GIS BASED SITE SUITABILITY ANALYSIS FOR THE IDENTIFICATION OF POTENTIAL SKIING RESORTS IN GILGIT BALTISTAN, PAKISTAN

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ABSTRACT: Tourism is of different types but the most famous type among tourists is adventure tourism. Skiing, a type of adventure tourism, is one of the most famous winter sports and a recreational activity among tourists. Although many northern areas of Pakistan have a great potential to promote ski adventure activities but in Pakistan skiing is not a well-known recreational activity. Gilgit Baltistan (GB) is a mountainous region of Pakistan that is famous for tourism because of its beautiful and natural scenic views. Realizing the potential to promote ski adventure tourism, this study was designed to identify the suitable sites for the development of potential skiing resorts in GB using GIS. For this purpose, three main parameters including temperature (average annual number of snow days, average annual number of months for ski season, average annual maximum air temperature days during ski season, average annual mean daily min-max. temperature), slope and elevation were analyzed. The results showed that 82% land of GB is not good for skiing which means that development of suitable sites for skiing resorts is only possible on the identified 18% area of GB. This suitable area was extracted and further classified into Vacational Ski resorts, Learning ski areas and ski areas for experienced skiers. The results showed that 18% area can be used for the construction of ski resorts for vacational purposes, 41% area can be can be utilized by tourists for learning purposes and 39% area can be used by those skiers who are expert in skiing. This study can be helpful for the relevant departments of the Government of Gilgit Baltistan to develop the potential ski sites. It was concluded that Gilgit Baltistan has a great potential for the development of different types of ski resorts that may generate substantial revenue by promoting ski adventure tourism.

Keywords: *Tourism, Skiing, GIS, Vacational Ski resorts, Gilgit Baltistan.*

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INTRODUCTION

As outdoor recreation is increasingly commercialized, adventure tourism is becoming one of the fastest growing sectors in the tourism industry (World Tourism Organization, 2014). It is widely accepted as a representative practice of eco-tourism. The widely distributed mountain environment provides unique resources for adventure tourism (Wang and Yang, 2021). Mountain based adventure tourism includes many activities like rock climbing, skiing, hiking and mountain biking. Skiing is the use of skis to glide on snow. The purpose of skiing may include a basic transportation, a recreational activity or a competitive winter sport. Many types of competitive skiing events are recognized by the International Olympic Committee (IOC) and the International Ski and Snowboard Federation (FIS). Globally, skiing is known as the backbone in the promotion of winter tourism (Abegg *et al.,* 2020; Fischer *et al.,* 2011). This sport attracts a large number of visitors and improves the income and employment status in the tourism sector (Steiger *et al.,* 2019). The European Alps are the most popular destination in the world for skiing and other snow related sports (Braghin *et al.,* 2016; Elsasser and Bürki, 2002). Ski tourism is also famous in the Caucasus range (Pestereva *et al.,* 2012) and certain destinations in the Andes Mountain range of South America (Kaenzig *et al.*, 2016). It has been reported that about 80% of the income is generated by tourism related activities in Switzerland and Austria (Pestereva *et al.,* 2012). However, in most of the Asian countries, the ski industry is not that developed as compared to Europe and the Americas (Deng *et al.*, 2019; Paudel, 2022).

Pakistan is situated in South Asia and covers a total area of 803,940 km^2 (Shedayi *et al.*, 2022). Owing to unique topography and climate, the northern areas of Pakistan are one of the dream destinations of many tourists around the world. Not only for observing diverse cultural and biophysical conditions but also for adventure activities like mountaineering and trekking. Gilgit-Baltistan is located in the North Eastern part of Pakistan (Shah *et al.*, 2023). It is a breathtaking, spectacular region due to its diverse natural scenic beauty, unique landscapes, snowcapped mountains, glittering glaciers, sparkling streams of unpolluted water, cold deserts, rich flora and fauna (snow leopard, Ibex, birds), linguistic diversity, rich cultural heritage, art and crafts. These characteristics are a primary source of attraction and indicate ecotourism potential in Gilgit-Baltistan (Israr *et al.,* 2009). Furthermore, Gilgit Baltistan is strategically positioned at the entrance of China Pakistan Economic Corridor in Pakistan (Nazneen *et al.,* 2022). There are many potential destinations for the development of skiing resorts and to promote winter tourism in GB (Sherpa, 2021). For vacation destinations, tourists prefer those areas that are snowy with the best accommodation and recreational facilities (Gabdrakhmanov and Hosseine, 2019). Skiing must be promoted in GB because not only is it one of the most famous winter sports, but it may also bring economic growth to the region in terms of improvements in the services sector and infrastructure.

The climatic conditions of any area are mainly based on its air temperature. Although temperature, precipitation, humidity and other climatic conditions all have a substantial impact on snowfall patterns (Matzarakis *et al.,* 2012) but Skiing is possible only in those areas where the temperature remains at or below 0^oC (Kapetanakis *et al.,* 2022). Furthermore, temperature variations control the rate at which snow melts (Zhong *et al.,* 2018). A recent study on the spatial and temporal assessment of China's skiing climate resources considered all parameters including temperature, humidity and precipitation to study the impacts of climatic changes on skiing resorts (Yu *et al.,* 2023). Deng *et al.* (2019), also used temperature parameter to identify suitable skiing sites in China. They analyzed daily mean air temperature and daily maximum temperature of the study area. Another study also considered mean daily min. temperature parameter to identify potential ski season or towns in the Rocky Mountains of the United States of America (Silberman *et al.,* 2010). Gabdrakhmanov and Hosseini (2019), considered different parameters including temperature for the site selection and construction of skiing resorts in Isfahan Province, Iran. To our knowledge, no study has yet been done so far in which a temperature parameter has been studied to identify suitable sites for skiing resorts in detail. Keeping in view the persistently low temperatures and the unexplored beautiful locations of GB, this study was designed to provide a baseline related to the development and promotion of ski adventure tourism in GB. The main objectives of this study were to (a) identify the potential sites for the development of skiing resorts in Gilgit Baltistan using GIS and (b) classify the identified potential sites into vacational, experiential and learning skiing.

