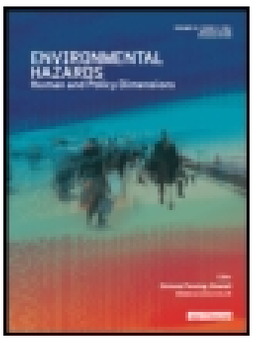

Environmental Hazards

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tenh20

A call for reducing tourism risk to environmental hazards in the Himalaya

A. D. Ziegler, R. J. Wasson, Y. Sundriyal, P. Srivastava, G. Sasges, S. J. Ramchunder, C. E. Ong, S. K. Nepal, B. G. McAdoo, J. Gillen, D. Bishwokarma, A. Bhardwaj & M. Apollo

To cite this article: A. D. Ziegler, R. J. Wasson, Y. Sundriyal, P. Srivastava, G. Sasges, S. J. Ramchunder, C. E. Ong, S. K. Nepal, B. G. McAdoo, J. Gillen, D. Bishwokarma, A. Bhardwaj & M. Apollo (2021): A call for reducing tourism risk to environmental hazards in the Himalaya, Environmental Hazards, DOI: 10.1080/17477891.2021.1984196

To link to this article: https://doi.org/10.1080/17477891.2021.1984196

Published online: 11 Oct 2021.

ENVIRONMENTAL HAZARDS
https://doi.org/10.1080/17477891.2021.1984196

Taylor & Francis
Taylor & Francis Group

ARTICLE COMMENTARY

A call for reducing tourism risk to environmental hazards in the Himalaya

A. D. Ziegler [a], R. J. Wasson[b,c], Y. Sundriyal[d], P. Srivastava[e], G. Sasges[f], S. J. Ramchunder[g], C. E. Ong[h], S. K. Nepal[i], B. G. McAdoo[j], J. Gillen[k], D. Bishwokarma[l], A. Bhardwaj[m] and M. Apollo [n,o*]

[a]Faculty of Fisheries Technology and Aquatic Resources, Mae Jo University, Chiang Mai, Thailand; [b]College of Science and Engineering, James Cook University, Cairns, Queensland, Australia; [c]Fenner School of Environment and Society, Australian National University, Canberra, Australia; [d]Department of Geology, Hemwati Nandan Bahuguna Garhwal University, HNB, Srinagar, India; [e]Wadia Institute of Himalayan Geology, Dehra Dūn, Uttarakhand, India; [f]Department of Southeast Asian Studies, National University of Singapore, Singapore, Singapore; [g]Department of Geography, National University of Singapore, Singapore, Singapore; [h]School of Tourism Management, Sun-Yat Sen University, Guangzhou, China; [i]Geography and Environmental Management, University of Waterloo, Waterloo, Canada; [j]Division of Earth and Climate Sciences, Duke University, Durham, USA; [k]Global Studies Program, University of Auckland, Auckland, New Zealand; [l]The National Planning Commission (NPC), Kathmandu, Nepal; [m]Department of Civil Engineering, Indian Institute of Technology, Roorkee, India; [n]Department of Tourism and Regional Studies, Pedagogical University of Krakow, Krakow, Poland; [o]Hainan University - Arizona State University Joint International Tourism College, Haikou, China

ABSTRACT

As mountain tourism rapidly expands in remote landscapes, there is a critical need for improved disaster risk management to ensure the safety of tourists and industry workers, safeguard infrastructure designed to support tourism and service industries (e.g., transportation), as well as protect the local economies that have come to depend on tourism revenue. Drawing from recent disasters in the Himalaya, we present evidence that the promotion of safe and sustainable tourism is out of sync with the proliferation of inbound tourists who are prone to many types of environmental hazards. The key driver of this situation is commercialisation. Other factors include increased mobilities/access of tourists who are often unaware of or ill-prepared to cope with hazards; lack of regulations with respect to overcrowding, safety and building codes increased exposure to climate change phenomena; and limited disaster response capabilities, including responsibility at the local level. In this perspective we argue that this particularly complex situation is best addressed through the lens of a dynamic system, whereby strong leadership, increased regulation of access and participation, and enhanced professionalism via training are key leverage points in countering uncontrolled commercialisation that drives increased risk to known hazards. The inclusion of tourism into disaster risk management systems is also needed where hazard risks and tourist traffic are high, as tourists are part of the transient population who are often unfamiliar with local conditions and ill-prepared to cope with extreme adversity.

ARTICLE HISTORY
Received 20 March 2021
Accepted 19 September 2021

KEYWORDS
tourism safety; hazard preparedness; climate change; mobility; access; overcrowding; commercialisation; systems dynamics

CONTACT A. D. Ziegler adj@mju.ac.th
*Authors are listed in reverse alphabetical order. All authors contributed equally to the conceptualization and writing of the paper.

Introduction

Since the 1960s, mountain regions worldwide have been experiencing an increasing level of tourist activity (Apollo et al., 2020; Jin-Hyung et al., 2001; Marek & Wieczorek, 2015; Musa & Sarker, 2019; Nepal, 2000; Nepal & Chipeniuk, 2005; Nyaupane, 2015). This increase is linked fundamentally to mountaineering but can also be traced to the rise of nature-based (Jones et al., 2021; Nagle & Vidon, 2021) and adventure tourism (Ong, 2005; Pomfret, 2021). In recent times, affordable transportation over newly constructed road networks, more intensive tourist mobilities, higher demand for access to popular destinations, rampant commercialisation, limited regulation of overcrowding, and insufficient focus on preparedness have led to a greater number of mountain tourists exposed to environmental hazards, particularly in the Himalaya (Angel, 2018; Malik & Bhat, 2015; Upadhayaya, 2015). In the meantime, disaster risk reduction capacity has not kept pace with increasing vulnerability, as exemplified during and following the 2013 Kedarnath disaster in northern India, as well as recent mountain disasters in Nepal (discussed below).

Regardless of motivation (secular or sacred), mountain tourists must deal with an exposition to various types of danger (Apollo, 2021). Quite simply, mountains are wild rugged places with unsavoury weather and a variety of environmental hazards that make any adventure activity inherently risky (Beedie & Hudson, 2003). Much of the mountain tourism literature is focused on pursuits of adventure flow experience, motivation, rationality, and search for meanings of self or affirmation of identity (e.g., Beedie & Hudson, 2003; Musa et al., 2015; Nepal & Mu, 2015). Another subset examines the impacts adventure tourism has on the environment and local cultures (Mu et al., 2019; Nepal et al., 2020). Arguably insufficient attention has been given to the issue of increasing vulnerability to environmental hazards (Lorenz & Dittmer, 2021; Miller & Heather Mair, 2020; Nyaupane et al., 2014; Ziegler et al., 2014; Ziegler et al., 2016a).

In this perspective, we briefly review the environmental hazards in the Himalaya before exploring the issue of increasing mountain tourism risk, drawing from specific examples in India and Nepal where the authors have extensive research and fieldwork experience. These discussions lead to two fundamental questions: can increasing risk be reduced and, if so, how best to achieve it? The answer largely relates to the drivers of increased risk as well as the practicality of identifying effective mechanisms to bring about change. Foreshadowing, we will argue that by viewing the key interlinked processes and actors as a dynamically complex system, one can attempt to identify ways to better safeguard tourists, tourism guides, and others employed in the adventure and religious tourism industry in the Himalaya, as part of a targeted initiative on tourism risk reduction. As these issues are generally common to all high mountain ranges in the world, our perspective should provide guidance in other regions with substantial tourism and hazards, for example in the European Alps, Pakistan, Peru, and North America. In what follows we briefly review the environmental hazards in the Himalaya before exploring the issue of increasing mountain tourism risk in India and Nepal.

Environmental hazards in the Himalaya

The Himalaya are a minacious, hazard-prone environment (Figure 1), characterised by significant, tectonic, geomorphologic, hydrologic and climatic processes (Apollo et al.,

Figure 1. The idyllic and minacious environment of the Himalaya. (top) The Chenab River and tributary in the Lahaul Himalaya where houses and terraces are built upon rubble from former landslides and debris flows. (Bottom) Rockfalls and debris flow deposits in the Miyar Valley, Lahaul Himalaya. Credit: M Apollo.

2020; Parkash, 2013; Sati, 2011). This dynamic setting is the result of the mountains being high, steep, and seismically active, having formed only about 50 million years ago (Pandey, 2002). Earthquakes of various magnitudes occur somewhere in the Himalaya each year, the larger ones posing a primary risk to people inhabiting poorly constructed buildings. Earthquakes may also generate a variety of secondary hazards, including both shallow and deep-seated landslides, which in addition to being a direct threat, can lead to the formation of landslide lakes in mountain rivers and streams. As these lakes fill with water, they potentially create secondary hydrological hazards including back-flooding

and landslide lake outburst flood (LLOFs) when the face fails. Similarly, glacial lake outburst floods (GLOFs) are caused by face failures of lakes formed by glaciers (Dubey & Goyal, 2020; Cook et al., 2018; Sharma, 2020; Srivastava et al., 2017; Figure 2). Of growing concern, however, is the priming for a great earthquake in locations along the 2,500-km-long Himalayan range where elastic strain has accumulated to dangerous levels because of the absence of very large earthquakes in recent history (Bilham et al., 2001; Dal Zilio et al., 2019). The most recent major earthquake occurred in Nepal in 2015 (Mw = 7.8, USGS 2015), killing more than 9,000 people (Kargel et al., 2016)–previous earthquakes include the 2005 Muzaffarabad (Mw 7.6), 1950 Assam (Mw 8.4), 1934 Bihar-Nepal (Mw 8.1), and the 1905 Kangra (Mw 7.8), along with two less well-documented events in 1803 (M~7.8) and 1505 (M~8.2).

Other Himalayan hazards include rockfalls and avalanches, or masses of flowing ice and/or snow on mountain slopes, and failure of hanging glaciers, all of which can be triggered by earthquakes, weather, and human activities (Apollo, 2017; Ballesteros-Cánovas et al., 2018). While the predisposition of mountain ranges for mass wasting hazards is related to their geological makeup (Clague & Stead, 2012), climate and weather events are often the trigger of slope instabilities (Apollo, 2017). Particular events have been linked to freeze-thaw, warm periods (e.g., Haegeli P et al., 2011) and rainfall (see Dahal & Hasegawa, 2008). Cloud bursts are rare, intense or long-duration rain storms falling in localized areas that may trigger landslides, flash floods and debris flows (Joshi &

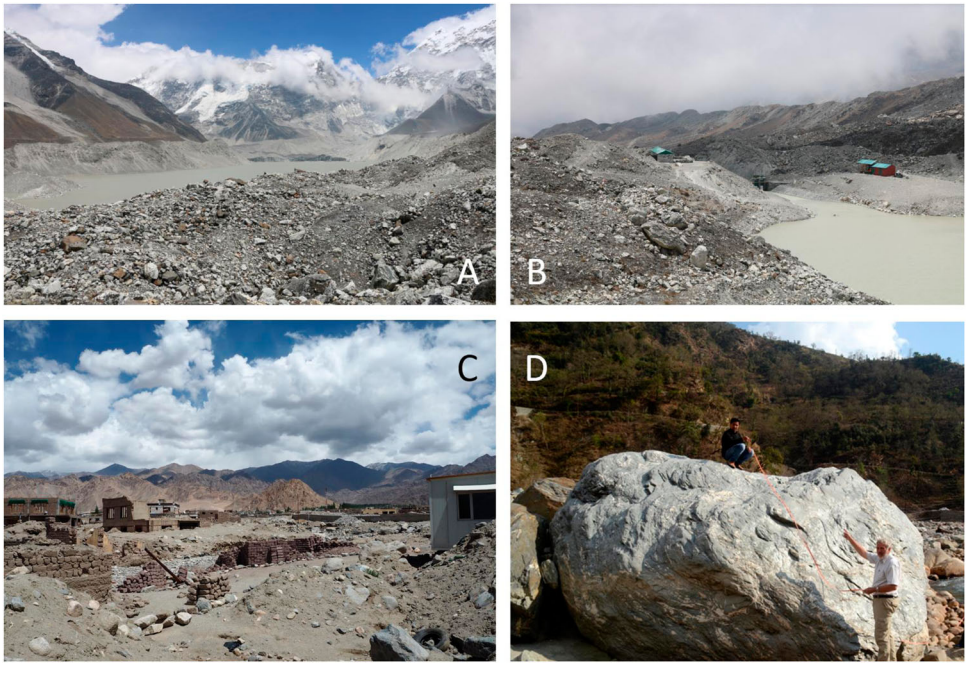

Figure 2. Himalayan Hazards. (a) View of Imja Tso glacial lake in the Everest region of Nepal (looking east). (b) Due to the high potential for a generation of a glacial lake outburst flood (GLOF), the Government of Nepal installed a warning system and constructed an outlet for lowering the lake level of Imja Tso (c) Debris from a flash flood in Ladakh in 2015; (d) Enormous boulder washed into the Mandakini River during the 2013 floods and landslides at Kedarnath. Credits SK Nepal, RJ Wasson, AD Ziegler.

