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Mr. Ashok Nepal

A panoramic view of the core Mahalangur mountains taken from Pumori High Camp during my Everest Expedition in Spring, 2023. In the picture: Everest-Lhotse Base Camp to the bottom left residing over the Khumbu Glacier, Chhyangtse behind the Lho La (pass), West shoulder and behind it is Everest in the center, while the west face of Nuptse dominates the view to the right.

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Journal of Nepal Mountain Academy is purely an official publication. As part of NMA's regular academic exercises, it has planned to publish an academic journal annually focusing on mountain science, the adventures and mountaineering. It has aimed at promoting researches in moutain science, socio-culture and tourism activities among the researchers, college and university professors, graduate and undergraduate students, personnel in administrative positions involved in research ventures, and academicians/ professionals immersed in the tourism sectors. As obvious from the title of the journal, mainly research articles from the field of tourism, adventure, mountain science, and mountaineering are preferred for publication.

The articles published in this journal in all its issues are from mountain science, environment, culture and general tourism area. The articles were assigned for peer review to the professors and practitioners in their respective fields, amendments were recommended followed by editing corrections ensured before they were processed for publication.

However, the editorial team does not bear any responsibility for any incongruences in contents and patterns presented in the articles as they are purely the products of their authors, and hence, the authors are subject to ethical interrogations in the circumstances that are marked to violate ethical parameters applicable in the field of academics and research.

The articles have been arranged in alphabetical order of the authors' name. Researchers and readers are welcome for their any kind of scholarly inquiries and suggestions.

Thank You.

Prof. Dr. Sunil Adhikary
Chief Editor

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Contents

Livelihood Options and Agrobiodiversity in Mountain Settlements of Manang District

Achyut Tiwari[1*], Kushal Ranabhat[2], Diken Maharjan[2], & Chitra Bahadur Baniya[1]
[1]*Central Department of Botany, TU*
[2]*Nepal Mountain Academy*
[*]*Corresponding email: achyut.tiwari@cdb.tu.edu.np*
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Abstract

Mountain ecosystems are experiencing rapid changes in natural environmental conditions and human activities including tourism and development activities. And such factors have substantial impacts on the livelihood of mountain people. Increasing road networks towards the rural settlements have increased the availability of goods and services from the nearby markets, thereby contributing to shifting away from traditional agricultural practices in the rural mountain settlements in Nepal. In this study, we sought to analyze the impact of tourism on agrobiodiversity and livelihood strategies in different villages of Manang with different level of tourist flow; low at Naar, moderate at Ngawal/Khangsar and high at Manang Nysyang. We used semi-quantitative field inventory data to compare diversity on agricultural plant species and livelihood options in these valleys. The study involved 72 households including 16 in Naar village, 26 in Ngawal/Khangsar and 30 in Upper Manang (Nysyang). We have confirmed a total of 60 species of agrobiodiversity in these mountain settlements (excluding microorganisms), with the minimum diversity at Naar Village with 28 species, and with maximum diversity in Upper Manang (51 species). The total number of species under agrobiodiversity is very poor in the mountain settlements of Manang which forms less than 1% of total agricultural species (60/6618) in Nepal. The poor agrobiodiversity in Manang is highly threatened due to various natural and anthropogenic drivers. We believe that our findings will be highly instrumental while making plans and policies for conservation of regional agrobiodiversity in context of changing climate and intensified human activities.

Keywords: agrobiodiversity, livelihood, Manang, mountain, tourism

Introduction

Mountains cover about 22% (32 million km^2) of the global land surface and accommodate about 1,010 million people (67% rural), and most of them (63%) are in developing countries (FAO, 2015). It is estimated that 40% of mountain people are vulnerable to food insecurity (FAO, 2019). Globally, only three crops, namely, wheat, rice, and maize, account for more than half of the dietary energy supply for humans, and the production diversity is declining rapidly (Adhikari et al., 2017; Mannar et al., 2020). In Nepal, the decline in agrobiodiversity is high, with the gradual disappearance of traditional nutritious food crops such as buckwheat, barley, millets, sorghum, oat, and beans from our food systems (Adhikari et al., 2017).

More than 60 percent people in Nepal rely on agriculture directly for their livelihood (GON, 2023). Agricultural activities in harsh climatic zones are highly critical in mountain landscapes such as Manang, where 6-10 persons per hectare land ratio in 1981 that has been increased to more than 10 persons per hectare by 2001 (Subedi, 2003). However, studies in recent years found decreasing pressure on agricultural land due to switching off from agricultural activities

to trade, tourism, and other livelihood options. This resulted in widespread migration and agricultural land abandonment in the valley, thereby the loss in local verities of agricultural crops. Agrobiodiversity holds significant importance within the broader spectrum of biodiversity, particularly in Nepal, where it is categorized into six primary components (cereals, legumes, vegetables, fruits, livestock, and fodder) and four subcomponents (value insects, aquatic animals, pest and disease) as representative species in each category (Joshi et al., 2020).

A total of 1,506 species of agricultural crop and forage genetic resources have been documented in Nepal (Joshi et al., 2020). This includes 93 introduced species, 670 wild edible plants, 224 crop wild relatives, 35 semi-domesticated species, and 484 cultivated native species. Among the cultivated native species, 64 are agronomic, 145 are horticultural, and 275 are forage species. Cultivated ornamental plant species consist of 100 exotic and 200 native varieties. In the realm of medicinal plants, out of 700 species, 120 native species are under cultivation, and 60 are exotic (Joshi et al., 2020). The existing crop genotypes exhibit a wide range, including landraces, modern, released, registered, de-notified, hybrid, inbred, open-pollinated variety (OPV), exotic, native, bulk, mixture, partial hybrid, breeding line, mutant, organ transplant organism (OTO), multiline, near-isogenic line (NIL), double haploid (DH), synthetic, clonal, and genetically modified organisms (GMO) (Joshi et al., 2020).

Manang in the Annapurna region of central Nepal has attracted trekkers from many countries since the late 1980s (Subedi & Chapagain, 2013). Upper Manang was not accessible to foreigners until early decades of the 20th (Kawakita, 2011), it was only notable to tourists after 1970. Tourism flourished in Annapurna Circuit and especially after the initiation of the Annapurna Conservation Area Project (ACAP) in 1986. However, in recent years the soaring number of visitors in Annapurna region has already created environmental problems including loss of biodiversity along with diversification in livelihood options. The agricultural production in the areas of extreme environment hardly supports local farmers to manage their livelihood. Hence, they are bound to seek alternative livelihood options for their survival (Van Spengen, 2000), with one of the highest rates of household out-migration in Nepal (Subedi, 2007). Different settlements of Manang were visited by tourists, and we could broadly categorize three types of settlements; most frequently visited by tourists and have a medium and low tourist flow. These differences impacted the livelihood options and agricultural practice in the region differently, and there are very few studies on the impact of tourism associated with infrastructure development in existing agricultural practices including agrobiodiversity.

Agrobiodiversity is very important as their insurance against pests, diseases, and climatic changes and as a coping mechanism in extreme conditions (Bahadur et al., 2016). They form an integral part of our food systems and maintain crop diversity, crop habitat diversity, and the assemblage of varieties of crops and livestock breeds (Negi et al., 2012). It is therefore highly important to improve diversity in agriculture with the revival of traditional food crops to improve both agricultural and environmental sustainability. The national data from Nepal showed that only a slight decline in the share of traditional crops, but there has been significant decline of agrobiodiversity in the country's high-altitude mountain districts (e.g., Humla and Jumla) (Gautam et al., 2019), and such decline has also been reported from Manang District, central Nepal. However, the causes and consequences about loss of agricultural crop diversity due to anthropogenic activities such as tourism and livelihood changes are not well explored in mountain settlements of Nepal such as Manang District. In this study, we compared the

diversity of agricultural plant species and livelihood options in Manang which is exposed to similar climatic conditions but different tourism and development activities. Specifically, we asked, (a) is there any difference in agrobiodiversity species richness among different settlements of Manang? (b) does agrobiodiversity richness in different settlements vary with different intensity of tourist flow?

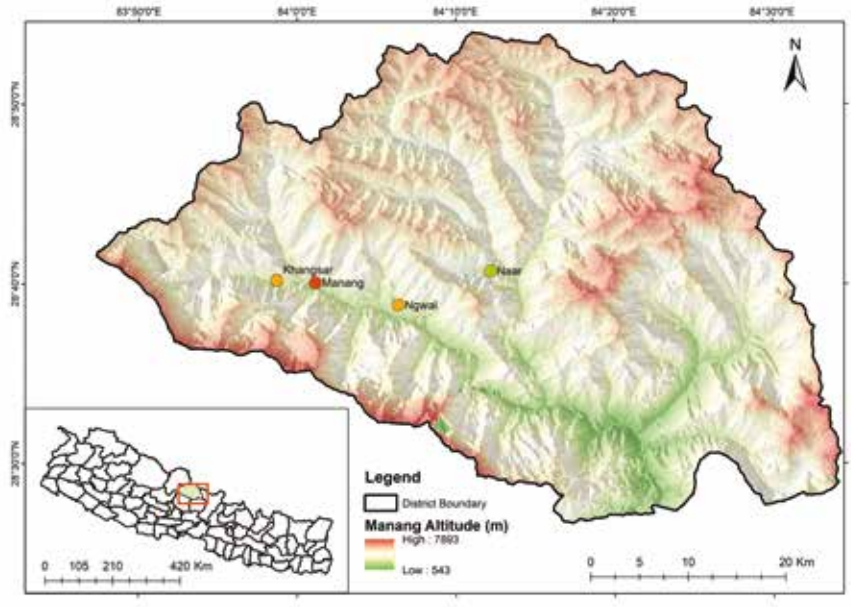
Materials and methods

Study area

The study was carried out in Manang District in central Nepal which is located behind the Annapurna Mountain range in the Nepal Himalayas (28° 27' to 28° 54' N latitudes to 83° 49' to 84° 34' E longitudes) (Figure 1). Manang District comprises three different regions such as the Upper Manang valley (Nyeshang Valley) in the west, the Lower Manang (Gasamdo) in the east and Naar-Pho Village in the north. The Upper Manang valley (Nyeshang) is extended from the lowermost settlement at Pisang (3100 m asl), to the uppermost settlement at Khangsar (3750 m asl). The Upper Manang valley is mainly formed with moraine deposited by Marsyangdi River and many glaciers from north and south. Manang Valley is a relatively cold and arid region with extreme cold winters (up to -5°C) and mild cool summers (up to 22°C) (DHM, 2017).

Figure 1

Map of Manang district showing study sites



Methods

Social survey on tourism and livelihood options

Household surveys were conducted in each village with the help of a semi-structured questionnaire for accessing local people's livelihood options. A field visit was carried out in

June 2023 at Manang. Altogether 72 respondents were interviewed regarding their livelihood options and agrobiodiversity practice in the villages. Among them 16 respondents were interviewed in Naar Village (low tourist flow), 26 respondents were interviewed from Nagwal and Khangsar villages (with moderate tourist flow) and 30 respondents were interviewed from Humde and Upper Manang (with the higher tourist flow). The households were selected by snowball method as per the respondents' hint, the households surveyed are 16 and 56 in Naar (13% of total households) and Manang Ngisyang (10 % of total household) rural municipality respectively. Rapid biodiversity survey was carried out with the help of semi-structured questionnaire for enumeration of plant species harvested for agricultural purposes in each village. The plant species were collected with the help of respondents. Plant enumeration data was tabulated into local names, scientific name, family, life form, plant habitat and their use potential and production volume (semi-quantitative) in the excel sheet.

An enumeration list of agricultural plants with their local names was produced. Plants were identified with the help of local people and comparing published literature and photographs (Shrestha, 1998; Joshi & Joshi, 2006; DPR, 2016). We followed Nomenclature by using the catalogue of life (https://www.catalogueoflife.org/col/search/). The unidentified plant specimens were collected, dried, and pressed for the herbarium preparation (Lawrence, 1951), they were given the Accession codes (CHG) and processed for identification. Further key informant interviews were also conducted with the hotel owners and villagers separately, who depend on agriculture for their livelihood.

Data analysis

Field inventory data were collected, compiled, categorized using computer software EXCEL and R 4.0.3.). (R Development Core Team 2020). Descriptive analysis (bar graph, and tables) was performed, in MS Excel 2021. Redundancy Analysis (RDA) was performed as a direct extension of multiple regression, as it models the effect of an explanatory matrix X (n x p) on a response matrix Y (n x m). Pearsons's correlation coefficients were computed between total agrobiodiversity richness and the livelihood options, and their relationship was analyzed by simple regression equations. The field interview questionnaire survey was conducted with the prior consent of the local people. Herbarium specimens and seeds were collected only for the identification purposes.

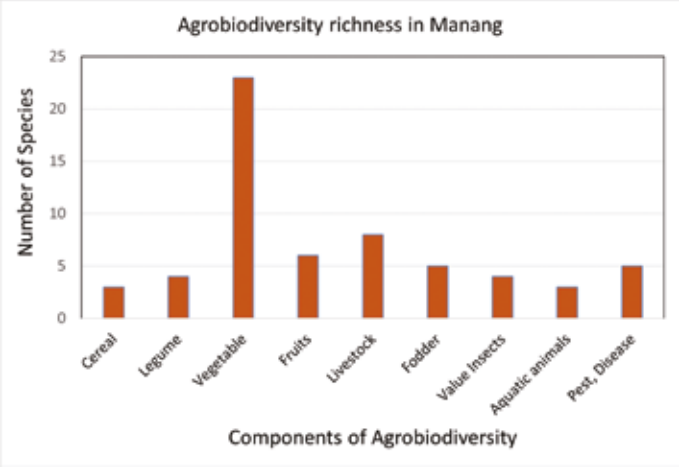
Results and discussion

Species in agrobiodiversity

We have confirmed a total of 63 species of agrobiodiversity in these mountain settlements (excluding microorganisms) (Figure 2). The minimum diversity was found in Naar Village (4200 m asl) with 28 species, and the maximum diversity was recorded in Upper Manang (51 species). The redundancy analysis showed that the species composition is oppositely seen in between Naar (low tourist flow) and Humde and Tankimanang (high tourist flow) (Figure 3). Among different components of agrobiodiversity, vegetable crops were the richest whereas the minimum diversity was found for main crops and aquatic animals (Figure 2). The total number of species under agrobiodiversity is very poor in the mountain settlements of Manang which forms less than 1% of total agricultural species (60/6618). The already poor agrobiodiversity in Manang is highly threatened due to various direct and indirect drivers of agrobiodiversity.

Figure 2

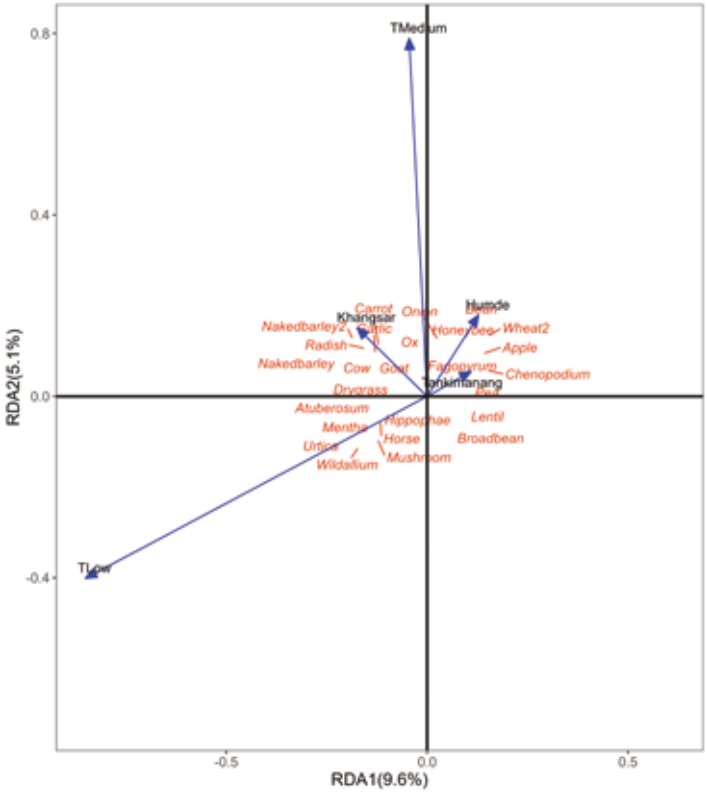
Agrobiodiversity in Manang District



Note: Cases of Naar, Ngawal, Khangsar and Upper Manang.

Figure 3

RDA plot shows the agrobiodiversity species in different settlements and the tourist flow (low and medium) of Manang district

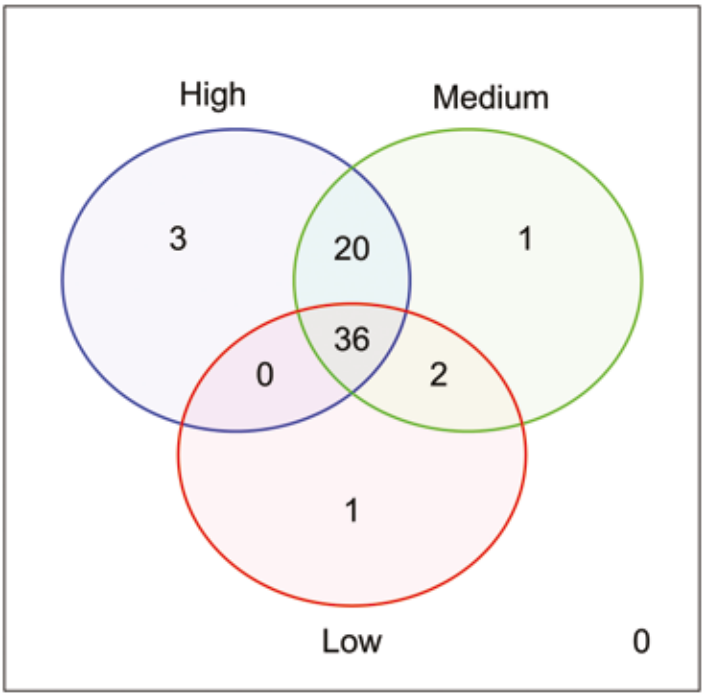


Analysis on agrobiodiversity richness

The total number of species (63) of agrobiodiversity components across the different settlements of Manang is relatively small, which is of course due to the harsh climate of the region and is also due to the exclusion of microorganisms. While observing the total species richness pattern, the species richness is common at different settlements categorized by the low, medium and high flow of tourists in the villages (Figure 4). The results showed that there are equal number of species at the locations with high and medium level of tourist flow, indicating that agrobiodiversity richness is high in the areas having high flow to tourist than the settlement having very low flow of tourists.

Figure 4

Vein diagram shows number of agrobiodiversity species



Note: Categorized by tourist flow (Low: Naar, Medium: Khangsar, Nagwal, High: Manang, Humde, Tankimanang).

The biodiversity in Nepal is extensive, encompassing a reported total of 24,300 biological species. Of these, 28% (6,618 species) are agricultural, excluding 27 exotic ornamental fish species. Agricultural fauna exhibits greater species richness (3,785 species) compared to agricultural flora (2,833 species) (Joshi et al., 2020). The insect component leads with the highest number of agricultural species (3,500), followed by the crop component (1,026 species) and the microorganism component (800 species) (Joshi et al., 2020). The livestock component has the lowest species richness among the six components of agrobiodiversity.

Manang was opened for tourists after 1977 (Watkins, 1996; Koirala, 1981) and has become one of the popular tourist destinations since the area became a part of Annapurna Conservation Area (ACA) in 1984 (Ives, 2006). Hence, the local people shifted from typical agriculture

and livestock towards tourism businesses such as hotels and trekking and trade. It was in 1980, only 14000 tourists trekked the route which cover Annapurna, Manang and Jomsom, and this number increased up to 110,000 by 2013, showing the highly intense tourist flow in the region (Subedi & Chapagain, 2013). Due to the harsh climate of the region tourism activity is quite seasonal in Manang, one is spring season (March-May) and the other is autumn (October-November). Interestingly, both tourist seasons overlap with the period of major agricultural activities such as ploughing, sowing/planting during spring and the harvesting in the autumn. Hence the local people in Manang have opportunity both tourism, trade and agriculture (Rogers, 2004). Tourism and tourist related business are more common in upper Manang (Manang valley) in comparison to the Naar-Phu village at which hardly receives visitors less than 500 a year (KMTNC, 2005). This strikingly different number of tourists visiting upper Manang and Naar-Phu village has shaped livelihood options in these two distinct settlements.

We followed the government (Government of Nepal) formulated protocol that includes the major six components (cereals, legumes, vegetables, fruits, livestock and fodder) and Four subcomponents (value insects, aquatic animals, pest and disease) of Agrobiodiversity in this study (Joshi et al., 2019, 2020) (Table 1). Notably, the count of wild edible species is higher in all components except forage and livestock components. However, it is noteworthy that in other agrobiodiversity components, there is low intra-specific diversity (different genotypes). Forage species and rangeland are distributed across elevations ranging from 60 m asl to 5000 m asl, with a total of 510 forage species, including 50 exotic varieties (Abington, 1992).

Tourism and livelihood options of local people

We have identified seven different livelihood options as mentioned by the local people. These options included agriculture and livestock, Business including tourism service, agricultural labor, non-agricultural labor, job, medicinal plant collection and remittance. It was observed that the peak season of agriculture and tourism overlap in Manang, that creates labor shortage in Manang (Figure 5). The local people have also mentioned that agriculture labor shortage is one of the important drivers for the loss of agrobiodiversity. The species richness indicated that agrobiodiversity is rich in areas with high and medium level of tourist flow, whereas the relatively poor richness was observed at the site with low flow of tourists. While checking the preference of agricultural species, local people mentioned that they have started growing plant crop species having higher demand from the visitors. Hence the people from areas with a higher flow of tourists are continuing the harvesting of traditional crops as well as the plant products with higher demand by visitors, making their localities rich in agrobiodiversity.

The livelihood options showed variation according to the places; agriculture and livestock is the major subsistence for local people in Naar Village as well as in Ngawal/Khangsar Village whereas tourism businesses were the major source of income in upper Manang (Nysyang) (Figure 6). Medicinal herb collection is more prominent source of income in Naar and Ngawal/Khangsar villages in comparison to upper Manang (Nysyang). However, there is increasing trend in tourist flow in Naar as well as Ngawal/Khangsar villages. There is rapid development of tourism infrastructure at Khangsar Village as it is the gateway of highly famous Tilicho lake trekking, which will create more livelihood options soon. If local people can maintain the traditional agricultural practices, and start growing new plant species as per the demand of visitors, the area can still maintain the richness of agrobiodiversity.

Figure 5

Annual calendar of activity of local people in Manang

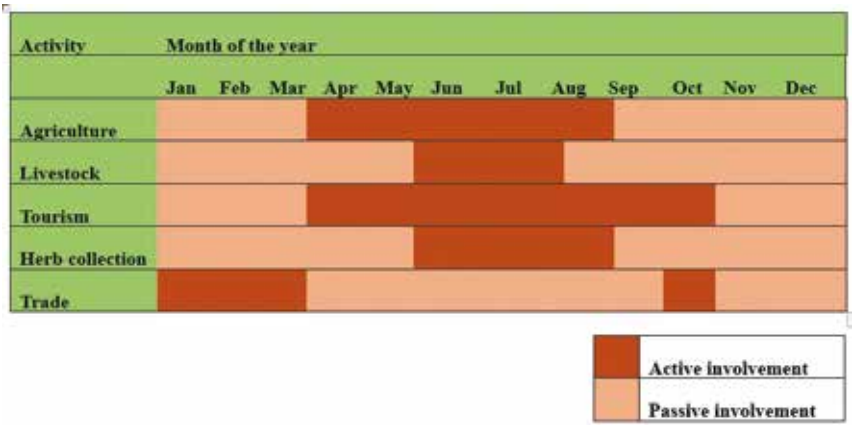
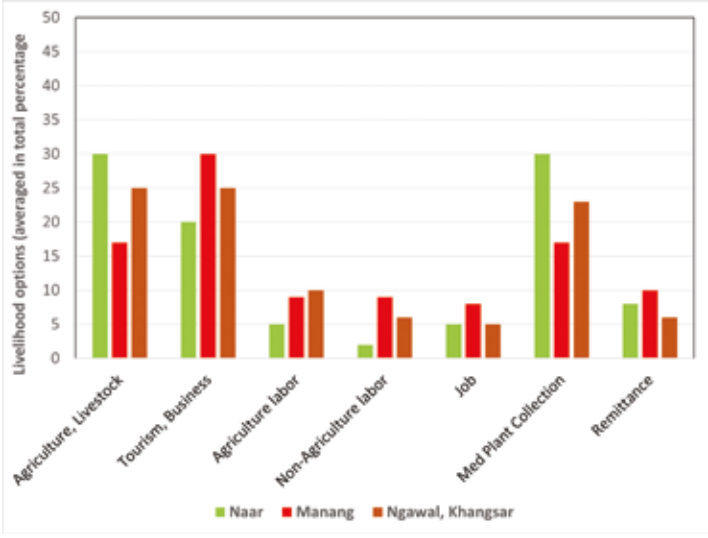


Figure 6

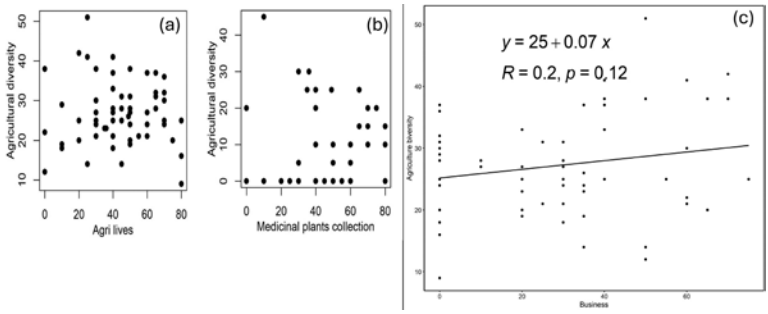
Livelihood options in study locations in Manang



It was found that there was no relationship of agrobiodiversity richness with agriculture and livestock, and medicinal plant collection as livelihood options. However, positive but insignificant relationship was observed between agrobiodiversity richness with tourism business (Figure 7). This is an important relationship to show the positive impact of tourism on agrobiodiversity contrary to our proposed hypothesis. However, commercialization of agriculture promotes monoculture, and the increased use of modern hybrids are the major contributors of genetic erosion on local agrobiodiversity (Shrestha & Shrestha, 1999; Chaudhary et al., 2016; Joshi et al., 2020). Hence, it is likely to happen that Manang will lose indigenous crop varieties if we continuously introduce modern hybrids. It is therefore highly critical to preserve local agrobiodiversity which is not only stress tolerant but also nutrient rich.

Figure 7

Relationship of agrobiodiversity richness with agriculture and livestock, and medicinal plant collection and tourism business as livelihood options

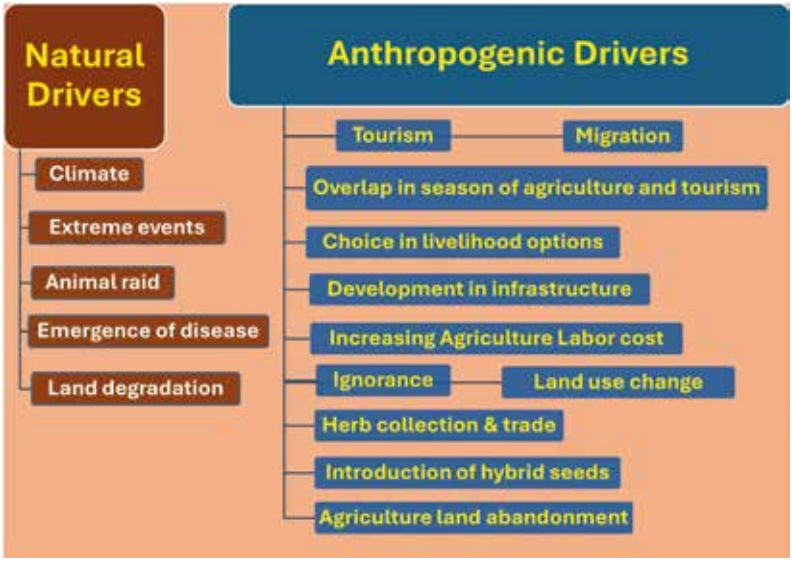


Drivers of agrobiodiversity richness

We have identified the five natural and 11 anthropogenic drivers of changes in agrobiodiversity in study regions, and the factors were as per local people's responses (Figure 8). Among them the anthropogenic drivers appear to be more influential than the natural causes. This indicated that agrobiodiversity in future is highly dependent on human activities although the environmental changes are very rapid and intense in the region. The utilization of agrobiodiversity at higher elevations greatly relies on water resources, the hydroclimatic balance is disrupted both by warming temperatures and by higher uncertainty in precipitation patterns (Thomas et al., 2007; IPCC, 2022) associated with excessive rainfall, snowfall, and drought as well as changing patterns of monsoon. Nepal has already witnessed sharp decline in winter crop harvest in 2009 across all regions. The decline of agrobiodiversity is also due to emerging pests and diseases as well as due to increasing invasive weeds (Tiwari et al., 2005), however, there were no such threats in case of studied sites at Manang at present.