MATERIALS AND METHODS

Study area: Gilgit Baltistan has longitudinal boundaries ranging from 34° to 37° N and latitudinal extents ranging from 72° to 76° E. It has more than 1.4 million population, accounting for less than 1% of Pakistan's population (Pakistan Bureau of Statistics, 2017). Gilgit Baltistan is situated in the Hindu Kush Himalayan (HKH) region of Karakorum, which is recognized as Pakistan's main supply of fresh water and covers a 72,496 km^2 area (Khan, 2017). The elevations here range from 428 to 8508 meters, with an average elevation of 3702.19 meters above mean sea level (a.m.s.l.). Gilgit Baltistan is administratively divided into three divisions (Diamer, Gilgit and Baltistan). On average, there are 196 days of precipitation per annum. According to the statistical analysis from 1991-2021, the mean temperature of Gilgit Baltistan in January was -19.3 °C, whereas, this value reached 11.1°C in July. This region has over 1100 glaciers (Hasson *et al*., 2017). There are a number of spectacular scenic spots in GB that attract visitors from all over the world and have the capacity to provide amazing adventurous recreational activities. The weather stations and district boundary of GB are shown in map (Fig. 1).

Data acquisition: Each research provides an appropriate framework of concepts and theories together with suitable techniques (Paudel *et al.,* 2022). This study analyzed different parameters for the site suitability analysis of potential skiing resorts in Gilgit Baltistan (An *et al.,* 2019). A 30m DEM was downloaded from the USGS website and the slope was computed. Minimum and maximum air temperature data were acquired from the Pakistan Meteorological Department (PMD), the Glacial Monitoring Research Center (GMRC) and the Surface Water Hydrology (SWH) and the data was converted into shapefiles for further processing in ArcGIS software. The data sources for different parameters are provided in Table 1 and the detailed methodological flowcharts of the study can be seen in Fig. 2.

Table 1: Sources of the data of all parameters

Data	Sources
Elevation and terrain slope	SRTM 30m DEM from USGS
Minimum and Maximum air temperature	PMD, GMRC and SWH
Detailed route mapping	Digitization

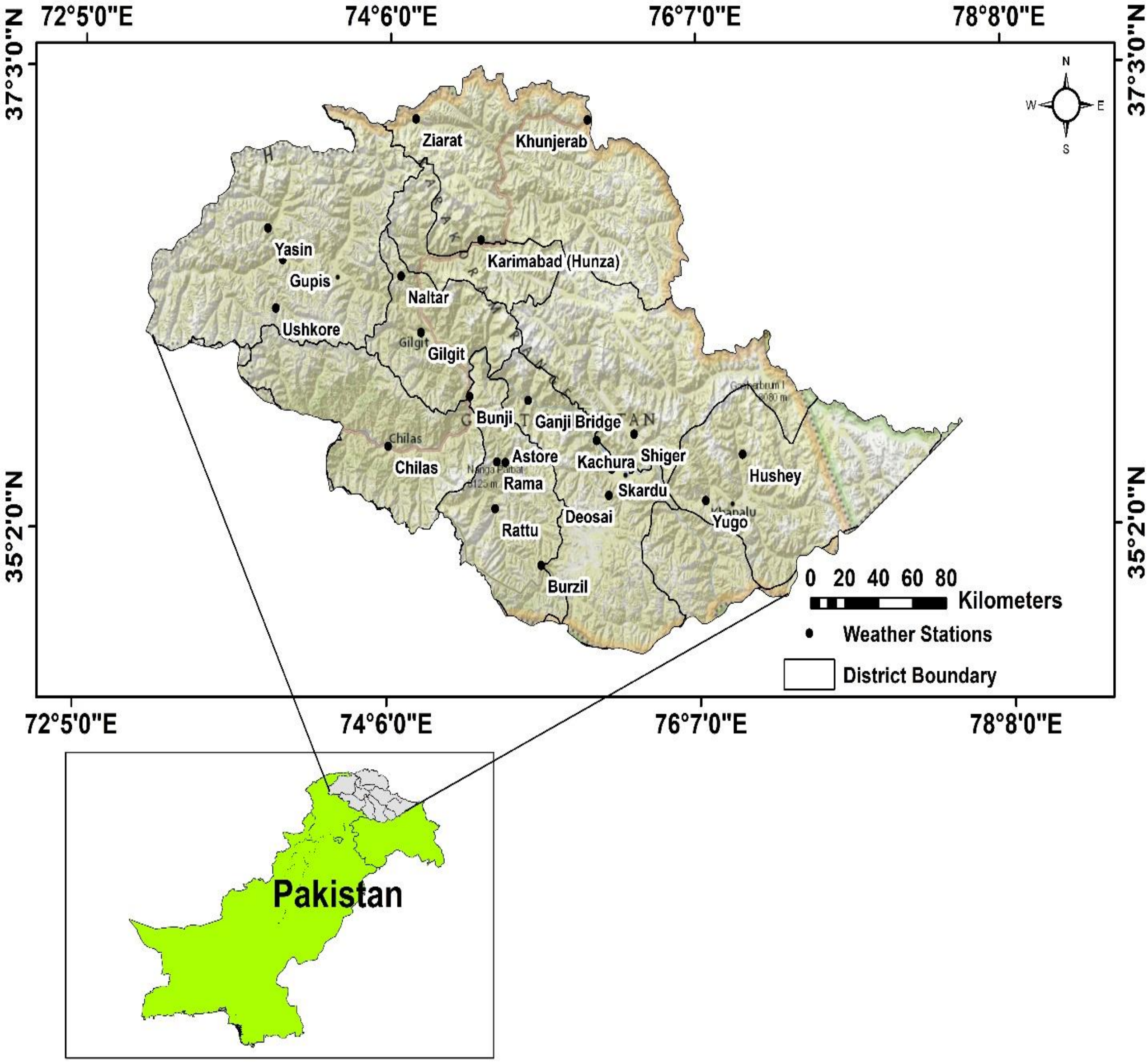

Fig 1 Map showing the weather stations and district boundary of GB.

Data analysis:

Identification of suitable areas for skiing

Temperature: The climatic conditions of any area are mainly based on its air temperature. Skiing is possible only in those areas where the temperature remains at or below 0^oC (32^oF). Thus, this study analyzed the temperature of Gilgit Baltistan in detail and classified the temperature parameter into four categories (Table 2).

Average Annual Snow Days (at or below 0^oC): The days when temperature remains at or below 0^oC are expected to have snowfall so they are considered snow days of the year. The daily mean air temperature data for 20 years (2001-2020) was used to find out the number of snow days for each district of GB (Table 2). The spatial interpolation was performed to create the map of average annual snow days. The map was then converted into a raster and it was reclassified into five classes. The areas with the maximum number of snow days were given highest rank and the areas with the minimum number of snow days were given the lowest rank in the analysis (Table 3).

