that people and institutions should be accountable for their actions</td>
<td>How rule-breaking and corruption is reported and investigated</td>
</tr>
<tr>
<td>Effectiveness— that the mechanisms of governance should achieve the ends they are intended to achieve</td>
<td>How effectively regulations are enforced</td>
</tr>
<tr>
<td>Efficiency— that governance should work with a minimum of waste</td>
<td>Reasonable costs of governance</td>
</tr>
<tr>
<td>Fairness— that the benefits and burdens of the forest resource should fall in a way generally viewed as just</td>
<td>Fair compensation for damage from wild animals</td>
</tr>
<tr>
<td>Participation— that all interested people should have an opportunity to be heard or to influence government decisions that affect the forest</td>
<td>Who makes decisions</td>
</tr>
<tr>
<td>Transparency— that information about the forest and how it is governed should be reasonably available to all</td>
<td>Training and education around regulations and governance</td>
</tr>
</tbody>
</table>

We used the object-case design of a BWS (Louviere et al., 2015) and a balanced incomplete block design (BIBD) to create the different combinations of the principles
(items). To do so, we used the library crossdes in R (Sailer, 2015) to create ten blocks of questions. We decided to present three principles in all cases from which respondents chose the most (best) and least important (worst; see example in Fig. 5.2). To minimise potential confusion and fatigue from answering too many BWS tasks, we split the ten generated sets into two blocks with each respondent being presented with one block, i.e., five BWS tasks. The two blocks were randomly allocated to respondents, ensuring that each block was used approximately the same number of times. When presenting the BWS, the enumerators first explained the principles in a general way, then provided an example to make each principle easier to understand.

| What do you think are the most and least important attribute when governing the red panda habitat? (Tick one on the left-hand side as the most important and one on the right-hand side for the least important) |
|---|---|
| MOST important | LEAST important |
| Who makes decisions (participation) | |
| How rule breaking and corruption is reported and investigated (accountability) | |
| Fair compensation for damage from wild animals (fairness) | |

Figure 5.2. Example of the best-worst scaling task used in our study, including the corresponding question.

5.3.4. Data analysis

Chi-square tests were used to compare the frequency of answers from respondents inside and outside the PA. Data obtained from the BWS were analysed using the counting approach, following Louviere et al. (2015). First, we obtained the best-worst (BW) score for each governance principle by subtracting the total number of times a principle was chosen as ‘least-preferred’ from the number of times it was chosen as ‘most-preferred’ across all respondents (at an aggregated level). Thus, a positive BW score indicates that the conservation strategy was chosen more often as ‘most-preferred’ than as ‘least-
preferred’ (Fig. 5.3). We also calculated the relative preferences for the governance principles by normalising the natural logs of the square root of the number of times it was chosen as ‘most-preferred’ divided by the total number of times it was chosen as ‘least-preferred’. This relative preference ranges from 0 (least-preferred) to 1 (most-preferred) and allows the interpretation of percentage differences in preferences.

At the respondent level, we calculated the individual BW score for each governance principle by calculating the number of times a respondent chose it as ‘least-preferred’ minus as ‘most-preferred’ and dividing the result by the number of times the respondent saw the item in the BWS tasks presented to them. We then used individual BWS scores to test for preference heterogeneity among respondents. We used the non-parametric Wilcox (W) test and Spearman’s rank correlations to assess the effect of socio-economic variables on the mean BW scores of each governance principle. As socioeconomic variables of interest, we chose age, gender, education, whether respondents were practising transhumance (see Table 5.2) or collecting bamboo and/or medicinal plants.

5.4. Results

5.4.1. Sample description

About 60% of the respondents lived inside the PA (Table 5.2). The average age of respondents was 42.6 years with a median of 40. More respondents were male (62%) than female. The majority (84%) collected bamboo from the forest, mostly for self-consumption, 79% collected medicinal plants and 23% took animals to the highland rangelands of the forest in spring and summer (transhumance).
Table 5.2. Socioeconomic characteristics of participants who completed the choice experiment in a survey among local people in and around red panda habitats in western Nepal (n=243: inside protected area = 145, outside protected area = 98).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondents inside the PA (%)</td>
<td>60</td>
</tr>
<tr>
<td>Average age (SD; median)</td>
<td>42.6 (11.9; 40)</td>
</tr>
<tr>
<td>Male (%)</td>
<td>62</td>
</tr>
<tr>
<td>Engaged in transhumance (%)</td>
<td>23</td>
</tr>
<tr>
<td>Engaged in collecting bamboo (%)</td>
<td>84</td>
</tr>
<tr>
<td>Engaged in collecting medicinal plants (%)</td>
<td>79</td>
</tr>
<tr>
<td>Level of education (%)</td>
<td></td>
</tr>
<tr>
<td>Not completed any formal education</td>
<td>57</td>
</tr>
<tr>
<td>Completed primary / elementary school</td>
<td>21</td>
</tr>
<tr>
<td>Attended secondary school (Years 8,9,10)</td>
<td>12</td>
</tr>
<tr>
<td>Attended or completed high school (Years 10,11,12)</td>
<td>7</td>
</tr>
<tr>
<td>Attended or completed university</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes: PA: Protected Area; SD: standard deviation.

5.4.2. Focus and current state of governance

Respondents considered that the greatest threat to red panda habitat, and therefore the activity where governance needed to be strongest, is coming from population growth and an associated higher demand for forest resources with some concern about people from outside harvesting excessive quantities of medicinal plants. Growth in tourist numbers, a shift from transhumance to agriculture and changing environmental and climatic conditions were not considered major problems (Fig. 5.3). There was no difference between inside and outside the PA ($\chi^2 = 20.7$, d.f. =14, P=0.295).
Questions relating to the current governance of the forests in and around Rara National Park were classified into the six governance principles (Table 5.3). In the area of accountability, nearly all respondents, inside or outside the park, believed that the governance of forests was either corrupt or very corrupt. However, most respondents, particularly inside the park, were aware that punishment of some form is investigated and meted out for forest-related infringements punishment, though fewer than half knew personally anyone who had been punished for inappropriate forest use.

In terms of effectiveness, there was a strong contrast between inside and outside the PA. Although over 80% of respondents in both areas considered that the rules and regulations should help conserve the forest, and a substantial majority thought the resources available for management likely to be adequate, the high confidence that the rules and regulations had a positive impact on forest resource inside the park was not matched by those outside, with over half of respondents feeling that the regulations either had no impact or that the resources are managed worse because the other regulations. In
neither place did a majority feel that money they paid was likely to make much difference to forest use sustainability, or that their livelihoods were secure into the future.

When *efficiency* is equated with monetary licensing of forest access, people inside the park not only paid for access but thought it appropriate. Even outside the park, over 60% approved payment for access to the forest, although less than half did so. Overall, over a quarter of households were being paid to manage resources sustainably, with over a third of the respondents in the park receiving benefits.

*Fairness* in access was greatest inside the park, both for households and specifically for women, with over half the respondents outside the PA not feeling they had the same access to resources as others in the village. Very few people received any compensation for losses to wild animals, particularly outside the PA, but the scale of the problem has not been assessed in this study.

With respect to *participation*, nearly three-fifths of respondents said they were consulted by the government about decisions, particularly inside the park, but few people felt empowered to report corruption, particularly outside the park, and very little training was being delivered to people about how to participate, although about a third were either on committees or would like to have been.

About half the people surveyed felt they knew those responsible for enforcing laws reasonably well, reflecting the level of *transparency*, with a lower proportion outside the park. The contrast inside and outside the park was much stronger for the provision of information from either government of conservation NGOs, but few in either place knew they could gain access to information on the forests or had done so.
Table 5.3. Responses to questions, sorted by governance principle and percentage of positive responses, relating to the use and governance of resources within the buffer zone and protected area of Rara National Park (inside protected area; PA) in western Nepal, and outside. Significant probability differences ($P<0.05$) between inside and outside are in bold ($n=243$: inside protected area = 145, outside protected area = 98).

<table>
<thead>
<tr>
<th>Question</th>
<th>% positive respondents</th>
<th>Entire study area</th>
<th>Inside PA</th>
<th>Outside PA</th>
<th>$\chi^2$</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accountability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the governance of forest resources corrupt or very corrupt?</td>
<td>95.1</td>
<td>95.2</td>
<td>94.9</td>
<td>0.01</td>
<td>0.923</td>
<td></td>
</tr>
<tr>
<td>Are you aware of any forest-related punishment?</td>
<td>73.7</td>
<td>84.8</td>
<td>57.1</td>
<td>23.10</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Are forest-related crimes and illegal activities are routinely investigated?</td>
<td>72.0</td>
<td>84.8</td>
<td>53.1</td>
<td>29.28</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Do you think complaints about inappropriate use of forest resources lead to investigation and appropriate sanctions?</td>
<td>67.9</td>
<td>75.2</td>
<td>57.1</td>
<td>8.72</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Do you know anybody who has ever been punished for inappropriate forest use?</td>
<td>40.3</td>
<td>45.5</td>
<td>32.7</td>
<td>4.02</td>
<td>0.045</td>
<td></td>
</tr>
<tr>
<td><strong>Effectiveness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think the current regulations and governance helps to conserve the forest?</td>
<td>88.5</td>
<td>93.8</td>
<td>80.6</td>
<td>9.97</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>Do you think there are enough resources to monitor the forest and enforce regulations?</td>
<td>79.4</td>
<td>89.0</td>
<td>65.3</td>
<td>20.03</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Do you think that the conservation rules and regulations are having a positive impact on the management of forest resources?</td>
<td>70.8</td>
<td>95.9</td>
<td>33.7</td>
<td>109.35</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Are the forest rules and regulation effectively implemented?</td>
<td>65.8</td>
<td>84.1</td>
<td>38.8</td>
<td>53.51</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Do you think payment for use of the common pastures will help regulate their use?</td>
<td>46.5</td>
<td>47.6</td>
<td>44.9</td>
<td>0.17</td>
<td>0.680</td>
<td></td>
</tr>
<tr>
<td>Do you think payment for forest use helps conserve the forest resources?</td>
<td>42.0</td>
<td>40.0</td>
<td>44.9</td>
<td>0.58</td>
<td>0.448</td>
<td></td>
</tr>
<tr>
<td>Do you feel that access to forest resources you depend on for your livelihood is secure?</td>
<td>39.1</td>
<td>31.7</td>
<td>50.0</td>
<td>8.20</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think your payment for access to the forest is appropriate?</td>
<td>75.7</td>
<td>84.8</td>
<td>62.2</td>
<td>16.22</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Do you pay for access to the forest?</td>
<td>74.5</td>
<td>93.1</td>
<td>46.9</td>
<td>65.58</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Do you get any economic incentives to promote your livelihoods and incomes while ensuring sustainable utilization of timber and non-timber forest products?</td>
<td>25.9</td>
<td>33.8</td>
<td>14.3</td>
<td>11.59</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td><strong>Fairness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

215
<table>
<thead>
<tr>
<th>Question</th>
<th>Entire Study Area</th>
<th>Inside PA</th>
<th>Outside PA</th>
<th>$\chi^2$</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you think men and women have the same right to forest resources access and use?</td>
<td>96.7</td>
<td>97.9</td>
<td>94.9</td>
<td>1.69</td>
<td>0.194</td>
</tr>
<tr>
<td>Do you think men and women are equally able to participate in decision-making?</td>
<td>85.2</td>
<td>88.3</td>
<td>80.6</td>
<td>2.72</td>
<td>0.099</td>
</tr>
<tr>
<td>Do you have the same access to forest resources as everybody else in your village?</td>
<td>74.5</td>
<td>93.1</td>
<td>46.9</td>
<td>65.58 &lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Do you get fair compensation for damage from wild animals?</td>
<td>14.4</td>
<td>22.8</td>
<td>2.0</td>
<td>20.36 &lt;0.001</td>
<td></td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are stakeholders allowed to seek review or reconsideration of the decisions of the forest / conservation agency?</td>
<td>52.3</td>
<td>56.6</td>
<td>45.9</td>
<td>2.65</td>
<td>0.104</td>
</tr>
<tr>
<td>Do the government forests office or national park and buffer-zone consult with stakeholders as part of the decision-making process?</td>
<td>49.0</td>
<td>60.7</td>
<td>31.6</td>
<td>19.76 &lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Does the government engage with, create space for, and support the participation of forest-dependent communities in forest-related planning and decision making?</td>
<td>45.7</td>
<td>49.7</td>
<td>39.8</td>
<td>2.29</td>
<td>0.130</td>
</tr>
<tr>
<td>Are you, or would you like to be more, involved in decision-making about the forest?</td>
<td>37.9</td>
<td>39.3</td>
<td>35.7</td>
<td>0.32</td>
<td>0.571</td>
</tr>
<tr>
<td>Do you have an opportunity to report corruption practices to an appropriate authority</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you get training and services from government agencies and, if so, are they appropriate for you?</td>
<td>11.5</td>
<td>12.4</td>
<td>10.2</td>
<td>0.28</td>
<td>0.597</td>
</tr>
<tr>
<td><strong>Transparency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How would you rate your knowledge about the people who are currently responsible for managing the forest?</td>
<td>54.7</td>
<td>59.3</td>
<td>48.0</td>
<td>3.04</td>
<td>0.081</td>
</tr>
<tr>
<td>How would you rate your access to information about how the resources of your forest are used and about forestry planning?</td>
<td>52.7</td>
<td>62.1</td>
<td>38.8</td>
<td>12.73 &lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Do you get any information from the government forest / conservation organizations?</td>
<td>52.7</td>
<td>69.0</td>
<td>28.6</td>
<td>38.28 &lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Do you get public notice of proposed forest / conservation policies, programs, laws, and projects?</td>
<td>46.9</td>
<td>60.0</td>
<td>27.6</td>
<td>24.72 &lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Are you aware of any activities in the forest that aim to conserve threatened species such as the red panda?</td>
<td>36.6</td>
<td>35.9</td>
<td>37.8</td>
<td>0.09</td>
<td>0.764</td>
</tr>
<tr>
<td>Question</td>
<td>Entire study area</td>
<td>Inside PA</td>
<td>Outside PA</td>
<td>$\chi^2$</td>
<td>$P$</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>------------</td>
<td>----------</td>
<td>------</td>
</tr>
<tr>
<td>Are you aware that you could access inventory data, management plans,</td>
<td>17.7</td>
<td>22.8</td>
<td>10.2</td>
<td>6.33</td>
<td>0.012</td>
</tr>
<tr>
<td>laws, and budgets for government-owned forests and protected areas?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever accessed inventory data, management plans, laws, and</td>
<td>7.8</td>
<td>11.0</td>
<td>3.1</td>
<td>5.16</td>
<td>0.023</td>
</tr>
<tr>
<td>budgets for government-owned forests and protected areas?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.4.3. Preferences for governance responsibility and good governance principles

Over 80% of 243 respondents, both inside and outside the park, felt that it was the responsibility of everyone in the village to ensure there was no over-use of resources, less than a quarter felt it was the responsibility of elders (Fig. 5.4). Those inside the park, however, were far more likely to consider that forest committee members ($\chi^2=26.82$, $P=<0.01$) and national parks officers ($\chi^2=39.32$, $P=<0.01$) should be responsible as well as the individual respondents ($\chi^2=33.11$, $P=<0.01$). More people outside the park favoured village appointees ($\chi^2=5.5$, $P=0.02$) but the proportion was <20%. Of those interviewed, 10% were already involved in forest committees with another 28% having an interest in becoming more involved. Proportions were similar both inside and outside the national park.
When BWS standardised scores were normalised between 0 and 1, *Participation* was the most preferred governance principle (Fig. 5.5), with *Transparency*, *Effectiveness* and *Accountability* valued less (33-37% less) but about the same as each other. Two principles, *Fairness* (84% less important than *Participation*) and *Efficiency* (77% less), were considered least important, having been chosen more often as least preferred in the BWS tasks than most preferred.
The location (inside or outside PA) and whether people collected bamboo resources had the greatest influence on preferences for governance principles (Table 5.4). Respondents living outside the PA had lower preferences for Accountability ($W = 8414$, $p$-value = 0.0120) and higher preference for Fairness ($W = 5906$, $p$-value = 0.0207) than those living inside the PA. Respondents who collected bamboo resources had a lower preference for Participation ($W = 4695$, $p$-value = 0.0675) and a higher preference for Efficiency ($W = 3097$, $p$-value = 0.0242) than those not extracting bamboo from the forest. Those who practised transhumance had a lower preference for Efficiency, on a 10% level of significance ($W = 5935$, $p$-value = 0.0861), than those not practising it. There was no gender effect on the preference on any of the principles, and whether respondents collected medicinal plants also had no influence on their preferences for governance principles (Table 5.4).
Table 5.4. The effect of socioeconomic characteristics on the respondent’s preferences for six good governance principles relating to the forest resource collection in and around a protected area in western Nepal.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Accountability</th>
<th>Efficiency</th>
<th>Effectiveness</th>
<th>Fairness</th>
<th>Participation</th>
<th>Transparency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Outside PA</td>
<td>** (negative)</td>
<td>ns</td>
<td>ns</td>
<td>** (positive)</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Transhumance</td>
<td>ns</td>
<td>* (negative)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Collecting medicinal plants</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Collecting bamboo</td>
<td>ns</td>
<td>** (positive)</td>
<td>ns</td>
<td>ns</td>
<td>* (negative)</td>
<td>ns</td>
</tr>
<tr>
<td>Age</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Education</td>
<td>ns</td>
<td>* (negative)</td>
<td>(positive)</td>
<td>** (negative)</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>

5.5. Discussion

5.5.1. Reasons to improve environmental governance

There are many threats to forest resources in western Nepal so understanding local perceptions of those most important is the first step in meeting the challenge of improving governance to meet those threats. The results we found here were unequivocal – that it is forest resource extraction and use that should be the focus for improved governance. People considered their own use to be the most critical. Harvesting by outsiders, particularly the harvest of commercially valuable medicinal plants, was also of concern but much less than that of local use. Studies elsewhere suggest that the effects of medicinal plant harvesting are species and area-specific and need not necessarily be harmful (Kunwar et al., 2020, 2021).