Figure 8

Driving factors for agrobiodiversity richness



As IPCC (2007) indicated the warming temperatures greater than 1.5°C could put 20-30% of species at a higher risk of extinction, and this risk is persistent throughout Nepal. Although few respondents mentioned that the loss of agrobiodiversity in the study area is also due to climate change, other have also observed that they can grow cauliflower, carrot, cabbage, chili, tomato, coriander, spinach and cucumber due to increasing temperature trends in the region. Some farmers also experienced improved size of apple and vegetable crops as well as upward elevation shifting of crops including maize, apple, and others in Manang. Additionally, the local farmers have substantially used plastic tunnels to grow vegetables which have been highly affecting to maintain temperature and save vegetables from frost damage. The local people have already started domestication of wild vegetables such as Jimbu *(Allium hypsistum)*, which has high market value and no chance of being raided by wild animals. One of the underlying causes of loss of crop diversity is due to increasing incidences of extreme climate events in the mountain settlements. These extreme events include hailstorm, drought episodes, untimely snowfall and rainfall instead of snowfall, which severely affect crop yield and crop cycle.

With the commercialization of agriculture, there is an increasing trend of monoculture and hybrid varieties that are continuously replacing local and diverse landraces (Joshi et al., 2020). For instance, there is increasing trend of replacing native agricultural plants with hybrid varieties since 1995, these introduction accounts for more than 620% in tomato, 123% in Cauliflower, 260% in carrot, 447% in brinjal, 146% in Okra and 100% in cabbage.

Crop raids by wild animals have been reported by more than 90% of respondents in the study area. The study area lies within the Annapurna Conservation Area, where killing of wild animal is forbidden and illegal. Hence instead of threating/killing the wild animals the local farmers are gradually shifting from agriculture to other means of livelihood. Manang represents the mountain settlement in Nepal with high outmigration, thereby there is a general trend of population decline and less people to work in farmland. Also, there is a higher trend of agriculture land abandonment causing agrobiodiversity to decline. And there are new livelihood options such as involvement in tourism, herb collection and trade, infrastructure development projects, agriculture as well as non-agriculture labors. Local people mentioned their involvement in non-agriculture sectors for their livelihood which is also responsible for general decline in agrobiodiversity. Interestingly, the present study showed richer agrobiodiversity in the region with diverse livelihood options than the region with higher dependency in agriculture. The results indicated that agrobiodiversity richness is highest in Manang Village of Upper Manang followed by Ngawal/Khangsar and Naar Village, and the richness corresponds to livelihood options in these villages, upper Manang showing more options for livelihood and Naar village with least options. Further it is also highlighted that Naar village lies above 4000 m asl and has low outcome from agriculture with limited opportunity for agriculture thereby showing low richness in agrobiodiversity.

Further, the fair overlapping in the peak season of tourism and agriculture in Manang has created labor shortage to work in farmland, and this is also an important driver for agriculture sustainability in Manang. The labor shortage coupled with outmigration of males and undergoing feminization as well as due to diversification on livelihood options such as availability or remittance money and cheaper substitutes in the market have led to the abandonment of local crops in Nepal (Bhattarai et al., 2015). We have found that people in Manang are gradually shifting from cultivation of Karu (naked barley) to cultivating wheat as the latter is less labor intense. However, the local people in upper Manang are still able to

manage agriculture as well as tourism and showed rich agrobiodiversity in comparison to Ngawal/Khangsar and Naar village of Manang district. In conclusion, there are both natural and anthropogenic drivers of agrobiodiversity in Manang, and these drivers differently influenced agrobiodiversity in the study areas.

The local people would ideally seek direct as well as indirect incentives from the government to conserve their agrobiodiversity resources. Although there has been some support for providing vegetable seeds from the local government and some incentives from Annapurna Conservation Area Project, they are inadequate. And people do not fully rely on these seed sources for their subsistence and manage seeds on their own. This clearly indicated that the policy measures are inadequate for the conservation of native agrobiodiversity resources. It is emphasized that the local farmers should be made aware of the importance of their indigenous biological resources and need supports at policy level to support them conserve agrobiodiversity while diversifying their livelihood options and improve their life in such remote locations with harsh environmental conditions.

Local knowledge on agrobiodiversity

Agricultural Genetic Resources (AGRs) in the mountainous regions of Manang district are relatively poor because of both climatic and topographic extremes in Manang district. Despite most mountain people still relying on agriculture, their knowledge is relatively poor in terms of components of agrobiodiversity. Our results indicated that people of Naar valley showed less knowledge on agrobiodiversity in comparison to the people of Ngawal/Khangsar and upper Manang (Figure 9). Hence, it is highly critical to create awareness among local people about the importance of various components of agrobiodiversity in their region. They may not recognize the importance of value insects for their agriculture and may use insecticides and pesticides to control them.

Figure 9

Semi-quantitative scores of knowledges of agrobiodiversity among local people in Manang

	Components of Agrobiodiversity	Naar	Ngawal	Manang
Main components	Crop	5	5	5
	Forage Crop	3.5	4	5
	Livestock	5	5	5
	Agricultural Insects (Value Insects)	3	3.5	4.5
	Agro-microbes (mushroom, soil microbes, pathogene)	2	3	4
	Aquatic Agricultural Resources (Aquatic fish, frog, wild lice)	1	2	3
Sub components	Domesticated plant/animal	2	2.5	2.5
	Semi-domesticated plants/animals	1.5	1.5	2
	Wild Relatives	1	1	0.5
	Wild Edible fruits	0.5	1.5	1.5
	Total Score	24.5	29	33

*Note: Major components =*5, sub components =*5)*

Nepal, despite being rich in agrobiodiversity, has faced a serious challenge as native genetic resources have not been given sufficient attention in research, education, and development. This neglect has led to genetic erosion, posing a threat to the diversity of native agricultural resources. Addressing this issue requires tackling several major challenges. One critical challenge is halting the ongoing genetic erosion to preserve the unique characteristics of native genetic resources (Joshi et al., 2020). Efforts are needed to enhance the competitiveness

of native Agricultural Genetic Resources (AGRs) and reduce the current heavy dependence, which stands at 95-100%, on foreign germplasm (Joshi et al., 2017). This shift aims to secure food and nutrition by conserving existing agrobiodiversity.

There is a need to replace foreign agricultural products and germplasm with those derived from native AGRs. This involves identifying globally potential native AGRs and promoting them in international markets. Additionally, it is essential to develop site-specific products to cater to diverse agricultural environments. Creating an enabling environment that supports diverse varieties, breeds, and strains is crucial. This involves policies that favor diversity-rich agricultural products and strains. Moreover, efforts should be made to accelerate the evolutionary population to capture diversity from a wide range of agricultural areas.

Conclusions

We found that agrobiodiversity is rich in Upper Manang in comparison to Ngawal/Khangsar and Naar Village of Manang despite its connection to roads leading to lower valleys (Beshisahar) and increasing tourism activities associated with number of tourists. It is found that agrobiodiversity is maintained high due to traditional agriculture practice as well as modern agriculture practice using irrigation, fertilizers, improved seeds, polyhouses etc. Tourism also promoted agriculture practice because local people have also started growing crops as per the demand of tourists. The local people mentioned about environmental changes and anthropogenic activities as important drivers for agrobiodiversity richness. There are some incentives from the level of local municipal and ACAP (Annapurna Conservation Area Project) for the promotion of sustainable agriculture, although it has some counterproductive influence on indigenous agrobiodiversity, because we should be cautious while introducing hybrid seeds as incentives to the local farmers. Rather, we could initiate the production of indigenous crops seeds for sustainability as the indigenous species are stress tolerant and with higher nutritive value. New tools such as livestock insurance, compensation for crop against animal raid and increasing attraction towards local food (domestic tourists). There is huge potential of harvesting high value medicinal plants such as Jimbu *(Allium hypsistum)* which is without risk to wild animals. Moreover, it is found that tourism activities in Manang have positively contributed towards increasing agrobiodiversity in Manang, and it will sustain until the local people shift from cultivating indigenous crops to only hybrid and exotic varieties. However, more precise studies on species introduction and indigenous bioresources are recommended while interpreting results of agrobiodiversity richness in mountain landscape like Manang.

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Measuring climate vulnerability of tourism-dependent livelihoods: The case of Lamgtang National Park

Anil Bhandari[1*], Namrata Thapa Magar[2], Bhavishya Jung Thapa[2], Pabita Shahi[3], & Til Prasad Pangali Sharma[2]

[1]Department of Environmental Science and Engineering, KU
[2]Nepal Mountain Academy, Kathmandu
[3]Power Shift Nepal, Kathmandu
[*]Corresponding email: askwithanil@gmail.com
DOI: http://doi.org/10.3126/jtha.v6i1.67397

Abstract

Climate change poses significant challenges to tourism-dependent communities in mountain regions, threatening their livelihoods and well-being. However, there is a lack of comprehensive assessments that consider the multidimensional nature of vulnerability and the specific socio-cultural contexts of these communities. This study assesses the livelihood vulnerability of tourism-dependent communities in Lamtang National Park exposed to climate change using the Livelihood Vulnerability Index (LVI) and the Livelihood Vulnerability Index -Intergovernmental Panel on Climate Change (LVI-IPCC) framework. A mixed-methods approach was employed, including household surveys (n=119), vulnerability index calculations, and analysis of weather data. The purposive stratified sampling based on ecological gradient and proximity to trekking trails ensured the representativeness of the sample. One hundred nineteen households were surveyed, with respondents from the Hill Janajati ethnic group. Results showed that the majority of households (63%) were tourism-dominant, followed by agriculture-dominant (17%) and mixed livelihood (13%). The LVI results revealed a moderate vulnerability (0.365), with financial and natural capitals being the most vulnerable. The LVI-IPCC analysis showed that the community's adaptive capacity (0.537) is slightly lower than its exposure (0.564), and sensitivity is comparatively low (0.296), resulting in a low LVI-IPCC index (0.01). Weather data analysis, including the Mann-Kendall trend test, Sen's slope analysis, and multi-model ensemble projections, indicated increasing precipitation trends and a warmer, wetter future for the region. The triangulation of LVI, LVI-IPCC, forecast data, and weather station data strengthens the findings and highlights the need for targeted interventions. The projected changes in temperature and precipitation patterns for Rasuwa district and vulnerability status of tourism-dependent communities highlight the urgency of implementing climate change adaptation measures, which may include diversifying livelihoods, improving access to education and training, strengthening social support systems, and promoting sustainable land and water management practices.

Keywords: adaptive capacity, climate change, livelihood vulnerability, resilience, tourism-dependent communities

Introduction

Climate change has emerged as one of the most pressing global challenges, with far-reaching implications for ecosystems, societies, and economies. Mountain regions, such as the Himalayas, are particularly vulnerable to the impacts of climate change due to their fragile ecosystems, high dependence on natural resources, and limited adaptive capacity (IPCC,

2007). The annual maximum temperature trend in Nepal is increasing by 0.056°C/yr, while the minimum temperature trend is increasing by 0.002°C/yr, which is insignificant, according to a study on climate trend analysis by the Department of Hydrology and Meteorology (DHM, 2017). The increased maximum temperature is consistently more significant in the hilly regions from East to West and is at its lowest in the Tarai districts (MoFE, 2021a). Many climate change studies have shown that changes in precipitation and temperature patterns in the middle and high mountains are substantial (Karki et al., 2017; DHM, 2017; MoFE, 2019), and remote places of such regions rely heavily on tourism for their earnings and livelihood (World Bank, 2021).

The livelihoods of mountain-based communities in Nepal are increasingly vulnerable to the impacts of climate change, which can significantly affect the tourism potential of these regions (World Bank Group, 2022). Tourism is a crucial driver of socioeconomic growth and prosperity in Nepal, contributing to the construction of essential community infrastructures, such as schools, healthcare facilities, and roads, which support local residents' livelihoods (Munanura et al., 2016; MoFE, 2021b). However, tourism-dependent populations in protected areas have fewer opportunities to explore alternate forms of income, making them more susceptible to climate change (MoFE, 2021b). This is particularly evident in Lamtang National Park, which has the fourth-highest climate change exposure index (0.625) and a low adaptation capacity index (0.47) among the 20 protected areas in Nepal (MoFE, 2021b). Lamtang National Park, located in the central Himalayan region of Nepal, is a popular destination for trekkers and nature enthusiasts. The park is home to diverse ecosystems, ranging from subtropical forests to high-altitude alpine meadows, and supports a rich biodiversity (LNP, 2020). The local communities residing within and around the park heavily rely on tourism activities for their livelihoods, making them particularly susceptible to the impacts of climate change. As tourism-related activities become the primary source of income for local people, hyper-dependence on tourism can become a significant vulnerability concern in the context of climate change (Shen, 2009). Consequently, understanding the vulnerability of tourism-dependent communities to climate change is crucial for developing effective adaptation strategies and policies in Nepal (MoFE, 2021b).

The impacts of climate change, such as rising sea levels, increased frequency and intensity of extreme weather events, and shifts in temperature and precipitation patterns, have direct and indirect consequences for tourism and livelihoods (Scott et al., 2019). As a climate-sensitive sector, tourism is particularly vulnerable to these changes, with implications for destination attractiveness, tourist behavior, and the sustainability of tourism-dependent economies (Gössling et al., 2020). Protected areas play a crucial role in biodiversity conservation, but their establishment can positively and negatively impact local livelihoods. Ward et al. (2018) examined the impact of protected area co-management on perceived livelihood impacts in Malawi, Botswana, and Namibia, suggesting that while co-managed protected areas may be more effective overall, governance processes can lead to local perceptions of inequity. Nyaupane et al. (2020) assessed the performance of contemporary protected area governance in Nepal and found that the outcomes varied across the protected areas primarily because of their governance approaches and local contexts.

The relationship between tourism and livelihood diversity has gained increasing attention in the context of climate change. The concept of vulnerability has been widely explored in the context of climate change and tourism (Adger, 2006). Studies have highlighted the varying levels of vulnerability among tourism destinations and communities, influenced by factors

such as geographical location, socio-economic conditions, and institutional support (Becken et al., 2020). Nyaupane and Chhetri (2009) assessed the vulnerability of nature-based tourism to climate change impacts in the Nepalese Himalayas, while Jamaliah and Powell (2017) conducted a vulnerability assessment of ecotourism to climate change in Dana Biosphere Reserve, Jordan. Tourism has been promoted to support biodiversity conservation and improve livelihoods in and around protected areas in many developing countries (Vedeld et al., 2012; Goodwin & Roe, 2001). Several studies have examined the impacts of tourism development on the livelihoods of destination communities, especially in rural areas (Su et al., 2018; Mbaiwa & Stronza, 2010; Kheiri & Nasihatkon, 2016; Snider, 2012). These studies show tourism's potential to enhance rural livelihoods through economic diversification, income generation, and synergies with traditional activities. However, asset levels affect individuals' ability to capitalise on these opportunities, with implications for equitable development.

Livelihood is often studied at the household level and is described as the set of various assets and activities that go toward making income for locals (Diniz et al., 2015). Numerous studies are directed at estimating the impact of climate change on the livelihood or tourism sector. However, only a few studies have connected and quantified tourism and livelihood together while both being impacted by climate change (Afandi, 2014; Gössling et al., 2020; Scott et al., 2019; Su et al., 2018; Vedeld et al., 2012; Ward et al. (2018). In 2015, the Lamtang region in Nepal experienced a catastrophic earthquake that triggered avalanches, burying 116 buildings, primarily hotels, and claiming the lives of 308 people (176 locals, 80 visitors, and 10 soldiers) (Callaghan & Thapa, 2015). The factors most vulnerable to severe climatic events and climate-induced hazards comprise tourism infrastructure, nature, tourists, and tourism-dependent people and their livelihoods (MoFE, 2021b). The Lamtang National Park management plan has stated that there is inadequate availability of off-farm employment and a low linkage to tourism activities with off-trail communities (LNP, 2020). Most of the funding and activities are targeted towards tourism management in the buffer zone to improve livelihoods, while the core tourism activity area remains in limbo to address the livelihood needs of the community not connected with the trekking trails (LNP, 2020).

The overall objective of this study was to explore the livelihood diversity of tourism-dependent communities in the face of climate change. The specific objectives were to compute the LVI and LVI-IPCC of these communities, explore different aspects of climate change vulnerability to tourism-dependent livelihoods, study the climate variability of the Lamtang National Park, and contribute to the enhancement, promotion, and development of mountain tourism studies. Methodologically, the composite index approach in evaluating the determinants of livelihood is widely exercised in measuring the LVI. However, there exist limitations in selecting indicators related to the sustainable livelihood tourism framework (Shen, 2009; Afandi, 2014). Thus, considering the aspect of climate change and the implication of catastrophic events, Lamtang National Park was regarded as the best study site to explore the accumulated impact of climate change on the livelihood of tourism-dependent communities.

Assessing the livelihood vulnerability of these communities is essential for identifying the factors that contribute to their vulnerability and developing targeted interventions to enhance their resilience. The LVI is a widely used approach for quantifying the vulnerability of communities based on multiple indicators across different livelihood capitals, such as social, human, natural, financial, and physical (Hahn et al., 2009). IPCC vulnerability framework,

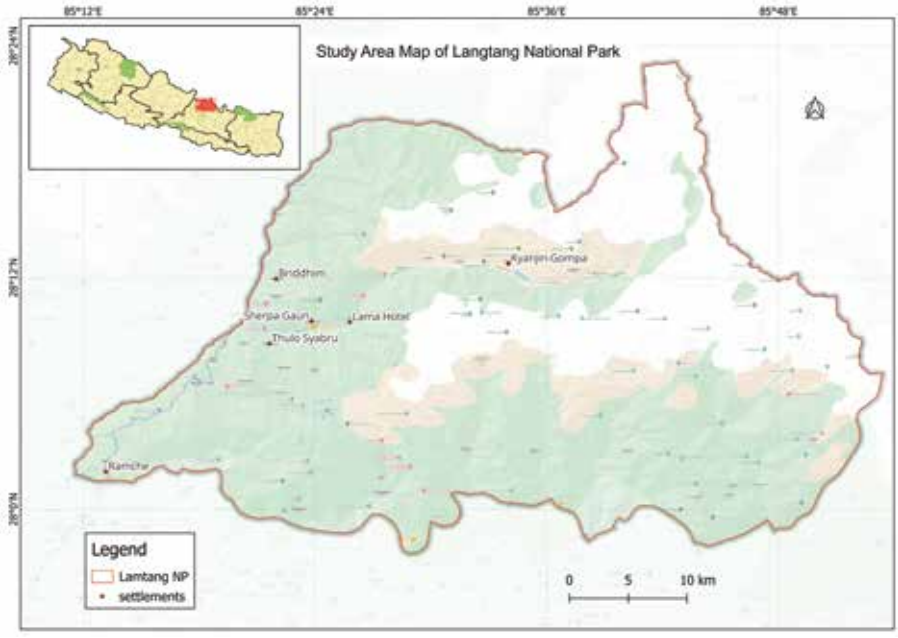
which considers exposure, sensitivity, and adaptive capacity, provides another lens for understanding vulnerability (IPCC, 2007). This study aims to bridge the gap in comprehensive assessments that consider the multidimensional nature of vulnerability and the specific socio-cultural contexts of the communities by assessing the livelihood vulnerability of tourism-dependent communities in Lamtang National Park using the LVI and LVI-IPCC approaches while also analyzing secondary weather data to understand the climate change trends in the region. The findings of this study can contribute to evidence-based decision-making and inform policies and programs aimed at building resilience and promoting sustainable livelihoods of tourism-dependent communities of mountain regions facing climate change challenges.

Study area

This research concept is designed to measure the livelihood diversity of local communities whose livelihood is partially or completely dependent on tourism activities and are further impacted by climate change. All field-based activities were concentrated in the Lamtang National Park (LNP), featuring the Gosaikunda Rural Municipality (RM) of the Rasuwa district.

Figure 1

Map of study sites in Lamtang National Park



LNP is situated in the central Himalayan region of Nepal in Province 3 and was gazetted on 9 Chaitra 2032 (26 March 1976). The Park has an area of 1,710 km^2 and extends over parts of Nuwakot (4.28%), Rasuwa (56.62%) and Sindhupalchowk (39.10%) districts, the southern mountainous terrain of the Nepal-China (Tibet) border. The geographical location of the Park is approximately between 85° 15' to 86° E and 28° to 28° 20' N. Lamtang National Park (LNP) is one of the nearest Himalayan National Parks from the capital city Kathmandu (LNP, 2020).

Table 1

Coverage of LNP, Districts and Rural Municipalities

District-wise coverage of LNP (1710 km²)	Coverage of National Park in Rasuwa District			
District wise coverage	**Area (km²)**	**District Area**	**% coverage**	**RM Coverage**
Rasuwa (56.62%)	968.2	1511 km²	The national park covers 64% District area	The total area of Gosaikunda RM is 978.77 km² (out of 6 wards in Palika, except ward 1, the rest 2,3,4,5,6 placed inside the park, and the area of ward 1 is 64.51 sq km. That means (978.77-64.51) 914.26 km² is inside the park (93.4%) of land lies within the national park.
Sindhupalchowk (39.10%)	668.6			
Nuwakot (4.28%)	73.2			

Materials and methods

The study assessed the livelihood vulnerability of tourism-dependent communities in Lamtang National Park considering the impact of climate change. This study has adopted a mixed-methods approach. Household surveys were conducted in the Gosaikunda Rural Municipality of the Rasuwa district, with 119 households selected using purposive stratified sampling based on ecological gradient and proximity to trekking trails. The LVI was calculated using the balanced weighted average approach and the IPCC vulnerability framework. Secondary weather data was analysed to assess climate change trends and projections in the study area.

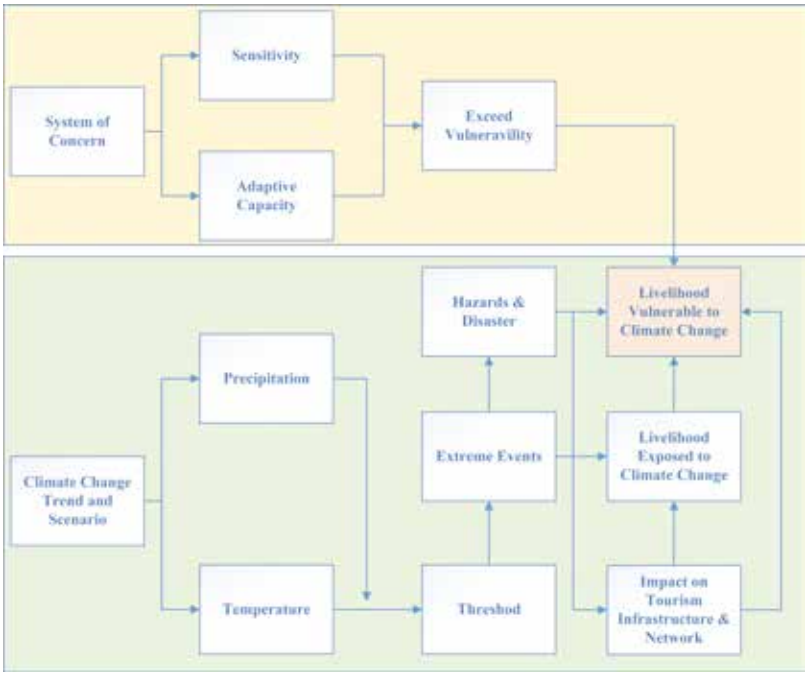
Conceptual framework

The research presents and analyses both qualitative and quantitative data. This study has applied a sequential mixed explanation approach, which entails gathering quantitative data before collecting qualitative information to illuminate the quantitative results better (Ayana et al., 2021). The Figure 2 shows that livelihood components are grouped into vulnerability parameters to measure the LVI.

The framework is adapted and modified from the Ministry of Forests and Environment's report on "Vulnerability and Risk Assessment and Identifying Adaptation Options in Tourism, Natural and Cultural Heritage" (MoFE, 2021b). Framework illustrates three components: livelihood components, vulnerability parameters, and weather data analysis. The livelihood components are divided into five capitals: social, human, natural, financial, and physical. Each capital comprises several sub-components gathered into three vulnerability parameters: exposure, sensitivity, and adaptive capacity. These parameters are used to calculate the LVI and the LVI-IPCC, which comprehensively assess the community's vulnerability to climate change. The weather data analysis supports and validates the findings from the primary data collection.

Figure 2

Assessment framework for climate change implication on the livelihood of the tourism-dependent community



Source: Adapted and modified from MoFE 2021b.

Components of the LVI framework

The LVI calculation incorporates a comprehensive set of livelihood capitals, major components, sub-components, and measurement scales to assess the vulnerability of tourism-dependent communities. The five main livelihood capitals considered in the LVI are social, human, natural, financial, and physical. Each capital is further divided into major components, such as socio-demographic information, health, land productivity, assets, and road network & services, which are then divided into specific sub-components as presented in

The sub-components are measured using a variety of scales and units, depending on the nature of the data being collected. Ratios and numbers are used for sub-components like the dependency ratio and average family member in a household, while percentages are employed for women-headed households and households with members trained in vocational training. Likert scales are set for assessing support during trouble and the degree of satisfaction with water supply, and time-based measurements are used for sub-components such as the average time to reach the nearest health centre and the time to collect forest or forest-related resources. This diverse range of measurement scales and units highlights the complexity of assessing livelihood vulnerability presented in Table 2 .

By incorporating quantitative data from various livelihood capitals, the LVI provides a comprehensive understanding of the challenges tourism-dependent communities experience in climate change exposure. Including sub-components from different livelihoods, capitals ensure that the index captures the multifaceted nature of the vulnerability, considering social, human, natural, financial, and physical aspects, ultimately leading to a more accurate

assessment of the communities' resilience to climate change impacts.

Components of the LVI-IPCC framework

The LVI-IPCC framework categorise vulnerability's major components and sub-components into three factors: adaptive capacity, sensitivity, and exposure. Adaptive capacity includes socio-demographic information, social networking, social cohesion, tourism-built relations, knowledge and skills, road network and services, and infrastructure. These components assess the community's ability to adapt and cope with the impacts of climate change on their livelihoods. Sensitivity comprises health, food and nutrition, land productivity, forest, water, finance, and tourism economy, evaluating the degree to which the community's livelihoods are affected by or responsive to climate change.

Exposure consists of climate variability, natural disasters, and assets, representing the external factors and environmental stressors that the community faces due to climate change. By organising these components into the three vulnerability factors, the LVI-IPCC framework provides a comprehensive approach to assessing the vulnerability of tourism-dependent communities to climate change, considering their adaptive capacity, sensitivity, and exposure to climate-related stressors. Presented in Table 2.

Table 2

Components of LVI & LVI- IPCC based on livelihood capitals

Livelihood	Major Components (LVI)	Vulnerability Factors (LVI-IPCC)
Capitals Social	Socio-demographic information	Adaptive Capacity
	Social networking	Adaptive Capacity
	Social cohesion	Adaptive Capacity
	Tourism-built relation	Adaptive Capacity
Human	Health	Sensitivity
	Food and nutrition	Sensitivity
	Knowledge and Skills	Adaptive Capacity
Natural	Land Productivity	Sensitivity
	Forest	Sensitivity
	Water	Sensitivity
	Climate variability	Exposure
	Natural Disaster	Exposure
Financial	Assets	Exposure
	Finance	Sensitivity
	Tourism Economy	Sensitivity
Physical	Road Network & Services	Adaptive Capacity
	Infrastructure	Adaptive Capacity

Categorising sub-components of the LVI-IPCC framework

The LVI-IPCC framework is composed of vulnerability's major components and subcomponents into three contributing factors: adaptive capacity, sensitivity, and exposure

(Table 3). Adaptive capacity encompasses various aspects such as socio-demographic information, social networking, social cohesion, tourism-built relations, knowledge and skills, road network and services, and infrastructure. These components collectively assess the community's ability to adapt and cope with the impacts of climate change. On the other hand, sensitivity includes factors like health, food and nutrition, land productivity, forest, water, finance, and tourism economy, which evaluate the degree to which the community's livelihoods are affected by or responsive to climate change. Lastly, exposure comprises climate variability, natural disasters, and assets, representing the external factors and environmental stressors that make the community vulnerable to climate change.

Table 3

LVI-IPCC contributing factors for Adaptation Capacity, Exposure and Sensitivity

Vulnerability Factors	Major components	Sub-components
Adaptive Capacity	Socio-demographic information	Dependency ratio
		The average family member in a household
		Women headed household
		The household head who has not attended the school
	Social networking	Support from family & relatives
		Access to local governments' services
		Membership in the local organisation
	Social cohesion	Support during the trouble
		Relations with administrative officers
		Trust among the neighbours
	Tourism-built relation	Increased social cohesion through tourism activities
		Increased access to information with development in tourism activities
	Knowledge and Skills	Household head with smartphone
		Household with its members trained in vocational training
		Household with its members trained by Lamtang National Park or Buffer Zone Management Committee
		Workforce in a family member
	Road Network & Services	Time to reach (walking) nearest land vehicle station/ motorable road
		Access to grid electricity
	Infrasture	Better infrastructure (such as roads, electricity, water, public transport) due to tourism
		Housing quality style

Sensitivity	Health	Average time to reach the nearest health centre
		critically ill household member in the past one month
		Household members suffered severe or other infectious diseases in the past six months.
	Food and nutrition	Food insufficient to the family from their production
		Consumption of varieties of food that do not meet the nutritional demand
	Land Productivity	Lack of ownership of productive land
		Degradation of productive land by climate-induced disaster
	Forest	Insufficient forest resources
		Time to get forest or forest-related resources
		The availability of firewood in comparison to 3o years back has decreased.
	Water	Invailability of water sources
		Conflicts related to water resource use
		Lack of everyday availability of water
		Degree of dissatisfaction with water supply
	Finance	Households with debt (informal)
		Households with loan from any Financial Institutions (bank/finance/cooperative) or other organisations
		Households that do not receive remittance
	Tourism Economy	Tourism income has decreased
		Wage income has not changed.
		Distribution of the economic benefits generated by tourism is not fair.
Exposure	Climate variability	Changes in the pattern of precipitation in the last 20 years
		Climate hazards (landslide, flood, drought, crop pest) damage to livelihoods.
		Perception of weather/climate changes in the region compared to the past decade
		Mean standard deviation of average annual temperature
		The mean standard deviation of average annual precipitation
	Natural Disaster	Death in the family due to climate-related disasters in the past 30 years
		Injury to family members due to climate-related disasters in the past 30 years.

