

Possibility and Development of Ski and Winter Adventure Tourism in Nepal Himalaya: Insights from Mera Peak

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Abstract

Adventure tourism is one of the main attractions in Nepal, however, ski and winter tourism are not famous yet. Therefore, this study carried out research on the possibility and development of ski adventure tourism in the favor of winter tourism. The Mera peak area has been selected as the study area, which is located in the Hinku Valley, Solukhumbu, at 6470-meter above sea level. This study used Remote Sensing approaches, a walk survey and photography, and conducted 27 Key Informant Interview (KII) to screen the possibility and development of the ski and winter tourism. Global Positioning System (GPS), Geographic Information System (GIS), and Satellite Images via Google Earth have been applied for route and ski sites mapping. Digital Elevation Model (DEM) data (12.5 m resolution) has been used for DEM, slope, hillshade, and contour analysis. Mann-Kendall trend test and Sen's slope was applied to determine the climatic trend of the region. The study explored detailed route and ski sites of the Mera peak area and identified it as one of the potential areas for skiing in Nepal. There were not noticeable risk factors for skiing except climate change and minor crevasses. There are several destinations for ski activities in Nepal, which would promote winter tourism in the country. The study uncovered that there have been increasing rates of temperature and decreasing rates of precipitation in the mountain region of Nepal. These climatic factors added some level of risk for a ski industry in the region because increasing trends of temperature result in high rates of snow ablation. The findings of this research will greatly help to promote ski and winter tourism in Nepal, and it will be one of the base documents for developing ski- related policy by the government of Nepal and will be useful for further academic and scientific research in Nepal.

Keywords: *Ski, winter tourism, adventure tourism, Mera peak, Nepal Himalaya*

Introduction

Tourism is known as the combination of the activities, facilities, services and industries, entertainment, recreation, historical and cultural experiences, destination attraction, shopping and other services available to travelers away from home (Agarwal & Upadhyay, 2006; Kharel, 2019; Lickorish & Jenkins, 2007). In a simple way, tourism is defined as spending time away from home in pursuit of recreation, relaxation, and pleasure, while making use of the commercial provision of services (Keller, 2018). Globally, skiing is known as the backbone to promote winter tourism (Abegg et al., 2020; Fischer et al., 2011). This sport attracts large numbers of winter visitors and helps to promote winter tourism and improve the income and employment status in the tourism sector (Steiger et al., 2019).

A study reported that, mainly five countries: Austria, Australia, Switzerland, United States,

and Canada are famous for ski and winter tourism in the world (Steiger et al., 2019). The European Alps is the most popular destination in the world for ski and snow related sports and activities (Braghin et al., 2016; Elsasser & Bürki, 2002). Ski tourism is also famous in Caucasus range (Pestereva et al., 2012). Some destinations in the Andes mountain range in South America are popular for ski tourism as well (Kaenzig et al., 2016; Palmedo, 1936). Thus, snow cover is very important for the ski industry because ski activities cannot run without snow coverage (Pestereva et al., 2012). However, global climate change has largely impacted ski tourism in different countries around the world (Dawson et al., 2009; Pons-Pons et al., 2012; Steiger & Stötter, 2013), which adds risk factors for sustainable winter tourism and a ski industry (Knowles & Scott, 2020; Steiger et al., 2019). In Asian countries, there is a lack of development of winter tourism and a ski industry compared to Europe and the Americas (Deng et al., 2019; Masaaki, 2014).

Due to unique topography and climate, Nepal is one of the dream destinations of many tourists in the world, especially for adventure activities such as mountaineering and trekking (Paudel, 2012; Stevens, 1988), as well observation for diverse biophysical conditions and cultural diversity (Paudel, 2021; Satyal, 1999). In Nepal, there is vast altitudinal difference within a short aerial distance from nearly 60 m. in the south to 8848.86 m. in the north (Mt. Sagarmatha/Everest). The climate ranges from tropical to a tundra climate with rich variations of flora and fauna. There are over ninety mountain peaks in Nepal above the height of 7000 m and 8 out of the 14 highest mountains peaks in the world lie in Nepal (Shrestha & Shrestha, 2012). Thus, the Nepal Himalaya is the very attractive destination for mountaineers, and adventure tourists. The tourist statistics shows that the number of tourists visiting Nepal has been increasing from only 6179 tourist in 1962 to 1,173,072 in 2018 (MoCTCA, 2019). According to the tourism statistics of 2018, out of the total number of tourists during the year 2018, by purpose of their visit, more than two thirds of them visited for vacation/entertainment, trekking and mountaineering.

In the Nepal Himalaya, there is a huge prospect for adventure tourism, natural tourism, and adventure sports tourism. It has also been realized that many beautiful locations are yet to be explored and accessed. The areas of intervention to increase the number of tourists visiting Nepal are the development of infrastructure, facilities and enhanced publicity. Skiing in high mountain regions, known as an adventure sport and a fun activity, is more suitable in winter seasons due to the greater depth of snow cover. Recently, there were some explorations of ski adventure mountain peaks and routes in the Nepal Himalaya, but a full promotion for the ski and winter tourism is yet to the place. The noticeable matter is that, there are many potential destinations in the Nepal Himalaya for the development of skiing and winter tourism (Sherpa, 2021). There is large gap of research and publication in the Nepali ski sector, which demands the initiation of further base academic scientific research in this field. Moreover, there is lack of development of infrastructure, promotion, and scientific research especially for winter tourism in Nepal. Most of the activities and studies in the adventure tourism section focus on summer, spring and autumn seasons, which make a large gap in the winter tourism and ski research in Nepal. In this context, and to fulfill this research gap and promote winter tourism in Nepal Himalaya, this research explored possibilities and development of skiing and winter tourism in Nepal: insight from Mera peak with the approach and application of advance geographical tools i. e. Global Positioning System (GPS), Geographic Information System (GIS), Remote Sensing, Key Informant Interview (KII) and real field observations.

Materials and methods

The researchers have applied various methods for detailed findings of possibilities and development of ski and winter adventure tourism on Mera peak. On the basis of various adopted methods and materials, this study has analyzed the possibility and development of ski and winter adventure tourism on Mera peak. Therefore, several sections have been presented here outlining different topics to explain about the scheme of the present study in detail.

