


SHOWCASING NEW TOURISM DESTINATION BY USING GIS: A STUDY OF SIKKIM

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ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received 20 January 2023</p> <p>Accepted 22 March 2023</p>	<p>Purpose: The main purpose of this research is to find out new tourist destinations and suggest developmental strategies through scientific ways for solving overtourism-related problems.</p>
<p>Keywords:</p> <p>Tourism Planning; Geographic Information System; MC-SDSS; Simple Additive Weighting.</p> <div data-bbox="172 927 480 1173" style="text-align: center;">  </div>	<p>Theoretical framework: In this research paper, the researchers emphasized finding new tourist spots and analyzing their potential both in touristic and infrastructural value was assessed by the researcher with the help of a most modern tool like Geographic Information System. The researchers have explained a scientific process of exploring new tourist destinations or tourist spots by using GIS and have shown how to develop proper infrastructure around those spots.</p> <p>Design/methodology/approach: A “Multicriteria Spatial Decision Support System modeling” was used to find out and validate the existing and new tourist spots. In the pair-wise comparison method, a criterion versus criteria was created to compare each pair of criteria and assign relative ratings using the scale of pair-wise comparison. In this research, the Simple Additive Weighting (SAW) method is used because it gives the “most acceptable results for majority of single-dimensional problems”. The researcher has created this map to support the ‘Destination Fetching Model’, and it can also be used for promoting sustainable tourism in the area. If the entire land cover is visible to the planners with an aerial view, they can plan for tourism infrastructure and superstructures from anywhere. GIS-based layer data has created an "all covered" aerial map with the help of advanced GIS technology, which not helped the planners to understand the current land condition, but also showed the open area which can be utilized for new tourism set-up. Manmade and natural resources are also classified through this LULC model.</p> <p>Findings: These new tourist spots will help planners and stakeholders to distribute excessive crowds to comparatively new destinations. It is observed that most of the Indian tourism destinations suffer from “over Tourism” in peak season. This research will help spread the flow of tourists to the nearest newly added destinations.</p> <p>Research, Practical & Social implications: Scientific tourism planning through GIS will also help tourism service providers and planners to add infrastructure to the new destinations, and would also help local people to generate income through tourism.</p>

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Originality/value: This research will solve the “over tourism” problem of any destination or state, and help generate more visitor’s day at the destination which is proportionate to extra revenue generation for the local, regional and national tourism stakeholders.

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MOSTRANDO O NOVO DESTINO TURÍSTICO USANDO GIS: UM ESTUDO DO SIKKIM

RESUMO

Objetivo: O principal objetivo desta pesquisa é descobrir novos destinos turísticos e sugerir estratégias de desenvolvimento através de meios científicos para resolver problemas relacionados ao turismo excessivo.

Estrutura teórica: Neste trabalho de pesquisa, os pesquisadores enfatizaram a descoberta de novos pontos turísticos e a análise de seu potencial tanto em valor turístico quanto de infra-estrutura foi avaliada pelo pesquisador com a ajuda de uma ferramenta mais moderna como o Sistema de Informação Geográfica. Os pesquisadores explicaram um processo científico de exploração de novos destinos turísticos ou pontos turísticos usando GIS e mostraram como desenvolver uma infra-estrutura adequada em torno desses pontos.

Design/metodologia/abordagem: Um "Multicriteria Spatial Decision Support System modeling" foi usado para descobrir e validar os pontos turísticos existentes e os novos pontos turísticos. No método de comparação de pares, foi criado um critério versus critérios para comparar cada par de critérios e atribuir classificações relativas usando a escala de comparação de pares. Nesta pesquisa, o método de Ponderação Aditiva Simples (SAW) é usado porque dá os "resultados mais aceitáveis para a maioria dos problemas unidimensionais". O pesquisador criou este mapa para apoiar o 'Modelo de Destination Fetching', e também pode ser usado para promover o turismo sustentável na área. Se toda a cobertura terrestre for visível para os planejadores com vista aérea, eles podem planejar a infra-estrutura turística e as superestruturas a partir de qualquer lugar. Os dados da camada baseada em SIG criaram um mapa aéreo "todo coberto" com a ajuda de tecnologia SIG avançada, que não ajudou os planejadores a entender a condição atual do terreno, mas também mostrou a área aberta que pode ser utilizada para novas instalações de turismo. Os recursos naturais e artificiais também são classificados através deste modelo LULC.

Descobertas: Estes novos pontos turísticos ajudarão os planejadores e interessados a distribuir multidões excessivas para destinos comparativamente novos. Observa-se que a maioria dos destinos turísticos indianos sofre de "excesso de turismo" na estação alta. Esta pesquisa ajudará a espalhar o fluxo de turistas para os destinos recém-adicionados mais próximos.

Pesquisa, implicações práticas e sociais: O planejamento científico do turismo através de SIG também ajudará os prestadores de serviços de turismo e planejadores a acrescentar infra-estrutura aos novos destinos, e também ajudará a população local a gerar renda através do turismo.

Originalidade/valor: Esta pesquisa resolverá o problema do "sobre turismo" de qualquer destino ou estado, e ajudará a gerar mais dias de visita ao destino, o que é proporcional à geração de renda extra para os interessados em turismo local, regional e nacional.

Palavras-chave: Planejamento Turístico, Sistema de Informação Geográfica, MC-SDSS, Ponderação Aditiva Simples.

PRESENTACIÓN DE NUEVOS DESTINOS TURÍSTICOS MEDIANTE SIG: UN ESTUDIO DE SIKKIM

RESUMEN

Objetivo: El objetivo principal de esta investigación es descubrir nuevos destinos turísticos y sugerir estrategias de desarrollo mediante métodos científicos para resolver los problemas relacionados con el turismo excesivo.

Marco teórico: En este trabajo de investigación, los investigadores han hecho hincapié en la búsqueda de nuevos lugares turísticos y en el análisis de su potencial tanto turístico como infraestructural, que ha sido evaluado por el investigador con la ayuda de una herramienta muy moderna como es el Sistema de Información Geográfica. Los investigadores han explicado un proceso científico de exploración de nuevos destinos turísticos o puntos turísticos mediante el uso de SIG y han mostrado cómo desarrollar una infraestructura adecuada en torno a esos puntos.

Diseño/metodología/enfoque: Se utilizó un "Sistema de Apoyo a la Decisión Espacial Multicriterio" para descubrir y validar los puntos turísticos nuevos y existentes. En el método de comparación por pares, se creó un criterio frente a criterios para comparar cada par de criterios y asignar puntuaciones relativas utilizando la escala de comparación por pares. En esta investigación, se utiliza el método de ponderación aditiva simple (SAW) porque ofrece los "resultados más aceptables para la mayoría de los problemas unidimensionales". El investigador ha

creado este mapa para apoyar el "Modelo de Búsqueda de Destinos", y también puede utilizarse para promover el turismo sostenible en la zona. Si toda la cubierta terrestre es visible para los planificadores con una vista aérea, podrán planificar las infraestructuras y superestructuras turísticas desde cualquier lugar. Los datos de capas basados en SIG han creado un mapa aéreo "todo cubierto" con la ayuda de tecnología SIG avanzada, que no sólo ha ayudado a los planificadores a comprender el estado actual del terreno, sino que también ha mostrado la zona abierta que puede utilizarse para nuevas instalaciones turísticas. Este modelo LULC también clasifica los recursos naturales y artificiales.

Resultados: Estos nuevos puntos turísticos ayudarán a los planificadores y a las partes interesadas a distribuir las multitudes excesivas a destinos comparativamente nuevos. Se ha observado que la mayoría de los destinos turísticos indios sufren de "sobreturismo" en temporada alta. Esta investigación ayudará a distribuir el flujo de turistas hacia los destinos más cercanos recién añadidos.

Investigación, implicaciones prácticas y sociales: La planificación científica del turismo mediante SIG también ayudará a los proveedores de servicios turísticos y a los planificadores a añadir infraestructuras a los nuevos destinos, y también ayudaría a la población local a generar ingresos a través del turismo.

