Integration of Participatory GIS and Local Knowledge to Identify Best Route for Sustainable Tourism in Machhapuchchhre Model Trek, Kaski, Nepal

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ABSTRACT

The Participatory Geographic Information System (PGIS), integrated with local knowledge, is a potential decision-supporting tool for sustainable tourism planning, performance evaluation, and site selection. The purpose of this study is to determine the optimal planning of resources for developing ecotourism through the integration of PGIS and local knowledge. The study investigates a case study in the Machhapuchchhre model trek and prepared sustainable ecotourism planning for this region located in the Machhapuchchhre Rural Municipality of Kaski, Nepal. The Machhapuchchhre model treks consist of natural resources, and the associated tourism industry has a significant impact on both the local community and, rural municipality of Machhapuchchhre, and the national economy of Nepal. This research enumerates about lack of planning and management of cultural, natural, and adventure trekking, sustainable tourism development. Ecotourism development and planning is considered using PGIS and local knowledge as a decision support tool for land use and land cover maps, educational tourism, cultural tourism, and adventure tourism using GIS tools. Six different factors maps were finally prepared, among them, the best route regarding the different factors was prepared.

Keywords: *PGIS, Participatory, Model Trek, Thematic Mapping, Ecotourism*

1.Introduction

The interest of the local population and their local knowledge for the development with success and sustainability of any region is crucial to consider to some extent. Governments, communities, and researchers are attracted by the development of an alternative form of tourism in a region. However, tourism and the environment are interrelated as a two-way link. The role of ecotourism depends and the importance of environmental conservation (Omarzadeh et al., 2022). Besides the use of forests as firewood for cooking, timber for building, which is used in the field of tourism, also has the impact on the forest cover region in tourism (Chaplin & Brabyn, 2013). Clearly indicates the decrease in the trend of deforestation with the increase in the distance from the tourist villages, which implies the tourist industry also has an adverse influence to the forest. As a result, tourist development must be planned, and a Participatory Geographical Information System (PGIS) can act as a decision support system throughout this procedure. The GIS technology and software produce all types of spatially related data and collect, manage, analyze, and display it (Environmental Systems Research Institute (ESRI),

2010). It has a plethora of applications, such as Environmental planning, park designing, facility regulation, visual resource assessment and selection of appropriate areas for tourism activity development, urban research, market research and business statistics (Chen,2007) which can still be accustomed to discover the appropriate site just that newly established tourist spot. Additionally, Geographic Information System (GIS) can be a useful tool for examining certain issues related to the development of the tourism industry, such as site location, local environmental conditions, societal trends, and patterns of resource use (Dye, 2006). But as of right now, ecotourism, educational tourism, and adventure tourism have not been adequately addressed by tourism research that integrates PGIS technology and local knowledge. The advantages of PGIS and local knowledge can be summed up in three different ways (Wang & Stauffer, 1996):

Geographic technologies GIS and Remote Sensing (RS) play a significant role in the planning of ecotourism. It offers effective tools for the analysis, manipulation, and storage of a wide range of spatial data. More specifically, depending on precise geographical data, it can be used to map out the best locations for various tourist attractions. These systems can be utilized for a wide range of purposes, such as the identification and clustering of diverse tree species for educational and recreational tourism, as well as mapping of different tree species. With the aid of technology, planning decisions may be made with the help of spatial and non-spatial data in a suitable manner, which is vital for sustainable ecotourism. Ecotourism, a sustainable kind of resource-based travel, focuses on getting to know nature, its landscape, flora, wildlife, and their ecosystems, as well as local cultural relics. A symbiotic and intricate interaction between the environmental and tourism activities can be achieved via appropriate policy, careful planning, and skillful practical philosophy (Fung, 2007).

In this research study, integration of local knowledge and PGIS is used to tourism-related activities, which helps to make sustainable ecotourism and profit from their experience to the development of the Machhapuchchhre model trek. This study's main contribution is to show how PGIS and local knowledge can be used to plan ecotourism using the resources available in the study area. It explores local stakeholders' experience of GIS knowledge to use the tourism resources and design ecotourism development in Machhapuchhre model trek, which is useful for other mountain treks in the future.

The general objective of this study is to investigate the possibilities for integrating PGIS, remote sensing, and local knowledge to plan resources important to the development of ecotourism in the Machhapuchchhre model trek. The following are the specific objectives: to locate ecotourism destinations and prepare with the help of PGIS, RS technology, and local

expertise; and to identify the educational, cultural, and adventure tourism in Machhapuchhre model trek and its planning using PGIS tools and local knowledge.