	Assets	The inverse of the average land holding index
		Limited to one house in a location

Note: Adapted from Hahn et al. (2009), Qian et al. (2022), Munamura et al. (2016), Afandi et al. (2014), Qian et al. (2017), Shi et al. (2022) and Lamichhane (2010).

Primary data collection

Sample size calculation

This study employed a purposive sampling strategy combined with stratification based on the household proximity to main trekking trails and ecological gradients. The primary focus of the study was to measure the impact of climate change on the livelihood diversification of families engaged in the tourism business, and this sampling approach allowed for targeting households that met this specific criterion while also considering the potential influence of trail proximity. To find suitable households for the study, we used criterion sampling - a purposive sampling that selected only those households involved in the tourism business. Total population and household size is presented in Table 4.

Table 4

Population and household size of Gosaikunda Rural Municipality

Source	Total Population	Male Population	Female Population	HH Size	Remarks
National Survey Report (CBS, 2021)	7788	3973	3815	2038	42% of municipality HH are within study area Ward 3, 4 & 5

The sample size calculation, as shown in Table 5, was based on the total number of households across three wards (3, 4 & 5) of the Gosaikunda Rural Municipality. One of the household selection criteria was households' proximity to the main trekking trails, and popular trekking trails LNP passes through these three wards. Out of the 862 total households, 119 were sampled, representing 14% of the entire household population under investigation. The percentage of sampled households varies across the wards, ranging from 8% in Ward 5 to 48% in Ward 4, due to differences in the total number of households and the specific sampling criteria applied within each ward.

Table 5

Ward wise households and study samples

Ward Number	HH Size	Sample Size	% of Sample HH
3	169	20	12
4	110	53	48
5	583	46	8
Total	**862**	**119**	**14%**

Sample size representativeness

Out of the 862 households in the three wards (3, 4, & 5) of the Gosaikunda Rural Municipality, which have part of major trekking trails, 119 households that met the criterion of proximity

to the main trekking trails were randomly sampled. While this sample size is not a probabilistic representation of the entire population, it is a purposive sample that directly addresses the research objectives.

Table 6

Distance of Sample Household from the major trekking trails

Proximity to main trekking trails	Sample Households	% of Sample Household
Next to the trekking trail	107	90
Within 500 meters away from the trekking trail	12	10
Far away from major trekking trail	0	0
Total	**119**	

Criteria for household stratification

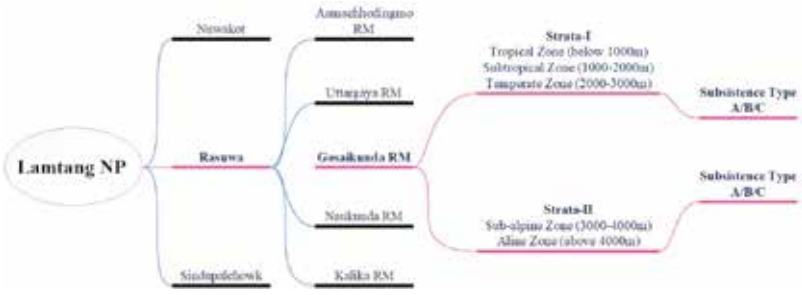
To improve the sample and capture potential variations in information, households were stratified into three groups based on their proximity to the main trekking trails and ecological gradient. Three criteria based on the proximity to the main trekking trails were:

- Households located next to the trekking trail
- Households within 500 meters of the trekking trail
- Households far away from the major trekking trail

Similarly, LNP comprises five ecological zones (LNP, 2020). Five ecological zones are further stratified into two strata, the first of which is the tropical, subtropical, and temperate zones, and the second of which is the sub-alpine and alpine zones. Based on the ecological strata, 73 households were sampled from strata-I, and 46 households were selected from strata-II. Additionally, households were classified according to the livelihood dominance as explained in Table 7.

Figure 3

Sampling strategy from district to household level with ecological stratification



The seasonality aspect is particularly prevalent in Nepalese tourism, with autumn being the most preferred season for tourists (Dhakal, 2013). This means communities that rely heavily on tourism must diversify their businesses to survive beyond the peak season. Considering this, the households in this research are classified using the criteria established by Qian et al. 2022.

Table 7

Types and classification criteria of households' livelihoods

Subsistence Type	Classification Indicator (%)	Livelihood Mix	Representative Livelihood Activities
Type A-Tourism dominant type	Tourism Income ≥ 70	Participate In Tourism + Short-term Employment + Farming	Operating Homestays, Hotels, Restaurants, Farmhouses, Food, Beverages, Fruit, Plantation Picking, Tourism and Transportation, Scenic Staff, Tour Guides
Type B: Working dominant type	Working Income ≥ 70	Perennial Worker + Participate In Tourism	Scenic Stalls, Hotels, Restaurants, Scenic Spot Security, Shopping Malls, Working Outside, construction odd jobs, coach drivers
Type C: Agricultural dominant type	Agricultural Income ≥ 70	Farming+ Short-term Employment + Participate In Tourism	Agriculture, Specialty Planting and Breeding, Temporary Employment

Source: Adopted and modified from Qian et al., 2022.

Household survey process

Based on the preliminary findings from the review of the literature, a household survey questionnaire was prepared to explore the community perception of tourism-based livelihood and the implication of climate change on such livelihood diversity. The survey team was rigorously trained on the survey questionnaire. The finalised questionnaire was further translated into Nepali, and field facilitators were trained in conducting surveys and coding the responses in MS Excel. The household survey was conveyed in March 2024 with three trained facilitators with support from local tourism entrepreneurs.

Questionnaire development approach

The livelihood index was constructed primarily following Hahn et al. (2009) adopting the approach of a sustainable livelihood framework (SLF) (DFID, 1999). However, it is suggested that the Sustainable Livelihood Approach (SLA) cannot fully address the issues when tourism is used as a rural livelihood strategy (Shen, 2009). This is further replicated by Afandi (2014) by adopting specific indicators specially designed for tourism-based livelihood. Thus, a household survey questionnaire on tourism-based livelihood indicators is adopted from (Qian et al., 2022; Munanura et al., 2016; Afandi et al., 2014; Qian et al., 2017; Shi et al., 2022).

Primary data analysis

Methods for LVI calculation

To assess the LVI, study has undertaken two analysis approaches: (1) calculation of a balanced weighted average LVI (Hahn et al., 2009) and (2) computation of LVI as suggested by the IPCC framework (2007). Weather data from Rasuwa district was also examined to assess the region's climate change state. The LVI is a composite index of all significant parameters of livelihood (Hahn et al., 2009), and the IPCC vulnerability approach categorises

the major livelihood indicators into exposure, sensitivity, and adaptive capacity, which are contributing factors of vulnerability (IPCC, 2001).

LVI indicators were calculated by adopting Hahn et al. (2009) in four steps (equations 1-4) and an additional calculation for the computation of LVI-IPCC (equation 5). The LVI constructs a balanced weighted average where each sub-component contributes equally to the overall index (Hahn et al., 2009). Each sub-component was measured on a different scale. They are first standardised as an index using an equation (1) acclimated from the Human Development Index to compute the life expectancy index (UNDP, 2008).

$$index_{S_d} = \frac{S_d - S_{min}}{S_{max} - S_{min}} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Where S_d is the original sub-component indicator

S_{min} & S_{max} are the minimum and maximum values for each sub-component indicator.

$$M_d = \frac{\sum_{i=1}^{n} index_{S_d i}}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$index_{Sdi}$ are the indexed sub-component for each district that makes each major component, M_d and n is the number of sub-component indicators in each major component.

$$CF_d = \frac{\sum_{i=1}^{n} w_{M_i} M_{di}}{\sum_{i=1}^{n} w_{M_i}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

CF_d is a contributing factor like exposure, sensitivity, or adaptive capacity to climate change, M_{di} is the major component of each community, w_{Mi} is the weight of each major component, and *n* is the number of major elements in each contributing factor.

Calculation of LVI-IPCC

Another method for integrating the major components into a vulnerability index was explored as attempts to develop a formula to represent the IPCC definition of vulnerability. The same major components in the composite index approach were applied to measure the IPCC's three contributing factors- exposure, sensitivity and adaptive capacity to the vulnerability.

$$CF_d = \frac{\sum_{i=1}^{n} w_{M_i} M_{di}}{\sum_{i=1}^{n} w_{M_i}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

CF_d is a contributing factor like exposure, sensitivity, or adaptive capacity to climate change, M_{di} is the major component of each community, w_{Mi} is the weight of each major component, and n is the number of major components in each contributing factor.

After calculating each community's exposure, sensitivity, and adaptive capacity, these values were integrated by applying the formula below.

LVI-IPCC = (exposure-adaptive capacity)*sensitivity ……(5)

LVI-IPCC represent LVI as a function of vulnerability defined by the IPCC vulnerability framework, scaled from least vulnerable (-1) to most vulnerable (1).

Secondary data collection and analysis

Weather data

Climate data was used to analyse the temporal pattern of temperature and precipitation, i.e., the ground station (point station) data from the Department of Hydrology and Meteorology

(DHM), to validate local perceptions of climate change. The precipitation data covers 32 years of data (1990-2022). Data was collected from the weather stations at Thamachit and Dhunche in Rasuwa district.

The future state of climate change in the Rasuwa District was analysed using the dataset employed in climate change scenarios for Nepal for the National Adaptation Plan (MoFE, 2019). The medium stabilisation scenario RCP4.5 and the very high radiative forcing scenario RCP8.5 were utilised to examine the temperature and precipitation scenarios for the medium-term (2016-2045) and the long-term (2036-2065) with the reference period of 1981 to 2010.

Weather data analysis and presentation

The non-parametric Mann-Kendall trend test (Kendall, 1975; Mann, 1945) and Sen's slope (Sen, 1986) analysis was employed due to its insensitivity to the normal distribution of data time series and outliers, this statistical model was used for patterns identifying in hydro-meteorological data time series.

The null hypothesis for this test is that there is no trend, and the alternative hypothesis is that there is a trend in the two-sided test or an upward trend (or downward trend) in the one-sided test. For the time series x1, .., xn, the MK Test uses the following statistic:

$$S = \sum_{i=1}^{n-1} \sum_{j=k+1}^{n} sign\left(x_j - x_i\right)$$

To assess projected changes in temperature and precipitation for Rasuwa district, multi-model ensemble projections from global or regional climate models were analysed for medium-term (2016-2045) and long-term (2036-2065) periods relative to the 1981-2010 reference period mean. Two Representative Concentration Pathway emission scenarios (RCP4.5 and RCP8.5) were considered. The multi-model mean temperature and precipitation projections were presented as time series plots, with the model spread shown as color-shaded uncertainty bands. This approach allows for quantifying the magnitude and range of potential future climate changes in the study area.

Result and discussion

Respondent demographics by age, gender, and ethnicity

The demographic characteristics of the survey respondents presented in Table 8 describe a diverse age distribution and gender composition, with all respondents belonging to the Hill Janajati ethnic group. Most respondents were 50-59 years (42 respondents), followed by the 40-49 age group (38). The 30-39 age group had 18 respondents, while the 60 and above age group had 19 respondents. The youngest age group, 18-29 years, had the least respondents, with only 2 individuals.

The gender distribution of the respondents shows that 96 out of the total 119 respondents were male, while 23 were female. Notably, 25 (21%) were women-headed, while 94 (79%) were male-headed. This information provides insight into the gender dynamics of the surveyed households and the representation of women in decision-making roles within the community. The ethnic homogeneity among the respondents, who all belong to the Hill Janajati ethnic group, is an essential factor to consider when interpreting the survey results.

Table 8

Number of respondents by age group and sex

The age group of the respondent	No of respondent	Male	Female
18-29	2	2	0
30-39	18	11	7
40-49	38	28	10
50-59	42	38	4
60 & above	19	17	2
Total	**119**	**96**	**23**

Marital status distribution of survey respondents

The majority of the respondents, 92 out of 119, were married at the time of the survey. The second-largest group among the respondents was widowed individuals, with 19 respondents falling into this category. Unmarried individuals constituted a smaller proportion of the respondents, with only 7 out of 119 identifying as unmarried. Lastly, only one respondent reported being divorced, suggesting that divorce is relatively uncommon or stigmatised within the community (Table 9).

Table 9

Marital status of the respondent

Marital Status	No of respondent
Married	92
Unmarried	7
Widowed	19
Divorced	1

Household engagement according to livelihood dominance

The status of livelihood dominance of household's presented in the Table 10. Most households (63%) in the study area are tourism-dominant, with tourism income constituting $\geq$70% of their total income. Representative activities for this group include operating homestays, hotels, restaurants, farmhouses, food and beverage sales, fruit plantation picking, tourism transportation, and working as scenic staff or tour guides. Agriculture-dominant households, where agricultural income is $\geq$70%, comprise the second-largest group at 17%. Their representative activities include agriculture, speciality planting and breeding, and temporary employment. Mixed livelihood households, with no single income source $\geq$70%, constitute 13% of the sample. The smallest group is working-dominant households (7%), where working income is $\geq$70%. Their representative activities include working in scenic stalls, hotels, restaurants, scenic spot security, shopping malls, outside jobs, and construction jobs. This distribution underscores the high dependence on tourism for livelihoods in the study area.

Table 10

Household engagement according to the livelihood dominance

Subsistence Type	Classification Indicator (%)	Livelihood Mix	Representative Livelihood Activities	Total HH
Type A-Tourism dominant type	Tourism Income ≥ 70	Participate In Tourism + Short-term Employment + Farming	Operating Homestays, Hotels, Restaurants, Farmhouses, Food, Beverages, Fruit, Plantation Picking, Tourism and Transportation, Scenic Staff, Tour Guides	75 (63%)
Type B: Working dominant type	Working Income ≥ 70	Perennial Worker + Participate In Tourism	Scenic Stalls, Hotels, Restaurants, Scenic Spot Security, Shopping Malls, Working Outside, construction odd jobs, drivers	8 (7%)
Type C: Agricultural dominant type	Agricultural Income ≥ 70	Farming+ Short-term Employment + Participate In Tourism	Agriculture, Specialty Planting and Breeding, Temporary Employment	20 (17%)
Mixed livelihood type	No single income source is ≥ 70%			16 (13%)

Comprehensive assessment of the LVI

The LVI calculation is organised according to the five livelihood capitals: social, human, natural, financial, and physical. Each capital is further divided into major components and sub-components, providing a detailed analysis of the factors contributing to the vulnerability of the surveyed community (Table 11).

Table 11

LVI of major components and livelihood capitals

Livelihood capital	Major Components	Vulnerability score	Weighted Average Vulnerability Score for respective livelihood Capital
Social	Demographic Vulnerability	0.27	0.304
	Network Vulnerability	0.66	
	Social vulnerability	0.18	
	Tourism-built relation vulnerability	0.025	
Human	Health vulnerability	0.075	0.348
	Food and nutrition vulnerability	0.38	

	Knowledge and Skills vulnerability	0.535	
Natural	Land Productivity vulnerability	0.51	0.42
	Forest vulnerability	0.36	
	Water vulnerability	0.095	
	Climate vulnerability	0.62	
	Vulnerability to natural disaster	0.57	
Financial	Assets Vulnerability	0.43	0.43
	Finance Vulnerability	0.37	
	Tourism Economy vulnerability	0.49	
Physical	Road Network & Services Vulnerability	0.25	0.28
	Infrastructure Vulnerability	0.311	
		LVI	**0.365**

The weighted average vulnerability score for financial capital has the highest vulnerability score of 0.43, followed closely by natural capital of 0.42. This suggests that the community faces significant challenges related to land productivity, forest resources, water availability, climate variability, and exposure to natural disasters. Additionally, financial aspects such as asset ownership, access to finance, and dependence on the tourism economy contribute to the community's vulnerability. Human and social capital have moderate vulnerability scores of 0.348 and 0.304, respectively. Within human capital, knowledge and skills vulnerability stands out with a high score of 0.535, indicating a need for improved education and training opportunities. Food and nutrition vulnerability also require attention, with a score of 0.38.

Regarding social capital, network vulnerability is exceptionally high at 0.66, highlighting the importance of strengthening social support systems and access to government services. Physical capital has the lowest vulnerability score among the five capitals at 0.28. However, this should not be overlooked, as sub-components such as road network and services vulnerability (0.25) and infrastructure vulnerability (0.311) still contribute to the community's overall vulnerability.

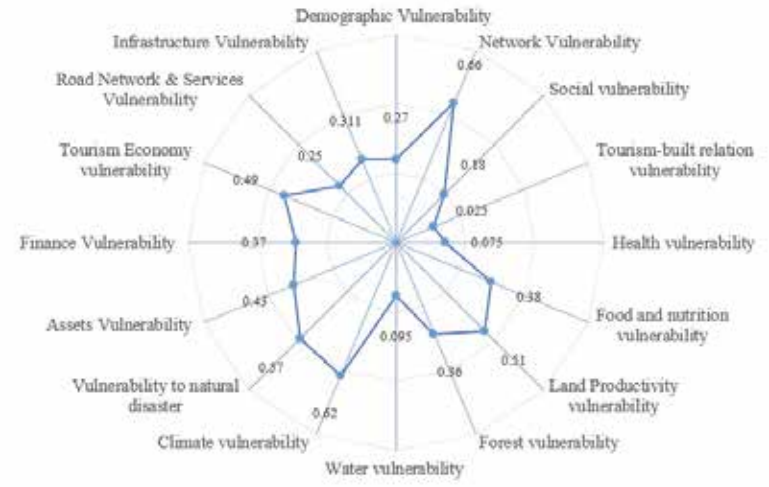
The LVI, the weighted average of all five livelihood capitals is 0.365. This value indicates a moderate level of overall vulnerability for the surveyed community. It is essential to recognise that the LVI provides an outlook of the current vulnerability status and can serve as a baseline for monitoring changes over time and evaluating the effectiveness of interventions to reduce vulnerability. This information can help policymakers, development practitioners, and community leaders identify targeted interventions and strategies to enhance the resilience and adaptive capacity of the community vulnerable to climate change and other livelihood challenges.

The radar chart (Figure 4) visually represents the dimensional indices for seventeen different sub-components of livelihood vulnerability. Each sub-component is plotted on a separate

axis, with the axis values ranging from 0 to 1. The chart shows that certain sub-components, such as network vulnerability, climate vulnerability, and knowledge and skills vulnerability, have relatively high dimensional indices, indicating a greater vulnerability to livelihood. On the other hand, sub-components like tourism-built relation vulnerability, water vulnerability, and infrastructure vulnerability have lower dimensional indices, suggesting a lesser vulnerability impact on livelihood vulnerability. Regarding financial aspects, assets vulnerability and finance vulnerability have moderate dimensional indices, while tourism economy vulnerability shows a slightly higher index, highlighting the significance of the tourism sector in the community's livelihood vulnerability.

Figure 4

LVI score of different sub-components



LVI-IPCC vulnerability assessment

A detailed vulnerability assessment is based on the IPCC framework, which considers three key components: adaptive capacity, sensitivity, and exposure. Table 12 calculates vulnerability indices for each element of LVI-IPCC by aggregating the scores of various sub-components, providing a comprehensive understanding of the community's vulnerability to climate change.

Table 12

Calculation of LVI-IPCC components

Vulnerability Factors	Vulnerability Index
Adaptive Capacity	0.537
Sensitivity	0.296
Exposure	0.564
LVI-IPCC= (exposure-adaptive capacity)*sensitivity = (0.564-0.537)*0.296= 0.01	

The adaptive capacity index, which represents the community's ability to cope with and adapt to the impacts of climate change, is 0.537. This moderate value suggests that the community

possesses some resources and strategies to respond to climate-related challenges. The community's moderate adaptive capacity indicates the opportunities to enhance its resilience and coping mechanisms. Strengthening adaptive capacity can involve investments in education, infrastructure, social networks, and livelihood diversification.

The sensitivity index, which measures the degree to which the community's livelihoods and well-being are affected by climate change, is 0.296, which is relatively low. This indicates that the community's livelihoods and well-being are less sensitive to climate variability and extremes than other factors. It is essential to acknowledge that even a low sensitivity index can significantly impact the community, particularly when combined with high exposure levels. The low sensitivity index indicates that the community's livelihoods and well-being are relatively less vulnerable to climate variability and extremes. However, it is essential to recognise that sensitivity can vary across different sectors and social groups within the community.

The exposure index, which quantifies the extent to which the community is exposed to climate change-related hazards and stressors, is 0.564, and it has the highest vulnerability score among the three components. This high exposure index underscores the community's vulnerability to climate-related risks such as changes in temperature, precipitation patterns, and the frequency and intensity of extreme weather events. The high exposure index emphasises the urgent need to reduce the community's exposure to climate-related hazards.

The LVI-IPCC index, calculated by combining the exposure, adaptive capacity, and sensitivity indices, assesses the community's vulnerability to climate change. The LVI-IPCC index is 0.01 in this case, indicating a relatively low vulnerability. This low value suggests that the community's adaptive capacity is slightly lower than its exposure, and the sensitivity is comparatively low. However, it is crucial to interpret this result with caution, as it does not imply that the community is resilient to the impacts of climate change. By enhancing adaptive capacity, reducing sensitivity, and minimising exposure, policymakers and development practitioners can work towards building a more resilient community better equipped to face the complexities of climate change.

Climate variability

Scenarios of temperature and rainfall in Rasuwa district

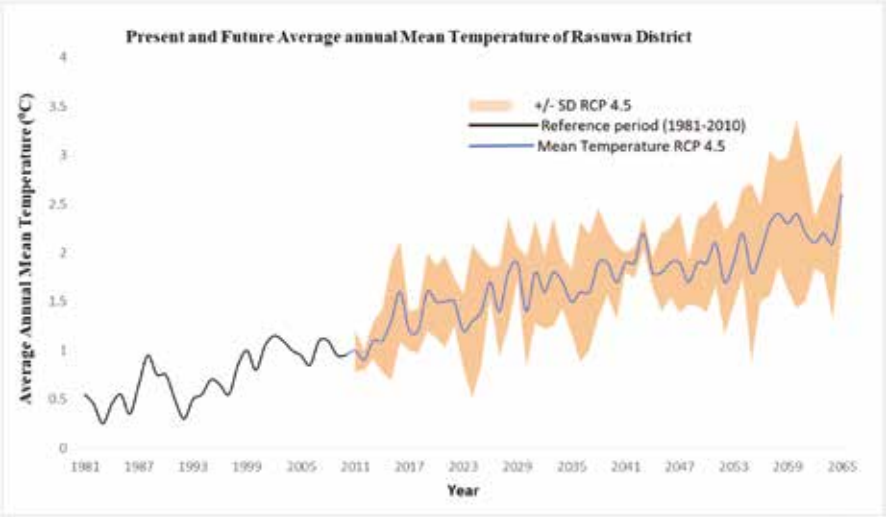
This analysis examines the output of global and regional climate models to quantify projected deviations in key climate variables over Rasuwa up to 2065 under different concentration pathways (MoFE, 2019). Observed precipitation data from local meteorological stations was also analysed for detectable trends amidst natural variations. The findings aim to support evidence-based decision-making for climate adaptation to support resilient tourism development in the Rasuwa district.

Projected temperature scenario of Rasuwa

The average temperature for the reference period of 1981 to 2010 is 0.7 °C. The projected changes in average annual temperature RCP 4.5 (Figure 5) in the medium-term (2016-2045) and the long-term (2036-2065) are 0.88°C and 1.26°C respectively. The coloured band represents the standard deviation resulting from the selected GCMs. The black line represents the reference period.

Figure 5

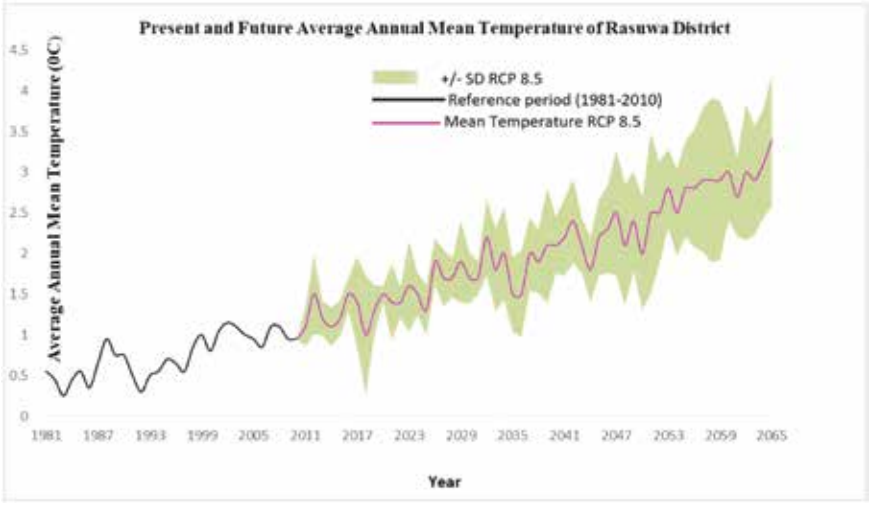
Multi-model temperature ensemble under RCP4.5 (dark blue) for 1981-2065



The projection for RCP 8.5 shows that the medium-term period will be warmer by 1 and 1.74°C in the long-term period, presented in Figure 6. The coloured band represents the standard deviation resulting from the selected GCMs. The black line represents the reference period.

Figure 6

Multi-model temperature ensemble under RCP8.5 (pink) for 1981-2065



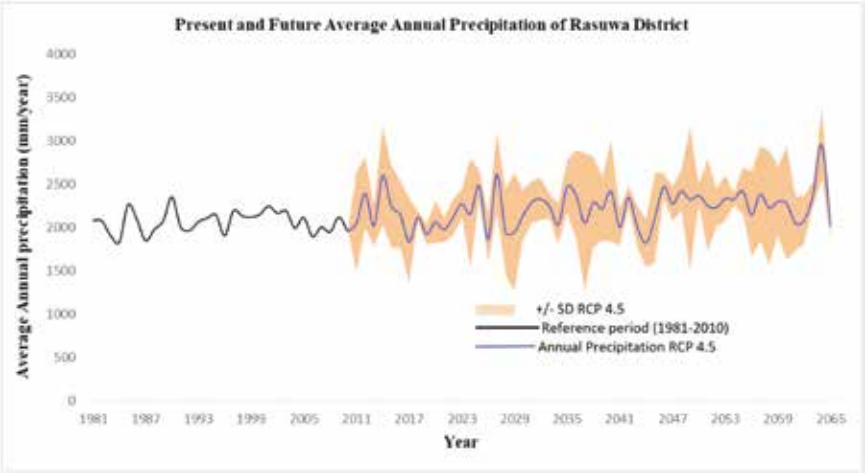
Projected Precipitation Scenario of Rasuwa

The average precipitation for the reference period of 1981 to 2010 is 2054 mm. The projected changes in average annual precipitation (%) RCP4.5 (Figure 7) in the medium-term (2016-

2045) and the long-term (2036-2065) are 4.33 and 9.6 respectively. The coloured band represents the standard deviation resulting from the selected GCMs. The black line represents the reference period.

Figure 7

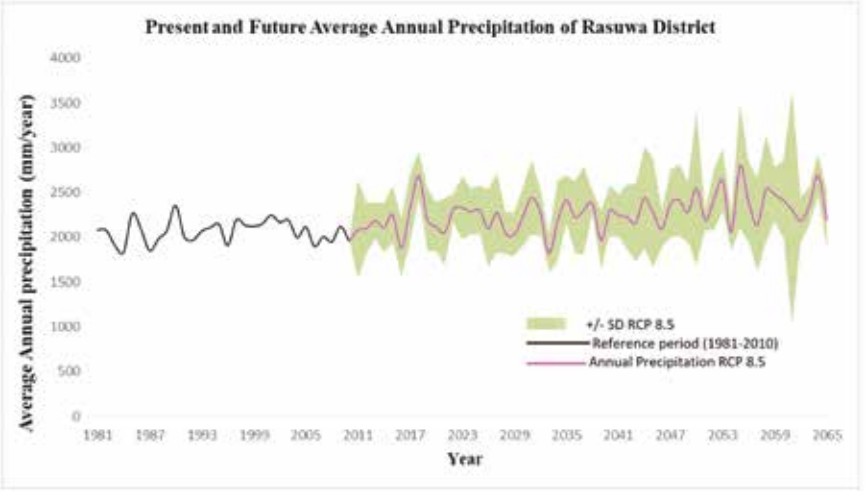
Multi-model ensemble of precipitation under RCP4.5 (dark blue) for 1981-2065



The coloured band represents the standard deviation resulting from the selected GCMs. The black line represents the reference period. The projection for RCP8.5 shows that the medium-term period will be wetter by 7.91% and 13.09% in the long-term period presented in Figure 8.

