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## **Climate Change and Eco-Tourism in Chitwan National Park and its Buffer Zone**

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### **Abstract**

Eco-tourism plays crucial role connecting biodiversity conservation with rural livelihoods around Nepal's protected areas, however, climate change is emerging as a threat to its ecological and socio-economic foundations. This study is concerned with the impacts of climate change on eco-tourism in Chitwan National Park (CNP) and its buffer zone, with particular emphasis on community adaptation and institutional response within eco-tourism systems. The study applies mixed-methods following explanatory sequential design combining a household (n = 385) survey with key informant interviews and focus group discussions. A majority of households observe temperature fluctuations and rainfall variability, protracted dry seasons, floods, and riverbank erosion impacting their wildlife habitats, modes of tourism and source of livelihood by slowing down tourist inflow and income stability. Although households are taking strategies like livelihood diversification and community conservation activities, institutional support is inconsistent. Applying Political Ecology, Triple-Bottom-Line Sustainability and Adaptive Capacity, the analysis underpins an analysis that detects governance deficits and recently emerging conflict sensitivities concerning participation and benefit-sharing, emphasizing the role of co-governance with climate responsiveness to enhance eco-tourism resilience in Nepal's lowland protected areas.

### **Keywords**

Climate change, Eco-tourism, Adaptation, Buffer-zone governance, Community resilience, CNP, Nepal

### **Introduction**

The impact of environmental changes on ecosystems, livelihoods and development is increasing, and nature-based tourism as well as eco-tourism is climate sensitive because of the critical importance placed on environmental quality and biodiversity (Becken &

Hay, 2007; IPCC, 2021; Hall, Scott, & Gössling, 2021). Rising temperatures, shifting precipitation patterns and more-extreme events are all ruining natural attractions and causing the dislocations it normally brings to tourism.

In Nepal, eco-tourism connects conservation of biodiversity to the livelihood in rural areas, including its conservation under the protected areas (DNPWC, 2020; Kunwar, 2017). National parks and buffer zones become socio-ecological reserves, in which societies provide guiding, homestays and small-scale entrepreneurial activity (DNPWC, 2025; WWF, 2022; Ghimire & Aryal, 2018). CNP, a UNESCO World Heritage Site, is a prime case in point; nature-based, and community-tourism-led.

Eco-tourism in CNP and its buffer zone feels increasing climate stress, such as increasing temperatures, variable monsoons, flooding, dry periods, riverbank erosion, and invasive species (KC et al., 2021; Paudel & Khadka, 2022). These pressures target wildlife habitats, infrastructure, and seasonal tourism, endangering livelihoods in buffer zones reliant on agriculture, forest resources, and tourism.

Although climate impacts of high-altitude tourism have been the subject of extensive research, lowland protected areas are poorly researched (Nepal & Saarinen, 2016; Dogru et al., 2019). Due to the year-round wildlife-based tourism at CNP, the area is especially vulnerable to climatically induced environmental change.

This study explores the impact of climate change on eco-tourism in CNP and its buffer zone with particular emphasis on community adaptation and institutional response. It adopts mixed methods research to examine local perceptions, adaptation strategies, and governance dynamics to guide inclusive, climate responsive eco-tourism policy.

## **Theoretical and Conceptual Framework**

The study applies an integrated framework as Political Ecology, Adaptive Capacity, Triple-Bottom-Line (TBL) Sustainability, this study assesses climate change effects on eco-tourism, livelihoods, and governance in protected areas.

Political Ecology identifies how access, decision-making and benefits are mediated by environmental change, resource governance and power relations (Nepal & Saarinen, 2016). In CNP and its buffer zone, climate impacts are uneven and characterized by social differentiation, institutional authority, and governance practices, contributing to analyses of participation, equity, and buffer-zone tensions.