Other threats mooted as important were not considered significant. Of these, tourism affects a small part of the forest, with most emphasis on the focal lake of Rara National Park, and is at a scale likely to cause little harm while also producing local economic benefits (Regmi & Walter, 2017). The shift from pastoralism and transhumance...
to intensified agriculture in the arable lands and emigration to the cities is, if anything, likely to be advantageous for the forests by reducing pressure from resource use (Jaquet et al., 2016). Perhaps the most surprising was that the lowest concern was environmental change, given the impact of climate change in the country, generally (Bocchiola et al. 2019). It may be that the area around Rara National Park is low enough that glacial meltwater, a concern elsewhere in the Himalayas, is not critical to local livelihoods and that the topography is so extreme that shifts in climatic suitability do not necessarily mean large changes in the distance between altered climatic zones, if in fact these zones have moved upwards. There is also substantial local adaptation to climate change among other Himalayan communities (Adhikari et al. 2017).

5.5.2. Existing state of environmental governance

The extraction of forest resources is locally recognised as a major problem, so the high level of satisfaction with existing laws was perhaps surprising. There was, however, a marked contrast between areas inside and outside the PA and a probable gap between the presence of the laws and their implementation. Inside the PA, there was much greater satisfaction with the prevailing laws and policies than outside. Respondents there felt that the rules were being enforced, that payments were equitable and efficient, that they had at least some opportunities to participate and they were reasonably well-informed about processes. However, confidence that the laws and policies protected forest resources was much lower, with about 40% of the respondents feeling that the laws did nothing or even had a negative effect. Less than a third were confident that their means of livelihood was secure. Outside the park, impressions of almost all facets of good governance were less favourable. A far smaller proportion of respondents outside than inside considered that there was much enforcement of rules and regulations, though it was still well over half
(65%). Less than half had faith in the effectiveness of law enforcement, thought resource use rights were equitable, felt there were opportunities to engage in decision-making and or felt informed and involved in decision-making.

While the park management seemed to be complying with policies to engage with local communities, there was much less connection with forestry officials. Partly this is likely to be a result of a long-standing policy to increase community engagement in PAs, particularly through support of buffer zones (Wells & Sharma, 1998) like that around RNP. Buffer zones were introduced as a means of ending conflict between parks and surrounding regions (Budathoki, 2004). While there are still many flaws in the operationalisation of buffer zones (Thing & Poudel, 2017), the fact that RNP is one of only seven national parks in the country is likely to mean that there are more resources dedicated to it than to the nearby state forests. From the central government’s point of view, the forests in Jumla District may be seen as a small part of extensive forests remote from Kathmandu. Protected areas in Nepal have also become involved in the political evolution of Nepal following the civil war of 1996–2006. Compliance in Rara National Park is assisted by the Nepal Army, a collaboration characterised as re-establishing central government control over areas that, in some parts of the country, became refuges for Maoist forces (Dongol & Neumann, 2021). While the presence of the army did not feature in any commentary by those surveys or in any of the FGDs, there may be greater attention paid to communities in buffer zones near parks than similar communities more distant from protected areas. Whatever the underlying cause, respondents outside the PA viewed existing governance arrangements far less favourably than those inside.

What 95% of respondents from all villagers shared, however, was the view that “the use of forest resources” was either corrupt or very corrupt (Table 5.3). Corruption is seen as inimical to good governance globally and a major reason for environmental
degradation (Morse, 2006; Tacconi & Williams, 2020). Such a finding needs to be seen in context. Nepal has a corruption score of 33 out of 100 on the 2020 Corruption Perception Index (Transparency International, 2021), 117th out of 180 ranked countries. Corruption, however, takes many forms from small-scale bribery through to extortion and political favouritism. Some theorists believe corruption is partly a social construct, and that gift exchange in one country can be viewed as graft in another (Granovetter, 2007).

Traditions, such as *chakari, natabad, crypabad, phariyabad* and *hanumanbad*, influence the influential advisers (*afno manche*) are deeply embedded in Nepalese life (Bista, 1991) and, even if some traditions were deliberately introduced by the elites to maintain power by distributing favours (Subedi, 2005), empirical research in Kathmandu suggests there is widespread tolerance of small-scale bribery (Truex, 2011). The development of corrupt practice is also more likely where people are well known to each other, as was the case with 60% of respondents within the PA and almost half outside, because private traditions and expectations of gift exchange can influence impartiality when exercising of public duties (Rose-Ackerman, 1999). However, recent research at a global level challenges acceptance of corruption as a cultural norm, arguing that there are strong universal correlates of corruption despite wide variation in social context (Jetter & Parmeter, 2018).

Such correlations include the rule of law, government effectiveness, urbanisation, the number of women in parliament and the extent of primary schooling (Jetter & Parmeter 2018), with the correlation between level of education and intolerance to corruption being particularly strong in Nepal (Truex 2011). However, measures of these indicators are mostly low in Nepal, and are particularly low in the study region.

Furthermore, while there have been some improvements in national corruption indices in the last decade (Transparency International, 2021), local level corruption has been exacerbated by the partial decentralisation that has been occurring with the policy of
federalism that has been pursued since the civil war ended in 2006; while extensive powers have been devolved to local regions, this has not been accompanied by fiscal decentralisation (Ghimire 2018), which this promotes budget capture by local elites (Hart & Welham, 2016). It is therefore unsurprising that there should be high levels of perceived corruption in and around a remote national park.

That local corruption is a social norm in the region is not so much a reflection on the behaviour of individual government officers, most of whom are junior functionaries in a national hierarchy, but is indicative of systemic institutional failure at a national level. The universal recognition of the pervasiveness of corruption by respondents is simply a reflection of this national failure. Corruption is the most likely reason for the disconnect between a belief that the laws and regulations are beneficial and the opinion of most respondents that they have little impact on the sustainability of forest resource use.

5.5.3. Preferences for governance principles

Widespread concern with corruption may be the reason that Participation emerged from the BWS as the most preferred good governance principle, and why there was such enthusiasm to assume personal or village responsibility for ensuring resources are not over-used. Unlike in some situations where wildlife conservation is the purpose of land use (Robbins et al., 2009) and there are strong motivations for multiple actors to extract resources excessively (Tacconi & Williams, 2020), the livelihoods of many of the respondents in our study were being affected detrimentally by poor governance. Greater participation in government necessarily also increases the likelihood of greater Transparency, Effectiveness and Accountability among those involved in governance. Fairness and Efficiency might be considered more distant aspirations that are contingent on raising the standards of the other good governance characteristics. Sectoral differences
are less readily interpreted without more detailed understanding of the drivers of preferences by groups like bamboo collectors or transhumant pastoralists. Some, like the greater priority placed on *Fairness* by those outside the PA may reflect the example given relating to compensation following damage to crops by wildlife. Almost no respondents from outside the PA were satisfied with the compensation they received. However, it also reflects the sentiment that less than half the respondents considered they had the ‘same access to forest resources as everybody else’ in their village, compared to 93% inside the PA. What the sectoral variation does illustrate, however, is that any improvements to governance need to be tailored to local needs (Heywood 2018), just as any compensation scheme for reduced resource use will need to incorporate different incentives for different population sectors (Chapter 4).

5.5.4. Cautions in interpretation of the results and research needs

Interviewing heads of household in Nepal inevitably leads to a male bias among the respondents. Our selection of participants also tended to favour males and those in positions of power. Nevertheless, the highest percentage of potential survey households (over 60%) means it unlikely that our results would vary greatly. Some results may also have been affected by the examples chosen, particularly in the Best-Worst scaling. While these grew out of a range of earlier fieldwork, examples inevitably focus respondents’ thoughts on the specific issues described (such as compensation from wildlife losses with respect to fairness) than on the more general principles we aimed to consider. Nevertheless, we do not believe our results would have been greatly affected given the divergence between the most and least favoured attributes to be considered in any improved governance regime. The strength of the results also implies that ambiguities in meaning that must inevitably have arisen as a result of translation of the questionnaire
from English through Nepali to Khas bhasa and back again are unlikely to have had much impact on the conclusions.

The area where greatest research is needed is on the design of a participatory governance approach tailored to the local communities of western Nepal. Such a governance regime must account not just for existing trends in resource use and availability, and on existing relationships between the State and the local community, but also anticipate changes that are inevitably are going to occur in the near future, and indeed are already underway. These include environmental changes as a result of both resource use and climate change, in the demographic composition of the local population, changes in access as infrastructure is improved and shifts in sources of income from transhumance and harvesting of resources to intensified agriculture and remittances. The most important feature of this research, if it is about the development of a governance regime, is that the research itself is participatory with adequate resourcing and involvement of the local community in the formulation of the final research questions, the conduct of the research and the analysis and interpretation of the research. Such community driven research not only ensures that understanding of the research results is embedded in the community but can itself be transformative (Garnett et al., 2009; Fazey et al., 2013).

5.5.5. Policy implications

The unintended consequences of the nationalisation of state forests in 1957 followed by the fairly rapid transition to community-based forests means that Nepal has led the way globally in the development of appropriate governance regimes over the last 40 years (Acharya, 2002; Fisher et al., 2018). However, governance regimes need to be tailored to local conditions (Heywood 2018) – as noted above, communities, both natural
and human, are changing rapidly in the region and research is needed to develop a regionally-targeted governance regime. One potential form of governance is payments to communities to reduce their resource use. This was considered highly acceptable to most respondents in the region (Chapter 4) and this survey illustrates why, with most respondents to the survey, both inside and outside the PA, being concerned for the future of their existing form of livelihood. While existing payments made by those harvesting from the forest or taking their stock to highland pastures were thought, by most respondents, to achieve little for forest sustainability, reversing the financial flows so that the forest users receive money as compensation for lower resource use warrants more detailed consideration.

The research also highlighted the differences between inside and outside the PA, with environmental management thought to be more effective inside. This suggests a particularly strong appetite among those communities outside the PA for more information, additional participation, expanded investment in compliance and greater equity in access among users. In many ways the additional investment in communities away from the PA can be seen as compensation for not having the good fortune to live within the buffer zone of a national park, particularly their distance from an attractive feature like Rara Lake. The forests outside the PA, however, still support red panda and other valuable biodiversity. Indeed, the populations of panda and other species protected by the relatively small Rara National Park would be unlikely to persist in the long term without additional protection of populations in the broader forest matrix of north-western Nepal, justifying biodiversity investment across the broader landscape, and the associated improvements in governance.

Both these initiatives would help deal with the most fundamental problem for effective governance of the red panda habitat, corruption. As noted by Tacconi and
Williams (2020), systemic corruption of the type embedded in the Nepalese government defies traditional approaches to countering corruption which are built on the theory that honest principals are misled by dishonest agents (Lambsdorff, 2007; Mungiu-Pippidi, 2015). They consider that communal action theory may be more relevant, although admit the difficulties in its implementation. One aspect is to strengthen civil society, a key part of the participation favoured by respondents in this study, although the means by which that is done are unclear. One approach could be to consider changing, at a local scale (Heywood 2018), the type of governance currently being enacted within the forests. A corrupt system is essentially fragmented because the interactions are generally specific to specific sectors or groups within the circle of corrupt practice (Zelli & van Asselt, 2013). However, the official system of governance, in both the PA and the forest, is monocentric (Kim, 2020), with a hierarchy of responsibilities leading back to Kathmandu bureaucracies and politicians. Perhaps a superior system of governance would be to introduce a polycentric governance regime to the region, whereby overlapping units of authority having separate but overlapping responsibilities grounded in local participation (Carlisle & Gruby, 2019). Such systems could promote not just the absence of corruption, since the different governance centres would monitor performance of each other, but promote integrity in performance (Heywood, 2018).

5.6. Conclusions

Villagers in and around a protected area in western Nepal consider that over-extraction of resources represents the major threat to forest resource sustainability. While there is general agreement that the laws and regulations in place to manage resource use ought to be effective, there is little confidence that they do so, particularly outside the PA. Respondents to a survey of local residents identified that increased participation in forest governance would be the change most likely to improve the sustainability of resource use.
This would probably have flow on benefits to the transparency and effectiveness of governance and would, in turn, be the change most likely to reduce the local expression of the systemic corruption that afflicts governance at a national level in Nepal. Increase in participation could be achieved by shifting the governance regime from one that is monocentric, if not fragmented, to one that is polycentric with greater power over some aspects of forest governance devolved to local communities. Creation of a PES-like compensation scheme to reduce extraction of forest resources could contribute to this change in governance with benefits for forests, people and biodiversity.
5.7. References


Chapter 6. Discussion and Conclusions

Red panda habitat outside the protected area near Khopry village in Jumla district.
Photo: Manoj Bhatta.
6.1. Thesis overview

The red panda, an endangered Himalayan-endemic mammal, has been facing intense pressure for survival due to various human-induced activities, such as habitat fragmentation and destruction, despite remarkable efforts to conserve the species in parts of Nepal. To date, most research on red pandas has been autecological, describing the species’ habitat, ecology, distribution and threats. Such studies provide a biological context for red panda conservation, but do not capture the socioecological pressures on its environment. An alternative way to understand these pressures is, therefore, necessary to conserve this species in the wild, ameliorate existing threats, and enhance the livelihoods of habitats dependent communities.

This PhD research represents, to my understanding, the first attempt to collate perception-based information from local communities, both inside and outside a protected area (PA), on the use and governance of ecosystem goods and services derived from red panda habitats. Through this research, I sought to provide information to help decision-makers sustainably manage forests in support of red panda conservation in Nepal, because the conservation of endangered species like red panda will not be possible without good governance of the resources it requires. To this end I have collected information using a mix-methods research approach, guided by the questions outlined in my thesis introduction:

1. What are the services provided by red panda habitats that contribute to the quality of life and to human wellbeing in western Nepal?

2. What are the values of the ecosystem services obtained from red panda habitats for local communities and what are the trends in their use, availability and condition?
3. How willing are local people to enter into an agreement to be compensated for use of the ecosystem services obtained from red panda habitats?

4. How can the governance of ecosystem services produced from the red panda habitat be improved and regulated more effectively?

In the following sections of this concluding chapter, I briefly summarise some of my key findings of this thesis, present its limitations, suggest future research directions, and summarise management implications.

6.2. Ecosystem good and services from the red panda habitats

In Chapter 2, I identified and categorised the ecosystem goods and services provided by red panda habitats, describing the services that local people value the most, the use of those services by local people, and their interdependencies. To assess these significant contributions to the livelihoods and well-being of local people residing inside and outside of a mountain PA is novel since most of the ecosystem services (ES) related studies in Nepal have focused on the mid-hills and plain lands of the country, largely ignoring mountain ecosystems.

The perceived higher diversity of ES from red panda habitats with more cultural benefits than provisioning demonstrates the reliance of people on diverse mountain resources as well as their strong cultural and religious connections to nature. People characterise some services used for valuing ecosystems, such as carbon storage, improved air and water quality, and biodiversity, as cultural services provided by mountain deities. Many sites in the mountains are considered holy, bearing spiritual power, a belief common to many of the religions practiced in mountainous areas. These services only appear to be acknowledged as services with a use-value by people from outside the region. This thesis also presents the understanding of the use and non-use ES obtained
from mountain red panda habitats, and in keeping with many rural communities in developing nations, there is significant reliance on forest ES with productive uses including medicinal herbs, bamboo products, transhumant practices, and ecotourism still being the major source of income for them. In general, about 80% of the Nepalese population rely on forest ecosystems for various goods and services which contribute approximately 90% of all the energy usage.

The top five ES for respondents’ livelihoods and for their cultural significance were seasonally grazed upland pastures, plant materials, plants for energy, transhumance culture, religious interaction with nature, and recreation activities and ecotourism. These priorities were found to be influenced by local context including proximity to the habitats, greater reliance on these specific services than others, strong cultural and religious interconnectedness, socioeconomic status and the forest resources management system. Similar preferences for ecosystem goods and services from forest resources are apparent across Nepal.

