

VISITORS' ENVIRONMENTAL IMPACT ON CONSERVATION AREAS: AN EVALUATION OF ANNAPURNA BASE CAMP TREKKING TRAIL IN THE ANNAPURNA CONSERVATION AREA, NEPAL

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ABSTRACT

Worldwide, natural landscapes possessing exceptional biodiversity are declared as protected areas for conserving unique biodiversity and ecosystem. With the invent of the concept of ecotourism, protected areas have been established as the most preferred nature-based tourism destinations. The increased tourism activity within the conservation area generates many negative environmental impacts which eventually deteriorates the ecosystem and threatens the biodiversity. The Annapurna Conservation Area is a mountain ecosystem providing shelter for various unique biodiversity and is also famous for tourism activity. Annapurna Base Camp Trekking trail within Annapurna conservation area has been established as one of the most preferred trekking destinations, however the negative environmental impacts of tourism to this trekking trail is yet unknown. In this study, we evaluated the environmental impacts of tourism across the Annapurna Base Camp Trekking trail via field visit observation, group discussion, and questionnaire survey on a Likert scale ranging from one to five. The result revealed that solid waste generation and spread of invasive alien plant across the trekking trail are the obvious environmental impacts of tourism while impacts on other aspect of environment are almost insignificant and within the threshold limit. The findings thus indicate the need of devising an effective strategy for mitigating the solid waste generation and preventing the spread of invasive plants. This finding provides important insights to formulate policies for the management of tourism in conservation area and protect the biodiversity, landscape, and ecosystem of Annapurna Base Camp Trekking trail and other similar trekking destinations across the entire country.

Key words: Biodiversity, conservation areas, ecosystem, sustainable tourism, tourism environmental impact

INTRODUCTION

The natural environment across the globe is continually impacted both by positively and negatively due to the recent rise of anthropogenic activities. Tourism is one of the anthropogenic activities that generates both positive and negative impacts on the

environment (Bestard and Nadal, 2007; Kozhokulov *et al.*, 2019). Tourism, on the one hand, raises awareness of environmental values and serves as an economic tool to financially support the various environmental protection activities (Maldonado-Oré and Custodio, 2020). Thus, tourism contributes for environmental

protection and conservation (Canteiro *et al.*, 2018; Das and Chatterjee, 2015). On the other hand, when management strategies are not effectively implemented, the increased tourism activity generates pronounced negative impacts such as solid waste accumulation, destruction of vegetation cover, pollution, and deterioration of overall ecosystem health (Aragon, 2018; Maldonado-Oré and Custodio, 2020; Romero, 2016). Most negative environmental impacts of tourism depend upon several factors such as the quality of the landscape of a destination, and are primarily linked with the tourism promotion activities such as construction of roads and airports, resorts, hotels, restaurants, shops, etc. Therefore, the net environmental impact of tourism varies spatially (Haralambopoulos and Pizam, 1996).

Globally, protected areas (PA) have been established as one of the major ecotourism destinations (Baral and Rijal, 2022; Chan and Bhatta, 2013; Maldonado-Oré and Custodio, 2020). Although the use of protected areas as the tourism destinations generates social and economic benefits to the local residents and the entire community, the intense tourism activities in the fragile mountainous ecosystem is likely to cause several intangible environmental degradations (Baral and Rijal, 2022; Brenner, 2011; Haralambopoulos and Pizam, 1996; Maldonado-Oré and Custodio, 2020; Pickering and Hill, 2007). In particular, when a destination with fragile ecosystem receives tremendous tourism activity beyond its threshold limit, it becomes susceptible to environmental deterioration, specifically leading to imbalance in resource availability and environmental capacity (Baral and Rijal, 2022; Brenner, 2011; Maldonado-Oré and Custodio, 2020; Ozturk *et al.*, 2016; Pickering and Hill, 2007). Moreover, increased tourism activity generates solid waste and congestion which not only degrades

