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Inbound tourism in Uttarakhand, India, before and after the 2013 Kedarnath disaster – evidence derived from social networking sites using GIS

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Tourism is an important industry for the developing nations. The Indian Himalayan region attracts a multitude of tourists, but is highly prone to natural disasters that affect tourism. The 2013 Kedarnath disaster in Uttarakhand caused by the torrential downpour and subsequent flooding is one such example. In the present study, visitation rates were assessed with regard to the Kedarnath disaster using geo-tagged photographs posted on Flickr as proxy. Continued decrease in photo-user days from 2012 to 2014 was witnessed and the effectiveness of GIS in the spatio-temporal analysis of inbound tourism using big data available on social networking sites has been demonstrated.

Keywords: Big data, natural disasters, social networking sites, tourism, visitation rates.

TOURISM is one of the world's largest industries having significant potential to drive the world economic growth. The World Travel and Tourism Council (WTTC) estimates that tourism generates about 10% of the global GDP and contributes to 284 million jobs. The revenue generated by tourism in India was Rs 8.31 lakh crores (US$ 120 billion), equal to 6.3% of the nation's GDP in 2015 and supported 37.315 million jobs, 8.7% of its total employment[1]. It is of major national economic importance for many developing countries that provide many natural attractions such as ecotourism, adventure tourism, extractive tourism, wildlife tourism, wilderness and nature retreats, which in turn succour livelihood of the local people. Globally, tourism is a US$ 625 billion industry, the single largest non-Government economic sector in the world[2]. Though negative aspects of tourism in terms of its impact on the environment have been often raised by conservationists, it plays a significant role in creating a sense of solidarity among people across the globe, as reflected by the affinity between tourists and their families and friends, and individuals and communities in various destinations.

Tourism constitutes a wide variety of sectors that provide diverse products and services to visitors. Some consider leisure, recreation, entertainment and hospitality as the main concepts related to tourism[3], whereas there are several other dimensions as well, e.g. education, natural disaster, research, business, etc.[4–7]. According to the United Nations World Tourism Organization (UNWTO), activities comprising persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes are considered as tourism. Thus, there are various classes of tourism based on motives, locations, type of visitors, etc. Depending upon the origin of visitors, tourism may be classified as inbound, outbound and domestic. Activities of non-resident foreign tourists visiting a country are known as inbound tourism (foreign tourism), whereas outbound tourism comprises activities of a resident visitor outside the country of reference, and domestic tourism involves residents of a country travelling only within it. India holds tremendous potential tourist destinations in the form of both inbound and domestic tourism. This potential is evidently palpable in terms of overall development and growth of our economy. India's total foreign tourist arrivals in 2013 stood at 6.84 million. Foreign exchange earnings from tourism in 2013 grew to US$ 18.44 billion, showing an annual growth rate of 4% (ref. 8).

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Although tourism has always been regarded as an impetus that brings in economic growth for a region as an industry, many tourist destinations are susceptible to natural disasters. The impact of natural disasters has been more profound during the last few years. Historically, from 1990 to 2012, the Indian Himalayan region has been drubbed by 532 natural disasters, standing second only to 670 in the Chinese part of the mountain range[9]. 'Kashmir' was struck by a fierce deluge in September 2014, leading to huge fatalities and an estimated loss of Rs 5400–5700 crores to the economy, including the tourism industry[10]. According to the National Planning Commission of Nepal, the 2015 Nepal earthquake resulted in casualties of over 8,790 and injured 22,300 people. This natural disaster not only led to a loss of Rs 44 billion, but also damaged several ancient cultural heritage and archaeological sites along with other infrastructure. The Uttarakhand region in India is known to attract a large number of tourists due to its aesthetic natural splendour and high pilgrimage tourism potential. It is also prone to several kinds of natural disasters and extreme events such as earthquakes, landslides and cloud bursts having a direct impact on tourism. The state witnessed a mega natural disaster at Kedarnath on 16 and 17 June 2013, leading to widespread damage and destruction along with heavy casualties as it coincided with peak tourist and pilgrimage season. More than 70,000 tourists and 100,000 local inhabitants were marooned in the difficult mountain terrain of the upper reaches of the Himalaya. The damage was so enormous and extensive that it was also called the Himalayan tsunami by the media[11].