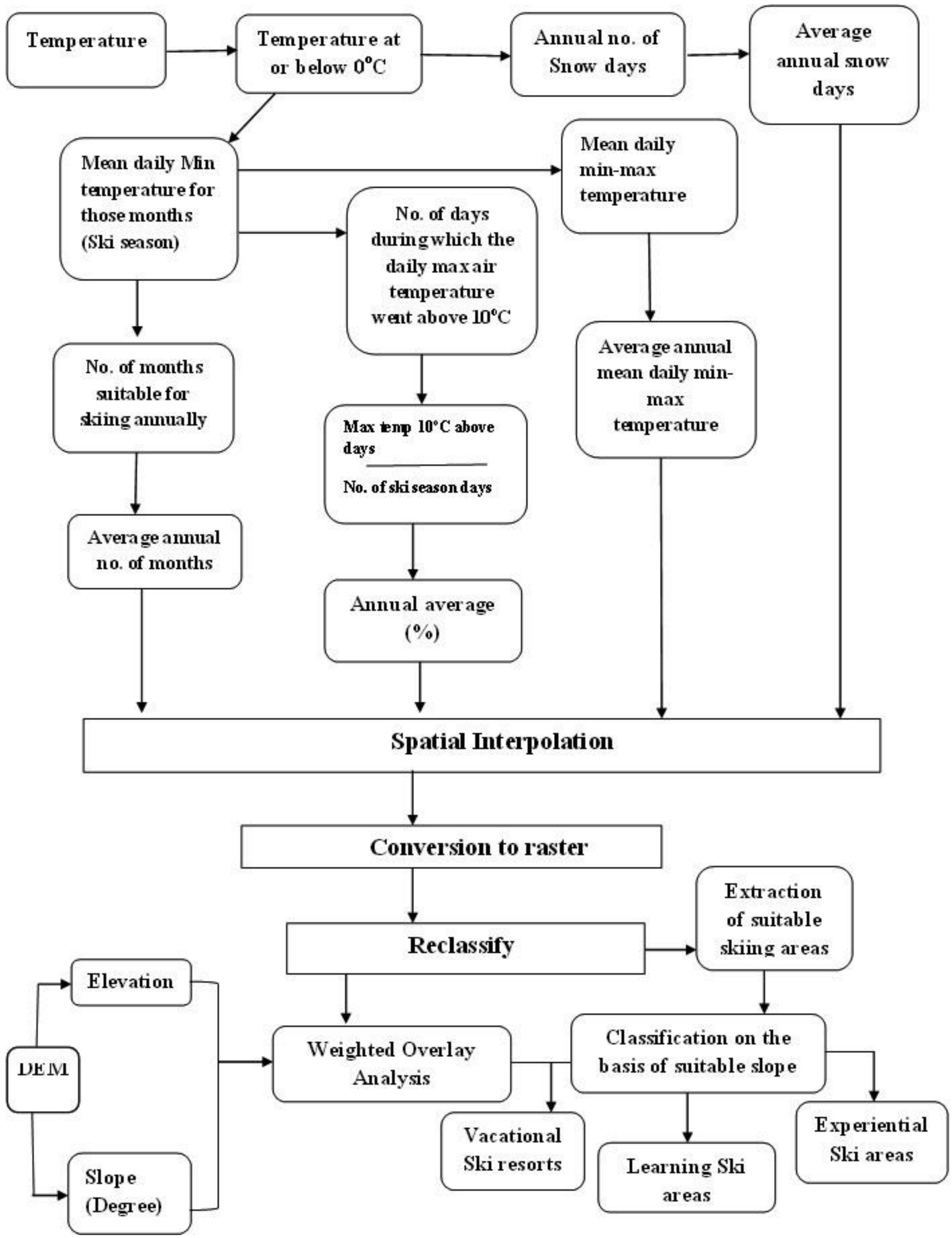

Fig 1 Methodological flow chart designed for the identification of suitable sites for skiing in GB.

Table 2: Average annual (number of snow days, number of months, percentage of maximum temperature days and mean daily min-max temperature) of each district in Gilgit Baltistan.

Sr. No.	Districts	Average annual Snow Days	Average annual number of months	Average annual percentage of maximum temperature days	Average annual mean daily min-max temperature
1	Astore	120	4	0	1.5
2	Bunji	32	1	1.1	6.7
3	Burzil	240	8	0.5	-7
4	Chilas	21	1	0	7.9
5	Deosai	174	8	0.5	-9.2
6	Ganji Bridge	27	1	26.7	5.2
7	Gilgit	23	0	39.8	6.8
8	Gupis	100	4	0.3	3.1
9	Hushay	127	5	3.7	-0.6
10	Kachura	91	3	32.2	2.9
11	Karimabad (Hunza)	81	3	0	3.4
12	Khunjrab	273	10	1.03	-8.2
13	Naltar	138	5	2.8	-1.7
14	Rama	164	5	12.3	-1.2
15	Rattu	148	5	15.7	0.6
16	Shigar	70	3	12.8	2.1
17	Skardu	120	4	0.2	3.3
18	Ushkore	156	5	7.1	-1.6
19	Yasin	153	5	4.3	-2.3
20	Yogo	95	3	33.1	3.3
21	Ziarat	193	7	5.8	-3

Table 3: Reclassified average annual snow days

Number of Days	Scale values
<=80	1
>80-100	3
>100-150	7
>150-200	8
>200	9

Average Annual Number of Suitable Months (Ski Season): This parameter identifies the number of months in a year that are suitable for skiing, known as the ski season. The length of the potential ski season was calculated by taking the mean daily minimum temperature of each month at or below 0^oC by using available air temperature data of 20 years (2001-2020). The average annual number of suitable months for each district of GB was calculated (Table 2) to apply spatial interpolation. The interpolated raster was reclassified and the regions with the maximum number of suitable months were given the highest value, while the (and) regions with the minimum number of suitable months were given the lowest value in the analysis (Table 4).

Average Annual Maximum Air Temperature days in Ski Season: After determining the ski season, this parameter involves identifying those days of the ski season when the temperature went above 10^oC for 90 non-continuous days in a year (Scott *et al.*, 2003). For this purpose, the daily maximum air temperature of ski season in a year was analyzed to find out number of days when the temperature went above 10^oC. These days (number of days) were then divided by the number of ski season days to calculate the percentage of maximum temperature days. The annual average percentage of daily maximum temperature in each district of GB was calculated (Table 2), and its spatial interpolation was reclassified to provide a higher percentage for the lower ranks and a lower percentage for the higher ranks (Table 5).