2. METHODOLOGY

2.1 Study Area

The study area is located in the 7,629 square kilometre Annapurna Conservation Area, which is Nepal's largest protected region. The study area covers 47.79 Km^2. The Machhapuchchhre model trek belongs to the Machhapuchhre and Annapurna Gaupalika of the Kaski district, Gandaki province. Its major work is to identify the sustainable ecotourism model trek. The model trek starts from Lumre and serves as a model for other routes. The Lumre is at 1200 meters elevation from sea level. Pokhara-Sidhing road serves as the beginning of a 25-kilometer trekking route from the airport in Pokhara. The foot trial belongs to borders and sides of the Mardi and Modi rivers. Primary attention is on the breath-taking vista of Mount Machhapuchhre, which the Telegraph ranked as the 13th most beautiful mountain in the world in April 2018.
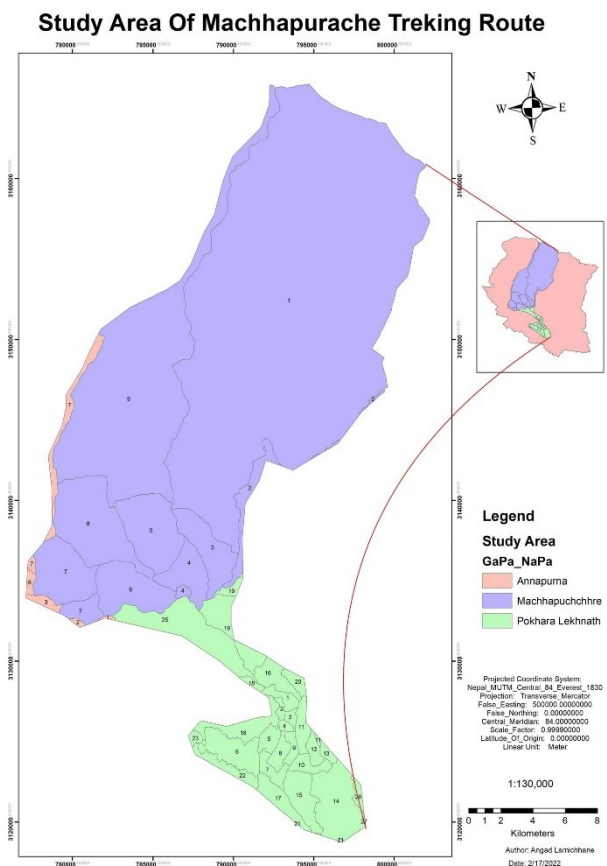

Figure 1: Location Map of the Machhapuchchhre Model Trek

On the way to the trekking route of the trek is Kuibang and saidi Ghatta at an elevation of 1300m. Saidi Ghatta is highly known for its trout fish and organic products, and Kuibang is a popular domestic and foreign tourist destination for home stays with supplemental organic meals. The following location are famous for which in our study of Gurung culture and organic products in Imu (1400m). Tokro (1450m) is situated along the route and is typical of the Tamang village. On the trek are Purundhung (1860m), Kaltha (1890m), and Naudhoke Cave (2500m). The main draw on the journey to Naudhoke cave, known for its religious significance, is a stunning vista of the Himalayas and a rhododendron forest. Before Meshroom was likewise

positioned in the research area, a perspective at Metapurung (2600m) and Coolhill (2653m) was available. Beautiful views of the Lamjung Himal, Machhapuchhre Range, Annapurna Range, Dhaulagiri Himal, Nilgiri Himal, and Gangapurna Himal can be seen from Korchon (3600 m), and these vistas are ideal for sunrise views. The sole justification for setting up a base camp here is the stunning vista of Machhapuchhre and Mardi Himal, which can be reached after traveling from Korchon through Lwang Ghalel and passing the Mardi East trail. Due to the majority of the trail crossing the Odane hill line, this hiking route appears to be a rigid line. Ideal for travelers seeking a more cozy and uncrowded hiking track. Additionally, Machhapuchhrre boasts a pure and unpolluted vista because it is revered by residents of adjacent communities and does not permit climbing.

2.2 Data and software

In order to map the Machhapuchhre Model Trek, primary data sets were employed. The GIS layer of field borders was combined with Sentinel-2 satellite images. Image processing was carried out using QGIS software. The Sentinel-2 (S2), which has a 10-meter resolution, is used to identify several forms of land cover, including paved areas, water, and farming. To enhance the estimation of parameters based on the Sentinel-2 image, the complete image was transformed to reflectance using SCP and DOS1 atmospheric correction.

2.3 Data gathering

Based on their relevance and value in fulfilling the project's objectives, appropriate primary data of hiking routes were designed and collected using both quantitative and qualitative techniques of data collection.

2.3.1 Primary data collection

In phase I, a questionnaire was developed for the gathering of primary data. Different stakeholders, including the hotel owner, mothers' group leader, social worker, teachers, and local politicians in the study area, and a face-to-face questionnaire survey was carried out. The most important details regarding various tourist destinations, religious and cultural sites, the presence of unique plants and other vegetation, and so forth, were gathered. Following PGIS mapping, a questionnaire was distributed to the stakeholders, who then used that base map to do PGIS mapping based on their knowledge and perceptions of the research area.

Based on the literature review and the situation of the study region at the time, a test sample was used to evaluate the questionnaire, validate it, and make it ready for data collection. Local

teachers, social workers, hotel owners, and mother groups are among those taking part in the Machhapuchhre Model Trek. The questionnaire was created with respondents of all ages, genders, origins, and religious beliefs in mind. In their goal for resource mapping and the continued growth of mountain tourism, the questionnaire was created to examine local product opportunities and tourist attractions. A map of the neighborhood, with the assistance of the researchers, was drawn. Participating in activities with the researcher was centered on developing a mountain tourism strategy and resource design. The primary aim of this study is to locate numerous local PGIS participants regarding sustainable mountain tourism. Pre-test, group exercise, and post-test research were some of these techniques. The proprietor of the ward hotel and the social worker of the Annapurna and Machhapuchhre Rural Municipality are among the participants. Participants were found to be very interested in the content of environmentally friendly mountain tourism.