The negative repercussion of this natural disaster is a decrease in the number of tourist arrivals in the subsequent years, which will affect the revenue generated by tourism. As an outcome of the Kedarnath disaster, several scientific studies have been undertaken. For example, using sundry geospatial techniques, the spatial extent of deluge and damage caused by this natural disaster in terms of loss to the infrastructure, agriculture, forest, etc. were studied[12] utilizing NDVI, LULC data, road network data, forest data, census data and the corresponding revenue village boundaries. The devastating impact of debris flow was studied[13] using rapid mass movement software (RAMMS), a numerical modelling technique. It provided velocity, height, momentum and pressure of flow along the path. This could help in the prediction of the extent of future potential debris flow, thus helping in devising mitigation measures. Ray *et al.*[14] recreated the Kedarnath disaster events with the prime aim to improve response and minimize damage in the case of similar natural disasters in future. Though several studies with respect to this mega natural disaster are available, none has been carried out using social networking sites (SNS)-based data in order to measure the effect of this natural disaster on tourism in the region. The present study is an attempt to assess the visitation rates (VRs) in Uttarakhand in the wake of the Kedarnath disaster based on geo-tagged, crowd-sourced photographs posted on Flickr.

Emergence of social media and open source geographic information in recent years has further lead to new technological developments presenting challenges and opportunities to the geospatial community. Social media information provides not only the news regarding event of disaster, but also highlights some of the hidden and unexplained facts about the event that if interpreted and analysed in GIS can provide crucial insights. For example, Wood *et al.*[15] utilized photo user days (PUDs) for estimation of tourist VR all around the world from data available on Flickr.

The breathtaking scenery of tourist destinations calls out for tourists to recreate them in large numbers. However, many of these sites are inherently linked with complex factors and processes that influence their vulnerability and resilience and hence the overall carrying capacity. Escalating flow of tourists beyond the carrying capacity further makes tourism sites susceptible to natural disasters and hazards. Understanding and identifying such drivers of hazards in tourist spots is important, which requires the formation and implementation of a strong vulnerability framework to combat the post-disaster impacts and also in improving the resilience of the affected region in case of future shocks[16].

In an event of the disaster, livelihoods of the communities are seriously hit. Therefore, to help the local people regain their livelihoods during post-disaster recovery, there is a need to deeply understand the mechanisms and compounded effects of the risk-induced stigmatization process and vulnerabilities inherent in the local environment and situation. Media communication is important component of rebuilding the disaster-hit areas by authentically presenting the losses that further effect the recovery of the physical facilities and also the secondary impact on destination image and reputation[17].

Uttarakhand was carved out of northwestern Uttar Pradesh (UP) on 9 November 2000, as the 27 state of India. The state covers a total geographical area of 53,483 sq. km of which 86% is mountainous and 65% is covered by forests[18]. It shares international boundaries with China (Tibet) in the north and Nepal in the east. The Indian states of UP and Himachal Pradesh lie on its southern and northwestern boundaries respectively. The average annual rainfall of the state is ~1896 mm and average annual temperature is 21.8°C (ref. 19). These factors along with altitude which varies from 560 to 7816 m amsl result in multitude of landscapes, enticing visitors throughout the year.