Overall, Chapter 2 provides the evidence base needed to support more sustainable resource management. In it I recommend an additional four steps that, if implemented, would support red panda conservation, sustainable resource use, improved governance, and local livelihood enhancement: i) quantify the goods and services that we have identified as being required to support local livelihoods, including ways of incorporating cultural and spiritual values; ii) estimate their value to different sectors of the community; iii) assess the status and trends in the availability of the ES, identifying drivers that might lead to negative trends; and iv) explore the policies, regulations, and changes to governance that will be most effective in sustaining provision of the ES from red panda habitats at healthy levels.
6.3. Condition and trends of ecosystem goods and services from red panda habitats

In Chapter 3, I assess the perceived conditions of ecosystem goods and services from red panda habitats that contribute significantly to local livelihoods, trends in current use, the availability of the services in the past two decades and the drivers of such changes. Building on the findings of Chapter 2, I demonstrate that local use of the red panda habitats is changing rapidly with implications for both the panda and the local communities which significantly depend on the ecosystem goods and services provided by its habitat. This thesis is important because understanding the trends in ecosystem goods and services is essential to i) conserving red pandas and associated biodiversity; ii) sustainable use of resources from the red panda’s habitat; and iii) improving the sustainability of livelihoods of people in the region.

Of the 51 provisioning and cultural ecosystem goods and services recognised as being derived from red panda habitats, seven were perceived as particularly significant to local livelihoods: bamboo, medicinal plants, firewood, fodder and bedding for animals, transhumance, recreational activities and ecotourism, and interactions with religious sites (Chapter 2). Among these benefits, firewood, fodder and bedding for animals created the greatest value for communities both inside and outside the PA. Local communities in and around the habitat also relied on medicinal plants and ecotourism as the primary source of cash income for subsistence; both are becoming an important source of income in Nepal, especially for the mountain communities because mountain ecosystems have a diverse range of medicinal plant species and are also significant tourist destinations. Overall, use of ecosystem goods and services was higher in communities outside the PA than inside, with most of these resources being extracted from government forest, although people living outside the PA had to travel further and to areas of higher elevation to obtain ecosystem benefits than did people living inside. A possible explanation for this might be
because people living outside were more dependent on the ES with fewer alternative livelihood opportunities than those living inside.

Another possible explanation for this is that gazettal of the PA in 1976 may have reduced the access of insiders to remote national park locations while declaration of the buffer zone in 2006 may have created some alternative sources of subsistence income including seasonal tourism activities and daily wage employment opportunities from developmental projects in and around the park and buffer zone. Such opportunities have arisen because PA management in Nepal has shifted from a nature-centric “fine and fence approach” to a more participatory human-centred paradigm. This has enabled communities living in the buffer zone to link conservation and livelihoods in and around PAs. Despite these successes derived from participatory approaches, weak legal and organisational capacity among local institutions, over-emphasis on infrastructure development, limited participation of deprived populations and minimal enhancement of the livelihoods of marginalised groups are hindering progress towards resource restoration, participatory conservation, and improved livelihoods. These shortcomings of the current approaches in and around mountain habitats of the red panda result in heavier reliance on forest resources than they can sustainably produce. This can lead to illegal excessive extraction of resources from forests, including those inside PAs. As a result, respondents reported declining trends in the condition and availability of some ecosystem goods and services from the red panda habitats. These trends of the use and availability for medicinal plants and nature-based tourism are largely consistent with regional, national and global trends.

Ecosystem services provided by the red panda’s forest habitats constitute a major asset to the natural resource dependent local livelihoods, but the management of benefits obtained from this asset is inadequately considered in traditional consumption behaviour,
legal frameworks and human well-being growth indicators as well and biodiversity conservation in Nepal. For example, higher use of medicinal herbs may provide short-term economic benefits to the locals and positive national revenue generation but is drawing down the capital currently held within red panda habitats and will ultimately have long-term negative impacts on livelihoods. In this context, the communities of our study area outside the PA are likely to suffer most, since the people within the park are earning some income from ecotourism activities. A decline in bamboo availability is of greatest concern given use of bamboo not only by the red panda in its diet but by people as a construction material for fencing, roofing and cattle sheds, for the weaving mats and baskets, for farming implements, and as fodder for animals. The marked decline in transhumant pastoralism will have consequences not only for the ways in which mountain communities earn their living but potentially also on their traditional and cultural identity since fewer people are visiting shrines and continuing the religious practices associated with the journeys to and from the mountain pastures. However, there may be benefits for the red pandas as there will be fewer attacks by livestock-guarding dogs, which has been considered a problem in the past both in the study area and elsewhere in Nepal.

The findings suggested 26 (13 each for trends of use and availability) underlying drivers that directly or indirectly caused the change in the use and availability of ecosystem goods and services from red panda habitats. Most of the direct drivers of change are comparable with regional, national and global assessments, including overexploitation of ES (e.g., unsustainable and conventional harvesting practices, overharvesting, illegal harvesting, and overgrazing), changes in weather patterns, demographic and economic factors (e.g., population dynamics, literacy, poverty and ecotourism), institutional governance, regulation and monitoring mechanisms, and recent developmental activities.
6.4. Willingness to participate in a potential PES-like scheme for conservation of red panda

In Chapter 4, I report on the results of a choice experiment among the villagers residing in and around the red panda habitats to determine their willingness to participate in a potential PES-like scheme to reduce use of forest resources, including the willingness of people to accept compensation and the form that compensation should take. The novelty of this thesis is that was the first to be designed specifically to further red panda conservation and could be useful for red panda range countries, as well as for application to similar locations where conservation of threatened species has become unsuccessful because of human-wildlife conflict or excessive resources use.

The results of the Choice Experiment (CE) showed that a very high proportion (87%) of the respondents were willing to reduce forest use in return for cash compensation. Interestingly, they preferred longer contracts and high conditionality with periodic inspection. This suggests that local people were aware of their unsustainable forest resource exploitation and that they believe that the forests and the services derived from them can only be conserved if used sustainably with a high level of compliance. People also preferred a system with lengthy contracts, potentially because this would provide a steady income from a source that is often variable in supply. The flexible CE design suggested that respondents would be allowed to collect the resource for self-consumption, which may be why respondents were happy to accept the restrictions on the collection of both medicinal plant and bamboo, or of bamboo alone over restrictions on medicinal plant collection. For transhumance, the respondents strongly disliked the idea of restricting the time they are allowed to take their animals to the upland rangelands, but they did not mind reducing the number of animals allowed for grazing. Interestingly respondents would prefer that the compensation payments be a combination of personal
and communal benefits rather than just personal benefits, consistent with findings from many developing countries and contexts across Asia.

6.5. Assessing good governance for red panda habitats

In Chapter 5, I assessed community perceptions of the current state of governance of red panda habitat and identified their preferences on the desired improvement for their governance. The study is important because this is novel research to assess the strength and weakness of the conservation policy instrument implemented on the ground to conserve the red panda and associated biodiversity. This thesis is built on the fact that good conservation governance of red panda habitats is a precondition for the sustainable management of ecosystem goods and services obtained from the habitats, enhancement of local livelihoods, and the survival of red panda and associated mountain biological diversity.

I found that there was generally a high level of satisfaction with governance inside the PA, but less so outside and that in both places there was a dissonance between respondents’ views on the rules and regulations, which were generally expected to be effective, and their implementation, which was found wanting by many. The key factor, agreed by 95% of respondents inside and outside the PA, was the systemic corruption that surrounds forest management both inside and outside the park. This warrants more detailed investigation, because corruption comes in many forms and the mechanics of its operation can vary greatly depending on the context.

6.6. Research implications

While the research described in this thesis expanded the scope of red panda conservation research from autecology to include the interactions between people and the red panda’s habitat, much more remains to be done to understand the social and cultural
context of red panda habitat use. The research suggests that there should be a particular focus on red panda conservation interventions outside PAs, as is the case for nearly 70% of the known distribution in Nepal. An approach linking biological diversity, ecosystem services, and livelihoods may be useful in other red panda habitats and equally applicable to the conservation of other threatened and flagship species in the mountains and elsewhere. This can only be achievable if policymakers appreciate the root causes and impacts of unsustainable usage of good and benefits from the habitats, line agencies implement comprehensive and targeted policies effectively and communities understand and embrace the reasons for policy change.

In this context, the red panda species is of particular interest, owing to its taxonomic distinctiveness, unique biological and ecological features, and unusual attractiveness. These factors have resulted in the adoption of the red panda as a flagship species for conservation in Nepal, where it is the subject of substantial action through legislation and policy. The National Parks and Wildlife Conservation Act 2029 (1973) listed the red panda under Schedule 1, making it a top priority threatened species facing the threat of extinction. Strategically choosing flagship species like the red panda to front a conservation strategy may support conservation of the entire ecosystem. This paradigm may therefore successfully raise the level of awareness and increase monetary value of conservation, highlighting it as a vital paradigm in nature conservation.

This thesis complements the increasing knowledge of the ecological requirements of the panda itself and will allow important refinements to the interventions, community-based conservation initiatives and other species-based monitoring and conservation programs and approaches currently practiced.

Assessment of ecosystem goods and services from red panda habitats ES can help to generate a knowledge base on the benefits of mountain ecosystems which, in turn, can
promote sustainable biodiversity conservation and help raise community awareness, build local capacity, engage communities and line agencies in decision-making processes, and ensure alignment of management with national conservation policies.

A thorough assessment of the values and trends of ES in red panda habitats can also potentially form the basis for the development of payments for ecosystem services (PES) scheme. In such a context, A PES scheme that is designed and implemented successfully has the potential to support effective conservation, sustainable resource utilisation and rural livelihood development.

Overall, governance of the ecosystem goods and services derived from the mountain habitats of the red panda needs to improve given the serious concerns for resources sustainability, biodiversity conservation, habitat management, and rural livelihoods. A key piece of participatory research will be development of a governance regime for the red panda habitat that overcomes discrepancies between existing laws and policies and their implementation, particularly the issues relating to rent-seeking.

6.7. Study limitations and future research

In Chapter 2, this thesis broadly categorized the ES described in the Focal Group Discussions (FGDs) and Key Informant Interviews (KIIs) according to the Common International Classification of Ecosystem Services. However, some services listed could not readily be described while some services known to be produced by the panda habitats were never mentioned. The CICES classification categorises religious services, cultural services, and spiritual services as potential ES but does not spell out what might be included, or excluded, from these categories. It made it difficult to find concordance between CICES classification and what really being described during FGDs and KIIs as being included in these categories.
On the other hand, FGDs and KIIs universally omitted mention of regulating and maintenance services as use-values, as participants believe these services are provided by mountain deities and that many aspects of nature are not considered separately from the gods and goddesses who are embodied in the mountains. These deities regulate and maintain the services western science has categorized as climate control, carbon storage, natural hazard reduction, and maintenance of air, water, and soil quality. Thus, for many residents, many regulating and maintenance services can be categorised most readily as cultural and spiritual services rather than use services. The finding highlights a need for future research to explore more deeply ways in which different worldviews can be accommodated into the largely utilitarian ES framework.

In Chapter 3, responses on trends in the last 20 years were only included from respondents older than 35 years as they would have been at least 15 years old when the trend period began. However, people’s perceptions and their responses to such trends and social processes are usually dynamic and change over time. Respondent’s self-reported recollections of changes may be biased by more recent experience. In addition, we only focused on the trends in ES of livelihood significance prioritised by the local communities. For further studies, it would be relevant to conduct a detailed assessment on overall service provision from these mountain habitats. Such large-scale studies should include perception-based research as well as use GIS mapping and modelling.

The study described in Chapter 4 successfully employed the purposive/judgemental sampling technique, a non-random sampling technique, which was adopted with chosen respondents being experienced and knowledgeable with the subject of this thesis. Despite that, the study had a limited sample size and only focused on the red panda habitats that were already known. A further detailed habitat-level study should attempt to execute a broad survey that could represent all identified 24 red panda range
districts in the mountains of north-eastern to north-western Nepal focusing on identification, quantification, valuation, and assessing the interrelationship between the ES obtained, human disturbance, and alternatives to reducing the human pressure, their trends and state of governance such that an incentive-based governance model can be designed and implemented for sustainable conservation of ecosystem benefits across the national range of the red panda.

The governance studies described in Chapter 5 would be more significant if greater detail could have been included on institutional governance in the region, not just the perceptions of local communities, and government perceptions of policy implementation status on the ground. There is also a major gap in knowledge on how best to manage the activities of resource collectors coming from outside the region, especially those gathering medicinal plants commercially. Inclusion of all players in governance studies would allow creation of a program that deals comprehensively with competing interests and power dynamics.

6.8. Conclusions

The wellbeing of both red pandas and the people amongst whom it lives have traditionally been inseparable, but all research on the red panda’s habitat have been autecological studies describing the biological context of the species. This research, which has had a major focus on effective governance of the species mountain habitats, provides a novel approach to the conservation of red panda in Nepal. Knowledge of the ecosystem goods and services flowing from the mountain habitats of the red panda to local communities, their value, trends, governance, and the willingness of communities to accept compensation in return for reducing use of these services provides an holistic framework for their long-term conservation.
Appendix 1. Household Questionnaire survey conducted during second field visit (August to October 2019)

Respondent____________________  Interviewer________________________
Location______________________  Date_________________________
Number: _________________  BWS: Block 1  CE: Block 1

Current livelihoods and changes in use

1) Income sources from forest

<table>
<thead>
<tr>
<th>Resource</th>
<th>Quantity collected</th>
<th>Quantity sold</th>
<th>Income</th>
<th>Time needed to walk</th>
<th>Core or buffer zone</th>
<th>Changes to 10 years ago</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamboo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ use more</td>
</tr>
<tr>
<td>□ Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ use less</td>
</tr>
<tr>
<td>□ No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ need more time to collect</td>
</tr>
<tr>
<td>Medical plants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ use more</td>
</tr>
<tr>
<td>□ Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ use less</td>
</tr>
<tr>
<td>□ No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ need more time to collect</td>
</tr>
<tr>
<td>Fire wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ use more</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ use less</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ need more time to collect</td>
</tr>
</tbody>
</table>

2a) Income from transhumance: □ Yes    □ No

2b) If NO, have you practices transhumance before? If so when have you stopped and what was the reason:


2c) If Yes, how many animals of what sort do you have and what is the income?

<table>
<thead>
<tr>
<th>Type and number of animals</th>
<th>Income</th>
<th>Time needed to walk</th>
<th>Core or buffer zone</th>
<th>Changes to 10 years ago</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ more animals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ less animals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ different routes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ spend more time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ spend less time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>other:</td>
</tr>
</tbody>
</table>
2d) What best describe how you feel about transhumance? Tick all that apply.
☐ It is my duty (responsibility) to continue it
☐ It is part of my tradition and culture
☐ I just do it because I received good money from the animals
☐ Others

3a) Do you think that in 10 years you will still be doing transhumance?
☐ Very likely  ☐ Likely  ☐ Unlikely  ☐ Very unlikely

3b) Do you have family who will continue transhumance?
☐ Yes ☐ No

3c) If YES, specify:
____________________________________________________________________

Other income per year:
4a) Do you own land? ☐ Yes ☐ No If yes, how much land?
____________________________________________________________________

4b) from agriculture:
____________________________________________________________________

4c) from apples farming:
____________________________________________________________________

4d) from bees:
____________________________________________________________________

4e) from ecotourism:
____________________________________________________________________

4f) of ecotourism, since when?
____________________________________________________________________

4g) from foreign employment?
____________________________________________________________________

4h) from other work:
____________________________________________________________________

4i) if other work, since when?
____________________________________________________________________

Valuation of ecosystem services – Choice experiment

I will now show you 6 different scenarios, they look the same, but they are all different.

Imagine an agency pays you some money to reduce the use of forest resources and the high pastures? What scenario would be most acceptable for you? Please always look at the three options in each scenario. If you do not like any of the Scenarios where you get
paid for not using so many resources anymore, you can always choose the ‘current situation’. You then do not get any payment, but you can continue with what you use now.