2.3.2 Secondary data collection

Quantitative data were extracted from Open Street Map, like roads, contours, houses, rivers, amenities, etc, in phase II Similarly, a Sentinel-2 image with minimum cloud coverage, Earth Explorer was used to get the digital terrain model (usgs.gov). Slope, aspect, and LULC maps with 6 classes were extracted from these satellite images and the Digital Terrain Model. The OSM data was processed before it was uploaded. The database was verified for external, duplicate, and missing data. To discern important themes and spot trends, data gathered from research publications, phone calls, and related texts were written down and coded. The flowchart below illustrates the methodological framework for the study in relation to its goal.

Setting up the layers

The layer map preparation function in QGIS is complete. The study area's perimeter was initially loaded and removed. With the aid of the modelling, an appropriate location was found. The slope of a location impacts tourists' mobility; excessively steep terrain is impractical for trekking, so this needs to be taken into account to make tourist destinations simple to access and convenient to use while traveling. The research area's height ranged from 785m to 7504m, and as places at higher altitudes are frequently difficult to access and difficult to climb while offering stunning views, it should be kept in mind while developing a tourist itinerary. Therefore, a specific map is created for each form of tourist, along with the best route that has already been chosen. Using a controlled categorization, the LULC of the research region with

an accuracy of 85% was derived from the Sentinel-2 image. The distinct layout map was then created in accordance with the necessary criteria and sub-criteria. follows: Table 1.

Table 2: Reclassification table

Significance	Description	Clarification
1	Equally significant	Both components equally contribute to the goal.
3	Significantly important	a slight advantage of one component over the other.
5	Very Important	strong preference for one element over another.
7	Very significant and backed by evidence	In contrast to the other part, one is heavily favoured and exercises dominance in practice.
9	Of utmost significance	Based on amply supported facts and data, one element is preferred over another.
2,4,6,8	and other middle values	

Source: Popi Konidari and Dimitrios Mavrakis (2018)

Supervised categorization of satellite image was carried out in order to prepare LULC. In supervised classification, a training sample for the research area was gathered from Google Earth Pro, which was then utilized to distinguish between classes and determine each class's signature. Following an examination of the training samples, overlapping classes were combined into a single class depending on the results of the evaluation. The Maximum Likelihood Classification, which is based on the maximum likelihood probability theory, was used to categorize the image. Based on the means and variances of the class signature, it categorizes each pixel into one of the various classes. The Maximum Likelihood Classification tool used to classify the image misclassified some cells (random noise) and produced a few minor incorrect regions. We reassigned these incorrectly categorized cells to a class or cluster that is right next to them in order to improve classification. Consequently acquired. Similarly, the slope and aspect layer maps were also created using ArcGIS's spatial analyst tools (Surface Analysis). There were also produced different layers for historical
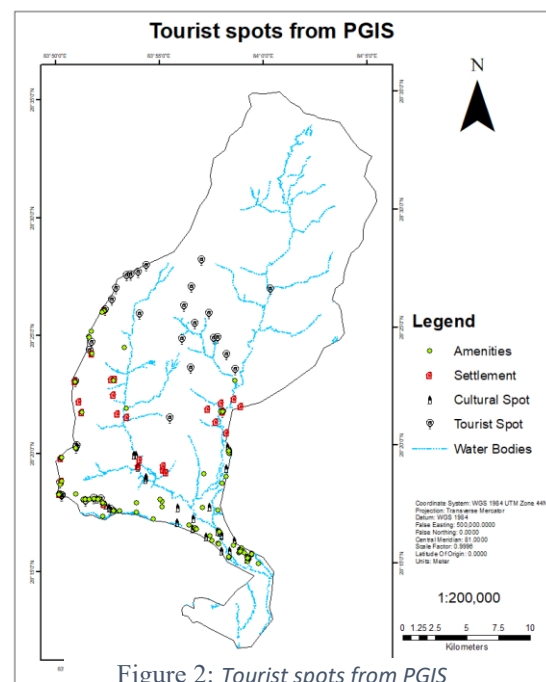