Kumar, 2006; Ziegler et al., 2014). Additional hazards humans face in the high Himalaya (elevations > 4000 m) include exposure to storms, extreme cold, and low-oxygen conditions (Garrido et al., 2019; Némethy et al., 2015; Windsor, 2019). The cascading nature of the multi-hazards in the region greatly amplifies the potential for disasters to occur.

Human activities also exacerbate or create a variety of environmental hazards in the Himalaya. Roads are a notorious cause of erosion and mass wasting events in mountains (Sidle & Ziegler, 2012; Vishal et al., 2017). Road accidents are also an important cause of loss of life to residents and tourists alike (Rautela & Pant, 2007; Rautela & Sharma, 2004). Dams that have been increasingly built within rivers and streams are frequently cited as features that exacerbate floods (Huber, 2019; Uprety et al., 2017). Other human activities/features that can lead to increased hazard risk include trails, mines, reservoirs, powerline construction, and land-use change (e.g., deforestation)–for example by destabilising hillslopes, increasing surface runoff, and creating concentrated flow paths that channelise and incise the landscape (Petley et al., 2007). An indirect consequence of tourism is deforestation that stems, in part, from the need to provide food and accommodation to a high volume of tourists (Stevens, 2003). Road network expansion has also aided tourist access to remote sites, compounding the issue of forest loss.

With respect to the consequences of climate change on exacerbating hazard risk in the Himalaya, warming-induced snow/ice melt is already contributing to the increased occurrence of avalanches and the continual formation of several glacial lakes (Krishnan et al., 2019b; Nepal, 2013; Nyaupane & Chhetri, 2009). About 1,410 lakes with areas ≥ 0.02 km^2 located throughout the Himalaya are considered large enough to cause GLOFs (Bajracharya et al., 2007, 2020; Dubey & Goyal, 2020). The High Mountain Areas chapter in the *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* concludes that there is high confidence that warming has altered the frequency, magnitude and location of various types of environmental hazards, but importantly the "exposure of people and infrastructure to natural hazards has increased due to growing population, tourism and socio-economic development" (Hock et al., 2019).

An unknown effect of climate change in the Himalaya relates to how variable warming influences large-scale climate processes that lead to extreme precipitation events, which in turn trigger secondary hazards (Bhardwaj et al., 2021; Houze et al., 2017; Kotal et al., 2014). While climate change is often indicated as the cause of contemporary storm-related disasters, such as that at Kedarnath (see below), attribution studies are needed to prove such assertions are rare (Joseph et al., 2015; Krishnan et al., 2019a, 2019b; Vellore et al., 2020). Further, extreme rains and floods have occurred in the region in the distant past (Joshi & Kumar, 2006; Wasson et al., 2013). Nevertheless, as all storms are influenced by the current state of the climate regime, any change of climate will play some role in influencing the magnitude, duration, and geographical location of storms.

An important qualification in studying the Himalaya is that disaster risk varies within the different physiographic regions owing to variable physiography, the size of resident and transient populations, and the level of risk reduction currently in place (Nyaupane & Chhetri, 2009). Transient populations include the various types of people participating in or assisting mountain tourist activities, including inter alia, pilgrimages, extreme sports, adventure tours, and sightseeing. As can be gleaned in the following case studies, transient populations in high-risk areas are often high, as are the residents who support their activities.

Case Studies

(a) The Kedarnath Disaster

A multi-day cloudburst centred on Uttarakhand state in north India triggered devastating flash floods and a variety of other cascading hazards that killed thousands of vulnerable people in June 2013 (Ziegler et al., 2014; Figure 3a and b). Many of those who perished were religious tourists on a pilgrimage to the Hindu temple at Kedarnath (Lorenz & Dittmer, 2021; Rautela, 2018; Singh, 2009). The disparity in casualties officially reported over the years, ranging from fewer than 200 to more than 10,000, perhaps reflects the exclusion of undocumented porters from neighbouring Nepal who assisted tourists on the arduous trek through a risky environmental setting (Talwar, 2016; Ziegler et al., 2014). An untold number of victims are still likely buried in deep rubble or were washed away to remote locations by the treacherous flood waters (Kakkar, 2018). Riverbeds in some locations were filled to depths of 40-50 metres with debris from thousands of shallow landslides (Bhardwaj et al., 2019; Champati Ray et al., 2016; Martha et al., 2015; Figure 3c and d). The banks of large sections of the Bhagirathi, Alaknanda and Mandakini rivers were eroded, collapsing into the flood waters, dragging with them roads and buildings, including dharamshalas, or rest houses for pilgrims. Low official casualty numbers may mirror a deliberate attempt to downplay the lack of an effective disaster management plan to help safeguard the various participants of a lucrative revenue source in a remote, low-income part of the world (cf. Rautela, 2018; Varghese & Paul, 2013).

Figure 3. Post-disaster Kedarnath. (a) Destruction of the shrine at Kedarnath following the 2013 flooding; (b). Approaching Kedarnath and the Chorabari Glacier from the south. Visible are landslide scars, debris flow rubble, and deposits from the glacial outburst flood. (c) The Mandakini River at Sitapur, where the rubble filled the channel 40-50 metres. (d) Overcrowding of tourists at the shrine after renovation. Credits Y Sundriyal, AD Ziegler, and M Apollo.

In the aftermath of the disaster, an estimated 70,000 tourists and 100,000 local inhabitants were marooned in the complex, high-altitude mountain terrain (Gupta et al., 2018). Rescue and disaster recovery issues were delayed and hindered by a lack of coordination and planning (Chowdhary, 2020). Rautela (2018) describes the lessons learned from the event and explores the lack of preparedness to respond to a disaster of this magnitude despite long-standing knowledge of the potential risks (cf Rautela, 2013). The shrine sits precariously on the floodplain of the Mandakini River, directly below a glacier lake, and upon rock and soil material deposited during past landslides and debris flows (Figure 1). While an extreme weather phenomenon set in motion secondary and cascading hazards (Vellore et al., 2020), it was the absence of risk reduction considerations to known hazards, a warming climate, and an unsustainable volume of tourists, that turned the situation into one of the worst hydrological disasters in the Himalaya (Champati Ray et al., 2016). Uniyal (2013) wrote in a perspective on lessons learned from the disaster that it was a mistake in recent years to commercialise the holy shrine on Kedarnath; and it would be a blunder to do so again afterwards. Yet, it happened.

While the numbers of visitors to the holy site plummeted in the year following the disaster, they rapidly climbed to more than one million by 2019, before dropping again drastically in 2020 during the COVID-19 pandemic (Figure 2d). The increased popularity of Kedarnath following the disaster was propelled by decisions to make access easier by rebuilding/expanding transportation networks and to improve accommodation/amenities to cater to a wider demographic of tourists, regardless of their purpose of visit, physical ability, or state of preparation (Basu & Singh, 2013; Lorenz & Dittmer, 2021). The rejuvenation of tourism in Kedarnath has drawn criticism because of the environmental degradation, loss of harmony, corruption of the spiritual experience, and importantly, increased vulnerability of tourists (cf Aukland, 2018; Lorenz & Dittmer, 2021; Singh, 2006)

Although the line between true pilgrims and tourists has long been somewhat blurred (Bleie, 2003), the people undertaking the Char Dham journey now are increasingly there for general tourist activities (Aggarwal, 2018a,b). The peaceful atmosphere long sought by pilgrims has been replaced by a cacophony of sightseers and merrymakers, the indiscriminate use of loudspeakers and sound systems, and noisy political rallies (Aggarwal, 2018b; see Bleie (2003) for a Nepalese analogy). Commercialisation of lucrative tourism has played a prominent role in post-disaster reconstruction of the site, creating new vulnerabilities and laying the groundwork for another potential disaster (Lorenz & Dittmer, 2021). Failing to keep pace with these tourist-friendly transformations has been a clear, coordinated response to the inherent risk of the hazards that are part of the fabric of the Himalaya. Aggarwal (2018a) drew attention to this situation by pointing out that within only five years after the disaster, , the renewed disregard for the dangerous mountain environment was an open invitation for more calamities.

The Kedarnath disaster is a spectacular example of how the dangers of tourism in risk prone areas not only exist, but persist and amplify over time because of underlying social, political, and economic drivers. Post-disaster, commercialisation of Kedarnath again has resulted in the exposure of thousands of people in a particular location with inherent risk to many environmental hazards (Lorenz & Dittmer, 2021; Nyaupane & Chhetri, 2009; Singh & Mishra, 2004), but without a sound disaster risk reduction plan that takes tourism into account. Complicating the issue is a fallacious view that hazard-related disasters are unscheduled and unpredictable acts of God, rather than acts of poor disaster

risk reduction efforts (Lokgariwar & Kaur, 2013; Ritu, 2020; Weichselgarner & Bertens, 2000).

(b) Overcrowding on Mt Everest

In recent years, mountaineering has gained popularity as commercialisation has increased accessibility to remote high mountains of the Himalaya, despite being one the most dangerous sports in existence (Apollo, 2017; Gatterer et al., 2019; Windsor, 2019). According to Salisbury and Hawley (2011), only about 50% of all climbers above base camp on Ama Dablam, Cho Oyu and Everest between 1990 and 2009 navigated the easiest routes used by commercial groups. In the case of Everest, when comparing periods of time before and after 1990, the number of mountaineers on commercial routes increased almost 700%, leading to the problem of overcrowding at dangerous elevations (Apollo, 2017; Figure 4).

In 2019, concerns over safety caused by widespread overcrowding on Mt Everest was reported by the worldwide media (PBS, 2019). The Himalayan Database lists eleven deaths in 2019, primarily from acute mountain sickness (AMS) and exhaustion (4 and 5 respectively), and two from falls (Salisbury, 2020). Nearly all (9) died on the descent from a summit bid. Some seasoned mountaineers and international news agencies blamed the reluctance of the Nepalese government to limit the number of pricey Mt Everest peak permits for unreasonably amplifying the life-threatening conditions facing climbers.

Figure 4. (a) Mt Everest and the Khumbu ice flow. (b) Stone marker on the route to Everest of a man who died in 2011 of a heart attack during a summit bid; (c) high-altitude porters in Nepal, part of the tourism industry with high exposure to hazards throughout the tourism season; (d) Trekkers in the Everest region. Credits SK Nepal.

Inexperienced climbers were said to have impeded others and caused delays that increased the risk of accidents in the harsh, low-oxygen environment (Svokos, 2019). The risks of overcrowding on Everest has been a growing issue since the commercialisation of the sport decades ago (Child, 1997; Eberle, 2012; Kayes, 2004; Schaffer, 2012). Many recognise that commercialism-related greed supplants safety concerns, as more climbers lead to more permits and therefore more revenue (PBS, 2019).

Official documents from Nepal's Ministry of Culture, Tourism and Civil Aviation states that 644 permitted climbers successfully completed an ascent of Mt Everest in May, 2019, of which 364 were Nepalese workers (Benavides, 2019). When China and Nepal lists were combined, a record-breaking 885 people reached the top in May of that year–up from 807 in 2018 (Benavides, 2019). Critical to note is that summit successes are often made during days with ideal weather conditions, which constitute only a small period of time annually. For example, in 2019 261 climbers made summit bids over two days (Huey et al., 2020)–and importantly, most ascended at a slow pace. In response to the high mortality rate in 2019, Nepal's Secretary of the Ministry of Tourism and Civil Aviation blamed the weather, equipment, and inadequate amounts of supplemental oxygen. Although the oxygen issue links to the problem of delays caused by overcrowding and slow pace, the Secretary further spoke of encouraging even more climbers to visit in the future, despite the likelihood of lengthy exposure in an unpredictable climate. Following the disastrous climbing season on Everest, the Nepalese parliament proposed inflating permit prices from US $11,000 to approximately US$30,000 and restricting access to climbers who had experience in summiting at least one Nepalese peak higher than 6500 m. These regulation measures were not imposed. Again, like overcrowding, the issue with inexperience is not new. In 1995, the year prior to a great blizzard-related climbing disaster when eight died (Kayes, 2004), Child (1997) returned with a sense of foreboding, having witnessed "hordes of novices mobbing the mountain and nearly killing themselves", and relying on "guides and Sherpas to carry up all provisions and to make all decisions for them". Somehow Everest had "become a classroom for the world's highest introductory course in alpinism" (Child, 1997). While regulation seems to be needed, the economic losses of doing so tend to sway policy decisions in favour of leniency (see discussion below).