Block 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a cash monthly compensation in winter season</td>
<td>0</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>6 to 10 years</td>
<td>3 to 5 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pastures</td>
<td>Yes, no restriction</td>
<td>No more grazing on high pastures</td>
<td>Yes, restrictions in terms of number of animals (fewer animals)</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on only bamboo (little amounts for self-use)</td>
<td>Restrictions on only medical plants (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5a) I prefer:  
- [ ] Current situation  
- [ ] Scenario A  
- [ ] Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>2,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>3 to 5 years</td>
<td>6 to 10 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>Restrictions in terms of months (fewer months)</td>
<td>Restrictions in terms of number of animals (fewer animals)</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on medicinal plants and bamboo (little amounts for self-use)</td>
<td>Restrictions on only bamboo (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5b) I prefer:  
- [ ] Current situation  
- [ ] Scenario A  
- [ ] Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>2,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Medium</td>
<td>medium</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>6 to 10 years</td>
<td>6 to 10 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>Restrictions in terms of number of animals (fewer animals)</td>
<td>Restrictions in terms of number of animals (fewer animals)</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on only medical plants (little amounts for self-use)</td>
<td>Restrictions on only bamboo (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5c) I prefer:  
- [ ] Current situation  
- [ ] Scenario A  
- [ ] Scenario B
<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>4,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Medium</td>
<td>medium</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>6 to 10 years</td>
<td>3 to 5 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>Restrictions in terms of months (fewer months)</td>
<td>No more grazing on high pastures</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on medicinal plants and bamboo (little amounts for self-use)</td>
<td>Restrictions on medicinal plants and bamboo (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5d) I prefer: [ ] Current situation [ ] Scenario A [ ] Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>3 to 5 years</td>
<td>6 to 10 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>No more grazing on high pastures</td>
<td>No more grazing on high pastures</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on only bamboo (little amounts for self-use)</td>
<td>Restrictions on only medicinal plants (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5e) I prefer: [ ] Current situation [ ] Scenario A [ ] Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>5,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>6 to 10 years</td>
<td>3 to 5 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>Restrictions in terms of months (fewer months)</td>
<td>Restrictions in terms of months (fewer months)</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on only medicinal plants (little amounts for self-use)</td>
<td>Restrictions on only medicinal plants (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5f) I prefer: [ ] Current situation [ ] Scenario A [ ] Scenario B

Next question only for those who always chose the ‘current situation’:

6) What was the reason for always choosing ‘current situation’? Please tick all that apply.
☐ the payments were never enough to compensate my loss
☐ I like the traditional lifestyle and do not want to stop going into the forest
☐ I would not know what else to do with my time then
☐ I do not like the monitoring and compliance
☐ other reason: _________________________________

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7a) Would you be willing to reduce the use of forest resources for income if there were other alternatives, no personal payment but communal payment system? □ Yes □ No

7b) Would you be willing to reduce the use of forest resources for income if there were other alternatives, no personal payment or communal payment system but livelihood support program (example: on- and off-farm and wage-based incomes? □ Yes □ No

8a) What else would you accept as compensation to stop transhumance (if applicable) and/or stop collecting bamboo and medical plants for commercial purpose?

8b) If you were to give up transhumance (if applicable), would you miss anything?

Governance – Best-worst scaling

9a) Do you think the natural resources around your community are getting less? □ Yes □ No

9b) If YES, how much less? □ a lot less □ moderately less □ just a bit less

10) What do you think is the biggest threat to the forest (red panda habitat)? Please rank from 1 _ biggest threat

<table>
<thead>
<tr>
<th>Threat</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing environmental and climatic conditions</td>
<td></td>
</tr>
<tr>
<td>People from outside taking too many resources (e.g. medical plants)</td>
<td></td>
</tr>
<tr>
<td>Growing number of tourists and associated infrastructure (e.g. hotels)</td>
<td></td>
</tr>
<tr>
<td>Decline in traditional practices while expanding agricultural activities</td>
<td></td>
</tr>
<tr>
<td>Population growth and associated higher demand for forest resources</td>
<td></td>
</tr>
</tbody>
</table>

11a) Are you aware about any rules that apply to the use of the common pastures (highland range land)? □ Yes □ No

11b) If YES, explain:

_______________________________________________________________________

12a) Do you think it might help to regulate the use of the common pastures when people had to pay for their use? □ Yes □ No □ Not sure

12b) Do you pay something to take your animals to high pastures? □ Yes □ No

12c) If YES, how much do you pay? NPR per year

_______________________________________________________________________

12d) If YES, do you think the money will help to conserve the forest resources? □ Yes □ No □ Not sure
13) Who do you think should make sure there is no overuse? Tick all that apply
☐ Ourselves  ☐ Everybody in village  ☐ the Elders  ☐ Forest Committee members
☐ Somebody from the village should be appointed to do so  ☐ National Park Officers

14a) Are you a member of a committee that looks after the forest?  ☐ Yes  ☐ No

14b) If yes, please name of the committee and your designation:

14c) If NO, would you like to be more involved in decision-making about the forest?  ☐ Yes  ☐ No

15) What do you think are the most and least important factors when managing the common resources, the forest and the pastures? Please tick one on the left-hand side and one on the right-hand side.

Block 1

<table>
<thead>
<tr>
<th>MOST important</th>
<th>LEAST important</th>
</tr>
</thead>
<tbody>
<tr>
<td>How effectively regulations are enforced (effectiveness)</td>
<td></td>
</tr>
<tr>
<td>Fair compensation for damage from wild animals (fairness)</td>
<td></td>
</tr>
<tr>
<td>Reasonable costs of governance (efficiency)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOST important</th>
<th>LEAST important</th>
</tr>
</thead>
<tbody>
<tr>
<td>How rule breaking and corruption is reported and investigated (accountability)</td>
<td></td>
</tr>
<tr>
<td>Training and education around regulations and governance (participation)</td>
<td></td>
</tr>
<tr>
<td>Fair compensation for damage from wild animals (fairness)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOST important</th>
<th>LEAST important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who makes decisions (transparency)</td>
<td></td>
</tr>
<tr>
<td>How rule breaking and corruption is reported and investigated (accountability)</td>
<td></td>
</tr>
<tr>
<td>Fair compensation for damage from wild animals (fairness)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOST important</th>
<th>LEAST important</th>
</tr>
</thead>
<tbody>
<tr>
<td>How effectively regulations are enforced (effectiveness)</td>
<td></td>
</tr>
<tr>
<td>How rule breaking and corruption is reported and investigated (accountability)</td>
<td></td>
</tr>
<tr>
<td>Reasonable costs of governance (efficiency)</td>
<td></td>
</tr>
</tbody>
</table>

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**Governance questions**

16) What do you know about how your forests are being used?

17) Where do you get your information from (if they unable to answer ask next question)?

18) Do you get any information from the government forest / conservation organizations?  
   - Yes  - No

19) What kinds of regulations are in place to manage forest resources?

20) How does this information change the behavior of people (you) using the forest?

21) What happens when people don’t follow the regulations?

22) Do you get training and services from government agencies and are they appropriate for you?  - Yes  - No

23) How would you rate your access to information about how the resources of your forest are used and about forestry planning?  
   - Very poor  - Poor  - Good  - Very good

24) Are the forest / conservation related rules and regulation effectively implemented?  
   - Yes  - No  - Not sure

25) How would you rate the impact the conservation rules and regulations have on how well the forest resources are managed?  
   - Great positive impact – the resources are managed better than without regulations  
   - Small positive impact – the resources are managed a bit better than without impact  
   - I cannot detect and impact  
   - Small negative impact – the resources are managed a bit worse than without regulations  
   - Great negative impact – the resources are managed worse than without regulations
26) Are you aware if the forest/conservation officers routinely investigate the forest-related crimes and illegal activities?  □ Yes  □ No  □ Not sure

27a) Are you aware of any activities in the forest that aim to conserve threatened species such as the red panda?  □ Yes  □ No

27b) If yes, what has been done to help the red panda?

28) Do you think the current regulations and governance helps to conserve the forest?  □ Definitely yes  □ Probably yes  □ Probably not  □ Definitely not

29) Are you aware of any forest related sanctions?  □ Yes  □ No

30) Do you think complaints about inappropriate use of forest resources lead to investigation and appropriate sanctions?  □ Yes  □ No  □ Not sure

31) Do you know anybody who has ever been sanctioned or fined (including yourself) for inappropriate forest use?  □ Yes  □ No

32) How would you rate the corruption around the use of forest resources?  □ Very corrupt  □ Corrupt  □ a little bit corrupt  □ not corrupt at all

33) Do you think the conservation agency (forest officers/conservation officers/rangers) have enough resources to monitor the forest and to enforce regulations?  □ Definitely yes  □ Probably yes  □ Probably not  □ Definitely not

34) Who do you think benefit the most from regulations and governance of forest resources?  □ Local communities  □ Local government line agencies  □ Nobody

35) How would you rate the secure access to the resources you depend on for your livelihood?
□ Plenty to get by easily
□ Enough to get by
□ Not quite enough to get by without some difficulties
□ Not enough at all to get by without a lot of difficulties

36a) Would you say you have the same access to forest resources than everybody else in your village?  □ Yes  □ No

36b) If no, why?

37) Do you have an opportunity to report corruption practices to an appropriate authority?  □ Yes  □ No

38) Do you get any economic incentives to promote your livelihoods and incomes while ensuring sustainable utilization of timber and non-timber forest products?  □ Yes  □ No

39a) Do you pay for access to the forest?  □ Yes  □ No
39b) If yes, do you think this payment is appropriate?
- Definitely yes
- Probably yes
- Probably not
- Definitely not

39c) If yes, do you think this payment is used appropriately to conserve the forest resources?
- Yes
- No
- I don’t know

40) Do you think men and women have the same right to forest resources access and use?
- Definitely yes
- Probably yes
- Probably not
- Definitely not

41) Do you get fair compensation for damage from wild animals?
- Yes
- No
- Not enough

42) Does government forests office/National park and buffer-zone conduct consultation consultations with stakeholders (you) for decision making process?
- Yes
- No
- Not sure

43) Do you think men and women have the equal chances to participate in the decision-making process?
- Definitely yes
- Probably yes
- Probably not
- Definitely not

44) What is the extent to which government engages with, creates space for, and supports the participation of forest-dependent communities in forest-related planning and decision making?
- Routinely encourages
- Sometimes encourages
- Seldom encourages
- Never encourages

45) Are stakeholders allowed to seek review or reconsideration of the decisions of the forest/conservation agency?
- Yes
- No

46) How would you rate your knowledge about the people who are currently responsible for managing the forest?
- Very good
- Good
- Poor
- Very poor

47) Do you get public notice of proposed forest/conservation policies, programs, laws, and projects?
- Yes
- No

48a) Are you aware that you could access inventory data, management plans, laws, and budgets for government-owned forests and protected areas?
- Yes
- No

48b) If so, have you ever accessed any of such data?
- Yes
- No
Respondent and household characteristics

49) What is your age? _______________

50) Relationship: □ Single □ Married □ Other: ______________________________

51) How many people are living in your household?
   Adults (16 and older): ________________
   Children (under 16): ________________

52) What is the highest level of education you have completed?
   □ not completed any formal education
   □ completed primary / elementary school
   □ attended secondary school (Years 8,9,10)
   □ attended or completed high school (Years 10,11,12)
   □ received some kind of training after school
   □ attended or completed university

53) All things considered, how satisfied are you with your life? Between 1 (extremely dissatisfied) and 10 (extremely satisfied)

   1 2 3 4 5 6 7 8 9 10

54) Gender (observe): □ Male □ Female

55) Household status (observe): □ very poor □ poor □ average □ above average □ wealthy
Appendix 2. Local market unit price of the ecosystem goods derived from red panda habitats in western Nepal

<table>
<thead>
<tr>
<th>Ecosystem goods obtained from the red panda habitats</th>
<th>Unit</th>
<th>Average price per unit (NRP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamboo (Number of bamboos used to prepare a bamboo product)</td>
<td>Bamboo product</td>
<td>600</td>
</tr>
<tr>
<td>Doko (20)</td>
<td>Bamboo product</td>
<td>600</td>
</tr>
<tr>
<td>Dalo (15)</td>
<td>Bamboo product</td>
<td>400</td>
</tr>
<tr>
<td>Supo (8)</td>
<td>Bamboo product</td>
<td>500</td>
</tr>
<tr>
<td>Thun (12)</td>
<td>Bamboo product</td>
<td>600</td>
</tr>
<tr>
<td>Channu (7)</td>
<td>Bamboo product</td>
<td>450</td>
</tr>
<tr>
<td>Syaku (15)</td>
<td>Bamboo product</td>
<td>700</td>
</tr>
<tr>
<td>Chapri (8)</td>
<td>Bamboo product</td>
<td>250</td>
</tr>
<tr>
<td>Medicinal plants (some common medicinal plants species for productive use)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bayajadi</td>
<td>Kg</td>
<td>1000</td>
</tr>
<tr>
<td>Padamchal (pokchallo)</td>
<td>Kg</td>
<td>300</td>
</tr>
<tr>
<td>Gunaino</td>
<td>Kg</td>
<td>450</td>
</tr>
<tr>
<td>Ghode machho</td>
<td>Kg</td>
<td>500</td>
</tr>
<tr>
<td>Firewood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average weight of firewood per Bhari is 35 kg</td>
<td>Bhari</td>
<td>500</td>
</tr>
<tr>
<td>Fodder and bedding for animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average weight of fodder and bedding for animal per Bhari is 30 kg</td>
<td>Bhari</td>
<td>400</td>
</tr>
</tbody>
</table>
Appendix 3. Socio-demographic characteristics of the study participants in and around the red panda habitats in western Nepal

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>Sample details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample included in the analysis</td>
<td>General sample</td>
</tr>
<tr>
<td></td>
<td>Inside the PA (n=97)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outside the PA (n=79)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Both (study site; n=176)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inside the PA (n=145)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outside the PA (n=98)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Both (study sites; n=243)</td>
<td></td>
</tr>
<tr>
<td>Respondent age (year)</td>
<td>Average age (SD; median)</td>
<td></td>
</tr>
<tr>
<td>&lt;35</td>
<td>47.3(9.9;45)</td>
<td>41.5 (11.7; 38)</td>
</tr>
<tr>
<td>35-44</td>
<td>46.4</td>
<td>47.2</td>
</tr>
<tr>
<td>45-54</td>
<td>24.7</td>
<td>24.4</td>
</tr>
<tr>
<td>55-64</td>
<td>22.9</td>
<td>19.9</td>
</tr>
<tr>
<td>65-75</td>
<td>6.2</td>
<td>7.9</td>
</tr>
<tr>
<td>&gt;75</td>
<td>0.6</td>
<td>0</td>
</tr>
<tr>
<td>Gender (%)</td>
<td>Male</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>32</td>
</tr>
<tr>
<td>Education level (%)</td>
<td>Not completed any formal education</td>
<td>59.8</td>
</tr>
<tr>
<td></td>
<td>Completed primary / elementary school</td>
<td>20.6</td>
</tr>
<tr>
<td></td>
<td>Attended secondary school (Years 8,9,10)</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>Attended or completed high school (Years 10,11,12)</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Received some form of training after school</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Attended or completed university</td>
<td>3.1</td>
</tr>
<tr>
<td>Relationship (%)</td>
<td>Single</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Married</td>
<td>100</td>
</tr>
<tr>
<td>Household population</td>
<td>Total population</td>
<td>606</td>
</tr>
<tr>
<td></td>
<td>Adults (16 and older; %)</td>
<td>63</td>
</tr>
<tr>
<td>Variables</td>
<td>Sample details</td>
<td>FGDs (n=56)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inside the PA (n=26)</td>
</tr>
<tr>
<td><strong>Gender (%)</strong></td>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>30-45</td>
<td>84.6</td>
<td>53.3</td>
</tr>
<tr>
<td>46-60</td>
<td>30.8</td>
<td>36.7</td>
</tr>
<tr>
<td>&gt;60</td>
<td>26.9</td>
<td>23.3</td>
</tr>
</tbody>
</table>
Appendix 4. Household survey sample selection in and around red panda habitats in western Nepal

<table>
<thead>
<tr>
<th>Study location (sites)</th>
<th>Number of households (CBS, 2012)</th>
<th>Number of households (Field survey 2019)</th>
<th>Sample selection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=317</td>
<td>n=334</td>
<td>n=243</td>
</tr>
<tr>
<td>Tila Rural Municipality-6, Ripi</td>
<td>34</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
<td>Tila RM-9, Khopry</td>
<td>41</td>
<td>39</td>
<td>31</td>
</tr>
<tr>
<td>Tatopani Rural Municipality-8, Budhabada, Imilcha, Mulchali, Raakshya</td>
<td>39</td>
<td>41</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total households in Jumla district (outside the PA)</strong></td>
<td><strong>114</strong></td>
<td><strong>114</strong></td>
<td><strong>98</strong></td>
</tr>
<tr>
<td>Chayanath-Rara Municipality-8 Jhyari, Chuga</td>
<td>107</td>
<td>113</td>
<td>72</td>
</tr>
<tr>
<td>Chayanath-Rara Municipality-9, Murma</td>
<td>66</td>
<td>75</td>
<td>47</td>
</tr>
<tr>
<td>Khatyed Rural Municipality-1, Jumphai, Sera</td>
<td>30</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td><strong>Total households in Mugu district (inside the PA)</strong></td>
<td><strong>203</strong></td>
<td><strong>220</strong></td>
<td><strong>145</strong></td>
</tr>
</tbody>
</table>
Appendix 5. Mean difference in sample characteristics based on choice behaviour among communities in and around red panda habitats in western Nepal

