

Exploring the Untapped Potential: Using AHP and GIS to Identify Suitable Areas for Tourism Development in Meghalaya

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Abstract: *Tourism has become an important driver of economic growth and development worldwide. In the context of India, Meghalaya is a state with immense tourism potential, given its rich cultural heritage and natural beauty. However, the full potential of Meghalaya's tourism industry has not yet been realized, and there is a need to identify suitable areas for tourism development. This study aims to identify suitable areas for tourism development in Meghalaya using the Analytical Hierarchy Process (AHP) based on the parameters of potential accessibility, distance from city center, linkage to tourism destinations, and accommodation quality. The study area is Meghalaya, located in northeastern India. The data used in this study were collected from various sources, including government reports, tourism department websites, and field surveys.*

The results of the study show that the areas with the highest potential for tourism development are Shillong, Cherrapunjee, Mawlynnong, and Dawki. These areas have high potential accessibility, proximity to major tourism destinations, and good accommodation options. The findings of this study can guide policymakers and investors in making informed decisions about tourism development in Meghalaya to promote sustainable tourism and economic development in the state.

The study demonstrates the potential of using the AHP method in combination with GIS technology to identify suitable areas for tourism development in Meghalaya. The findings of this study can help promote sustainable tourism in the state, which can have a positive impact on the local economy, environment, and cultural heritage. This research highlights the importance of using data-driven approaches to promote sustainable tourism.

Keywords: *Tourism potential index, GIS, AHP, Meghalaya, Internal tourism potential, External tourism potential, Sustainable tourism development.*

1. Introduction

Tourism has emerged as a crucial industry worldwide, contributing significantly to the economic development of regions [1]. In developing countries like India, tourism has become a key driver of growth, generating revenue and creating employment opportunities. Northeastern Region (NER) of India has unique natural resources, cultural heritage, and adventurous activities,

which attract tourists from all over the world. Tourist inflow into the region rose from 71.62 lakh in 2014-15 to over one crore visitors in 2018-19, according to a CAG Report [2]. The tourism industry in the NER has immense potential, and it is expected to contribute significantly to the region's economic growth and development.

Meghalaya, located in the Northeast region of India, has immense tourism potential due to its rich culture, biodiversity, and scenic beauty [3]. However, despite the potential, the region faces various challenges such as poor infrastructure, inadequate marketing, and low connectivity, which hamper the growth of the tourism industry. However, there is still scope for improvement in the tourism infrastructure and services in Meghalaya [4]. Therefore, it is crucial to identify suitable areas for tourism development and prioritize them based on their tourism potential. In recent years, Geographic Information System (GIS) has emerged as a useful tool for analyzing and visualizing spatial data related to tourism. GIS allows for the integration of various data sources, such as satellite imagery, maps, and demographic data, to identify areas with high tourism potential and to develop strategies for governance and sustainable tourism development [5,6]. This study aims to explore the potential of GIS technology in improving tourism in Meghalaya [7].

Tourism Potential Index (TPI) is a widely used tool for identifying potential tourist sites, and it has been applied in various countries to evaluate the tourism potential of different regions [8]. The TPI method uses a multi-criteria decision-making approach that evaluates the tourism potential of each site based on various criteria, such as accessibility, infrastructure, natural resources, cultural heritage, and tourist demand. This paper aims to use the TPI method [9] to identify the most promising tourist sites in the NER region and provide insights to policymakers, investors, and tour operators on where to invest in tourism infrastructure.

2. Study Area & Data Used

The study area for this research is Meghalaya, a state located in northeastern India known for its natural beauty and cultural heritage. Meghalaya is known for

its unique natural and cultural attractions, such as the living root bridges, the cleanest village in Asia, and the Nohkalikai waterfall, which attract a large number of tourists every year.

The data used in this study to calculate the internal and external Tourism Potential Index (TPI) included parameters such as potential accessibility, distance from city centre, linkage to other tourist sites, accommodation quality, bio sensitivity, footfall, seasonality, and national/international recognition. These parameters were computed using layers from Table 1. The data were analyzed using the Analytic Hierarchy Process (AHP) [10] to identify the most suitable areas for tourism development in Meghalaya. The findings of this study can help guide policymakers and investors in making informed decisions about tourism development in Meghalaya to promote sustainable tourism and economic development in the state.