Another concern for Everest is exposure to hazards in a remote location with limited access when relief is needed. For example, at the time of the 7.8 M earthquake in Nepal in 2015, 359 climbers, 350 Nepali guides and approximately 300 support staff were at Mount Everest Base Camp. Ground motion triggered a swarm of avalanches that caused fifteen deaths and over seventy injuries (Moore et al., 2020). More than 100 climbers and guides were stranded above base camp after the routes were compromised. Swann et al. (2016) provide an examination of negative emotional and behavioural responses and post-traumatic stress among some mountaineers who at the time of the incident were at the Everest Base Camp or nearby. The earthquake destroyed some mountain villages, including the well-known tourist destination Lantang; and landslides blocked access routes to remote locations (Gnyawali et al., 2020; Kargel et al., 2016). Mortality throughout the country, in general, was elevated by a number of factors including insufficient preparation for a high-magnitude disaster, weak communication channels, and lack of effective coordination at all levels of response.

(c) The Everest Avalanche

A disaster on Everest occurred in 2014 when twenty-five climbing Sherpa were buried in an ice avalanche triggered when a large serac (ice block) broke off the western shoulder of the mountain (Nepal, 2014). Thirteen were confirmed dead; the bodies of three others were never recovered. The event occurred in the dangerous Khumbu Icefall, which is one of the most threatening areas on the southern route (Figure 4a). The Sherpa workers support paying climbers by transporting equipment, fixing ropes, and clearing routes. The event was tragic because the ice blocks above the passage were a known threat (Stokes et al., 2015). The icefall is on the Khumbu glacier that moves naturally but is also believed to be melting because of climate change (Narula, 2014). In addition to the risk of large ice avalanches from the hanging glacier above, the blocks of ice within the icefall also move/collapse frequently and require daily maintenance by the Sherpa "ice doctors". As they work many hours a day throughout the climbing season, they are exposed to enormous daily risk (Stokes et al., 2015). Other high-altitude porters and camp workers are vulnerable to a variety of hazards as well (Figure 4c).

The intersection between economics and risk highlights a negative aspect of the commercialisation of adventure mountain activities affecting tourism workers. In particular, Sherpas who are often exposed to a disproportionate amount of the risk during mountaineering are arguably compensated with a disproportionate amount of the revenue earned. Sherpas' average pay is $5000 USD for a three-month climbing season, which is an amount that is an order of magnitude above the mean national income. It is, however, small compared to what climbers spend ($30,000-$200,000 USD; average is $45,000) for their summit attempts, which for most, could simply not be made possible without support from guides, porters, and other support staff (Nepal & Mu, 2015). It is also small compared with the compensation provided to the family if injured or killed while guiding/working–initially $400 USD at the time of the avalanche in 2014 (roughly the mean annual salary in Nepal at the time). Further, some of the families of those who perished had trouble collecting final settlements (Pert, 2015).

Following the ice avalanche in 2014, the climbing season ended as the Sherpa refused to work out of respect to those who died; some likely in protest of work conditions. Insurance was reported to be raised to $15,000 USD in 2015; and the most dangerous part of the route was changed. Nevertheless, the icefall represents a risk to those who cross it, regardless of one's level of experience, acumen, or health. In 2020, several international mountaineering related organisations recognised the importance of worker (guides, porters, others) training and rights as an important part of reducing safety concerns (UIAA, 2019). The joint statement from the groups expressed concern that a price war among some mountaineering agencies was exposing workers to insufficient rates of pay and unnecessarily dangerous working conditions (UIAA, 2019). A knock-on effect of excessive risk but limited compensation is a reduction in the professionalism and adequate training that contributes to making mountaineering activities safe.

(d) The Annapurna snowstorm

The last example pertains to perceived low-risk trekking. A non-typical snowstorm disaster killed forty-three trekkers in Annapurna in October of 2014 (Neckel et al., 2015). At

the time, the Nepalese government claimed the tragedy was the result of the reluctance of budget tourists to hire qualified guides who could have helped them survive in unanticipated extreme conditions (Burke & Walker, 2014; Sharma & Najar, 2014). However, others cite the failure to properly warn trekkers on their way through the Thorong Pass of an unusual weather event that was predicted in advance to produce unusual seasonal rainfall in the area (Burke & Walker, 2014). Some trekkers who knew of the impending storm claimed to have received conflicting advice from local tourism personnel regarding risk. The controversial part of this issue is that while unusual, this type of storm is not unprecedented in the Himalaya (Wang et al., 2015)–and warnings of strong winds and heavy rainfall had been made by both Indian and Nepali meteorological offices (Burke & Walker, 2014). While climate change may play some role in the genesis of the storm, the disaster was again man-made, as in Kedarnath. Safety considerations were not made for the situation of a known environmental hazard occurring at a time when a high volume of tourists wereengaged in an activity that is advertised as non-technical, and generally safe.

Drivers of increasing tourism risk: mobility, commercialisation, and access

The commonality in the cases mentioned above is that unlike in the past, a high volume of tourists of various levels of preparedness now visit areas with known, potentially deadly environmental hazards. This various pilgrimage, cultural, aesthetic, and adventurer destinations are often a major source of income for local people and the government (Sati, 2013; 2018; Singh, 2006). For example, Yamunotri, Gangotri, Kedarnath and Badrinath, collectively known as the Chota Char Dham, are historically four holy Hindu pilgrimage sites in North India. These sites have been visited for centuries by saints and pilgrims in search of a rejuvenating spiritual experience gained by traversing the mystical valleys that are the headwaters of important river systems (Bansal & Gangotia, 2010). Historically, sites like Kedarnath were accessible only by arduous and lengthy walking of high-altitude trails, typically by fit people or others of means who could hire an entourage. In 2018, a staggering 2.77 million people undertook (some part of) the Chota Char Dham trek (Talwar, 2018).

Historically, mass tourism in the Himalaya evolved during the second half of the twentieth century after Tenzing Norgay and Sir Edmund Hillary succeeded in the first summitting of Mt Everest in 1953. Since then, the doors have increasingly opened to international tourists to partake in many types of activities of varying perceived risk (Nepal, 2000). In addition to pilgrims and mountaineers, many of the first waves of tourists were "hippies" in the seventies who as discoverers of new places to interact (spiritually) with local peoples played enormous roles in exploring mountains and finding new trekking routes and sites (Liechty, 2017). The expansion of roads, though often of poor quality, gradually opened remote places to a coming wave of visitors who were the source of much needed revenue for development and livelihood improvement (Beazley & Lassoie, 2017; Nepal et al., 2002). Road expansion also resulted in environmental degradation and an increase in risk of landslide hazards (Petley et al., 2007; Sudmeier-Rieux et al., 2019).

Recently, remote pilgrimage sites high up the mountains in other places of Nepal have also seen a surge in domestic religious tourists, which is again driven by

entrepreneurialism and broader decisions to increase access (Bhattarai & Conway, 2021). Greater demand by domestic tourists is inherently linked with the proliferation of package adventure tour options and the emergence of affordable and comfortable transportation (Roy, 2018). Specifically for Nepal, domestic tourism contributes 56% of the national tourism revenue. The increased numbers are associated with people with disposable incomes taking advantage of improved land and air connectivity and increased awareness–the latter associated with ripple effects of social media. Further, with COVID-19 restricting international tourists, Nepalese have been encouraged to visit their own 'backyards' (Nepal, 2020).

On Mt Everest, the growing number of climbers and support staff, condensed into a narrow window of the season, brings to mind the issue of "carrying capacity" of particular activities in regard to safety to both environmental hazards and high altitude maladies (Garrigos-Simon et al., 2004; Mu & Nepal, 2016). We use the contentious term carrying capacity in reference to the amount of pressure that can be accommodated after which risk to some particular hazard becomes of great concern. Thus, carrying capacity is a "process" that varies over time in response to the environmental setting, practices, and management (Saveriades, 2000). However, it must be based on frequent location-specific and activity-specific risk assessments. Despite carrying capacity being a controversial term, we see this concept as an important element for assessing variable levels of pressure, and therefore, the need for some type of regulation.

Ladakh is another epicenter of tourism in the Indian Himalaya where mass tourism numbers increased dramatically in the last few decades, largely for trekking in remote high-desert landscapes (Lundup, 2019; Michaud, 1991). The vicinity of Leh, Ladakh, is no stranger to recent disasters: flash floods in 2010 killed at least 234 people (Gupta et al., 2012). However, the signposts of recurrent hazards on the landscape are largely ignored, as much of the economy, which is reliant on the tourism industry, drives development onto lands that are historically susceptible to floods and debris flow hazards, but were avoided in the past because land pressure was low (Ziegler et al., 2016a; Figure 1d). Greater tourist pressure has been one of the byproducts of Ladakh's unregulated commercialised tourism, in addition to water stress, intense pressure on vulnerable ecosystems, and unsafe trekking trails. Williams and Soutar (2005) contend that many adventure tour company practices are too "close to the edge", failing to address the critical issues of protecting the natural environment and participants alike, and therefore, the sustainability of tourism in general. The ease of access adds to tourism pressure, as even the unfit can make the trips. The construction of a new Leh airport terminal in 2021 will likely increase the strain on resources and the ecosystem in the future, as well as increase tourist exposure to hazards.

A potential framework toward addressing tourism disaster risk

The COVID-19 pandemic of 2020-21 decimated the tourist industry in the Himalaya (Ghimire, 2016; Khanal, 2020; Ulak, 2020). As tourism is an important source of livelihood in many areas of the region, we fully expect the industry to restart quickly once travel restrictions ease. Nepal (2020) cautions that the restart of mass tourism should be carefully planned and not allowed to be "free for all", with steps needed to limit new development to preserve local cultural and environmental integrity. In the examples above, we

see the same progression of tourism development that features an increase in an unsustainable number of tourists in locations with risks to environmental hazards, complicated by inadequate disaster risk reduction initiatives that consider the nuances of tourism specifically. Experience shows that many of the mistakes made and tragedies incurred in previous cases of rapid tourism development do not seem to resonate with stakeholders driving such new endeavours. Importantly, learning and reflection are missing in the recovery period following disasters.

We see the need for tailoring targeted disaster risk reduction actions for the tourism sector (cf. Becken & Hughey, 2013; Ritchie, 2008). The complexity of the issue calls for incorporating transdisciplinary and system dynamic approaches with the cooperation of all participating actors (cf. Vaidya et al., 2019). We promote the term transdisciplinary because of its inclusiveness of a variety of contributors within a common context who are willing to transcend traditional boundaries in an effort to arrive at a collective outcome. System approaches are well suited for collaborative problem solving and for identifying leverage points to affect change (e.g., Simonovi, 2011; Ziegler et al., 2016b). Further, it encourages non-linear thinking which is appropriate for complex issues such as disaster management (Simonovi, 2015). Recently, Simonovi (2015) questioned why systems approaches were not used more for disaster risk management (e.g, Joakim et al., 2016; Powell et al., 2016; Zarghami & Dumrak, 2021).

The result of our reflections on the issue can be visualised in a causal loop diagram that ultimately points to the positive relationship (designated with "+" in Figure 5) that strong political leadership should have on the disaster management cycle, which is composed of four main components (mitigation, preparedness, response, and recovery; Table 1). These four actions all work to reduce ("-") disaster impact (Figure 5). In brief, strengthening preparedness increases the ability to perform mitigation and recovery activities. Assessment

Table 1. Components of the disaster management cycle.

Phases	Goal	Measure/Actions
Preparedness	Develop a satisfactory level of readiness to respond to any emergency.	Preparedness plans; vulnerability and risk assessments; emergency exercises; training; warning systems; emergency communications; evacuations plans and training; tourist-centered awareness training; resource inventories; emergency personnel contact lists; mutual aid agreements; public information; education.
Mitigation	Eliminate or reduce the probability of disaster occurrence, or reduce the effects of unavoidable disasters.	Construction codes; vulnerability analyses updates; zoning and land use management; usage regulations and safety codes; preventive health care; hazard reduction; public education.
Response	Provide immediate assistance to maintain life, improve health and support the morale of the affected population.	Search and rescue, evacuation, medical attention, providing food and shelter, coordinate/ communicate; rapid impact assessment.
Recovery	Conduct activities aimed at restoring livelihoods and infrastructure following a disaster, as well as learning from events to feedback into preparedness for the future.	Restore vital life-support infrastructure, provide temporary housing; disseminate public information, provide health and safety education, reconstruction; provide counseling programmes; perform economic impact studies; learn from mistakes leading to the disaster.