Figure 8

Multi-model ensemble of precipitation under RCP8.5 (pink) for 1981-2065



Source: MoFE, 2019.

The climate projection results for the Rasuwa district indicate a warmer and wetter future under both RCP4.5 and RCP8.5 emission scenarios. For the medium-term (2016-2045)

period, the multi-model mean temperature is projected to increase by 0.88°C under RCP4.5 and 1.0°C under RCP8.5 relative to the 1981-2010 reference period mean of 0.7°C. The projected warming is greater for the long-term (2036-2065) period, reaching 1.26°C under RCP4.5 and 1.74°C under RCP8.5. Precipitation is also projected to increase, with the multi-model mean showing a 4.33% increase for the medium-term and 9.6% for the long-term under RCP4.5, compared to the reference period mean of 2054 mm. Under RCP8.5, precipitation increases are projected to be even higher, at 7.91% for the medium term and 13.09% for the long term. These projections suggest that Rasuwa district is likely to experience substantial changes in climate in the coming decades, with implications for water resources, ecosystems, and livelihoods.

Weather data analysis

This study has statistically tested precipitation data from 1990-2022 to study the region's annual and seasonal rainfall trends. Data was collected from the precipitation monitoring stations at Thamachit and Dhunche in Rasuwa district. Details of the geographic coordinates and elevation of these two stations are outlined in Table 13.

Table 13

Weather stations of Rasuwa District

Station Index	Location	District	Latitude	Longitude	Elevation (m)
1054	Thamachit	Rasuwa	28.1835	85.30183889	1770
1055	Dhunche	Rasuwa	28.1053	85.3076915	2005

The average annual precipitation for the analysis period is higher at Dhunche station (1859 mm) than at Thamachit station (751 mm). There is also higher rainfall in winter, spring, and the summer monsoon at Dhunche compared to Thamachit. However, there is considerable year-to-year variability in precipitation, as shown by the high standard deviations relative to the mean values. For example, at Dhunche, the standard deviation of annual rainfall is 535.9 mm compared to a mean of 1859 mm. This highlights precipitation distributions from these two stations were further analysed to detect significant trends amidst the high rainfall variability in the district.

Table 14

Summary statistics of weather data

Variable	Thamachit				Dhunche			
	Min	Max	Mean	Std. deviation	Min	Max	Mean	Std. deviation
Annual	193	2158.2	751.0	563.0	373.8	2625.6	1859.0	535.9
Winter	0.10	221.9	39.1	51.7	0.0	237.2	80.3	70.5
Spring	3.60	261.6	69.5	75.6	0.0	329.2	186.3	75.5
Monsoon	157.6	2088.0	627.0	496.4	236.8	2331.2	1533.2	467.4
Autumn	0.0	126.4	15.4	29.4	0.0	172.6	59.1	47.4

The results of Mann-Kendall and Sen's slope analysis of precipitation trends at Thamachit station are presented in Table 15. The annual precipitation data analysis reveals an increasing

trend, with Kendall's tau of 0.428 and a p-value of 0.001. This upward trend of 36.622 mm per year from 1990-2022 is statistically significant.

For the winter season, precipitation has increased at a rate of 1.533 mm annually, as evidenced by the p-value of 0.003 and Sen's slope estimate. Similarly, the spring rainfall trend is upwards at 1.865 mm per year.

The summer monsoon precipitation has shown the most pronounced increasing trend in Thamachit, rising at 30.464 mm per year as Kendall's tau of 0.411 and low p-value of 0.001 denote.

Thus, Thamachit station has witnessed rising precipitation across annual and seasonal metrics over the past three decades. Only autumn lacked a discernible trend. This has implications for water resources planning for Rasuwa district.

Table 15

Annual and seasonal Mann-Kendall trend test (Two-tailed test) and sen's slope calculation of precipitation data from Thamachit Station

Series\Test	Kendall's tau	p-value	Sen's slope
Annual	0.428	0.001	36.622
Winter	0.376	0.003	1.533
Spring	0.363	0.004	1.865
Monsoon	0.411	0.001	30.464
Autumn	-0.022	0.878	0.000

The annual precipitation time series graph for 1990-2022 visually depicts the long-term increasing trend in rainfall at Thamachit Station. The high year-to-year variability can be seen. The overlaid linear trendline indicates the rising trend, consistent with the statistically significant positive Kendall's tau value and Sen's slope estimated in Table 15.

Figure 9

Annual precipitation trend of Thamachit station

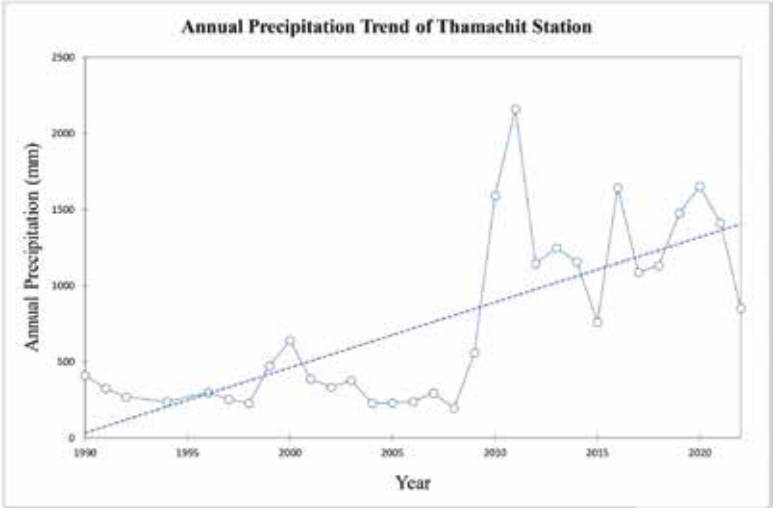


Table 16 presents the results of the Mann-Kendall and Sen's slope tests for precipitation data from the Dhunche weather station to detect trends. On an annual timescale, Dhunche shows a positive Kendall's tau value of 0.192, indicating an increasing trend. Still, with a p-value of 0.149, this annual trend is not statistically significant from 1990-2022.

Based on Sen's slope estimate, seasonal analysis shows that winter precipitation has increased by 2.067 mm per year. However, Kendall's tau of 0.167 and p-value of 0.209 indicate that winter trends also lack significance in rising trends. Similarly, spring and monsoon seasonal trends are positive but statistically insignificant according to the p-values. Only autumn shows no discernible trend.

Table16

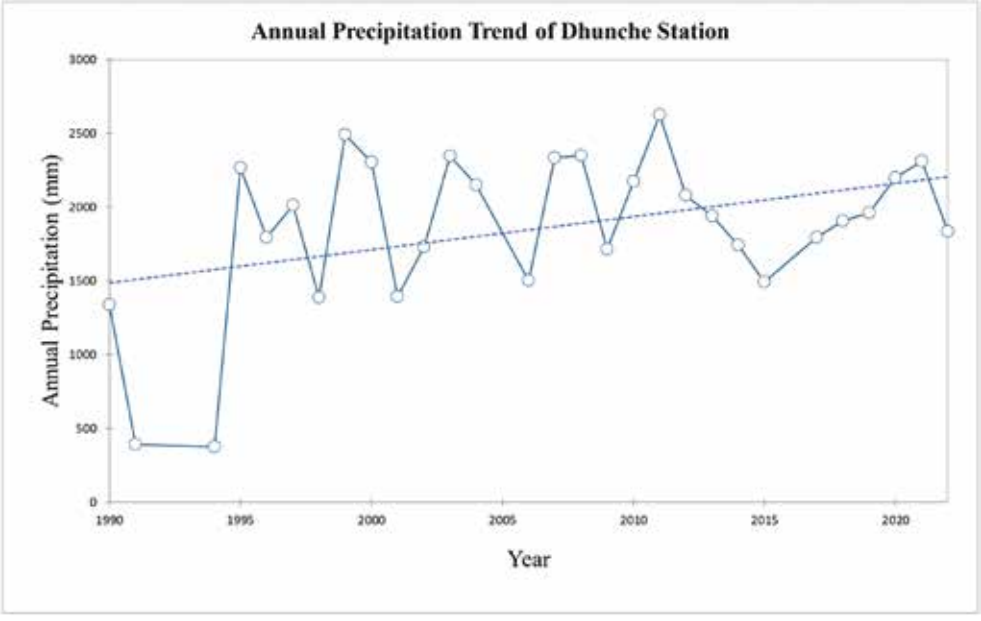
Annual and seasonal Mann-Kendall trend test (Two-tailed test) and sen's slope calculation of precipitation data from Dhunche Station

Series\Test	Kendall's tau	p-value	Sen's slope
Annual	0.192	0.149	12.457
Winter	0.167	0.209	2.067
Spring	0.153	0.252	1.493
Monsoon	0.163	0.223	9.082
Autumn	0.010	0.955	0.051

The annual precipitation plot for Dhunche Station from 1990-2022 shows high interannual variability. The linear trendline depicts a directional increasing trend. However, statistical testing shows that increasing tendency is not statistically significant.

Figure 10

Annual precipitation trend of Dhunche station



Conclusion

Mountain regions are particularly vulnerable to the impacts of climate change, with far-reaching implications for the livelihoods and well-being of tourism-dependent communities. Recognizing the pressing need for comprehensive assessments that consider the multidimensional nature of vulnerability and the specific socio-cultural contexts of these communities, this study aims to provide a holistic understanding of the vulnerability of communities in Lamtang National Park by employing a mixed-methods approach that combines the LVI, the LVI-IPCC framework, forecast data and weather station data analysis and presentation.

The Gosaikunda Rural Municipality of Rasuwa district was selected as a study area based on its ecological gradient and proximity to major trekking trails. A total of 119 households were surveyed, with 73 households sampled from the tropical, subtropical, and temperate zones and 46 households from the sub-alpine and alpine zones. The majority of the respondents were male (96 out of 119), and 21% of the households were women-headed. All respondents belonged to the Hill Janajati ethnic group; most were married (92 out of 119). The study's mixed-methods approach, which included household surveys, LVI and LVI-IPCC calculations, and analysis of secondary weather data, allowed for a comprehensive understanding of the community's vulnerability. The purposive stratified sampling based on ecological gradient and proximity to trekking trails ensured the representativeness of the sample, while the customized MS Excel database application facilitated efficient data entry, cleaning, validation, and analysis.

The LVI results revealed that the surveyed community has a moderate overall vulnerability, with a weighted average index of 0.365. Financial and natural capitals had the highest vulnerability scores, while physical capital had the lowest. The LVI-IPCC analysis showed that the community's adaptive capacity (0.537) is slightly lower than its exposure (0.564), and sensitivity is comparatively low (0.296), resulting in a relatively low LVI-IPCC index of 0.01.

The weather data analysis provided valuable insights into the climate change trends and projections in the study area. The Mann-Kendall trend test and Sen's slope analysis of precipitation data from two stations in Rasuwa district revealed increasing trends in annual and seasonal rainfall, particularly at the Thamachit station. The multi-model ensemble projections under RCP4.5 and RCP8.5 emission scenarios indicated a warmer and wetter future for the district, with substantial changes in temperature and precipitation expected in the coming decades.

The triangulation of LVI, LVI-IPCC, forecast data analysis, and weather station data analysis strengthens the study's findings. The increasing trends in precipitation and the projected warmer and wetter future align with the community's high exposure to climate variability and natural disasters, as demonstrated by the LVI and LVI-IPCC results. The moderate adaptive capacity and low sensitivity suggest that targeted interventions focusing on enhancing livelihood capitals, particularly financial and natural capitals, could improve the community's resilience to climate change impacts.

The assessment of livelihood vulnerability using the LVI and LVI-IPCC approaches provided valuable insights into the multidimensional nature of the challenges faced by tourism-dependent communities in Lamtang National Park, encompassing social, human, natural,

financial, and physical aspects of livelihoods. The findings underscore the need for targeted interventions and strategies to enhance these communities' resilience and adaptive capacity in the context of climate change, particularly in addressing vulnerabilities related to network support, climate resilience, knowledge and skills development, land productivity, and natural resource management. The projected changes in temperature and precipitation patterns for Rasuwa district highlight the urgency of implementing climate change adaptation measures, which may include diversifying livelihoods, improving access to education and training, strengthening social support systems, and promoting sustainable land and water management practices. Policymakers, development practitioners, and community leaders should work together to address these identified vulnerabilities and develop comprehensive strategies to build resilience and ensure the long-term sustainability of tourism-dependent communities exposed to climate change.

Acknowledgement

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Tourism Policy for Sustainable Mountain Tourism: A Systematic Literature Review

Bharat Ram Dhungana
School of Business, PU, Pokhara, Nepal.
Corresponding email: dhunganabharat.pu@gmail.com
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Abstract

The tourism sector is a key driver of socio-economic advancement. This study aims to assess tourism policy for sustainable mountain tourism using a systematic literature review. The research is based on a review of empirical studies, reports, and policy documents. The Google Scholar search engine was applied using the keywords "tourism policy" and "sustainable mountain tourism". All papers that were published from January 2010 to February 2024 have been checked for the study and 27 research papers were selected for this study using the PRISMA framework. An increased emphasis on sustainability and responsible practices has resulted in a paradigm change in the global tourism business. Sustainable tourism promotes ecological sustainability, economic viability, and social equality by mitigating the negative effects of tourism on the environment, society, and economy. Collaboration with stakeholders is essential for implementing integrated sustainable mountain tourism policies. For this, government strategies should be directed toward improving sustainability awareness, strengthening local communities and political leaders' participation, and adopting new technologies and renewable energy sources for sustained growth.

Keywords: mountain tourism, regulations, sustainability, tourism industry, tourism policy

Introduction

One of the main components of the United Nations (UN) 2030 agenda is the sustainable development goals (SDGs) (UN, 2015). After the UN declared 2017 to be the international year for sustainable tourism for development (Boluk et al., 2019; Sharpley, 2020), it is appropriate to re-examine the effects of tourism and encourage policies for attaining SDGs. The Brundtland report primarily addressed the ideas of sustainability and sustainable development regarding ecological or environmental sustainability. To quantify sustainability, economic, environmental, and social performance were taken into account using the Triple Bottom Line (TBL) conceptual framework (Hourneaux et al., 2018; Khan et al., 2022). Table 1 shows the sustainability measures in the framework of TBL suggested by Slaper and Hall (2011).

Enterprises must assess their operations through metrics beyond the conventional financial performance, which is conveyed through earnings, return on investment, and shareholder value. Broader effects on the environment and the society in which they operate should be taken into consideration while measuring (Dainienė & Dagilienė, 2015). The triple bottom line emphasizes social justice, environmental quality, and economic prosperity—a factor that business tends to ignore (Jennifer Ho & Taylor, 2007). Establishing a balance between these factors is necessary for sustainable mountain tourism. It includes various cross-disciplinary

elements such as smart technology, green buildings, green infrastructure, green agriculture, green energy, and green transportation (Ali et al., 2021; Pan et al., 2018; Perkumienė et al., 2020; Trombadore, 2018). To reduce poverty, promote sustainable development, and facilitate the shift to a green economy worldwide, mountain economies are crucial building elements (Pan et al., 2018; Zeng et al., 2022).

Table 1

Sustainability Measurement in TBL Framework

Economic Measurement	Environmental Measurement	Social Measurement
• Job opportunities and growth • Sectoral employment distribution • Number and size of firms • Revenue contribution by sectors	• Consumption of electricity • Consumption of fossil fuel • Management of solid waste • Management of hazardous waste • Depletion of resources	• Unemployment • Women force participation • Household income • Relative poverty • Violent crimes • Post-secondary degree • Life expectancy

Source: Khan et al., 2022.

Tourism policy identifies the tourism sector as an important vehicle for economic and social development (Sharpley, 2020; Smith, 2007; Telfer & Sharpley, 2015). Several empirical research found that there is a nexus between tourism and economic growth (Brida et al., 2020; Dhungana, 2023; Tugcu, 2014; Wu et al., 2022). The development of tourism policy is a complicated process that may prioritize environmental sustainability, establish industrial diversity, encourage innovation, and strategically improve the sector's productivity (Baloch et al., 2023; Haxton, 2015; Weidenfeld, 2018). A worldwide concern for biodiversity and cultural preservation is connected to the growth of sustainable mountain economies through mountain tourism (Ali, 2023; Lama & Sattar, 2004; Shokirov et al., 2014). Development of the mountain tourism industry should adhere to sustainability norms, reducing effects on biological resources and ecosystem diversity, supporting the preservation of mountain cultures, and enhancing the welfare of mountain peoples (Boudjemaa, 2023; Draper, 2000; Nepal, 2002).

Respect for cultural diversity, fairness, and minimal negative effects on the environment are the eco-development and sustainable tourism theories (Sachs, 1993). Focusing on the environmental, financial, and cultural facets of tourism promotes sustainable tourism and its goals are enhanced by the eco-development approach. Several indices of eco-development are the environment, the welfare of the host population, the economic advantages, and the material and intangible heritage (Leroux, 2010).

The main concerns in sustainable mountain tourism include the direction of policy towards building responsible tourism, infrastructural development, cultural heritage and social repercussions, environmental conservation, and climate change (Castellani & Sala, 2010; Geneletti & Dawa, 2009). This study aims to assess tourism policy for sustainable mountain tourism using a systematic literature review. The outcome of this research helps governments and policymakers to adopt tourism policies for adopting sustainable mountain tourism with environmental, social, and governance goals. To explore the issues of sustainable mountain tourism, the following questions will be designed: (i) What are the strategies for adopting sustainable mountain tourism? and (ii) How can a tourism policy address the issue of

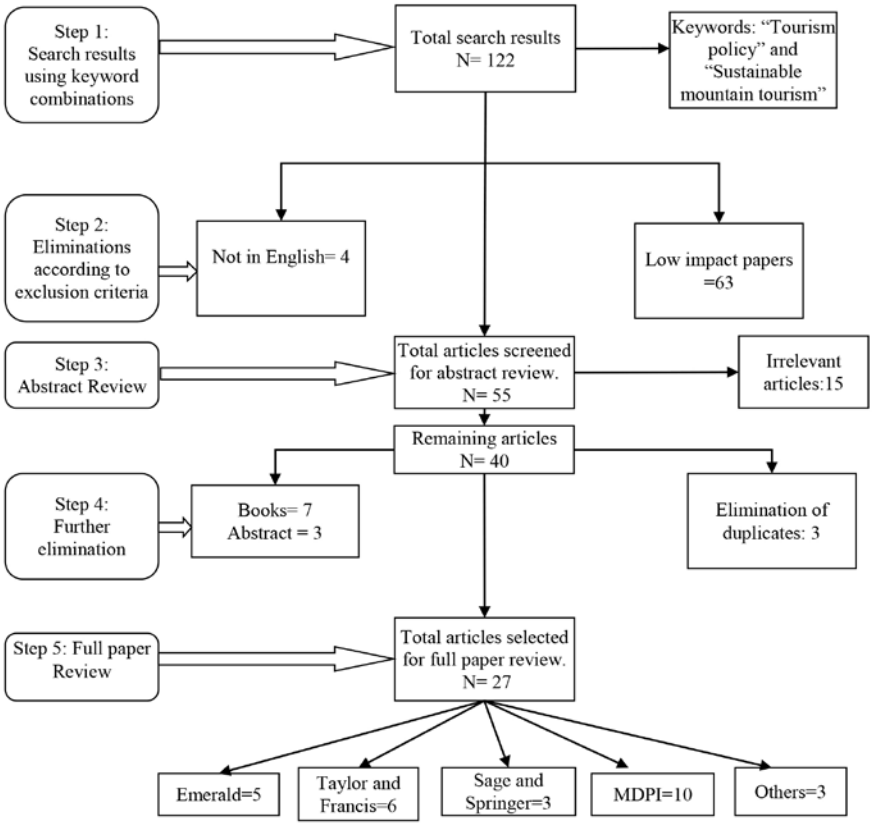
maintaining sustainable mountain tourism?

Materials and methods

This study aims to assess tourism policy for sustainable mountain tourism. The research is based on a review of empirical studies, reports, and policy documents. The Google Scholar search engine has been used to find research publications on tourism policy for sustainable mountain tourism. The search keywords are "tourism policy" and "sustainable mountain tourism" under the domain of the Google Scholar Open Database. All papers that were published from January 2010 to February 2024 have been checked for the study. The reasons behind limiting the period are to study the most current advancements and trends in this field and to make the analysis more manageable in terms of the quantity of critical publications. 122 documents were discovered during the initial inquiry. We removed 63 low-impact articles (beyond Scopus and Web of Sciences) and 4 not in English. Out of 55 documents for abstract review, we further removed 15 irrelevant articles, 7 books, 3 abstracts, and 3 duplicates. Finally, 27 research papers were selected for this study using a systematic literature review. The inclusion and exclusion criteria for this research are mentioned in Figure 1 using the Preferred Reporting Items for the Systematic Reviews and Meta-Analyses (PRISMA) framework.

Figure 1

Inclusion and Exclusion Criteria for this Study



Results

Based on systematic review on tourism policy for sustainable mountain tourism, the following results are presented on different themes:

Key issues and opportunities of mountain tourism

The tourism sector has experienced fast growth on a global scale, and its negative impacts on cultural values, natural resources, and social structures have made tourism a significant issue (Kişi, 2019). The growth of mountain tourism may be hampered by a variety of causes, including lack of attraction, low demand, resistance to change in the community, and effects of climate change. The development of tourism destinations based on consumption patterns, as well as reciprocal cooperation and partnerships, depend heavily on cross-border cooperation (Paunović & Jovanović, 2017).

Mountain people and landscapes are extremely vulnerable to the effects of climate change. Mountainous areas rely heavily on natural resources and tourist destinations are vulnerable to fluctuations in the weather (Steiger et al., 2022). Sustainability parameters like environmental, sociocultural, and economic factors are used to assess the growth of tourism. The environmental, sociocultural, political, legal, and technological contexts are more crucial for the development of mountain destinations than the economic environment (Kuščer et al., 2017). The natural ecosystem of mountains is harmed by tourism. The protected places are thought to be in danger from tourism (Karim et al., 2022).

The consequences of climate change on mountain tourism have given rise to three main themes: (1) the relationship between weather and mountain tourism, (2) the effects of climate change on mountain tourism, and (3) climate change adaptation in mountain tourism destinations. The most weather-sensitive type of tourism is mountain tourism. The weather can influence recreational activities in both positive and negative ways. Adaptation and engagement, accessibility and risks, biodiversity and landscape appeal, seasonality, and climate attractiveness, and subsequent visitors are all factors that affect mountain environments. The implications of global warming, such as the increased danger of natural calamities and decreased accessibility, have an impact on mountain tourism locations (Steiger et al., 2022).

There are great opportunities for the promotion of economic development because of the faster rate of tourism development. To promote mountain tourism activities such as hiking and trailing, cultural, and sports tourism, tourism development authorities may collaborate with local communities (Karim et al., 2022). The development of mountain destinations is directly influenced by environmental factors, which also have a significant impact on the capacity for innovation. The metrics used to gauge a destination's innovativeness, including the ability to adapt, the degree of local support for change, the use of alternative energy sources, the opportunities presented by climate change, and the use of dynamic online resources (Kuščer & Mihalič, 2016). Sustainable tourism enables us to optimize the socio-economic benefits of tourist sites while minimizing their negative environmental effects. Tourism growth and the preservation of the tourism industry are two aspects of sustainability (Kişi, 2019).

Sustainable development in rural and mountainous locations is largely dependent on nature-based and mountain tourism. In areas endowed with natural resources, there is potential for

both environmental preservation and new business ventures. It is believed that diverse economic activity is produced by mountain tourism (Tampakis et al., 2019). Long-term tourism destination competitiveness is significantly influenced by sustainability (Paunović et al., 2020). Rich historical and cultural legacy, diverse scenery, mild climate, natural resources, the availability of healing mud and mineral waters, and an excellent location all contribute to the potential for successful tourism development (Panasiuk & Zubrytska, 2021).

The behavior of Millennials is influenced by sustainability principles, and there is a high degree of willingness and awareness of sustainability. Millennials typically spend longer vacations in the mountains during the summer, while their stays are usually shorter during the winter (Bonadonna et al., 2017). The development of sustainable tourism mitigates the effects of tourism on the local economy, environment, and community while preserving and improving the area's resources to meet the requirements of both visitors and locals in the present and the future (Milićević et al., 2021). The tourism sector improves societies, creates jobs, advances economic growth, and enriches culture. Benefits of sustainable community-based tourism include enhanced "community involvement, cultural exchange, support for local skills, and local knowledge" (Jeelani et al., 2023). The tourism industry is prioritized in Nepal's 2009 Tourism Policy as a crucial tool for the country's socioeconomic growth (Ojha, 2020).

Role of government and stakeholders in developing sustainable mountain tourism

A community-based initiative involves a variety of stakeholders, including corporations, non-governmental organizations, and public and private agencies. It is challenging to expand tourism without greater cooperation between various organizations and resource users. It is crucial for attaining economic, environmental, and social development for women, minorities, and locals to be community-based (Acharya & Halpenny, 2013). Innovations in sociocultural sustainability and stakeholder participation are required to adjust to demographic shifts; reciprocal relationships between people, organizations, systems, and institutions are also required (Kuščer et al., 2017). Ski resorts require the informed participation of all pertinent stakeholders and strong governmental support to develop successfully. Public-private collaborations can be advantageous. In contexts of tourism development, it might be possible to get stakeholders together, but it has proven more difficult to sustain commitment over time (Kuščer & Dwyer, 2019).

The tourism industry comprises multiple stakeholders, each with distinct goals and concerns. The success of the industry relies on the active participation of these stakeholders (Wagenseil et al., 2022). By utilizing modern information and communication technologies, maximizing the use of available environmental resources, and establishing an organizational structure that fosters stakeholder engagement, destination managers may foster innovation (Kuščer & Mihalič, 2016). Communication regarding sustainable tourism must be directed at consumers or visitors, as well as towards local stakeholders, citizens, or the local community, to implement sustainable tourism (Paunović & Jovanović, 2017). Planning for sustainability necessitates addressing stakeholders' and tourists' perspectives to implement the services and goods that make destinations popular. Collaboration and local community empowerment are now critical issues for sustainability (Usmonova et al., 2022).

Mountain tourism is primarily supported by ecological performance, the "uniqueness" of

mountain environments, which includes cultural landscapes, a base in natural and cultural heritage, and central engagement of local stakeholders and actors (Dax & Tamme, 2023). The tourism industry's participation and sustainable expansion are largely dependent on the views of local people towards it. A key component of sustainable tourism development is the local population's acceptance and tolerance of tourists (Jeelani et al., 2023). Within the existing institutional and legal framework, the role of local people and organizations determines the sustainability of mountain tourism. To do this, they must jointly develop and apply sufficient resources and competencies to create a sustainable tourism model (Dornier & Mauri, 2018). The goal of the policy is to raise the standard of living for Nepalese citizens through improving quality, collecting foreign reserves, and generating employment opportunities (Ojha, 2020).

Strategies for sustainable mountain tourism

The primary tactics for sustainable mountain tourism are funding for integrated development in the mountains, collaboration between mountain regions, adopting scientific research, education and awareness of mountain ecosystems, and biodiversity conservation management (Karim et al., 2022). To adapt to climate change, mountain destinations must devise a plan for introducing novel procedures, goods, and services. Advanced transportation technologies, such as electric cars and bikes, improve accessibility to destinations and promote sustainable transport management. These developments are complemented by more ecologically friendly ski infrastructure, such as solar-powered lifts and sophisticated snowmaking machinery (Kuščer et al., 2017). Integrating sustainability, social responsibility, and ethics into a fundamental strategy for sustainable and responsible tourism is required for the operator. The sustainability of ski resorts depends on environmental education, which helps to lower the net consumption of materials and resources and use the money saved for the preservation of the natural and sociocultural environments (Kuščer & Dwyer, 2019). Tourism systems will need to learn new skills and tactics to deal with shifting water supply, species seasonality, weather, and risks to adapt to nature (Steiger et al., 2022). The implementation of eco-friendly technologies can mitigate the adverse effects of a declining natural environment through innovation (Kuščer & Mihalič, 2016). The governance of tourism in mountain regions plays a crucial role in supervising, regulating, and controlling activities that pose a risk to the resources that are essential to mountain tourism (Mutana & Mukwada, 2020).

In the tourism industry, sustainability has been accepted at a strategic level but is not well operationalized or executed (Paunović & Jovanović, 2017). A long-term sustainable approach must be used to properly plan, manage, and monitor tourism-related activities (Kişi, 2019). Changes in business models, the adoption of organizational procedures for providing climate change mitigation, the adoption of clean and smart technologies, the significance of cultural heritage for sustainable tourism product concepts, rural development, green investment, sustainable standards, and sustainable reporting are all important aspects of sustainable tourism practices (Roblek et al., 2021). Managing social, economic, and environmental challenges can boost sustainability performance. Reducing socioeconomic effects on the local population, fostering local entrepreneurship, fostering human capital development, and offering local financial facilities are all areas where stakeholders should be involved in promoting environmental preservation (Usmonova et al., 2022). The organizations engaged in mountain tourism and sustainable development need managerial support (Barthod-Prothade & Leroux, 2020).