Theoretical and conceptual framework

Each study presents a clear theoretical and conceptual framework with proper strategies (Clydesdale, 2007). In this context, this study is mainly based on Remote Sensing approaches as well as real ground experiences and Key Informants Interview (KII) data. Thus, the study handled this research theme with Satellite Remote Sensing data, KII, and walk survey and photography. ArcGIS 10.8 (ESRI, USA) has been used for overall ski site mapping and route analysis of the study. The DEM, slope, hill shed, and contour mapping are also prepared from ArcGIS. The detailed mapping of the route has been conducted using GPS and Google Earth Images of the study area. The study has applied the Mann-Kendall trend test (Kendall, 1975; Mann, 1945) and Sen’s slope (Sen, 1968) for climatic trend analysis of the study region. Based on these various datasets and tools, the study analyzed the possibility and development of ski adventure tourism and winter tourism in Mera peak, as well as analyzed potential risk factors of the study area. The conceptual framework of the study is summarized in Figure 1.

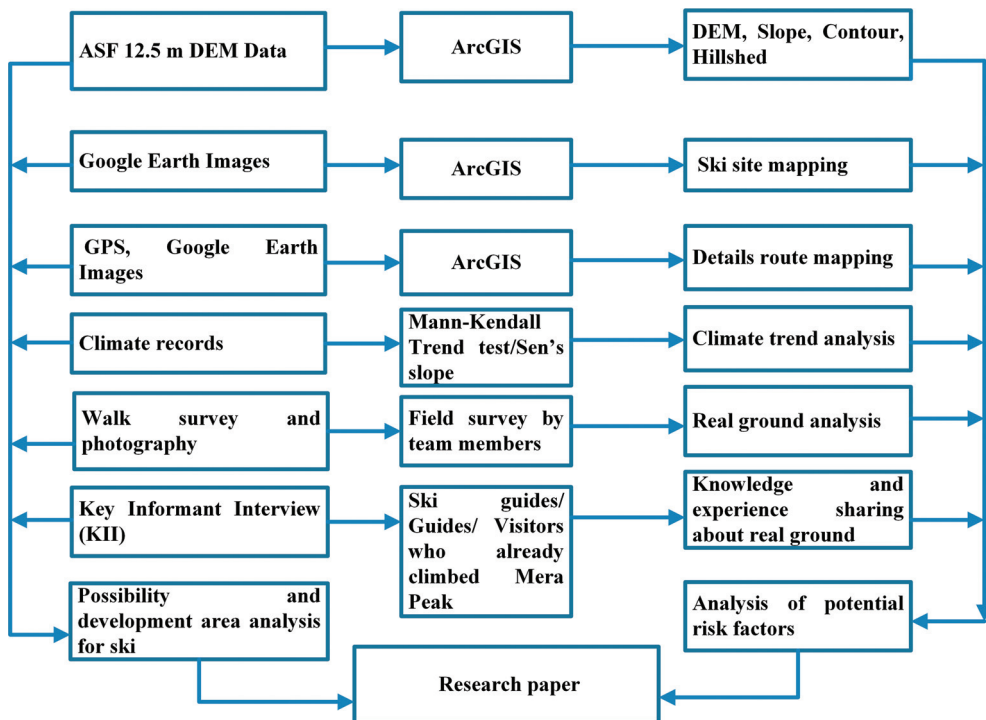


Figure 1: The conceptual and methodological framework of the study

Further, based on this theoretical and conceptual framework, the statement of the problem, research gaps and issues, the study designed various research questions as: 1) Is there a possibility of development of skiing on Mera peak?; 2) Is there support to promote skiing and winter tourism in Nepal?; 3) Is winter tourism important for sustainable tourism development in Nepal?; and 4) What are the risk factors associated with the development of skiing in Nepal? Moreover, based on designed research questions, this study further set-up the major objectives which are able to address and fulfill the research gap of the development of ski activities and winter tourism in Nepal Himalaya. The specific objectives are: 1) find out the possibilities for development of skiing on Mera peak; 2) detail mapping of connecting routes to Mera peak; 3) identify and analyze the potential risk factors for the development of skiing on Mera peak; and 4) identify possibilities and challenges of winter tourism in Nepal.

Study area

The Mera peak region is the study area for this study. It is located in Mahalangure section and Barun sub-section of the Nepal Himalaya at 6470 amsl. (Figure 2). Administratively, Mera peak lies in Solukhumbu district of Province 1 within Makalu Barun National Park. In general, this peak is known as the highest trekking peak, and has three major peaks: Mera North (6476m), Mera Central (6470m), and Mera South (6065m). However, Mera peak in recent years is mainly known as an adventure ski peak in the world. The skiable area extends around the length of 4.5 km and nearly 1 km width. Thus, this peak is one of the best destinations for skiing in the Nepal Himalaya. There are two camps on Mera peak, named “Base Camp” and “High Camp”, which attracts diverse ski visitors on the peak. Therefore, this study selected Mera peak for detailed study of the possibility for development of skiing and winter tourism in Nepal.

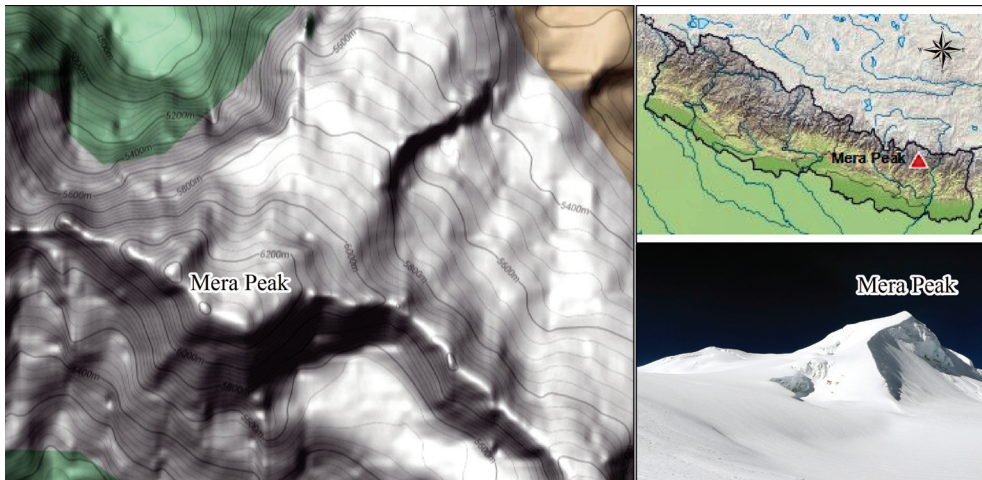


Figure 2: The location of study area: Mera Peak, lower right photo credit Mr. Tshiring Jangbu Sherpa