Table 4: Reclassified average annual number of months

Reclassification	Scale values
<2	1
2 - <4	3
4 - <6	6
6 - <8	8
>8	9

Average Annual Mean Daily Min-Max temperature: The mean daily min-max temperature of ski seasons was computed to analyze those areas that (which) have overall below freezing point temperature ranges. The average annual mean daily min-max temperature of each district of GB was computed (Table 2), and spatial interpolation was performed for the average annual mean daily min-max temperature. The spatially interpolated raster was reclassified to provide maximum mean temperature areas with lower values and minimum mean temperature areas with higher values (Table 6).

Table 5: Reclassified average annual percentage of maximum Temperature days

Reclassification	Scale values
<=6%	9
>6%-9%	8
>9-%12%	7
>12%-15%	6
>15%	4

Table 6: Reclassified average annual mean daily min-max. Temperature

Reclassification	Scale values
<= -3	9
>-3- -1	8
>1-0	7
>0-3	3
>3	2

Slope: To identify suitable sites for skiing, it is essential to consider their topographic conditions. Skiing requires a certain topographic slope (Dezsi *et al.,* 2015). In 2014, the China National Tourism Administration announced that the most suitable slope for skiing ranges from 10^o to 30^o but 6^o to 40^o slope can also be considered for skiing. The areas with more than 40^o slopes are unsuitable for skiing. The study area slope calculated from USGS DEM was reclassified into five classes, in which $<6^o$ and $>40^o$ slopes that were unsuitable were assigned restricted areas, and the remaining classes were given the same scale value as shown in (Table 7).

Table 7: Reclassified slope values

Reclassification	Scale values
$<6^o$	Restricted
$>6^o$-10^o	9
11^o-30^o	9
31^o-40^o	9
$>40^o$	Restricted

Elevation: Elevation is another important topographic condition for identifying suitable locations for skiing. Those regions where the elevation is > 4000m are not suitable for skiing due to a lack of oxygen (Deng *et al.*, 2019). The digital elevation model GB was reclassified into 2 classes, in which > 4000m elevation areas were assigned restricted and the remaining areas were given the highest scale value as shown in (Table 8). All these parameters were incorporated into a particular technique to model site suitability, i.e., weighted overlay analysis (Hassan *et al.,* 2020). In this method, each reclassified raster was assigned a specific percentage influence on the basis of its expected impact on suitable location identification (Table 9).

Table 8: Reclassified elevation ranges values

Reclassification	Scale values
<= 4000m	9
>4000m	Restricted

Table 9: Percentage influence assigned to each parameter.

Parameters	Influence (%)
Number of snow days	20
Mean daily minimum temperature	20
Daily maximum air temperature	20
Mean daily min-max temperature	20
Slope	15
Elevation	05

Table 10: Slope ranges for each suitable site classification

Suitable sites classification	Required Slopes
Va-ski resorts	6^o - 15^o
Le-ski areas	15^o – 30^o
Ex-ski areas	30^o – 40^o

Classification of identified suitable sites for skiing: After the identification of suitable sites for skiing in GB, the highly suitable and moderately suitable sites were extracted from suitable sites and were classified into three ski resort types: a) vacationing (Va- ski resorts), b) learning (Le-ski areas) and c) experienced skiers (Ex-ski areas). This classification was done on the basis of slope and elevation. Different types of skiing resorts require different types of slopes (Table 10), but elevation remains at or below 4000 m.

RESULTS AND DISCUSSIONS

Average Annual Snow Days of GB: The map showing the average annual number of snow days in GB is shown in (Fig. 3a). Except in Gilgit, Bunji, Chilas, Ganji Bridge, Kachura, Shigar, Yogo and Karimabad (Hunza), the average annual number of snow days exceed 100 days. Khunjrab and Burzil have the highest average annual snow days (>200 days). Areas with the maximum number of snow days are good for skiing; otherwise, skiers may cancel trips if the snow condition is poor (Scott *et al.*, 2003; Steiger and Abegg, 2018). Tervo (2008) evaluated the number of snow days required to ski in a certain area. He came up with the most important parameter of snow reliability, i.e., the 100-day rule, which states that the areas where the number of snow days remain above 100 days per season are best for skiing. He also concluded that 90-120 skiable days are sufficient to generate revenue. This study showed that 77% area of GB have >100 snow days, 11% area have 80-100 snow days and the remaining 12% area have <80 snow days annually. It shows that the maximum area of GB fulfills the demand of the 100-day rule for skiing.

Average Annual Number of Months (Ski Season) of GB: The map (Fig. 3b) showing the average annual number of months for the identification of ski season in GB revealed the (a) longest ski season (> 8 average annual number of months) in Khunjrab. Khunjrab is located at a very high altitude and the temperature there remains below freezing point for most of the year, resulting in a permanent snow cover. Deosai, Burzil and Ziarat had 6-8 average annual number of months for ski season, Naltar, Ushkore, Gupis, Yasin, Rama, Astore, Rattu, Skardu and Hushay had 4-6, whereas, Gilgit, Chilas, Bunji and Ganji Bridge had the least ski season (< 2 average annual number of months). It shows that various areas of GB have different suitable months in a year for skiing. In 2010, Silberman *et al.* carried out a study for the Rocky Mountains of the United States of America and considered this mean daily minimum temperature parameter to identify a potential ski season there and found the same average annual number of months for the ski season. However, our study area has a lot of altitudinal variations, so the ski season also varies significantly.