Four key phases of the disaster management cycle aim to reduce, or avoid, the potential losses from hazards, assure prompt and appropriate assistance to victims of disaster, and achieve rapid and effective recovery. It reflects an ongoing process by which governments, businesses, and society plan for and reduce the impact of disasters, react during and immediately following a disaster, and take steps to recover after a disaster has occurred (Warfield, 2021).

and reflection during the recovery phase should act to strengthen preparedness in the future by identifying critical issues that must be addressed. Figure 5 represents an overarching framework (within the established disaster management cycle) from which a more specific causal loop diagram can be constructed for examining tourist disaster risk in the Himalaya. The example shown in Figure 6 represents one such "model" based on the issues we discuss in the case studies above.

Again, the connections from Figure 5 are present and relevant in Figure 6. Mitigation is linked with actions to reduce the risk of a particular hazard from occurring (e.g., draining a lake; hillslope stabilisation) and addressing environmental degradation (e.g, from road building, forest conversion, etc). Regulations would reduce the negative effects of commercialisation, limit access based on risk assessments, and boost professionalism. Here, professionalism refers to the level of health, training, fitness, and certification of both tourists and industry workers. Regulation reduces pressure (overcrowding) by limiting access to dangerous sites or conditions, as well as encouraging sustainable tourism activities. An integral part of regulation is ensuring accommodation and transportation networks are constructed to recognised design codes. A higher level of professionalism, verified through permitting/certification, fundamentally reduces risk. It also strengthens disaster response because it fosters a greater level of ability to (re)act when hazards occur. Disaster insurance is a key aspect of boosting professionalism, for example, by compensating families of experienced guides who are injured or killed on the job through adequate

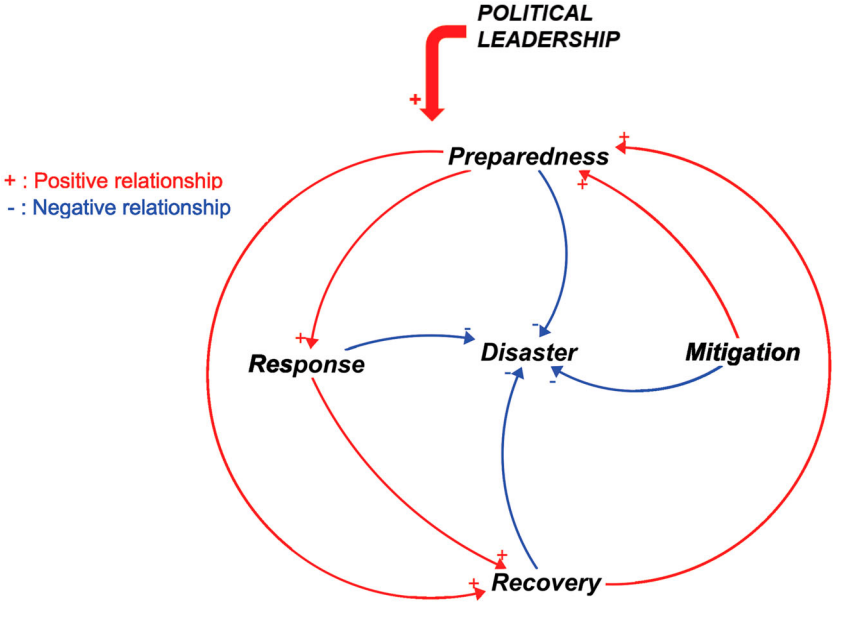

Figure 5. Conceptualisation of the causal relationship between political leadership and the disaster management cycle (Table 1). In the diagram, increases/improvements in any one process cause either a negative ("-") or positive ("+") reaction for the process it flows to. Strong political leadership is needed to bolster disaster management.

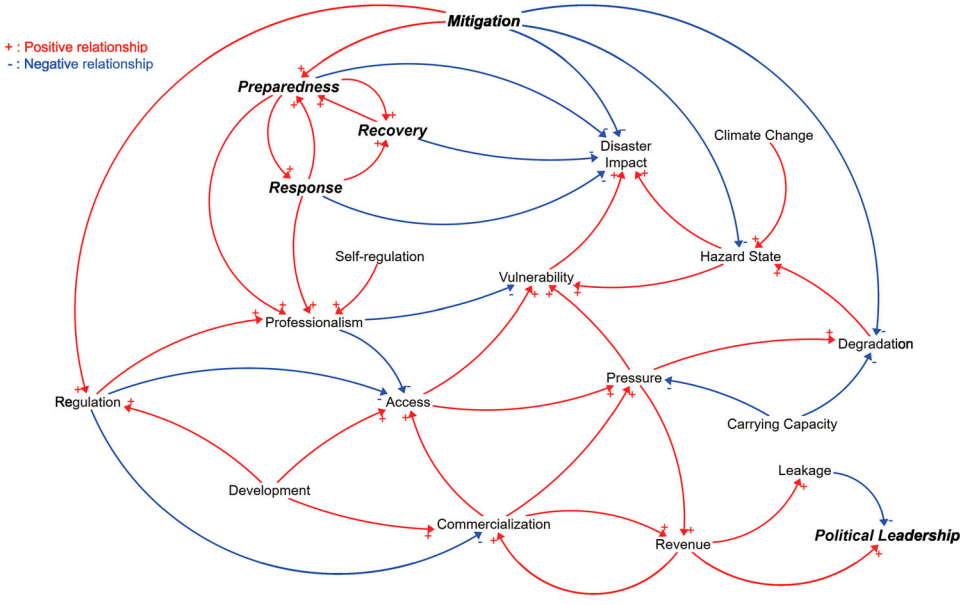

Figure 6. Causal loop diagram visualising some of the key drivers of Himalayan tourism risk within the framework of the disaster management cycle. The four main components of the disaster management cycle (mitigation, preparedness, response and recovery) reduce the disaster impact for all actors including tourists, operators and guides. Ideally, tourist revenues act to strengthen political leadership, but greed-driven leakage acts to reduce it. All components of the disaster management cycle are strengthened by strong political leadership (Figure 5). Also crucial, but often absent following disasters, is the positive feedback from the response to the preparedness component. The diagram represents one of many possible permutations and is meant as an example to encourage the use of systems thinking in addressing this complex issue. See the text for explanation of arrow directions and signs.

insurance coverage. Self-regulation by tourists is a part of professionalism and includes education and fitness training in preparation for any risky activity.

High tourist pressure generates large amounts of revenue, which encourages commercialisation through reinforcement (Figure 6). Commercialisation also increases tourist mobility by developing new routes and transportation methods, as well as creating cheaper participation costs. Commercialisation is a key driver of tourism pressure that increases vulnerability. The risk of hazards should decrease tourist pressure, but that has rarely been a long-term response in the region (e.g. Everest crowding and Kedarnath disasters discussed above). Again, many hazards exist naturally in the Himalaya; others are related to land-use/land-cover change (including those related to tourism pressure and road building). Some hazards are being exacerbated by climate change.

The need for tourism disaster risk reduction worldwide has been given attention in the last two decades (e.g., Ritchie, 2009; 2008; Vogel & Field, 2020). A recent study on the impacts of disasters in the Indian Himalaya concluded that ongoing tourism-related vulnerability continues long after disasters, often threatening livelihoods more than the original event (Lorenz & Dittmer, 2021). This reality points to flaws with respect to the disaster management cycle–namely the lack of regulations aimed at reducing vulnerability and, related, limited feedback from the recovery to the preparedness phase.

A complicating factor in this dynamic system is "leakage", which refers to any mechanism that reduces the will/ability of political leaders to enforce the policies and practices at any stage of the process (cf Karki & Salike, 2020). The primary driver of leakage tends to be greed that is associated with high revenues and the process of commercialisation. A major difficulty lies in implementing regulation mechanisms to ensure that revenues foster strong government leadership to support the development of a sound disaster management plan, rather than detract from it. While much thought has been given to improving disaster risk reduction in general for the region (e.g., Kala, 2014; Ghimire, 2016; Rumbach & Nemeth, 2018), tourism needs to be a focused component in areas where tourism numbers and risks are both high–in part because tourists comprise the transient community who are often unfamiliar with the environment and ill-prepared to cope with hardships when hazards occur.

We stop short of identifying more detailed interactions because such a process should involve all actors, importantly, political leaders, tourist entrepreneurs, and local people whose collaborative support is needed for long-term success. We do believe that greater regulation is at the core of making adventure tourism safer in the Himalaya because of its influence on access, commercialisation, and professionalism (Figure 6). Our contribution is encouraging the use of systems-based approaches, as visualised in Figure 6, which again, is one of many possible systems-based models that can be constructed depending on the local context and specific objectives (cf. Simonovi, 2011).

Discussion: regulation concerns and uncertainties

The objection with tourism regulation is the loss of revenues at multiple levels. For example, a reduction of one hundred Everest climbers in Nepal would mean a $1.1 million USD annual loss directly to the government via permitting losses, and about $3.4 million USD loss to others associated in the business (based on a mean expedition cost of $45,000 USD per person). Raising the permit price could ensure that the government take is the same, but the tourism sector loss would remain. To date, the proposed restrictions to reduce overcrowding on Everest have not been implemented, perhaps because of the uncertainty on their effectiveness for risk reduction, but likely because of the fear of lost revenues. One restriction was however recently implemented in 2021: the banning of sharing online photos of other climbers (tacitly including overcrowding situations) on Everest, ostensibly because of lack-of-consent issues (Business Insider, 2021).

An example showing the negative economic impact of regulation is the recent 2018 Uttarakhand overnight camping ban on high-altitude hikes which was projected to result in more than $70 million USD loss in tourist revenue in that region of the Himalaya (Business Standard, 2018). The ban by the Uttarakhand High Court was, in part, a response to increasing tourist related deaths, but also environmental degradation, including deforestation and pollution, related to overcrowding and failure of tourists/operators to act sustainably (Braun, 2018). The move was criticised as a knee-jerk reaction that punished all parties, not simply those guilty of unsustainable or risky practices. Earlier, in the 1980s, the closing of the Nanda Devi Peak (also in Uttarakhand) to adventure tourism forced unemployed people to emigrate from the area and others to adopt marginal agriculture

and animal husbandry practices for livelihoods that degraded the environment (Rao et al., 2000).

Other types of regulation that are frequently mentioned include those related to health, experience, or fitness. For example, licenses might also be required of guides demonstrating a required level of acumen that is beneficial to reducing the risk of a disaster from occurring. Commercialised activities could be regulated to ensure safe and sustainable practices, as well as risk knowledge transfer to clients (Ryan, 2003; Fletcher, 2010). A critical issue however regards the validity of the argument that inexperienced or unfit participants elevate risks. In a recent analysis, Huey et al. (2020) determined that prior experience was not a factor in success nor death rates for climbers attempting to summit Mt Everest in the last two decades (cf Burtscher, 2012; Cheng, 2013; Westhoff et al., 2012). Compared with young mountaineers, those between the age ranges of forty to sixty years old have reduced odds of summiting because they are climbing in a more conservative manner or they are physically less capable (Huey et al., 2007; Tsianos et al., 2006). While experience and age restrictions would reduce the number of climbers (again, 60% of the 2019 permits were issued to inexperienced climbers), the loss in revenue may degrade the positive effect of qualified expedition teams who provide support and guidance during the climbing season. Age restrictions are also problematic because a reduction of some physical ability with advanced age might be compensated by judgement and skill gained from years of experience (Burtscher, 2012; Westhoff et al., 2012).

In comparing the success and deaths of climbers attempting summit bids for past versus current periods (1990–2005 versus 2006–2019), Huey et al. (2020) determined that while the probability of summiting basically doubled between the two periods, the mortality rate stayed the same. This analysis of reliable data from the Himalayan database (Salisbury, 2020) counters claims that recent overcrowding was responsible for high death tolls in particular years. However, a question persists as to why have death rates remained the same if the rising success of summiting is a product of better weather forecasting, presence of newly fixed ropes on much of the route, accumulated logistic and route experience, improved oxygen equipment and usage strategies, more commercial expeditions, coordination between "competing" expeditions and more experience of high-altitude workers (Huey et al., 2020). These improvements should also reduce risk.

The conflict between on-the-ground expert testimonies of dangerous overcrowding, but lack of statistical verification of increased risk, may indicate the arrival at a threshold regarding excessive risk. Overcrowding at critical high altitude zones where supplemental oxygen is needed contributes to a greater risk of acute mountain sickness (AMS), exhaustion, and other exposure maladies when it impedes climbing pace (Huey & Eguskitza, 2001). Again, at various points in time, the government's promise to regulate the number of participants with the aim of greater safety is inevitably thwarted. Some experts believe the key is regulating the number of trekkers summiting on the same day, not simply regulating total permits or climber qualifications (cf Both, 2019).