Table 1: List of parameters used to compute TPI and data used generate those parameters

(NeSDR: North Eastern Spatial Data Repository)

Name	Layers Used	Data Sources
Potential Accessibility	Road layers, railway stationslayer, Airport Point Layers and Meghalaya tourist point layers	NeSDR
Distance From City Center	District Headquarter Point layer overlay with Meghalaya tourist points layer	NeSDR
Linkage To Other Tourist Destinations	Meghalaya Tourist Point layers	NeSDR
Accommodation Quality	Hotels Point layer and Meghalaya Tourist Point Layers	NeSDR
Bio Sensitivity	Depending on the Protected Forest Area and the number of endemic species presents in a particular location	NeSDR
Footfall Area	The number of tourist that particular spot can accommodated at a time. We have generated footfall area From google earth for each tourist spot	Web Services of High resolution satellite images
Seasonality	The data is taken from internet, Field Visits and Talking With local People	NA
National/ International Recognition	Data is taken from UNESCO website and National parks list from Wikipedia	NA

3. Methodology

This study used the Analytical Hierarchy Process (AHP) to identify suitable areas for tourism development in Meghalaya, considering both external and internal tourism potential. AHP is a multi-criteria decision-making method that enables the prioritization of alternatives based on a set of criteria. The method involves breaking down the decision problem into a hierarchical structure of criteria, sub-criteria, and alternatives, and then comparing them pairwise to determine their relative importance.

For external tourism potential, the criteria used were potential accessibility, distance from city center, linkage to other tourist sites, and accommodation quality. The potential accessibility criterion was measured by the distance of the area from the nearest transportation hub, such as an airport, railway station, or bus terminal. The distance from the city center criterion was measured in terms of the driving time from the city center to the area. The linkage to other tourist sites criterion was measured by the number of tourist destinations that can be visited from the area within a 5 km radius. Finally, the accommodation quality criterion was measured by the number of hotels, resorts, and guesthouses in the area and their star rating.

For internal tourism potential, the criteria used were bio sensitivity, footfall, seasonality, and national/international recognition. The bio sensitivity criterion was measured by the fragility of the ecosystem in the area and the potential impact of tourism on the environment. The footfall criterion was measured by the number of tourists visiting the area. The seasonality criterion was measured by the distribution of tourists throughout the year. The national/international recognition criterion was measured by the level of awareness and interest among domestic and international tourists.

To calculate the Tourism Potential Index (TPI), each criterion was assigned a weight based on its relative importance (Table 2) in the decision-making process. The weights were determined using a pairwise comparison matrix, where each criterion was compared to every other criterion to determine its relative importance. The participants in the pairwise comparison were experts in the field of tourism development and planning.

Table 2: Margin specifications

Parameter	TPI	Criteria weight
Potential accessibility	External	0.11200
Distance from city centre		0.04200
Linkage to other tourist destinations		0.05600
Accommodation quality		0.07000
Bio-sensitivity	Internal	0.19636
Footfall area		0.065454
Seasonality		0.065454
National/International recognition		0.39273

To calculate the external TPI, each alternative (i.e., tourism destination) was given a score on each criterion, ranging from 1 to 5, where 1 indicated poor performance and 5 indicated excellent performance. The scores were then multiplied by the weights assigned to each criterion and summed to obtain the external TPI score for each alternative.