Average Annual Maximum Air Temperature days in Ski Season of GB: The average annual daily maximum air temperature of the ski season was analyzed to identify those areas where the temperature went above 10^oC for the maximum number of days during the ski season. The results (Fig. 3c) showed that in Gilgit, Ganji Bridge, Kachura and Yogo, the ratio of average annual daily maximum air temperature days to the average annual number of ski season days goes above 15%. This is because these areas are located at relatively low altitudes and have a minimum ski season each year. The least number of average annual maximum air temperature days were identified in Khunjrab, Yasin, Gupis, Chilas, Burzil and Hunza (<=6% days). Yasin, Gupis and Burzil have maximum length of ski season in a year so average annual maximum air temperature days are minimum in these regions. Although Chilas has the minimum ski season length in a year, it remains cold and dry during the ski season. That's why the least average annual maximum air temperature days were identified there. Ushkore, Ziarat, Naltar, Bunji, Rama, Astore, Deosai, Sakardu and Hushay where the average annual maximum air temperature days range between 6-12%. These areas have maximum length of ski season in a year, so this percentage of maximum air temperature days does not affect the duration of ski season there. Rattu is the only area where the average annual maximum air temperature days range between 12-15%. In 2019, Deng *et al.* considered the daily maximum air temperature to find out if the temperature goes above 10^oC for 90 non-continuous days during ski season. Their study area was whole of China, so they did find out those areas where the temperature went above 10^oC for 90 days. However, high mountain ranges run through Gilgit Baltistan, so there were very few chances of identifying those areas where temperatures went above 10^oC for 90 non-continuous days. So the average annual percentage of maximum air temperature days was calculated to identify the areas where the temperature goes above 10^oC for maximum days during the ski season.

Average Annual Mean Daily Min – Max Temperature of GB: The map (Fig. 3d) showing the average annual mean daily min-max temperature during ski season for GB revealed that the highest average annual mean daily min-max temperature during ski season was found (>3^oC) in Gilgit, Chilas, Bunji and Ganji Bridge. This is because these areas are situated at low altitudes, and the length of the ski season there is also short. Khunjrab, Burzil and Deosai (<= -3^oC) had the lowest value of average annual mean daily min-max temperature. Khunjrab, Burzil and Deosai also had the longest ski season and the temperature remained below freezing point for most of the days during the ski season. That's why their average annual mean daily min-max temperature also fell in the lowest range. Ziarat and Yasin had the average annual mean daily min-max temperature range from > -3^oC to 1^oC and Ushkore, Naltar and Hushay had the average annual min- max temperature range from > -1^oC to 0^oC. Gupis, Hunza, Astore, Rama, Rattu, Kachura, Skardu, Shigar and Yogo had the average annual mean daily min-max temperature range from >0^oC to 3^oC. Deng *et al*. (2019) classified the temperature ranges to find out which areas were least or more suitable for skiing in China. In this study, the average annual mean daily min-max temperature ranges were classified into 5 classes and identified hot regions and cold regions which might be suitable for skiing. The results showed that 7%, 16% and 77% area of GB had the least, moderate and highest average annual mean daily min-max temperature range.

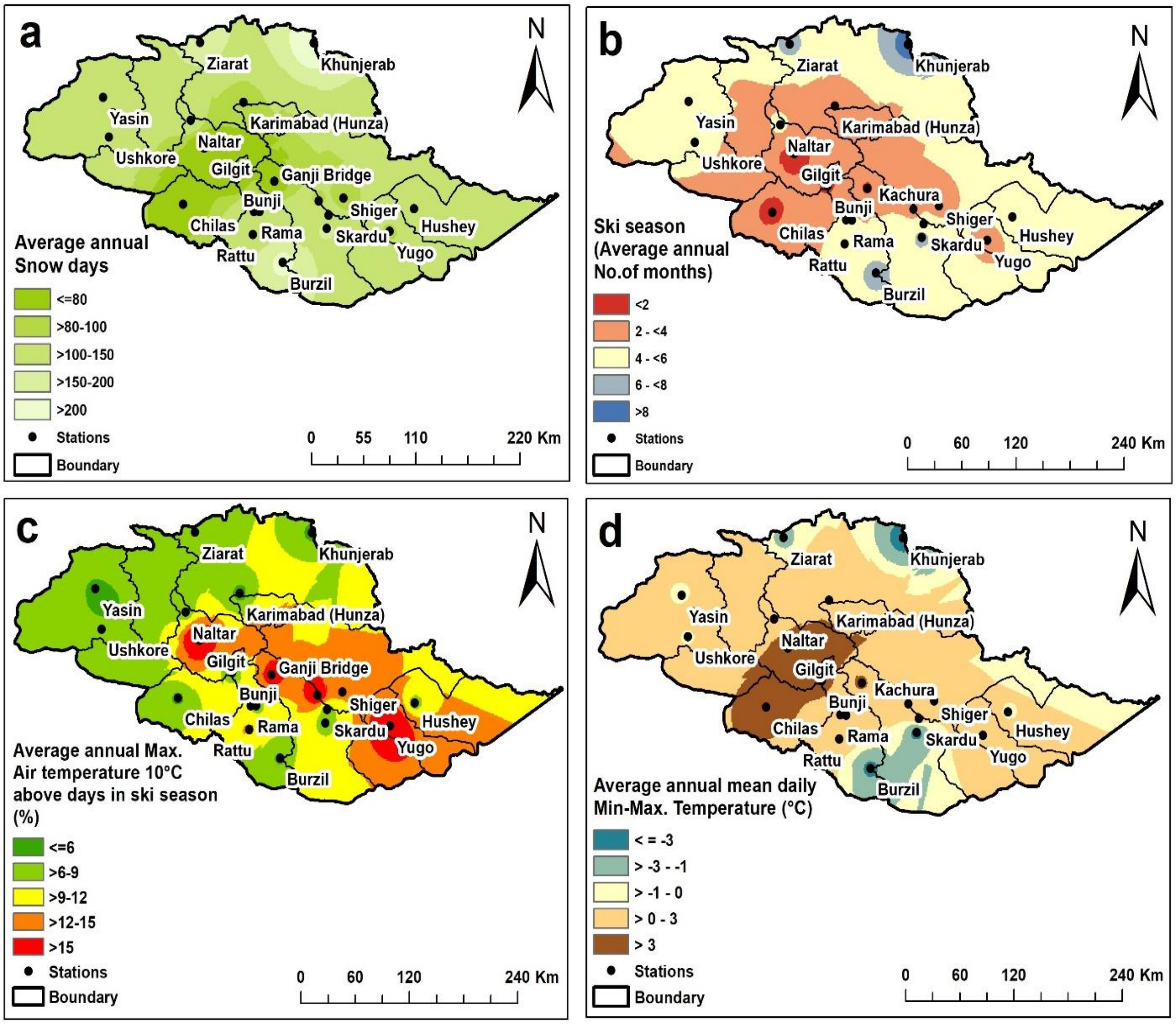

Fig.3 Map showing (a) average annual number of snow days (b) average annual number of months (Ski Season) (c) average annual maximum air temperature days (%) in ski season and (d) average annual mean daily min-max. temperature in GB.