Figure 2: Tourist spots from PGIS

locations, existing routes, lodging, protected places, resource areas (hotel, hospital, police station), water amenities (pool, lakes, rivers), and visitor areas (viewing tower, viewing area). The necessary data was taken directly from OSM and used in these layers. And on all layer
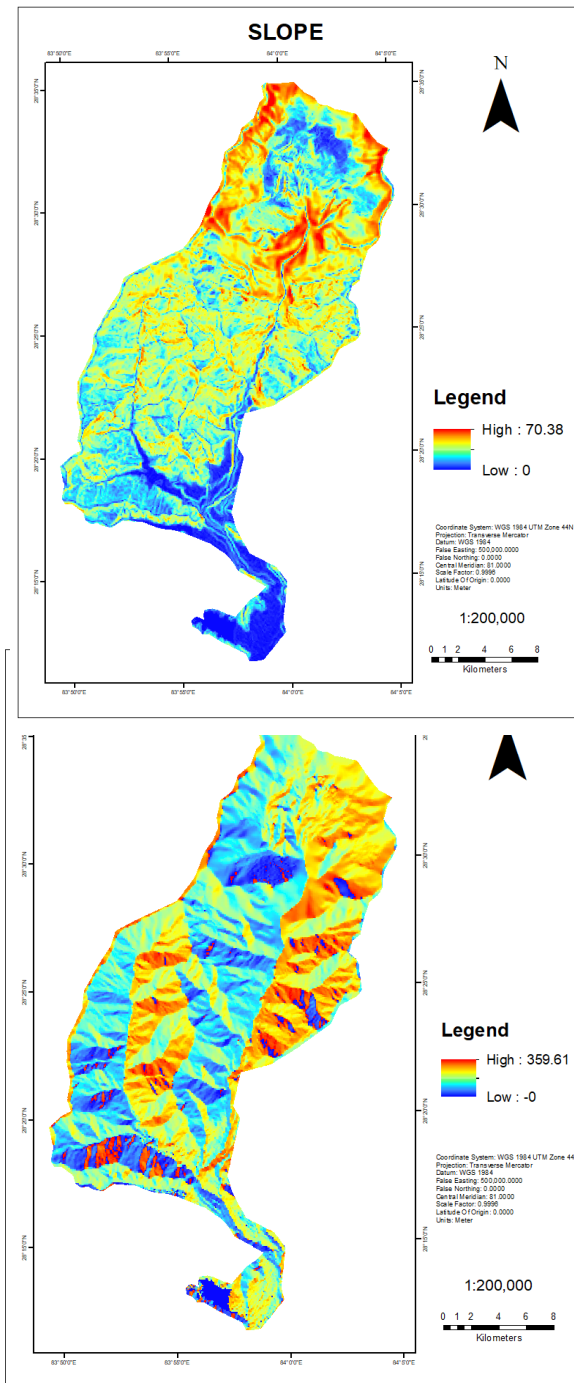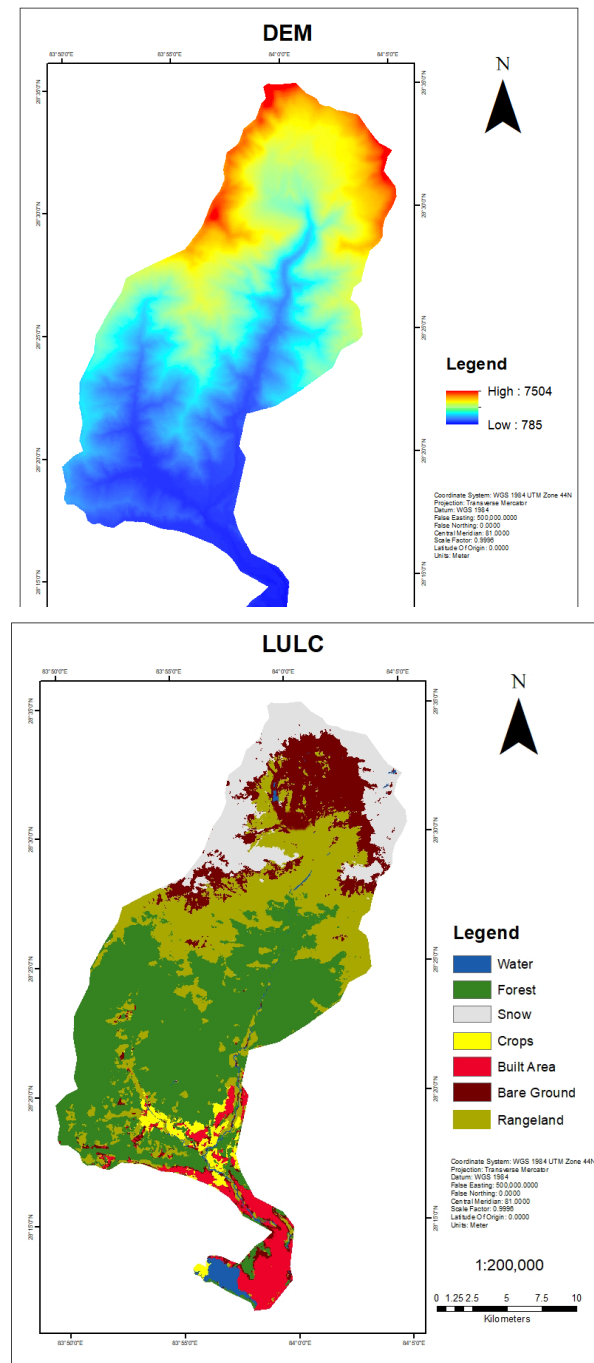

Figure 5: Aspect of study area

Figure 6: Land use land cover of study area

maps—a buffer was built. All levels were reconfigured, and marks were assigned to each layer based on how important they were, as seen below.

Multicriteria decision analysis

A sustainable trekking route has to be chosen. Various factors were taken into consideration when making decisions to make it sustainable. LULC, accessibility, amenities, topography, and tourist attractions were the main considerations. Saaty created the Analytic Hierarchy Process (AHP), one of the conventional MCDA techniques. Using AHP, weighting to specific criteria. There were eight criteria in total. It is a methodical strategy for making difficult decisions and analyzing them that is based on mathematical and cognitive processes.