DEM, slope, contour and hill shade data

This study used the satellite remote sensing-based data for detailed study and mapping for the possible development of ski adventure and winter tourism on Mera peak. The Digital Elevation Model (DEM) data (12.5 m resolution) by Alaska Satellite Facility (ASF) has been used for DEM, slope, hillshade, and contour analysis of the study area. GPS route track and

Google Earth Images have been used for detailed route mapping as well as ski site mapping of the Mera peak region. Similarly, the study also used station-based climatic data for overall climatic trend analysis of this region. Further, based on these various data and KII, the study also analyzed potential risk factors of the study area.

Key Informants Interview (KII)

The study has conducted a total of 27 KII with the mountain professionals/experts, mountain guides, technical persons and visitors who have already climbed and did ski activities on Mera peak. Based on KII, the study sorts out the possibility, development analysis and risk factors of ski and winter tourism in the Mera peak region, as well as their real ground experience for detailed analysis of the study. The KII has been conducted through use of both online Google form fill-up and direct face to face interview. Out of the total respondents, 81.5% are male and 18.5% are female respondents.

Walk survey and photography

In order to become familiar with the study area for real ground and ski activities, three team members of the research have done a field visit to Mera peak. One team member has been to Mera peak over 20 times and was involved in ski activities several times on the peak and other sites in the Nepal Himalaya. The other two-team members have climbed Mera peak once. The field study was mainly conducted in October 2021 and successfully ascended Mera peak on 8 October 2021. Thus, we used a walk survey and detailed photography by three team members of this study to analyze the real ground situation, ski site details, and details of a route from Bung to Mera peak and Pangom.

Data analysis and tools

The study has used ArcGIS 10.8 (ESRI, USA) for overall mapping and analysis of the study. The DEM, slope, hill shade, and contour mapping has been prepared from ArcGIS as well. The detail mapping of the route and ski site were conducted using GPS and Google Earth Images and ArcGIS of the study area. For climatic analysis, the study performed Mann-Kendall trend test (Kendall, 1975; Mann, 1945) and Sen's slope (Sen, 1968) analysis. The climatic data for 27 stations for rainfall Chainpur (East), Bahrabise, Chepuwa, Chaurikhark, Bahunipati, Dovan, Gumthang, Jiri, Charikot, Kabre, Chautara, Lungthung, Khadbari, Nagdaha, Dhap, Pekarnas, Num, Tarkeghyang, Sarmathang, Duwachaur, Thokarpa, Melung, Nawalpur, Salleri, Sangachok, Siruwa, Tumlingtar and nine for temperature Chainpur (East), Jiri, Kabre, Khadbari, Bahrabise, Charikot, Chautara, Salleri, and Sarmathang of the mountain region of north-east Nepal were used being collected by the Department of Hydrology and Meteorology of the Government of Nepal. The data from KII will analysis using Google online form and Microsoft Excel. In addition, the EndNote referencing tool is used for systematic citation and references of the study in APA 7th edition style.

Results and discussion

Possibility and development of skiing on Mera peak

Ski site in Mera peak

One of the objectives of this study is to map a suitable ski site in the Mera peak region. Our study found that a ~4.5 km length from Mera peak to lower area called Mera La has been

perfectly suitable for adventure ski activities (Figures 3, & 4). The width of the ski site on Mera peak is highest in the middle part of the region, and is ~ 0.7 km to 1.23 km in width. The width is ~ 0.1 km to 0.33 km in the upper/higher ski site on the Mera peak region and it is ~ 0.2 km to 0.45 km in the lower part of the ski run.

The upper part of the ski site, which is located nearby Mera peak is suitable for adventure ski for the professional skiers and professional mountain guides. Further, the lower part of the ski site in the Mera peak region, which is situated below the high camp is suitable for beginner skiers because the lower part, which is located just above Mera La, is comparatively less steep than the upper part. The middle part of the ski site is perfect due to wilderness of the topography and snow cover area and the thickness of the snow cover is higher in this part in comparison to the lower and upper part of the ski sites.

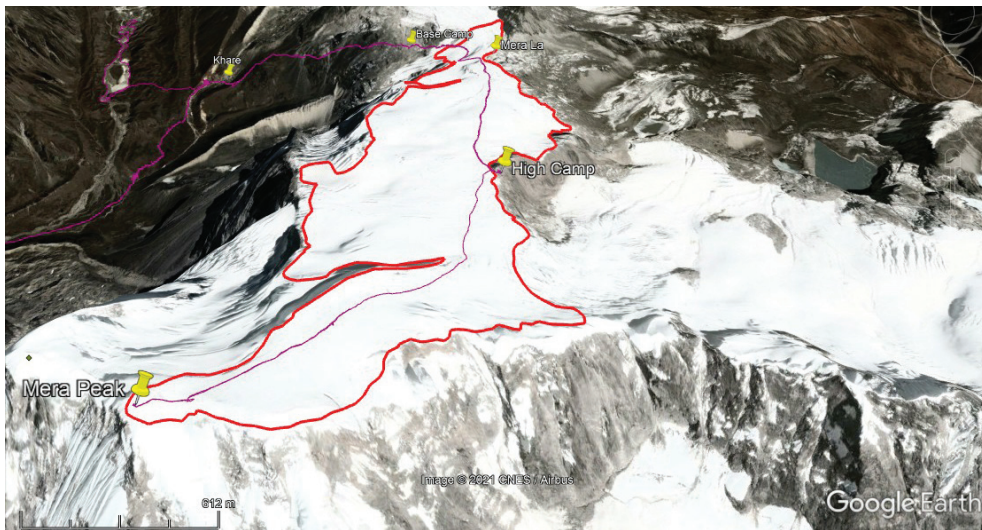


Figure 3: Ski site of the Mera peak region with real ground view and GPS tracked route