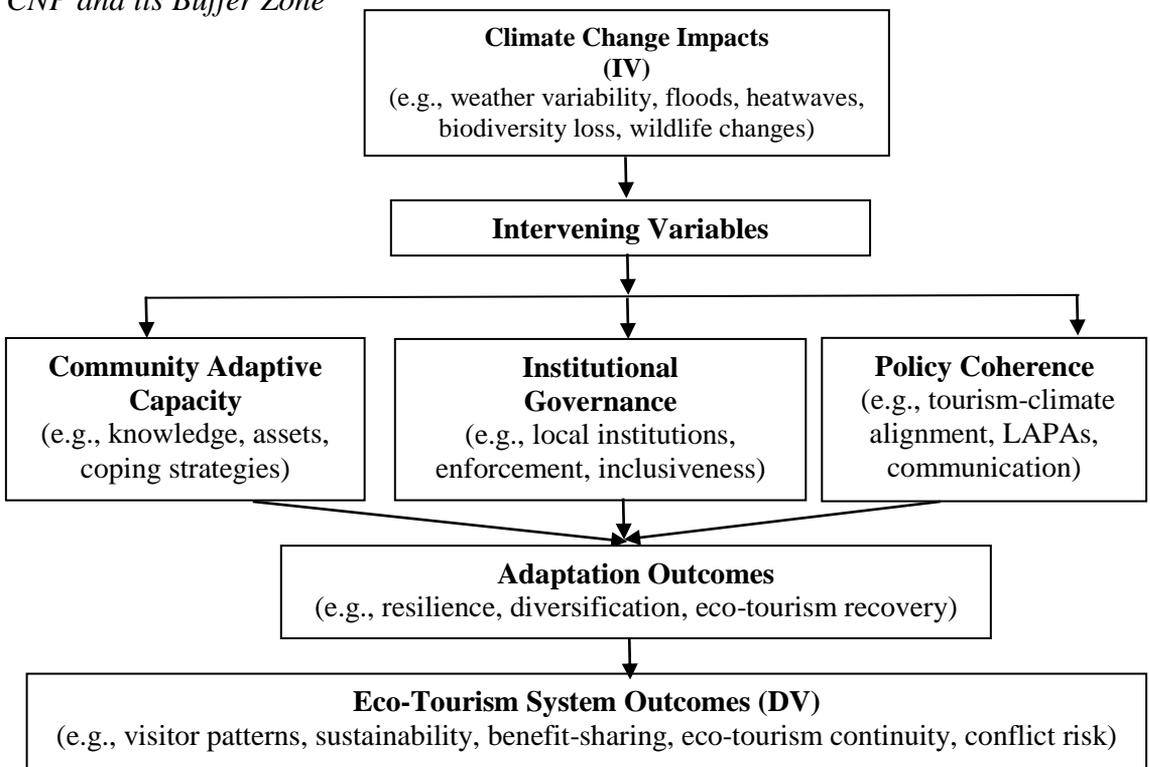
The TBL framework addresses three critical components of eco-tourism sustainability, including environmental, economic and socio-cultural dimensions (Weaver, 2005; Kunwar, 2017), while Adaptive Capacity theory highlights households'

and institutions' capacity to foresee, adapt and cope with climate stress, which is determined by natural, financial, human and social capital (Becken & Hay, 2007; Piya et al., 2019). The adaptive outcomes vary across buffer zone communities based on the extent of livelihood diversification, tourism participation and access to governance.

The conceptual framework (Figure 1) reflects interconnectedness between climate stressors, eco-tourism dynamics, livelihood outcomes, adaptation strategies, and governance processes. Climate change impacts ecological condition and tourism performance and can affect livelihoods and household adaptation. Governance serves as a mediator of these relationships that influence resource access, participation in decision-making processes, and benefit distribution to create differentiated livelihood outcomes and under-resolved conflict dynamics in buffer zone.

**Figure 1**

*Conceptual Framework of Climate Change Impacts on Eco-Tourism and Adaptation in CNP and its Buffer Zone*



Source: Author's construct based on Nepal & Saarinen (2016), Weaver (2005), Piya et al. (2019), Becken & Hay (2007), and relevant literature reviewed.

## Methodology

This study applied a mixed-methods explanatory sequential design to investigate the impacts of climate change on eco-tourism in CNP and its buffer zone. Quantitative data were gathered via a household survey of purposively selected eco-tourism dependent 385 households across four major buffer-zone sectors of CNP and its buffer-zone applying Cochran’s formula. The questionnaire included socio-demographics, climate perceptions, environmental change, eco-tourism impacts, livelihood dependence, adaptation practices, and institutional support, and was analyzed with the aid of descriptive statistics. Qualitative data were gathered through 11 key informant interviews (KIIs) and 2 focus group discussions (FGDs) using semi-structured guides in Kasara and Madi involving government officials, buffer-zone institutions, eco-tourism operators, and community members selected purposively based on their roles and experience. Qualitative data were triangulated and put in context based on survey results.

## Interface between Climate Change and Eco-Tourism in CNP and its Buffer Zone

### Climate Change Perception and Environmental Stressors

Household survey report confirms that climate change is highly perceived among buffer-zone communities in CNP. High percentile of respondents shared temperature rise, irregular rainfall, unpredictable monsoons, prolonged dry periods, and flash floods are new realities. These perceived realities of locals are substantiated by identifiable environmental stressors (invasive plants spread, grassland loss, disappearing wetlands, flash floods damaging fertile lands, riverbank erosion). Table 1 validates that 95.3% of households have experienced this phenomenon in one way or other, only minor segment of locals; 0.8% report no awareness, and 3.9% are unsure of climate change, indicates that there are definitely direct effects of climate change, particularly environmental and livelihood impacts. The high awareness reinforces community views of eco-tourism impact and commitment of local adaptation practices.