landscape beauty, vegetation cover, and overall ecosystem health but also causes impacts on wild lives (both floras and faunas) leading to their local declines, extirpation, and/or ultimate extinction (Ozturk *et al.*, 2016; Pickering *et al.*, 2003). Therefore, there is a need of devising an effective strategy in managing tourism industries within a conservation area. Previous studies suggest that the impacts of tourism are site specific which may vary temporarily (Allen *et al.*, 1988; Dwyer and Forsyth, 1993; Liu and Li, 2018; Tsundoda and Mendlinger, 2009). This fact suggests that in order to achieve the goal of sustainable tourism development without environmental deterioration, there is a need of site-specific assessment of the environmental impacts of tourism. Identifying visitors' impacts on the environment together with the assessment of carrying capacity of a destination is the most important potential strategy for mitigating visitors' impacts on protected areas. Such studies are instrumental not only in formulating plan and policies for tourism management but also for the conservation of natural environment and the ecosystem. Although, in the global context, several studies have analysed the overall environmental impacts of tourism at several destinations (Allen *et al.*, 1988; Das and Chatterjee, 2015; Mikayilov *et al.*, 2019; Ozturk *et al.*, 2016; Pickering and Hill, 2007), in the Nepalese context studies on the identification of visitors' environmental impacts are meagre.

The Annapurna Conservation Area (ACA) extending in five districts (Manang, Mustang, Kaski, Myagdi, and Lamjung) in Gandaki province was established in 1986, mainly for biodiversity conservation and tourism promotion. The conservation area is the home to over 100,000 residents mainly belonging to Gurung, Magar, Thakali, Loba and Manange ethnicity, each of the ethnic group with their unique cultural and linguistic diversity. The

ACA extending within the elevation range of 790 m to the peak of Annapurna I at 8091m asl harbors some of the unique geographical features such as the world's deepest river gorge: Kali Gandaki Gorge, fossil remains of the Tethys Sea, the world's highest altitude fresh water lake: Tilicho lake. In addition to cultural and geographical diversity, ACA is also diverse in biodiversity. It is one of the biodiversity rich areas in the country harbouring 1,605 species of flowering plants, 16 species of gymnosperms, 118 species of ferns and fern allies, 518 birds, 105 mammals, 40 reptiles, and 23 amphibians (NTNC, 2013; Tiruwa *et al.*, 2022). The Ghorepani-*Rhododendron* forest within ACA is one of the largest *Rhododendron* forests in the country. Due to these unique features, ACA is believed to be one of the most geographically, culturally, and biologically diverse areas in the world. Therefore, ACA has been established as one of the most popular ecotourism destinations in the country, both for the domestic and international visitors (NTNC, 2013). The conservation area attracts a majority of country's total trekkers and thus tourism has been firmly established as the major sector of local economy (Baral and Rijal, 2022; Buckley, 2003).

ACA encompasses Annapurna Himalayan range and known for several trekking routes including the Annapurna Base Camp trekking Route (ABC), one of the most famous trekking destinations in the world. The final destination of this trekking route is Annapurna Base Camp located at an elevation of 4197 m asl. From the base camp, a panoramic 360° view of snow-capped mountains can be seen (Buckley, 2003; NTNC, 2013). This amazing spectacular view creates an unforgettable experience to the visitors. Due to such a stunning feature of the base camp, over the last few decades, there has been exponential increase in trekking activities along this trekking route. The massive

increase of visitors along this trekking route is causing increased fuelwood consumption thereby creating pressure to its forest resources. In addition, solid waste, particularly non-degradable solid waste generated by trekkers and tourism related industries is the other important environmental concern. However, studies assessing the environmental impact of tourism in such an ecologically fragile destinations are yet meagre. Therefore, there is a need of comprehensive studies evaluating the net environmental impacts of visitors along this most famous trekking route. In this study, we assessed the environmental impacts of tourism in the Annapurna Base Camp Trekking trail, one of the most famous trekking trails in Nepal. The findings of this study would provide meaningful insights to evaluate whether the further promotion of tourism along this trekking route would be ecologically sustainable or not.