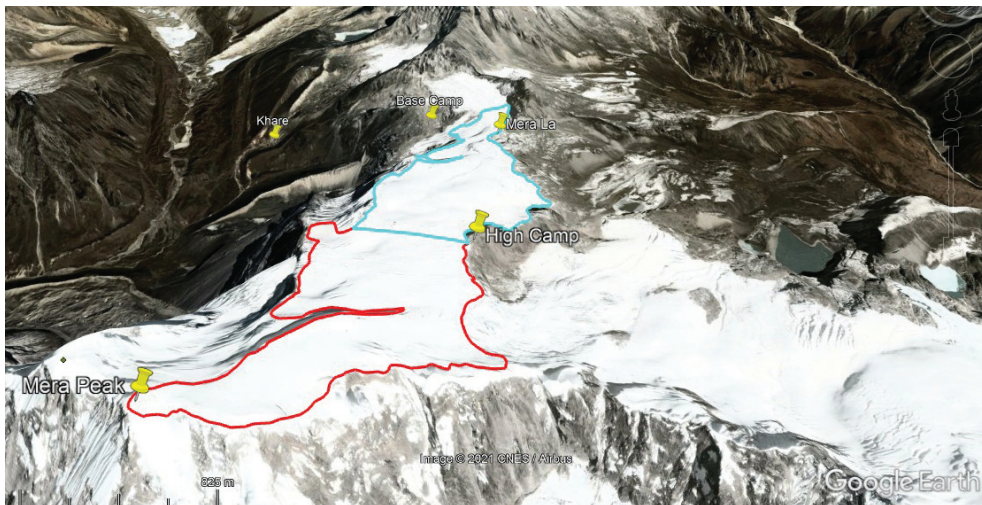


Figure 4: Site for both professional (red) and beginners (blue)

Ski site for beginners

The snow covered part of the lower region below Mera high camp is the most suitable site for the ski beginners (Figure 4). In this section the landscape is more flat and there are fewer crevasses, thus facilitating the learning process of adventure skiing at around 5500 amsl. The length of this beginners' ski site is around 2.2 km and the middle part width of the beginners ski site is 1.1 km, which provides enough land for ski activities with flat landscape. This site can be used for training the amateur skiers because the topography highly supports ski activities.

Ski site for professional skiers in Mera peak

The area above of high camp is suitable for professional skiers because the slope and landscape is steeper compared to the middle and lower part of the Mera peak region (Figure 4). In addition, this area is situated at higher elevation in comparisons to the middle and lower part. The high camp of Mera peak is situated at the 5801 masl. Thus, this may create some level difficulties for the beginner skiers due to higher elevation and altitude sickness. The length of this site is around 2.18 km and the width of the professional ski site is around 0.77 km in the middle area. This site is one of the best destinations for professional skiers and adventure lovers. A site with such altitude also has potential for ski related sports competition.

Best site for skiing in Mera peak region

The landscape of the middle part of Mera peak region is the best destination for ski development because the slopes are comparatively less in this area. The length and width also perfectly supports skiing. The length of the best ski site area is 2.67 km, and the middle part width is around 1.23 km. This part is situated both above and below the high camp. The slope of this region is less than 15 degree, which is best for skiing in the higher Himalaya region. The thickness of the snow coverage is also higher in this part which perfectly supports ski activities at the site.

Screened possibility and development of skiing

The study found that the Mera peak region is suitable for development of skiing and related activities. The ski site situated above high camp region is more suitable for professional skiers and lower part of the ski site situated nearby Mera La region or below part of the high camp is more suitable for the beginner. The study conducted KII with total of 27 climbers and skiers who already climbed Mera peak and some with ski experience in the region. The experience shared by the KII respondents shows that 44.4% of them skied at Mera region and they were involved in ski activities along with their ascent to Mera peak. However, 55.6% respondents climbed Mera peak but they were not involved in any ski activities in the region. On the other hand, among 27 total KII respondents 51.9% of them skied in destinations other than Mera peak in Nepal. The experience shared by the KII respondents shows that, out of 27 respondents, 100 percent (100%) state that the Mera peak region is a perfectly suitable place for developing adventure ski activities. This result shows that, the Mera peak is perfectly suitable place for development of ski activities and it is supported by results found by Remote Sensing based analysis of ski site mapping. In the similar manner, 96.3% KII respondents provided their view that, the Mera region needs sustainable ski development projects and government support for sustainability of ski and winter tourism in Nepal.

In the point of view of KII respondents, there is the possibility for both beginners and professional adventure ski activities in the Mera peak region. Out of the 27 respondents of the KII, 96.3% agreed that the Mera peak region is suitable for beginners and professional adventure activities, and the remaining 3.7% agreed that only professional adventure ski activities are possible in the Mera peak region. Moreover, the 100% respondents agreed that it is possible to develop skiing as the adventure sport for promotion and sustainable development of winter tourism in the Mera peak region. These valuable results indicate that there is high possibility for development of ski and ski-related activities in the Mera peak area and the government of Nepal and concerned bodies of the tourism in Nepal need to focus on enhancement of this region for promoting the ski industry and winter tourism activities. The results show that the middle part of the ski site of the Mera peak region is the most suitable location for skiing due to the high level of thickness of snow cover.

The slope situated in northern part of the Mera peak is the most suitable for ski due to suitable topography, gentle slopes and high level of snow cover thickness. The snow cover level on north-east face is also higher but the topography and slope factors are not as safe for skiing on this face. The south slope and west slope of the region are steeper. Therefore, these two slopes are not suitable for ski activities in the region. Among the 27 KII respondents, 100% of the respondents pointed that the northern slope is suitable for skiing in the Mera region. The rest of the three direction slopes are not suitable for ski activities. The views from the respondents who have already climbed Mera peak are in the line of satellite and GIS based mapping results because the mapping pointed to the northern slope as suitable for ski activities.