**Table 1**

#### *Household Perceptions of Climate Change*

Awareness of Climate Change	Frequency	Percentage
Don't Know	15	3.9
No	3	0.8
Yes	367	95.3

Source: Household Survey (n = 385), (June 22–28, 2025).

These quantitative local perceptions are further reinforced by KIIs and FGDs. Local population had also pointed about widespread volatility in climatic conditions causing disruption in ecological processes and livelihoods. Local residents, even in the absence of technical terminology, still recognize environmental changes.

A nature conservation officer highlighted that awareness was relatively high, especially in areas close to the eco-tourism centers. However, among some marginalized groups, the term itself was not familiar even though they observed the effects quite clearly (KII 07, Sauraha, 10 July 2025).

Similarly, a participant doing homestay pointed their children were taught about global warming in school and its impacts on crops, weather, and eco-tourism and were widely recognized by local residents, as well as by visiting tourists (FGD 01, Kasara, 08 July 2025).

Such broad recognition demonstrates that climate change is felt locally in the form of visible environmental and livelihood changes, and, in doing so, accords with the view of political ecology that considers environmental stress to be socially embedded, as opposed to an abstract feature.

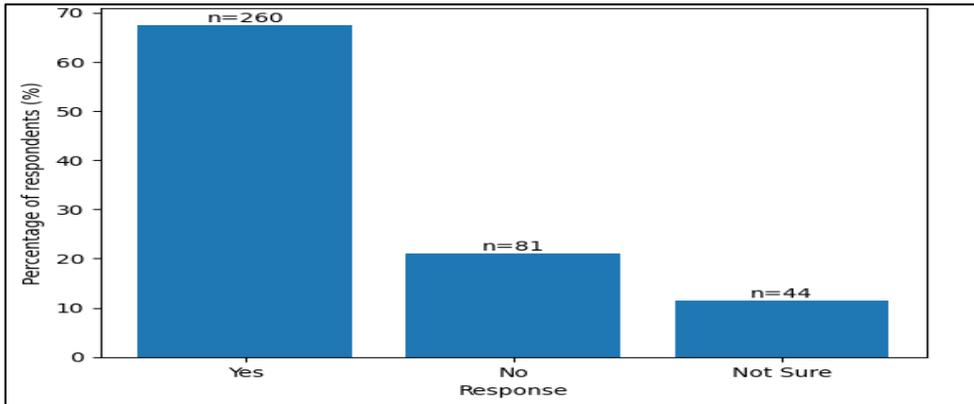
### **Effects of Climate Change in Eco-Tourism Activities**

Climate change has impacted eco-tourism in CNP directly and indirectly, survey data shows. More than half of households reported reduced tourist arrivals as a result of floods, extreme heat, and degradation of natural attractions, and wildlife safaris, canoeing, and nature-based activities were disturbed by changing water levels and shifting behaviors of animals.

As shown in Figure 2, 67.5% of respondents (n = 260) perceived impacts on eco-tourism, indicating widespread recognition of climate-related pressures on wildlife-based tourism sustainability.

**Figure 2**

*Perceived Climate Change Impacts on Eco-Tourism Activities*



Source: Household Survey (n = 385), (June 22–28, 2025).

Interviews with various key informants of eco-tourism operations revealed escalating uncertainty in wildlife sightings and increasing operational challenges.

Furthermore, a KII informant remarked that tourist flow used to be consistent, however, in recent it remained unpredictable due to uncertain floods and unbearable heat and last minute cancellations were surging (KII 05, 08 July 2025).

A local homestay worker reinforced his observation by adding up that wildlife sighting, like deer, peacocks, rhinos and even tigers was more frequent in the past, whereas nowadays animals tend to move deeper inside the jungle or change their routes in search of food and water reducing the tourists' sightings (KII 10, 11 July 2025).

The preponderance of perceived effects on eco-tourism corresponds with the ecological sensitivity of nature-based tourism systems to climate vagaries; it aligns with sustainability frameworks which emphasize the vulnerability of tourism livelihoods where they are interrelated in terms of ecological and economic interdependence.