Tourism policy for sustainable mountain tourism

Sustainable tourism has emerged, to reduce the negative effects of tourism-related activities (Milićević et al., 2021). National mountain policies are necessary for decisions and actions related to mountain management that are important to mountain habitats (Karim et al., 2022). Increased political support, developed policies, increased stakeholder participation, enhanced sustainability awareness, and satisfaction, strengthened relationships with local communities, adoption of new technologies and renewable energy sources, increased collaboration, innovative and creative service delivery, and adaptation to the growing demand for sustainable ski-related goods and services help to promote sustainable mountain tourism (Kuščer & Dwyer, 2019). Sustainable tourism development is a long-term strategic objective that requires coordinated efforts as well as effective management and planning procedures (Wagenseil et al., 2022).

Most mountain tourist destinations in Europe are subject to strict regulations, whereas those in Africa and Asia are not. This has led to several unfavorable effects of tourism, including garbage pollution and damage to the natural environment. Incentives for local communities and organizations to mitigate the negative effects of tourism are another important function of tourism governance. The approval of tourism policy by business operators and tourists determines its effectiveness in promoting sustainability. To improve tourism governance and sustainability in mountainous areas, the state should endeavor to enhance local government as well as institutions (Mutana & Mukwada, 2020). A mountain destination must invest significant resources in building networks of stakeholders in sustainability who collaborate with common goals and values (Paunović & Jovanović, 2017).

The tourism sector is attempting to adopt responsible and sustainable business practices around the globe. To maintain a balance between the natural environment, local populations, and economic interests, a thorough assessment framework is required to assure its long-term viability (Xu et al., 2023). The Alpine Convention's "Mountaineering Villages" program is one of several initiatives aimed at changing attitudes and encouraging tourists to participate in eco-friendly travel experiences. Achieving low-intensity tourism development can be viewed as an art form that balances ecological performance, preservation, and the prudent use of mountain area amenities, such as scenic values and landscapes, to create room for outdoor experiences and activities (Dax & Tamme, 2023). Improved sustainability indicators play a greater role in transforming mountain tourism from a predominantly white tourist destination to green tourism based on national and regional sustainable framework policy (Milićević et al., 2021). The sustainability of the Nepalese tourism industry will be greatly enhanced by the appropriate use of sustainable tourism principles (Ojha, 2020). The insufficient attention given to mountain tourism by the tourism policy has resulted in an unbalanced growth of the tourism industry. To make mountain tourism sustainable, responsible, and sensitive—both ecologically and culturally—separate and distinct regulations including an integrated approach are urgently required.

Discussion

As the effects of tourism on the environment and society are becoming more widely acknowledged, integrating sustainable practices into the tourism sector has become increasingly important (Murphy & Price, 2012). Sustainable development emphasizes the equitable use of resources while taking the needs of future generations into account (Guerra

et al., 2022). Maintaining a high level of customer happiness, ensuring a noteworthy experience, raising consumer awareness of sustainability issues, and promoting sustainable tourism behaviors are all necessary components of sustainable tourism (Breiby et al., 2020). Tourism growth is evaluated using sustainability metrics such as social, environmental, and economic aspects (Joshi et al., 2017).

The key components of sustainable tourism include smart technologies, green buildings, green infrastructure, green energy, and green agriculture (Pan et al., 2018). Sustainable tourism focuses on ecological sustainability, economic viability, and social equity by mitigating the adverse impacts of tourism on the environment, society, and economy (Maniktala & Sharma, 2024). A cross-disciplinary approach to implementation is required to transform tourism toward sustainability and a green economy (Millar et al., 2012). Integrative policies at the international, national, and local levels include investments in cutting-edge technologies, strong partnerships between governments and tourism companies, and the promotion of green practices, such as integrated waste management and the efficient use of water and energy (Falcone, 2019).

Activities related to tourism need to be carefully planned, managed, and monitored using a long-term sustainable strategy (Guerreiro, 2019). A mountain destination needs to devote substantial resources to creating networks of stakeholders who work together toward common objectives and values to maintain sustainable tourism (Spadaro et al., 2023). The government's plans and programs, as well as the stakeholders' productive collaboration, are critical to the long-term development of mountain tourism (Colasante et al., 2024).

Conclusions

The tourism industry is a key driver of social and economic advancement. Sustainable tourism development balances social, ecological, and economic growth to ensure prosperous conditions for future generations. Due to changes in global warming, the disruption of the ecological balance, the erosion of societal values, and the disregard for natural, historical, social, and cultural resources, sustainable tourism is crucial. An increased emphasis on sustainability and responsible practices has resulted in a paradigm change in the global tourism business. Sustainable tourism promotes ecological sustainability, economic viability, and social equality by mitigating the negative effects of tourism on the environment, society, and economy. Collaboration with stakeholders is essential for implementing integrated sustainable mountain tourism policies related to enhancing the role of government and tourism industry, innovative technology investments, and environment-friendly behaviors at global, national, and local levels. For this, government strategies should be directed toward improving sustainability awareness, strengthening local communities and political leaders' participation, and adopting new technologies and renewable energy sources for sustained growth.

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Evaluation of Ecotourism Practices: A Comparative Study of Lowlands and Mountains of Nepal

Bibek Khanal[1], & Kamal Raj Gosai[2*]
[1]*Department of Environmental Science, Tri Chandra Multiple Campus, TU*
[2]*Central Department of Environmental Science, TU*
[*]*Corresponding email: krgosai@cdes.edu.np*
DOI: http://doi.org/10.3126/jtha.v6i1.67392

Abstract

This research provides valuable insights into tourist profiles, market demand, attractions, motivations, amenities, and satisfaction levels in Chitwan National Park (CNP), the lowland park, and Annapurna Conservation Area (ACA), the park in the mountains of Nepal. Through qualitative and quantitative research methods, including surveys, interviews, and field observations, this study compared the current state of ecotourism practices in the protected areas (PAs). Though both the PAs showed consistent growth in tourist flow, ACA exhibited signs of saturation, suggesting the need for strategic management. Attractions differed in the PAs; natural scenery and photography draw visitors to ACA while wildlife and cultural experiences attract tourists to CNP. Disparities in amenities highlight areas for improvement, particularly in ACA. Community engagement is always an added benefit to any tourism development. Overall, satisfaction levels are satisfactory, but challenges such as overcrowding, decreasing quality of tourism, environmental degradation, and accessibility constraints require attention for sustainable tourism development. Collaborative efforts can address these issues and ensure the long-term viability of ecotourism in CNP and ACA while preserving their natural and cultural heritage.

Keywords: Annapurna; attractions; Chitwan; ecotourism; tourist satisfaction

Introduction

Ecotourism is responsible travel to natural areas to enjoy and appreciate nature and associated cultural features (IUCN, 2023) and an ethical journey to natural areas the byproduct of which is benefit to local communities and protection of the environment (TIES, 2015; Cheia, 2013). It aims to promote conservation, minimize visitor impact, and actively involve local communities in beneficial socioeconomic activities. The people who follow ecotourism are called Eco-tourists. Hijriati and Mardiana (2014) emphasize the positive impacts on local communities, environmental preservation, and socio-cultural heritage, fostering a sense of empowerment and pride among residents as cited by Fionasari, 2024. Over 45% of tourists visiting Nepal are drawn to the country's rich natural assets, including snow-capped mountains, plentiful rivers, and sub-tropical forests (World Bank 2022). So, the government of Nepal has established various protected areas, including national parks, wildlife reserves, buffer zones, conservation areas, and cultural heritage sites, to preserve wildlife and promote ecotourism, as Baral et al. (2012) outlined. The main motive for establishing the protected areas is to support conservation efforts to meet local demand and reduce negative sentiments (Thapa, 2014).

Nepal's extensive network of Protected Areas, including 12 National Parks, 1 Wildlife Reserve, 1 Hunting Reserve, 6 Conservation Areas, and 13 Buffer Zones, covering 23.39%

of the nation's land (DNPWC, n.d.), not only contribute significantly to in-situ conservation of ecosystems and biodiversity but also offer immense potential for ecotourism development, attracting over half of Nepal's international tourists (Aryal & Maharjan, 2018; Shrestha et al., 2023).

Although two-thirds of tourists visit protected areas, they are concentrated in only four out of the 20 protected areas (World Bank, 2022). While ecotourism plays a significant role in the sustainable development of buffer zones within protected areas and the livelihood around, its focus remains largely concentrated on selective destinations such as the Annapurna Conservation Area, Chitwan National Park, Manasalu Conservation Area, and occasionally Bardiya National Park (Aryal & Maharjan, 2018; K.C. et al., 2015; Nepal, 2002), consequently limiting the benefits derived from tourism activities. The country faces a lower benefit ratio for tourism than others due to underdeveloped and under-maintained tourism infrastructure, including trails, bridges, activities, and lodging. Factors such as the appeal of specific attractions, accessibilities, the adequacy of site infrastructure, market demand, available capacity, and socioeconomic connections to biodiversity are critical determinants of ecotourism potential (Hariant et al., 2020).

Though many researchers have unveiled socioeconomic risk, potential, impacts, and perception towards national parks and conservation areas individually, there lies a significant gap regarding direct comparisons between PAs in amenities, potentiality, demand, and motive of tourists. The comparison of these aspects can help policymakers and tourism stakeholders to plan and execute the plans for better service and tourism promotion. Hence, the research compared Annapurna Conservation Area and Chitwan National Park to shed light on their respective strengths, weaknesses, and potential synergies in promoting biodiversity conservation and sustainable tourism.

Material and methods

Study area

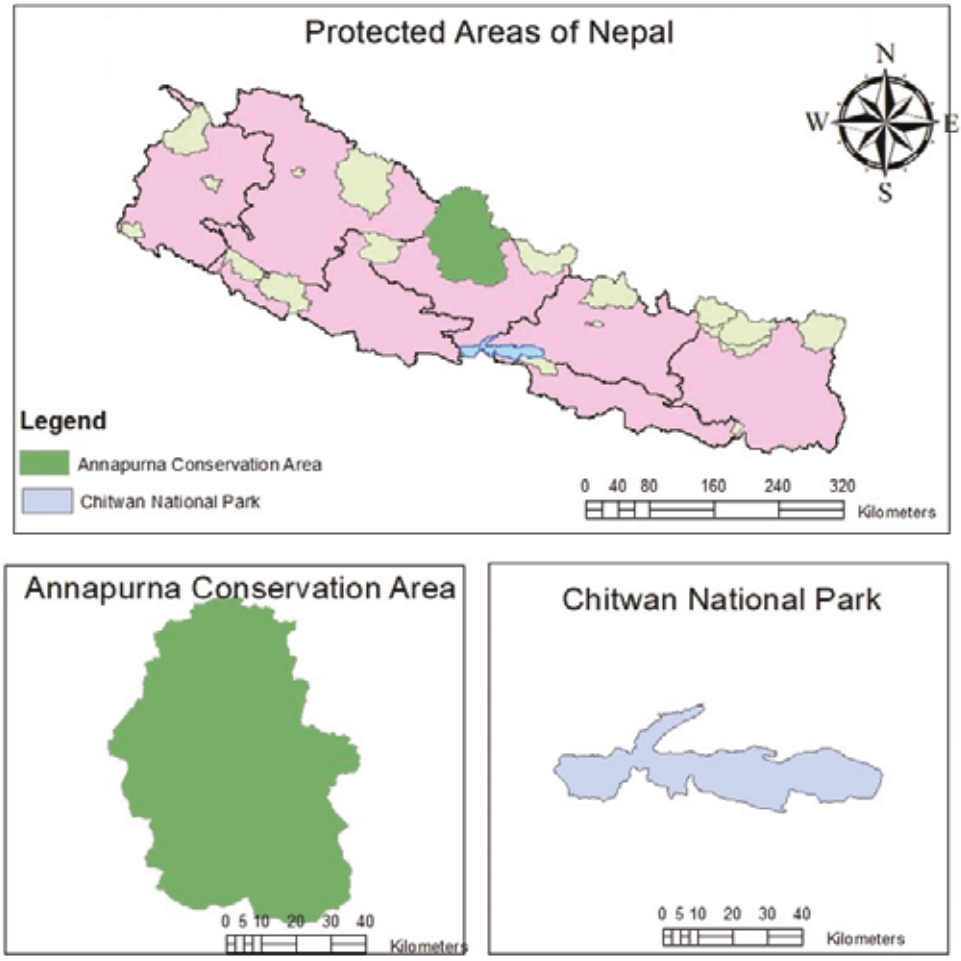
This study was conducted in Chitwan National Park (CNP) and the Annapurna Conservation Area (ACA) (Figure 1).

CNP, established in 1973, initially adopted a centralized management model of Fine and Fence, supported by the Nepal Army led to conflicts with local communities over land rights and resettlement (Michael et al., 2016). ACA emerged as a pioneering solution, representing Nepal's first foray into community-engaged conservation initiatives. ACA aimed to harmonize conservation objectives with the socio-economic needs of resident communities. Remarkably, both CNP and ACA collectively attract a substantial majority, nearly 51%, of total tourists visiting protected areas, since FY 2060/61 underscoring their pivotal role not only in biodiversity conservation but also in driving the nation's tourism sector.

Since its establishment in 1986, the Annapurna Conservation Area Project (ACAP) has been Nepal's flagship project of the National Trust for Nature Conservation (NTNC). It is the country's largest Protected Area and the beginning of the Conservation Area initiative. ACAP, which spans 7,629 square kilometers, is home to a population that is more than 100,000 people and exhibits a mosaic of linguistic and cultural diversity with Gurung and Magar communities dominating the southern terrain and Thakali, Manange, and Loba communities prevailing in the northern reaches (NTNC, 2022).

Figure 1

Map of study area



ACAP is known for its exceptional biodiversity and hosts a diverse range of flora and wildlife. ACA has become Nepal's most popular trekking destination, drawing the interest of a sizable percentage of the country's trekking lovers. The growing tourist industry has become a vital part of the local economy, as seen by the growth of more than 1,000 lodges, tea shops, and other related businesses that meet the various demands of trekkers, pilgrims, and the support systems that go along with them (NTNC, 2022). ACA is the home to the famous Dhaulagiri range and Annapurna Range including Mt. Dhaulagiri (8151 m asl.), 7th and Mt. Annapurna I (8091 m asl.), 10th highest peak in the world (Prajapati et al., 2020; NTNC, 2022; Michael et al., 2016). To maximize the effectiveness of conservation efforts, ACA has been divided into seven-unit conservation offices. This division allows for the implementation of customized conservation plans that are specific to the natural dynamics of each area (NTNC,2022; Nepal et al., 2022).

UNESCO designated CNP as a World Heritage Site in 1984, highlighting its exceptional value to humanity. CNP hosts a diverse ecosystem of wildlife, boasting 68 mammalian

species, 544 avian species, 56 herpetofauna species, and 126 fish species (CNP, 2022; Pandit et al., 2015). Embracing a holistic approach to conservation, CNP established a buffer zone encompassing 750 square kilometers of surrounding inhabited areas in 1996. This buffer zone initiative aims to foster participatory conservation by engaging local communities in collaborative efforts with park authorities to manage and protect the park's ecological integrity while promoting sustainable development initiatives.

CNP stands out as one of Nepal's premier protected areas, attracting significant attention from both domestic and international visitors. Moreover, CNP's commitment to community engagement and participatory conservation is evident in the transfer of 68 Buffer Zone Community Forests (BZCFs) to local communities for management and utilization. This initiative, covering a total area of 13,418.85 hectares, benefits a substantial population of 42,886 households and 223,555 users. Despite challenges posed by population migration and growth, CNP continues to uphold its reputation as a world-class destination for wildlife-based safari tourism, earning distinction as the foremost safari tourism destination in South Asia (Kandel et al., 2020).

These two parks in the lowlands and mountain regions of Nepal with diverse attractions, amenities, and offerings were selected for the research. Comparative study in two types of protected areas in diverse geography is the unique aspect of the research.

Methodology

Data collection was conducted in April and October of 2023 in Annapurna Circuit Trail (Besisahar to Tatopani) including the Ghorepani and Poon Hill of ACA and in Sauraha and Kasara in January and November of 2023 of CNP. Purposive sampling was performed and the locations were chosen based on popularity, tourism demand, and the major attractions of the PAs. Altogether, questionnaires were conducted with 136 respondents (ACA: n=79, CNP: n=57). Both the closed and open-ended questions were employed to gather insights on demographics, amenities, motivational factors, satisfaction levels, experiences, key attractions, and tourism impacts. 27 key informants (ACAP, CNP, NTNC officials, and locally elected local representatives) were interviewed. The snowball sampling method was applied to select the KI to make the work holistic and comprehensive. The sites were visited to validate the information provided by the respondents and informants. Likert scale was used to evaluate attitudes, perceptions, and opinions. Informal conversations with the local hotel owners, trekking guides, nature guides, residents, and respondents in the trail and fields were done to further validate the discussions with the respondents. In addition, the secondary data were collected from various reports and scientific articles.

Market demand analysis was done based on statistical analyses, including growth rate calculations and correlation assessments, which were performed to understand trends and relationships in tourist visits, revealing an overall annual increase in total protected areas and highlighting specific patterns in CNP and ACA with correlation coefficients. It shows the changing dynamics in tourism of both the parks compared with the rest of the PAs and reflects the socioeconomic impacts on the localities in the park premises. The average comparison of tourist ratings on five aspects of ACA and CNP, analyzing responses to identify key attractions, motivation, and amenities experience examining the impact of these attractions on tourism quality, length of stay, and visitor loyalty was quantified with the help of the Likert scale in the range of standard deviation. The study utilized questionnaire surveys

and interviews to evaluate socio-economic factors, visit frequency, and trip-related variables to understand their impact on visitor satisfaction, focusing on parameters such as trail conditions, amenities, budgets, accessibility, and cultural experiences, with results compared against existing literature and previous research.

Results and discussion

Demography of respondents

There were more male respondents (68%), most were in the age range 18-39 (52%), most of them were Asians (39.7%), and most of them (76%) opted for organized tours. Most of the respondents stayed. Tourists stayed less in CNP (3.95±0.44 days) than in ACA (12.35± 0.42 days). It is less than the average time spent by tourists who visited Nepal (13.1 days on average in the year 2022) (MoCTCA, 2023) (Table 1).

Table 1

Demographic background of respondents

		Frequency	Percentage
Gender	Male	93	68%
	Female	43	32%
Age Group	0-18	6	4%
	18-39	71	52%
	40-59	42	31%
	60+	17	13%
Region	Asian	54	39.7 %
	Europe	47	34.6%
	Other	35	25.7%
Mode of Travel	Organized	104	76%
	Self	32	24%
Length of Stay	ACA	3.95 ± 0.437	
	CNP	12.35 ± 0.424	

Market demand

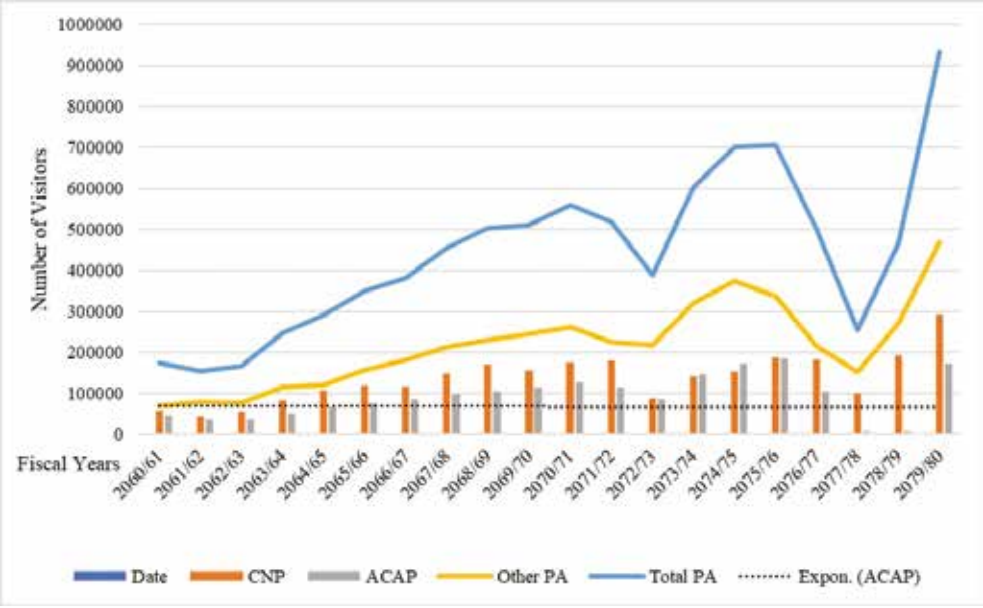
There is an increasing trend of tourists flowing in both the PA with an exception in FY 2015/16 (because of a massive earthquake in Nepal) and FY 2019/20 (because of Corona Pandemic). The tourist flow in PAs increased at the rate of 9% per annum from 2003 to 2023 and plunged to 6% per annum in the year 2013 to 2023. For the last 10 years, the growth rate of tourists in CNP and ACA was 5 % and 3 % respectively which is lower than the amount tourists visited in PAs of Nepal.

The visitor count in other PAs was correlated with the tourist count in all PAs, with a correlation coefficient of 0.95, while that of ACA and CNP was 0.59 and 0.89, respectively. Though the tourist flow in all the PAs and CNP is highly correlated with the total tourist count in the nation, the correlation with ACA seems to be decreasing each year. This might be because the tourists visited other PAs that offered equivalent attractions in a similar budget and amenities to that of ACA. It can be further demonstrated by the flat exponential trendline

of the ACA, indicating the saturation limit of the ACA.

Figure 2

Trend of tourist flow in CNP and ACA



Data Source: DNPWC, n.d.

All the PAs, including CNP, created the successive highest tourism flow after their highest count in FY 2076/76, except the ACA. For the nation, it is always good to have diversified sites of attractions but big questions about the economic activities uncertainties in ACA is something the stakeholders need to concentrate on. Regarding the concerns of KII in ACA, there is big doubt about the risk of being a destination of mass tourism at the cost of natural capital due to the depletion of the cultural aspects, commercialization, and lack of interest in the youth. They seemed worried about the days of stays and average expenditure which has been depleting since the last 10 years in the major trekking routes of ACA.

According to Noonan (2022), cultural attractions such as landmarks, museums, and concerts positively influence tourism demand. The tourism industry stakeholders should be conscious of crafting recovery strategies post-pandemic by identifying the key cultural amenities that drive visitor interest and strengthen the quality of tourism to influence the demand for tourism. Proper research on the potential products that can act as add-on products to the destination's core product can elongate the duration and quality of a tourism stay. Though the divergence in tourism was seen and anticipated for ACA and CNP for the coming FY, the stakeholders should be concerned about improving the quality of tourism promoting and sustaining the region's livelihood. The success of tourism should not be judged based on the arrival of the visitor counts in Annapurna as suggested by Holden and Sparrowhawk (2002).

Attractions

The respondents mentioned that they visited ACAP for natural scenery, similar to findings in earlier research (Phuyal & Poudel, 2016) and for wildlife and birding in CNP (Upadhaya et

al., 2022) (Table 2). Aryal et al. (2019) underscore megafauna, birds, and Tharu cultures as the main tourist attractions of CNP while mountain range, snow leopard, blue sheep, and Gurung culture are highlights of ACA. It also aligns with the study by the World Bank Group in 2022 that natural assets captivate around 45% of the total tourists (World Bank, 2022).

Table 2

Attractions of study area

Location	ACAP	CNP
Natural scenery	4.42 ± 0.06	3.88 ± 0.07
Trekking and adventure	4.20 ±0.08	3.04 ± 0.12
Wildlife and birding	2.87 ±1.12	4.25 ± 0.07
Cultural immersion	2.94 ± 0.13	4.15 ± 0.06
Nature photography	4.34 ± 0.76	3.10 ± 0.79

Table 2 compares the Likert scale ratings of the tourists on 5 different aspects of the ACAP and CNP expressed in an Average Likert scale of 5 with standard deviation. Visitors are attracted by the natural scenery and photography followed by the adventurous trek in the lap of the Himalayas in ACA while wildlife and cultural activities are the major highlights in CNP. Though the wildlife and cultural aspects play a vital role in visitors of ACAP, the pull factors seem natural splendor and scenery of the snowcapped mountains. For CNP, a significant portion of tourists were present only to witness certain species of megafauna, and the cultural performance of the indigenous Tharu community. A notable portion of travelers seek to see wild flora and fauna on the trail of ACA. All of the hotel owners (3) in Yak Kharka and the majority of the hotel owners in Manang have administered the increasing trends of the tourists staying in the hotel to witness the snow leopard. An owner also added due to conservation, witnessing Snow leopards in Yak Kharka has been easier than in the past. Often, they can see it every 3-4 days a week during the season.

The scenery seems the first option for the visitor followed by the adventure and photography for the ACA coherent (Phuyal & Poudel, 2016) which revealed that 23% of travelers were primarily attracted to visit Nepal by its scenic beauty, followed closely by 21% seeking adventure, with pilgrimage, work, and nature escape each accounting for 16.5% and 11%, respectively. Numerous research and government reports justify natural and cultural treasures, diverse landscapes, climates, rich flora and fauna, numerous temples and shrines, hot springs, and so on are the major attractions in Nepal (MoCTCA, 2023; Dhakal, 2014). The major attractions of Chitwan National Park (CNP) include its diverse wildlife, opportunities for community engagement, and immersive experiences in Tharu culture, art, lifestyle, and traditions (Upadhaya et al., 2022) and our survey revealed similar outcomes. It also aligns with the study by the World Bank Group in 2022 that natural assets captivate around 45% of the total tourists(World Bank, 2022).

Key Informant Interview (KII) of ACA also agreed that natural scenery is the most important luring point to tourists while KIIs of CNP felt that wildlife and local cultural settings attract tourists. Local representatives in Manang and Chame agree on the bitter truth of decreasing cultural traditions and interest in youth for cultural preservation while it was reversed in Ghandruk. Though natural scenery and landscape are the gems of ACA, cultural aspects and faunal sightings can add value to the tourism of ACA increasing the quality of the tourism

and remediating the decreasing length of stay in ACA. Similarly, according to hotel owners and nature guides; adventures like jungle walks, elephant feedings, and Tharu dance have been increasing in the last 5 years contributing to the length of stay, quality of the tourism, and loyalty in visitors towards CNP. So, it is pivotal for the stakeholders to work in the weak rating area to improve the quality of the tourism and loyalty of the tourists.

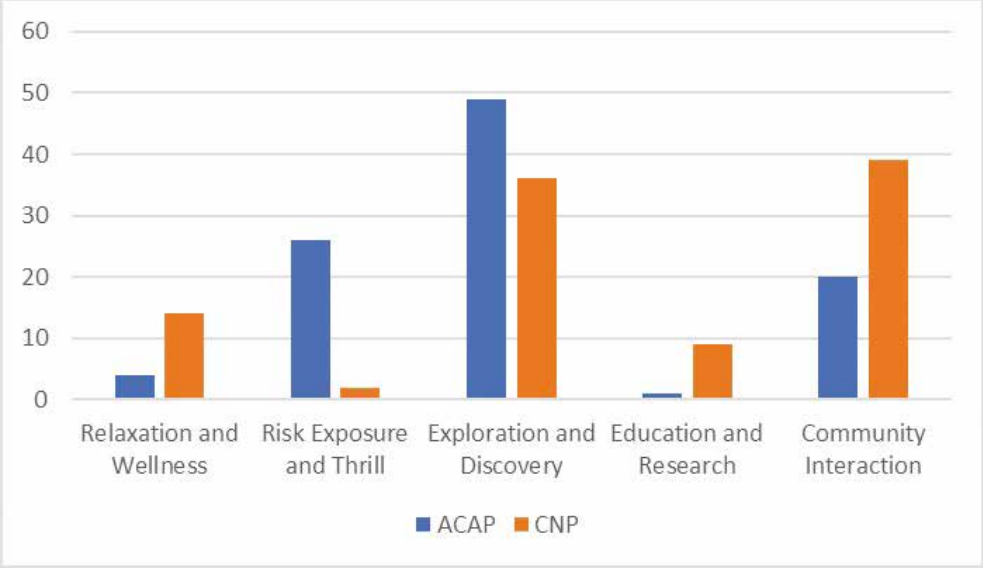
Motivation

Almost half of the respondents visited ACA for the exploration of nature, landscape, and the mighty Himalayas while slightly more than one-third of visitors go to CNP to explore diverse nature, cuisine, and culture as illustrated in Figure 3. About a quarter of tourists are excited about the thriller experience and risk in the high altitude and Himalayan Pass though the majority of the visitors agree the Thorong La Pass (5,416 m asl.) is the main highlight of their treks. A minimal chunk of the tourists was found engaged in research or education as the motive of their visit to both protected areas. This might be due to the selection of foreigners as the majority of the samples for the study.

Physical relaxation doesn't seem to be the motive of the visitor in Nepal, the trekkers in ACA are willing to take risks and challenges which is quite similar to Holden & Sparrowhawk (2002) that almost 60% of trekkers in Annapurna try to test their abilities. In the same study, almost 87% of visitors desired to get connected to nature which is coherent to the motive of visitors of both of the destinations in our study.