Table 1: LULC classes of the study area

OBJECTID	Name Class	Area (Km^2)
1	Water	6.79
2	Trees	203.80
3	Crops	9.89
5	Built Area	25.09
6	Bare Ground	60.65
7	Snow/Ice	59.73
8	Rangeland	125.06
	Total	491.01

Criteria weight and class weight

To generate the suitability map, we require the factor weights and class weights of the research-related criteria. Analytic Hierarchy Process can be used to methodically determine this weightage (AHP). AHP was created in the 1970s by Thomas L. Saaty, and it has undergone considerable research and usage in decision-making for complex situations when a team of individuals collaborates to make a choice where human perceptions, judgements, and outcomes have long-term effects. (2018) Sharma. Because this approach allows for formulation as a hierarchical structure and accepts a blend of quantitative and qualitative criteria as well, it is one of the systems that is considered to make decisions with numerous criteria that is the most inclusive. Enter text here by clicking or tapping (Taherdoost, 2017). The four key steps of the AHP technique are as follows:

- Creating a hierarchical problem model for which a decision needs to be made is the first step. The aim or goal is positioned at the top of the hierarchy, followed by the criteria and sub-criteria at lower levels, and the alternatives at the bottom, as shown in the picture below.

- At each level of the hierarchy, the criteria are compared pair-wise and their relative relevance is determined using the Saaty scale of relative importance. The scale has five

levels and four significance sublevels that describe the intensity. The table below provides the scale's 1–9 rating range.

- It can be used to calculate local criteria, sub-criteria, and alternatives after determining the relative importance of items from each level of the hierarchical structure. The options' overall priorities are then combined after that. The aggregate of local priorities, which are weighted by components from higher levels, is used to establish the overall priority of each alternative.

- Sensitivity analysis is finally performed.

In order to successfully apply the AHP technique, four axioms must be satisfied: the reciprocity axiom, the homogeneity axiom, the dependence. a technique for including end-user behavior in energy efficiency scenario modelling

GIS Suitability map for trekking

An influence percentage was allocated to raster layers. As previously said, AHP computed the percentage influence. The output raster was produced by multiplying the cell values by the percentage influence of each, then adding the resulting values. A weighted overlay is the name of the entire procedure. A GIS trekking suitability map was created by multiplying the non-reclassified LULC layer with a weighted overlay.

Table 2: Reclassification table

SN	Layer	Reclassifying Class	Score
1	Slope	0 – 30	9
		30-40	7
		40-50	5
		50-60	4
		>60	2
2	Aspect	South, Flat, Southwest, Southeast	2
		North, Northwest	7
		Northeast	9
		East, West	4
3	Proximity to Existing Route	0-350	9
		350-500	8
		500-800	6
		800-1000	5
		>1000	4
4	Proximity to Cultural and Religious Site	0-350	9
		350-500	7
		500-800	6
		800-1000	4
		>1000	2
5	Proximity to Settlement Area	0-250	10
		250-500	8
		500-800	6
		800-1000	4

		>1000	2
6	LULC	Settlement	7
		Water bodies	1
		Snow	6
		Barren Land	5
		Vegetation	9
7	Amenities (Hotels, PoliceStation, Hospital, Bank, Shop)	0-300	9
		300-600	7
		600-750	5
		750-1000	3
		>1000	2
8	Tourist Spot (View Tower, View Point, Caves, Lake, Ponds)	0-100	9
		100-200	8
		200-400	6
		400-800	5
		>800	3

Theme-based map preparation

 Once the aforementioned suitable trekking route had been chosen. To ascertain various tourism prospects, data gathered and route traces on base maps by locals using PGIS, data and location traces on Kobo Collect, and OSM tracker are combined (Adventure, Cultural and religious, Educational, Ecotourism). The integrated data includes location-specific information for various tourist attractions, view towers, greenery, culture and festivals, food, adventure locations, caves, and so forth. Then, each of them is categorized and organized according to the type of tourism they represent. Temples and Gumbas fall under the headings of "culture tourism," "adventure tourism," and "animal and vegetation-based tourism." Consequently, a specific map is made for each form of tourist, along with the best route that has already been chosen.

3. RESULTS AND DISCUSSION

3.1. Results

 This study identifies the framework for creating mountain tourism planning and implementation strategies, which is one of the most crucial aspects of Nepal's tourism industry. It identifies the local tourism resources that can be preserved and used to promote tourism by fusing local information with GIS technology.

3.1.1 Settlements based tourism

It was identified that using the aid of the Participatory Geographic Information System (PGIS), there were various communities along the Machhapuchhre Model Trek, but some of the most well-known ones include Kuibang, Saidighhata, Imu, Tarko, and Promdhu, among others. The majority of the population represented
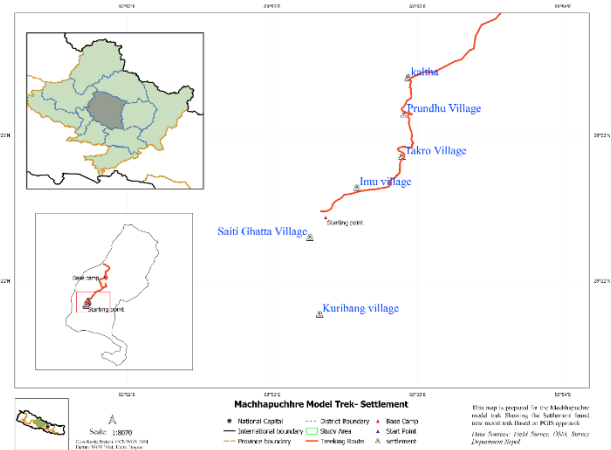

Figure 7: Settlement based map

to the Gurung and Tamang communities, and they have their own traditional cultural dance performance that draws the majority of tourists in this model trek.