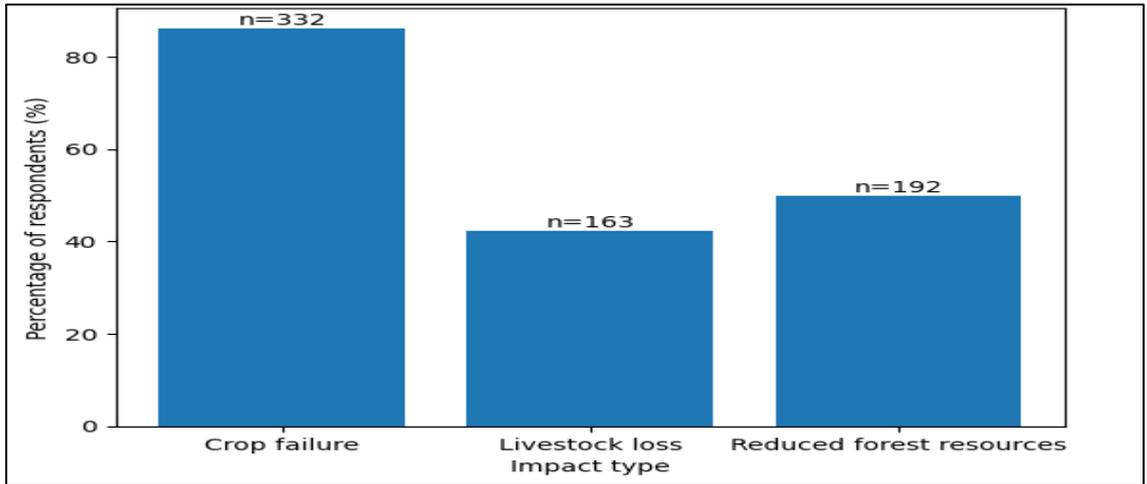
**Livelihood Implications of Climate-driven Eco-Tourism Transformation**

Climate-related disruptions to eco-tourism have significant effects on livelihoods of buffer-zone households. Many had decreasing or unstable income in tourism and very dependent households were most at risk, including households highly dependent on tourism, while agriculture suffered from climate stressors in large numbers of households.

As illustrated in Figure 3, 86.2% of households (n ≈ 332) reported crop failures related to irregular rainfall and climatic extremes, 42.3% (n ≈ 163) loss of livestock, and 49.9% (n ≈ 192) indicated that forest resources were declining. These results show broad levels of vulnerability of households that maintain weather-sensitive agricultural, forest and tourism livelihoods.

**Figure 3**

*Perceived Impact of Climate Change on Agriculture and Livelihoods*



Source: Household Survey (n = 385), (June 22–28, 2025).

FGD participants unequivocally highlighted that declining tourism income hindered households from handling agricultural losses caused by climate shocks (FGD 02, Madi, 11 July 2025).

These results are the major indicators to explain how the impact of climate change on agriculture as well as flora indirectly affects families dependent on eco-tourism. Consequently, compel dependent families to explore livelihood diversification options. This interconnection stands as an example of climate change as a compounding stressor within co-existence of human-ecology system, unlike a sector-specific upset.

## **Community Adaptation Practices in Response to Climate Change**

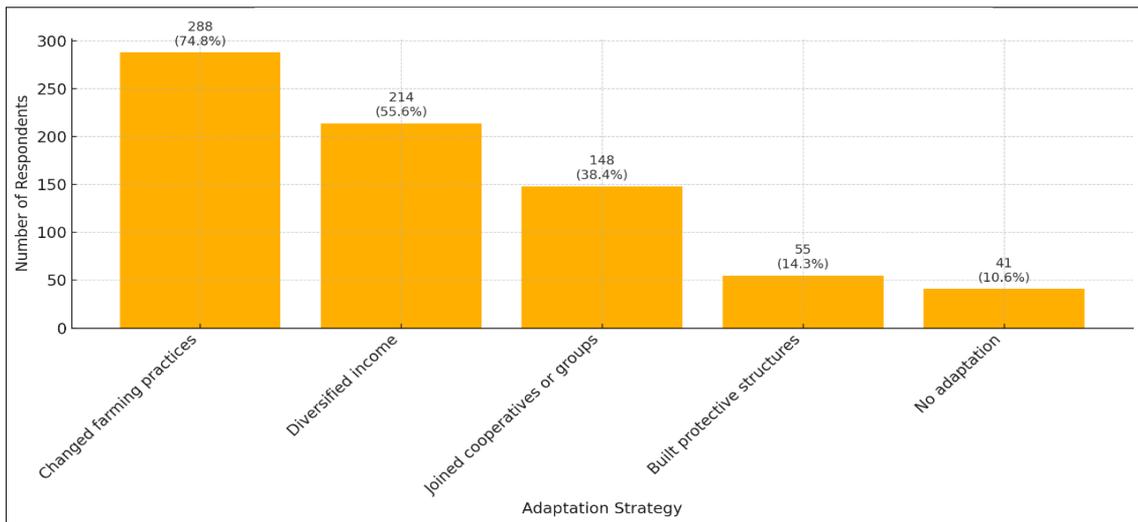
### **Household-level Adaptation Strategies**

Survey report showcases (Figure 4), communities in CNP buffer-zone have exercised numerous adaptation strategies, namely changed farming practices and income diversification by involving in eco-tourism related works, waged labour, and small

enterprises to fill resource gap caused by climate stress. Locals have also indulged in cooperative groups to expand their adaptive capacities as well as construct small scale protective structures to safeguard their farms. Financial robustness of individuals was identified as key to adaptive capacity, households with stronger financial reach have better options to adapt while others are constrained by resources, awareness, and institutional support.