Figure 3

Factors of motivation in visitors



Interaction with the community and cultural shows motivates significant portions of the visitors of CNP than in ACA. The popularity of CNP for culture and community interaction may be due to the priority and interest of the local community towards ecotourism and cultural preservation as supported by research (Upadhaya et al., 2022). The main purpose of a visit to the CNP was recreation followed by education and official visits in 2005 (Saha &

K.C., 2005). Results are coherent with the results of Saufi et al. (2014), Community involvement is crucial for accessing the benefits of ecotourism, yet it also involves granting them a voice in regulating the development of ecotourism. The sense of ownership and perceptions of ecotourism within host communities are significant factors in its development. The study is consistent with a study in 2016 that implies 51% engaged in trekking activities during their time in Nepal, while 41.5% took part in cultural events (Phuyal & Poudel, 2016). The findings also imply exploration which includes trekking, safari, and other exploration means motivates around 50 % of the tourists while community interaction and culture attract roughly 40% of the visitors.

Research indicates that tourists' reasons for visiting a destination are closely linked to the appeal of the destination itself and may differ from one place to another (Amuquandoh, 2017; Paudyal et al., 2020). Demographic parameters have greatly influenced visitors' motives regarding the destination, specifically thrill seekers and pleasure aspirants. Similar research by Baniya et al. (2021) in the Gaurishankar Conservation Area indicates that tourists' motivations differ significantly in their socio-demographics, travel patterns, satisfaction levels, recommendations, and travel profiles.

Amenities

Food and hospitality received the highest perceived rating as satisfactory in ACA whereas accommodation received the satisfactory rating for CNP. The tourists praised the freshness of the food and hospitality of the hosts in ACA. Many tourists complain about the accessibility and transport to the ACA reflected by below-average ratings in Table 3. It is partially according to the research on tourist satisfaction in Nepal which implies the discomfort of tourists on transportation and accessibility (Phuyal & Poudel, 2016).

The hospitality and community engagement in the service of the visitor seems poor in CNP compared to ACA. This may be influenced by the selected sampling site of CNP or due to the commercial settings of the Sauraha. The response towards accommodations has improved drastically compared to similar research in 2005 (Saha & K.C., 2005) while the road and transport seem similar enduring for almost 2 decades.

The residents and KII of the ACA have mixed opinions towards road and transport; some accept the condition of the road is setting back tourism and development while others argue the road is decreasing the length of stay of tourists in their area and shrinking the economy of the locality. Some of the local representatives complain about the objections of ACAP during the construction of the road and development activities. Unlike another parameter, quite diverse views were obtained from the tourists in the ACA region and CNP.

Table 3
Amenities of study area

Rating scale	ACAP	CNP
Transportation	2.89 ± 0.12	3.06 ± 0.13
Food	4.31 ± 0.01	3.07 ± 0.10
Accommodation	3.011 ± 0.12	4.52 ± 0.27
Hospitality	4.06 ± 0.08	2.97 ± 0.31
Community engagement	3.37 ± 0.89	2.75 ± 0.14

Community engagement is always the ace in the hospitality and tourism industry for any destination as it is the key matrix to increase the loyalty, satisfaction, and repetition of the tourists to the location, also noted by Baniya et al. (2021). Numerous studies have explored the fundamental concepts of community involvement, engagement, and significance in the context of tourism development (Salazar, 2012; Goodwin & Santilli, 2009; MacDonald & Jolliffe, 2003). The research on homestays also suggests that cultural aspects and lifestyles are crucial for sustainability and satisfaction, among the all-important parameters like amenities and safety, reception, local cuisine and accommodation, local lifestyle and costumes, and cultural performance. A comparative study in Annapurna, and Yunnan, China (Nyaupane et al., 2005), justifies the degree of host engagement in management, coupled with the quantity and characteristics of tourists, elucidated the diverse levels of economic outflow, local authority, and socio-economic disparity across these destinations (Biswakarma, 2015). This is consistent with K.C. et al. (2015) findings, whereby it reflects the need for awareness and education for the locals to increase the length of stay of guests. It is supported by the findings of a study in India that limited community ownership within the realm of ecotourism has been identified as one of the constraining factors preventing communities from realizing their full potential in ecotourism development (Patricia et al., 2021). On the other hand, ecotourism is a great source of economic empowerment for the locals (Nyaupane & Poudel, 2011). However, some research contradicts the findings as unmanaged and mass tourism brings negative effects on society and ignores the heterogeneity of the community. Residents express disappointment as they have grown reliant on ACAP for training, development opportunities, and financial benefits (Michael et al., 2016).

Adequate infrastructure plays a crucial role in supporting biodiversity conservation, enhancing livelihoods, and fostering tourism development. The facilities built for conservation, like roads, emergency health posts, trails, forest roads, embankments, artificial lakes, picnic areas, and watchtowers are common for locals and tourists and are utilized by local communities (Nyaupane & Poudel, 2011). Environmental elements such as accessibility and amenities significantly impact tourist satisfaction, being vital for their visits equally as the socio-cultural factors like cultural heritage, local wisdom, and socio-cultural tolerance (Fionasari, 2024).

Satisfaction

The majority of the tourists were found satisfied with the environment setting of the ACA unlike that of the CNP though respondents responded to the average conditions of the environment as shown in Table 4. The parameters for it were the condition of the trails, trash bin, signboard, toilets, and other amenities. Accessibility was found poor in ACA compared to CNP. The cultural experience in CNP was found to be far better compared to ACA. The cost of the facilities was cheap in both of the destinations.

Other research on tourist satisfaction in Nepal also evidenced high satisfaction with the hospitality and natural beauty of the destination (Phuyal & Poudel, 2016) which is coherent with our findings but foreign visitors in CNP and ACA don't show dissatisfaction towards the cost of amenities, unlike that research.

Table 4

Satisfaction parameters in visitors

Satisfaction parameter	ACA			CNP		
	Good	Ok	Satisfied	Good	Ok	Satisfied
Cultural immersion	24	47	29	9	23	68
Cost and budget	17	25	58	23	56	21
Accessibility	21	66	13	12	37	51
Unique and quality of experience	23	29	48	31	32	37
Environmental quality	4	3	93	19	74	7

Various socio-economic, frequency of visits, and trip-related factors influenced visitors' assessments of ecotourism within the ACA (Baral et al., 2012). Overall, the satisfaction scale was found okay for both of the parks which coincides with the findings of Baral et al. (2012). Visitors generally expressed satisfaction and positive evaluations of ecotourism in the ACA, yet repeat visitors tended to voice criticisms. Declining cultural engagement and waning youth interest in cultural activities pose significant threats to the durability and excellence of tourism within ACA. According to Joshi and Dahal (2019), visitors expressed high satisfaction with the tourism activities, as well as with the conservation and development efforts at ACA but our study shows average satisfaction of visitors towards parameters of development and accessibility. However, it is in line with our study of anticipated challenges shortly including perceived crowding, congestion, and cultural degradation.

Conclusion

This research offers important insights into the dynamics of tourism practices in relevance to conservation, competitiveness, and visitor satisfaction of Chitwan National Park and Annapurna Conservation Area in Nepal. While both destinations witness steady growth in visitor numbers, ACA faces the challenge of saturation, crowding, and poor quality due to mass tourism requiring strategic management interventions. Motivations for visits, including nature exploration, adventure, and cultural immersion, highlight diverse visitor interests in different parks. Tailored marketing, preferences, and development strategies are necessary due to the differing attractions of the two destinations. Despite fair satisfaction levels, challenges such as overcrowding, declining tourism quality, environmental degradation, and accessibility constraints require urgent attention to ensure sustainable tourism development in ACA. Cultural aspects and youth interest in culture are found declining, which is creating threats to the quality and sustainability of tourism in ACA. Improvement in cultural assets can increase the number of days of stay of visitors, so learning from CNP's success in promoting culture to strengthen cultural aspects in ACA and promoting the growing demand for jungle walks in CNP can enrich the tourism offerings of both destinations. The two destinations complement each other's strengths and weaknesses in amenities, hospitalities, attractions, and motivations. Stakeholders can create a master plan integrating adventurous activities in mountain parks and relaxing/cultural activities in lowland parks for holistic tourism development. Collaboration is crucial to ensure the sustainability of ecotourism in Himalayan and lowland parks, preserving natural and cultural heritage.

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Homestay Operators' Experiences in Initiating and Developing Homestay Enterprises

Chet Nath Kanel[1], Prakash C. Bhattarai[1] & Laxman Gnawali[1]
[1]Kathmandu University- School of Education, Hattiban, lalitpur, Nepal
Correspondening email: chetnathkanel@gmail.com
DOI: http://doi.org/10.3126/jtha.v6i1.67393

Abstract

Community homestay development is one of the strategies to culture-based accommodation, mostly in the rural and remote settlements in Nepal. Homestay tourism has been in practice for more than two decades, and it is rapidly spreading in many parts of the country. This article attempts to bring the views and experiences of community homestay operators regarding their understanding, awareness, perceived benefits, and homestay initiation and development practices from Mahabharat Hills of Bagmati Province. Ethnographic field observations and 'bhalakusari' (in-depth talk) were the dominant methods applied during the data collection process. The findings suggest that due to multiple types of perceived as well as experienced benefits from community homestay tourism, locals have enthusiastically learned and adopted homestay enterprising, in which local-level institutional facilitation and support activities have become main motivators in the processes. In such areas, gradual increase in external facilitation, exposure and capacity development endeavors, increasing tourist arrivals, and wide ranges of direct and indirect economic, socio-cultural, and environmental benefits are visible. All these factors have encouraged the locals to engage and expand community homestay development initiatives in their areas. Despite multiple positive facets of homestay tourism, there exist some challenges too. The article also suggests some policy and practice-level implications.

Keywords: capacity development, community homestay, enterprising, Mahabharat Hills

Introduction

Tourism is considered one of the most potential growth sectors of Nepal's economy (Bhattarai, 2019; Shrestha & Shrestha, 2021); and, due to tourism and its limitless resources, Nepali tourism has been famous in the world (Sharma, 2019). Among different types of Nepali tourism, 'homestay tourism' occupies significant space, providing not only the accommodation facility to the tourists but also numerous opportunities to exchange and promote cultural assets with direct engagement of local people/stakeholders (Lama, 2014). According to Taragaon Development Board (TGDB,2016), due to homestay tourism's multifaceted contributions, such as economic, social, cultural, educational, environmental, and so on; its popularity in Nepal is increasing. Now, there are homestay destinations in all seven provinces, and almost in all the districts of Nepal (TGDB, 2016). The homestay operators/ entrepreneurs (the 'hosts') are the backbone of homestay tourism-based enterprising in Nepal. According to the Ministry of Culture, Tourism and Civil Aviation (MoCTCA, 2021), there are two types of homestays: community homestays and private homestays, which can be opened and run in both rural as well as in urban areas. So far, Nepal's homestay tourism is dominated by community homestay, and its rapid expansion in Nepal is greatly realized by all types of

stakeholders (Nepal Tourism Board [NTB], 2023). The expansion of such endeavors depends on the overall capacity of the operators as well as other stakeholders in the destinations. There are different issues associated with the learning and capacity development of community homestay operators. Due to this, the expected quality growth of Nepal's homestay tourism has also been a challenging issue. In this context, Lama (2014) and Pandey (2011) also assert that the total stay of the tourists and the expansion of homestay businesses are directly associated; because, in each destination, "tourists' stays depend on the quality and hospitality services as well" (Baniya & Poudel, 2016; Devkota & Poudel, 2019; Paudel & Bhandari, 2021).

In the homestays, guests can enjoy practicing all types of rural traditions, cultures, foods, and costumes (Nepal Rastra Bank [NRB], 2015; Sharma, 2019). From these activities, locals earn economic as well as other benefits. These trends and practices have instigated locals to open homestays in many destinations like Sirubari (Syangja); Ghalegaun, Ghanpokhara, Bhujung, Kaulepani and others in Lamjung; Hattibang (Chitwan), Amaltari (Nawalpur), Briddhim (Rasuwa), Shree Antu (Ilam), Bandipur and Tanahunsur in Tanahun; Namje (Dhankuta), Gabhar Valley (Banke), Dallagaun (Bardiya), Bhada (Kailali), and so on (Sedai, 2018; NTB, 2023). These are a few renowned homestay sites in Nepal; and, among them, Sirubari is the first community homestay village in Nepal, which formally began in 1997 (MoCTCA, 2010). It started working as a 'live school of homestay' for many new homestay communities and destinations in Nepal. However, local people's understanding about homestay enterpreneurship and their initiatives for establishing and developing homestay is less studied and less documented in Nepal.

Therefore, this article intends to bring some lived experiences about how those homestay operators experienced the initiatives and efforts to think of homestay enterprising and bringing the thoughts into reality in response developing community-based homestays in their respective areas/villages. Thus, the main purpose of this article is to illustrate how the homestay operators describe their experiences in conceptualizing, initiating and developing homestay enterprising in Nepal, particularly focusing on 'Mahabharat Hills' of Bagmati Province, Central Nepal (proper location is not shown in this article due to ethical reason).

This exploration revolves around the following two research questions with an intention of investigating the "lived experiences" of homestay initiation and development processes in the community-based rural tourism destination in the Mahabharat Hills: i. How do the community homestay operators in the area describe their know-how, initiatives, and motivation for setting-up homestay enterprises?, and ii. What key challenges are these homestay operators facing since the establishment of such community homestays in the area?

Review of literature

Homestay benefits and community engagement

Many researchers have claimed that rural tourism and homestay tourism can be a boon for the rural populace creating multifaceted opportunities (Acharya & Halpenly, 2013; Bhattarai, 2019; Lama, 2013; TGDB, 2016); and, according to them, in Nepal, homestay tourism and village tourism are highly appreciated for multiple benefits for the rural inhabitants including economic, cultural, social, environmental, infrastructural, and community empowerment—particularly of women. In the same manner, through an empirical study in the Mid- and Far-Western part of Nepal, Sedai (2018) shows that the tourism development process is expected

to bring several opportunities for the local stakeholders for their overall benefits; otherwise, there would be no meaning of developing tourism or increasing the number of tourists. Similarly, referring to an Indian case (Garhwal), (Nigam, 2002) reported that local tourism would significantly support in creating new employment through the tourism sector, mainly in the businesses such as hotels and holiday resorts, guest houses, river rafting, and water sports complexes, skiing resorts, wildlife sanctuaries, pilgrim places; and, transport and tour agencies. In the same manner, research in India's famous tourism destination Sikkim State, carried out by Lama (2014), reports that homestays have become integral to rural/ecotourism developing local capacities. Many eco-tourism destinations exist in national parks, wildlife reserves, hunting reserves, and surrounding eco-areas, due to which many homestay entrepreneurs have emerged as 'homestay operators' in these sites.

Likewise, the study by NRB (2015) in the western Nepal found that homestay development efforts are also capacitating locals to enhance their knowledge and skills, which have supported in bringing out the local stakeholders, more importantly, women entrepreneurs in the front of the local development processes, and ultimately such endeavors have enhanced their empowerment and social status, giving power to individuals to assert their rights responsibly. The NRB study (2015) further asserted that owing to such empowerment-related actions, the fascination of community people towards homestay, particularly women, has escalated in Nepal as a part of human and community capital development. These contribute to education, motivation, working skills, physical health, mental health, well-being, happiness, and human potential growth.

Capacity enhancement and motivation

Developing human and social capital within the communities is also very important in these scenarios. Based on a research, Dube and Sharma (2018) conclude that homestay host families can have a myriad of motivations ('drivers') for running the homestay enterprises, despite some obvious de-motivating factors or the 'barriers', such as seasonality, irregularity in tourist arrivals, etc. While visiting homestays, some tourists share their culture (called 'cultural interface') and languages with the local host families. A cultural bridge is considered essential to achieve successful and sustainable ventures through collaboration, especially in conservation-focused tourism and development. Homestay can be a good means of cultural exchange (Kandel, 2011), and also a good example of ethical enterprising (Kanel, Bhattarai, & Gnawali, 2023). The main beauty of homestay tourism is that tourists there pay 'good money' and leave a 'good memory' to the host family, which could be a good source of motivation to be indulged further and further.

Reflecting on the research experience from Chitwan Terai, which would be, to some extent, applicable to similar areas of Bagmati province and in the Mahabharata Hills, Kunwar (2002), Pradhanang (2002), and Poudel (2014) also suggested developing various village-tourism products linked with conservation sites taking into consideration various factors such as short- and long-term tourism development strategy; ecological perspectives; active participation of local stakeholders through user groups, functional groups, and management committees; local ethnicity and culture; human and wildlife behavior; interrelationships and chain reactions in the local economy; multiplier effects of local tourism enterprises; rural-urban (village-city) linkages; and so on. Likewise, a study in the eastern side of Nepal, Barahachhetra, Sunsari, by Prasai (2023) also reveals that if proper education and training are given and business environments are created, local people can profoundly change their

economic status and tourism business capacities through an enhanced employment opportunity with greater confidence. Ghimire (2013) also found similar examples from Ghalegaun, Lamjung. Homestay and small hotel operators' enhanced exposure and awareness in such areas are crucial.

Similarly, in the western part of Nepal, Sedai (2018) found that local stakeholders of homestay tourism lack the proper skills and knowledge to manage their homestays. Also, he noted that proper facilitation at the local level is also a missing part. Likewise, the research carried out by Acharya and Halpenny (2013) in the Annapurna region of Nepal concludes that the homestay enterprise focuses on women's capacity development and empowerment with an understanding that empowerment creates many opportunities for dignity and prosperity. However, KC (2003) notes that women entrepreneurs in the tourism sector face several challenges. including lack of proper skills and knowledge, lack of financial support, limited marketing opportunities, etc. In addition, in our observations too, lack of business literacy, limited exposure on information and communications technologies (ICTs), and lack of technical backstopping were some of the hindrances faced by the entrepreneur women.

Gaps in the capacity and motivational issues

Different researchers have indicated some gaps in the capacity development issues as well as motivational issues. For stance, based on research on awareness, capacity enhancement, and human resources issues in Nepal's tourism, Pandey (2011) illustrated four major gaps experienced in the community-oriented tourism training and workshop programs or capacity development endeavors in the fields. He also advocated for timely updates and periodical revisions, as well as improvised curricula and reading/reference materials for bettering training programs and their effectiveness. Likewise, Bhandari (2013) and Mahato (2013) concluded that homestay's main contributions are economical, followed by social, infrastructural, cultural, environmental, educational, etc. In the motivational efforts, such issues are to be dealt with cautiously (Yaza et al., 2023). There are observations that community-based tourism (CBT) in the Annapurna region, where, for example, in Manang, most of the households are engaged in tourism businesses (mostly hotel/tea-house) and they do not allow any outsider to enter as 'hotel operator'. Thus, homestay's multifaceted roles are acknowledged and recognized widely (Ghimire, 2023); and gaps in the capacity enhancement and local facilitation processes need to be addressed accordingly (Bhandari, 2021 & 2023; Chimariya, 2014; Kunwar, 2002; TGDB, 2016). In this regard, the learning from the project (Tourism for Rural Poverty Alleviation Program- 'TRPAP'; 2002-2007), run by Ministry of Culture, Tourism and Civil Aviation (MoCTCA) and the UNDP in six districts of Nepal, were remarkable (UNDP/TRPAP, 2007). The lessons were further replicated by various institutions/projects in Nepal, such as The Himalaya Trail Project, Sustainable Tourism Livelihoods Recovery Project (STLRP), and others (Choegyal, 2011; NTB, 2023).

Policy instruments and local codes of conduct (CoC)

In this last section of the literature review, let me discuss some of the policy/legal provisions associated with homestay establishment and development in Nepal. Replacing the old Tourism Policy- 1972, the Government of Nepal (GoN) brought a new Tourism Policy- 2008 (BS 2065) (MoCTCA, 2008). It particularly envisioned bringing tourism benefits to the poor communities, especially in the rural areas. Later, 'Nepal's Tourism Vision 2009- 2020' envisaged attracting two million tourists and providing jobs to one million people by 2020 (MoCTCA, 2014). After the formulation of Tourism Vision 2020, efforts are made to

translate this into action by preparing and implementing a 10-year National Tourism Strategy and Action Plan, 2016-2025 (MoCTCA, 2016). Equally important, Nepal's new 'Constitution' (Constitution Assembly, 2015), for the first time in history, under the 'Directive Principles, Policies and Obligations of the State (Part 4)' has inscribed the importance and roles of the tourism sector for the overall development and prosperity of the country.

Likewise, the above-mentioned 10-year 'Strategic Plan for Tourism Sector (2016-2025)' seeks huge investments from the government, private sectors, and international investors (MoCTCA, 2016), aiming to bring 2.5 million international tourists by 2025. However, COVID-19 seriously hampered the efforts, and global tourism suffered an unprecedented setback (UNWTO, 2022). Now in the years 2023 and 2024, Nepal's tourism is reviving, which has put special emphasis on homestay tourism as well. Homestay Federation of Nepal (HOFAN) is helping the homestay operators to unite, capacitate and raise the quality of homestay services in Nepal. 'Homestay Operation Directive 2010' (MoCTCA, 2010) is the main base for initiating and developing homestay services in different provinces and local municipalities in Nepal. Lately, all provinces and most of the local governments have also been facilitating local communities to establish and develop homestay enterprises through policy provisions, grant support, training activities and also linking local products/services with different markets in close collaborations with Nepal Tourism Board (NTB) and other organizations.

The 'Homestay Operation Directive' entails basic criteria for establishing a homestay, registration, and renewal procedures, types of homestays in Nepal, homestay management committee's formational and operational process, reporting obligations and techniques, monitoring mechanisms, auditing processes, code of conduct (COC), etc. According to the Directive, homestay facilities can be operated in rural and urban areas (Karki, 2013). Generally, rural homestays mainly focus on two services: accommodation services and cultural exchange services. Commonly understood, homestays should always serve as 'cultural homestays' (Kandel, 2011). To serve those purposes, the 'Directive' encompasses seven important objectives. After the formulation of the Directive, rural communities in tourism sites were encouraged to open their houses as homestay service providers, further expanding the tourism accommodation infrastructure in the destination (MoCTCA, 2010; TGDB, 2016). In the homestay development, locals develop certain rules for effectively managing the system.

Certain 'codes of conduct' ('aachaar-samhitaa') are similar to every municipality or province because centrally developed codes of conduct mostly influence them (Bhadgaunle, 2022). Such 'codes' outline some important rules like rotational distribution of guests, common menu (package) and price, no entertainment activities/no noise after 10 pm, no special demands to be made by the tourists, respect to each other, emphasis on the pre-information system for the visitors, tourists' arrival in the village before the sun-set; respecting each others' religion, caste, language, culture, dresses, etc.; no debate on religion, caste, and political matters. However, based on its various federal and provincial level interactions, TGDB (2016) concluded that those codes are not properly implemented in many homestay destinations. Furthermore, the monitoring of the implementational parts is also lacking (Kandel, 2011; TGDB, 2016). These situations demand more coordinated and concerted efforts to effectively develop those policies and guidelines and subsequent executions of community homestay development.

Methodology

In this research, the researchers are guided by the philosophy that each person and each community has different experiences, methods, opportunities, abilities, perceptions, and capabilities. Different homestay operators have different experiences and feelings. Thus, to properly grasp the ideas and experiences, while designing this ethnographic research, we have adopted an interpretive paradigm with a 'reflective approach' (Bogdan & Biklen, 2011; Hammersley & Atkinson, 2019; Saldana, 2015), which enabled us to seek the meaning of the 'social world' of homestay operators in the 'Mahabharat Hills' of Central Nepal. According to Gobo (2011); Khan (2011); Saldana (2009, 2015), and Van Maanen (2011), ethnographers observe, participate, interact, analyze, reflect, write, rethink, and describe cultures, their members, and their involvement with them.

For the study, we chose one of the homestay sites ('Mahabharat Hills': MH, name changed) in the Bagmati province, Central Nepal, where dominantly ethnic people Chepangs reside. Other castes are Giri-Puri (Dasnami), Magar, and Brahman-Chhetri. Here homestay tourism development efforts, although on a limited scale, have been going on for almost two decades. All initiatives here have been geared towards developing hill tourism, like 'hill-station tourism' based on community homestay initiations. This area is one of the famous rural tourist destinations in Nepal.

The Bagmati province is the epicenter of Chepangs' inhabitation in Nepal (Gautam & Thapa-Magar, 1994). Chitwan, Makawanpur, Dhading, and Gorkha are famous for Chepang-dominant communities in this province. Chepangs have their language (but no separate script), rituals, foods, and costumes. Irrespective of difficult life conditions (Gurung, 2016; Khanal, 2014; Mukul & Byg, 2020; Sapkota & Uranw, 2013). Chepangs' unique lifestyle, traditional cultures, and geographical landscapes are great assets/resources for CBT development/ promotion in the MH. Considering the nature of the inquiry, we designed the research to adopt a purposive sampling technique to find the 'natural' and 'actual' worlds, where first-hand experiences do naturally and explicitly exist. Thus, as mentioned above, in such a subjectivist inductive study, the research participants were the "homestay operators" of the MH. In this study, we chose seven homestays as our research units. Families having homestay experience and being able to provide such services at present were the main basis for selecting as research participants. Both male and female participants were observed in their day-to-day life activities, particularly focusing on homestay operational works and other cultural activities. The field research was accomplished from 2019 to 2021. For ethical reasons, pseudonyms of the research participants are used in this article.

During the field study processes, different techniques and tools were applied for qualitative data collection, including observations, bhalakusari/kurakani, and focus group discussions (FGD). The scratch notes ('rough notes'), field notes (elaborative notes from those rough notes), conversational interview/bhalakusari records (audio) and transcripts, photographs (with their prior approval), local artifacts, and key participants' diaries/copies, as well as the homestay management records, were the main sources of research 'data.' The data were further synthesized manually and appropriate "themes" and "issues" were developed and analyzed to illustrate the findings logically and systematically.

Keyinsights, and discussions

Research participants' experiences and reflections, along with our observations, have been

categorized into four major themes as described below. Related discussions are also embedded within those themes as kew issues on how the locals get tourism-related information, how they develop their knowledge and skills, how they are motivated and facilitated to run homestay enterprises, as well as on what sorts of challenges are these homestay operators (mostly women) facing at present in in the Mahabharat Hills of Bagmati Province, Central Nepal.

Knowing, observing, and experimenting

First, let's share a brief story about how the homestay operators of the MH got an opportunity to hear and know more about homestay enterprising as a possible new economic and social venture in the area. As mentioned in the previous sections, in Nepal, homestay tourism is considered a reliable vehicle for economic growth and overall development of the local area and its people/stakeholders' capacities (from a 'human capital' perspective). Based on the empirical experiences, UNDP/TRPAP (2002-2007) was an example from Nepal to implement a pro-community rural tourism initiative that developed several CBT-based products, including SRT models and homestays in the pioneer areas. According to the project document (UNDP/TRPAP, 2007), the main aim was to make the local people aware of the potential of their area and encourage them to engage in tourism enterprises directly and/or indirectly to increase household-level incomes with preservation/ conservation of natural and cultural resources and their promotions. In this context, one day, the key researcher was talking to one of the research participants, she was Shukrikala. She shared that:

> *From the tourism project I learned many things, and gradually I started experimenting with them in my daily life. Initially, the tourism development project gave an introductory orientation about local tourism potentials. It was—at the start—just a two-day event. The event taught us about tourism, rural tourism, and the importance of the Mahabharat Hills area from rural tourism development potentials. We heard a lot about the need to protect and develop local cultures and traditions; and also the protection of plants, trees, animals, soil, water, and many more. We also learned about waste management, health, and hygiene, etc. After the event, I also showed my interest in getting engaged more in tourism-related activities and businesses. I was very hopeful of getting more and more benefits from the tourism businesses.*

In the same connection, while having a bhalakusari with the research participant Buddhi Maya, who was Shukrikala's neighbor too. She also shared that after some developmental support from the rural tourism project, the locals started getting some tourists from different parts of Nepal and some from foreign countries too. And, due to the absence of accommodation (hotels) in this area, "we decided to open homestays in our village", she happily shared. She further stated that, before, tourists used to come with camping equipment and gears (e.g., tents, utensils, etc.) and used to stay in the open grounds.; and, realizing this, the locals decided to start homestays in their houses.

Accordingly, as she claimed, before launching homestays in the village(s), locals learned more about the basics of homestay development and management with some cultural considerations. More importantly, local tourism facilitators helped them from the very beginning; and, later, the then local government—village development committee (VDC)—also started talking about rural tourism and homestay development activities. In an FGD, they also shared that the locals gradually knew about the profitability of homestay, being a good source of earning (additional) money, and more. They also got a chance to visit Sirubari, Syangja—the pioneer homestay village in Nepal—which provided a better understanding of

homestay entrepreneurship. According to them, the trip also helped develop an understanding that, if properly developed, it can provide many things and many benefits such as new knowledge, hygiene, and sanitation-related ideas and concerns.

It was also added by the participants that from Sirubari they learned about local women's leadership, green development, local infrastructure development, and so many other things. They developed their overall confidence. Likewise, in a separate bhalakusari, research participant Shanishchara, highlighting the initial stages of her involvement, shared that she was also one of the participants in the exposure-visit team, and once she got that opportunity, as an experiment, she immediately decided to open a homestay room in her house and also decided to be in the homestay entrepreneurs' group of MH.

