

# **An Assessment Framework of Impact factors using Multi-Criteria Decision Making System – A Tourism Case study of Garhwal Region, India**

***Adarsh Jaiswal, Mahima S, Munivel S\****

*Christ (Deemed to be University), Bangalore - 560029, Karnataka*

## **Abstract**

Tourism is one of the growing sectors in India, especially the Garhwal Himalayan region, which contributes to socio, cultural and economic importance. The hills, valleys, and rivers of the place attract tourists all around the world. Despite facing various calamities and climatic instabilities, it mesmerizes globetrotters. This study proposes a variant of Multi-Criteria Decision-Making Algorithm named TOPSIS which delivers the result of parameter prioritization using various dynamic criteria in different situations. In order to overcome the pitfalls of existing decision-making algorithms, various other methods are probed and compared. Performance analysis proves that the TOPSIS which is a combination of decision making and Machine Learning algorithms. This research work measures the importance of tourist spots and categorizes them under different themes. The result suggests a priority list contains criteria that can be focused on the management plan. Multi-Criteria Decision Making System methodology named "Technique for Order Preference by Similarity to Ideal Solution" also known as TOPSIS, is used to create the priority list. Resultant list says Awareness of Solid Waste management among local communities should be treated as the top priority. Next is identifying the employment source and income of the local community, and the list contains nine selective criteria framed concerning the theme of tourist spots.

**Keywords:** Multi-Criteria Decision Making System, TOPSIS, Uttarakhand, Garhwal Himalayas, Tourism

## Introduction

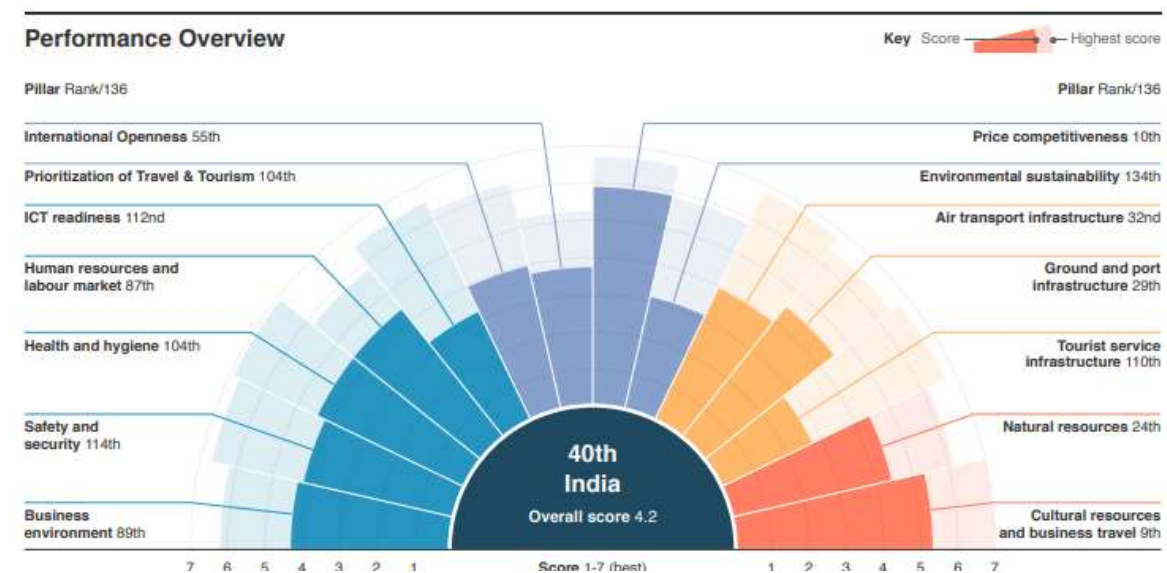
Tourism plays a crucial role in building up a country's economy by promoting employment opportunities, which pave the way for generating income and foreign exchange earnings. The competitive index of Travel and Tourism of the year 2017 ranks India 40<sup>th</sup> position out of 136 countries globally as shown in figure 1, with a growing score of 3.86%, which is an escalation of twelve places, when comparing the 2015 ranking index. India has several socio-economic, cultural sites spread across its vicinity, which attracts more global trotters. This case study is about the Uttarakhand region of India as it has several tourist hubs, and despite various calamities, its cultural importance has the capability of attracting pilgrims.

Health consists of the place for rejuvenation, 5. Rural Area tour, Figure 2 shows sub-region of the Uttarakhand state of India.

## Review of Literature:

Some pertinent literature works help derive key indicator factors from being focused on for the betterment of tourism at Uttarakhand.

(Kala, 2013) discusses the efforts of the Government of Uttarakhand to promote eco-tourism, like establishing Dhanolti eco-park, and suggests an excellent model retain eco-friendly tourism. The author also insists the benefits of established Dhanolti eco-park, such a solution for unemployment, persisted among local communities by providing them income



Source: Travel & Tourism Competitiveness Index 2017 edition

Figure 1: Global Performance overview of Indian Tourism

The case study categorizes the theme of tourist spots into five based on guidelines of the Uttarakhand government and literature works (Dhiraj et al., 2017), (Bansal and Amit, 2010). The categories are 1. Adventure sports include Trekking of several mountain regions, 2. The Pilgrimage consists of Kedarnath, Badrinath, etc., 3. Sightseeing includes Valley of flowers, Parks, 4.

generation strategies from tourists by attracting them for various participatory activities like renting bamboo eco huts for stay, adventure sports facilities, and others, handling deforestation activities by hoteliers and locals.