<table>
<thead>
<tr>
<th>Respondent characteristics</th>
<th>Respondent Choice decision</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alternative scenario (at least once)</td>
<td>Current situation (always the status quo)</td>
</tr>
<tr>
<td>Respondent age</td>
<td>42.11</td>
<td>46.06</td>
</tr>
<tr>
<td>Gender (Male)</td>
<td>0.61</td>
<td>0.71</td>
</tr>
<tr>
<td>Not completed any formal education</td>
<td>0.58</td>
<td>0.61</td>
</tr>
</tbody>
</table>
Appendix 6. Results of basic multinominal logit model (N = 243) undertaken with local people in and around red panda habitats in western Nepal

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compensation (in USD)</td>
<td>0.055***</td>
</tr>
<tr>
<td>Low conditionality</td>
<td>0.141</td>
</tr>
<tr>
<td>High conditionality</td>
<td>0.296**</td>
</tr>
<tr>
<td>Length of contract 3-5 years</td>
<td>-0.497***</td>
</tr>
<tr>
<td>Restriction in number of animals for grazing</td>
<td>0.079</td>
</tr>
<tr>
<td>Restriction in months of grazing</td>
<td>-0.461***</td>
</tr>
<tr>
<td>Restriction on bamboo collection</td>
<td>0.032</td>
</tr>
<tr>
<td>Restriction on medicinal plants collection</td>
<td>-0.286***</td>
</tr>
<tr>
<td>Constant for SQ alternative</td>
<td>0.833***</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1458</td>
</tr>
<tr>
<td>AIC</td>
<td>2665.7</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-1323.8</td>
</tr>
</tbody>
</table>

SE = Standard error

*** p < 0.01, ** p < 0.05, * p < 0.1.
Appendix 7. Questionnaire used for Choice Experiment and Best Worst Scaling conducted during second field visit (September and October, 2019)

Respondent____________________ Interviewer____________________
Location____________________ Date_________________________
Number: _________________ BWS: Block 1 CE: Block 1

Current livelihoods and changes in use

1) Income sources from forest

<table>
<thead>
<tr>
<th>Resource</th>
<th>Quantity collected</th>
<th>Quantity sold</th>
<th>Income</th>
<th>Time needed to walk</th>
<th>Core or buffer zone</th>
<th>Changes to 10 years ago</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamboo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ use more</td>
</tr>
<tr>
<td>☐ No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ use less</td>
</tr>
<tr>
<td>☐ use more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ need more time to</td>
</tr>
<tr>
<td>☐ use less</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>collect</td>
</tr>
<tr>
<td>☐ need more time to collect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical plants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ use more</td>
</tr>
<tr>
<td>☐ No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ use less</td>
</tr>
<tr>
<td>☐ use more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ need more time to</td>
</tr>
<tr>
<td>☐ use less</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>collect</td>
</tr>
<tr>
<td>☐ need more time to collect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ use more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ use less</td>
</tr>
<tr>
<td>☐ use less</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ need more time to</td>
</tr>
<tr>
<td>☐ need more time to collect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>collect</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ use more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ use less</td>
</tr>
<tr>
<td>☐ use less</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☐ need more time to</td>
</tr>
<tr>
<td>☐ need more time to collect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>collect</td>
</tr>
</tbody>
</table>

2a) Income from transhumance: ☐ Yes ☐ No

2b) If NO, have you practices transhumance before? If so when have you stopped and what was the reason:
2c) If Yes, how many animals of what sort do you have and what is the income?

<table>
<thead>
<tr>
<th>Type and number of animals</th>
<th>Income</th>
<th>Time needed to walk</th>
<th>Core or buffer zone</th>
<th>Changes to 10 years ago</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>more animals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>less animals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>different routes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>spend more time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>spend less time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>other:</td>
</tr>
</tbody>
</table>

2d) What best describe how you feel about transhumance? Tick all that apply.
☐ It is my duty (responsibility) to continue it
☐ It is part of my tradition and culture
☐ I just do it because I received good money from the animals
☐ Others

3a) Do you think that in 10 years you will still be doing transhumance?
☐ Very likely ☐ Likely ☐ Unlikely ☐ Very unlikely

3b) Do you have family who will continue transhumance? ☐ Yes ☐ No

3c) If YES, specify:
_______________________________________________________________________________

Other income per year:

4a) Do you own land? ☐ Yes ☐ No If yes, how much land?
_______________________________________________________________________________

4b) from agriculture:
_______________________________________________________________________________

4c) from apples farming:
_______________________________________________________________________________

4d) from bees:
_______________________________________________________________________________

4e) from ecotourism:
_______________________________________________________________________________

4f) of ecotourism, since when?
_______________________________________________________________________________

4g) from foreign employment?
_______________________________________________________________________________

4h) from other work:
_______________________________________________________________________________

4i) if other work, since when?
_______________________________________________________________________________
Valuation of ecosystem services – Choice experiment

I will now show you 6 different scenarios, they look the same, but they are all different.

Imagine an agency pays you some money to reduce the use of forest resources and the high pastures? What scenario would be most acceptable for you? Please always look at the three options in each scenario. If you do not like any of the Scenarios where you get paid for not using so many resources anymore, you can always choose the ‘current situation’. You then do not get any payment, but you can continue with what you use now.

Block 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a cash monthly compensation in winter season</td>
<td>0</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>6 to 10 years</td>
<td>3 to 5 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pastures</td>
<td>Yes, no restriction</td>
<td>No more grazing on high pastures</td>
<td>Yes, restrictions in terms of number of animals (fewer animals)</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on only bamboo (little amounts for self-use)</td>
<td>Restrictions on only medical plants (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5a) I prefer:  
- [ ] Current situation  
- [ ] Scenario A  
- [ ] Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>2,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>3 to 5 years</td>
<td>6 to 10 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>Restrictions in terms of months (fewer months)</td>
<td>Restrictions in terms of number of animals (fewer animals)</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on medicinal plants and bamboo (little amounts for self-use)</td>
<td>Restrictions on only bamboo (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5b) I prefer:  
- [ ] Current situation  
- [ ] Scenario A  
- [ ] Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>2,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Medium</td>
<td>medium</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>6 to 10 years</td>
<td>6 to 10 years</td>
</tr>
<tr>
<td>Description</td>
<td>Current situation</td>
<td>Scenario A</td>
<td>Scenario B</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>-------------------</td>
<td>------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>Restrictions in terms of number of animals</td>
<td>Restrictions in terms of number of animals (fewer animals)</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on only medical plants (little amounts for self-use)</td>
<td>Restrictions on only bamboo (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5c) I prefer:  □ Current situation  □ Scenario A  □ Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>4,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Medium</td>
<td>medium</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>6 to 10 years</td>
<td>3 to 5 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>Restrictions in terms of months (fewer months)</td>
<td>No more grazing on high pastures</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on medicinal plants and bamboo (little amounts for self-use)</td>
<td>Restrictions on medicinal plants and bamboo (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5d) I prefer:  □ Current situation  □ Scenario A  □ Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Length of contract</td>
<td>No contract</td>
<td>3 to 5 years</td>
<td>6 to 10 years</td>
</tr>
<tr>
<td>Seasonal grazing on high-land pasture</td>
<td>Yes</td>
<td>No more grazing on high pastures</td>
<td>No more grazing on high pastures</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on only medicinal plants (little amounts for self-use)</td>
<td>Restrictions on only medicinal plants (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5e) I prefer:  □ Current situation  □ Scenario A  □ Scenario B

<table>
<thead>
<tr>
<th>Description</th>
<th>Current situation</th>
<th>Scenario A</th>
<th>Scenario B</th>
</tr>
</thead>
<tbody>
<tr>
<td>You received a monthly compensation of</td>
<td>0</td>
<td>5,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Level of compliance</td>
<td>None</td>
<td>High</td>
<td>Low</td>
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<td>No contract</td>
<td>6 to 10 years</td>
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<td>Yes</td>
<td>Restrictions in terms of months (fewer months)</td>
<td>Restrictions in terms of months (fewer months)</td>
</tr>
<tr>
<td>Taking of other forest resources</td>
<td>Yes, no restriction</td>
<td>Restrictions on only medicinal plants (little amounts for self-use)</td>
<td>Restrictions on only medicinal plants (little amounts for self-use)</td>
</tr>
</tbody>
</table>

5f) I prefer:  □ Current situation  □ Scenario A  □ Scenario B
Next question only for those who always chose the ‘current situation’:

6) What was the reason for always choosing ‘current situation’? Please tick all that apply.
- [ ] the payments were never enough to compensate my loss
- [ ] I like the traditional lifestyle and do not want to stop going into the forest
- [ ] I would not know what else to do with my time then
- [ ] I do not like the monitoring and compliance
- [ ] other reason: _________________________________

7a) Would you be willing to reduce the use of forest resources for income if there were other alternatives, no personal payment but communal payment system?  [ ] Yes  [ ] No

7b) Would you be willing to reduce the use of forest resources for income if there were other alternatives, no personal payment or communal payment system but livelihood support program (example: on- and off-farm and wage-based incomes?  [ ] Yes  [ ] No

8a) What else would you accept as compensation to stop transhumance (if applicable) and/or stop collecting bamboo and medical plants for commercial purpose?

8b) If you were to give up transhumance (if applicable), would you miss anything?

Governance – Best-worst scaling

9a) Do you think the natural resources around your community are getting less?
- [ ] Yes  [ ] No

9b) If YES, how much less?  [ ] a lot less  [ ] moderately less  [ ] just a bit less

10) What do you think is the biggest threat to the forest (red panda habitat)? Please rank from 1 _ biggest threat

<table>
<thead>
<tr>
<th>Threat</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing environmental and climatic conditions</td>
<td></td>
</tr>
<tr>
<td>People from outside taking too many resources (e.g. medical plants)</td>
<td></td>
</tr>
<tr>
<td>Growing number of tourists and associated infrastructure (e.g. hotels)</td>
<td></td>
</tr>
<tr>
<td>Decline in traditional practices while expanding agricultural activities</td>
<td></td>
</tr>
<tr>
<td>Population growth and associated higher demand for forest resources</td>
<td></td>
</tr>
</tbody>
</table>

11a) Are you aware about any rules that apply to the use of the common pastures (highland range land)?
- [ ] Yes  [ ] No

11b) If YES, explain:

_______________________________________________________________________

12a) Do you think it might help to regulate the use of the common pastures when people had to pay for their use?
- [ ] Yes  [ ] No  [ ] Not sure
12b) Do you pay something to take your animals to high pastures?  □ Yes  □ No

12c) If YES, how much do you pay? NPR per year ________________________________

12d) If YES, do you think the money will help to conserve the forest resources?
□ Yes  □ No  □ Not sure

13) Who do you think should make sure there is no overuse? Tick all that apply
□ Ourselves  □ Everybody in village  □ the Elders  □ Forest Committee members
□ Somebody from the village should be appointed to do so  □ National Park Officers

14a) Are you a member of a committee that looks after the forest?  □ Yes  □ No

14b) If yes, please name of the committee and your designation: ____________________________

14c) If NO, would you like to be more involved in decision-making about the forest?
□ Yes  □ No

15) What do you think are the most and least important factors when managing the common resources, the forest and the pastures? Please tick one on the left-hand side and one on the right-hand side.

Block 1

<table>
<thead>
<tr>
<th>MOST important</th>
<th>LEAST important</th>
</tr>
</thead>
<tbody>
<tr>
<td>How effectively regulations are enforced (effectiveness)</td>
<td></td>
</tr>
<tr>
<td>Fair compensation for damage from wild animals (fairness)</td>
<td></td>
</tr>
<tr>
<td>Reasonable costs of governance (efficiency)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOST important</th>
<th>LEAST important</th>
</tr>
</thead>
<tbody>
<tr>
<td>How rule breaking and corruption is reported and investigated (accountability)</td>
<td></td>
</tr>
<tr>
<td>Training and education around regulations and governance (participation)</td>
<td></td>
</tr>
<tr>
<td>Fair compensation for damage from wild animals (fairness)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOST important</th>
<th>LEAST important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who makes decisions (transparency)</td>
<td></td>
</tr>
<tr>
<td>How rule breaking and corruption is reported and investigated (accountability)</td>
<td></td>
</tr>
<tr>
<td>Fair compensation for damage from wild animals (fairness)</td>
<td></td>
</tr>
<tr>
<td>MOST important</td>
<td>LEAST important</td>
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<tr>
<td>----------------</td>
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</tr>
<tr>
<td>How effectively regulations are enforced (effectiveness)</td>
<td></td>
</tr>
<tr>
<td>How rule breaking and corruption is reported and investigated (accountability)</td>
<td></td>
</tr>
<tr>
<td>Reasonable costs of governance (efficiency)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOST important</th>
<th>LEAST important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who makes decisions (transparency)</td>
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</tr>
<tr>
<td>How effectively regulations are enforced (effectiveness)</td>
<td></td>
</tr>
<tr>
<td>Training and education around regulations and governance (participation)</td>
<td></td>
</tr>
</tbody>
</table>

**Governance questions**

16) What do you know about how your forests are being used?

17) Where do you get your information from (if they unable to answer ask next question)?

18) Do you get any information from the government forest / conservation organizations?
   □ Yes □ No

19) What kinds of regulations are in place to manage forest resources?

20) How does this information change the behavior of people (you) using the forest?

21) What happens when people don’t follow the regulations?

22) Do you get training and services from government agencies and are they appropriate for you? □Yes □No

23) How would you rate your access to information about how the resources of your forest are used and about forestry planning?
   □Very poor □Poor □Good □Very good

24) Are the forest / conservation related rules and regulation effectively implemented?
   □ Yes □No □Not sure
25) How would you rate the impact the conservation rules and regulations have on how well the forest resources are managed?

☐ Great positive impact – the resources are managed better than without regulations
☐ Small positive impact – the resources are managed a bit better than without impact
☐ I cannot detect and impact
☐ Small negative impact – the resources are managed a bit worse than without regulations
☐ Great negative impact – the resources are managed worse than without regulations

26) Are you aware if the forest/conservation officers routinely investigate the forest-related crimes and illegal activities?

☐ Yes  ☐ No  ☐ Not sure

27a) Are you aware of any activities in the forest that aim to conserve threatened species such as the red panda?

☐ Yes  ☐ No

27b) If yes, what has been done to help the red panda?


28) Do you think the current regulations and governance helps to conserve the forest?

☐ Definitely yes  ☐ Probably yes  ☐ Probably not  ☐ Definitely not

29) Are you aware of any forest related sanctions?

☐ Yes  ☐ No

30) Do you think complaints about inappropriate use of forest resources lead to investigation and appropriate sanctions?

☐ Yes  ☐ No  ☐ Not sure

31) Do you know anybody who has ever been sanctioned or fined (including yourself) for inappropriate forest use?

☐ Yes  ☐ No

32) How would you rate the corruption around the use of forest resources?

☐ Very corrupt  ☐ Corrupt  ☐ a little bit corrupt  ☐ not corrupt at all

33) Do you think the conservation agency (forest officers / conservation officers / rangers) have enough resources to monitor the forest and to enforce regulations?

☐ Definitely yes  ☐ Probably yes  ☐ Probably not  ☐ Definitely not

34) Who do you think benefit the most from regulations and governance of forest resources?

☐ Local communities  ☐ Local government line agencies  ☐ Nobody

35) How would you rate the secure access to the resources you depend on for your livelihood?

☐ Plenty to get by easily
☐ Enough to get by
☐ Not quite enough to get by without some difficulties
☐ Not enough at all to get by without a lot of difficulties
36a) Would you say you have the same access to forest resources than everybody else in your village?  □ Yes  □ No
36b) If no, why?
________________________________________________________________________

37) Do you have an opportunity to report corruption practices to an appropriate authority?  □ Yes  □ No
38) Do you get any economic incentives to promote your livelihoods and incomes while ensuring sustainable utilization of timber and non-timber forest products?  □ Yes  □ No

39a) Do you pay for access to the forest?  □ Yes  □ No
39b) If yes, do you think this payment is appropriate?
□ Definitely yes
□ Probably yes
□ Probably not
□ Definitely not

39c) If yes, do you think this payment is used appropriately to conserve the forest resources?
□ Yes  □ No  □ I don’t know

40) Do you think men and women have the same right to forest resources access and use?
□ Definitely yes  □ Probably yes  □ Probably not  □ Definitely not

41) Do you get fair compensation for damage from wild animals?  □ Yes  □ No  □ Not enough

42) Does government forests office / National park and buffer-zone conduct consultation consultations with stakeholders (you) for decision making process?  □ Yes  □ No  □ Not sure

43) Do you think men and women have the equal chances to participate in the decision-making process?
□ Definitely yes  □ Probably yes  □ Probably not  □ Definitely not

44) What is the extent to which government engages with, creates space for, and supports the participation of forest-dependent communities in forest-related planning and decision making?
□ Routinely encourages  □ Sometimes encourages  □ Seldom encourages  □ Never encourages

45) Are stakeholders allowed to seek review or reconsideration of the decisions of the forest / conservation agency?  □ Yes  □ No

46) How would you rate your knowledge about the people who are currently responsible for managing the forest?
□ Very good  □ Good  □ Poor  □ Very poor

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47) Do you get public notice of proposed forest / conservation policies, programs, laws, and projects? □ Yes □ No

48a) Are you aware that you could access inventory data, management plans, laws, and budgets for government-owned forests and protected areas? □ Yes □ No

48b) If so, have you ever accessed any of such data? □ Yes □ No

**Perception of environmental changes**

49a) Have you observed any changes in the environmental or the occurrence of extreme weather events over the last 10 years?