Inspiration and motivation for homestay enterprising

According to the research participants, as primarily shared during bhalakusari and FGDs, the initial facilitator of the homestay initiative was a tourism project, supported by foreign aid, oriented towards community homestay entrepreneurship. From this perspective, research participant Som Maya's voice was worth noting:

> *My husband and I both attended a two-day workshop organized by the project, and we got information about tourism potential in our area and the possible participation of men and women in different tasks and businesses. Also, we got to know about entertaining guests in our houses. But, initially, we (my family) were not interested in keeping guests in our house since our house was so small compared to other's houses in this area. We first decided to get involved in handicraft-making (bamboo-based crafts) and then started getting many opportunities to have more training in other subjects. After a few years, we added an extra room to our house with a thatched roof, and gradually we could also welcome guests. Thus, primarily, the project's facilitation and support motivated us to participate in homestay enterprising and other skill-based activities, including handicraft-making, bee-keeping, poultry, etc.*

According to locals, besides the project, some other organizations and local VDC offices also supported further skills development ('software') and some logistic or materialistic/ 'micro-finance' supports ('hardware') (Lamichhane, 2020). Those inspiration and support were their main foundations or 'drivers' for starting homestay and other related businesses. However, after the devastating earthquake of 2015 (April 25), most of the houses were damaged; and now rebuilt with support from the government (National Reconstruction Authority- NRA). Before there were thatched houses, but now they are all metal (tin)-roofed. Under this support, each victimized household was expected to make a new single-story building with two to three rooms. Equally, as 'special model' for such reconstruction work was provided by the government through NRA; accordingly, most of the reconstructed houses in the MH are uniform in key patterns and features, with blue, red, or green tin roofs. Now some families have two buildings too, the old one (repaired/ retrofitted); and the new one. Now, those who have two houses can offer better homestay services than before. Nevertheless, those with just a single house constructed under the 'earthquake-grant-support' from the government cannot adjust the guests (tourists) as such since rooms are insufficient, and they are involved in other types of micro-enterprises, such as bamboo-based handicrafts, vegetable farming, poultry-keeping, etc.

In this context, in another follow-up *bhalakusari*, participant Som Maya quite frankly shared that she had a very good and positive experience with the tourism project. Recalling her

experience, she added that the seed money as 'Ghumti-Kosh' (revolving funds/micro-finance) provided by those organizations was one of the major factors for being motivated towards new initiatives (tourism) in the village. Now, from that fund, the homestay operators and other members of the community have established a multipurpose cooperative in the village. They said, "Our savings in this cooperative have increased, and we have no trouble getting small loans when needed for business or (even) social causes".

This way local women and men were inspired and motivated to be engaged in homestay enterprising and associated enterprising in the area. In gist, we can say that potential direct economic gains from homestay business and micro-finance facilities through different governmental and non-governmental organizations were prime factors for their initiation and motivation towards homestay tourism in the MH. Small groups have come together through a cooperative as well.

Tourism resources mobilization, marketing support, and networking

There is a general saying that 'tourism marketing begins from the products'. Once initial homestay products and services were available in the MH, according to the research participants, several travel and trekking companies started promoting 'MH Tourism' as a new tourism product with different hiking and cultural trekking opportunities. Based on Sirubari's experience (as they gained first-hand experience through exposure visits), they were also able to be more clear that homestay tourism cannot vibrate and flourish until and unless a good promotion is carried out. In such cases, external facilitation and support mechanisms are instrumental in promoting national and international tourism products. These facilitational supports trigger the processes of local resources conservation and mobilization, product development, promotion, branding, and marketing, as well as equitable benefit sharing. In the FGD, one local leader expressed:

> *As competitive sites, other rural destinations are also emerging in this area/province. We have been promoting this area as a culturally rich tourism site having a two- to nine-day package of tours considering the availability of time, energy, and money of the visitor(s). These increased developmental exposures and enhanced institutional support and networking have also facilitated us to conserve and preserve our natural as well as cultural resources, develop a homestay-based production system, such as green vegetables, off-season vegetables, organic farming, emphasizing on local and traditional resources; as well as initiating some new activities to reduce imports and increase exports. These all have helped us develop MH as a new rural tourism destination.*

From various observations, it was clear that due to beautiful hills, nicely settled settlements/ villages of different ethnicities and castes (such as Chepang, Brahmin/Chhteri, Gurung, Magar, Dashnami, Tamang and Newar); old forts, green jungles with rhododendron national flower, spectacular waterfalls, and some unexplored caves; the area is also considered a good destination from natural attractions as well. The Himalayan and mountainous views from here are stunning. Thus, there are many excursionists (only day-trippers) in the area. "These excursionists make a short trip of half-day or three to five hours; and return to their place or other destination(s) on the same day.

All these initial transactions and vibrations in the Mahabharat Hills also encouraged local men and women to be members of the local homestay group, allowing at least one room for visitors. Gradually, promotional and marketing networkings kept rising, raising the local

hopes and aspirations further.

Challenges experienced and observed

As mentioned above, homestay enterprising in this area started almost two decades ago with a special branding- "Naturally and Culturally Rich 'Mahabharat Hills'". The area was considered feasible for developing homestay-based community tourism efforts in the Bagmati province. Different international and national organizations (e.g., MoCTCA, Ministry of Local Development, UNDP, SNV Nepal, DFID, local NGOs, some private companies, etc.) supported the initiative. Initially, the settlement had seven homestays, and later some more were added, making a total of 12 now, although all are not active and not very functional. In this context, research participant Aaita Kumari adds,

> *During the project period (which was most intensively between 2004-2007); we had some businesses in all homestays. But now only very few homestays are getting business. Especially after the termination of support from that tourism project and after the deadly earthquake of 2015, the homestay enterprise here in the MH is almost docile.*

Supporting Aaita Kumari's views, a local guide also mentioned that, for the last seven-eight years the homestay business in the MH has been shrinking unexpectedly. Instead, "hometel" (individual home/'family-based small hotel') is gradually growing and occupying the homestay spaces. In the area, some homestays have been transformed or converted into "hometel". However, national or local guidelines do not mention the "hometel" system. In the MH, now old signboards of homestay could not be seen in these hometels. Instead of small wooden sign-boards commonly placed in every homestay household from the very beginning, now they display big flex-boards saying: "यहाँ अर्डर बमोजिमको खाजा, खाना र जलपानको राम्रो व्यवस्था छ ।" *("Yeha order bamojim ko khaja, khana ra jalpaan ko ramro byabastha chha"*: literally, "Here we provide all types of snacks, food items, and different types of drinks as per your interest and order"). These notices denote that, unlike homestays, hometels are more demand-driven than supply-driven. These hometels, thus, lately, are affecting the motivation of other old homestay operators. Now-a-days tourists (mostly youngsters) are attracted towards such hometels where 'order' comes first, then is served accordingly. Relatively, as per the field interactions, hometel prices are a bit expensive as well; thus, more profit is possible from the hometel service than from the usual homestays.

Another challenge is local actors' mobilization due to less number of tourists in the area. According to the former social mobilizer (SM) of the area, a reduced amount of facilitation by the concerned organizations has also discouraged local people from getting engaged in rural tourism development and homestay business operations, including engagement in various types of skills-focused tourism-related enterprises, as compared to the past. Since COVID-19 (Gautam & Khatri, 2021; UNWTO, 2022), tourism in this area has further faced a new challenge, unexpectedly the lowest number of tourists in those homestays. This is another big challenge in the enterprising homestay. Similarly, according to the key persons of the homestay operators, lately, there has been less focus on sustainable concepts in homestay and local resources management from related authorities; no special loan/grant support provisioned for the area, and also there are no new programs or activities to revive those homestays, established some two decades ago. In addition, as they mentioned, after the restructuring of the local government system, the homestay registration process hasn't got priority; and due to this, the provision of extending different support and grants in the name of the homestay is being missed or delayed. Lately, "climate change issues" in the local

tourism system are also in discourse (KC, Giri & Khadka, 2021; Nyaupane & Chhetri, 2009). Such discourses have raised the issues of increasing temperatures, decreasing biodiversity, unprecedented disasters, shrinking water resources, increasing deforestation, and so on, which are directly related to tourism resources and activities threatening its sustainability.

Another pertinent issue, based on the physical infrastructures and facilities, the 'classification of homestay' (as advocated by TGDB, 2013; 2016) is also not done, due to which best/better homestays and medium/poor homestays in the MH have not been identified yet. This has also been a critical issue for genuine homestay entrepreneurs. Among others, the lack of a proper system for capacity development of the Homestay Committee was another noticeable issue as found during several interactions/bhalakusaris in the study site. The value chain concept in homestays, including the overall local tourism system, has also not gotten adequate attention.

Conclusion

From the study, it can be concluded that the social mobilization processes were implemented as a step-wise 'combined package,' which included: the basic orientation through tourism awareness, group formation/ reformation; saving and credit schemes, management skills development training, production-focused various skills-oriented training, exposure/ educational tours to famous tourist/ homestay destinations, venture capital fund or revolving fund supports, business plan development related capacity enhancement, market linkages, and so forth in the process of developing community homestay in the MH. The homestay operators got a chance to get some introductory and motivational sessions from the facilitator organization(s), and they also got a chance to make some study/ observational visits to some of the pioneer (model?) sites of community homestay tourism, which inspired them to be homestay-entrepreneurs in the area.

Based on participants' experiences and reflections, it can also be interpreted that when the facilitating organizations provide multiple opportunities, including monetary back-ups like 'seed money' for micro-enterprise development, local people prefer working in groups, remain intactly in groups, and continuously show interest in taking new ventures through such groups. And, gradually, those groups can be converted into cooperative(s). This was a good example of the CBT initiative in Nepal, evidently citing the case from the Mahabharat Hills. Further, the above experiences demonstrate that the tourism program (project) shared lots of knowledge, provided some materials, and tried to boost the courage to do something even by continuously placing locally-recruited social mobilizers/ rural tourism facilitators in the area; however, due to less focus of local and other governments, such initiatives face a hitch after the termination of the project. Local leadership development endeavors are also crucial in such efforts.

Implications

The study implies that the facilitating organization(s) should have both hard- and software-support for motivating and backstopping the locals to be engaged in new ventures, like homestay. Community's own initiation and locally developed leadership is also vital, for which the supporting institutions need to think from the very beginning. Furthermore, a new venture for conceptualizing, developing, and institutionalizing the "hometel" practice within and/or beyond the 'community homestay system' is also equally important. Convincingly, a new mode of village-based accommodation "hometel" is gradually replacing the homestay

concept in the MH.

It can also be implicated that due to less focus of marketing agencies and promotional authorities, homestay enterprising has not been an attractive initiative in this area for several reasons, including the inactiveness of the entrepreneurs after the devastating earthquake of 2015 and also the global pandemic COVID-19. Here, additional income sources are also being increasingly shifted from traditional farming and homestay enterprising to various types of off-farm jobs, modern commercial vegetable cultivation, more commercialized "hometel" (albeit limited), and poultry-farming, among others. These need further investigative studies and also locally-devised policy instruments with better plans and budget.

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First Results on Lake Bathymetry of Panch-Pokhari Complex, Langtang Region, Central Nepal

Narayan Prasad Ghimire[1*], Raju Chauhan[2], Sudeep Thakuri[3,4], & Ashish Aryal[1]

[1]*Central Department of Botany, TU*
[2]*Department of Environmental Science, Patan Multiple Campus, TU*
[3]*Graduate School of Science and Technology, MU*
[4]*Central Department of Environmental Sciences, TU*
Corresponding email: nghimire077@gmail.com
DOI: http://doi.org/10.3126/jtha.v6i1.67395

Abstract

The Panch-Pokhari complex, a group of five lakes, is one of the high-altitude wetlands of Nepal that has received very less attention. While these lakes hold significant religious importance, they are less known from a morpho-ecological perspective. The objective of this study is to develop a bathymetry model of the lakes through afield survey and geospatial analysis. This study generated new insights into the limnological and morphometric features of the five lakes through detailed mapping and profiling. The bathymetric analyses revealed diverse basin morphometry among the lakes, with Lake 1 being the largest, in term of its depth of 12.1 m and water volume of 208,352 m^3. In contrast, Lake 5 was the smallest and the shallowest with a depth of 1.4 m and volume of 1,921 m^3. This study establishes a new baseline to advance scientific understanding of the Panch-Pokhari complex. Further, integrated research combining limnological, ecological, and social aspects is recommended to support evidence-based planning for the conservation of these vital Himalayan wetlands.

Keywords: bathymetric, high-altitude lake, morphometry, Panch-Pokhari, water depth

Introduction

Freshwater wetlands are the most productive ecosystems, providing a wide range of ecological benefits to people. Further, the wetlands have a unique role in ecosystem support by controlling the water cycle (Mitsch et al., 2015). By holding huge volumes of water and releasing it during shortages, proper lake operation can reduce the impact of floods and droughts. Lakes also recharge groundwater, acts as sink by improving the water quality of downstream watercourses, and supports the area's biodiversity and ecosystem (Kumar & Lamsal, 2016). With this insight, the Convention on Biological Diversity of 1992 gave wetlands protection a high priority since the benefits they provide directly contribute to people's lives and economy (CBD, 1992). Lake dynamics are the indicator of paleoenvironment. In mountain regions, lake development and changes over time are an obvious and easily measurable indication of human activities and climate change consequences (Thakuri et al., 2021a; 2021b). A lake is closely related to the atmosphere, biology, soil and other factors, and it is very sensitive to changes in the climate and environmental system (Li et al., 2015; Sharma et al., 2012).

Studies show that the climate factors are more important for lake changes, while human activities such as the area of cultivated land and the built-up area had obvious effects on the lakes (Jing et al., 2018). In 2017, there were 1,541 lakes larger than 0.36 hectares located

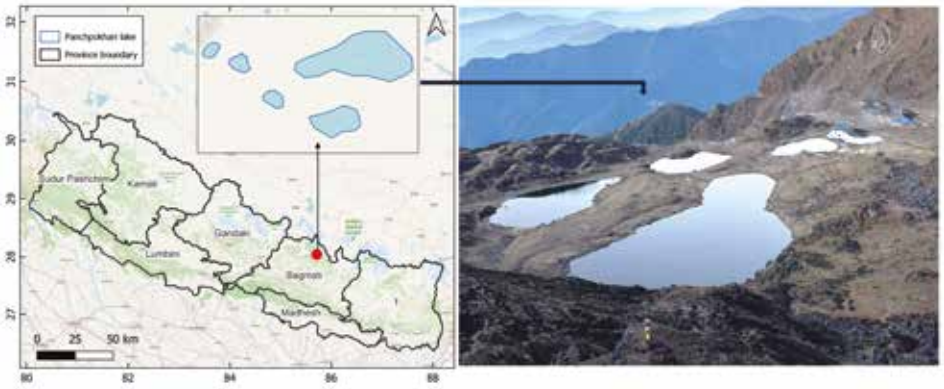
above 3,000 meters in elevation, a significant increase from 606 lakes in 1977 (Khadka et al., 2018). Attempts were made to list some of these lakes, including Panch-Pokhari, in Ramsar site of Nepal. Yet, there is no detailed geomorphological, socio-economic, biological, and physico-chemical study of the lake and its periphery watershed. Therefore, it would add value to the process if the lake's geomorphological characteristics can be known. Thus, the aim of this study is to develop a lake bathymetry of Panch-Pokhari of Nepal.

Study site

Panch-Pokhari, one of the high-altitude lakes, is located in Sindhupalchok district in Bagmati Province of Nepal. It is an association of five Hindu holy lakes (Figure 1). The five lakes of Panch-Pokhari are located at an elevation from 4,055 to 4,068 m above sea level. The lake is popular among the Hindu and Buddhist pilgrims. The Panch-Pokhari is considered one of nature's most beautiful, unspoiled, and well-kept secrets with mysterious landscapes. This region is characterized by the magnificent mountains, exceptionally unspoiled natural beauty, amazing wetland features, and diverse flora and wildlife. This lake is one of the major attractions of Langtang National Park as well. A range of peaks known as the Jugal Himal, which includes the peaks of Dorje Lhakpa (6,966 m), Madiya (6,257 m), and Phurbi Chhyachu (6,637 m), is located to the north of the Kathmandu valley along the trekking route of Panch-Pokhari. Despite being located close to Kathmandu, this area is rarely visited by people, except as pilgrims.

Figure 1

Location map of study area



Note: A map of Nepal showing the location of Panch-Pokhari complex (upper) and a horizontal photo of the lake complex

Data source

This study uses the data collected from the field survey and remote sensing. To develop a bathymetric model of the lakes, we used data obtained by depth soundings from systematic transects across each lake using echo-sounders/sonar, GPS mappings to delineate lake boundaries, topographic maps and digital elevation model (DEM) for the catchment area delineation, satellite imagery for analysing lake morphology. The Google Earth Imagery, Sentinel 2 and ASTER GDEM (30 m) were used for obtaining the basin characteristics and analysing lake surface area changes.

Field activities

The field study was conducted from October 31 to November 6, 2023. During the field survey, bathymetric data was collected using Depth sounder and GPS. The morphological characteristics of lakeshore (including mountain slope, inlets, outlets, land use) were collected. Line transects were established along the surface of the lakes to measure the bathymetry as demonstrated in Figure 2.

Figure 2

Bathymetric survey plan (left) and water depth measurement during the field (right)

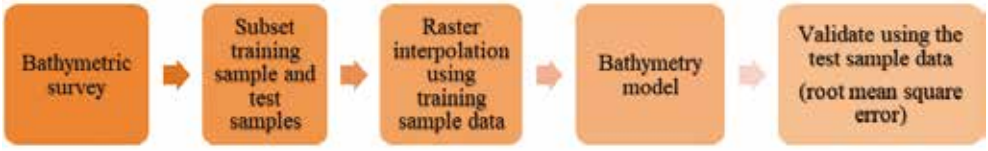
A depth sounder (HDR 650 Hummingbird®) and Garmin GPS 64s were employed for the bathymetric survey. The depth sounder had the capacity to measure depths upto 180 m. Prior to its use, the depth sounder underwent calibration to address any discrepancies in measurement. The Garmin GPS 64s had a positional accuracy of 3 m. Similar method was applied by Thakuri et al. (2021a) who also deployed depth sounder and GPS to measure the depth across different regions in Rara and Begnas lake.

Data analysis

The depth data collected for each lake water column was used to generate bathymetric maps and lake terrain elevation models. Further, the area and volume of the lakes was computed. Altogether 459 depth points were collected. The depth data collected were divided into training samples (75%) and test samples (25%). The Inverse Distance Weighting (IDW) interpolation technique was used (Diaconu et al., 2019) with power 2 and number of points (n=12) using the training samples to generate the bathymetric model (Figure 3).

Figure 3

Process of bathymetry modelling



The IDW interpolation is a suitable technique for generating continuous prediction surfaces from a small number of point samples, like lake depth soundings. It assumes that points closer together are more similar than those farther apart. The influence of a known data point on the prediction surface diminishes with increasing distance. The interpolated values are weighted averages of the sampled points, with closer points given higher weights. The

weighting power parameter controls how steeply weights decline with distance. The IDW interpolation is given by,

$$Z_p = \frac{\sum_{i=1}^{n}\left(\frac{z_i}{d_i^p}\right)}{\sum_{i=1}^{n}\left(\frac{1}{d_i^p}\right)}$$

Where, Z_p = interpolated values for the given power, n= number of points, p = power, d_i = distance between the points

The validation of the model was performed using Root Mean Square Error (RMSE) using the test sample and the extracted modelled value for the sites of the test samples (Yang et al., 2022a, 2022b).

The result was plotted in the ArcGIS software and presented through maps and charts.

Results and discussion

$$RMSE = \sqrt{\sum_{i=1}^{n}\frac{(\hat{y}_i - y_i)^2}{n}}$$

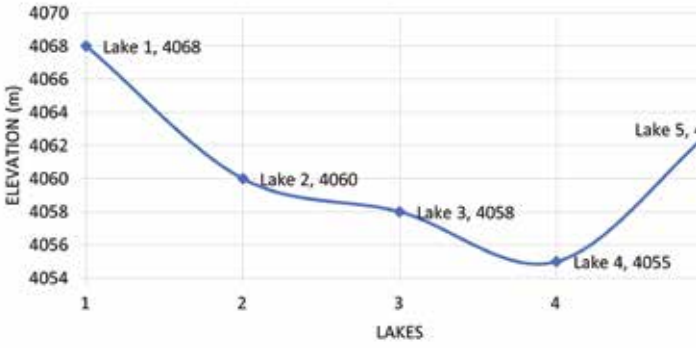
$\hat{y}_1, \hat{y}_2, \ldots, \hat{y}_n$ are predicted values
$y_1, y_2, \ldots, y_n$ are observed values
n is the number of observations

Lake characteristics and bathymetric modelling

The Panch-Pokhari complex located in the Sindhupalchok district is characterized by its unique setting of five lakes situated at elevations between 4049 m and 4063 m (Figure 4). The lakes fill deep basins carved out by glacial processes and exhibit diverse morphometry, with areas ranging from 0.14 ha (the smallest Lake 5) to over 2.6 ha (the largest Lake 1). The water depth extends to over 12.10 m in the deepest sections of Lake 1 (Table 1). The minimum depth was observed for Lake 3 with only 0.87 m. The steep surrounding hill slopes are forested while the lakeshores have some marshy stretches. The lakes are recharged by rains and snow melt, small inflows, and groundwater springs.

Figure 4

Elevation profile of the Panch-Pokhari complex



The total area of the lake accounts for 4.013 ha, Lake 1 having a maximum area and Lake 5 having a minimum area. The average depth also shows a similar pattern with Lake 1 having maximum depth (7.7 m) and Lake 5 having minimum depth (1.3 m). The detailed characteristics of the lake complex is given in Table 1.

Table 1

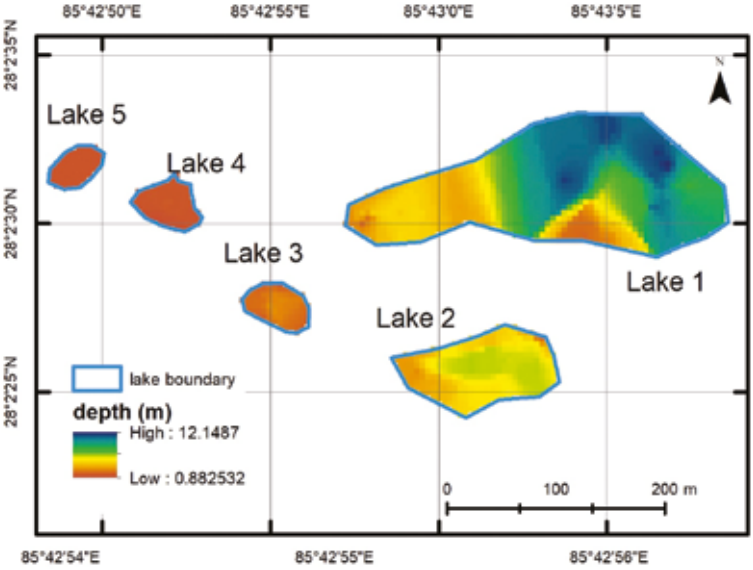
Characteristics of the lake complex

Lake	Area (m^2)	Min depth (m)	Max depth (m)	Range (m)	Average depth (m)	SD	Volume of water (m^3)	Maximum width (m)
Lake 1	26887	1.19	12.10	10.92	7.75	3.03	208353	318
Lake 2	7981	1.95	6.10	4.16	4.90	0.96	39061	150
Lake 3	19530	1.36	2.80	1.44	2.21	0.36	4314	59
Lake 4	1897	0.87	1.50	0.62	1.37	0.10	2596	68
Lake 5	1414	1.24	1.41	0.17	1.36	0.07	1921	50
Total	**40130**						**256246**	

The high-resolution bathymetric maps were generated for each of the Panch-Pokhari complexes (Figure 5). The map illustrates the distinct morphometry and depth contours of each water body (Figure 6).

Figure 5

Modelled depth distribution of Panch-Pokhari complex



The largest lake, Lake 1, the deepest in the complex spans over 318m lengthwise and has an irregular oval shape, with contours showing a relatively gradual slope along the northern and eastern shallow littoral shelf which then drops off more steeply along the southern basin to reach maximum depth of over 12.1 m. Several isolated depression zones between 11.0 and 11.5 m deep are also scattered across the central sector of Lake 1 (Figure 6a). The minimum

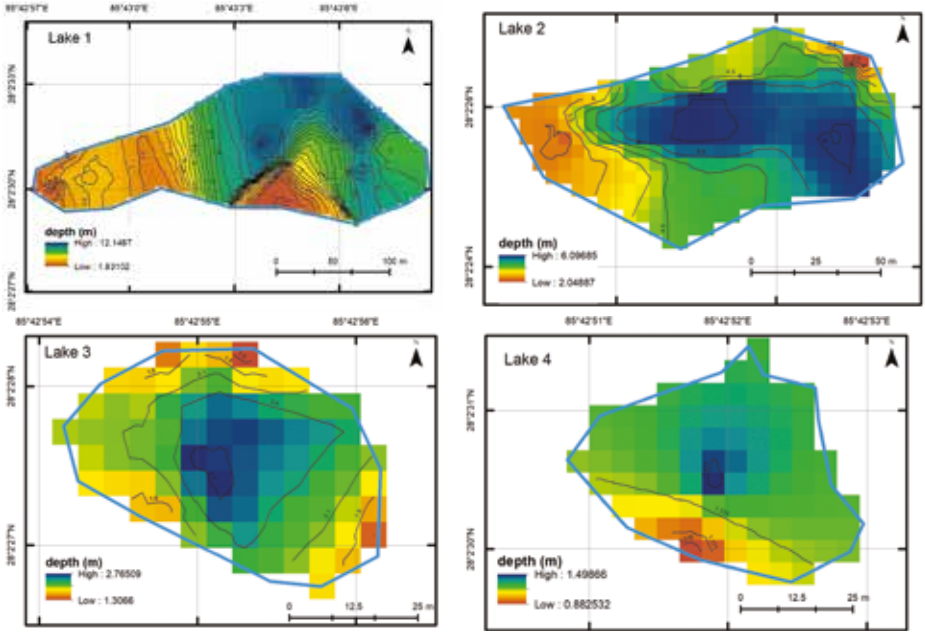
depth of 1.2 m was observed on the south and southwest aspect of the lake. The average depth was calculated to be 7.74 m. The volume of water in the lake was estimated to be 208,352.97 m^3. Lake 2 shows a linear elongated form orientated east-west, with steeply dipping margins plunging to over 6.1 m depth. The minimum depth of Lake 2 is 1.9 m. The bathymetry delineates an underwater ridgeline that runs longitudinally, dividing the southern part of Lake at 2.1 m. The maximum length of Lake 2 is 149.7 m (Figure 6b). The volume of water in the lake was estimated to be 39,061 m^3.

Lake 3 exhibits an oval basin morphology, with a rather consistent slope descending radially from the near shore lake margins to the flat basin floor lying with the depth range of 1.3- 2.7 m. The distinct shelves and depressions reflecting the underlying bedrock topography are captured in the detailed bathymetric renderings (Figure 6c). The lake extends to a length of 59.24 m. The lake has an average depth of 2.21 m and contains an estimated 4,314.4 m^3 of water in the lake (Figure 6c). Lake 4 manifests slight round basin morphology. Analysis of depth soundings across the lake surface showed the depth range of 0.8 – 1.5 m. The mean depth across the entire lake area was determined to be 1.36 m, indicating the presence of a shallow water pool. The total estimated water volume contained in Lake 4 was calculated to be 2,596.4 m^3. The lake occupies a surface area of 1896.8 m^2 according to the bathymetric model (Figure 6d). Lake 5 is the smallest of all, having an area of 1413.75 m^2. It is also the smallest in terms of the width (50.21 m). The lake is very shallow with a depth range of only 0.172 m. The maximum depth was predicted to be 1.41 m and a mean depth of 1.35 m. The volume of water in the lake was estimated to be 1921 m^3.

The RMSE for the model was determined to be 0.32 m indicating the acceptability of the model. Several other studies (Yang et al., 2022b; Wang et al., 2023) have reported even higher RMSE for the Bathymetry Model.

Figure 6

Bathymetry model for the four lakes of the Panck Pokhari complex



The high-resolution maps and depth profiles provide new insights into the physiographic factors and processes controlling the morphometry of the Panch-Pokhari. The location of rock basins, shelves, and ridges reflected in the bathymetry corresponds well with the underlying bedrock geological structure and faults affecting the lake complex. The deeper areas manifest where bedrock depressions have subsided, while shallower zones correlate to in-filled sediments. The slope morphometry relates to each lake's development history within the glaciated valleys. Lake 1's gentle littoral zone reflects substantial alluvial and deltaic sediment deposits, while Lake 2's steeply plunging margins conform more to the original glacial over-deepened basin morphology. The bathymetric data enhances understanding of the hydrology, water circulation and ecological conditions of the lakes. There is high biodiversity of phytoplankton, zooplankton, fishes, birds and other biota, though populations are threatened by pollution and habitat loss (Krstić et al., 2012; Raut et al., 2017). The Panch-Pokhari is culturally significant for local religious practices and recreationally valued for its pristine beauty, attracting many hikers, and pilgrims. Conservation initiatives aim to balance ecological protection with low-impact tourism at this important wetland complex.