Slope: Most of the GB has a degree slope greater than 10 ^{o} (Fig. 4a). According to the China National Tourism Administration, the most suitable slope for skiing ranges from 10° to 30^{o} (Deng *et al.*, 2019). Another study carried out in the Isfahan Province, Iran, for the identification of suitable sites for skiing reported that the suitable percentage slope for skiing should range between 10% to 35%, which, if converted in degree slope would be <20^{o} (Gabdrakhmanov and Hosseini, 2019). It means that different researchers have considered different ranges of slope on the basis of their selected study areas. GB is a mountainous area, so 6^{o} to 40^{o} slope was considered as suitable slope range for skiing in GB. Less than 6^{o} or greater than 40^{o} slope is not suitable for skiing. The results showed that 13% area of GB had less than 10^{o} slope and the remaining 87% area of GB had greater than 10^{o} slope.

Elevation: Elevation was categorized into two classes only, i.e. ">=4000m" or "<4000m" elevation (Fig. 4b). The results showed that Khunjrab is the only region of GB that is located above 4000 m. Skiing is not recommended over 4,000 meters because of low oxygen levels (Deng *et al.,* 2019). On this basis, skiing may not be possible in the Khunjrab. The remaining area fell into the suitable category of skiing on the basis of elevation.

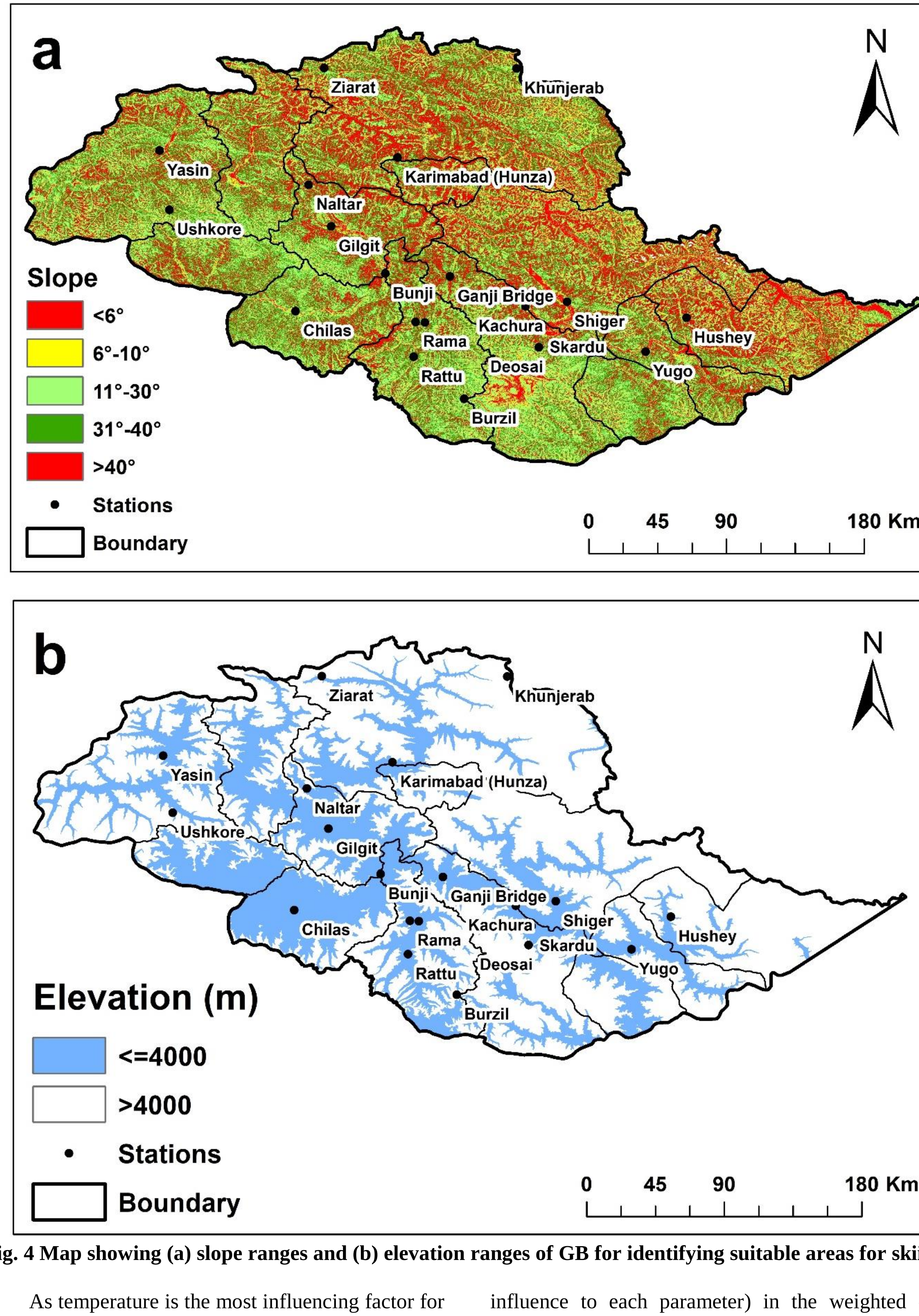

Fig. 4 Map showing (a) slope ranges and (b) elevation ranges of GB for identifying suitable areas for skiing.

As temperature is the most influencing factor for the site suitability of skiing resorts, all four parameters of temperature were given the highest influence (20% influence to each parameter) in the weighted overlay analysis. The slope and elevation parameters were given 15% and 5% influence, respectively. The results (Fig. 5) were classified into four categories: highly suitable, moderately suitable, least suitable and not suitable sites for skiing. The highly suitable sites for skiing were identified in Yasin, Ushkore, Naltar, Deosai, Burzil, Hushay and Ziarat. These areas have an adequate length of annual ski season. Moreover, the slope and elevation parameters are also good for skiing. Moderately suitable sites for skiing are located in Skardu, Rattu, Rama, Astore, Gupis and Hunza. These areas also have a good length of ski season annually but their slope condition may be poorer than the highly suitable areas. The least suitable sites for skiing are Chilas, Gilgit, Bunji, Ganji Bridge, Kachura, Shigar and Yogo because they have a very small ski season, which means that tourists may not find required snow cover for skiing there even during the ski season. Khunjrab is not suitable for skiing. Although Khunjrab has a maximum ski season length but it is located at a very high elevation (>4000m) where skiing cannot be done due to low oxygen levels. These results showed that 18% area of GB is good for skiing, while remaining 82% of GB is not good for skiing. It means that the development of suitable sites for skiing resorts is only possible in the identified 18% area of GB**.**