Connecting route to Mera peak

Another main objective of the study is mapping the connecting routes to Mera peak from three different locations. In this regard, the research team used a GPS tracking survey for the route mapping from Kathmandu to Mera summit. We have conducted GPS survey in the routes of Bung to Mera peak and Pangom to Mera peak. The third route (Lukla to Mera Peak) was mapped based on ground survey experience and Remote Sensing approaches. We have used GPS, Google Earth and GIS techniques for detailed route mapping. The GPS track-based survey shows the distance of Mera peak from Kathmandu is 270 km (Figure 5).

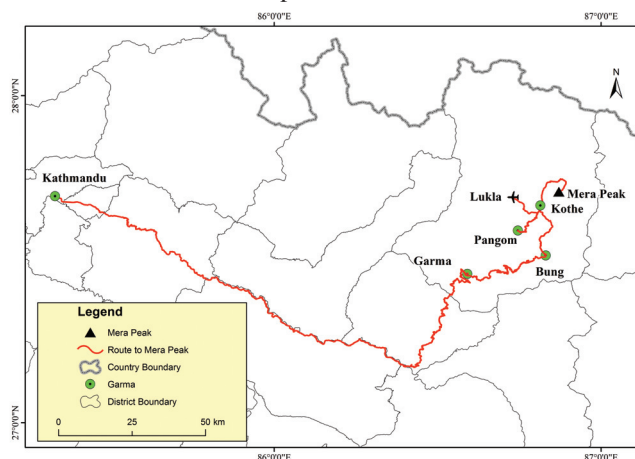


Figure 5: GPS tracked route to Mera peak from Kathmandu

The mapping of the trekking route from Lukla to Mera peak found around 35 km of distance, which is around 13.6 km in aerial distance. Based on mapping results real ground experience by team members of the study and participated KII responses, the trekking journey starts from Lukla and it goes through Chutanga – Kharka Teng – Chhetrala Pass– Thule Kharka – Thasing Dingma – Kothe - Mosam Kharka – Saure Kharka – Gumba – Thangnag – Sabhai Tsho – Khare – Base Camp – Mera La – High Camp – and Mera Summit (Figure 6). In this way, we have mapped the most common route for skier and climber in Mera peak, which will be useful for proper planning for the development of the ski activities in the region. For the route of Lukla to Thasing Digma map based on real ground experience by team members and Google Earth, and after Thasing Digma we used GPS tracked data for mapping. The GPS survey-based mapping results show that another trekking journey to Mera summit starts from Bung. It passes through Khiraule Stupa (Chorten) – Khiraule – Bhirthaplo – Chharakharka – Phokte Danda – Phokte Pokhari – Hurhure Pass – Jharkharka – Ongkila Pass – Panch Pokhari – Khola Kharka – Bagale Deurali – Kothe – Mosam Kharka – Saure Kharka – Gumba – Thangnag – Sabhai Tsho – Khare – Base Camp – Mera La – High Camp – and Mera Summit (Figures 6 & 7). The distance from Bung to Mera peak is 45 km. This route is one of the famous trekking route to the Mera peak. The third route is Pangom to Mera peak. This route starts from Pangom and it passes through Thasing Dingma – Kothe – Mosam Kharka – Saure Kharka – Gumba – Thangnag – Sabhai Tsho – Khare – Base Camp – Mera La – High Camp – and Mera Summit (Figures 6 & 7). The distance from Pangom to Mera peak is 40 km.