Uttarakhand is also known as Devbhumi or 'Land of Gods' due to the presence of numerous Hindu temples and pilgrimage sites throughout the state. It also attracts a large number of tourists due to its location amidst the awe-inspiring Himalaya. Many ancient temples at the holy Hindu shrines of Kedarnath, Haridwar, etc. attract

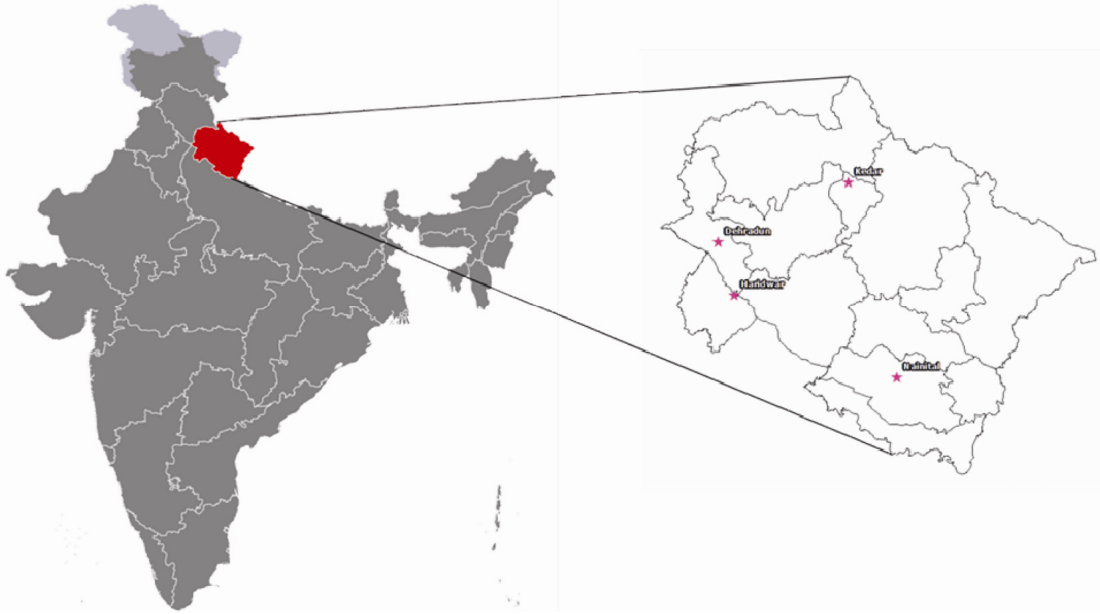

Figure 1. Location map of the study area showing four major tourist spots in Uttarakhand, India.

pilgrims not only from India, but also from abroad. Hill stations like Dehradun and Mussoorie attract a large number of tourists due to good connectivity by road and rail networks. The mountain peaks and waterfalls provide a landscape suitable for trekking, climbing, skiing, camping, rock climbing, river rafting and paragliding, and draw a large number of tourists from all over the world[20].

In the present study, we have analysed the impact of a natural disaster on the tourism industry in a disaster-struck area of Uttarakhand using VRs derived from social media as a proxy for the years 2012, 2013 and 2014 for four major attraction locations, viz. Kedarnath, Haridwar, Dehradun and Nainital (Figure 1). Wood *et al.*[15] demonstrated the earliest use of data available on Flickr for assessment of VRs at 836 recreational sites all around the world. A similar approach was used by Keeler *et al.*[21] to estimate the recreational value of changes in water quality utilizing data on recreational visits to lakes for over 1000 lakes in Minnesota and Iowa, USA[21]. This approach can help in expanding the knowledge of tourism and its various aspects in spatially explicit ways. In the present study, integrated valuation of ecosystem services and tradeoffs (InVEST) ver. 3.3.1 recreation module has been used to assess the spread of person-days of recreation in Uttarakhand using geotagged photographs posted on Flickr, as a proxy. The model approximates the total number of annual person-days of photographs uploaded to Flickr to estimate the current VRs. These photographs are geotagged along with user specification, which is counted by the model for the specified geographic region as PUDs. The model sums the number of PUDs for all days of the given year to return the average annual number of PUDs. These computations are performed on an extensive global dataset at a remote server curated and maintained by the Natural Capital Project (NatCap), under the partnership of Stanford University and the University of Minnesota, USA.