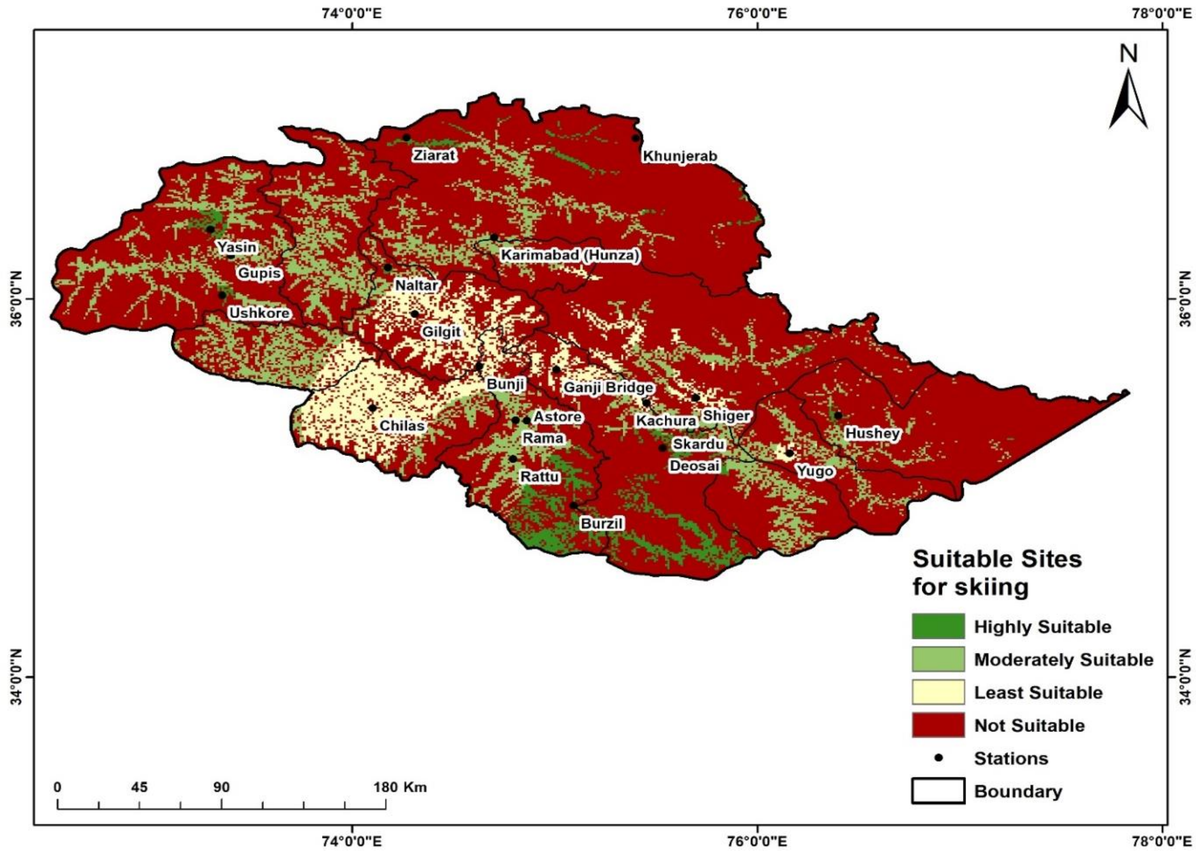

Fig 5 Map showing suitable sites for skiing in GB.

Classification of identified suitable sites for skiing in GB: In 2019, An *et al.* carried out a study for China in which they classified suitable skiing areas into three further categories. In this study, the highly and moderately suitable sites for skiing were further classified into vacational, learning and experiential skiing resorts as per 6^o to 15^o, 15^o to 30^o and 30^o to 40^o slope, respectively (Fig. 6a – 6c). The result showed that areas near Burzil and Deosai were highly suitable for Va-ski resorts while areas near Skardu, Hunza, Astore and Rattu were moderately suitable for Va-ski resorts. The locations near Burzil, Yasin, Ushkore, Hushay and Ziarat were highly suitable for Le-ski areas while locations near Gupis, Naltar, Astore, Rama, Rattu and Hunza were moderately suitable for Le-ski areas. The sites near Ziarat, Yasin and Ushkore were highly suitable for Ex-ski areas while sites near Rattu, Astore, Rama and Gupis were moderately suitable for Ex – ski areas.

Finally, all the classifications of Va-ski resorts, Le-ski areas and Ex-ski areas were shown on a single map (Fig. 7). The results showed that the construction of ski resorts for Vacational purposes, utilization of ski area by tourists for learning purposes and development of ski areas for expert skiers can be done on 18%, 41% and 39% of all suitable sites for skiing in GB, respectively.