Regardless of motivation (secular or sacred), mountain tourists must deal with an exposition to danger, both objective and subjective (Apollo, 2021; Pröbstl-Haider et al., 2016). Being a passive tourist is arguably not acceptable because the risk of hazards is so high. We advocate for providers and tourist to self-regulate their activities and actions through education, fitness, and training in an effort to reduce their vulnerability to hazards

(Prideaux & Master, 2001;). This degree of preparation was once an obvious and necessary element of early adventure tourism but has been dangerously obviated through commercialisation that allows easier access and promotes bucket list mentalities (Nepal & Mu, 2015).

However, self-regulation is not easily addressed, because mountain adventure tourism involves the entanglement of emotions, risk, challenge, active physical involvement, and uncertainty of outcome (McKay, 2018; Pomfret, 2011). Plainly, the potential for "misadventure" is inherent (Mortlock, 1984; Mu & Nepal, 2016). While most adventure tourists accept the risks of this paradoxical mix of fun and danger, some may be uninformed or ill-prepared (cf Fletcher, 2010; Ryan, 2003). Cater (2006) concludes that rather than seeking tangible risks, most participants of commercial adventure activities seek the thrill and fear aspects. Further, as the most successful adventure tourism operators are often those who achieve the fear/thrill aspect safely, reducing risks is not only ethical, but a sound strategy for long-term business sustainability (Cater, 2006). It may however be foolish to assume all operators would take this approach, particularly without some type of outside regulation.

Some attempts at strengthening regulation have merit in the region. Nepal in the early 1990s opened culturally sensitive areas, for example Upper Mustang, to encourage "quality tourism", but with expensive fees ($75/day) and a quota of 1000 annual tourists. For many years, the quota was never reached, presumably because of the high expense, but also arguably due to lack of destination awareness among potential wealthy tourists, many who were familiar with other renowned places on the Everest and Annapurna routes that were crowded even then. Within a twelve-month period in 1996 and 1997, more than 27,000 entries were made to the park at Everest by various types of porters alone. Today, there are several trekking routes to "restricted zones" in Nepal, including Upper Mustang, Upper Dolpa, and Gorkha Manasul where an ample demand of tourists are willing to pay a $500 flat fee for 1-10 days trekking ($50 per day thereafter), as well as hire porters and support the local economy through purchasing goods and services. Owing to the geographical risk, importantly high-altitude sickness, individual (foreign) tourists are not permitted to trek alone.

This example seemingly demonstrates the effectiveness of regulating tourist pressure on promoting safety, protecting the environment and cultural integrity, while also producing substantial revenue. However, this example is problematic because recent commercialisation of such treks has created a situation where the government and a few tour operators benefit the most economically (Shapiro, 2020). As tourists are now often driven quickly to their trekking entry points on new roads, former businesses along the former trekking routes are often no longer profitable. Further, tourists now face new risks during transport on unsafe roads (Geneletti & Dawa, 2009; McAdoo et al., 2018; Lee, 2015; Sudmeier-Rieux et al., 2019). Another issue is that high prices may prohibit members of the local middle class from participating. Whereas half a century ago it was accepted that some adventures were only accessible to the rich (e.g. mountain expeditions), that "model" has increasingly been replaced via commercialisation aimed at providing opportunity to people with modest means, as well as modest capabilities.

Conclusion

In this perspective, we make the case that mountain tourism in many locations of the Himalaya has developed in a manner that increases the risk of disasters to occur. A key driver has been the rapid, opportunistic development of tourist spots and activities that cater to wider audiences at cheaper costs, leading to great tourist pressure. This development has been enabled further by expansions and affordability in transportation networks to improve access to large numbers of adventurists who are unprepared for extreme conditions. High tourism pressure has also increased the population of industry-related stakeholders exposed to known hazards. Given the great benefit of tourism to national and local economies, governments should look to develop a strong disaster risk reduction approach that balances the need to reduce risks to environmental hazards, meanwhile allowing tourism to evolve in a sustainable way that preserves the environment and local cultures, but importantly, maintains profits.

We see the benefit of tighter regulations to reduce the negative aspect of commercialisation, improve the level of preparedness of all participants, and restrict access in some locations to increase safety and reduce the impacts of excessive pressure. To achieve disaster risk reduction, difficult choices will likely be required regarding safety versus profit, as well as participant qualifications. We also emphasize that insurance should be fully explored to support the wellbeing of the families of skilled and unskilled guides/workers who risk their lives to make some adventure activities possible (e.g. mountaineering). In most places, improved building codes and their enforcement are needed to reduce loss of life when hazards occur. Further, roads need to be designed following standards suitable for mountain terrain. Also needed is more reflection and assessment during post-disaster recovery phases to prevent (re)developing in ways that are again threatening. Further, better coordination and advanced preparation are needed to assist tourists when disasters occur. As a framework for addressing this issue, we encourage the use of systems dynamics approaches by practitioners to see nonlinear interactions and to identify key leverage points that are most likely to initiate change. For example, we initially identify the need for stronger leadership that values long-term sustainability and safety within the industry over short-term monetary gains that allow risky practices to continue.

ORCID

A. D. Ziegler http://orcid.org/0000-0001-5305-2136
M. Apollo http://orcid.org/0000-0002-7777-5176

References

Aggarwal, M. (2018a). Five years since Uttarakhand floods: Continued disregard for the environment is an open invitation for more calamities. Mongabay Series: India's Iconic Landscapes. Retrieved January 30, 2021, from https://india.mongabay.com/2018/06/five-years-since-uttarakhand-floods-continued-disregard-for-the-environment-is-an-open-invitation-for-more-calamities/.

Aggarwal, M. (2018b). This stairway to heaven is breaking: religious tourism in Uttarakhand. Mongabay Series: India's Iconic Landscapes. Retrieved January 30, 2021, from https://india.mongabay.com/2018/07/this-stairway-to-heaven-is-breaking-religious-tourism-in-uttarakhand/.

Angel, M. (2018). Tourism to the Himalayas causes a mountain of problems. Retrieved February 5, 2021, from https://www.businessdestinations.com/destinations/tourism-to-the-himalayas-causes-a-mountain-of-problems/.

Apollo, M. (2017). The true accessibility of mountaineering: the case of the High Himalaya. *Journal of Outdoor Recreation and Tourism*, *17*, 29–43. https://doi.org/10.1016/j.jort.2016.12.001

Apollo, M. (2021). *Environmental impacts of mountaineering: A conceptual framework*. Springer.

Apollo, M., Andreychouk, V., Moolio, P., Wengel, Y., & Myga-Piatek, U. (2020). Does the altitude of habitat influence residents' attitudes to guests? A new dimension in the residents' attitudes to tourism. *Journal of Outdoor Recreation and Tourism*, *31*, 100312, 1–8. https://doi.org/10.1016/j.jort.2020.100312

Aukland, K. (2018). At the Confluence of Leisure and Devotion: Hindu Pilgrimage and Domestic Tourism in India. *International Journal of Religious Tourism and Pilgrimage*, *6*(1), Article 4, 18–33. https://doi.org/10.21427/D7ZB0B

Bajracharya, B., Shrestha, A. B., & Rajbhandari, L. (2007). Glacial Lake Outburst Floods in the Sagarmatha Region. *Mountain Research and Development*, *27*(4), 336–344. https://doi.org/10.1659/mrd.0783

Bajracharya, S. R., Maharjan, S. B., Shrestha, F., Sherpa, T. C., Wagle, N., & Shrestha, A. B. (2020). Inventory of glacial lakes and identification of potentially dangerous glacial lakes in the Koshi, Gandaki, and Karnali River Basins of Nepal, the Tibet Autonomous Region of China, and India. Research Report. ICIMOD and UNDP. Retrieved March 7, 2021, from https://lib.icimod.org/record/34905.

Ballesteros-Cánovas, J. A., Trappmann, D., Madrigal-González, J., Eckert, N., & Stoffel, M. (2018). Climate warming enhances snow avalanche risk in the Western Himalayas. *Proceedings of the National Academy of Sciences*, *115*(13), 3410–3415. https://doi.org/10.1073/pnas.171691311

Bansal, S. P., & Gangotia, A. (2010). Perception of Tourist: A case study of Uttarakhand. *International Journal of Hospitality & Tourism Systems*, *3*(1), 55–63.

Basu, S., & Singh, J. (2013). Man-made reasons for Uttarakhand disaster. Retrieved February 12, 2021, from https://www.downtoearth.org.in/news/natural-disasters/man-made-reasons-for-uttarakhand-disaster-41407.

Beazley, R. E., & Lassoie, J. P. (2017). *Himalayan Mobilities: An Exploration of the Impact of Expanding Rural Road Networks on Social and Ecological Systems in the Nepalese Himalaya*. Springer.

Becken, S., & Hughey, K. (2013). Linking tourism into emergency management structures to enhance disaster risk reduction. *Tourism Management*, *36*, 77–85. https://doi.org/10.1073/pnas.1716913115.10.1016/j.tourman.2012.11.006

Beedie, P., & Hudson, S. (2003). Emergence of mountain-based adventure tourism. *Annals of Tourism Research*, *30*(3), 625–643. https://doi.org/10.1016/S0160-7383(03)00043-4

Benavides, A. (2019). *A record 885 atop Everest in May*. Retrieved February 22, 2021, from https://nam12.safelinks.protection.outlook.com/?url=https%3A%2F%2Fexplorersweb.com%2F2019%2F06%2F20%2Fa-record-885-atop-everest-in-may&data=04%7C01%7Cprakash%40novatechset.com%7Ccfd07f68c8104f92115108d987e21259%7Ca03a7f6cfbc84b5fb16bf634dbe1a862%7C1%7C0%7C637690228347116685%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C2000&sdata=cZIfYpJYFlpKJbxZffbt4G35riJqrUqEj%2FD7QoRVsIA%3D&reserved=0

Bhardwaj, A., Wasson, R. J., Chow, W. T. L., & Ziegler, A. D. (2021). High-intensity monsoon rainfall variability and its attributes: a case study for Upper Ganges Catchment in the Indian Himalaya during 1901–2013. *Natural Hazards*, *105*(3), 2907–2936. https://doi.org/10.1007/s11069-020-04431-9

Bhardwaj, A., Wasson, R. J., Ziegler, A. D., Chow, W. T. L., & Sundriya, Y. (2019). Characteristics of rain-induced landslides in the Indian Himalaya: A case study of the Mandakini Catchment during the 2013 flood. *Geomorphology*, *330*, 100–115. https://doi.org/10.1016/j.geomorph.2019.01.010

Bhattarai, K., & Conway, D. (2021). Impacts of Economic Growth, Transportation, and Tourism on the Contemporary Environment. In Bhattarai K. & Conway D. (Eds.), *Contemporary Environmental Problems in Nepal* (pp. 563–662). Springer. https://doi.org/10.1007/978-3-030-50168-6_7

Bilham, R., Guar, V. K., & Molnar, P. (2001). EARTHQUAKES: Himalayan Seismic Hazard. *Science*, *293* (5534), 1442–1444. https://doi.org/10.1126/science.1062584

Bleie, T. (2003). Pilgrim tourism in the Central Himalayas. *Mountain Research and Development*, *23*(2), 177–184. https://doi.org/10.1659/0276-4741(2003)023[0177:PTITCH]2.0.CO;2

Both, A. (2019). 'Group think': Everest climbers say new rules won't stop deaths. The Sydney Morning Herald. Retrieved July 30, from https://www.smh.com.au/world/asia/group-think-everest-climbers-say-new-rules-won-t-stop-deaths-20191218-p53lal.html.

Braun, D. (2018). Adventure Tourism in India Leading to Deaths and Massive Environmental Degradation. Retrieved March 6, 2021, from https://www.outdoorjournal.com/featured/opinion-editorial/adventure-tourism-in-india-uttarakhand-ban/

Burke, J., & Walker, P. (2014). Nepal blames 'cheap tourists' for falling victim to snowstorm in Himalayas. Retrieved February 5, 2021, from https://www.theguardian.com/world/2014/oct/17/nepal-cheap-tourists-snow-disaster.

Burtscher, M. (2012). Climbing the Himalayas more safely. *BMJ*, *344*, article e3778, 1–3. https://doi.org/10.1136/bmj.e3778.

Business Insider. (2021). Nepal's is banning Mount Everest climbers from taking pictures and videos of 'others' without consent. Retrieved March 15, 2021, from https://www.businessinsider.in/international/news/nepal-is-banning-mount-everest-climbers-from-taking-pictures-and-videos-of-others-without-consent/articleshow/81432950.cms.