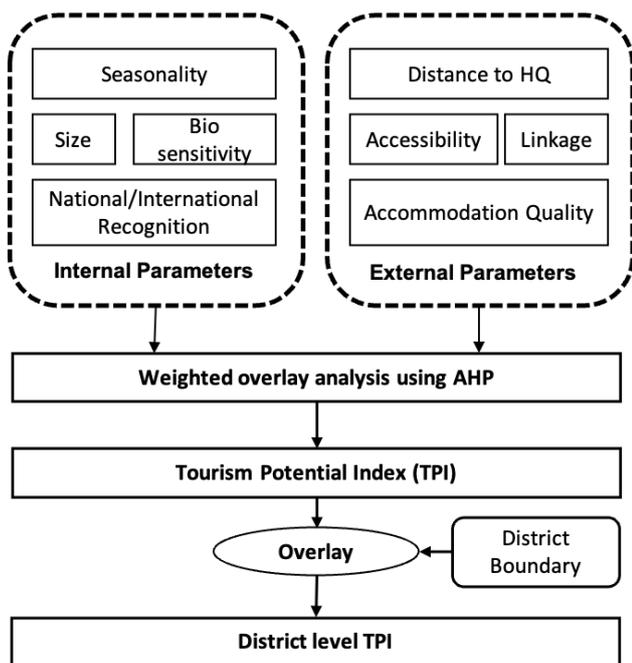


Figure 1: Schematic flow of the methodology followed

Similarly, for the internal TPI, each alternative was given a score on each criterion, ranging from 1 to 5. The scores were then multiplied by the weights assigned to each criterion and summed to obtain the internal TPI score for each alternative. The high level methodology is depicted in figure 1.

The TPI scores were then mapped using GIS technology to identify the areas with the highest potential for tourism development. The maps were generated using GIS software, and the data used in the analysis were obtained from various sources, including government

reports, tourism department websites, and field surveys.

The results of the study were validated through field surveys and expert consultations. The findings of the study can guide policymakers and investors in making informed decisions about tourism development in Meghalaya to promote sustainable tourism and economic development in the state.

3. RESULTS & DISCUSSIONS

The study focused on computing both internal and external tourism potential of Meghalaya. The parameters used for computing internal TPI were bio-sensitivity, footfall, seasonality, and national/international recognition. The parameters used for computing external TPI were potential accessibility, distance from city center, linkage to other tourist sites, and accommodation quality. The parameters to estimate external tourism potential are visualized in Figure 2 & 3.

The results showed that the areas with the highest internal TPI were selected regions in Garo Hills (Figure 4). These areas were found to have high bio-sensitivity, footfall, seasonality, and national/international recognition.

For external TPI, the areas with the highest scores were Shillong, Cherrapunji, and Mawlynnong. These areas were found to have good potential accessibility, linkage to other tourist sites, and accommodation quality, and were located at a moderate distance from the city center. The areas with the lowest external TPI scores were Tura and Williamnagar, which were found to have poor potential accessibility, poor linkage to other tourist sites, poor accommodation quality, and were located far from the city center. The results are depicted in figure 4 and figure 5. The total area under different districts for internal and external TPI are depicted in table 3 and table 4. The districts are encoded as, EGH: East Garo Hills, EKH: East Khasi Hills, WGH: West Garo Hills, SGH: South Garo Hills, SWKH: South West Khasi Hills, WJH: West Jaintia Hills, SWJH: South West Jaintia Hills, EJH: East Jaintia Hills, NGH: North Garo Hills and WKH: West Khasi Hills.

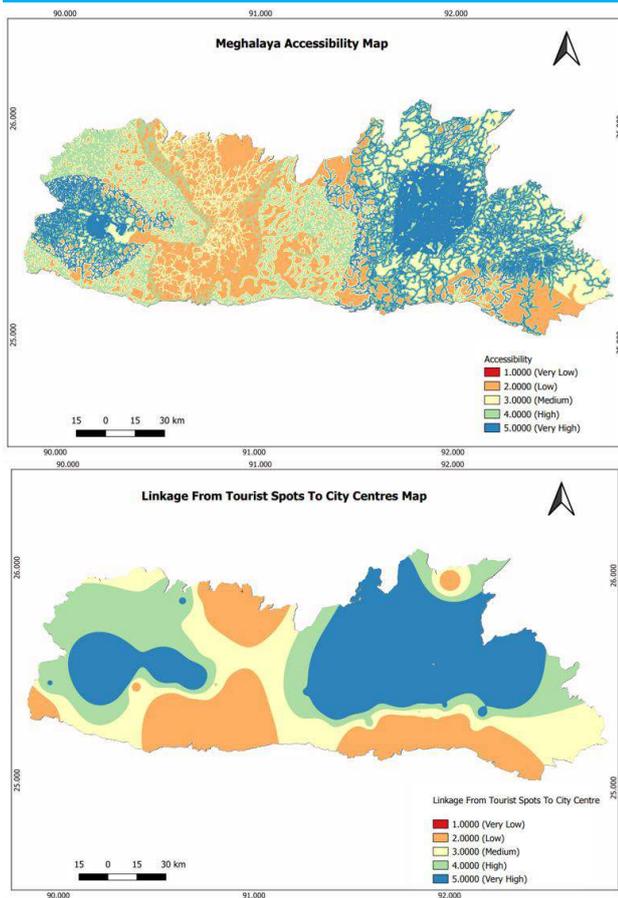


Figure 2: Accessibility (top) and Linkage to city center (bottom) Parameters used to estimate external tourism potential using weighted overlay analysis