**Figure 4**

*Household and Community Level Adaptation Responses*



Source: Household Survey (n = 385), (June 22–28, 2025).

Adaptive capacity and experiences of households are further corroborated qualitative interpretations of the verbatim. Respondents view adaptation initiatives as very slow and limited by several constraints in the face of snowballing ecological uncertainties.

These concerns were prevalent on qualitative level. During a KII in Kasara, a local community member remarked that significant number of peasants stopped farming paddy crop like earlier due to uncertain rainfall. Alternatively, most of them switched to cash crops like vegetables, fruits and even work as laborer instead (FGD 01, Kasara, 08 July, 2025).

In a similar tone, participants from the Madi buffer zone mentioned that local women’s group had raised small amount of money to build a minor barrier to control monsoon floods in the village (FGD 02, Madi, 11 July 2025).

Although such strategies highlight adaptive responses, however, they are primarily reflective of temporary coping mechanisms instead of planned adaptation, also in keeping with adaptive capacity literature that links effective adaptation to access to resources, skills, and institutional support.

### **Role of Eco-Tourism in local adaptation**

Prospered eco-tourism can be considered as a tool to facilitate adaptation through an income diversification like survey and qualitative outcomes has also unveiled. However, uncertain climatic conditions and lack of community capacity to cope up with the challenges imposed, eco-tourism is becoming unreliable option. Households adapted engagement by changing services, reducing investment or pursuing seasonal substitution. Eco-tourism thus becomes a supplementary instead of the final stand-alone adaptation strategy, an indicator this study has expressively identified of how households are now shifting their livelihood and investment strategies away from eco-tourism related enterprises.

A homestay operator working in the buffer zone commented that, Eco-Tourism income had become increasingly unreliable due to erratic weather patterns and seasonal disruptions (KII 11, 11 July 2025).

Also, a ward-level representative noted that, although the communities had been trying to adapt, institutional and financial support for climate-resilient eco-tourism remains limited, constraining their efforts to respond effectively to climate related challenges (KII 01, 06 July 2025).

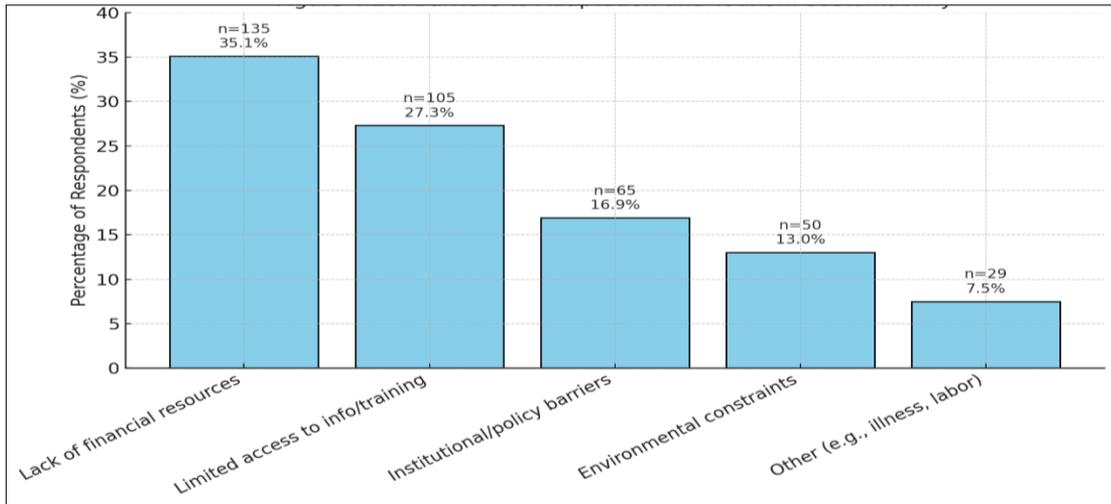
In brief, verbatim of respondents indicates the status of eco-tourism as a contingent adaptation strategy only. It can create a buffer during stable conditions while remaining very vulnerable to climatic uncertainty. This outcome is consistent with sustainability debates that warn against relying too much on climate-sensitive economic activity without paired resilience-building.

### **Constraints to Effective Adaptation**

The study also found that respondents have experienced inadequate adaptive capacity, based on lack of financial resources, limited technical training, institutional and policy barriers, uncertainly created by climatic extremes (Figure 5). Respondents who are over reliant on eco-tourism outcomes and having limited livelihood options are most affected by adverse climate change.

**Figure 5**

*Adaptation and Eco-Tourism Sustainability Barriers*



Source: Household Survey (n = 385), (June 22–28, 2025).

The quantitative results are further supported by the qualitative findings as well. They underline inconsistencies between policy directions and ground level realities. A senior conservation official noted that, although programs existed to support community adaptation, constrained resources cause outreach programs limited, leaving many households out of direct assistance (KII 06, 08 July, 2025).