MATERIALS AND METHODS

Study site

Among the different trekking routes to the Annapurna Base Camp, the trekking trail starting from Matkiu through Jhinu and Chhomrong is most widely trekked, and thus this trekking route was selected as the focal study site (Fig. 1). This trekking route is the best legendary and classical trail in the world that offers the breath stopping mountain experience including spectacular and tranquil landscapes through Gurung and Magar villages with lush green vegetation, the bloom of *Rhododendron*, bamboo and alpine forests. In this trek route, visitors can engage in activities such as hiking, mountaineering, viewing wildlife, visiting cultural sites and ethnic museums, and nature photography. The lower point of this trekking route Matkiu (28.3893° N, 83.8216° E) located close to Ghandruk, one of the famous touristic destinations in Gandaki Province, can be easily

accessed by a vehicular transport from Pokhara in around 3-4 hours. Matkiu is the beginning point of trekking. The provision of hotels, teahouses, and restaurants at almost every two hours of trekking is the important beauty of the trekking route. The next destination of the route is Jhinu where visitors can cleanse their body spiritually in the natural hot spring at the lap of mountain. The route then passes through Chhomrong, Sinuwa, Bamboo, Dovan, Himalaya, Deorali, Machhapuchhre base camp, and finally the Annapurna base camp. It usually takes 4-6 days for trekking straight up to the Annapurna Base Camp and back to Matkiu via the same trekking route. There are a total of 81 hotels and lodges distributed at 12 spots along the trekking trails. The final destination of the trekking trail, The Annapurna Base Camp, has six hotels/lodges that can accommodate *ca* 150 visitors per day.

Ethical consideration

Necessary permission was taken from the hotel association at Ghandruk. Before conducting an interview/questionnaire survey, a Free Prior and informed consent (FPIC) was obtained from all the respondents. All the respondents were informed that the collected information will be used only for this research. Respondents were also assured that their identity will not be disclosed anywhere.

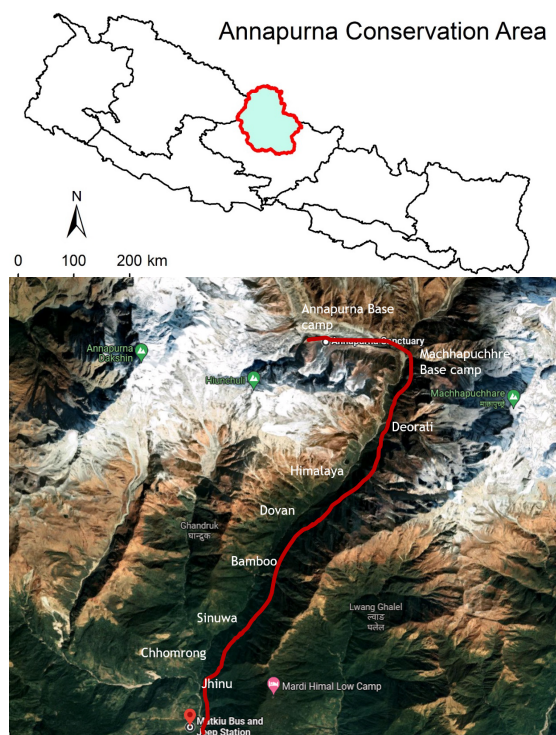


Figure 1: Study site showing the location of Annapurna Conservation Area in Nepal and different destinations along the trekking route in the study site (Image source: Google Earth)



Figure 2: A panoramic view of the snow-capped mountains seen from the Annapurna Base Camp

Research Design and Data Collection

The present research was based on the primary data collected via field visit's observation, group discussion, personal interview, and questionnaire survey with the stakeholders and local residents.

We considered eight different parameters: solid waste generation, effects on vegetation, impact on air, noise pollution, effects on soil, effects on water quality of stream and other water sources along the trekking route, effects