Business Standard. (2018). Ban on high-altitude night stay to cause Rs 533 cr loss to Uttarakhand. Retrieved March 6, 2021, from https://www.business-standard.com/article/news-ians/ban-on-high-altitude-night-stay-to-cause-rs-533-cr-loss-to-uttarakhand-118090701062_1.html.

Cater, C. I. (2006). Playing with risk? Participant perceptions of risk and management implications in adventure tourism. *Tourism Management*, *27*(2), 317–325. https://doi.org/10.1016/j.tourman.2004.10.005

Champati Ray, P. K., Chattoraj, S. L., Bisht, M. P. S., Kannaujiya, S., Pandey, K., & Goswami, A. (2016). Kedarnath disaster 2013: causes and consequences using remote sensing inputs. *Natural Hazards*, *81*(1), 227–243. https://doi.org/10.1007/s11069-015-2076-0

Cheng, E. K. (2013). Is high-altitude mountaineering Russian roulette? *Journal of Quantitative Analysis in Sports*, *9*(1), 1–14. https://doi.org/10.1515/jqas-2012-0038

Child, G. (1997). Everest a Year Later: Lessons in Futility. Outside. Retrieved February 22, 2021, from https://www.outsideonline.com/1909866/everest-year-later-lessons-futility#close.

Chowdhary, P. (2020). A Helping Hand: Indian Military's Relief and Rescue Operations. Retrieved February 5, 2021, from https://www.thedefencearchive.com/post/a-helping-hand-indian-military-s-relief-and-rescue-operations.

Clague, J. J., & Stead, D. (2012). *Landslides: Types, mechanisms and modeling*. Cambridge University Press.

Cook, K. L., Andermann, C., Gimbert, F., Adhikari, B. R., & Hovius, N. (2018). Glacial lake outburst floods as drivers of fluvial erosion in the Himalaya. *Science*, *362*(6410), 53–57. https://doi.org/10.1126/science.aat4981

Dahal, R. K., & Hasegawa, S. (2008). Representative rainfall thresholds for landslides in the Nepal Himalaya. *Geomorphology*, *100*(3), 429–443. http://doi.org/10.1016/j.geomorph.2008.01.014 https://doi.org/10.1016/j.geomorph.2008.01.014

Dal Zilio, L., van Dinther, Y., Gerya, T., & Avouac, J.-P. (2019). Bimodal seismicity in the Himalaya controlled by fault friction and geometry. *Nature Communications*, *10*(1), Article 48, 1–11. https://doi.org/10.1038/s41467-018-07874-8

Dubey, S., & Goyal, M. K. (2020). Glacial Lake Outburst Flood Hazard, Downstream Impact, and Risk Over the Indian Himalayas. *Water Resources Research*, *56*(4), e2019WR026533, 1–21. https://doi.org/10.1029/2019WR026533

Eberle, L. (2012). The story behind another deadly year on Everest. Retrieved February 22, 2021, from https://abcnews.go.com/International/story-deadly-year-everest/story?id=17407789.

Fletcher, R. (2010). The Emperor's New Adventure: Public Secrecy and the Paradox of Adventure Tourism. *Journal of Contemporary Ethnography*, *39*(1), 6–33. https://doi.org/10.1177/0891241609342179

Garrido, E., Soria, J. M., & Salisbury, R. (2019). Breathless and dying on Mount Everest. *The Lancet Respiratory Medicine*, *7*(11), 938–939. https://doi.org/10.1016/S2213-2600(19)30281-4

Garrigos-Simon, F., Narangajavana, Y., & Marqués, D. (2004). Carrying capacity in the tourism industry: A case study of Hengistbury Head. *Tourism Management*, *25*(2), 275–283. https://doi.org/10.1016/S0261-5177(03)00089-X

Gatterer, H., Niedermeier, M., Pocecco, E., Frühauf, A., Faulhaber, M., Menz, V., Burtscher, J., Posch, M., Ruedl, G., & Burtscher, M. (2019). Mortality in different mountain sports Activities primarily practiced in the summer season-a narrative review. *International Journal of Environmental Research and Public Health*, *16*(20), 3920, 1–13. https://doi.org/10.3390/ijerph16203920

Geneletti, D., & Dawa, D. (2009). Environmental impact assessment of mountain tourism in developing regions: A study in Ladakh, Indian Himalaya. *Environmental Impact Assessment Review*, *29*(4), 229–242. https://doi.org/10.1016/j.eiar.2009.01.003

Ghimire, H. (2016). Disaster management and post-quake impact on tourism in Nepal. *The Gaze Journal of Tourism and Hospitality*, *7*, 37–57. https://doi.org/10.3126/gaze.v7i0.15119

Gnyawali, K. R., Xing, A., & Zhuang, Y. (2020). Dynamic analysis of the multi-staged ice–rock debris avalanche in the T Langtang valley triggered by the 2015 Gorkha earthquake, Nepal. *Engineering Geology*, *265*, 1–10. https://doi.org/10.1016/j.enggeo.2019.105440

Gupta, P., Khanna, A., & Majumdar, S. (2012). Disaster management in flash floods in leh (ladakh): a case study. *Indian journal of community medicine*, *37*(3), 185–190. https://doi.org/10.4103/0970-0218.99928

Gupta, S., Anand, S., & Gwal, S. (2018). Inbound Tourism in Uttarakhand, India, before and after the 2013 Kedarnath Disaster – Evidence Derived from Social Networking Sites Using GIS. *Current Science*, *114*((08|8)), 1755–1759. https://doi.org/10.18520/cs/v114/i08/1755-1759

Haegeli P, F., Brugger H, M., Etter, H. J., & Boyd, J. (2011). Comparison of avalanche survival patterns in Canada and Switzerland. *Canadian Medical Association Journal*, *183*(7), 789–795. http://doi.org/10.1503/cmaj.110347 https://doi.org/10.1503/cmaj.101435

Hock, R., Rasul, G., Adler, C., Cáceres, B., Hirabayashi, Y., Jackson, M., Kääb, A., Kang, S., Kutuzov, S., Milner, A., Molau, U., Morin, S., Orlove, B., Steltzer, H., (2019). High Mountain Areas. In H.-O. Pörtner, & D. C. Roberts et al. (Eds.), *IPCC Special report on the ocean and cryosphere in a changing climate* (pp. 131–202). Intergovernmental Panel on Climate Change. https://www.ipcc.ch/srocc/

Houze, R. A., McMurdie, L. A., Rasmussen, K. L., Kumar, A., & Chaplin, M. M. (2017). Multiscale Aspects of the Storm Producing the June 2013 Flooding in Uttarakhand, India. *Monthly Weather Review*, *145*(11), 4447–4466. https://doi.org/10.1175/MWR-D-17-0004.1

Huber, A. (2019). Hydropower in the Himalayan hazardscape: Strategic ignorance and the production of unequal risk. *Water*, *11*(3), 414, 1–23. https://doi.org/10.3390/w11030414

Huey, R. B., Carroll, C., Salisbury, R., & Wang, J.-L. (2020). Mountaineers on Mount Everest: Effects of age, sex, experience, and crowding on rates of success and death. *PLoS ONE*, *15*, e0236919, 1–16. https://doi.org/10.1371/journal.pone.0236919

Huey, R. B, & Eguskitza, X. (2001). Limits to human performance: elevated risks on high mountains. *Journal of Experimental Biology*, *204*(23), 4115–4124. https://doi.org/10.1242/jeb.204.23.4115

Huey, R. L., Salisbury, R., Wang, J.-L., & Mao, M. (2007). Effects of age and gender on success and death of mountaineers on Mount Everest. *Biology Letters*, *3*(5), 498–500. https://doi.org/10.1098/rsbl.2007.0317

Jin-Hyung, L., Scott, D., & Floyd, M. F. (2001). Structural inequalities in outdoor recreation participation: A multiple hierarchy stratification perspective. *Journal of Leisure Research*, *33*(4), 427–449. https://doi.org/10.1080/00222216.2001.11949953

Joakim, E., Mortsch, L., Oulahen, G., Harford, D., Klein, Y., Damude, K., & Tang, K. (2016). Using system dynamics to model social vulnerability and resilience to coastal hazards. *International Journal of Emergency Management*, *12*(4), 366–391. https://doi.org/10.1504/IJEM.2016.079846

Jones, T. E., Apollo, M., & Bui, H. T. (2021). Mountainous protected areas & nature-based tourism in Asia. In T. E. Jones, H. T. Bui, & M. Apollo (Eds.), *Nature-based tourism in Asia's mountainous protected areas* (pp. 3–25). Springer. https://doi.org/10.1007/978-3-030-76833-1_1

Joseph, S., Sahai, A. K., Sharmila, S., Abhilash, S., Borah, N., Chattopadhyay, R., Pillai, P. A., Rajeevan, M., & Kumar, A. (2015). North Indian heavy rainfall event during June 2013: diagnostics and

extended range prediction. *Climate Dynamics*, *44*(7-8), 2049–2065. https://doi.org/10.1007/s00382-014-2291-5

Joshi, V., & Kumar, K. (2006). Extreme rainfall events and associated natural hazards in Alaknanda valley, Indian Himalayan region. *Journal of Mountain Science*, *3*(3), 228–236. https://doi.org/10.1007/s11629-006-0228-0

Kakkar, N. (2018). Ghosts of kedarnath floods: 5 years on, remains of 670 victims still unidentified. Hindustan Times. Retrieved February 2, 2021, from https://www.hindustantimes.com/india-news/ghosts-of-kedarnath-floods-5-years-on-remains-of-670-victims-still-unidentified/story-QP6TPd4aaPlzv0xKbltMMM.html

Kala, C. P. (2014). Deluge, Disaster and Development in Uttarakhand Himalayan Region of India: Challenges and Lessons for Disaster Management. *International Journal of Disaster Risk Reduction*, *8*, 143–152. https://doi.org/10.1016/j.ijdrr.2014.03.002

Kargel, J. S., Leonard, G. J., Shugar, D. H., Haritashya, U. K., Bevington, A., Fielding, E. J., Fujita, K., Geertsema, M., Miles, E. S., Steiner, J., Anderson, E., Bajracharya, S., Bawden, G. W., Breashears, D. F., Byers, A., Collins, B., Dhital, M. R., Donnellan, A., Evans, T. L. … Young, N. (2016). Geomorphic and geologic controls of geohazards induced by Nepal's 2015 Gorkha earthquake. *Science*, *351*(6269), aac8353, 1–8. https://doi.org/10.1126/science.Aac8353

Karki, T., & Salike, N. (2020). Disaster governance in South Asia: Special reference to Nepal. In S. Bandyopadhyay, C. R. Pathak, & T. P. Dentinho (Eds.), *Urbanization and Regional Sustainability in South Asia. Contemporary South Asian Studies book series* (pp. 311–329). Springer.

Kayes, D. C. R. (2004). The 1996 Mount Everest climbing disaster: The breakdown of learning in teams. *Human Relations*, *57*(10), 1263–1284. https://doi.org/10.1177/0018726704048355

Khanal, B. (2020). Impact of the COVID-19 in Tourism Industry in Nepal and Policy Recommendation. *Journal of Tourism & Adventure*, *3*(1), 76–91. https://doi.org/10.3126/jota.v3i1.31357

Kotal, S. D., Roy, S., & Bhowmik, S. K. (2014). Catastrophic heavy rainfall episode over Uttarakhand during 16-18 June 2013 - observational aspects. *Current Science*, *107*(2), 234–245. https://doi.org/10.18520/CS/V107/I2/234-245

Krishnan, R., Sabin, T. P., Madhura, R. K., Vellore R. K., Mujumdar, M., Sanjay, J., Nayak, S., & Rajeevan, M. (2019a). Non-monsoonal precipitation response over the Western Himalayas to Climate Change. *Climate Dynamics*, *52*(7-8), 4091–4109. https://doi.org/10.1007/s00382-018-4357-2

Krishnan, R., Shrestha, A. B., Ren, G., ., (2019b). Unravelling climate change in the Hindu Kush Himalaya: Rapid Warming in the Mountains and Increasing Extremes. In P. Wester, A. Mishra, A. Mukherji, & A. Shrestha (Eds.), *The Hindu Kush Himalaya assessment* (pp. 57–97). Springer. https://doi.org/10.1007/978-3-319-92288-1_3

Lee, S. (2015). Taking the high road. Nepali times. Retrieved July 31, 2021, from http://archive.nepalitimes.com/article/Nepali-Times-Buzz/Manang-will-prosper-from-its-new-road,2749

Liechty, M. (2017). *Far Out: Countercultural Seekers and the Tourist Encounter in Nepal*. University of Chicago Press.