Table3: Area covered under Different Category of Eternal Tourism Potential Index for different districts in Meghalaya:

District	TPI area (Sq. Km)				
	Very Low	Low	Medium	High	Very High
EGH	439.75	380.67	656.88	109.06	14.103
EKH	1.1538	33.30	302.76	549.89	1969.07
SGH	652.30	476.59	592.94	131.67	0
SWKH	29.38	384.55	368.52	346.58	110.34
WGH	92.19	157.47	1040.70	841.88	476.73
WJH	61.40	119.94	198.47	723.34	769.73
SWGH	25.07	114.35	192.68	363.55	117.84
EJH	152.92	477.61	458.71	618.50	199.01
NGH	695.52	178.31	354.30	23.83	0
Ri Bhoi	0	24.58	175.87	907.32	1238.92
WKH	674.76	629.44	981.87	820.27	832.62

The study also highlights the importance of using a multi-criteria approach such as AHP to compute TPI, as it takes into account multiple parameters that influence tourism potential. Furthermore, the use of GIS technology to map and visualize TPI scores can aid in identifying areas with high potential for tourism development.

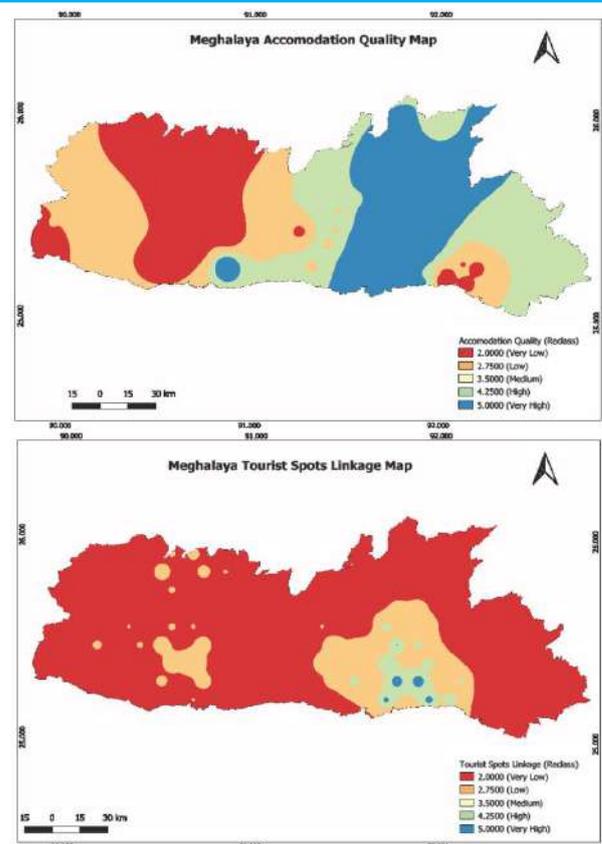


Figure 3: Accommodation quality (top) and linkage to tourist spots (bottom) used to estimate external tourism potential using weighted overlay analysis

The results of the study suggest that Meghalaya should focus on developing tourism infrastructure in areas with high internal and external TPI scores. For areas with high internal TPI scores, the focus should be on promoting the natural and cultural heritage of the region to increase footfall and national/international recognition. For areas with high external TPI scores, the focus should be on improving accessibility, developing linkage to other tourist sites, and upgrading accommodation quality.