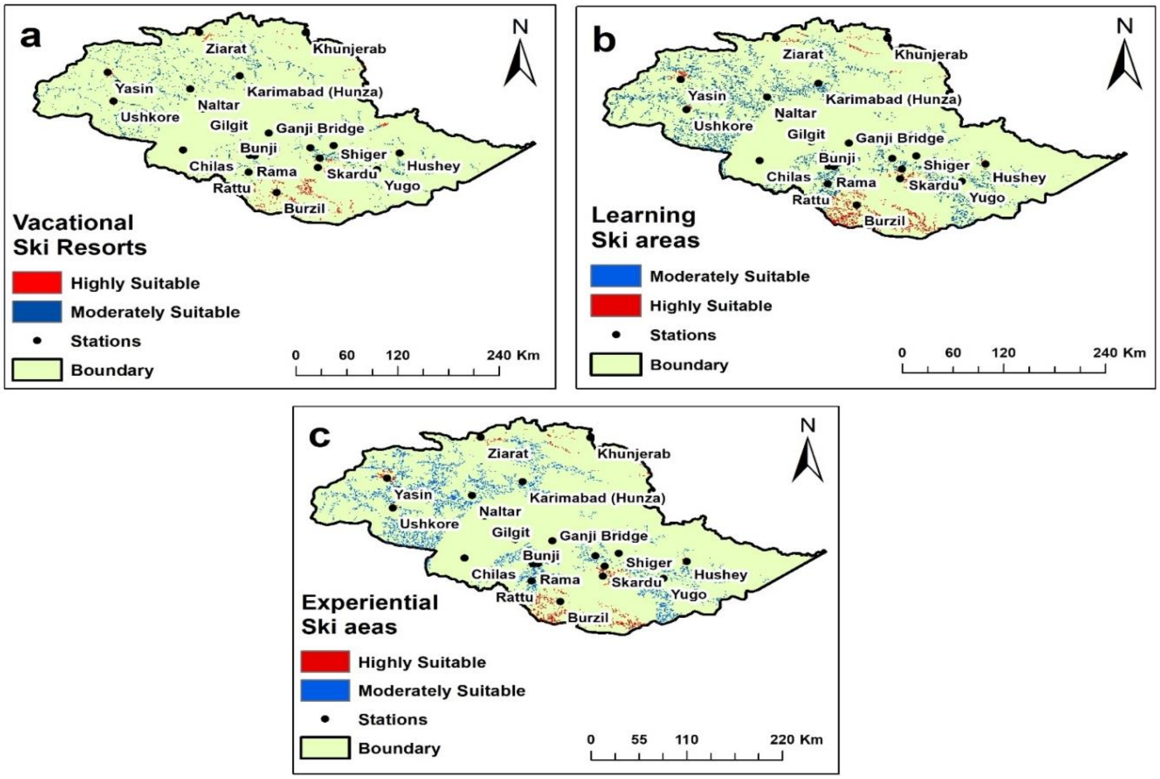

Fig 6 Maps showing suitable sites for (a) Vacational ski resorts (b) Learning ski areas and (c) Experiential ski areas in GB.

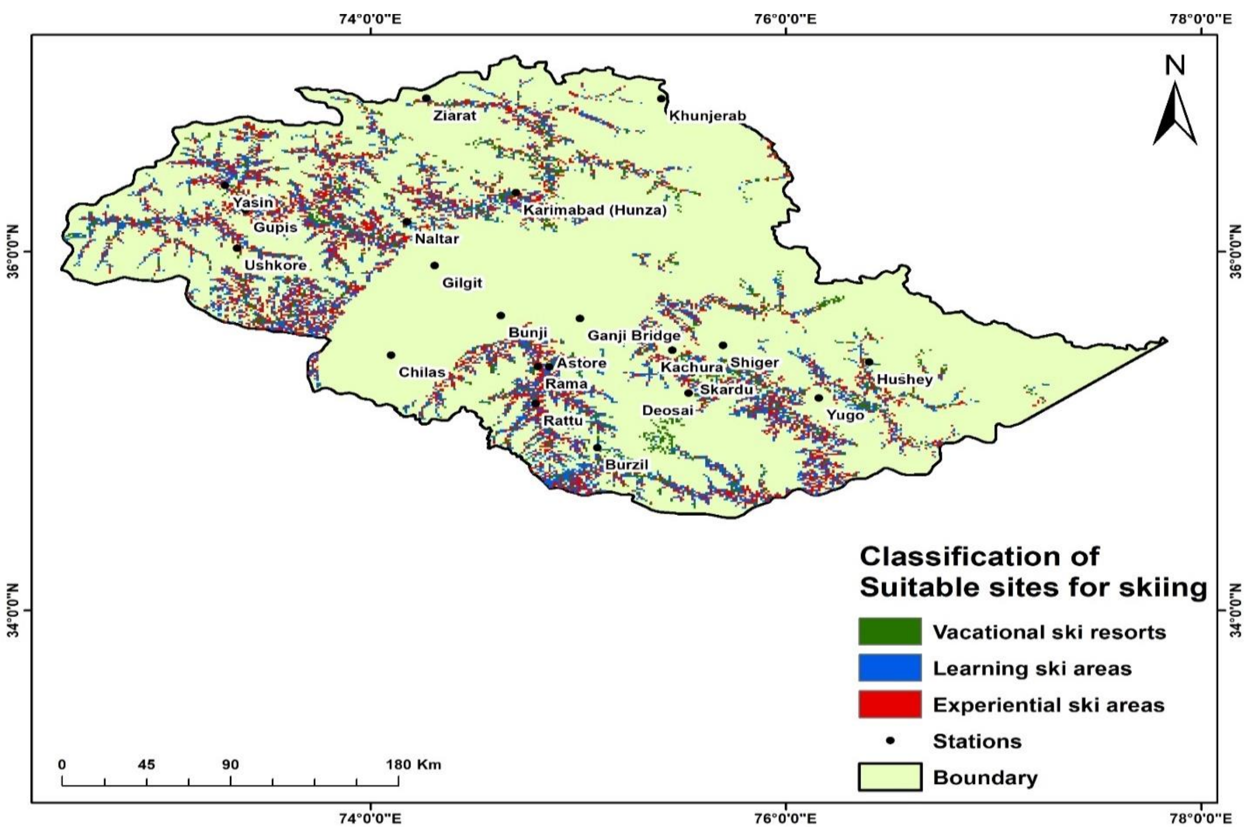

Fig 7 Map showing combined areas for vocational, learning and experiential skiing in GB.

Conclusion: This study concludes that 18% area of GB is good for skiing while remaining 82% GB is not suitable for skiing which means that the development of suitable sites for skiing resorts is possible in the identified 18% area of GB. The highly suitable sites for skiing are located in Districts Yasin, Ushkore, Naltar, Deosai, Burzil, Hushay and Ziarat, whereas, moderately suitable sites for skiing are located in Districts Skardu, Rattu, Rama, Astore, Gupis and Hunza. These potential sites were further classified on the basis of slope into vacational ski resorts, learning ski areas and ski areas for experienced skiers. The results showed that Burzil, Deosai, Skardu, Hunza, Astore and Rattu are suitable for the development of Vacational ski resorts (18% area), whereas, Burzil, Yasin, Ushkore, Hushay, Ziarat, Gupis, Naltar, Astore, Rama, Rattu and Hunza are suitable for the development of Learning ski areas (41% area) and Ziarat, Yasin, Ushkore, Rattu, Astore, Rama and Gupis are suitable for the development of ski areas for experienced skiers (39% area). This study was based on geospatial analysis, so it is recommended that the Gilgit Development Authority (GDA) should conduct a ground survey at these identified suitable sites to check which areas have more potential to promote skiing adventure activities. This survey will be easier for them because this study has already reduced the suitable sites for skiing in GB and they do not need to visit the whole GB. Moreover, the techniques and methods used in this study can be helpful for the Gilgit Development Authority for the development of ski resorts in GB to promote tourism in order to generate more revenue for the locals.

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