□ Yes, have seen many changes □ Yes, little changes □ No changes

49b) If YES, can you describe what has changed?


49c) If you have observed changes, are there any activities that you cannot do anymore or where you changed activities and patterns or are there strategies you use to cope with the changes? □ Yes □ No

49d) If YES, for each change, please explain how you changed your activities to adapt

<table>
<thead>
<tr>
<th>Changes in activities, adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

50) In the future (in about 10 years) which of the following natural hazards do you think are most likely to affect you, your household members and your agricultural livelihood? Please rate each hazard on a scale from 1 (no effect at all) to 10 (major effect)

<table>
<thead>
<tr>
<th>Natural Hazard</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landslides / Avalanches</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy rain and storms</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Drought and heat waves</td>
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<tr>
<td>Soil degradation</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Dwindling forest resources</td>
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<td></td>
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<td></td>
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<tr>
<td>Extreme cold and cold spells</td>
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<tr>
<td>Pollution</td>
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<td></td>
<td></td>
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<tr>
<td>Heavy snowfall / hail</td>
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</tr>
</tbody>
</table>
51) How would you rate your personal experience with the following natural hazards?

<table>
<thead>
<tr>
<th></th>
<th>I have personally been affected by it</th>
<th>I have not personally been affected but I am aware of the risks</th>
<th>I am not aware of any risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landslides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy rain and storms</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Drought and heat waves</td>
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<tr>
<td>Soil degradation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Dwindling forest resources</td>
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<tr>
<td>Extreme cold and cold spells</td>
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<td></td>
</tr>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy snowfall / hail</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

52a) How did you perceive the local temperature this winter season?
- [ ] mostly a bit cooler than usual
- [ ] mostly much cooler than usual
- [ ] mostly a bit hotter than usual
- [ ] mostly much hotter than usual
- [ ] pretty usual like it always has been

52b) How did you perceive the local temperature this summer season?
- [ ] mostly a bit cooler than usual
- [ ] mostly much cooler than usual
- [ ] mostly a bit hotter than usual
- [ ] mostly much hotter than usual
- [ ] pretty usual like it always has been

53a) Have you heard about climate change?  [ ] Yes  [ ] No

53b) If YES, what do you think are the causes of climate change?
- [ ] climate change is mainly caused by natural processes
- [ ] climate change is mainly caused by human activities
- [ ] climate change is partly caused by natural processes and partly by human activities
- [ ] I don’t believe climate change is happening

**Mobility questions**

54a) Have you been living here all your life?  [ ] Yes  [ ] No

54b) If NO, when have you moved here?
__________________________________________________________

54c) and from where?
__________________________________________________________

55) How likely is it that you will move away from your village in the next 5 to 10 years?
- [ ] Extremely likely
- [ ] Likely
- [ ] Unlikely
- [ ] Extremely unlikely

Next 4 questions (56a to 56e) only for those likely to move away:
56a) Where would you move to? □ within my village □ Other village nearby □ Nepalgunj □ Kathmandu □ somewhere else within Nepal: ____________________ □ to another country: ____________________

56b) What are the main reasons for you moving away? Please list and rank up to three main reasons.
________________________________________________________________________

56c) When you think of all possible reasons for moving away, to what extent do natural hazards affect your decision to move?
 □ Major influence □ Some influence □ Minor influence □ No influence at all

56d) Would you come back? □ Yes, very likely □ Yes, likely □ No, unlikely □ No, very unlikely

56e) If YES, roughly after how many years?
________________________________________________________________________

57a) Do you have sons or daughters who moved away from this village? □ Yes □ No

57b) Number of daughters in total: ________________ Number of sons in total: ________________

57c) Please list your children who are currently living outside the village.

<table>
<thead>
<tr>
<th>Person (son or daughter, age)</th>
<th>Moved away when</th>
<th>Moved to</th>
<th>Reason for moving away</th>
<th>Likelihood of coming back to village permanently</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td>□ Very likely □ Likely □ Unlikely □ Very unlikely</td>
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<td>□ Very likely □ Likely □ Unlikely □ Very unlikely</td>
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<td>□ Very likely □ Likely □ Unlikely □ Very unlikely</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ Very likely □ Likely □ Unlikely □ Very unlikely</td>
</tr>
</tbody>
</table>

58a) If your children are under 16, do you think that in the future they will move away permanently? □ Yes □ No

58b) If YES, how many and who:
58c) Where would they move to?
_____________________________________________________________

58d) What will be the reasons:
_____________________________________________________________

**Respondent and household characteristics**

49) What is your age? _______________

50) Relationship: ☐ Single ☐ Married  ☐ Other: _____________________________________________

51) How many people are living in your household?
Adults (16 and older): _______________
Children (under 16): _______________

52) What is the highest level of education you have completed?
☐ not completed any formal education
☐ completed primary / elementary school
☐ attended secondary school (Years 8,9,10)
☐ attended or completed high school (Years 10,11,12)
☐ received some kind of training after school
☐ attended or completed university

53) All things considered, how satisfied are you with your life? Between 1 (extremely dissatisfied) and 10 (extremely satisfied)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
</table>

54) Gender (observe):  ☐ Male  ☐ Female

55) Household status (observe):  ☐ very poor  ☐ poor  ☐ average  ☐ above average  ☐ wealthy
Appendix 8. Questions used for Focus Group Discussions and Key Informant Interviews conducted during first field visit (November 2017 to January 2018)

Focus Group Discussions and Key Informant Interviews (outside and inside the Protected Area)

The aim of this research project entitled “conservation governance of ecosystem goods and services obtained from red panda habitats in Western Nepal” is to understand the effectiveness of conservation governance in the range of the red panda in Jumla and Mugu districts, to explore and value the ecosystem services provided by red panda habitat and to develop practical measures for sustainable management of those services in a manner that enables conservation of the species.

I would like to ask you some questions regarding what you think about the governance of red panda habitat. It is intended that this interview will help to describe and resolve many of the conservation governance issues affecting red panda habitats of Nepal.

A. Local Governance
   1. Who looks after the forests that could have red pandas living in them?
   2. Are there any particular forest sites / tenure types from where you harvest resources?
   3. Do you walk in the Red panda habitat every day? if not, how many times per week?
   4. Who makes decisions about who can access these forests?
   5. Who makes decisions about how the forests are used?
   6. Do the forests have any religious or spiritual significance that affects how people access and use them?
   7. Who make decisions for where to take their cattle and where from harvest resources?
   8. Who do you think are responsible for forming these boundaries and how do they form?

B. Ecosystem Services
   9. What are the resources / services used from Red panda habitat?
10. Why are these resources used? (Construction activities, feeding wild animals, business purposes, others)
11. What are the most important products you get out of the habitat for a) own use, b) selling in markets
12. How much money do you get for the product sold?
13. How much the products you use from the red panda habitat would cost?
14. If the products are not sold in any market, and you were not able to harvest it, what effect would this have on your livelihood?
15. Which 5 products would you say are the MOST important for your livelihood?
16. Which 5 services would you say are MOST important for you?
17. Do the people who harvest / use the product / services come from any particular socio-economic group, and if so what is it (e.g. specific ethnic groups, women, landless people)
18. Are harvesters organised in any way (is there a harvesters’ organisation or cooperative)? Give details.
19. Are any harvesters particularly dependent on this product for their livelihood?
20. Where within the site are these resources harvested?
21. Does the availability of the products vary during the year (is production seasonal)? Explain
22. How has availability of the harvested wild goods at the site changed in the past 20 years? (Declined a lot; declined a little; about the same; increased slightly; increased a lot).
23. Has the time spent harvesting changed in the past 20 years? (Declined a lot; declined a little; about the same; increased slightly; increased a lot).
24. If the availability of the harvested wild goods has changed (or time spent harvesting has changed), what do you think are the reasons?

C. Conservation / forest laws and policies

25. Do you have a relationship with the Division Forest Office/National Park Office?
26. Do you (or your family) get any support from the Division Forest Office / National park office to help look after the forest?
27. Do you know where you are allowed to harvest resources and how much?
28. Are you aware of National conservation / forest laws and policies?
29. How do know about these regulations?
30. Are the laws about harvesting resources being enforced?
31. If they are not why do you think that's the case?
32. Is there anything you think could happen that would improve compliance with the laws?
33. Are you aware any of the national and international human rights instruments relating to conservation and indigenous people’s issues? If yes, what are they? And how you know about them?

D. Additional questions for respondents inside the protected area (Buffer Zone)
34. Who do you think are the decision-makers in the Rara National Park Buffer Zone?
35. Do you think forest conditions improved after the establishment of the Buffer Zone?
36. Who do you think contributes the most to the health of the forests?
37. Do you (or your family) get any support from National park office /management to help look after the forest?
38. Are local people using the forests in the way they always have? Or have things changed since the park has been in place?
39. Has the number of the households accessing or using the forest changed since the park was established?
40. What changes have you noticed?
41. Do you have any ideas about how local can be supported to access and/or use the forests for traditional purposes?
42. Are there any traditional or customary governance systems in place in the park and buffer zone?
43. How socially inclusive is your BZUG? Are all ethnic groups, ethnic minorities and males and female represented in your group?

E. Additional questions adapted from PROFOR forest governance framework
44. Do you (forest dependent communities) have secure access to the resources that they depend on?
45. Do you (the public) have an opportunity to report corrupt practices to an appropriate authority?
46. Do complaints of alleged forest corruption lead to investigation and appropriate sanctions?
47. For government forests / National park and buffer-zone, are consultations with stakeholders (you) carried out and is the feedback used in decision making?
48. Are there practical and effective avenues for stakeholders (you) to seek review or reconsideration of the decisions of the forest / conservation agency?

49. Do relevant authorities give public notice of proposed forest conservation policies, programs, laws, and projects?

50. Are inventory data, management plans, laws, and budgets for government-owned forests and protected areas easily accessible to the public (you) in a user-friendly format?

51. Are training and education services offered at times, places, and in formats that are appropriate for the public (you)?

52. Are there serious conflicts between different communities and user groups in the context of forest access / buffer-zone and use?

53. When the government extinguishes rights to land, are the affected rights-holders provided fair compensation?

54. Would you like to say anything more?

I would like to thank you for your valuable time and presence.
Appendix 9. Informed consent for Focus Group Discussion

Informed Consent Form

Project title: Conservation Governance of Ecosystem Goods and Services obtained from Red Panda Habitats in Western Nepal

We,…………………………………………………………………of………………………………………………………………………………………………………..…………………………

Hereby consent to participate in a research project designed by Mr. Manoj Bhatta of Charles Darwin University (CDU).

We acknowledge that:

• We voluntarily and freely give our consent to our participation in this study.
• The objectives, methods, anticipated benefits, and possible risks of the research project, have been explained to us by the researcher.
• We voluntarily and freely give our consent for all interviews to be recorded in written, audio and video forms.
• We understand that our real name can be used in the research work.
• We understand that the research outcomes will be published in books, reports and academic journals
• We understand that the information and photos will be used in talks at conferences and workshops.
• We are free to withdraw our consent at any time during the study, and if we do, any information collected from us will be taken out of the research project.

We clearly understand the purpose of this study, from the conditions written in the Plain Language Statement of the project and in this Consent Form and we freely give our consent to be a part of this project.

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Appendix 10. Informed Consent for Key Informant Interviews

Informed Consent Form

Project title: Conservation Governance of Ecosystem Goods and Services obtained from Red Panda Habitats in Western Nepal

I, ................................................................................................................ of ..........................................................

Hereby consent to participate in a research project designed by Mr. Manoj Bhatta of Charles Darwin University (CDU).

I acknowledge that:

- I voluntarily and freely give my consent to my participation in this study.
- The objectives, methods, anticipated benefits, and possible risks of the research project, have been explained to me by the researcher.
- I voluntarily and freely give my consent for all interviews to be recorded in written, audio and video forms.
- I understand that my real name can be used in the research work.
- I understand that the research outcomes will be published in books, reports and academic journals.
- I understand that the information and photos will be used in talks at conferences and workshops.
- I am free to withdraw my consent at any time during the study, and if I do, any information collected from me will be taken out of the research project.

I clearly understand the purpose of this study, from the conditions written in the Plain Language Statement of the project, and in this Consent Form and I freely give my consent to be a part of this project.

Participant’s signature: .................................................. Date: ............................................

Research Institute for the Environment and Livelihoods
Charles Darwin University, Casuarina Campus, Darwin NT 0909, Australia
T. +61 89466378 | M. 0451922833 | E. manoj.bhatta@cdu.edu.au
Appendix 11. Informed consent for Household survey

Informed Consent Form

Project title: Conservation Governance of Ecosystem Goods and Services obtained from Red Panda Habitats in Western Nepal

We, villagers of ………………………………………………………………………………………………………………………………

Hereby consent to participate in a research project designed by Mr. Manoj Bhatt of Charles Darwin University (CDU).

We acknowledge that:

- We voluntarily and freely give our consent to our participation in this study.
- The objectives, methods, anticipated benefits, and possible risks of the research project, have been explained to us by the researcher.
- We voluntarily and freely give our consent for all interviews to be recorded in written, audio and video forms.
- We understand that our real name can be used in the research work.
- We understand that the research outcomes will be published in books, reports and academic journals.
- We understand that the information and photos will be used in talks at conferences and workshops.
- We are free to withdraw our consent at any time during the study, and if we do, any information collected from us will be taken out of the research project.

We clearly understand the purpose of this study, from the conditions written in the Plain Language Statement of the project and in this Consent Form and we freely give our consent to be a part of this project.

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Appendix 12. Plain Language Statement for first field visit

Plain Language Statement / Information Sheet

Project title: Conservation Governance of Ecosystem Goods and Services obtained from Red Panda Habitats in Western Nepal

My name is Manoj Bhatta. I am originally from Amargadhi-06, Dadeldhura district, Far-west, Nepal. I am a PhD candidate at Charles Darwin University, Darwin Australia. This research aims to find out what services local people obtain from habitats used by red pandas, what the rules, regulations and customs are that control use of these resources and what can be done to improve the way they are regulated. We already know about the official government policies on resource use. Now we want to know how local people feel about how these resources are regulated.

We will be inviting government officials particularly District Forest Officers, forest rangers, and Village Development Committee Officials, representatives from Non-Government Organisations working in the conservation sector, local school teachers, local leaders, and representatives of marginalised social groups for interviews. We shall also be inviting groups in the community such as Forest User Groups, women’s groups (Aama Sanskriti), local clubs, deprived groups, etc. to have group discussions about the issues. Participants will be selected on the basis of their knowledge and experience, their position in society or their professional expertise or role. Members of these groups of eight to ten participants will be made familiar with the research aims, selected for their ability to respectfully share their opinions and willing volunteer at least two hours of their time for the discussion.

The information collected from participants will be recorded in written, audio, photos and / or videos forms. The permission will be sought for taking photos and / or videos. The information will be kept confidential and stored safely. The research outcomes will be published in books, reports and academic journals and information and photos and / or videos will also be used in talks at conferences and workshops. People who are invited to participate are not obliged to do so and can decide to withdraw from the discussions at any time, in which case they can decide that nothing they have contributed can be used.

The research will benefit local communities residing in and around red panda habitat, conservationists and policy makers. The community will potentially benefit from improved
governance of the ecosystem services provided by the red panda habitat. In addition, it is intended that the research provide reassurance to funding bodies that governance is being improved, enabling more effective conservation projects. Policy makers will be provided with recommendations for plans and policies and amendment of the existing policies, in order to develop practical measures to manage the panda's range sustainably.

There is some risk associated with the project should activities be discussed that are potentially illegal under the law. To minimise these risks, which are probably very small, all participants will be described in a way that means they cannot be identified individually – they will be described as a member of a group and any recordings will be destroyed once they have been written down. However, should people feel comfortable being identified, or have a role that cannot be made anonymous, I will make sure you are provided with a copy of the material I intend to use in my research to check and will also make sure your contribution is properly acknowledged.

Because this is a fairly short project, I shall not be able to return to present the final results to you but shall employ someone to do so at the end of the research.

If you want more information about this research or to see the results, you can contact the researcher, Manoj Bhatta, by T. +61 89466378 | M. 0451922833, or email: manoj.bhatta@cdu.edu.au.