During FGD in Madi a participant pointed out that respondents often didn't know whom to contact for assistance during floods destroy their crops and rarely financial support received on time at villages (FGD 02, Madi, 11 July 2025).

Respondents' experiences further clarify the gap between policy objectives and lived experiences. It indicates that effectiveness of adaptation programs are reliant to household resources and institutional capacity. To resolve these limitations good governance, fair distribution of resources, and conflict sensitivity can be instrumental.

**Institutional Response, Governance, and Conflict Sensitivity**

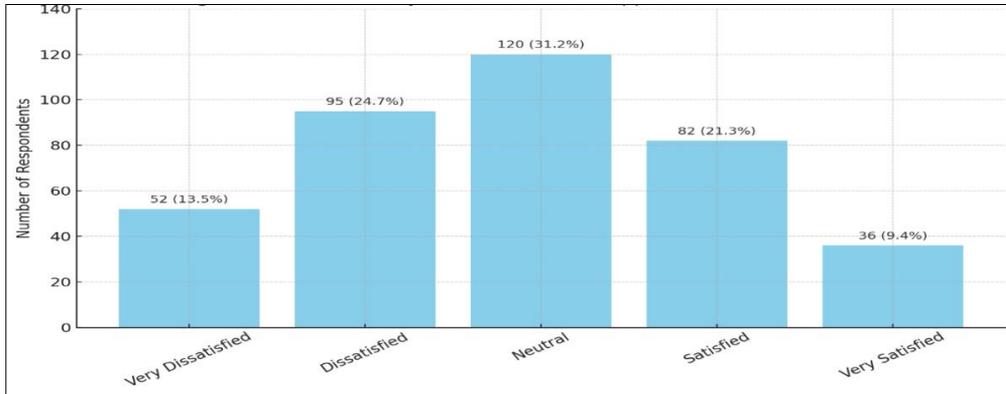
**Institutional Support for Climate Adaptation and Eco-Tourism**

Household survey findings (Figure 6) illustrate varying administrative support across CNP's buffer areas. Though some households received some kind of technical training or backing, others said support was insufficient or unreachable. Climate change actions are

largely focused on conservation compliance instead of livelihood resilience, which aggravates vulnerability among households that lack institutional access.

**Figure 6**

*Community Satisfaction with Support from Local Institutions*



Source: Household Survey (n = 385), (June 22–28, 2025).

Figure 6 expresses how various respondents observe and experience institutional support. Even though institutional support frameworks are existing on paper, key informants thought resources are limited and administrative challenges restricts institutional mechanisms from being widely adopted. Qualitative insights also validate these apprehensions.

A ward chairman acknowledged that though meetings were convened regularly to ensure transparency and participation in decision making, limited turn out of community members meant most decisions were endorsement by the participants only, excluding the feeling of absent local community members (KII 01, 06 July, 2025).

Similarly, a senior official in the Buffer Zone Management Committee admitted, institutional efforts were constrained due to limitations in budgetary resources causing uneven distributions across all communities and feeling of neglect among communities receiving comparatively less assistance (KII 04, 08 July 2025).

These interpretations further strengthen the need to improve institutional capacity and accountability in order to further climate-resilient eco-tourism governance.

### **Governance, Participation, and Conflict Sensitivity in Eco-Tourism**

This section assesses how the local people perceive governance, participation, and benefit-sharing in eco-tourism and conservation in the buffer zone of CNP, their attitudes

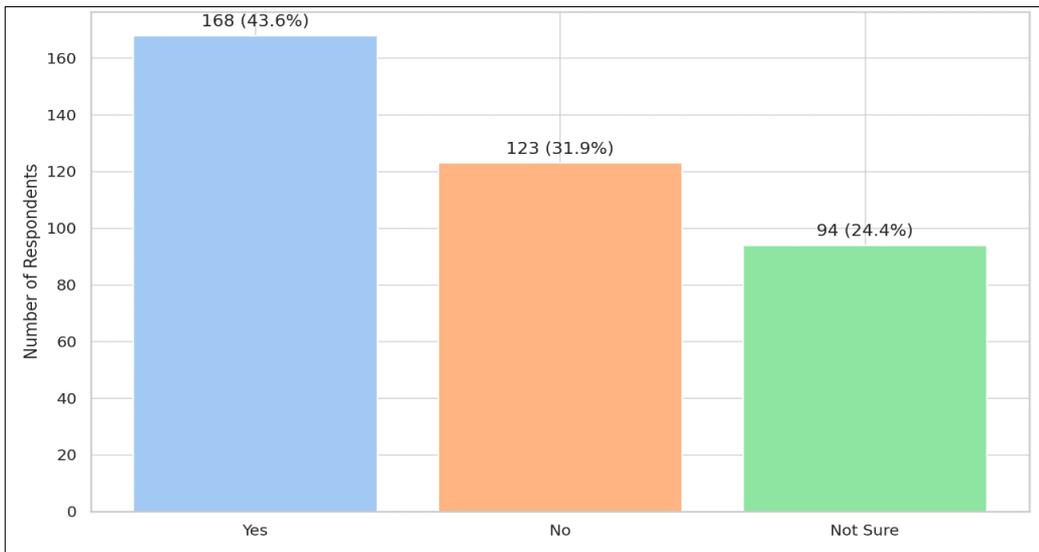
towards governance, participation, and benefit-sharing, and how such perceptions of community dynamics relate to latent conflict dynamics under climate stress.