This study generated new insights into the limnological and morphometric features of the five lakes through detailed mapping and profiling. The bathymetric analyses revealed diverse basin morphometry among the lakes, with Lake 1 being the largest, deepest and most voluminous with a maximum depth of 12.1 m and volume of 208,352 m^3. In contrast, Lake 5 was the smallest and shallowest with a depth of only 1.4 m and volume of 1,921 m^3. Compared to other lakes of similar altitude, the Panch-Pokhari complex has a shallower depth and smaller area. The Gosaikunda and Bhairbakunda that lie in similar altitude have the maximum depth of 26.5 m and 59.1 m with area of 13.3 and 16 ha, respectively (Neupane et al., 2022).

The depth of Lake 1 of the Panch-Pokhari is similar to the depth of the Begnas Tal. The Begnas Lake had a maximum depth of 12.5 m, spanning an area of approximately 2.98 km^2, but the Rara Lake's dimensions were too high, with a depth reaching 169 m, and covering an area of 10.52 km^2 (Thakuri et al., 2021a). The bathymetric analysis of lakes in Ramroshan, Achham showed that Jingale Lake (44 m), Batula (15 m) had higher depth than the Panch-Pokhari Lake, but Mathillo Dhaune (9.5 m) had depth similar to that of Lake 2 in Panch-Pokhari (Chalaune et al., 2020). The varying slopes, shelves and depressions reflected the underlying bedrock structure shaped by lacustrine processes. Sedimentation patterns also differ from the lake's developmental history (Watson et al., 2019).

These quantifications of lake morphometry provide critical physical data to improve hydrological and habitat modeling for conservation and management of this high-altitude wetland (Bhusal, 2008; Yagi et al., 2010). The volume estimates help assess risks from climate change impacts on water availability (Thakuri et al., 2021a), and identifying areas of infilling informs lake sedimentation management strategies (Watson et al., 2019). Bathymetric data enables further limnological research on water quality, circulation and productivity (Bhusal, 2008).

The detailed bathymetric mapping provides critical high-resolution baseline data on the physical dimensions and submerged morphometry of the Panch-Pokhari. The quantification of parameters, like lake depth, volume, basin slope, and area provide integral information to improve hydrological and habitat modeling for conservation and management of this Ramsar designated wetland system (Kumar & Lamsal, 2016). The volume estimation fills an important data gap for water balance assessments, especially regarding water shortage risks

during winter and drought periods anticipated under climate change. Mapping of sedimentation patterns allows identification of near-shore areas at higher risk of infilling to guide siltation management. The bathymetric data enables multi-disciplinary research on the limnology, water quality, biodiversity, and ecosystem functions of the lake complex. Thus, the modeling outputs significantly advance scientific understanding to support evidence-based planning for this ecologically vital lake system. The lake ecology faces threats from unsustainable tourism, pollution and habitat degradation (Raut et al., 2017; Bhusal, 2008; Watson, 2019). Managing visitor impacts and local communities' resource use is essential to safeguard the biodiversity and ecosystem services of this unique wetland ecosystem (Kumar & Lamsal, 2016).

Conclusions

This study generated new insights into the limnological characteristics and basin morphometry of the Panch-Pokhari through detailed bathymetric mapping and profiling. The analyses revealed the diverse morphology of the five lakes, with Lake 1 being the largest, deepest, and most voluminous. The quantification of physical parameters, like lake depth, and volume provides valuable data to improve hydrological and habitat modeling for conservation planning of wetland. The findings will help assess risks from climate change impacts on water availability as well as identify priority areas for siltation management. We suggest to expand the study of the lake complex and cover additional parameters, like water quality, underwater habitats, conduct seasonal/annual resurveys to quantify sedimentation rates, and morphometric changes over time and integrate bathymetric data with water quality, flow and watershed data to refine hydrological modeling.

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Mountains Mysteries: Unraveling the Mystical Allure of Mount Everest and Mount Annapurna

Pragya Gautam
Padmakanya Multiple Campus, Tribhuvan University
**Corresponding email: gautampragya53@gmail.com*
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Abstract

This article explores the mysterious and mystical allure of Mount Everest and Mount Annapurna, delving into the rich tapestry of cultural, religious, and historical narratives associated with these towering peaks. Drawing upon the perspectives of geographers, mountaineers, and authors, the article navigates the spiritual significance of high–altitude mountains like Mount Everest and Mount Annapurna, and the captivating legends of mythical beings like Yeti. The narrative unfolds with a vivid portrayal of the sacredness attributed to the Himalayan region, emphasizing the belief in deities and spirits inhabiting these majestic peaks. It also sheds light on the transformative experiences of climbers who, despite acknowledging the risks and challenges, find liberation, joy, and a profound connection with nature upon reaching the summit. The article concludes by highlighting the unparalleled beauty of the Himalayas, drawing on the accounts of climbers and authors who describe the sublime landscapes, pristine environments, and the spiritual resonance that makes these mountains a timeless source of inspiration and fascination.

Keywords: Himalayan, mysteries, mystical allure, sublime, Yeti

Introduction

The natural world, shrouded in its cloak of mystery, stands as an expansive realm of fascination for both nature lovers and adventure seekers. From the majestic summits of towering peaks to the depths of the ocean's abyss, nature's mysterious and mystical charm beckons the curious soul to unravel its secrets. Chand and Puri (1989) illuminate the profound attraction that nature exerts upon travelers. They articulate That nature is one of the greatest attractions for most mountain travelers. As the saying goes "There are three voices of Nature. She joins hands with us and says, struggle and endure. She comes close to us, we can hear the heart beating; she says wonder, enjoy, and revere. She whispers secrets to us but we cannot always catch her words, she says search and enquire. Thus, these are the three voices of Nature that appeal to our head and heart. This trinity of our being has, therefore, attached men of various interests to the holy mountains (Chand & Puri, 1989).

Chant and Puri acknowledge the aesthetic appeal of nature, arguing that only those who genuinely cherish it can fully grasp its miracles and attain higher energies. These sentiments resonate with Kant's observations in *Critique of Judgment* (1951)the sight of them is the more attractive, the more fearful it is, provided only that we are in security; and we willingly call these objects sublime because they raise the energies of the soul above their accustomed height and discover in us a faculty of resistance of a quite different kind, which gives courage to measure ourselves against the apparent almightiness of nature (Kant, Critique of Judgement, 1951).

Kant emphasizes the immensity of nature and our insufficiency of understanding the superiority of the natural world. He emphasizes the infinite and indefinable aspects of natural phenomena, offering a unique form of contentment for those who immerse themselves in its embrace.

Throughout history, the remote and untouched parts of the natural world have been shrouded in mystery, giving birth to tales of mystic encounters and inexplicable phenomena. Their lofty peaks like Mount Everest and Mount Annapurna veiled in perpetual snow, have been imbued with mysterious and divine connotations, often depicted as bridges between the earthly and celestial realms. Moreover, the occurrence of unexpected noises, mysterious lights, and apparitions has perpetuated their enigmatic reputation, fostering a sense of wonder and reverence among those who dare to venture into their midst. In his work, Peaks and Pinnacles (2004) Nepali geographer and author, Gurung, delves into the profound mystical surroundings of Mount Everest, highlighting its overwhelming presence in the skies that instill both awe and wonder. He describes its sheer size dominating the firmament evokes awe and wonder. As the last frontier of human occupancy, it is the home of myth and mystery: the haunt of elemental Mahadeva, Hindu Shiva, and Tantrik Padma Sambhava. Individual peaks are objects of reverence while glacier tarns, sacred caves, and the thermal springs are destinations of pilgrimage. The sanctity of peaks is related more to shape and its associated imagery rather than to their absolute height. For example, the modest Khumbu Yul-Lha (5761) has more immediacy in the Sherpa lore than the supreme Everest (Gurung, 2004).

Gurung (2004) portrays the Himalayas, Everest at their heart, as a landscape imbued with mysterious and spiritual allure, captivating a thrilling and intoxicating picture with its blend of natural grandeur and spiritual significance. The mystical landscape is further enhanced by the presence of monasteries with their vibrant art, devoted monks, and colorful surroundings, casting an indelible enchantment on all who visit.

Mountains mysteries: Unraveling the mystical allure of Mount Everest and Mount Annapurna

The Himalayan region beckons adventurers and seekers to immerse in its majesty, offering unparalleled encounters with nature in its most sublime form. This magnetic allure draws many well-known and celebrated mountaineers from the world to scale Mount Everest and Mount Annapurna every year. In Puranas, sacred texts of the Hindus, have portrayed high-altitude mountains as mysteries and holy places, believed to be the abode of gods and goddesses. Ed Douglas in *Himalaya: A Human History* (2020) reinforces this idea as these mountains are the region of Swarga, or paradise, the home of the righteous. 'Here there is no sorrow, nor weariness, nor anxiety, nor hunger, nor apprehension; the inhabitants are exempt from all infirmity and pain, and live in uninterrupted enjoyment for ten or twelve thousand years.' At the center of this cosmic landscape, we are told, is the mountain Meru, in the shape of a lotus seed, like an inverted, rounded cone, on its summit is the city of Brahma, among its petals the abode of the gods, ...Meru is often taken to be Mount Kailas... (Douglas, 2020).

Douglas (2020) claims that the high mountains are considered to be the region of paradise, where only righteous individuals may reside. The summit of the mountain Meru, often considered Mount Kailas, is viewed as the center of the cosmic landscape. Similarly, Barcott in *The Measure of A Mountain* (Barcott, 1997) highlights the sacredness of mountains across various cultures and religions in the following words: in Nepal, the mountain the rest of the

world calls Everest is known as *Chomolungma*, the mother goddess of the Earth. Thousands of Hindu pilgrims each year circumnavigate the Tibetan peak Kailas, upon whose summit dwells Shiva, Lord of the world. Buddhists and Jainists also hold Kailas sacred . . . Zeus, the supreme god of the ancient Greeks, ruled from high on Mount Olympus. Muhammad met the angel Gabriel and received the word of God in a cave on Mount Hira (Barcott, 1997)

Barcott's (1997) reflection on the sanctity and sublimity inherent in mountains, characterized by their vastness and infinite nature aligns with philosophical discourses on the sublime, particularly those of Kant who asserts, "nature is therefore sublime in those of its phenomena whose institution brings with the idea of its infinity" (Kant, Critique of Judgement, 1951). Kant's assertion is similar to Barcott (1997) who believes that the natural world has vast and infinite qualities that evoke the sublime, and help to attain sublimity.

The high mountains are not only mystical, they are horrible, and terrific due to their landscape. Many narratives comprise the myths of dragons and monsters, believed to inhabit these regions. Shipton, in *Mountain Conquest* (Shipton, 1966), articulates until two hundred years ago mountains were regarded with profound distaste. Eighteen-century travelers through the high alpine valleys described the peaks as 'fearful', 'horrid', and 'repulsive', their beauty seems to have been hidden from sight. These places, where today thousands of tourists go each year for recreation and pleasure, were then believed to be the abode of evil spirits and demons. Even educated people thought that dragons dwelt among the glaciers, ready to pounce upon anyone bold enough or stupid enough to intrude upon their domain (Shipton, 1966).

Shipton (1966) claims that ancient culture held negative views of mountains and mountaineering, considering them the homes of monsters and demons, like the dwelling of the fire-breathing creature.

However, the attitude towards these natural wonders began to change in the mid-eighteenth century with the advent of the Age of Enlightenment, the French and American revolutions, the voyages of Captain Cook, and the birth of modern science, among other factors, according to Shipton (1966). The frontiers of human knowledge, like the knowledge of Voltaire and Rousseau, challenged age-old traditions and inquiry, challenged traditional beliefs, and encouraged a new appreciation for mountains. Shipton (1966) further asserts, "Rousseau, a passionate advocate of a return to nature, was largely responsible for opening men's eyes to the beauty and wonder of wild places, especially of the mountain" (Shipton, 1966; Brady, 2013). Shipton (1966) perceives nature as a source of aesthetics, joy, mystery, and sublimity, recognizing humanity's innate longing to experience joy and contentment in life. They willingly embrace challenges and risks in pursuit of fulfilling these desires.

The high-altitude landscape has adventurous tales and cultural beliefs, which encompass a wide array of myths and legends across different religions and cultures. These stories often revolve around creatures such as dragons, snowmen, and fire-breathing beasts that dwell in the high mountains. Despite the lack of scientific evidence, people continue to uphold the existence of such dreadful creatures and spirits. For instance, the inhabitants of the Everest region hold a strong belief in the existence of the Yeti, a half-human, half-animal creature, as well as terrifying beings such as bears. Chester in *The Himalayan Experience* (1990) discusses the existence of the Yeti. He explains the Yeti, also known as the abominable snowman, is probably the most infamous creature associated with the Himalayas, yet there is no scientific proof to date that such a beast exists. This fabled creature is said to live between 2,000 m

(65600 ft.) and 3500 m (11,480 ft.) in the thick forests of the eastern Himalayas. Wall paintings in temples and monasteries show two types, one that looks similar to a large monkey and the other resembling a bear. The smaller Yeti is said to feed on humans while the larger ones eat yaks (Chester, 1990).

Chester (1990) acknowledges that due to the absence of scientific proof to support the existence of this fabled creature, which is said to reside within the dense forests of the eastern Himalayas, between 2000m. and 35000m. Depictions and descriptions of the Yeti in temples and monastery wall paintings show two distinct types, one resembling a large monkey and the other a bear. Despite the lack of empirical evidence, the Khumbu Icefall area has been the site of the human encounter with the Yeti, suggesting that the creature remains an enigmatic figure in Himalayan folklore. Hillary (2000) also mentions the existence of Yeti in *View from the Summit* in the Khumbu valley, we interrogated monks and local Sherpas but, although they all expressed their belief in the existence of the Yeti, there was only one Sherpa, Sen Tenzing, who claimed to have seen one. He told me the story of how he had been attending an important festival at Tengboche Monastery which concluded... He was alone and halfway down when he suddenly saw a hairy yeti approaching him (Hillary, High Adventure: the True Story of the First Ascent of Everest, 2003).

Hillary's (2000) remarks present a cultural divergence in perceptions regarding the Yeti, with Himalayan communities holding a firm belief in its existence, contrasting with skepticism often found among Westerners who consider it merely an anecdote. This dichotomy enriches the narrative of the Yeti search, blending elements of fear, horror, delight, and excitement, into a complex tapestry of the sublime experience. The allure of the unknown and the allure of discovery drives mountaineers to embark on expeditions in pursuit of Yeti, despite the lack of conclusive evidence. Hillary (2003) mentions "I had always been a little skeptical about the existence of the yeti myself. There had been quite a lot of evidence that I could not explain- footprints in the snow; a scalp in the Khumjung Monastery; a bony hand at Pangboche Monastery; stories of a sighting by monks in their monasteries and by Sherpa in lonely shepherd huts (Hillary, View from the Summit, 2000).

Hillary (2003) admits to having been skeptical about the existence of the Yeti himself. Although there has been substantial evidence such as footprints in the snow, a scalp at the Khumjung Monastery, a bony hand at Pangboche Monastery, and sightings primarily reported by monks in their monasteries and Sherpa in isolated huts, Hillary remains doubtful of the creature's existence. He suggests that the Yeti may exist only in the imagination of the Himalayan people. Despite skepticism from the foreign mountaineers, the Yeti's story holds significant intrigue and entertainment for the Nepali people. In an article entitled, "Yeti died in Dhampus Pass, Near Dhaulagiri Mountain," Gururng and Gurung (2021) elaborate further the story has always stuck with us, especially the name Yeti, which made us wonder about this mysterious and elusive mythical creature supposedly native to my country, in the Dhaulagiri range. We thought to ourselves; what if we could find the Yeti? While trekking in the Himalayas, we were constantly on the lookout for footprints or stories of Yeti by the locals (Gurung & Gurung, 2021).

Gurungs share a compelling narrative that highlights their fascination with the Yeti, a mythical creature reputed to inhabit the Dhaulagiri range in Nepal. Their account reflects a blend of intrigue and skepticism, rooted in the lore of their homeland.

The pursuit of the Yeti leads the mountaineers through the moments of sublime as their

journey encompasses pain, fear, and horror alongside excitement and satisfaction. This idea resonates with the philosophical concept of Burke, as asserted by Brady (2013) who emphasizes that Burke's sublime puts the strongest emphasis on terror and fear, and looking ahead, we may also claim that this degree of emphasis remains unmatched by successive treatments (Brady, 2013). Brady (2013) claims that Burke's sublime focuses on fear and terror but when these elements are coupled with excitement and joy, they culminate in sublime moments. In the case of Yeti, the creature instills fear and horror yet these emotions are intertwined with delight and excitement, contributing to the sublime nature of the endeavor.

Moreover, the high-altitude landscape of the Himalayas is considered sacred and revered by both Hindus and Buddhists as the abode of various deities and spirits. In *The Himalayas: An Aesthetic Adventure*, Pal (2003) mentions that all over the globe there are mountains, but none larger or more majestic than the lofty peaks of the Himalayas. All over the earth mountains are held sacred, but none with more passionate fervor than the Himalayas (Pal, 2003). Pal (2003) argues that the Himalayan peaks are held in the highest esteem worldwide, and their spiritual significance is unparalleled. Pal (2003) further elucidates numerous are the spirits and semi-divine beings, peaceful and wrathful celestials, and deities who populate the mountains. They vary from region to region, from passes to valleys; hence, the diversity of their material representations is enormous, as will be clear from even a cursory glance at the image included here (Pal, 2003).

Pal (2003) insists that both Hindus and Buddhists believe in the countless deities who dwell on the high mountain peaks and the image of *Miyolangsangma*, as a protector goddess who resides on Everest, is revered by both Buddhists and Hindus. Sherpa (2013), a journalist and a mountaineer expresses the same sentiments in *Deadline Chomolungma*, "शिखरमा पाइला राख्नु अघि देवी देउताले बास गरेको त्यस चुचुरोलाई ढोगें । अनि सगरमाथालाई दुई हात जोडेर प्रणाम गरे । त्यतिखेर आफ्नो प्रार्थना पूरा भएको अनुभव गरें" (१५१) (Sherpa, 2013) - Before placing his feet on the summit, Ang Chring Sherpa worshipped with reverence. He paid homage to Sagarmatha by joining his hands with the deities and experiencing the fulfillment of his prayers- (Translated by Gautam, 2024). Sherpa (2013) claims that mountaineers have deep respect and love for the Goddess and he approaches the mountain with great care and attention. Both Hindus and Buddhists perceive the Himalayasas not only a magnificent mountain range but also the sacred abode of the gods. In their various texts, the range is considered the manifestation of the divine and is often referred to as *devatma* or god-souled.

This sentiment is echoed in the work of a devout Buddhist mountaineer, Norgay (2001) who advocates that the Himalayan peaks are inhabited by various deities and spirits, including *Miyolangsangma*. In *Touching My Father's Soul: A Sherpa's Journey to the Top of Everest,* Norgay (2001) recounts the tale from Buddhist mythology of *Miyolangsangma* being one of the five Long Life sisters, providing protection and spiritual nourishment to Khumbu and nearby valleys. Norgay (2001) describes the Buddhist texts that *Miyolangsangma* is one of the 'Five Long Life Sisters' who provide protection and spiritual nourishment to Khumbu and nearby valleys. Originally, *Miyolangsangma* and her sisters, who reside on nearby peaks, were pre-Buddhist demonesses, but they were subdued and converted to a Buddhist path of beneficence by Padmasambhava, the great 'lotus-born' saint known as Guru Rimpoche (Norgay, 2001).

Norgay (2001) worships *Miyolngsangma*, as the Goddess bestowing safeguard and guiding

him towards the spiritual path. His devotion and inner discovery from the journey find resonance with Gupta's (2006) explanation in his book, *Spirituality Unplugged*. Gupta (2006) asserts by pursuing the spiritual path, one goes through a process of evolution and internal cleansing. Any process of change involves pain; hence one may face certain difficulties. However, one should stick on with determination and go through the process in its entirety (Gupta, 2006). Gupta (2006) insists that a spiritual path entails a process characterized by personal development and inner purification. Moreover, it needs to confront difficulties and endure hardships as the mountaineers while ascending the summit.

The connection between Mount Annapurna and Annapurna Devi, the Hindu goddess of the harvest, is deeply revered in Nepali culture. It is believed that the goddess plays a crucial role in agriculture by influencing the flow of streams and rivers from the mountain glaciers, which in turn irrigates the crops. This belief is encapsulated in the publication *Mountain: An Adamant Landscapes*, by the Nepal Mountain Academy (2023) explains the name Annapurna is derived from the Sanskrit language where '*Anna*' means food and '*Purna*' means filled. Annapurna means 'full of grains' in the Sanskrit language, though it is most often translated as 'Goddess of Harvest.' Annapurna is another name for the Hindu Goddess of fertility. The mountain is named after Annapurna, the Hindu goddess of food and nourishment, who is said to reside there (Nepal Mountain Academy, 2023).

Further, affirming the mountains' significance beyond the physical grandeur, Thakuri et al. (2020) in their article "Glacial Hazards and Avalanches in High Mountains of Nepal Himalayas" highlights the mountains of Nepal Himalayas, "Mountains across the globe have been the most interesting places for trekking and mountaineering adventure tourism. Further, most mountains serve as important sources of water as they store water in the form of snow and ice..." (Thakuri et al., 2020). These dual perspectives not only showcase the mountains' physical challenges and dangers but also their profound cultural and spiritual significance, intertwining the physical and metaphysical realms in the collective consciousness of the communities, residing in their shadows.

Being a foreigner, Viesturs (2013) acknowledges the belief of the locals in the presence of powerful deities around Mount Everest and Mount Annapurna. Despite Westerners practicing different forms of faith when they reach the Base Camp, they participate in sacred rituals conducted by the locals as a sign of respect towards the supernatural power believed to reside in the snow-peaked mountains. Viesturs (2013) in *The Mountain: My Time on Everest* articulates at the Rongbuk Monastery, the team receives a stunning psychological blow. The head lama, pleasing illness, declines to perform the puja. . . the ceremony blessing the climbers about to attack the mountain, intended to ensure their protection by gods. Even today, almost ninety years later, a puja is required before we set foot on Everest (Viesturs, 2013)

Viesturs (2013) recounts the significance of the puja ceremony, which is performed to bless climbers and ensure their protection by Himalayan gods. He further asserts that the puja is deeply ingrained in the psyche of the local climbers, and even Western climbers demonstrate reverence and veneration towards the mountains. The Puja is seen as a petition of the gods for permission to climb, good weather, and safe passage and is regarded as a mysterious aspect by the people.

Despite the myths and challenges, the Himalayas are a destination that attracts trekkers and climbers due to its mysteries and natural beauty. The towering mountains, vast glaciers, thick

layers of snow, and unspoiled landscape provide a fascinating and intoxicating sublime experience for those who venture into the region. Herzog (2010) in *Annapurna: The First Conquest of an 8,000-Meter Peak* portrays the aesthetic and magnificent of Mount Annapurna as, the snow, sprinkled over every rock and gleaming in the sun, was or a radiant beauty that touched me to the heart. He claims that "I had never seen such complete transparency, and I was living in a world of crystal. Sounds were indistinct, the atmosphere like cotton wool" (Herzog, 2010). Herzog's (2010) description highlights the aesthetic of nature, which is indescribable and unimaginable. Similarly, when a Nepali mountaineer and author, Dhakal (2069 BS) reaches the Thorong La Pass of the Annapurna Circuit, situated at an elevation of 5,416 m, a new realization dawn upon him. In his words, "कहिल्यै नदेखेको दृश्य देख्न पाएर आँखाहरू तृप्त छन् । कहिल्यै नगरेको अलौकिक अनुभूति गर्न पाएर मन त्यसै त्यसै दङ्ग छ। फुरुङ्ग छ। कष्ट छ शरीरलाई अलिकति... अनि उमङ्ग छ मनलाई भरिभरि..." (१३६) (Dhakal, 2069 BS) - Observing, the magnifying view, the eyes are satisfied. Experiencing the mystical sensation, the mind is captivated, and enchanted. The body felt a bit tired but there was a sense of excitement in the heart- (Translated by Gautam, 2024). Dhakal (2069 BS) achieves an eternal feeling that he has never achieved before. His unprecedented experience can be connected to the philosophical discourse of Burke and Kant on the sublime. Dhakal's (2069 BS) profound encounter with the mountain marked by an unparalleled visual feast and an otherworldly sensation, catapults him into a realm of sublimity.

Amidst the myriad tales of deities, spirits, and mystical entities, the serene and unspoiled nature of the snow-clad terrain, the graceful contours of the steep slopes, and the exquisite formation created by the winds and frost on the wall of Mount Everest and Mount Annapurna present awe-inspiring vistas. Climbers are captivated by the beauty and visual appeal of these mountains. Upon reaching the summit, after enduring tremendous physical and mental challenges, climbers report their sublime experience as an epiphany, a true liberation of the mind and soul. Gautam's (2078 BS) reflection upon reaching the summit of Mount Everest, as articulated in *Pandrau Chuli* vividly captures the profound emotional and psychological impact of mountaineering. His expression of joy and contentment, despite the inherent risks, highlights a moment of self-transcendence. He mentions, "शिखरमा पुग्दा त्यति अप्ठ्यारोमा पनि यति धेरै आनन्द आयो कि आफैँलाई बिर्सन्छु कि जस्तो भयो । ...चुलीमा पुग्दाको खुसी र आनन्द व्याख्या गर्ने शब्दहरु मसँग थिएनन् / छैनन्" (१६४-१६५) (Gautam, 2078 BS)-Despite the risks, there was so much joy and contentment at the summit. I nearly forgot myself as I ascended. At the summit, I felt, I had no words to describe the happiness and contentment (Translated by Gautam, 2024). Gautam (2078 BS) finds himself at a loss for words to convey the depth of happiness and fulfillment that he experiences at the summit. He experiences a state of sublime, marked by a transformative revelation. This sentiment echoes Brady's (2013) observation in *The Sublime in Modern Philosophy: Aesthetics, Ethics, and Nature*, "If our attention manages to leave our own peril and become directed to the powerful forces at hand, we may be rewarded with the thrill and awe and of the sublime" (Brady, 2013). Both, Brady (2013) and Gautam (2078 BS) assert how the summit's tranquility and isolation, combined with the energy and awe-inspiring beauty of the surroundings, contribute to this sense of ineffability.

Regarding this notion, Tirth (2016) in his article "The Himalayas: A Mystic's Viewpoint" posits that the Himalayas are not just a geographical marvel but a sacred expanse, where the natural environment fosters a deep spiritual connection. He articulates the Himalayan has three unparalleled qualities, which is amazing. Firstly, there is solitude; the environment is

pristine and spiritually vibrant. Secondly, there is eternal silence, eternal concentration, and the light of energy (Shakti) flowing here. That is why mountain peaks, snow-covered areas, and such places are considered holy (Tirth, 2016).

Tirth (2016) argues that the spiritual and transformative power of the Himalayas, emphasizing how their untouched beauty and profound silence offer a path to spiritual awakening. He suggests that the Himalayas serve as a nexus where physical and spiritual dimensions intertwine, marked by deep silence, solitude, and dynamic energy about these landscapes. This sacred environment, according to Tirth has historically drawn a diverse group of seekers- from sages and yogis to artists, philosophers, and adventurers, each attracted by the Himalayas' unique capacity to inspire and elevate the human spirit. Tirth (2016) articulates it also includes the highest peaks in the world, which are a sight to inspire awe and wonder in people of any race or creed. From times immemorial, the Himalayas have given out speechless invitations to sages, anchorites, yogis, artists, and philosophers. The mighty altitude of the Himalayas constantly reminds us of the loftiness of the human soul and its vastness (Tirth, 2016).

Tirth (2016) emphasizes the Himalayas' ability to evoke awe and wonder, not merely due to their physical grandeur but also because of the spiritual resonance they carry.

Conclusion

Mount Everest and Mount Annapurna beckon the adventurers with their majestic and mystical allure. Beyond the physical challenges, the mystique and enigma surrounding these mountains invite deeper exploration of secrets and spirituality. The narratives associated with these mountains delve into the interplay between the awe-inspiring experiences and the spiritual revelations they offer. Through examining climbers' accounts, it becomes evident that ascending these summits transcends the pursuit of sublime moments, transforming into an inner journey toward sublimity and enlightenment.

The journey to the lofty heights of mountains like Mount Everest and Mount Annapurna represents the zenith of mountaineering challenge, characterized by their sheer altitude, capricious weather, and treacherous terrains. Yet within these daunting expeditions lies an unparalleled opportunity to confront the mysteries and sublime beauty of nature, catalyzing moments of deep insight and expanded consciousness. The pull of these mountains is not just in their physical stature but in the promise of solitude, beauty, and the thrill of navigating the unknown, particularly the divine. For the audacious and skilled climbers who dare to tread these paths, the mountains' allure is multifaceted- encompassing its inherent dangers and the mystical aura that surrounds their summits.

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Government of Nepal
Ministry of Culture, Tourism & Civil Aviation
NEPAL MOUNTAIN ACADEMY
Thapagaun, Bijulibazar, Kathmandu, Nepal
Tel: 977-1-5244312, 5244888 | Fax: 977-1-5244312
Email: journal@nepalmountain.edu.np | URL: www.nma.gov.np