If you are not happy with this research you can contact the project supervisor, Professor Stephen Garnett, by phone: (08) 8946 7115, or email: stephen.garnett@cdu.edu.au

If you have any concerns about this project, you are invited to contact the Ethics team of the Charles Darwin University Human Research Ethics Committee by email: ethics@cdu.edu.au, telephone: (08) 8946 6498, and toll free number: 1800 466 215 or mail: Research Office, Charles Darwin University, Darwin NT 0909. The Ethics team can pass on any concerns to appropriate officers within the University.
Appendix 13. Plain Language Statement for second field visit

Plain Language Statement / Information Sheet

Project title: Conservation Governance of Ecosystem Goods and Services obtained from Red Panda Habitats in Western Nepal

My name is Manoj Bhatta. I am originally from Amargadhi-06, Dadeldhura district, Sudurpaschim province, Nepal. I am a PhD candidate at Charles Darwin University, Darwin Australia. This research aims to find out what services local people obtain from habitats used by red pandas, quantification and valuation of these services, what the rules, regulations and customs are that control use of these resources and what can be done to improve the way they are regulated. This is our second field visit, at this stage, we already know about the goods and benefits that people obtain from the red panda habitats. Quantification and valuation of the services created from these habitats would be of our great interest. We will be conducting semi-structured questionnaire survey with the households in the study area both inside and outside the protected area.

The information collected from participants will be recorded in written, audio, photos and / or videos forms. The permission will be sought for taking photos and / or videos. The information will be kept confidential and stored safely. The research outcomes will be published in books, reports and academic journals and information and photos and / or videos will also be used in talks at conferences and workshops. People who are invited to participate are not obliged to do so and can decide to withdraw from the discussions at any time, in which case they can decide that nothing they have contributed can be used.

The research will benefit local communities residing in and around red panda habitat, conservationists and policy makers. The community will potentially benefit from improved governance of the ecosystem services provided by the red panda habitat. In addition, it is intended that the research provide reassurance to funding bodies that governance is being improved, enabling more effective conservation projects. Policy makers will be provided with recommendations for plans and policies and amendment of the existing policies, in order to develop practical measures to manage the panda's range sustainably.

There is some risk associated with the project should activities be discussed that are potentially illegal under the law. To minimise these risks, which are probably very small, all
participants will be described in a way that means they cannot be identified individually - they will be described as a member of a group and any recordings will be destroyed once they have been written down. However, should people feel comfortable being identified, or have a role that cannot be made anonymous, I will make sure you are provided with a copy of the material I intend to use in my research to check and will also make sure your contribution is properly acknowledged.

Because this is a fairly short project, I shall not be able to return to present the final results to you but shall employ someone to do so at the end of the research.

If you want more information about this research or to see the results, you can contact the researcher, Manoj Bhatta, by T. +61 89466378 | M. 0451922833, or email: manoj.bhatta@cdu.edu.au.

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Appendix 14. Societal Recognition of Ecosystem Service Flows from Red Panda Habitats in Western Nepal

Societal Recognition of Ecosystem Service Flows From Red Panda Habitats in Western Nepal

Maanj Bhatta1, Kerstin K. Zander2, Beau J. Austin3, and Stephen T. Garnett4
1 Research Institute for the Environment and Livelihoods, Charles Darwin University, Eliegnawr Drive, Darwin, Northern Territory 0909, Australia
2 Northern Institute, Charles Darwin University, Eliegnawr Drive, Darwin, Northern Territory 0909, Australia

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The biologically and culturally diverse mountain habitats of the red panda (Ailurus fulgens) produce numerous ecosystem goods and services of global significance and satisfy the daily sustenance requirements and wellbeing of poor and vulnerable local communities. Most studies of ecosystem services conducted in Nepal have investigated community forest management and protected areas, largely in the lower hills and plains of the country. However, to conserve red pandas and associated biodiversity, knowledge is needed of the services instrumental to the livelihoods and wellbeing of people living in and around their Himalayan mountain habitats. Using case studies of 6 remote villages near to known red panda habitats inside and outside a protected area in western Nepal, this study reports on key informant interviews, focus group discussions, informal interactions, and participant observations to identify and categorize the goods and services provided by these habitats. Among the provisioning and cultural ecosystem goods and services obtained from red panda habitats, local people prioritize seasonal grazing in high-altitude pastures, plant materials for medicines and food, wild plants for energy, transhumance culture, and religious interaction with nature. Their dependence on these services varied with season and location, with greater reliance on the services outside the protected areas. Some services used for valuing ecosystems, such as carbon storage and improved air and water quality and biodiversity, were only ever mentioned in a manner that would characterize them as cultural services provided by mountain dwellers. They only appear to be acknowledged as services with a use value by people from outside the region. This study suggests that understanding the value of the services provided to local communities could allow development of a policy that would help conserve red pandas, particularly if income can be obtained for providing services to outsiders who have no perceived local economic benefit.

Keywords: mountain habitat; livelihoods; transhumance culture; highland rangeland; traditional medicinal herbe; governance.

Peer-reviewed: December 2019 Accepted: February 2020

Introduction

Although mountains cover only about 22% of the Earth’s land surface area and are home for only about 13% of the population (Romero et al. 2015), well over half of all humans rely directly or indirectly on mountain resources (Rodriguez-Rodriguez et al. 2011; Maselli 2012). Mountains provide provisioning services such as food, timber, fiber, and medicine, regulating and supporting services including water purification, climate regulation, nutrient cycling and soil formation, and cultural services such as aesthetic, symbolic, and religious values (MEA 2005; Macchi and ICMOD Team 2010; Molden and Sharma 2013; Hamilton 2015). They are also biologically diverse and home to 25% of global terrestrial biodiversity (Sharma et al. 2019).

Among the species relying on mountain habitats are the red panda (Ailurus fulgens). Red panda habitats are found between 2500 and 4800 m above the junctions of Bhutan, China, India, Myanmar, and Nepal (Gilchrist et al. 2015). In Nepal, of which three-quarters is mountainous (Thapa 1996), potential habitats of red panda cover 24,000 km² in 24 districts (Bista et al. 2016; DNPWC and DFNCF 2018), in which there are numerous threatened plant and animal species (Maëren et al. 2015). Red panda habitats also sustain local livelihoods (Chaudhary et al. 2009), based on livestock and non-timber forest products (NTFPs) (BPP 1995).

However, population growth, overexploitation, and land fragmentation are all altering traditional practices of resource usage and degrading these mountain habitats (Adhikari et al. 2007; Tiwari and Joshi 2015; Everard et al. 2019). Current policies, regulations, and practices and demand for goods and services also tend to overlook or undervalue the benefits obtained from nature and lead to suboptimal investment in conservation and management of ecosystems (MEA 2005; BNP 2011).

While people have long obtained services from mountain ecosystems, the articulation of ecosystem services (ES) as an idea is comparatively new. Quantifying, classifying, and understanding ES has now become a significant field of investigation (Fisher et al. 2009), and several frameworks, approaches, tools, and research (Lee and De Groot 2003; Suholt 2009; Raud et al. 2011; Haines-Young and Potschin 2011, 2018; Poh 2015; Bennett et al. 2015; Díaz et al. 2015; La Notte et al. 2017) have been proposed to gain insight into the goods and services that nature produces, how they should be categorized and classified, and how their
value should be quantified, and how the linkages between ES, livelihoods, and wellbeing can be understood (Carpenter, DeFries, et al 2006; Tallis et al 2008). However, apart from studies of community forest management systems and lower-altitude protected areas (Lamal et al 2018), there is little understanding of ES instrumental to the livelihoods and wellbeing of people living in mountainous Nepal or how those services benefit the many animals, such as the red panda, with which mountain communities coexist.

This study identifies the services provided by red panda habitats that contribute to the quality of life and wellbeing of the remote communities living in and around a protected area (PA) in western Nepal. First, we categorize the benefits derived from red panda habitats using a recent ES framework, the Common International Classification of Ecosystem Services (CICES; Haines-Young and Potschin 2018). Then we analyze the ecosystem goods and services obtained from red panda habitats that local people value the most, the services people use, and their interdependencies. In doing so, we aim to improve understanding of nature–human interactions in the region to help develop a policy that will potentially improve local livelihoods and wellbeing but also ensure sustainable management of ES derived from red panda habitats.

Materials and methods

Study area

The research was undertaken in Jumla and Mugu districts, two remote, mountainous districts of Karnali province in the northwest corner of Nepal (Figure 1). Karnali province is the largest (24,583 km²) of Nepal’s seven federal provinces but has the smallest population (1.6 million); Jumla district (2500 km², population 109,000; CBS 2012) ranges from 2100 to 6400 masl (DDC 2013), annual temperature is generally between 13 and 15°C, and it receives about 800 mm of rain annually (DDM 2017). Muga district to the north (5500 km², 55,000 people; CBS 2012) is equally mountainous (1200–6500 masl; DDC 2016) but a little cooler (c.01 to 10°C) and slightly drier (800 mm; DDM 2017).

The study was conducted in the 6 villages nearest to known red panda habitats in Rara National Park (RNP), the adjacent buffer zone of Muga district (Jumali et al 2012), and an additional area in Jumla district outside both (Bhatta, Shah, et al 2014). Most people in the area depend on agriculture for their livelihood but are often short of food because there is little arable land and agricultural productivity is low. Economic activity in the villages is largely limited to traditional occupations such as agriculture, animal husbandry, the collection of medicinal herbs and high-value NTFPs, home trade industries, and seasonal outmigration for employment. Within this traditional economy, the mountains of the study area constitute core resources for both local people and globally threatened species, such as red panda, snow leopard (Panthera uncia), musk deer (Moschus moschiferus), and Himalayan tahr (Hemitragus jemlahicus).

Data collection

Data were collected from November 2017 to January 2018 using qualitative research methods including Key Informant Interviews (KIs; Holloway and Galvin 2017), Focus Group Discussions (FGDs; Morgan and Spanish 1984), informal interactions, and participant observation (Kawulich 2005; Musame and DeWalt 2011). Participants in KIs and FGDs were selected on the basis of their intimate knowledge of and experience in the region and its environments. Informants’
knowledge was based on their social role, professional expertise, or experience in the sector of our research interest. KFBs (n = 15) were conducted with the District Forest Officer of Jamul district, the rangers of RNP, members of the RNP buffer zone management committee and community forest user groups, the customary village chief (Mukaijat) of each of the study villages, representatives from the mothers’ groups (Aama Wogroo), school teachers, senior citizens, and herders. A total of 6 FGDs, 3 inside and 3 outside the PA, were also carried out in the study area. For most FGDs, village leaders nominated people they thought would increase the likelihood of obtaining reliable information relevant to the research questions. A discussion with 8 to 10 participants was then conducted for a period of around 2 hours. Relevant information was also collected from various governmental administration bodies, line agencies, and nongovernmental organizations and international nongovernmental organizations. Informal community consultation was first established with customary village heads, elders, and other local leaders who further facilitated KFBs and FGDs.

The purpose of the research project was explained to all groups with a description of the methods to be employed and the affiliations of the researchers. Information during the individual interviews and group discussions was gathered by using a semistructured questionnaire (Longhurst 2003; Baumbusch 2010) that had been designed to elicit information about the ecosystem goods and services provided by red panda habitats that contribute to the livelihoods and wellbeing of the local people. The FGD participants then ranked the 5 main ES perceived as most important to their livelihoods and wellbeing. Relevant information was collected by taking notes and through digital recordings in the local language.

Data presentation and analysis

The information was transcribed, translated into English, imported in Qualitative Data Analysis (QDA) software, NVivo 11, and then analyzed using CICES, version 5.1 (www.cices.eu). The CICES classification allows translation among various alternative ES classification schemes (Haines-Young and Potschin 2018). Such schemes include the Millennium Ecosystem Assessment (MEA; Leemans and De Groot 2005), The Economics of Ecosystems and Biodiversity (TEEB; Suklody 2008), and the Intergovernmental science policy platform on biodiversity and ecosystem services (IPBES; Díaz et al. 2015). Under CICES’s hierarchical structure, the 3 major categories (“sections”) of provisioning, regulating, and cultural services are divided into more precise “divisions”, “groups,” and “classes” (Haines-Young and Potschin 2012; Potschin and Haines-Young 2016; Crúez et al. 2018) into which users can place the services they are assessing (Crúez et al. 2018). In contrast, the MFA, the first large-scale ecosystem assessment framework (EC 2015), had no structured classification at lower levels. To aid interpretation of the information (Miley and Reid 2011), a visual representation of the responses from the FGD participants inside and outside RNP was encapulated in word-counts using the online word-cloud generator WordArt (https://wordart.com), based on those words that occurred with highest frequency (Heinemel et al. 2014) after they had been translated.

Results

Major benefits obtained from red panda habitats

The ES provided by remote red panda habitats were categorized into 4 sections, 6 divisions, 9 groups, and 17 classes (Table 1), according to CICES version 5.1 (Haines-Young and Potschin 2018). Consumptive uses included terrestrial wild plants, animals, and surface water, for nutrition, materials, or energy, and seasonal transhumances; productive uses included direct use goods such as medicinal herbs, bamboo products, and the products of beekeeping; goods and services with nonconsumptive uses identified were recreational activities, research, aesthetic experiences, and symbolic and religious interactions with nature. Nonuse ES were also recognized in the red panda habitats, including existence, option or bequest values, and cultural abiotic services in the form of religious sites, caves, and high-altitude rangelands.

Contribution of ES from red panda habitats to local communities

The main source of income for all villagers was the collection and sale of traditional medicinal herbs and seasonal transhumances. FGD participants described how most villagers depend on red panda habitats, although the level of dependency varies. Some villages rely primarily on transhumance sheep and goat pastoralism, others on harvesting of medicinal herbs, and some on both. After herb collection and grazing on highlands in summer, villagers generally look for alternative sources of income during winter, including short-term employment in India, weaving baskets using bamboo collected from the forest, making wool rugs, etc. The men were responsible for transhumant pastoralism and for picking medicinal herbs while women undertook household (domestic) work and collected firewood, fodder, and bedding for animals.

Provisioning contributions: The FGD participants identified edible wild fruits, flowers, mushrooms, green leafy vegetables, wild birds, and freshwater fish as supplementary sources of nutrition derived from red panda habitats.

Red panda habitats also supplied medicinal and aromatic plants used directly by villagers in traditional remedies, conventional therapeutics, and income generation. Medicinal plants were used for traditional health benefits and generated relatively high financial returns. FGD participants described how leaves, shoots, flowers, fruits, seeds, bark, resin, tubers, roots, rhizomes, or whole plants were all utilized to prepare traditional medicine and for trade.

Plant resources from red panda habitats also provided forage and bedding for domestic stock. Forests supported beehives for honey production, flowers were used in religious and traditional rituals, and the fibrous inner bark of loba bushes (Daphne spp.) provided raw materials for handmade loba paper. Some species had many uses, for example, bamboo (Dendrocalamus spp.) was used for fencing, roofing, construction of cattle sheds, weaving of mats and baskets, and fodder for animals. A major forest good was firewood, the primary means of energy for cooking and heating with timber, and lumber was also used for household construction and creation of agricultural implements. Slates from these habitats were used as a roofing
material. Red panda habitats also supplied potable water through pipelines, brooks, and springs, as well as for various other domestic uses, for crop irrigation, and to operate traditional mills. Streams and rivulets were also used to generate micro- and pico-hydropower.

Cultural contributions: Red panda habitats in the study area provided biotic and abiotic cultural benefits on a local, regional, and global scale. Seasonal transhumance culture has been practiced in these habitats for as long as any of the FGD participants could remember with livestock—mainly sheep and goats—then to high-altitude meadows where NTFPs were also collected. Not only does this generate income, but it is also seen as an integral to local culture.

FGD participants also explained how deities were worshiped every year following traditional rituals at religious temples, holy sites, lakes, and caves inside the red panda habitats. These were provided active or passive interactions with nature through their aesthetic value to both local people and visitors, while endangered flora and fauna in the region provided a range of existence, option, or bequest values.

The cultural values also provide economic benefits to local communities through provision of services to tourists, including homestays, horseback riding, boating, tourist guides, etc. Scientific investigation on the status and biology of mammals, birds, fish, and forests regularly occurred inside the PA. These areas also provided a venue for local and regional educational opportunities through field excursions and research training. Study sites were also used for making films and documentaries.

ES important to the local communities

Participants’ preferences for the “5 goods and services from red panda habitats most important for your livelihood” were consistent among the 6 FGDs, but their priority varied according to the respondents’ accessibility and availability of resources and services. Respondents outside the PA gave higher priority to the seasonal grazing highland pastures and plant materials, with transhumance culture next and wild plants for energy and religious interaction with nature as the least important (Figure 2B). Respondents inside the PA, however, put greater emphasis on plant materials, with less importance to the other 4 attributes (Figure 2B).