### **Inclusivity in Eco-Tourism and Conservation Decision-Making**

The survey findings are mixed on the perceived inclusivity of eco-tourism and conservation decision-making. Only 43.6% of the respondents (n = 168) found processes to be inclusive, while 31.9% (n = 123) declared them to be non-inclusive, and 24.4% (n = 94) said they were uncertain, with limited transparency and uneven communication taking place between institutions and communities.

**Figure 7**

*Perception of Inclusivity in Eco-Tourism Decision-Making*



Source: Household Survey (n = 385), (June 22–28, 2025)

An eco-tourism homestay operator cited challenges to effective participation, although community always attempted to participate in decision-making processes, invitations rarely passed on time, therefore, often notified in the aftermath (KII 11, 11 July 2025).

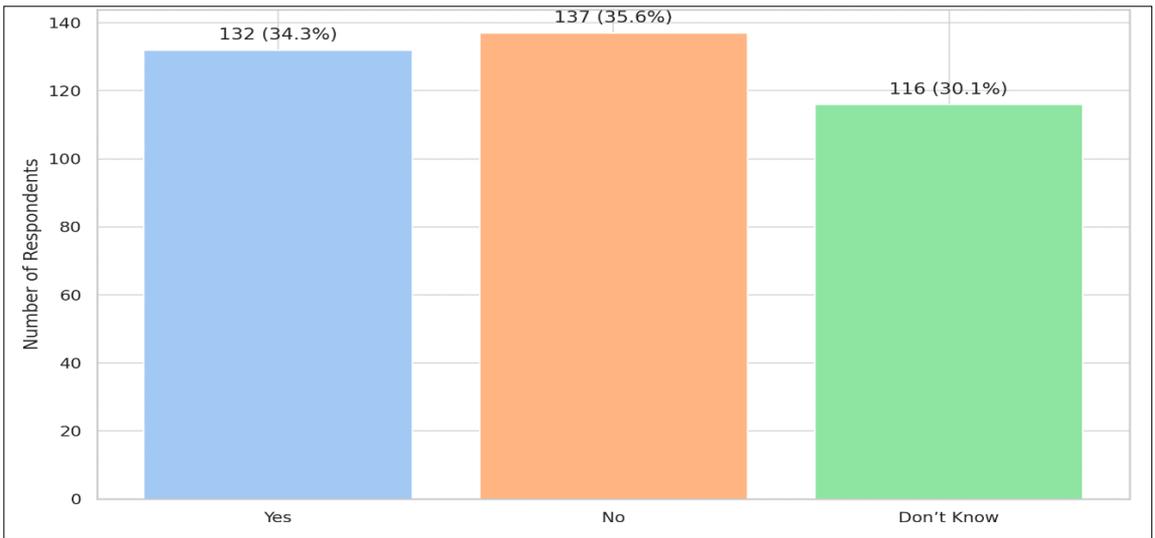
Such governance gaps point to the fact that formal participation mechanisms do not necessarily translate into substantive inclusion, consistent with political ecology’s arguments that power relations shape who participates and who benefits from conservation and tourism governance.

### Benefit-Sharing, Latent Tensions, and Conflict Sensitivity

Survey results (Figure 8) indicate divided perceptions about benefit-sharing and governance. Tensions or dissatisfaction were reported by around 34.3% of the participants (n = 132), with 35.6% (n = 137) reporting none and 30.1% (n = 116) being uncertain, which may indicate potential institutional distance or community marginalization.

**Figure 8**

*Perceptions of Tensions around Benefit-Sharing or Eco-Tourism Governance*



Source: Household Survey (n = 385), (June 22–28, 2025).

Qualitative narratives reveal how these perceptions are manifested as implicit grievances. A community forest user committee representative stated that not all communities felt that buffer zone benefits shared fairly. Often, communities closer to the decision-makers bag more projects and grants (KII 03, 07 July 2025).

These issues were also raised in a FGD in Madi by the community members, where they expressed uncertainty about the allocations of funds and increasing doubts about the transparency of the institutions (FGD 02, 11 July 2025).

The existence of dissatisfaction and grievances may reflect latent governance tensions rather than overt conflict. From a conflict-sensitivity perspective, these unpaid grievances are likely to be amplified within climate sensitive and livelihood insecure contexts if not addressed.