Originalidad/valor: Esta investigación resolverá el problema del "sobreturismo" de cualquier destino o estado, y ayudará a generar más días de visita en el destino, lo que es proporcional a la generación de ingresos adicionales para los agentes turísticos locales, regionales y nacionales.

Palabras clave: Planificación turística, Sistema de Información Geográfica, MC-SDSS, Ponderación aditiva simple.

INTRODUCTION

Tourism is a vital global industry (Wallace & Riley, 2015; Salehi & Farahbakhsh, 2014). It has a massive contribution to the local, regional and global economy (Theobald, 2012). Host destinations enjoy huge benefits from tourism (Chalip & McGuirly, 2004). The industry contributes to the economy by generating income for local people. It creates employment for people at every level. It also helps developing infrastructure and superstructure for both local habitats and tourists (Crouch & Ritchie, 1999). Tourism helps protect and maintain heritage sites, wildlife sanctuaries and national parks by generating revenue through entry fees (Mvula, 2001). Furthermore, tourism plants a high sense of cultural exchange between national and international citizens, which is essential in recent days for eradicating the threat of terrorism (Hashimoto, 2014). Tourism includes different sectors such as the agricultural sector, telecommunication sector, health and welfare division, education institute etc (Roberts & Hall, 2001; Aithal, 2019). The government of any nation invariably depends on the revenue generated from the tourism sector and heavily invest in it. As a result, famous tourist spots are generally better developed than nearby cities, villages and townships (Antrop, 2004). Apart from infrastructure, transportation and amenity centres, the hospitality industry also grows up in those spots (Lhouvum, 2016). Many renowned international hotel chains invest in Indian tourist spots, serve tourists, and offer substantial job opportunities even in remote tourist places (Falk, 2016). A tourist spot is a geographical place containing all of the necessary components to attract tourists and meet all of their expectations and needs. All destinations have a life cycle, and that plays a significant role in promoting a destination (Hovinen, 2002). The third stage of

the "Destination Life Cycle' (Cooper & Jackson, 1989), where the destination reaches the maturity stage, becomes overcrowded. Extravagant tourist flow to a particular spot or a city creates problems for the visitors as well as local people. It may initiate dissatisfaction to both the parties, and later, a tourist may lose attraction to the overcrowded spots and tries to avoid them (Popp, 2012). Besides, many pose a negative opinion to the tourists because of the problem faced by them (Barbhuiya, 2020). New Normal Tourism Behaviour of Free Independent Travellers in the Covid-19 Pandemic. (Aujirapongpan. Et. Al., 2023) indicates disinterest of FIT to such overcrowded destination. It is also observed that major Indian tourist spots are seasonal (Rizal & Asokan, 2014), i.e. they are suitable for a visit either in summer or winter. Visitors always avoid monsoon as they do not feel comfortable in the rainy season. Most of the Indian destinations are a cluster of cities and villages (Mody & Day, 2014). The centre of the attraction might be located outside the city and accommodation is concentrated in the nearby big cities. For example, Tsomgo Lake in Sikkim is far away from Gangtok (Paul, 2017), the state's capital city, and people generally take an excursion trip to visit it and prefer to take their night stay at Gangtok due to the non-availability of accommodation at Tsomgo Lake (https://www.darjeeling-tourism.com/darj_000103.htm). It is also observed that the tourist spots often encounter heavy traffic due to inadequate and narrow roads approaching them, and visitors do not prefer to spend unnecessary time at the roadside and plan to avoid them. Many famous spots in Sikkim like Tsomgo lake Ganesh top and the narrow road and maintenance of those roads are done by BRO (Border Road organisation) (Zakiah & Feenstra, 2013) that is not done correctly throughout the year. Both tour organisers and tourists calculate an approximate time frame to cover spots during their sightseeing because they have stipulated time for covering top places of interest within certain limited days. Besides, due to heavy traffic jams in nearby areas, they fail to cover all predefined places in a single day. Over tourism makes a destination dirty and polluted, leading to loss of potential tourists because of word-of-mouth publicity. A mass concentration of visitors in a single place produces all kinds of pollution such as air, water and sewage at the spot. Pollutants such as SO₂, CO₂, Nitrous Oxide, dust and other particles in the air produces smog in the winter in most of the hill stations in India (Arya, 2009). Gangtok, Pelling and other cities suffer from smog from September till February (Barua, Tiwari, & Kesari, 2013). During their peak season, tourists are deprived of experiencing the beauty of the sunrise. It causes dissatisfaction in their mind, and later they do not recommend anyone to visit those spots and do not even revisit in the near future. Once a destination becomes popular, and a massive footfall of tourists is experienced, big multinational companies, reputed international hotel chains and other Foreign Direct investors put their set up at the destination.

Besides, they also expect a high return from the spot. If the destinations are very seasonal and become nonoperational in a few months, investors do not step into it. The income of the government, as well as local and international tourism service, provides depend on the spending of tourists (Eadington & Redman, 1991). In many cases, it is experienced that tourists spend limited days at the destination because of a lack of places of interest. The quality of visitors experience at the destination should be enhanced sustainably so that they spend more nights at the destination and enjoy it (Edwards & Griffin, 2013). Tourist spending is proportionate to the number of nights spent at the destination. If it can be increased, the stakeholders will benefit and be interested in further investment or expansion. Another problem that noticed is the over the popularity of a particular tourist spot. For example, Sikkim has few lakes to offer to visitors, but most tourists prefer to visit Tsomgo. Besides, the state is full of natural resources and the birthplace of many waterfalls, but tourists are not aware of those beautiful waterfalls. While visiting a spot, their many attractions fall on the way to the prime place of interest, but tourists do not visit them as they are unaware of them. The basic reason is that small pockets which are full of tourism potential might not have been indentified, developed and promoted in a timely manner. The researchers have depicted a clear picture of identifying new spots or destinations in Sikkim by implementing GIS technology and formulating a “Destination Fetching Model (DFM)”. The Technological Innovation: Characterization and the Status of Business Accelerators in a Metropolitan Region. (Lara, J et. Al., 2021) supports the implementation of Technology in showcasing destination. Moving with a limited number of tourist spots and destinations and promoting Sikkim as an excellent destination for nature lovers can put both the government and the society into big trouble. It is already discussed that the tourism products of Sikkim are seasonal due to extreme weather conditions, but many of the new tourist spots can be developed as a winter destination to keep the tourist inflow intact. Destinations and spots can be identified and developed by using scientific tools like Geographic Information System. Proper planning for spot development and review of existing infrastructure will help to expand tourism in Sikkim. It is also anticipated that the number of domestic and international tourist arrival is exponentially increasing in recent days. Both the government and tourism stakeholders must set up an adequate number of accommodation facilities, amenities, and many different types of activities for the tourists to satisfy them. Sustainability must be maintained while creating new tourist facilities like the carrying capacity of the destination, or the state should not lose the balance. A fair understanding of local communities should be made, and it is only possible when infrastructure development would take place in a balanced manner. It is also difficult for planners to visit the entire state and count all facilities and technical aspects.

A geographic Information System (Cooperative & Collins, 1988) with a unique Multi-Criteria Spatial Decision Support System (Ghavami, 2019) can help formulate a good architecture that would help planners with a complete proof plan in the scientific way with a shorter time. As the GIS technology works with spatial data, the physical presence of the planners is not very important (Wridt, 2010). Moreover, it saves both time and money.