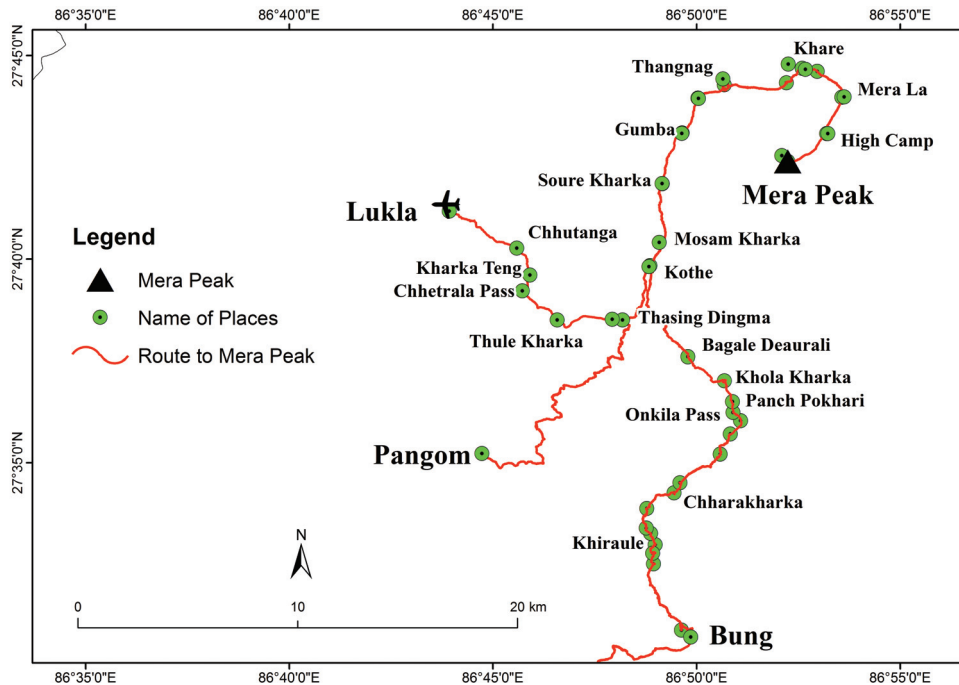


Figure 6: The details route to Mera peak from Lukla, Pangom, and Bung

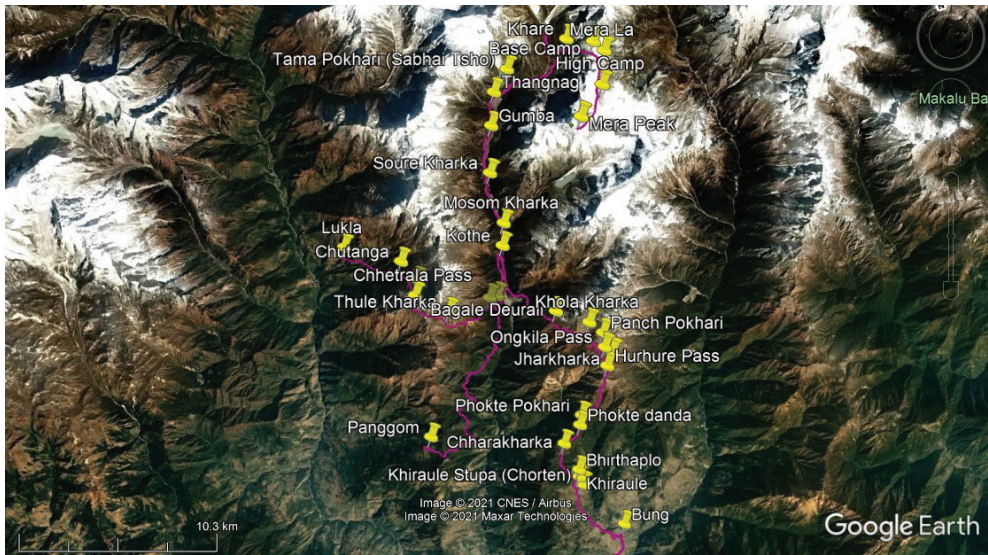


Figure 7: The details route to Mera peak from Lukla, Pangom and Bung

Status of DEM, slope, and hill shade

The altitudinal variation ranges of the DEM map presented in Figure 8 show 3789 meter above sea level (masl) to 6667 masl in the overall Mera region. The Mera Central peak lies in this region at the elevation of 6470 masl. Further, the slope map of the northern slope shows that the slope is perfectly suitable for ski activities in northern slope of the region. The slope map indicates that most of the area of the northern slope has a slope within 15 degree (Figure 8). In addition, the highest hill-shade value of the region is noted to be until 254 (Figure 9).

The contour maps (Figure 9) show the steepness/flatness of the Mera peak region with different contour value. In the Figure 9, we can observe in 20 m interval contour status that the northern slope is more flat than other slopes of the Mera peak region. Therefore, only the northern slope is suitable for skiing in the Mera peak region. The research team found that the southern, western and eastern slopes are not suitable for skiing due to higher steepness.

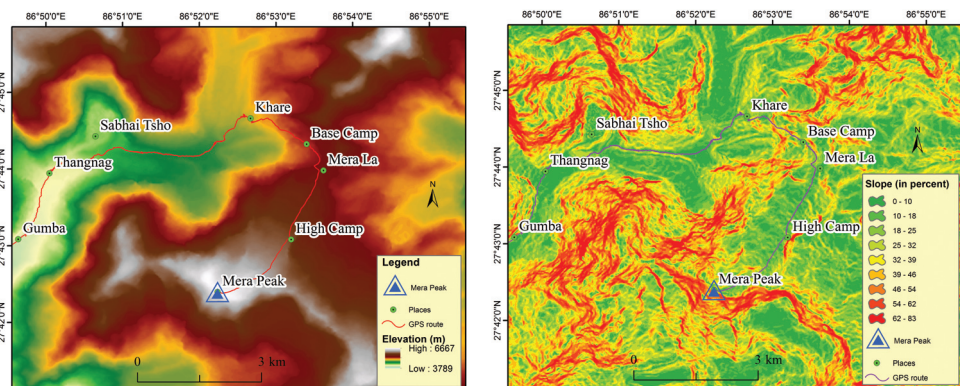


Figure 8: DEM (left) and slope (right) maps of Mera peak region

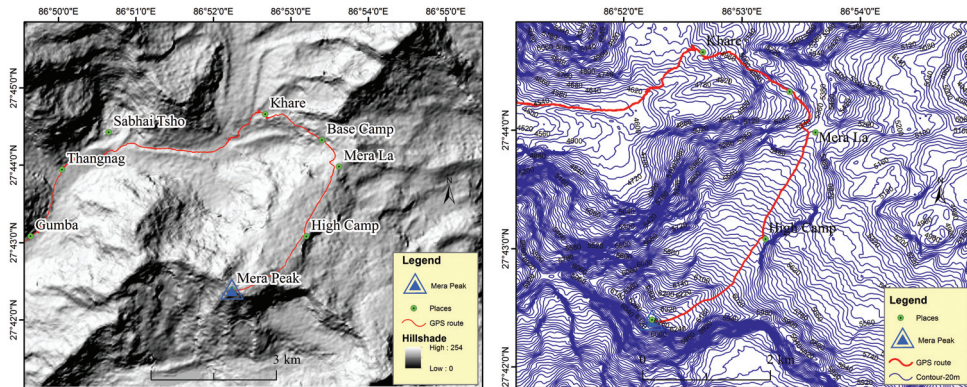


Figure 9: Hill-shade (left) and contour (right) maps of Mera peak region

Potential risk factors for the development of skiing

The other main objective of the study is to identify potential risk factors for the development of ski adventure tourism in Nepal especially in the Mera peak region. The KII survey, remote sensing techniques, and real ground observations show that there are some risk factors existing in the region for the development of ski tourism in the Mera peak region and Nepal Himalaya. Some identified risk factors are indicated herein.

Climate change

The studies report that there are climatic impacts in ski industries in different locations of the world (Gilaberte-Búrdalo et al., 2014; König, 1998; Scott et al., 2020). The station-based climatic data show that trends of the mean annual temperature increased noticeably at a rate of $0.084^{\circ}\text{C}/\text{a}$ between 1980 and 2018 in the mountain region of north-east Nepal (Paudel et al., 2021) (Figure 10). At the same period, the total annual precipitation is found to be decreasing at the rate of $-10.424 \text{ mm}/\text{a}$ (Figure 11). These results indicate that the climate change has impacted some level of risk in the ski industry due to higher temperatures and lower precipitation.