**Linkages between Climate Stress, Eco-Tourism Disruption, and Livelihood Results**

The integrated survey, KII, and FGD data (Table 2) clearly indicate the link between climate stressors and eco-tourism disruption. Irregular rainfall, floods, heat stress, invasive species have curtailed tourist flows and damaged infrastructure, causing income decline, a decrease in livelihoods, temporary migration and reliance on climate-sensitive agriculture.

**Table 2**

*The interaction between Climate Stressors, Eco-Tourism Disruptions, and Livelihood outcomes in CNP and its Buffer Zone*

<b>Climate Stressors Identified in the Study</b>	<b>Eco-Tourism Disruptions</b>	<b>Livelihood Outcomes Reported</b>
Irregular rainfall, extended dry spells	Decline in wildlife visibility; reduced seasonal tourist flow	Reduced tourism income; increased reliance on agriculture and wage labour
Flooding, riverbank cutting	Trail damage, homestay damage, mobility disruption	Repair costs; short-term loss of tourist bookings; crop damage
Heat stress, water scarcity	Wildlife movement toward settlements; safety concerns	Human-wildlife conflict affecting crops and livestock; reduced food security
Invasive species expansion (e.g., Mikania)	Habitat degradation affecting wildlife-based tourism products	Reduced guide income; seasonal unemployment; lowered BZUC revenue
Agricultural unpredictability	Limited supply for homestays; decline in agro-based attractions	Dual livelihood pressure; partial migration; increased borrowing

Source: Fieldwork on buffer zones in CNP (June 22–July 11, 2025).

The connection between climate stressors, eco-tourism disruption, and livelihood outcomes illustrates the way that climate change can serve as a stress multiplier that increases vulnerability. Governance arrangements structure access to resources, institutional supports, and adaptive opportunities that influence these outcomes. If governance looks to be exclusionary or inequitable, climate pressures are more likely to act as livelihood stressors and as latent conflict.

## **Discussion of Climate Change, Eco-Tourism, and Governance Interactions**

Climate change in CNP's buffer zone is a systemic force shaping eco-tourism, livelihoods and governance. Climate variability interferes with agriculture and wildlife-based tourism, constraining eco-tourism alone as a coping mechanism. Household adaptation is highly reactive, and diversification is limited by falling agricultural productivity and sporadic tourism revenue. People with stronger skills, networks and institutional support have more adaptive capacity, but some experience compounded risks with others.

Climate impacts and adaptation are mediated by governance. Material results and social cohesion are impacted by limited inclusivity, uneven benefit sharing and weak transparency. While open conflicts are rare, simmering tensions suggest grievances within governance systems that may emerge if institutional responses do not carry much weight.

Overall, findings are consistent with the conceptual framework that points out that climate stressors, eco-tourism, adaptation strategies, and governance are intertwined and therefore the needs for integrated, conflict-sensitive approaches to resilience, inclusivity, and institutional accountability are highlighted.

## **Conclusions**

Based on the mixed-methods evidence, the study concludes that impact of climate change in CNP and its buffer zone is already undermining ecological, economic and social dimensions of eco-tourism, including livelihood well-being and community resilience. The eco-tourism systems are experiencing disruptions due to climatic variability, environmental degradation and disturbances caused to wildlife.

Eco-tourism offers livelihoods to local communities but continues to be vulnerable to climatic stresses. Disruption caused by climate change to eco-tourism infrastructure and ecosystem services; deteriorate the income reliability, particularly making households relying intensely on eco-tourism activities at risk. Furthermore, adverse effects on agriculture compounds the vulnerability to absorb the shocks triggered by climate change.

Though, it is relatively reactive and episodic, community response to the adversities created by the climate change in eco-tourism systems via various adaptation measures is apparent with different level of resources, skill levels, and support from institutions. It is evident, in the absence of required level of community adaptation and institutional

support system, thriving eco-tourism systems is hardly sufficient in CNP and its buffer zone.

### **Implications**

The study has revealed some pertinent key policy, practice, and research implications. Primarily, policies need to mainstream climate adaptation with buffer-zone management and eco-tourism planning. They supposed to be guided by adequate institutional support that assimilates livelihood resilience, equity, and inclusion, rather than merely conservation.

On the basis of need assessment, affected community need to have better access to training, resources, inclusive concerning enhancement of community adaptive capacity, livelihood diversification and resource inclusion. Finalization of Eco-tourism projects have to be adaptable to climatic challenges and mitigate against income volatility.

From a governance standpoint, meaningful community participation, transparent benefit sharing, and inclusive decision making have the potential to avert tensions at latent stage consequently it can reinforce social cohesion and additionally facilitates long-term conservation and tourism sustainability.

This study offers an exclusive contribution to the existing literature on climate change and its impacts on eco-tourism focused primarily on lowland protected areas, which may contribute to specific context-based approaches to develop climate-resilient strategies in CNP and its buffer zone and in similar settings.

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