Table 4: Area covered under Different Category of Internal Tourism Potential Index for different districts in Meghalaya:

District	TPI area (Sq. Km)				
	Very Low	Low	Medium	High	Very High
EGH	0.02	93.25	435.34	762.55	309.32
EKH	20.57	1661.81	533.56	355.09	285.13
SGH	0	31.15	66.87	332.85	1422.74
SWKH	0.38	108.064	192.74	171.43	766.77
WGH	0	14.44	397.09	887.57	1310.25
WJH	0	1854.94	18.26	0.08	0
SWGH	0	74.43	73.02	421.70	244.84
EJH	0	947.47	938.88	21.29	0
NGH	0.14	448.41	588.76	213.09	2.01
Ri Bhoi	0	752.91	788.21	563.73	242.57
WKH	0	486.21	824.07	950.67	1678.31

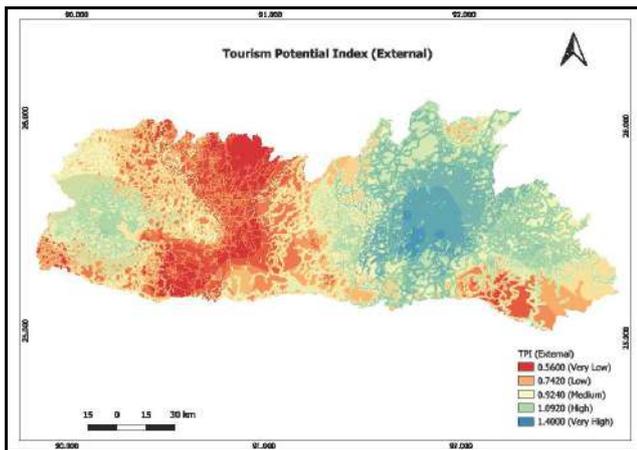


Figure 4: Estimated external tourism potential using weighted overlay analysis for Meghalaya

However, the study has some limitations. The TPI scores were computed based on secondary data sources, and the accuracy of the results may vary depending on the quality and reliability of the data. Additionally, the study did not take into account the socio-economic and environmental impacts of tourism development, which are important considerations for sustainable tourism planning.

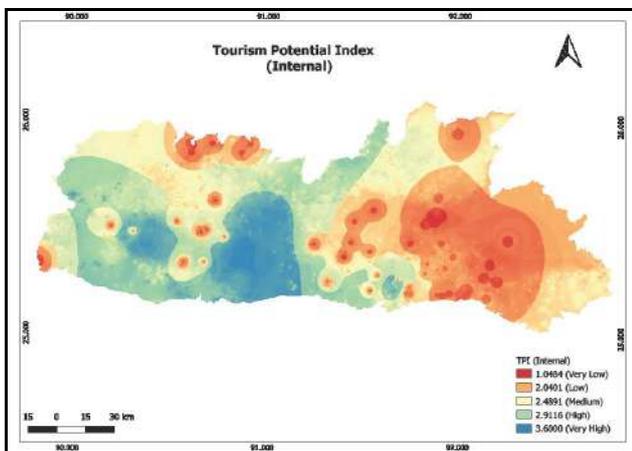


Figure 5: Estimated Internal tourism potential using weighted overlay analysis for Meghalaya

The study provides valuable insights into the internal and external tourism potential of Meghalaya, and can be used as a basis for formulating tourism development policies and strategies in the region.

4. Conclusions

In conclusion, this study aimed to identify potential tourism sites for expansion in Meghalaya using GIS and AHP techniques. The results of the study showed that the state of Meghalaya has a high potential for tourism development, both in terms of internal and external TPI.

The internal TPI analysis revealed that bio-sensitivity and national/international recognition were the most significant parameters that influenced tourism potential in Meghalaya, while footfall and seasonality were the least significant parameters. The external TPI analysis showed that potential accessibility and linkage to other tourist sites were the most important parameters, while distance from the city center and accommodation quality were less significant. The findings of this study can assist policymakers and tourism stakeholders in identifying and prioritizing areas for tourism development, which can lead to sustainable economic growth and employment opportunities for local communities.

However, there are several limitations to this study. Firstly, the study relied on secondary data sources for the analysis, which may not be entirely accurate or up-to-date. Secondly, the study did not consider the socio-cultural and environmental impacts of tourism development, which may have long-term consequences for local communities and the environment. Future studies should address these limitations and incorporate a comprehensive analysis of the socio-cultural and environmental impacts of tourism development.

In summary, the study demonstrated the potential of GIS and AHP techniques in identifying potential tourism sites for development. The findings of this study can be used as a foundation for future research and policy decisions in the tourism sector in Meghalaya.

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