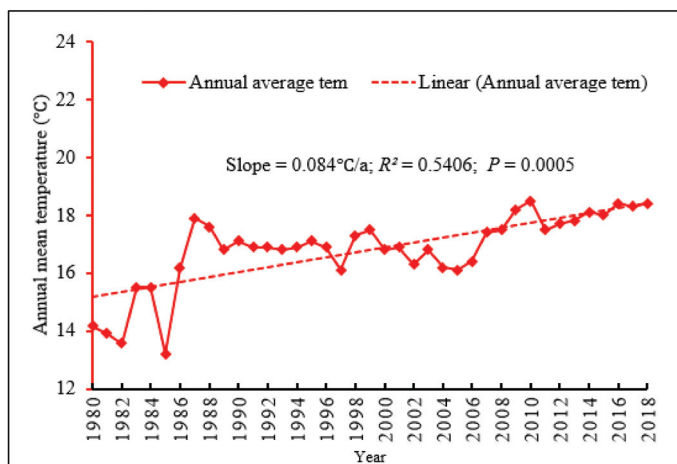


Figure 10: Temperature trend in the north-eastern mountain region of Nepal between 1980 and 2018

We have asked the questions regarding the risk factors to the respondents in KII as “Has climate change added risk factors for sustainable winter tourism and ski industry in Nepal?”, and out of 27 respondents, 96.3% answered “Yes”. It means almost all of the climbers and skiers think that the climate change adds a risk factor for ski development in the Mera peak region.

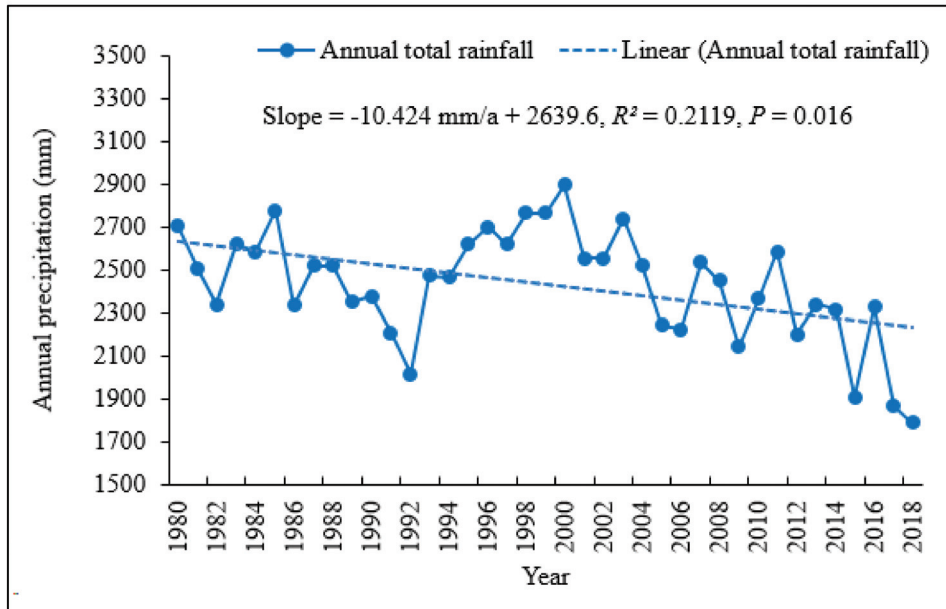


Figure 11: Rainfall trend in the north-eastern mountain region of Nepal between 1980 and 2018

Crevasse

In the alpine region, there is always a chance for injury during skiing. However there are some preventive techniques as well (Harris, 2003; Koehle et al., 2002). In real field observation, some small crevasses were noticed in the Mera peak region. During KII survey as well, many respondents remarked that the crevasses are one of the risk factors for skiing and changing climate may lead to the formation of more crevasses, especially in the summer season. Thus, crevasses are the noted risk factors. We also observed some crevasses during our field visit to Mera peak on 8 October 2021.

Altitude sickness

Mera peak is known as the highest trekking peak in the Nepal Himalaya. The elevation of Mera Central is 6470 masl. We recorded that the snow line of the Mera peak region started from 5195 masl in October 2021. The suitable snow and slope is above 5300 masl. The Mera La region, a proposed site for beginner skiers, is situated around 5400 masl. The High camp is located at 5801 masl. Thus, the aforementioned elevation profile shows that the Mera peak region itself is located in the Alpine region, which could make some difficulties for visitors. However, most of the people who climbed Mera peak did not use supportive oxygen. Therefore, altitude sickness is one of the probable risk factors for skiing in the Mera peak region.

Uncertain weather and white out

The weather conditions in the Mera peak region adds other risk factors for development of skiing. The weather conditions change unpredictably in this region. The weather is clearer in the morning time but it typically changes in the afternoon and evening time. During our field visit, we observed white out conditions more commonly happening in the afternoon. This weather also adds a risk factor for ski activities. Further, we observed while hiking with crampons at the high camp area that the blue ice adds risk factors for ski activities in the Mera peak region.

Possibilities and challenges of winter tourism

Identifying possibilities and challenges is one of the main objectives of this research and the study found some interesting facts in this regard. Out of the total 27 KII respondents, 100 percent agreed that, it is important to promote and develop winter tourism and activities in Nepal Himalaya. 88.9% KII respondents acknowledged that there are many other potential destinations in Nepal Himalaya for the development of skiing, which can directly promote winter tourism of the Nepal Himalaya. According to the KII respondents, the other potential destination are: Putha Himchuli, Upper Mustang (Bhrikuti peak), Larpak-Gorkha, Langtang region, Kuri (Kalinchowk, Dolakha), Manaslu, Khaptad, Larke La, Tsum Valley, Humla, Annapurna Base Camp, Khumbu, Sailung, Himglung, Dhorpatan, Borunche, Komala Region (Makalu), and Pike peak.

The possibilities of skiing in the Nepal Himalaya seem to be in many locations from east to west, which indicates that Nepal could be one of the important destinations for winter tourism as well. In this regard, we have asked with KII respondents “In your opinion, is skiing the backbone to promote winter tourism in Nepal?”. 92.6% of responses were “Yes”. This indicates that there is a higher possibility to develop ski activities in the Nepal Himalaya to promote and run winter tourism in the country. In this regard, 66.7% respondents of the KII strongly agreed that the winter tourism is important for sustainable tourism development in Nepal Himalaya. The rest of the 33.3% agreed and none of them indicated neutral, disagree and strongly disagree. These results signify that, the promotion of winter tourism is very necessary for all round development of tourism activities in Nepal Himalaya.