The model output consists of a map showing VRs in the form of PUDs for the period 2012–2014. The attribute table of this map also provides average PUD values per year as well as average PUD values derived for each month. The results were analysed for four major tourism destinations in Uttarakhand, viz. Nainital, Haridwar, Dehradun and Kedarnath, before and after the devastating floods of 2013 (Figure 2).

Overall there was a gradual decline in the average VRs from 2012 to 2014. The highest VRs (2.08) were obtained in 2012, followed by 2013 with an average VRs of 1.17 and the lowest value of 0.95 in 2014. The decline in 2013 might be attributed to the Kedarnath flood, its impact on visitations continued to persist even during 2014. This was because of the adverse impact on infrastructure, hence limiting the accessibility to these destinations.

To present further insight on the impact of floods on tourism, graphs were obtained using data from the attribute table acquired as one of the products of processing of the model (Figure 3). These graphs gave the monthly average VR. Interpretation of these values for 2012 versus 2013, that is, for the period prior to the flood indicates reduction in average VR, thus highlighting the abysmal condition of the tourism industry in the state. The causes for this are beyond the scope of the present study and need more investigation. The post-disaster comparison showed reduction in VR in 2013, which continued in 2014 till January–February, but recovered slightly during March–May. Again, June–August, i.e. the monsoon season

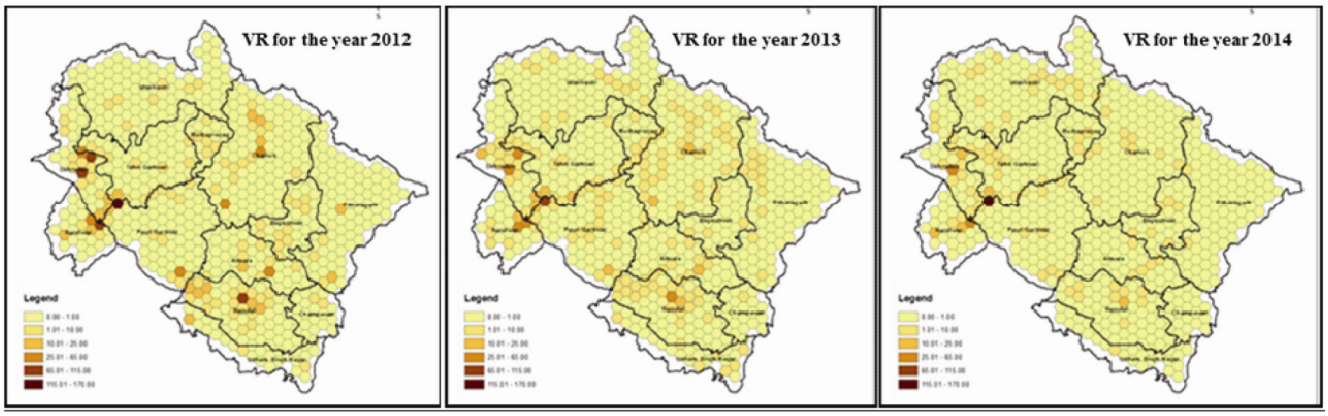

Figure 2. Map of Uttarakhand showing distribution of visitation rates for the years 2012–2014.

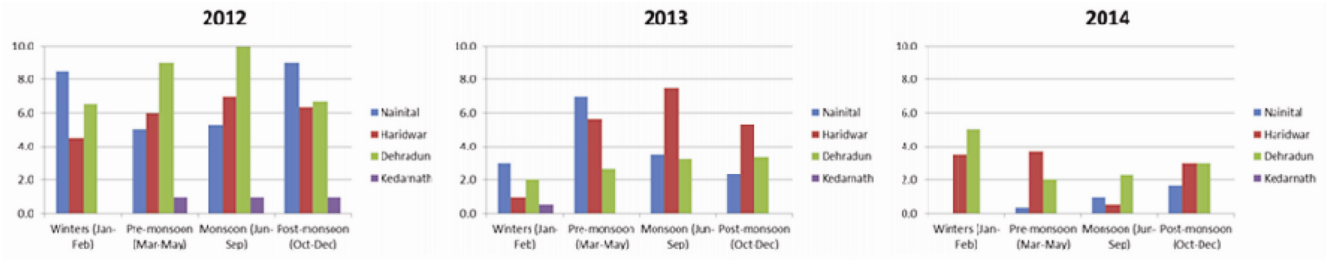

Figure 3. Graphs showing season-wise visitation rates for the four major tourist spots in Uttarakhand.

witnessed reduction in VR, followed by increasing trends in September–November.