on wild lives, and landscape degradation as the proxy measures of environmental impacts of tourism. Various factors associated with the eight parameters considered for the current study (Table 1) were determined by the direct field observation, literature review (Baral and Rijal, 2022; Maldonado-Oré and Custodio, 2020; Mikayilov *et al.*, 2019; Pickering *et al.*, 2003; Pickering and Hill, 2007), consultation with the environment and biodiversity experts, interaction with the various stakeholders, and local residents. The data were collected by field observation comprising the team of three researchers. During field data collection, the team of researchers assessed the impacts of tourism on all the 35 subfactors (Table 1) by observation over a month. The impact of tourism on the variables: vegetation damage, effects on wild lives, noise pollution, landscape degradation, effect on water quality, and effects on soil were measured by observation in the field. For assessing the impact on air, the presence of dust, smoke, and noxious smell in the air was evaluated by observation/smelling. The data on solid waste generation were obtained through direct quantification. In order to obtain the data on solid waste generation, we collected the daily garbage from the ten dumping places along the walking trails. The garbage was then divided into degradable and non-degradable. The collected garbage was separately weighed, and the impact of each category of garbage was evaluated on a five-point Likert scale where scores from one to five respectively represent “completely insignificant”, “insignificant”, “average”, “significant”, and “strongly significant”.

In addition to direct field data collection, we also conducted a questionnaire survey with the key respondents. A total of 52 respondents were selected randomly from different groups of peoples including biodiversity and

environment conservation scientists working within the ACA, the staffs/managers of the conservation area, local residents not involved in tourism industry, and entrepreneurs of hotels and other subsidiary tourism industries within the trekking route. The questionnaires were designed incorporating the issues relevant to the trekking route. A total of 35 survey questions were asked to the respondents for assessing the perceived environmental impacts of tourism to the trekking route on the various eight subfactors (Table 1). Respondents were asked to evaluate the environmental impact of tourism on a five-point Likert scale where scores from one to five respectively represent “completely insignificant”, “insignificant”, “average”, “significant”, and “strongly significant”. Besides the structured questionnaire, the respondents were asked to express their perceptions if any factors were missing in the questionnaire survey and evaluate them on the Likert scale of 1-5 as mentioned above.

Data analysis

The data on the environmental impact of tourism on the various subfactors collected by the direct field observation and through questionnaire survey with the key respondents were pooled together. The data were then analysed by descriptive statistics and their mean values and standard errors are presented in Table 1.

RESULTS AND DISCUSSION

The findings of the current study revealed that the impact of tourism on all the eight studied variables in the ABC trekking route were minimal (nearly completely insignificant). Among the eight studied variables, the impact by solid waste generation was highest (Mean \pm SE: 2.99 \pm 0.98), followed by impact on landscape (Mean \pm SE: 2.37 \pm 0.09), and vegetation (Mean \pm SE: 2.21 \pm 1.04) while impact on water quality was the least (Mean \pm SE: 1.12 \pm 0.39). The result

clearly revealed that the impact of tourism on all the eight variables were below average score. The result revealed that the indiscriminate disposing of garbage such as chocolates and biscuits wrappers, cigar filters and butts, glass bottles, and metallic cans (soft drinks such as beers and red bull) by the trekkers along the trekking trails was the clearly spotted impact of tourism. Although the Chhomrong Tourism Management Committee has kept a number of garbage disposing bins along the trekking trails, the visitors are neither given clear instruction about the legal/environmental consequences of indiscriminate garbage disposal nor their activities are monitored by the concerned authorities such as Chhomrong Tourism Management Committee and Annapurna Conservation Area. Although the conservation area is specifically responsible for instructing visitors of the trekking trail to follow the rules of the conservation area and monitoring their activities, due to lack of sufficient number of check posts of the conservation area, the monitoring activities has been ineffective. Currently, there is only one office of the conservation area located at Chhomorong, therefore visitors if themselves are not aware, feel no obligation for following the rules of the conservation area. Thus, most visitors, particularly domestic visitors dispose the garbage elsewhere. Although Chhomrong Tourism Management Committee has kept a number of notice boards in Nepali language targeting to the domestic visitors requesting to dispose the garbage in the proper bin, yet the garbage has been found disposed elsewhere along the trekking trail. This activity, particularly the accumulation of plastics, papers, and cigar butts may induce forest fire while metals and glass pieces which take years to decompose affects the quality of landscape and soil. In addition, the disposing mechanism of garbage by the restaurants and lodges along the trekking