MATERIAL AND METHODOLOGY

Sikkim is titled as “Beautiful Himalayan Queen of the East, and East Sikkim District is the crown jewel of it which is located within the coordinates of 27°04' to 28°07' North and 88°00' to 88°55' East (Panneerselvamet. Al., 2021). The East Sikkim District occupies about 964 Square Kilometer of area and high density and moderate density forest cover about 71.17 % of the total district's area (Chaudhuri, 2007). Highly dense forest land covers 162 Square Kilometer and open forest covers about 396 Square kilometer of the land area (Secretariat, 2015). The physiographic components are mostly hills, valleys and sloppy terrains. The district is also the homeland of three major rivers of North- East Region namely Chhu, DikChhu, Rangpo which is also known as Bramhaputra and the beautiful Teesta (Khatiwara & Bhutia, 2020). Tourism deals with Five As; Attraction, Accessibility, Accommodation, Amenities and Activities (Xu, 2010). In this chapter, the researcher emphasized on first 3 A's; attraction, accessibility and accommodation, because they are the integral part of the tourism industry. Finding new tourist spots and analyzing their potential both in touristic and infrastructural value was assessed by the researcher with the help of a most modern tool like Geographic Information System. Sikkim offers a limited number of destinations to visitors; every destination includes a few popular touristic sites resulting in fewer tourism nights spent at destinations. New sports (Attraction) will help the tourism stakeholders, the government, and tourists increase the night stay. Moreover, it will generate better revenue and will also keep sustainability intact. New tourist spots might increase the number of night stay and tourist inflow to the destination, need proper access to those spots. Bad road conditions, excessive walking for reaching the spot, unfurnished muddy pathways might create discomfort for the tourists. Moreover, it could be time-consuming too. The newly discovered tourist spots may offer an excellent visitor's experience but require a hefty investment in infrastructure development to make it accessible to the tourists. It is evident that the tourism industry is allotted minimal funds in very financial budgets published by both state and central government. Foreign Direct Investment and the interest of private stakeholders are a bit skeptical for the hilly states like Sikkim. Therefore, it would be challenging to develop a new road network to connect the new spot. Instead, the

planner should search for specific spots with road connectivity almost up to the point of interest. A little investment in connectivity may create a better visitor's experience and reduce pressure from the old popular spots because people always look for the new experience. Once the new tourist spots have been identified, and road connectivity is assessed, the tourism stakeholders might promote them through different media. The inflow of tourists to the destination will increase as people always search for new experiences, but it will put the destination under tremendous pressure due to insufficient accommodation capacity. Tourist by nature prefers to stay near to the desired place of interest to access them whenever they wish. Accommodating them at a far way or offering them a day excursion is not the ultimate solution. Creating new and appropriate accommodation facilities would be the prime solution provider. Besides, a hilly state like Sikkim faces difficulties identifying Barron land in terrain with proper infrastructure facilities. Depending on the land category, the planner should suggest the types of accommodation most suitable for the area. Some places can be appropriate for constructing a tall building, or some may be suitable for camping and tented accommodation, depending on soil quality. Less fertile cropland can also be used for hotel construction.

Finally, the assessment of three basic A's like attractions, accessibility and accommodation would be considered as prime factor for tourism of a place. In the mountainous state like Sikkim, various physiographic factors like relief, drainage, climate, natural hazards and administrative factors like accessibility, accommodation are the governing components for this five A's. Therefore, the MC – SDSS model has been developed based on the physical and administrative factors.

Scientific tourism planning for identifying new tourist spots using a Geographic Information System is the most appropriate way in recent days. Generally, new tourist spots are discovered when some explorers visit unknown destinations or spots and spend some time at the place by using non-orthodox types of accommodation like a tent, homestay etc. Later, they share their experience on social media or within the own surroundings. Gradually, visitors take an interest in experiencing those destinations and spots and spread goodwill. Finally, these tourist spots become popular, and infrastructure is developed around them. Most of the newly popular tourist destinations like Mandermoni in West Bengal, Zuluk in Sikkim became famous.

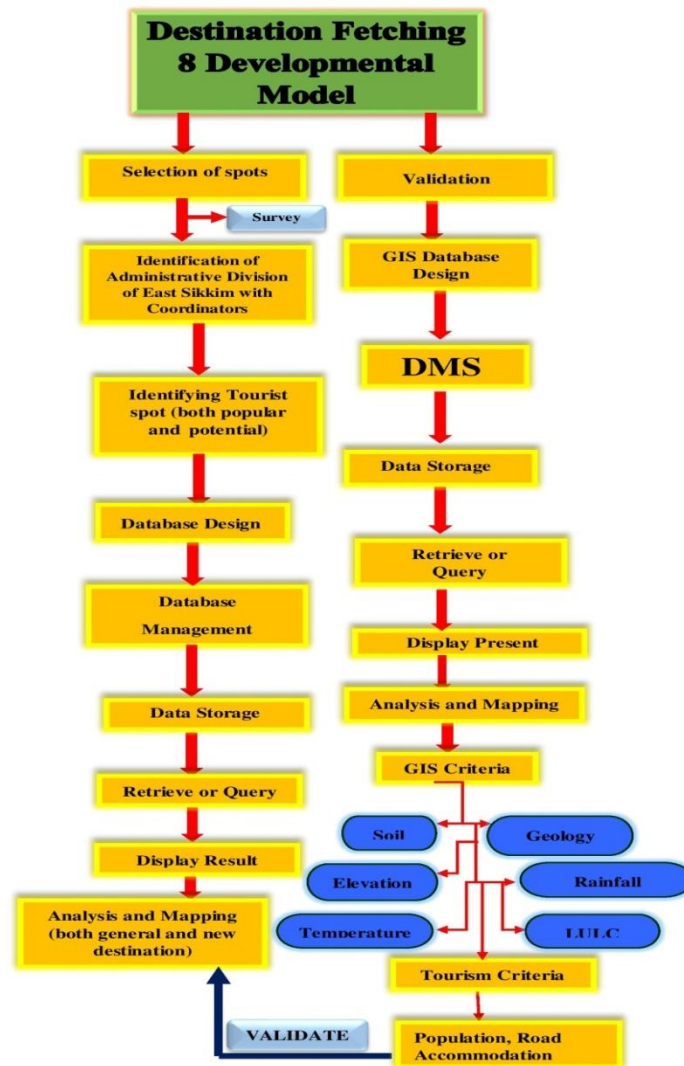
In this research, the researchers have explained a scientific process of exploring *new tourist and destination* or tourist spots by using GIS and has shown how to develop proper infrastructure around those spots. A “Multicriteria Spatial Decision Support System modeling” was used to find out and validate the existing and new tourist spots. There were many different decision support systems, with definitions varying between fields and nations. A system focus,

a model focus, an application focus, and decision aids are examples of these. Multiple factors are critical in making judgment decisions. The phrase "multicriteria" has several different meanings. Humans frequently confuse criteria, characteristics, and aims. The word was coined in the field of data science to represent an emphasis on modelling used to help support the decision - making. Different civilizations, and even diverse individuals within each culture, are likely to have different perspectives on what is logical. Each pair of options is evaluated, and the decision-maker provides a set of weights representing relative significance. Multicriteria models had already found several uses in decision support systems. Unfortunately, it would be impossible to examine due to space constraints and human weakness in search. When MC- DSS is carried out with the help of GIS, it is called MC –SDSS modelling.

The first phase research was conducted by using a survey method by using hand held GIS device where the researcher took Sikkim, especially, East Sikkim. As a next step, the researcher surveyed the area with the help of hand-held GIS device and collects the coordinate to identify potential spots and plotted them on a digital map. Information related to potential spots is also collected through secondary data sources like TripAdvisor and other travel journals and social blogs. Most of the authorized hotels are also plotted on the map as accommodation is one of the prime criteria in the model. Roads were taken from the Sikkim government published map.

Once the first phase of the research was over, the researcher had run the MC-SDSS modelling using GIS considering various criterions to validate all the tourist spots and identify the potential new tourist destination. The detail flow diagram is shown in Fig. 1.

Fig: 1. Detail flow of methodology.



Source: Prepared by the authors (2022).

SDSS Model Development

The researcher has formulated a model by using both tourism-based criteria and GIS-based components. Following criteria are taken into consideration:

- a) Land use and land cover
- b) Geology
- c) Elevation
- d) Soil
- e) Rainfall
- f) Temperature
- g) Road/ Accessibility
- h) Accommodation

i) Major tourist places are also taken into consideration to validate the model and new tourist places are identified from the model generated suitability maps and field survey as well as Google Earth.

The entire criterions are represented as a spatial component i.e., map. The criterion maps are described below:

Land use and land cover: The satellite images of Landsat 8 hve been classified and derived the LULC map of Sikkim. Major LULC classes like Baren land, Snow, Grass land, Forest, Water bodies, Wetlands, Crop land and Settlements are taken. The LULC map of Sikkim are shown in the Fig. 2.