The respondents indicated that the best time for ski in Mera peak is autumn season (September-November) by 48.1%, Spring seasons (March-May) by 29.6%, Winter season (December-February) by 18.5%, and 3.7% for Summer season (June-August). This result denotes that the tourism in Nepal Himalaya can be actively run all over the year in any seasons. The proportion of the tourist flow in Nepal is less in the winter season. Hence, we need to promote winter tourism and develop infrastructure and winter tourism activities all over the country.

There is a high possibility for adventure skiing and winter tourism in the Mera peak region. However, there are also some challenges for sustainable ski and winter tourism in the Nepal Himalaya and the Mera peak region as well. Some noticeable challenges are: lack of ski and winter tourism policies and regulations; lack of proper management and promotion of suitable winter destinations for winter tourism and activities; lack of communication facilities in the potential destination areas of winter tourism; lack of ski resorts and huts, lack of technological adoption to promote winter tourism in Nepal; lack of skilled human resources; and lack of a proper plan for safety, security and rescue systems for winter tourism.

Policy recommendation

The finding of this study has explored the possibility of ski and winter tourism in the Nepal Himalaya and the feasibility and necessity to promote sustainable tourism activities in all the seasons. The winter tourism of Nepal is still in shadow. Therefore, it is necessary to promote the winter adventure tourism and in this context skiing is the backbone of the winter tourism development. There are many such destinations to promote winter tourism. Ice skating is another activity which can help to run winter tourism in Nepal.

For proper development of skiing and winter tourism in the Nepal Himalaya as well as in the Mera peak region, the Government of Nepal needs to take some initiation in the favor of tourism and the promotion of winter tourism in the global arena. Based on the finding of this study, some important recommendations have been made which will be fruitful while preparing the winter tourism policies and ski regulations.

The technological adoptions are necessary and there are basic requirements needed to promote ski tourism in the Nepal Himalaya as well as in the Mera peak region. In this context, the government needs to support suitable technology, development and installation in the appropriate destinations. For example, in the Mera peak region, it is highly recommended to use ski cable cars, ski lifts and related technologies. Such technological adoptions highly facilitate the attraction of domestic as well as foreign tourists and create a high level of job opportunities and revenue for the nation. To achieve this result, the Government of Nepal needs to facilitate and develop appropriate policies and regulations to sustain such winter tourism activities and destinations. The Mera peak region located within the Makalu Barun National Park, thus strongly needs the specific policy for ski and winter tourism. This needs to be formulated from the government side. At the same time, stakeholders need to be aware of the essence of conservation of flora, fauna and environmental parameters. Then, it is possible to run winter and ski activities without harming the environment and causing environmental degradation.

In the favor of winter and ski tourism, it is necessary to develop ski resorts and huts in the appropriate locations after in-depth study of geological and environmental impact assessment. Such ski resorts and huts would highly facilitate the running of winter and ski activities in the Mera peak region as well as other potential destinations in the Nepal Himalaya. We suggest that the Government of Nepal should initiate the development of such winter accommodation facilities in the potential areas. We can learn lessons in this regard from the European Alps. In the initial period, it was mainly summer based tourism only later it dramatically changed summer tourism by adding winter tourism and skiing. This change was all possible due to the adoption of technological advancement and construction of required accommodation and infrastructure facilities.

Another recommendation on this behalf is the development of snow sport adventure tourism in Mera peak. This is the best way to promote snow tourism in Nepal by introducing a new and untapped adventure tourist activity and market segment, which will lead to the development of the economy and industry as a whole. Skiing and snowboarding has to be developed as an adventure sport from the ground level, not only as a recreational tourism activity to unleash its true potential. The slopes of Mera peak are feasible and can be considered easy for skiers and snowboarders around the world. We need proper-trained guides who can also access rescue and leadership needed during the trip. As it is an adventure sports, safety is always first so we need to strengthen the qualities and skills of guides so that

clients can share Mera skiing, adventurous and its quality. Mera peak is one of the best visiting areas where many international and domestic tourist come to enjoy natural beauty, and snowcapped mountains. Thus, ski development in Mera peak is highly suitable and feasible due to the geographical structure and good viewpoint. Nonetheless, strong supports from the government is necessary to promote and develop this destination. Therefore, Mera peak, a good viewpoint of more than five 8000+ mountains, needs to be promoted and developed as a winter tourism activity destination for ski tourism in the Nepal Himalaya.

Conclusion

There is lack of scientific research with reference to the possibility for the development of ski adventure tourism and winter tourism in the Nepal Himalaya and the Mera peak region. Thus, this study has carried out scientific research on this topic, which is a totally novel concept in this sector. Therefore, the present study provides important data relating to the development potential for ski adventure and winter tourism. The study will largely help to explore and promote ski adventure tourism as well as winter tourism in Nepal. In this way, this novel study and approach assists in the promotion of sustainable tourism in the Nepal Himalaya and it will be a primary research document in this research field in Nepal. This study is conducted mainly based on the Remote Sensing approaches and KII of the climber/skiers who have already ascended Mera peak and some involved in skiing at the study area. The study also used real ground experience from a field survey and ski activities in the Mera peak region. The study has carried out detailed route mapping of the area from Lukla, Pangom and Bung to Mera peak trekking and also mapped the ski site of the Mera peak region and identified the potential area for skiing for beginners and professional skiers. In an additional note, the study recorded some risk factors for the development of the ski industry in the region, such as climate change, uncertain weather conditions, crevasses, altitude sickness and white out conditions. The research concluded that the Mera peak region is one of the best destinations for ski activities of the Nepal Himalaya, which can largely help in the promotion of winter tourism in Nepal. Nepal also has other potential destinations for the development of skiing and winter tourism such as Kuri (Kalinchowk), Putha Himchuli, Sailung and so on. We believe that this research work will be a national priority because it deals with promoting adventure and winter tourism in the Nepal Himalaya. It will significantly help in the promotion of ski and winter tourism in Nepal. In parallel, the research study is one of the first academic research documents focused on the ski and winter tourism potential in Nepal.

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