Further impacts with respect to season were also studied as tourism is a function of seasons. Hence yearly or monthly insights alone can be sometimes insufficient. So we have carried out seasonal analysis at four major tourist locations of the state, viz. Nainital, Haridwar, Dehradun and Kedarnath to understand the seasonal distribution of VR. For 2012, Nainital exhibited the highest VR in winter and post-monsoon season, while for pre-monsoon and monsoon seasons, Dehradun had maximum VR, followed by Haridwar which had VR lower than both for all seasons; and least VR was obtained in Kedarnath, which was analogous throughout the year. During 2013, Nainital displayed high VR only during pre-monsoon season and Dehradun showed discernible decline in VR compared to 2012. VR for Haridwar city remained comparable to the previous year and only decreased during winter season, due to pilgrimage tourism. Hence, it is not affected by seasons. Kedarnath showed VR values only during winter and none during the remaining periods of 2013. The absence of VR in 2014 is the ramification of closing of the area for a year after the natural disaster to recover from the infrastructure damage. As evident from Figure 3, 2014 also witnessed a decline in VR in all the four tourist spots, more so in the monsoon season, which may be due to the fear of damage to life and property in tourists' mind especially as an aftermath of the disaster witnessed few years ago. Also, the major inbound tourism is concentrated in Dehradun, Haridwar and Nainital, not in Kedarnath.

To study the impact of natural disasters on tourism, the number of visitations before and after the disaster is a prerequisite. Traditionally, databases on VR by the tourists are maintained by government agencies. For example, Garhwal Mandal Vikas Nigam and Uttarakhand Tourism Development Board (UTDB) maintain tourism information based on advance bookings made at the government-recognized hotels, guesthouses and homestays in the state[22]. However, these records are far from adequate due to incompleteness; for example, detailed nature of tourists and places visited (personal information collected during the fieldwork), as some tourists stay in camps and private hotels which are cheaper with easier bookings for those who make unplanned visits during the weekends. This hampers any relief measures where quick responses are needed. After the Kedarnath flood tragedy UTDB has started the biometric registration of tourists at the point of entrance in Rishikesh. However, this alone is not sufficient to endorse the tourist spots that they may visit.

In recent years, there has been an increased use of social media and people's repository of images along with metadata to provide information on various aspects of tourism. It is also found to be highly expedient in the event of a disaster in many countries, as it helps the concerned authorities in making better decisions for

emergency response[23]. In India, recent efforts by the Ministry of Home Affairs, Government of India and National Remote Sensing Centre, Indian Space Research Organization have translated the use of social media in the form of National Database for Emergency Management assisted by a set of decision support system tools along with social media inputs for effective monitoring and planning in the event of a natural disaster[24]. The present study demonstrates the use of geotagged photographs obtained from Flickr, as a proxy to map the impact of Kedarnath disaster on Uttarakhand tourism in four major locations. In addition, the popularity of various tourism destinations with respect to season using the content available through social media is also evaluated. Though the results analysed represent a surveillance approach making use of volunteer geographic information, more appropriate inferences could be drawn by designing targeted monitoring approach using citizens (tourists) as an effective tool. The model is based on the assumption that all geotagged images available on Flickr are uploaded by tourists who are foreign nationals, as Flickr is not popular among Indians[25], and that no image corresponds to no visitation. This, however, needs to be validated in future studies and more robust approaches are required to exploit the potential of the SNS and GIS technology in tourism planning, decision making and preparedness in case of any unforeseen events like the 2013 flash floods in Uttarakhand.

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