3.1.2 Culturally based tourism

Along with the Tamang culture, there are so many Hindu-based tourism cultural places like Siddhi Baraha temple, Dudhpokari Cave, Deurali temple etc. Many tourists can delight in and have wonderful lives while worshiping God. There is also Buddhist culture, such as that of Gummba, in addition to Hindu culture. There were a few caves and the Nau
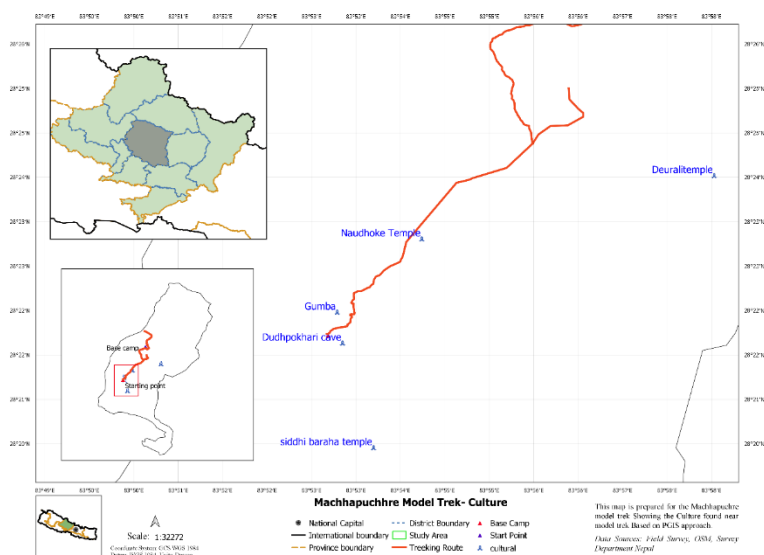

Figure 8: Cultural site-based map

Dhoke Temple, one of the most well-known locations in the model trek. The majority of tourists can draw attention there because it is close to the trek's lunch camp. According to locals, it features as nine openings and caves with having natural structure inside, it stated for further research.

3.1.3 Adventure-based tourism

Many of the adventure destinations are located close to the trip route, in addition to the cultural sites and locations. One of the difficult journeys for tourists is the hilly route with the forest, snow, and mountains. Along with this, the beginning of the journey path features many exciting

locations, such as canoeing. Other exciting locations are at the 4120-meter-height of Machhapuchhre View Point. At 3920 meters above sea level, Shirka Peak View Point is close to the hike route and offers views of most peak point of Kaski district and other parts of Nepal. Piper Lakes, which are located a little off-course from the main hike at 3310 meters above sea level. Numerous people can camp there viewing unwind in the splendor of

Figure 9: Adventure site-based map

the surrounding forest, lake, and snowy landscape. This area can be further improved as a camping area. The viewpoint known as Korchan viewpoint, which is 3682 meters above sea level, is located below this. One of the best existing things about this viewpoint is that the fish tail view of Machhapuchre and the crystal colour of Mardi Himal is in front of the viewers. In addition to the mountain, this viewpoint also offers a stunning view of the Laali Guarans (National flower), Sallo, Gheukumari, Tite pati, Bimiro, and Methi plants. Along with the historical site of Naudhoke Temple, there is also a more adventurous location called Naudhoke Cave nearby, where visitors can travel and see inside the cave. There are a few difficulties like fears of various wild animals, such as Bear, Tiger, etc., and a few difficulties with the weather, such as snowfall (cold), forest in every direction, and lack of sunlight, which also makes them one of the most adventurous locations along the trekking route

3.1.4 Hotel and Restaurant

It was found that a large number of tourists were travelling along the trekking route; they needed hotels, restaurants, and places to stay at home in addition to sharing experiences, ideas, and knowledge about cultural adventures, plants, animals, and natural beauty. As there are few hotels, restaurants, and homestays along the recommended route,
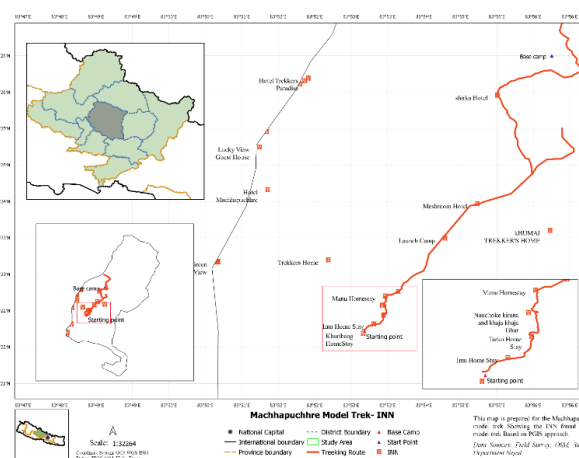

Figure 10: Hotel and restaurant-based map

which provide the greatest services in their hotels and homestays despite their minimal facilities and resources.