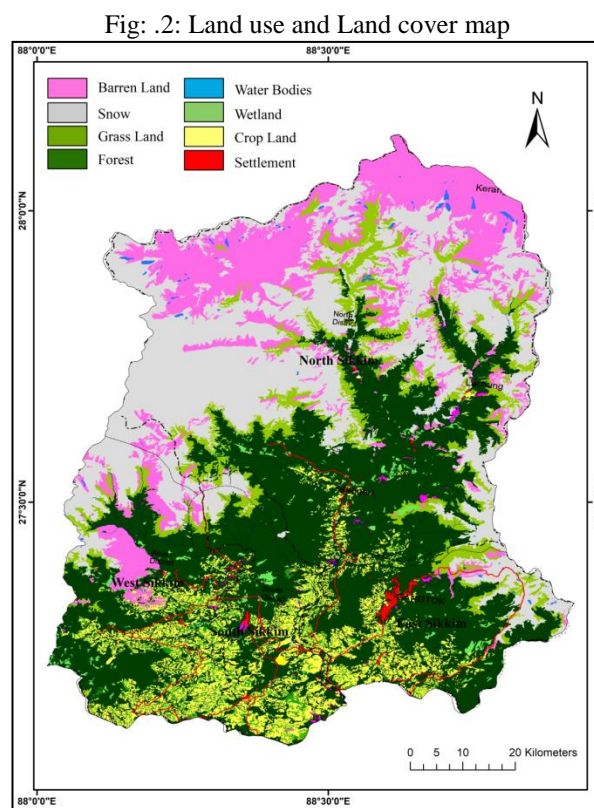
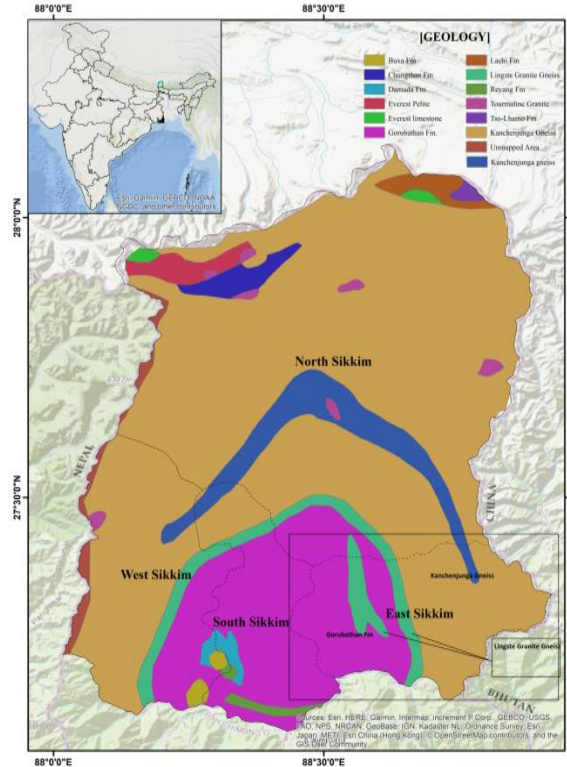


Fig 3: Geology of East Sikkim, existing tourist spots are superimposed



Source: Prepared by the authors (2022).

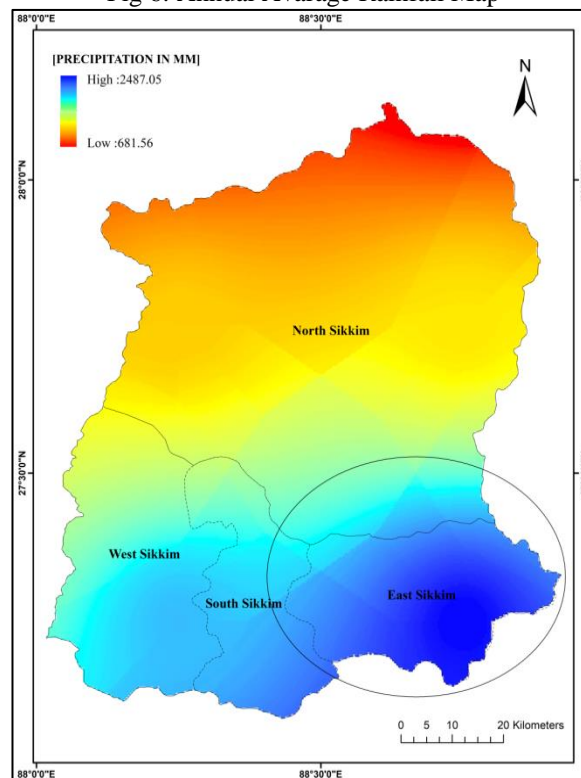
Geology: Geology is the main control of structural part of a place. It also impact on the relief of any area. This also discusses the hazards and risks connected with rock falls, radon, landslides, fast clay, landslides, and earthquakes. Geology can help us understand historical climate change, which can help us forecast future possibilities (Kusky, 2003). Geology map of Sikkim is shown in Fig: 3.

Elevation: Elevation of a place is its height above or below of Mean Sea Level or Detum/ Geoid surface. Most frequently a reference geoid, a mathematical model of the Earth's sea level as an equipotential gravitational surface. In a general language, elevation denotes altitude. Tourism is the activities done by people of all ages. Physical fitness is one of the essential factors for travel. If the location is situated at the high altitude, it would be difficult for senior citizens to visit the spot. On the other hand, young travellers can be more interested in trekking, hiking, jungle safaris and other adventure activities. Moreover, tourism prompters can also promote high altitude spots among the specified age groups. Besides, different construction measures would be followed to create primary infrastructure such as hotels, motels, amusement parks etc., which are very much dependent on the elevation. An elevation model (Fig 4) for Sikkim is created in this study to identify the altitudes of the study area.

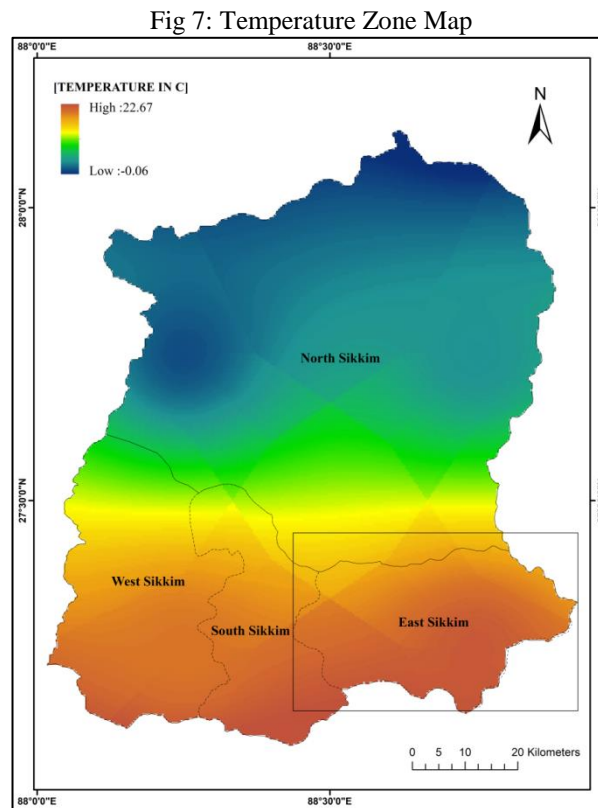
landfills, bursting dams, and flooded sports fields. Any kind of construction work done for developing infrastructure like hotel, amusement park, bridge, soil becomes an essential factor. Soil condition of Sikkim (shown in Fig 5) creates a favourable condition for construction work. Thus, major construction project can be carried out near the tourism site.

Rainfall: Rainfall of a place is one of the most important factor for SDSS modelling for destination fetching. It causes flood in the region and in the mountainous area it cause flash flood. Natural calamities are considered barriers for tourism; the flood is one of them, which is probably another basic factor for a seasonal destination. The Flood of Kashmir in 2014 can be one of the notable examples where the major loss of life, property and tourism days were counted. Sikkim has a history of floods. Flooding is a regular occurrence in the Tista basin. The basin's plain gets inundated every year. Previously devastating floods happened in 1950, 1968, 1973, 1975, 1976, 1978, 1993, 1996, 2000, 2003, and 2015. Among these, the 1968 flood was the most devastating in the previous sixty-five years. Excessive rainfall is one of the major reasons for the flood. So average rainfall data (Fig: 6) were also analysed and shown below.