trail was also not sustainable. Our observation indicates that the hotels/restaurants along the trekking trails dispose the garbage either by burning in a pit or by dumping them along the sides of rocks or by burying under the ground. These activities, although apparently reduces the immediate over piling of garbage, but in the long run they induce several potential negative impacts. The burying practice of non-degradable wastes may deteriorate the soil quality in the long run, while burning of plastics emits noxious smoke which creates both immediate (air pollution) and long run effects (impact on the health of wildlife and local residents). The current finding is consistent with the finding of Baral and Rijal (2022) in Ghorepani, a mountainous village within Annapurna Conservation Area that receive intense tourism activities during the peak touristic seasons. The finding reveals that the haphazard disposing of garbage by the trekkers along the trekking trail, and also the current unsustainable practice of waste disposal by the hotels/restaurants are the serious concerns that need an immediate action. As the prevailing conservation effort of Annapurna Conservation Area Project (ACAP) is particularly aimed to conserve the natural ecosystem of the conservation area as a whole, present policy of ACAP is insufficient in addressing the site-specific environmental impact of tourism. Therefore, the conservation area in collaboration with the concerned stakeholders and local residents should establish a few additional check posts and implement the trekking trail-specific conservation effort to mitigate the potential negative impacts of tourism on the environment of Annapurna Base Camp trekking trail.

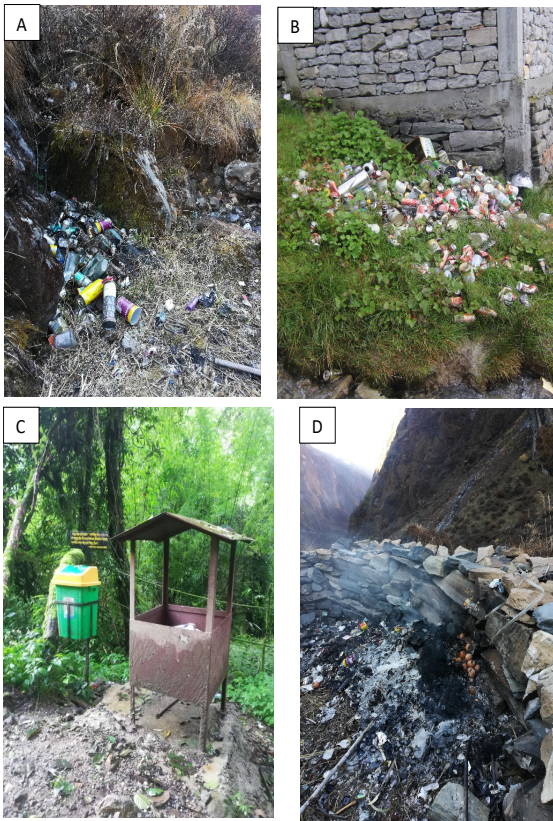


Figure 3: Current status of Garbage disposal and garbage management practice along the trekking trail. A and B- Indiscriminate throwing of garbage along the trekking trail, C- Garbage disposal bin at Dovan, and D- Garbage management by burning in a stone pit.

In addition, the result reveals that the spread of invasive plant species along the trekking trail is another important negative environmental impact of tourism in the ABC trail that needs an immediate attention and action plan. Our observation reveals that Kalo Kuro (*Bidens pilosa*) has reached up to Jhinu danda and Kalo Banmara (*Ageratina adenophora*) has reached up to Dovan. If the spread of these aggressively colonizing annual herbs is not controlled in time, this would ultimately not only replace the valuable native wild plants and crops of the conservation area but also affects the ecosystem functioning by disturbing several biotic interactions such as plant-pollinator interaction.

Therefore, stakeholders should implement an immediate action plan such as Invasive Plant Management Strategy to check the further spread of invasive plants along the trekking trail.



Figure 4: Plants along the trekking trail. A-An invasive plant, *Ageratina adenophora*, growing along the edge of Annapurna Base Camp Trekking Trail at Jhinu Dada, B- An alpine wild ornamental plant (*Rhododendron lepidotum*) growing along the trekking trail from Deurali to Machhapuchre Base Camp.

Beside these two variables, other environmental components are little or not affected by the tourism activities. Therefore, in general, it can be concluded that at its current form the environmental impact of tourism along the Annapurna Base Camp trekking trail is insignificant and within the threshold limit. However, due attention should be paid towards the solid waste management and control of the spread of invasive species, should tourism activities along the ABC trekking route be continued in its current form or further promoted.