Lokgariwar, C., & Kaur, R. (2013). Uttarakhand - ravaged by God or Governance? Retrieved February 8, 2021, from https://www.indiawaterportal.org/articles/uttarakhand-ravaged-god-or-governance

Lorenz, D. F., & Dittmer, C. (2021). Disasters in the 'abode of gods'—Vulnerabilities and tourism in the Indian Himalaya. *International Journal of Disaster Risk Reduction*, *55*, 102054, 1–12. https://doi.org/10.1016/j.ijdrr.2021.102054

Lundup, T. (2019). Tourism and Ladakhi Culture in Transition. *Indian Anthropologist*, *48*(1), 47–59. https://doi.org/10.2307/26633111

Malik, M. I., & Bhat, M. S. (2015). Sustainability of tourism development in Kashmir — Is paradise lost? *Tourism Management Perspectives*, *16*, 11–21. https://doi.org/10.1016/j.tmp.2015.05.006

Marek, A., & Wieczorek, M. (2015). Tourist traffic in the Aconcagua Massif area. *Quaestiones Geographicae*, *34*(3), 65–76. https://doi.org/10.1515/quageo-2015-0022

Martha, T. R., Roy, P., Govindharaj, K. B., Kumar, K. V, Diwakar, P. G., & Dadhwal, V. K. (2015). Landslides triggered by the June 2013 extreme rainfall event in parts of Uttarakhand state, India. *Landslides*, *12*(1), 135–146. https://doi.org/10.1007/s10346-014-0540-7

McAdoo, B. G., Quak, M., & Gnyawali K, R. (2018). Roads and landslides in Nepal: how development affects environmental risk. *Natural Hazards and Earth Systems Science*, *18*(12), 3203–3210. https://doi.org/10.5194/nhess-18-3203-2018

McKay, T. (2018). The regulations governing South Africa's adventure tourism industry: an overview. Proceedings of the Biennial Conference of the Society of South African Geographers: 1–5 October 2018, University of the Free State, 189-207.

Michaud, J. (1991). A social anthropology of Ladakh, India. *Annals of Tourism Research*, *18*(4), 605–621. https://doi.org/10.1016/0160-7383(91)90077-O

Miller, M. C., & Heather Mair, H. (2020). Between space and place in mountaineering: navigating risk, death, and power. *Tourism Geographies*, *22*(2), 354–369. https://doi.org/10.1080/14616688.2019.1654538

Moore, G. W. K., Cristofanelli, P., & Bonasoni, P. (2020). Was an Avalanche Swarm Responsible for the Devastation at Mount Everest Base Camp During the April 2015 Nepal Earthquake? *High Altitude Medical Biology*, *21*(4), 352–359. https://doi.org/10.1089/ham.2019.0069

Mortlock, C. (1984). *The Adventure Alternative, Milnthorpe*. Cicerone Press.

Mu, Y., & Nepal, S. (2016). High Mountain Adventure Tourism: Trekkers' Perceptions of Risk and Death in Mt. Everest Region, Nepal. *Asia Pacific Journal of Tourism Research*, *21*(5), 500–511. https://doi.org/10.1080/10941665.2015.1062787

Mu, Y., Nepal, S. K., & Lai, P. (2019). Tourism and sacred landscape in Sagarmatha (Mt. Everest) National Park, Nepal. *Tourism Geographies*, *21*(3), 442–459. https://doi.org/10.1080/14616688.2018.1558454

Musa, G., Higham, J., & Thompson-Carr, A. (eds.). (2015). *Mountaineering tourism*. Routledge.

Musa, G., & Sarker, M. (2019). History and Future of Mountaineering Tourism. In I. Yeoman, & U. McMahon-Beattie (Eds.), *The Future Past of Tourism: Historical perspectives and future evolutions* (pp. 215–228). Channel View Publications.

Nagle, D. S., & Vidon, E. S. (2021). Purchasing protection: outdoor companies and the authentication of technology use in nature-based tourism. *Journal of Sustainable Tourism*, *29*(8), 1253–1269. https://doi.org/10.1080/09669582.2020.1828432

Narula, S. K. (2014). The year climate change closed everest. The Atlantic. Retrieved March 4, 2021, from https://www.theatlantic.com/international/archive/2014/04/the-year-climate-change-closed-everest/361114/.

Neckel, N., Kropáček, J., Schröter, B., & Scherer, D. (2015). Effects of cyclone Hudhud captured by a high altitude Automatic Weather Station in northwestern Nepal. *Weather*, *70*(7), 208–210. https://doi.org/https://doi.org/10.1002/wea.2494

Némethy, M., Pressman, A. B., Freer, L., & McIntosh, S. E. (2015). Mt Everest base camp medical clinic "Everest ER": epidemiology of medical events during the first 10 years of operation. *Wilderness & Environmental Medicine*, *26*(1), 4–10. http://doi.org/10.1016/j.wem.2014.07.011 https://doi.org/10.1016/j.wem.2014.07.011

Nepal, S. K. (2000). Tourism in protected areas: The Nepalese Himalaya. *Annals of Tourism Research*, *27*(3), 661–81. https://doi.org/10.1016/S0160-7383(99)00105-X

Nepal, S. K. (2013). Mountain Tourism and Climate Change: Implications for the Nepal Himalaya. *Nepal Tourism and Development Review*, *1*(1), 1–14. https://doi.org/10.3126/ntdr.v1i1.7367

Nepal, S. K. (2014). Eye-witness: death and despair in the aftermath of Everest's deadly avalanche. The Conversation. Retrieved March 6, 2021, from https://theconversation.com/eye-witness-death-and-despair-in-the-aftermath-of-everests-deadly-avalanche-27495

Nepal, S. K. (2016). Tourism and change in Nepal's Mt. Everest Region. In H. Richins, & J. S. Hull (Eds.), *Mountain Tourism – Experiences, Communities, Environments and Sustainable Futures* (pp. 270–279). CABI.

Nepal, S. K. (2020). Adventure travel and tourism after COVID-19 – business as usual or opportunity to reset? *Tourism Geographies*, *22*(3), 646–650. https://doi.org/10.1080/14616688.2020.1760926

Nepal, S. K., & Chipeniuk, R. (2005). Mountain tourism: Toward a conceptual framework. *Tourism Geographies*, *7*(3), 313–333. https://doi.org/10.1080/14616680500164849

Nepal, S. K., Kohler, T., & Banzhaf, B. R. (2002). *Great Himalaya - Tourism and the dynamics of change in Nepal* (pp. 92). Swiss Foundation for Alpine Research.

Nepal, S. K., & Mu, Y. (2015). Mountaineering commodification, and risk perceptions in Nepal's Mt. Everest Region. In G. Musa, J. Higham, & A. Thompson-Carr (Eds.), *Mountaineering Tourism* (pp. 250–264). Routledge.

Nepal, S. K., Mu, Y., & Lai, P. (2020). The *Beyul*: Sherpa perspectives on landscapes characteristics and tourism development in Khumbu (Everest), Nepal. In K. A. Shinde, & D. H. Olsen (Eds.), *Religious Tourism and the Environment* (pp. 70–82). CABI.

Nyaupane, G. P. (2015). Mountaineering on Mt Everest: Evolution, economy, ecology and ethics. In G. Musa, J. Higham, & A. Thompson-Carr (Eds.), *Mountaineering Tourism* (pp. 265–271). Routledge.

Nyaupane, G. P., & Chhetri, N. (2009). Vulnerability to Climate Change of Nature-Based Tourism in the Nepalese Himalayas. *Tourism Geographies*, *11*(1), 95–119. https://doi.org/10.1080/14616680802643359

Nyaupane, G. P., Lew, A., & Tatsugawa K, K. (2014). Perceptions of trekking tourism and social and environmental change in Nepal's Himalayas. *Tourism Geographies*, *16*(3), 415–437. https://doi.org/10.1080/14616688.2014.942233

Ong, C. E. (2005). Adventurism: Singapore Adventure Tourists in "Soft" Capitalism. In C. Ryan, S. Page, & M. Aicken (Eds.), *Taking Tourism to the Limits: Issues, Concepts and Managerial Perspectives* (pp. 81–91). Elsevier.

Pandey, B. W. (2002). *Geoenvironmental Hazards in Himalaya, Assessment and Mapping (The Upper Beas Basin)*. Mittal Publications.

Parkash, S. (2013). Earthquake related landslides in the Indian Himalaya: Experiences from the past and implications for the future.. In C. Margottini, P. Canuti, & K. Sassa (Eds.), *Landslide science and practice* (pp. 1–7). Springer.

PBS. (2019). Overcrowding on Mount Everest contributes to rise in deaths. World. Retrieved March 1, 2021, from https://www.pbs.org/newshour/world/overcrowding-on-mount-everest-contributes-to-rise-in-deaths

Pert, C. (2015). Sherpa families angry and fearful eight months on from Everest disaster. Retrieved March 6, 2021, from https://www.theguardian.com/world/2015/jan/04/-sp-sherpa-families-everest-disaster-guides-avalanche-compensation

Petley, D. N., Hearn, G. J., Hart, A., Rosser, N. J., Dunning, S. A., Oven, K., & Mitchell, W. A. (2007). Trends in landslide occurrence in Nepal. *Natural Hazards*, *43*(1), 23–44. https://doi.org/10.1007/s11069-006-9100-3

Pomfret, G. (2011). Packaged mountaineer tourists holidaying in the French Alps: An evaluation of key influences encouraging their participation. *Tourism Management*, *32*(3), 501–510. https://doi.org/10.1016/j.tourman.2010.04.001

Pomfret, G. (2021). Family adventure tourism: Towards hedonic and eudaimonic wellbeing. *Tourism Management Perspectives*, *39*, 1–12. https://doi.org/10.1016/j.tmp.2021.100852

Powell, J., Mustafee, N., Chen, A., & Hammond, M. (2016). System-focused risk identification and assessment for disaster preparedness: Dynamic threat analysis. *European Journal of Operational Research*, *254*(2), 550–564. 10.1016/j.ejor.2016.04.037

Prideaux, B., & Master, H. (2001). Reducing risk factors for international visitors in destinations. *Asia Pacific Journal of Tourism Research*, *6*(2), 24–32. https://doi.org/10.1080/10941660108722096

Pröbstl-Haider, U., Dabrowska, K., & Haider, W. (2016). Risk perception and preferences of mountain tourists in light of glacial retreat and permafrost degradation in the Austrian Alps. *Journal of Outdoor Recreation and Tourism*, *13*, 66–78. https://doi.org/10.1016/j.jort.2016.02.002

Rao, K., Nautiyal, S., Maikhuri, R., & Saxena, K. (2000). Management Conflicts in the Nanda Devi Biosphere Reserve, India. *Mountain Research and Development*, *20*(4), 320–323. https://doi.org/10.1659/0276-4741(2000)020[0320:MCITND]2.0.CO;2

Rautela, P. (2013). Lessons learnt from the Deluge of Kedarnath, Uttarakhand, India. *Asian Journal of Environment and Disaster Management*, *5*(2), 167–75. https://doi.org/10.3850/S1793924013002824

Rautela, P. (2018). Lessons Learned from 16/17 June 2013 Disaster of Uttarakhand, India. Chapter 9. In I. Pal, & R. Shaw (Eds.), *Disaster Risk Governance in India and Cross Cutting Issues* (pp. 169–184). Springer. https://doi.org/10.1007/978-981-10-3310-0_9

Rautela, P., & Pant, S. H. (2007). Delineating road accident risk along mountain roads. *Disaster Prevention and Management*, *16*(3), 334–343. https://doi.org/10.1108/09653560710758288

Rautela, P., & Sharma, R. (2004). Insights into the nature of road accidents from data on injured and dead. *Disaster Prevention and Management*, *13*(5), 374–378. https://doi.org/10.1108/09653560410568499

Ritchie, B. (2008). Tourism Disaster Planning and Management: From Response and Recovery to Reduction and Readiness. *Current Issues in Tourism*, *11*(4), 315–348. https://doi.org/10.1080/13683500802140372

Ritchie, B. W. (2009). *Crisis and Disaster Management for Tourism*. Channel View Publications.

Ritu. (2020). Living with and responding to risk in the Uttarakhand Himalayas: A call for prioritizing lived experiences in research policy praxis. *International Journal of Disaster Risk Reduction*, *48*, 1–16. https://doi.org/10.1016/j.ijdrr.2020.101499

Roy, A. (2018). The Middle Class in India: From 1947 to the Present and Beyond. *Asian Politics*, *23*(1), 32–36.

Rumbach, A., & Nemeth, J. (2018). Disaster risk creation in the Darjeeling Himalayas: Moving toward justice. *Environment and Planning E: Nature and Space*, *1*(3), 340–362. https://doi.org/10.1177/2514848618792821

Ryan, C. (2003). Risk acceptance in adventure tourism — paradox and context. In J. Wilks & S. F. Moore (Eds.), *Managing tourist health and safety in the new millennium* (pp. 55–65).