Fig 6: Annual Avarage Rainfall Map



Source: Prepared by the authors (2022).



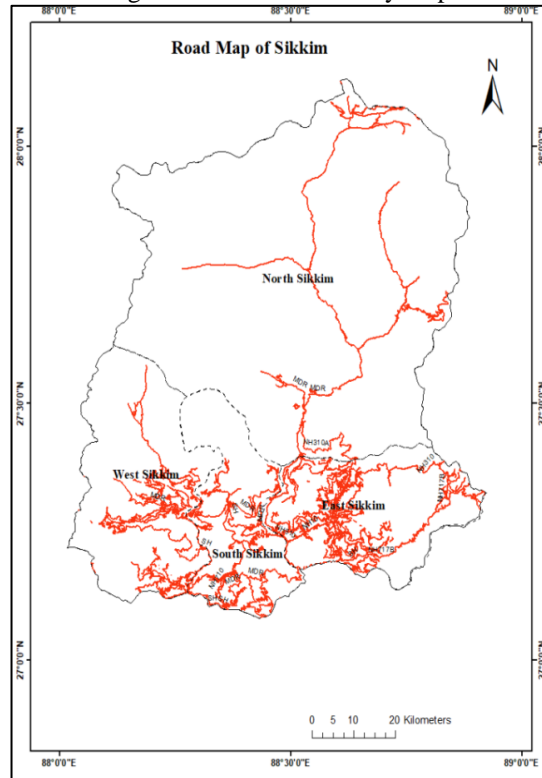
From the above mentioned map, it is clear that East Sikkim District is flood prone compared to the other districts. So tourism activities should be planned carefully in the Moonsoon.

Temperature: It has been discussed that Sikkim is a seasonal destination, and it does not receive many tourists in the winter due to the extreme weather. A temperature zone map (Fig 7) was created by using geospatial data for analysing, giving a clearer picture of the high and low temperature and average temperature.

From the GIS based map, it can be decided that East Sikkim (The Chosen Study area) might be promoted as all seasons destination. If more tourist spots are identified in North Sikkim, It will be a visitor's paradise in winter. Moreover, the map (Fig: 7) also clarified that the other districts of barring North Sikkim also can be showcased as " All season destination" , and all the stakeholders and the government would be benefited form this analysis.

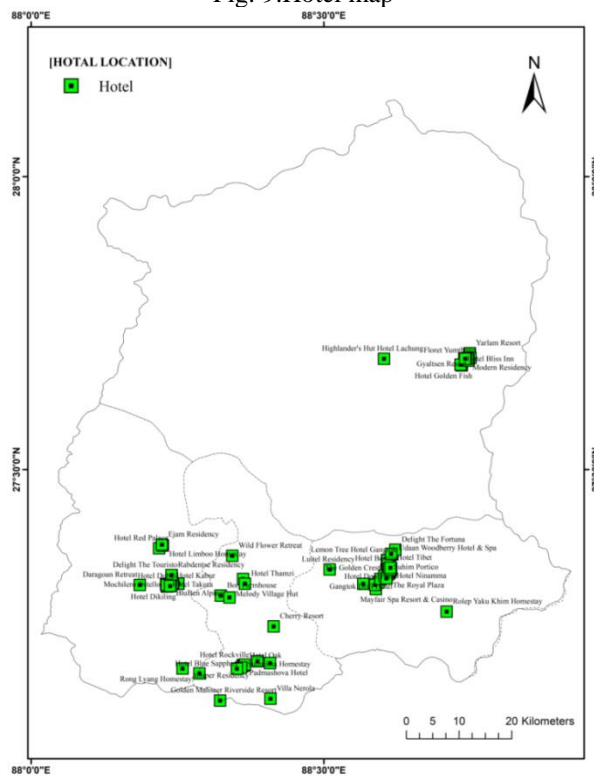
Road/ Accessibility: It is an essential of tourism as well as common people. If the destination is not connected with proper approachable road, the influx of tourist will be very low and the business will get affected. As Sikkim is located in the core of mountain, the possibility of natural calamities are higher compared to the other plain lands. Therefore, road is an important factor for emergency evacuation purposes. The road map is shown in Fig.8.

Fig: 8. Road / Accessibility map



Source: Prepared by the authors (2022).

Fig: 9. Hotel map

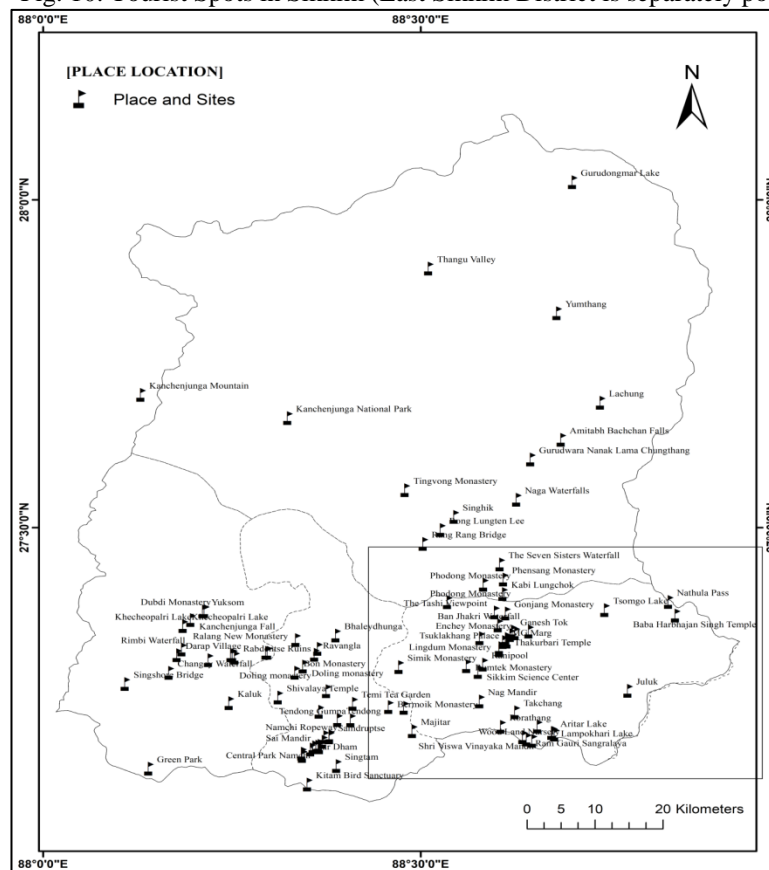


Source: Prepared by the authors (2022).

Accommodation: Accommodation is considered one of the prime factors in tourism and considered in the DFM as a decision-making criterion, and accessibility is another main factor for reaching the tourist spots; both of them were plotted on the GIS map for tourism possibility study. The areal and physical distance between hotels and tourist places were be measured digitally. Hotel map of the Sikkim is shown below (Fig: 9).

Tourist Spot of Sikkim: In the initial phase of the study, existing tourist spots of the entire Sikkim was plotted on the GIS map, and segregated East Sikkim part and marked (Fig: 10). It helped to be well aware of the presence of popular destinations and spots of Sikkim, especially East Sikkim District.

Fig: 10. Tourist Spots in Sikkim (East Sikkim District is separately positioned)



Source: Prepared by the authors (2022).

Selection of Criteria: The criteria factor mentioned above are taken for model development. These include LULC (L_{ulc}), Geology (G_i), Elevation (E), Soil (S), Rainfall (R_f), Temperature (T_p), Road / Accessibility (R), Accommodation (A). Tourist spots are used for validation. These factors have been considered because tourist destination of Sikkim has a pronounced history of being influenced by these processes. Therefore, in this study of destination fetching modelling (D_{FM}) is given as:

$$D_{FM} = f \int_{i=1-10}^{w_i} (L_{ulc}, G_l, E, S, R_f, T_p, R, A) \quad (1)$$

Assigning of Weights to the Factors

In MC-SDSS, assigning relative weights to the different criteria under consideration is a critical decision. A number of methods are available in GIS. The most important are the Pair-wise Comparison method, the Ranking method, and the Trade-off analysis method. (Malczewski 1999). In the present research, Pair-wise comparison method had been accepted to compute the weight. In this method, researcher had prior knowledge of the relative importance of different criteria for the study area under consideration.