Table 1: Environmental impact of tourism along the Annapurna-Base Camp trekking Route. The data were obtained by direct field observation involving three researchers and via questionnaire survey with 52 key respondents. Letters A, B, C, D, and E respectively indicate completely insignificant; insignificant; average; significant; and extremely significant. Values represent the number of respondents who evaluated the impacts of tourism at the listed level of significance.

Questions on the survey	A	B	C	D	E	Mean \pm SE
Visitors' activities cause impacts on						
1. Water Quality						1.12\pm0.39
1.1 Decreased transparency	55					1.0 \pm 0.0
1.2 Presence of solid residue	50	3	2			1.13 \pm 0.06
1.3 Untreated human waste	48	5	2			1.16 \pm 0.06
1.4 Sewage discharge	46	8	1			1.18 \pm 0.06
1.5 Glacier length	49	5	1			1.13 \pm 0.05
2 Air Quality						1.75\pm0.66
2.1 Presence of dust	55					1.0 \pm 0.0
2.2 Presence of smoke		50	2	2	1	2.13 \pm 0.06
2.3 Presence of noxious smell		50	2	2	1	2.13 \pm 0.06
3 Soil quality						1.54\pm0.83
3.1 Erosion	49	6				1.11 \pm 0.04
3.2 Flooding	47	8				1.15 \pm 0.05
3.3 Compaction	11	9	34	1		2.45 \pm 0.01
3.4 Land degradation	40	3	11	1		1.45 \pm 0.11
4 Vegetation						2.21\pm1.04
4.1 Damage of aerial parts	16	18	11	8	2	2.31 \pm 0.16
4.2 Uprooting	23	19	8	4	1	1.93 \pm 0.14
4.3 Spread of disease		26	19	8	2	2.75 \pm 0.11
4.4 Spread of invasive species	2	19	20	8	6	2.95 \pm 0.14
4.5 Fire damage	18	21	14	2		2.00 \pm 0.12
4.6 Firewood collection			26	19	10	2.71 \pm 0.10
4.7 Collection as a traditional medicine	50	2	3			1.15 \pm 0.07
4.8 Slash and burn			18	23	14	1.93 \pm 0.10
5 Wild lives						1.95\pm0.16
5.1 Disturbance in movement /breeding	17	14	19	5		2.22 \pm 0.13
5.2 Local extirpation	7	21	8	12	7	2.84 \pm 0.17
5.3 Extinct	46	3	4	1	1	1.33 \pm 0.11
5.4 Hunting	47	5	3			1.20 \pm 0.07
5.5 Poaching	43	5	7			1.35 \pm 0.09
5.6 Spread of disease	12	16	17	10		2.45 \pm 0.14
5.7 Loss of habitat	21	14	8	7	5	2.29 \pm 0.18
6 Noise pollution	34	11	6	3	1	1.65\pm0.14
7 Solid waste generation						2.99\pm0.98
7.1 Biodegradable/organic waste		10	23	11	11	3.42 \pm 0.14
7.2 Papers and cigar filters		9	27	19		3.18 \pm 0.09
7.3 Plastics		8	23	24		3.29 \pm 0.10

7.4 Glasses	14	11	19	11	2.49±0.15
7.5 Metals	8	16	21	10	2.60±0.13
8 Landscape					2.37±0.09
8.1 Erosion and landslide	7	19	18	7	2.69±0.15
8.2 Avalanche	19	18	15	2	2.05±0.13

CONCLUSIONS

The findings of this study reveal that tourism at the ABC trekking route is creating an average negative impact on environment by solid waste generation and below average negative environmental impact on vegetation by the spread of invasive species. Besides these two minimal negative impacts, the tourism activity has no obvious negative impacts on the other studied environmental components of the ABC trekking route. Therefore, at its current form, the tourism activities at ABC trekking route have no remarkable environmental impact. However, due attention should be paid towards the solid waste management and control of the spread of invasive species, should tourism activities along the ABC trekking route be continued in its current form or further promoted.

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