As shown in Figure 3A, key ecosystem goods and services identified by focus group participants in all 6 villages were those that contributed directly to their livelihoods (eg wild plants for energy, seasonal grazing highland pastures, and plant materials) and cultural values (eg transhumance culture, religious interaction with nature, and recreation activities and ecotourism). Participants outside the PA prioritized seasonal grazing highland pastures, while plant materials were more important to respondents inside the PA (Figure 3A, B). The FGD in one community inside the PA identified recreational activities and ecotourism in the top 5 ES from red panda habitats (Figure 3B).

Discussion

The novelty of this study lies in its identification and categorization of the major goods and services that people living in the locality obtain from the remote mountain habitats of the red panda. The study demonstrates the important contribution of these services to sustaining the livelihoods of the communities residing inside and outside the mountain PA. Most research in Nepal relevant to red pandas has so far focused on the status, distribution, habitat preferences, diet, diseases, conservation needs, and the ecology of the species (Yonzon 1985; Bhatta, Shah, et al 2014; Sharma et al 2014; Lama et al 2015; Pandit et al 2015, 2017; Acharya et al 2018; Thapa et al 2018; Bista et al 2019). To date, research has focused on how these habitats are contributing to the daily needs of the human communities with whom the pandas coexist, both inside and outside the PAs. ES-related studies in Nepal, which could have covered this gap, have largely neglected the montaneous parts of the country (Lamsal et al 2018). Our work has showcased the people’s understanding of services that they obtain from these mountain areas. Determining the dependency of villagers on the diverse resources from these habitats can inform development of relevant policies and plans and can help to conserve red pandas while simultaneously improving the sustainability of resource management by local people.

Identifying contributions of ecosystem goods and services from red panda habitats

In this study, we identified 51 types of ES from 17 different classes that were recognized by people as provided by the panda’s mountain habitats (Table 1), including 23 provisioning and 28 cultural goods and services. By way of comparison using a categorization broadly similar to our own, 42 ES were identified in the Churia region in central Nepal (Acharya et al 2019), 37 in the Panchase mountain ecological region of western Nepal (Adhikari et al 2018), 10 from the Churia region of western Nepal (Bhatta, et al 2016), 24 in the Jagadishpur reservoir catchment area of western Nepal (Baral et al 2016), 15 from the Kohi Tappu wildlife reserve of eastern Nepal (Sharma et al 2014), and 19 from the community-managed forests in central Nepal (Panday et al 2015). The higher diversity of services provided by red panda habitats may be because the communities who provided the information have a greater reliance on the diverse mountain resources and stronger cultural connections with nature than other sites, as there are few alternatives to support their livelihoods. Respondents also claimed more cultural benefits than provisioning services from red panda habitats, possibly because people living in and around red panda habitats consider these places to be holy sites bearing spiritual power, a belief common to many of the religions practiced in the area (Bernbaum 2006; 396). The ancient practice of seasonal transhumant pastoralism also draws on a wide range of services that are then transformed into economic goods—in Nepal’s western mountains a herder can make about US $200 a year from this custom (Gentle and Thwaites 2016).

Communities near Rara Lake inside the National Park also engaged in tourism activities such as homestays, horseback riding, and boating and were aware that the red panda habitats inside the park are providing platforms for scientific research, guided tours, films, and documentaries. Overall, the panda habitats inside the PA tended to provide more cultural services, while those outside offered more provisioning services. This may be because park regulations limit access to the resources, so people have started seeking...
<table>
<thead>
<tr>
<th>Section</th>
<th>Group</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>Biomass</td>
<td>Terrestrial wild plants for nutrition, materials, or energy</td>
</tr>
<tr>
<td>(biotic)</td>
<td></td>
<td>Fibers and other materials from wild plants for direct use or processing (excluding genetic materials)</td>
</tr>
<tr>
<td></td>
<td>Wild animals (terrestrial and aquatic) for nutrition, materials, or energy</td>
<td>Terrestrial wild plants used as a source of energy</td>
</tr>
<tr>
<td></td>
<td>Other types of provisioning service from biotic sources</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>Surface water used for nutrition, materials, or energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surface water for drinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Freshwater surface water used as an energy source</td>
</tr>
<tr>
<td>Cultural</td>
<td>Direct, in situ, and outdoor interactions with living systems that do not require presence in the environmental setting</td>
<td>Characteristics of living systems that enable activities promoting health, recreation, or enjoyment through active/passive or immersant/observational interactions</td>
</tr>
<tr>
<td>(abiotic)</td>
<td>Physical and experiential interactions with natural environment</td>
<td>Characteristics of living systems that enable scientific investigation, education, and training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Characteristics of living systems that are resonant in terms of culture or heritage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Characteristics of living systems that enable aesthetic experiences</td>
</tr>
<tr>
<td></td>
<td>Intellectual and representative interactions with natural environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting</td>
<td>Spiritual, symbolic, and other interactions with natural environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elements of living systems that have symbolic meaning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elements of living systems that have sacred or religious meaning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elements of living systems used for entertainment or representation</td>
</tr>
<tr>
<td></td>
<td>Other biotic characteristics that have a nonzero value</td>
<td></td>
</tr>
<tr>
<td>Cultural</td>
<td>Direct, in situ, and outdoor interactions with natural physical systems that depend on presence in the environmental setting</td>
<td>Physical, experiential, intellectual, and representative interactions with abiotic components of the natural environment</td>
</tr>
<tr>
<td>(abiotic)</td>
<td></td>
<td>Natural, abiotic characteristics of nature that enable active or passive physical, experiential, and intellectual interactions</td>
</tr>
</tbody>
</table>

Notes: Mode of use of goods and services: Use services: direct (C: consumptive, P: productive use); indirect (N: nonconsumptive use); nature services: N1: Service locations: C: outside the protected areas (Arba District), I: inside the protected areas (Mago District).
<table>
<thead>
<tr>
<th>Services годs and services from red panda habitats</th>
<th>Use of services</th>
<th>Services locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edible wild fruits and flowers, bamboo shoots, mushrooms, green leafy vegetables</td>
<td>C</td>
<td>0 and I</td>
</tr>
<tr>
<td>Medicinal plants/herbs, weed and wood products, roofing slate, bamboo species and products, handmade paper, fishglo, fodder and bedding for animals, flowers for religious offerings</td>
<td>C and P</td>
<td>0 and I</td>
</tr>
<tr>
<td>Firewood, pine sticks</td>
<td>C</td>
<td>0 and I</td>
</tr>
<tr>
<td>Beeskeeping, hillland pastures</td>
<td>C and P</td>
<td>0 and I</td>
</tr>
<tr>
<td>Potable water through pipelines, springs, brooks, springs</td>
<td>C</td>
<td>0 and I</td>
</tr>
<tr>
<td>Water for domestic uses, agricultural uses, traditional mills</td>
<td>C</td>
<td>0 and I</td>
</tr>
<tr>
<td>Microhydro, microhydro</td>
<td>C</td>
<td>0 and I</td>
</tr>
<tr>
<td>Traditional walking routes, roads, tourist activities, hiking, horseback riding, boating, and other recreational activities in and around Rara Lake inside the red panda habitats</td>
<td>NC</td>
<td>0 and I</td>
</tr>
<tr>
<td>Research/studies on biological diversity or forest resources, bird watching, mammal inventory, faunly research, educational tours</td>
<td>NC</td>
<td>0 and I</td>
</tr>
<tr>
<td>Seasonal transhumance culture</td>
<td>C and P</td>
<td>0 and I</td>
</tr>
<tr>
<td>High-altitude rangelands, picturesque landscapes, Rara Lake (&quot;the queen of lakes&quot;)</td>
<td>NC</td>
<td>0 and I</td>
</tr>
<tr>
<td>Himalayan monal (&quot;national bird of Nepal&quot;); Rododendron (&quot;the national flower of Nepal&quot;); endemic fish species</td>
<td>NC</td>
<td>0 and I</td>
</tr>
<tr>
<td>Presence of temples, holy sites, lakes, caves inside the red panda habitats</td>
<td>NC</td>
<td>0 and I</td>
</tr>
<tr>
<td>Documentaries and films</td>
<td>NC</td>
<td>I</td>
</tr>
<tr>
<td>Threatened flora and fauna, biological diversity inside the RNP</td>
<td>NU</td>
<td>0 and I</td>
</tr>
<tr>
<td>Presence of caves, lakes, religious sites, temples, scenic views, mountains</td>
<td>NU</td>
<td>0 and I</td>
</tr>
</tbody>
</table>

For some people, cultural services, specifically ecotourism in the effectively managed region, are progressively being accepted as a substitute for traditional livelihoods (Fleming and Fleming 2009).

Our study presents the understanding of the use and non-use ESs obtained from mountain red panda habitats that are crucial for the welfare of local communities. Respondents stated that, in keeping with many rural communities in developing nations (Vira and Kontoleon 2012), there is significant reliance on forest ESs, with productive uses including medicinal herbs, bamboo products, transhumance practices, and ecotourism still being the major sources of income for them. Indeed, forest ecosystems are critical to the national Nepalese economy, providing food, fiber, freshwater, and medicine to 86% of the Nepalese population and contributing almost 96% of all energy usage (DNPWC and BCN 2012).

**High-value ESs**

The top 5 ESs for livelihoods and cultural significance are similar to those identified from the community-managed forests in central Nepal (Panday et al. 2015), but they are influenced by local context (Dau et al. 2011; Chaudhary et al. 2013). Thus, as noted by He et al. (2016) in southeast China, proximity to a PA limited access to the forest resources but provided opportunities to draw on other services such as ecotourism and associated recreational activities. Likewise, in the Chure region of Nepal (Acharya et al. 2019), proximity to the forest, socioeconomic status, and forest management systems influence ES priorities. Although local communities in our study area needed to travel a whole day to reach the important high-altitude rangelands, these areas were still valued highly; such preferences may be because of a greater reliance on these services for livelihoods than others. This may also be because of the priority given to religious sites—such as temples and holy sites inside the red panda habitats—as also noted in China (He et al. 2018). Firewood from these forests was also vital as a source of energy regardless of the distance, in keeping with many rural communities (Muhamed et al. 2014; Shukumard et al. 2019). About 64% of houses in Nepal use firewood as the primary means of energy for cooking (CBS 2012), and globally, around 2.4 billion population use firewood for cooking, heating, and boiling water (FAO 2018).

**Gaps in the identification and classification of ESs**

We broadly categorized the ES described in the FGDs and KIBs according to the CICES. However, some services listed could not readily be described, while some services known to be produced by the panda habitats were not mentioned. The two gaps are related. The CICES classification categorizes religious services, cultural services, and spiritual services as potential ES but does not spell out what might be included, or excluded, from these categories. As in the study of the Panchase mountain ecological region of western Nepal (Adhikari et al. 2018), we found it difficult to find concordance between the CICES classification and what was described in the FGDs and KIBs as included within these categories. On the other hand, FGDs and KIBs universally omitted mention of regulating and maintenance services as use values.
We think this was at least partly because of the ontological framing of the concepts. It became evident in the FGDs and KILs that many aspects of nature are not considered separately from the gods and goddesses who are embodied in the mountains. These deities regulate and maintain the services western science has categorized as climate control, carbon storage, natural hazard reduction, and maintenance of air, water, and soil quality. If the environment is thought of as sentient, which seemed to be the case from the way in which people spoke of the mountains, then people have little control of the services provided, even if, to outsiders, the ongoing provision of many of these services is critical to wellbeing and livelihoods beyond the mountains. This means that many regulating and maintenance services can be categorized most readily as cultural and spiritual services rather than use services. This finding is consistent with other research exploring the application of the ES framework to spiritual services provided by the natural environment (Cooper et al. 2016), particularly where there are interrelationships between people and nature (Pasqua et al. 2017). It highlights a need to explore more deeply ways in which these different...
worldviews can be accommodated into the largely utilitarian FS framework (Sangha et al. 2010).}

**Management Implications**

Identification and classification of FS benefits accruing to local communities from red panda habitats provide an evidence base and the first step toward supporting more sustainable resource management. There are 5 steps that logically follow this exercise (constituting the first step). The second step will be to quantify the goods and services that we have identified as required to support local livelihoods, including ways of incorporating cultural and spiritual values (Sangha et al. 2019). The third is to estimate their value to different sectors of the community, including to communities beyond the region that draw on the regulating and maintenance services provided by the panda habitats. The fourth is to assess the status and trends in the availability of the ES, identifying factors that might lead to negative trends. The fifth step is to explore the policies, regulations, and governance regimes that will be most effective in sustaining provision of the ES from red panda habitats at healthy levels.

Understanding the level and trends in resource use and the distribution of benefits among the stakeholders would help reveal the extent to which these habitats address poverty and equity issues in the region. Research on trends in the availability of resources is required to explore not just current uses but also how future service provision is likely to be affected by a range of drivers such as climate change and changes in socioeconomic trends. Assessments of ES can help to accumulate a knowledge base on the benefits from FS, which, in turn, can promote sustainable biodiversity conservation and help raise community awareness, build local capacity, engage communities and line agencies in decision-making processes, and ensure alignment of management with national conservation policies (Thapa et al 2016).

Trade-offs between current and prospective uses of the same ES (Carpenter, Bennett, et al 2006; Rodríguez et al 2006), as may happen in our study area from overharvesting of medicinal herbs or the excessive extraction of Himalayan bamboo species (the sole food for red panda), need not always have negative consequences (Bennett et al 2006; Turkellboom et al 2010). This is apparent in KNP, and elsewhere in the red panda’s range (Bista 2018), where reduction in delivery of one ES (transhumant pastoralism) is
resulting in an increase in another (ecotourism), as has happened in other areas where there have been synergies between improving wildlife habitats and enhancing prospects of recreation and ecotourism (Lindsey et al. 2007; Baral et al. 2017).

A thorough assessment of the values and trends of ES in red panda habitats can also potentially form the basis for development of a payments for ecosystem services (PES) scheme (Bhatta, van Oort, et al. 2014; Baral et al. 2017). However, carefully planned and locally defined incentive-based mechanism for maintaining ES (Jacks et al. 2008; Patterson et al. 2017) can often be more effective than a market-based PES mechanism (Syder and Bedir 2006). This, however, requires an effective governance system, particularly of the ES that are being overexploited. The national policy environment for such governance is already in place. As a part to the Convention on Biological Diversity, Nepal has formulated a National Biodiversity Strategy and Action Plan (NBSAP 2014–2020) as a policy instrument focusing on effective conservation of biological diversity, sustainable utilization of natural resources, and mainstreaming biodiversity into policies and plans (MoFSC 2014b). Realizing the gaps and major constraints in sustainable mountain ecosystem management and the urgency of incorporating the values of mountain ES into governmental planning and decisions, the NBSAP has addressed mountain biodiversity as a separate thematic area for the purpose of strategic planning. The declaration of PAs can also help safeguard the future delivery of ES (Thapa et al. 2016). Nepal has already satisfied Aichi Target 11, which required a conservation of at least 17% of terrestrial areas, by gazetting 23% of the country as PAs (MoFSC 2014a), including 84% of mountain areas (MoFSC 2014b). However, deep-rooted poverty-induced human pressure and human-induced climate change means protected mountain sites are not yet improving the status of Nepal’s biological diversity (Bhattarai and Kindlimann 2013). Also, many areas with high biodiversity value, including 79% of red panda habitats, fall outside the PAs (MoFSC 2014b). This suggests that a community-based, landscape-level approach (Lindemayer et al. 2008; Sayer 2009; Arts 2017) to ES governance is needed to build a positive nexus between preservation of mountain habitats, species conservation, and sustainable livelihoods of deprived communities.

While community-based management approaches to strengthen ecosystems and conserve landscapes are gaining popularity in Nepal (Bhatta, van Oort, et al. 2014), and a conservation intervention by the Red Panda Network in red panda habitats of eastern Nepal underpins community-based red panda conservation (MoFSC 2014a), if these initiatives are to succeed there is a need to focus on sustainability both of ES from these habitats and of the ways in which use of the ES supports societal livelihoods and wellbeing. Similarly, policy instruments targeted at red panda conservation should include detailed habitat-level studies focusing on identification, quantification, valuation, and the interrelationship between ES obtained, human disturbance, and alternatives to reducing the human pressure. The information obtained could drive more equitable and sustainable policies. Thus, conservation of this charismatic priority species could simultaneously safeguard the wellbeing and sustainability of associated biodiversity, ecosystems, and local communities.

Conclusions

This study describes provisioning and cultural ecosystem goods and services perceived by local people as supporting rural livelihoods in the habitats of the red panda in the mountainous western Nepal, including their significance for local subsistence. Identification of ecosystem goods and services from these mountain landscapes provides an evidence base that may inform policy reform for the sustainable conservation of biodiversity and equitable management of ES in the region. Understanding the nature and scale of such services can help to emphasize the need for effective ES governance. Overall, knowledge of ES flowing from the mountain habitats of the panda can help to regulate their use and management for the current and future delivery of needed and desired goods and services.

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References

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