In pair-wise comparison method, a criteria versus criteria matrix (shown in Table 1) was created to compare each pair of criteria and assign relative ratings using the scale of pair-wise comparison (Saaty 1980). Table 2 shows the pair-wise comparison of the different criteria used in this research. Next, this matrix was normalised by the sum of the column to create another matrix. the sum of the rows had been computed in this new matrix, which was then divided by the number of criteria under consideration to get the Relative Criterion Weights (Table 3). The sum of the weightage for all criteria is 1.

Table 1: Criteria versus Criteria Matrix

Criteria (C)	L _{ulc}	G _l	E	S	R _f	T	R	A
L _{ulc}	1	2	3	4	5	6	7	8
G _l	0.5	1	2	3	4	5	6	7
E	0.33	0.5	1	2	3	4	5	6
S	0.25	0.33	0.5	1	2	3	4	5
R _f	0.2	0.25	0.33	0.5	1	2	3	4
T	0.15	0.2	0.25	0.33	0.5	1	2	3
R	0.5	0.15	0.2	0.25	0.33	0.5	1	2
A	0.3	0.5	0.15	0.2	0.25	0.33	0.5	1
Column Sum(∑c)	3.23	4.93	7.43	11.28	16.08	21.83	28.5	36

Source: Prepared by the authors (2022).

Table 2: Pair-wise comparison of Criteria Used in the Research

Intensity of Importance	Definition
1	Equal importance
2	Equal to moderate importance
3	Moderate importance
4	Moderate to strong importance
5	Strong importance
6	Strong to very strong importance
7	Very Strong importance
8	Very very strong importance

Source: Prepared by the authors (2022)

Table 3: Relative Criterion Weights.

Criteria C	L _{ulc}	G _i	E	S	R _f	T	R	A	Row Sum (∑ _r)	Relative Criterion Weight (RCW = Sum of R/8)
Lulc	0.308	0.367	0.324	0.269	0.223	0.186	0.124	0.212	2.013	0.251625 (0.25)
GI	0.154	0.153	0.182	0.177	0.158	0.131	0.152	0.158	1.265	0.158125 (0.16)
E	0.136	0.11	0.141	0.185	0.194	0.19	0.141	0.194	1.291	0.161375 (0.16)
S	0.102	0.068	0.071	0.092	0.129	0.111	0.079	0.14	0.792	0.099 (0.1)
Rf	0.082	0.048	0.047	0.046	0.064	0.093	0.047	0.064	0.491	0.061375 (0.6)
T	0.068	0.047	0.035	0.068	0.068	0.048	0.095	0.068	0.497	0.062125 (0.6)
R	0.105	0.101	0.146	0.105	0.111	0.18	0.196	0.111	1.055	0.131875 (0.13)
A	0.045	0.106	0.054	0.058	0.053	0.061	0.166	0.053	0.596	0.0745 (0.07)
Column Sum(∑_c)	1	1	1	1	1	1	1	1		1

Source: Prepared by the authors (2022).

Decision rule generation

For solving MC-SDSS problems, various decision rules may be employed. However, the most common ones are Simple additive weighting method, Value/utility function method, Analytical hierarchy process method, Ideal point method and Concordance methods (Malczewski, 2010)

In this research, the Simple Additive Weighting (SAW) method is used not only because of its simplicity (Hobbs et. al, 1922), but because it gives the “*most acceptable results for majority of single-dimensional problems*” (Triantaphyllou et. al., 1998). It is based on the concept of weighted average and is also known as the weighted least square method. In this method, the decision maker directly assigns weights of relative importance to each attribute. A total score is obtained for each alternative by multiplying the weight assigned for each attribute by the scaled value given to the alternatives on that attribute and summing the products of all attributes, as under (Jiang & Eastman, 2000).

$$S = \sum_j w_j \times x_{ij}(2)$$

where S = total score, w_j = normalized weight of the j^{th} criterion and x_{ij} = score of the i^{th} alternative with respect to the j^{th} criterion. For the simple additive method to work, $\sum w_j = 1$.

In this research, individual categories of each alternative/ criterion are classified into four classes and given a score ranging from 1 to 4.

$$S_t = \int W_1 S_{ct1} + W_2 S_{ct2} + \dots + W_n S_{ctn} \quad (3)$$

Where, S_t = total score, W_n = weight assigned to the n^{th} criterion and S_{ctn} = score of the n^{th} criterion.

The weights and scores assigned to each criterion are shown in Table 4:

Table 4: Weight Vs Score.

Criteria /Alternatives	RCW	Scale	Score
L_{utc}	0.25	Low 1 ↓ 2 ↓ 3 ↓ High 4	0.25 0.50 0.75 1.00
G_i	0.16	Low 1 ↓ 2 ↓ 3 ↓ High 4	0.16 0.32 0.48 0.56
E	0.16	Low 1 ↓ 2 ↓ 3 ↓ High 4	0.16 0.32 0.48 0.56
S	0.1	Low 1 ↓ 2 ↓ 3 ↓ High 4	0.1 0.2 0.3 0.4
R_f	0.6	Low 1 ↓ 2 ↓ 3 ↓ High 4	0.6 0.12 0.18 0.24
T	0.6	Low 1 ↓ 2 ↓ 3 ↓ High 4	0.6 0.12 0.18 0.24
R	0.13	Low 1 ↓ 2 ↓ 3 ↓ High 4	0.13 0.26 0.39 0.52
A	0.07	Low 1 ↓ 2 ↓ 3 ↓ High 4	0.07 0.14 0.21 0.28

Source: Prepared by the authors (2022).

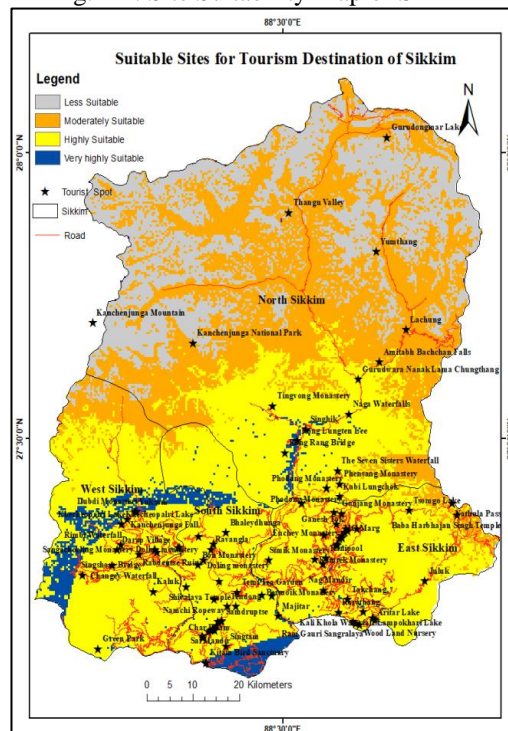
Based on the above-mentioned methodology, the MC SDSS modelling has been carried out in ArcGIS 10.2 version software. The results are described in the result section.

RESULTS AND DISCUSSION

Sikkim is famous for its natural beauty. The state has beautiful snow-capped mountain, lush green forests, famous Buddhist monasteries, enchanting villages, fascinating cultural resources, colorful fairs and festivals and many more to attract domestic and international tourists to the state. The researcher has carried out a by using MC-SDSS for finding out site suitability for the state and its tourist destinations. The result (11) exhibits that the most of the tourist spots of the state is in the highly suitable zone, and they are located in East and West and South Sikkim District (Marked in yellow in the map). Whereas, North Sikkim falls under less suitable and moderately suitable zones. So tourism development can be easily done in three districts of Sikkim and the destinations located in these districts can be promoted to the visitors.