Salisbury, R. (2020). The Himalaya database. The Expedition Archives of Elizabeth Hawley. Retrieved February 2, 2021, from https://www.himalayandatabase.com

Salisbury, R., & Hawley, E. (2011). *The Himalayan database. A statistical analysis of mountaineering in the Nepal Himalaya*. Vajra Publications.

Sati, V. (2013). Tourism practices and approaches for its development in the Uttarakhand Himalaya, India. *Journal of Tourism Challenges and Trends*, *6*(1), 97–111.

Sati, V. P. (2011). Climate disasters in the Himalaya: risk and vulnerability. Proceedings of the International Conference on Climate Change and Natural Hazards in Mountain Areas, Dushanbe, Sept. 19-21, 2011, http://www.mountainhazards2011.com/souboryeditor/Paper%20Vishwambhar%20P.%20Sati.pdf

Sati, V. P. (2018). Carrying capacity analysis and destination development: a case study of Gangotri tourists/pilgrims' circuit in the Himalaya. *Asia Pacific Journal of Tourism Research*, *23*(3), 312–322. https://doi.org/10.1080/10941665.2018.1433220

Saveriades, A. (2000). Establishing the social tourism carrying capacity for the tourist resorts of the east coast of the Republic of Cyprus. *Tourism Management*, *21*(2), 147–156. https://doi.org/10.1016/S0261-5177(99)00044-8

Schaffer, G. (2012). Take a Number. Retrieved March 20, 2021, from https://www.outsideonline.com/1929136/take-number

Shapiro, M. (2020). In remote Nepal, new roads bring opportunity–and conflict. National Geographic. Retrieved July 29, 2021, from https://www.nationalgeographic.co.uk/adventure/2020/12/in-remote-nepal-new-roads-bring-opportunity-and-conflict

Sharma, B., & Najar, N. (2014). Blizzard and Avalanche Kill at Least 20 Trekkers in Himalayas. The New York Times. Retrieved February 4, 2021, from https://www.nytimes.com/2014/10/16/world/asia/himalayas-blizzard-and-avalanche-kill-at-least-20-and-leave-dozens-missing.html.

Sharma, M. (2020). Himalayas the only place in the world where a large quake can occur on land, say geophysicist Roger Bilham. Retrieved February 6, 2021, from https://timesofindia.indiatimes.com/home/sunday-times/all-that-matters/himalayas-the-only-place-in-the-world-where-a-large-quake-can-occur-on-land-says-geophysicist-roger-bilham/articleshow/77043174.cms.

Sidle, R., & Ziegler, A. (2012). The dilemma of mountain roads. *Nature Geoscience*, *5*(7), 437–438. https://doi.org/10.1038/ngeo1512

Simonovi, S. P. (2011). *Systems approach to management of disasters: Methods and applications*. Wiley.

Simonovi, S. P. (2015). Systems approach to management of disasters – A missed opportunity? *Journal of Integrated Disaster Risk Management*, *5*(2), 70–83. https://doi.org/10.5595/idrim.2015.0099

Singh, R. B., & Mishra, D. K. (2004). Green tourism in mountain regions-reducing vulnerability and promoting people and place centric development in the Himalayas. *Journal of Mountain Science*, *1*(1), 57–64. https://doi.org/10.1007/BF02919360

Singh, S. (2006). Tourism in the Sacred Indian Himalayas: An Incipient Theology of Tourism? *Asia Pacific Journal of Tourism Research*, *11*(4), 375–389. https://doi.org/10.1080/10941660600931226

Singh, S. (ed.). (2009). *Domestic Tourism in Asia: Diversity and Divergence*. Earthscan.

Srivastava, P., Kumar, A., Chaudhary, S., Meena, N., Sundriyal, Y. P., Rawat, S., Rana, N., Perumal, R. J., Bisht, P., Sharma, D., Agnihotri, R., Bagri, D. S., Juyal, N., Wasson, R. J., & Ziegler, A. D. (2017). Paleofloods in the Himalaya. *Geomorphology*, *284*, 17–30. https://doi.org/10.1016/j.geomorph.2016.12.011

Stevens, S. (2003). Tourism and deforestation in the Mt Everest region of Nepal. *Geographical Journal*, *169*(3), 255–277. https://doi.org/10.1111/1475-4959.00089

Stokes, S., Koirala, P., Wallace, S., Bhandari, S., et al. (2015). Tragedy on Everest: the Khumbu Icefall. *Emergency Medicine Journal*, *32*(5), 418–420. https://doi.org/10.1136/emermed-2014-20448

Sudmeier-Rieux, K., McAdoo, B. G., Devkota, S., Rajbhandari, P. C. L., Howell, J., & Sharma, S. (2019). Invited perspectives: Mountain roads in Nepal at a new crossroads. *Natural Hazards and Earth Systems Science*, *19*(3), 655–660. https://doi.org/10.5194/nhess-19-655-2019

Svokos, A. (2019). So many people are dying on Mount Everest this year because of inexperience, experts say. Retrieved March 20, 2021, from https://abcnews.go.com/International/people-dying-mount-everest-year-inexperience-experts/story?id=63319682

Swann, C., Crust, L., & Allen-Collinson, J. (2016). Surviving the 2015 Mount Everest disaster: A phenomenological exploration into lived experience and the role of mental toughness. *Psychology of Sport and Exercise*, *27*, 157–167. https://doi.org/10.1016/j.psychsport.2016.08.012

Talwar, G. (2016). 3 yrs after Kedarnath tragedy, number of deaths yet to be ascertained. Times of India. Retrieved January 30, 2021, from https://timesofindia.indiatimes.com/city/dehradun/3-yrs-after-kedarnath-tragedy-number-of-deaths-yet-to-be-ascertained/articleshow/52768933.cms.

Talwar, G. (2018). Char Dham Yatra witnesses record footfall; over 4 lakh more pilgrims than last year, says Uttarakhand police. Retrieved March 11, 2021, from https://timesofindia.indiatimes.com/city/dehradun/char-dham-yatra-witnesses-record-footfall-over-4-lakh-more-pilgrims-than-last-year-says-uttarakhand-police/articleshow/66625671.cms

Tsianos, G., Woolrich-Burt, L., Aitchison, T., Peacock, A., Watt, M., Montgomery, H., Watt, I., & Grant, S. (2006). Factors affecting a climber's ability to ascend Mont Blanc. *European Journal of Applied Physiology*, *96*(1), 32–36. https://doi.org/10.1007/S00421-005-0066-8

UIAA. (2019). UIAA Statement: 2019 Mount Everest climbing season. Retrieved February 5, 2021, from https://www.theuiaa.org/uiaa/uiaa-statement-2019-mount-everest-climbing-season/.

Ulak, N. (2020). COVID-19 Pandemic and its Impact on Tourism Industry in Nepal. *Journal of Tourism & Adventure*, *3*(1), 50–75. https://doi.org/10.3126

Upadhayaya, P. R. (2015). Sustainability threats to mountain tourism with tourists mechanized mobility induced global warming: a case study of Nepal. *Journal of Tourism and Hospitality*, *4*(2) article 148, 1–7. https://doi.org/10.4172/2167-0269.1000148

Uprety, A., Ozaki, A., Senoo, Y., Yoshida, I., Leppold, C., Higuchi, A., & Tanimoto, T. (2017). Flood damage in Nepal exacerbated by underlying conflict with India. *The Lancet Planetary Health*, *1*(9), E351–E352. https://doi.org/10.1016/S2542-5196(17)30159-6

Vaidya, R. A., Mandira, S. S., Nasab, N., Gurung, D. R., Nagami, K., Neera, S. P., Wasson, R. J., (2019). Disaster risk reduction and building resilience in the hindu Kush Himalaya. In P. Wester, A. Mishra, A. Mukherji, & A. Shrestha (Eds.), *The Hindu Kush Himalaya Assessment* (pp. 389–419). Springer. https://doi.org/10.1007/978-3-319-92288-1_11

Varghese, B., & Paul, N. I. J. (2013). Disaster Management: A Case Study of Uttarakhand. Proceedings of Water, Climate and Tourism - is it a boon or bane to mankind & economic environment?. *Bangalore*, ISBN: 9789382715986, 1–12. https://doi.org/10.13140/2.1.4617.1521

Vellore, R. K., Bisht, J. S., & Krishnan, R. (2020). Sub-synoptic circulation variability in the Himalayan extreme precipitation event during June 2013. *Meteorology and Atmospheric Physics*, *132*(5), 631–665. https://doi.org/10.1007/s00703-019-00713-5

Vishal, V., Siddique, T., Purohit, R., Phophliya, M. K., & Pradhan, S. P. (2017). Hazard assessment in rockfall-prone Himalayan slopes along National Highway-58, India: rating and simulation. *Natural Hazards*, *85*(1), 487–503. https://doi.org/10.1007/s11069-016-2563-y

Vogel, B., & Field, J. (2020). Re)constructing borders through the governance of tourism and trade in Ladakh, India. *Political Geography*, *82*, 1–10. https://doi.org/10.1016/j.polgeo.2020.102226

Wang, S. Y., Fosu, B., Gillies, R., & Singh, P. (2015). The Deadly Himalayan Snowstorm of October 2014: Synoptic conditions and associated trends. *Bulletin of the American Meteorological Society*, ((96 (12)), S89–S94. https://doi.org/10.1175/BAMS-D-15-00113.1

Warfield, C. (2021). The disaster management cycle. Retrieved March 20, 2021, from https://www.gdrc.org/uem/disasters/1-dm_cycle.html

Wasson, R., Sundriyal, Y., & Chaudhary, S. (2013). A 1000-year history of large floods in the Upper Ganga catchment, central Himalaya, India. *Quaternary Science Reviews*, *77*, 156–166. https://doi.org/10.1016/j.quascirev.2013.07.022

Weichselgarner, J., & Bertens, J. (2000). Natural disasters: Acts of god nature or society? On the social relation to natural hazards. WIT Transactions on Ecology and the Environment. Retrieved January 30, 2021, from https://www.witpress.com/elibrary/wit-transactions-on-ecology-and-the-environment/45/4660

Westhoff, J. L., Koepsell, T. D., & Littell, C. T. (2012). Effects of experience and commercialisation on survival in Himalayan mountaineering: retrospective cohort study. *BMJ*, *344*(jun13 2), e3782,1-17. https://doi.org/10.1136/bmj.e3782

Williams, P., & Soutar, G. (2005). Close to the "edge": Critical issues for adventure tourism operators. *Asia Pacific Journal of Tourism Research*, *10*(3), 247–261. https://doi.org/10.1080/10941660500309614

Windsor, J. (2019). Mountain Deaths. In G. Rutty (Ed.), *Essentials of autopsy practice* (pp. 111–127). Springer. https://dx.doi.org/10.1007/978-3-030-24330-2_6

Zarghami, S. A., & Dumrak, J. (2021). A system dynamics model for social vulnerability to natural disasters: Disaster risk assessment of an Australian city. *International journal of disaster risk reduction*, *60*, 1-12. https://doi.org/10.1016/j.ijdrr.2021.102258

Ziegler, A. D., Cantarero, S. I., Wasson, R. J., Srivastava, P., Spalzin, S., Chow, W. T. L., Gillen, J. (2016a). A clear and present danger: Ladakh's increasing vulnerability to flash floods and debris flows. *Hydrological Processes*, *30*(22), 4214–4223. https://doi.org/10.1002/hyp.10919

Ziegler, A. D., Echaubard, P., Lee, Y. T. Chuah, C. J., Wilcox, B. A., Grundy-Warr, C., Sithithaworn, P., Petney, T. N., Laithevewat, L., Ong, X., Andrews, R. H., Ismail, T., Sripa, B., Khuntikeo, N., Poonpon, K., Tungtang, P., & Tuamsuk, K. (2016b). Untangling the complexity of liver fluke infection and cholangiocarcinoma in NE Thailand through transdisciplinary learning. *Ecohealth*, *13*(2), 316–327. 1–12 pp. https://doi.org/10.1007/s10393-015-1087-3

Ziegler, A. D., Wasson, R. J., Bhardwaj, A., Sundriyal, Y. P., Sati, S. P., Juyal, N., Nautiyal, V., Srivastava, P., Gillen, J., & Saklani, U. (2014). Pilgrims, progress, and the political economy of disaster preparedness – the example of the 2013 Uttarakhand flood and Kedarnath disaster. *Hydrological Processes*, *28*(24), 5985–5990. https://doi.org/10.1002/hyp.10349