3.1.5 Education-based tourism

People visit new places not only for the fun and stunning scenery, also to pick up new skills. Along with tourism, it may also include educationally based travel, where travelers can follow a model trek path to learn about various plants and animals. People can research plants and bushes, animals, historical sites, waterfalls, caves, and
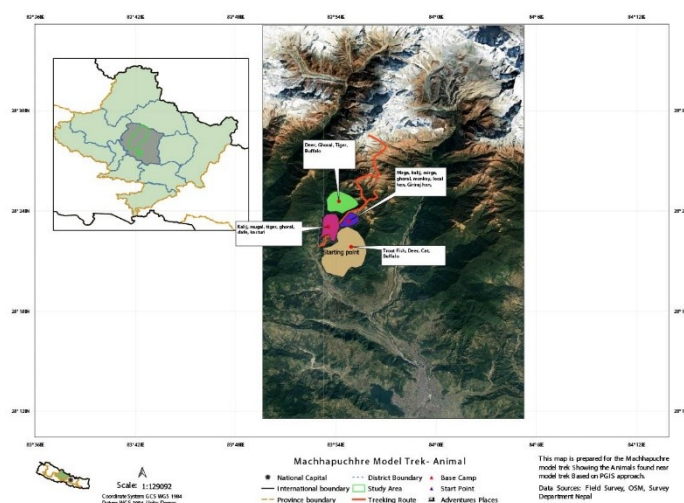

Figure 1: Animal site-based map

vistas while on a trip. Maps based on vegetation and animals may be utilized for study purpose.

3.1.5.1 Vegetation tourism

Many visitors or, more precisely, researchers came here as part of the model walk for the study about various plant species prevalent in this area. This is known as plant-based tourism. Various types of flora identified along the walk path have medicinal uses as well. When local people become ill and that to be cured is believed that a medicinal vegetated plant that is found in their area, many locals utilize this medicinal plant as a last resort. National Flowers were found in this model trek. Along with this, a lot of the medicinal plants and bushes, such as harro, Barro, Sisno, Kurilo, Karkalo, Tea plant, Phapar, Aalainchi, lakhuto, were found in these locations. Many different trees, including dhupi sallo, Lapsi, Banmara, and others, can also be found in these areas together with these medicinal herbs and shrubs, which also means that it is a location that can be used for plant-based tourism.

3.1.5.2 Animal-based tourism

Many visitors or more precisely, researchers came here as part of an animal-based tourism to examine the various species of animals that can be found here. There are various species of animals to be discovered along this hiking path, including tigers, deer, and other domestic animals, as it is covered by forest. The buffalo farm in the heart of the forest was found to produce local products that are utilized for economic purposes.

3.2 Discussion

Using technical GIS and PGIS expertise, project was successful in determining the best route approach. Slope, DEM, land cover, Settlements, hotels, various facilities (banks, ATMs, etc.), cultural sites, tourist destinations, adventure destinations, and the existing route were employed in the technical section. Just like the existing path, so is ours. The route is not only the quickest, but it also takes use of several ecotourism-related elements including communities, diverse cultures, adventure locations, etc. In addition to visiting Machhapuchhre Mountain, tourists may also familiar with other cultures such as Tamang culture, several Hindu temples, and Buddhist Gumba. Visitors can visit many tourist' attraction's locations and points including domestic and wild animals. Local birds, Giriraj, Kalij, and other domestic animals can be seen in the domestic area together with wild animals like tigers, deer, and bears. After successfully planning the ideal route for the sample hike, a map was created with five various themes. Based on the PGIS's fundamentals, theme-based maps were created. The various interviews with key informant respondent suggest and prepare various cultural, adventurous, educational, hotel, and homestay-based layers. A small group of the locals are knowledgeable about maps, and they suggested various sketches of the routes and gave information for various subjects on these paper maps. Different racial, age, and cultural groups express their opinions on many issues. They provide their views on how they can build the model trek. When creating their maps, their advice was also taken into account. Different vegetation-based maps and animal-based maps were created based on what individuals observe when they visit along the suggested path and what they want to share experiences in their surroundings. With the growth of ecotourism, many locals will have the chance to expand their economies using sustainable natural resources. Many local people have access to jobs like those of local guides. Opening of various hotels, homestays, and restaurants for tourists may generate money while putting minimal strain on the environment. It was found through research and PGIS-based methods that there are just a few homestay establishments at present, and inspire locals to build and manage various hotels and homestays in the future.

With this thing, people can come up with creative ideas for managing hotels in that difficult setting. Local governments have the opportunity to generate money by leasing land to members of the community who will run tourism-related programs like hotels, restaurants, parks, and other businesses. At present, a hospital or helipad exists. With this knowledge, locals can make plans for how to deal with these issues. The necessities in these locations for the betterment of both the local people and trekkers are of hospital and a helipad. This route offers financial as

well as social benefits to locals, the local government, as well as commercial businesses. Banks and other private companies can open their branches and ATMs, which are essential when traveling. For the tourist, shoe and clothing stores can be established using local materials.

Although this idea has many advantages, a few risks also exist. It may involve trash and waste management, crowding, or security concerns. When tourists travel to various cultural and adventurous locations, they can leave various rubbish. Various unlawful activities may also take place which results in a rise of illicit activity, such activities can be minimized by previous of security management in coordination with local people.