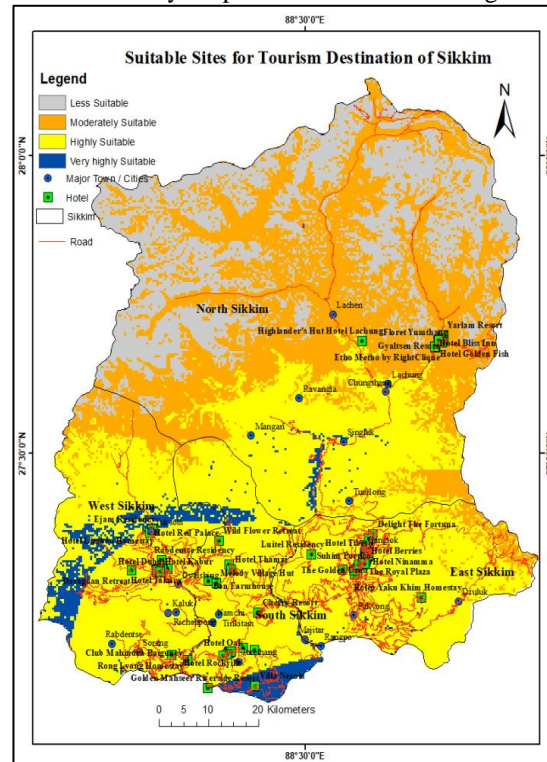
On the other hand, new tourist spots can be introduced in this area by carrying out expensive research. The districts mentioned above are highly potential and suitable for different types of tourism. The spots are well-connected by road and they can accommodate sufficient number of tourists as per the present scenario.

Fig: 11 : Site Suitability Map of Sikkim



Source: Prepared by the authors (2022).

Fig: 12 : Site Suitability Map of Sikkim with Existing Tourist Spots



. Source: Prepared by the authors

East Sikkim

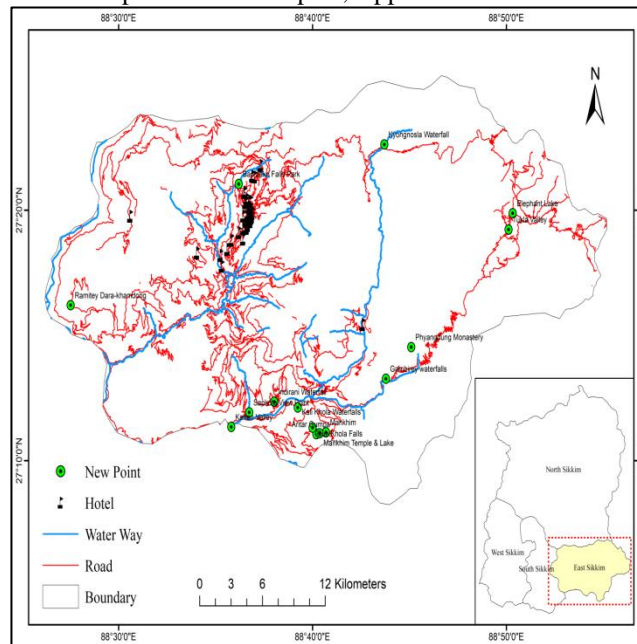
For the further development of the study, East Sikkim Administrative divisions were separately taken and divided into all blocks/ villages. It helped to identify the location of both comparatively low famous and unknown places of interest during the survey. Once the survey was carried out, and spots were identified, coordinates were collected by using field survey and Google Earth . It is made out form the map that a certain part of East Sikkim does not have any villages or population.

Fig: 13: Villages and Block of East Sikkim



Source: Prepared by the authors (2022).

Fig 14 : Combined Map New Tourist Spots, Approachable road and accommodation



Source: Prepared by the authors (2022).

The above mentioned figure clarified that the new places of interest (mentioned in Fig 14)are well-connected by road and not very far away from the accommodation. So these places might be promoted as new tourism sites in future.

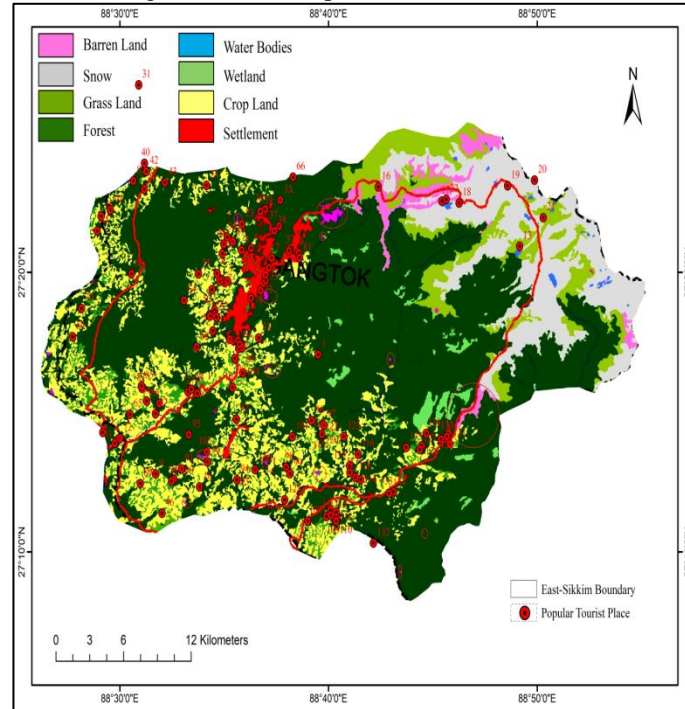
GIS Based Decision Support System for Validating Tourist Spots

In the second phase of the study, newly recognised tourists spots were validated by using GIS-based criteria (Rwanga & Ndambuki, 2017). LULC map of East Sikkim District (Fig: 15) with marked tourist spots indicates "Barren lands", which are marked in "Pink" and circled by Red. Those places can also be utilized for constructing hotels and other amenity centers for tourists. The area marked in "Green" indicates the forest resources where any tourism activities would be carried out sustainably. The map also indicates that the "Grassland areas" (marked in Light Green) used for domestic cattle should not be interrupted. Apart from this, a large area in East Sikkim is covered by the snow where seasonal camping activities for the visitors can be carried out, but a permanent concrete set-up might be fatal for both nature and investors. All the croplands are marked in Yellow which helps the state to supply with food grains should not be utilized for tourism development purpose. The areas marked in "Red" denote the settlement which is already congested and suffers from high footfall of tourists and deeply polluted due to human activities. The majority of the hotels are also located in these areas. This concentration should be decentralized by spreading up infrastructure in the comparatively open land for creating a better tourism environment.

Some areas marked in "Blue" denotes the water bodies in the district which can be appropriately preserved and can also be utilized for water-based sports keeping sustainability in mind.

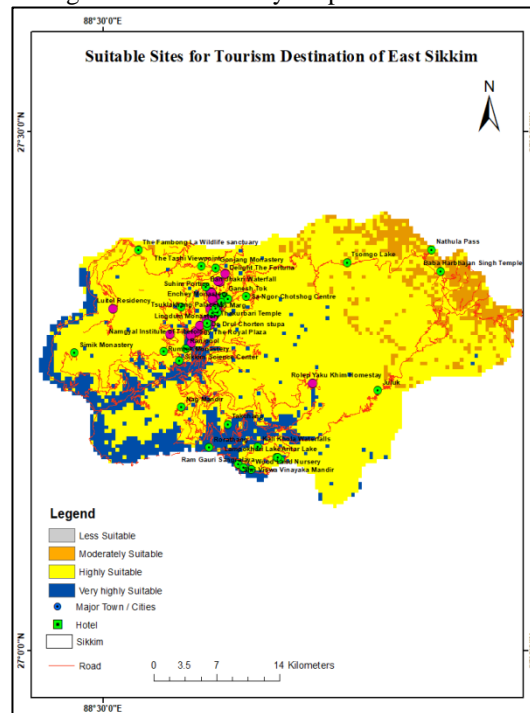
The researcher has created this map to support the Destination Fetching Model, and it can also be used for promoting sustainable tourism in the area. If the entire land cover is visible to the planners with an aerial view, they can plan for tourism infrastructure and superstructure from anywhere. GIS-based layer data has created an "all covered" aerial map with the help of advanced GIS technology, which not helped the planners to understand the current land condition, but also showed the open area which can be utilized for new tourism set up. Manmade and natural resources also classified through this LULC model. Once a single map is created, it can be edited and compared on an annual basis. The apex tourism body also can find out whether sustainable tourism growth is taking place or not. They can also closely monitor tourism-related activities on a periodical basis with the help of digital map. This model confirms the steady growth of tourism and helps to keep the environment in favour of humanity.

Fig: 15: LULC Map of East Sikkim District



Prepared by the authors (2022).

Fig 16: Site Suitability Map of East Sikkim



Prepared by the authors (2022).

Analysis of Site Suitability Map of East Sikkim District

The researcher has created another Site Suitability map (Fig 16 & 17), taking East Sikkim district as a study area. This was created to understand better that the new destinations

can be fetched and validated with this model. Fifteen new spots were identified and validated through the model presented in a digital map (Fig 17). Eight of them are located in the highly suitable zone, and seven of them are located in the very highly located zone as per the criteria mentioned in the methodology.

The detail of the spots are mentioned in a table (Table 5) below:

Table 5: Suitability Analysis for New Tourist Spots.

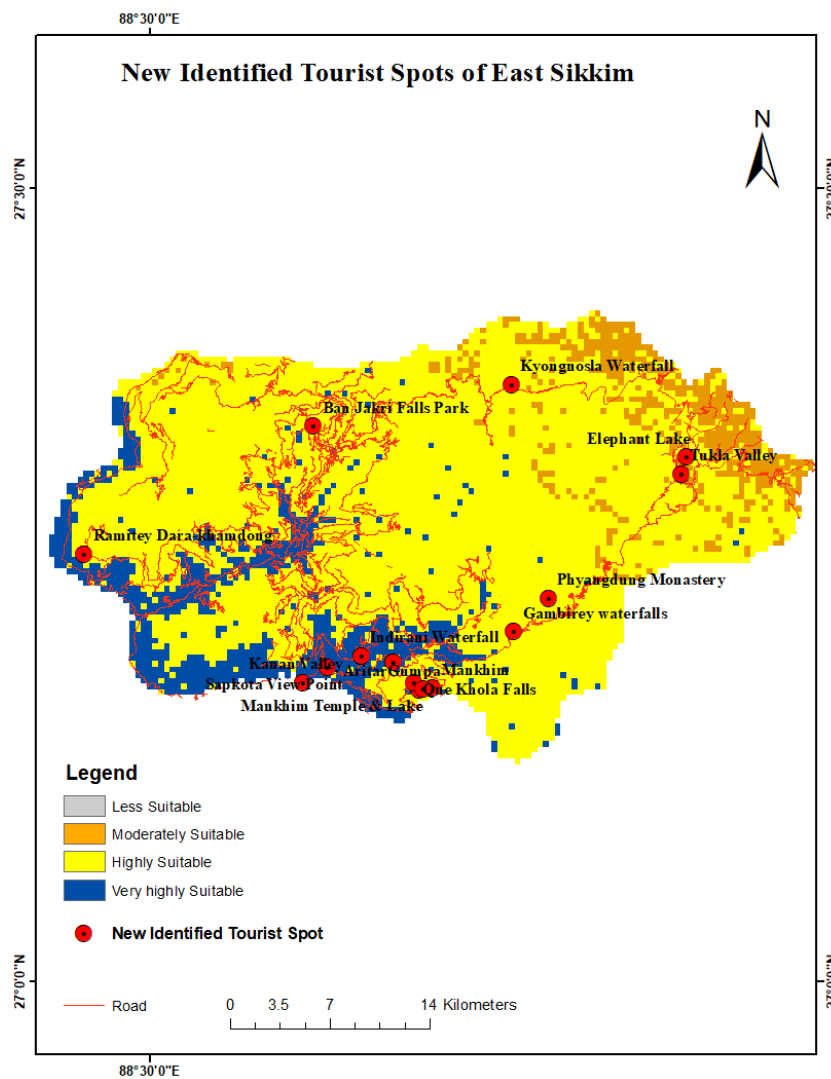
Sl. No	Name of the Spot	Latitude (^o N)	Longitude (^o E)	Suitability Zone	Elevation (m)	Slope	Land Cover Type	Road Connectivity
1	Ban Jakri Falls Park	27.350787	88.603225	Highly Suitable	1239	6.93237	Forest	Yes
2	Tukla Valley	27.320479	88.835201	Highly Suitable	4056	13.4974	Forest	Yes
3	Elephant Lake	27.331265	88.83883	Highly Suitable	4052	16.7971	Forest	Yes
4	Ramitey Darakhamdong	27.270099	88.458756	Very Highly Suitable	1356	32.3149	Forest	Yes
5	Kyongnosla Waterfall	27.377088	88.728405	Very Highly Suitable	3358	8.58427	Forest	Yes
6	AritarGumpa	27.184352	88.670001	Very Highly Suitable	1495	21.5667	Closed Shrublands	Yes
7	Mankhim	27.1855699	88.6782684	Highly Suitable	1547	24.8613	Open Shrublands	Yes
8	QueKhola Falls	27.1886253	88.6667679	Very Highly Suitable	1569	11.2923	Woddy Savannas	Yes
9	Mankhim Temple & Lake	27.1849043	88.6726372	Highly Suitable	1547	13.659	Savannas	Yes
10	Phyangdung Monastery	27.24225576	88.75154484	Highly Suitable	2096	24.5135	Grasslands	Yes
11	Gambirey waterfalls	27.22118882	88.72974473	Highly Suitable	1264	42.1304	Wetlands	Yes
12	Kali Khola Waterfalls	27.20205271	88.65399864	Highly Suitable	798	26.353	Croplands	Yes
13	Sapkota View Point	27.19875337	88.61236083	Very Highly Suitable	550	21.3282	Urban & build up lands	Yes
14	Kanan Valley	27.18913411	88.59682548	Very Highly Suitable	2249	20.3458	Croplands	Yes
15	Indirani Waterfall	27.20585775	88.63368751	Very Highly Suitable	672	10.7604	Permeant Snow & Ice	Yes

Source: Prepared by the authors (2022).

From the table mentioned above, it can be interpreted that almost fifty per cent of the newly introduced tourism spots are located in the high altitude, and they are under either very highly or highly suitable zone. Most of the newly existing spots are located near the forest and are ideal for adventure and wildlife tourism. They are also located in the high altitude and can be accessed by the age group who are physically fit and between 18 to 50 years. All the spots are well connected by road.

The suitability map can interpret and give accurate and scientific results for the planner and the tourists. The planning authority might change the criteria factors as per their requirement and receive the desired outcome. The analysis is done in a very scientific manner, so the results are very authentic and can be considered during planning.

Fig: 17: New Identified Tourist Spots of East Sikkim District



Prepared by the authors (2022).

CONCLUSION

From the above-mentioned modelling framework (DFM) guided with Geographic Information System, it is proved that scientific tourism planning with the aid of modern technology is evident. This model can identify new places of interest and empower the planners and stakeholders to set up the required infrastructure in a sustainable manner. Once the model is created digitally can be gradually added anything on the data layer, and time and money can be saved. Moreover, it has the capacity of identifying and providing desired information with visiting the location. So planning and monitoring of the destination can be done from any space of the world where internet connectivity and digital gadgets are available. This model is empowered with most modern technology, and the conceptual framework can be implemented anywhere in the world. This research will solve the "overtourism" problem of any destination or state, and help generate more visitor days at the destination, which is proportionate to extra revenue generation for the local tourism stakeholders. The research is done to give all tourist destinations or countries a common set of ideas. Sikkim is considered the study area because of the availability of the desired data. Mainly, open-source data is used in this research to complete it within a limited timeframe. The result could be more accurate if data is collected from different paid sources. Lastly, the above research provides a permanent solution to the problems caused by "overtourism" by making new places to visit. It also provides an authentic and scientific way of showcasing new tourism destinations to tourists, promoters, and developers of the destinations, as well as helping to generate more revenue for all tourism stakeholders. DFM is an established model which can be used in tourism planning and research in future.

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