4. Conclusion

Integration of the Participatory GIS approach and use of local knowledge is more useful for optimal trek route determination and thematic map preparation than just using expert knowledge and technical GIS and its tools. A suitable trek route was obtained from interviews, cultural sites, forests, traditional cuisine, animals, and medicinal herbs and shrubs. So, their nature-saving activity and this project help to maintain ecotourism. Current research used GIS tools to model the trek as the best route. Several geographical, natural, and demographic factors are used to obtain a suitable trek route. Five different maps are made to show the different features along the route. MCDM method, AHP is used for weight determination of each parameter, and each parameter is ranked according to its importance. This research has concluded that the AHP method is one of the best methods for weightage calculation where both qualitative and quantitative judgments have to be applied. As local knowledge has been used to integrate their knowledge to model the route. The obtained final suitable route is nearly similar to the existing route. From this, it has been concluded that most of the important places where tourists might visit are near the existing route. But the reason for not being the same as obtained in a suitable map is the topology along the existing route. It is easier to identify places of various features if a map contains only the collection of the same types of features, so, for this project, theme-based maps are a perfect match. It's people's nature to explore different places and elements which is available in their travels. To show the different elements along the route, thematic maps based on settlement, cultural sites, adventure, hotel and restaurant, and education are obtained. For the best trek route determination, the data that are not available from the map and other technical resources are acquired from local people, trek guides, i.e., from PGIS, and the data that cannot being able to achieved from PGIS are acquired through technical GIS resources and also the analysis was done in technical GIS software.

Acknowledgement

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REFERENCES

(2015, 2). Retrieved from NepalTimes: http://archive.nepalitimes.com/page/adventure-tourism-nepal-billion-dollar-industry

Bahaire M., &. E.-W. (1999). The Application of Geographical Information Systems (GIS) in Sustainable Tourism Planning: A Review. Journal of Sustainable Tourism. 159-174.

Balli, E. &. (2017). Identifying Motivational Factors For Trekking Activities. Journal of Recreation and Tourism Research.

Barano Siswa Sulistyawan, P. A. (2018). Integrating participatory GIS into spatial planning regulation: the case of Merauke District, Papua, Indonesia. 34.

Brabyn, J. A. (2013). Using remote sensing and GIS to investigate the impacts of tourism on forest cover in the Annapurna Conservation Area, Nepal. Applied Geography.

Chen, R. (2007). Geographic information systems (GIS) applications in retail tourism and teaching curriculum. Journal of Retailing and Consumer Services. 289–295.

Dye, A. S. (2006). A GIS-based spatial decision support system for tourists of Great Smoky Mountains National Park. Journal of Retailing and Consumer Services. 269–27.

Environmental Systems Research Institute (ESRI). (2010). Retrieved from https://www.esri.com/en-us/home

Frederick Dayoura, G. Y. (2021). Do ecotourism sites enhance rural development in Ghana? Evidence from the Wechiau Community Hippo Sanctuary Project in the Upper West Region, Wa, Ghana. 121-146.

Fung, T. &. (2007). Ecotourism planning using multiple criteria evaluation with GIS', Geocarto International. 87-105.

Hasan, S. R. (2015). Exploring Bandarban Through Trekking Trails: A New Horizon For Community-Based Tourism Development. European Scientific Journal.

Justin Beall, B. B. (2021). An ecotourist by whose standards? Developing and testing the Ecotourist Identification Scale (EIS).

K.C., A. (2020, 12 20). trekking in nepal. Retrieved from aticlebiz: https://articlebiz.com/article/1051724120-trekking-in-nepal

Mohammad Abousaeidi, R. F. (2015). Geographic Information System (GIS) modeling approach to determine the fastest delivery routes, 10.

Mohammad Abousaeidi, R. F. (2015). Geographic Information System (GIS) modeling approach to determine the fastest delivery routes, 35.

Nepal – Border, Facts, Tourism, Places, Introduction, Information All About Nepal. (2013). Retrieved from imnepal: https://www.imnepal.com/nepal-tourist-tourism-places/

Periodic planned development of tourism in Pokhara . (n.d.). Retrieved from newnepaldream: http://newnepaldream.blogspot.com/2016/08/periodic-planned-development-of-tourism.html

Ryngnga, P. K. (2008). Ecotourism Prioritization: A Geographical Information System Approach. South Asian Journal of Tourism and Heritage. 49-56.

SDFDFDF. (3243). SFAAFD. BGSFG.

Shrestha, A. E. (2000). Application of DEM Data to Landsat Image Classification: Evaluation in a Tropical Wet-Dry Landscape of Thailand. 8.

Taejin Parka, ,. W.-K. (2011). Assessment of land-cover change using GIS and remotely-sensed data:A case study in Ain Snoussi area of northern Tunisia. 75-81.

Taherdoost, H. (2017). Decision Making Using the Analytic Hierarchy Process (AHP); A Step by Step Approach. International Journal of Economics and Management Systems.

Trekking in the Nepal Himalaya. (2022, 6 7). Retrieved from footprintadventure: https://www.footprintadventure.com/blog/trekking-in-the-nepal-himalaya

Upreti BR, U. P. (2013). Tourism in Pokhara: Issues, Trends and Future. Prospects for Peace and Prosperity. Pokhara Tourism Council, Pokhara South Asia Regional Coordination Office of NCCR North-South And Nepal Centre for Contemporary Research, Kathmandu.