(Pandey et al., 2016) discussed how natural disasters like cloud bursts, debris flow, landslides, and flash floods impact hydrological hazards in

Alakananda Basin, Uttarakhand. The study detailed the causes and consequences of Anthropogenic activities like establishing mining and power projects in rivers valleys. Adapting technical skills to handle the disaster and risk reduction is suggested.

(De Lone et. al. 1992) has analyzed from pertinent literature and presented the features of Information systems' success in six dimensions namely –Quality of the System, Quality of the Information, Usage, Satisfaction of the user, Impact on individual and Impact of Organization. The quality of the system and information has

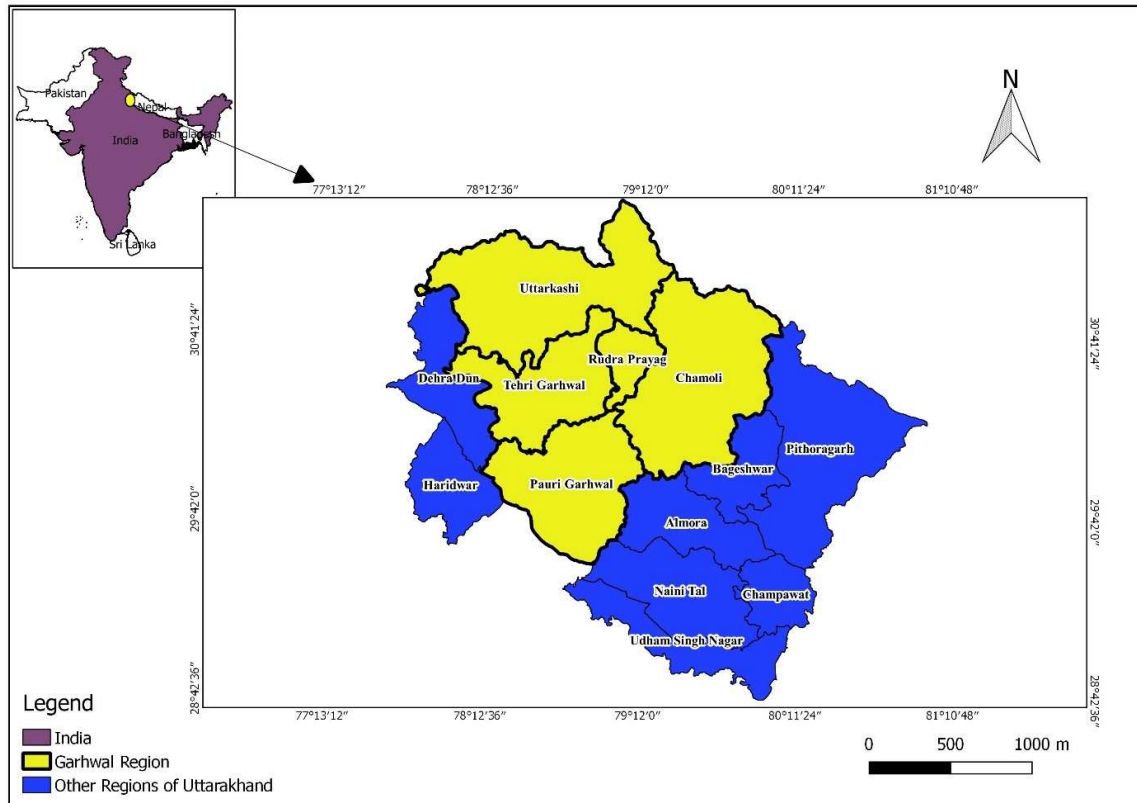


Figure 2: sub-region of the Uttarakhand state of India

(Rana, 2013) The history of flood occurrences in the Himalayan region of the Alakananda basin is described in detail in the literature, starting from 1994 to 2013. Authors commented that the damage increases as the human intervention and ignorance to warning of nature. Flash floods that occurred in 1894 and 1970 caused more damage to lives. (Sati, 2010) has done a detailed study on livelihood analysis of local communities, primarily based on agriculture, tourism, hydro projects.

various metrics such as Convenience of access, Flexibility of the system, Integration of the systems, Response time, Ease of learning, Reliability, Resource Utilization and Investment Utilization, stored record error rate. The information quality includes accuracy, precision, currency, timeliness, reliability, completeness, conciseness, format. Relevance to decisions. User satisfaction measure includes use or nonuse of computer-based decision aids, Use of information system to support production, use of numerical and nonnumerical information, Frequency of requests

for specific reports, Voluntariness of use, Extent of use, regularity of use, Hardware satisfaction, software satisfaction and enjoyment. Individual impact includes, user confidence, quality of decision analysis, efficient decisions, Time to arrive at decision using provided data and system provided by the system, Time taken to complete a task, time to make pricing decisions, Interpretation accuracy, Decision quality, forecast accuracy. Though there are six dimensions, all are interrelated components, they can be combined focused on the expected outcome. This detailed study of the authors shared a baseline idea about project information management system.

(Abbas et. al. 2015) This review article reviews different domains such as such as energy, environment, sustainability, supply chain management, quality management, GIS, construction, project management, safety, risk management, manufacturing, technology management, operations research, strategic management, knowledge management, production management, and tourism where Multi criteria Decision Making Systems like AHP, PROMETHEE, ANP, VIKOR, TOPSIS, DEMATEL, ELECTRE I, II, III are used predominantly. There are hybrid and modular methods combining well-known techniques with fuzzy and grey number theory. Recent methods like COPRAS, ARAS-F, MOORA, MULTIMOORA, SWARA, and WASPAS are rapidly developed and applied to real-life problems.

(Chaghooshi et al 2016) The fuzzy hybrid approach effectively addresses the complexity of project manager selection by providing a systematic and accurate decision-making framework. The study highlights the importance of personal qualities in project manager selection and demonstrates the applicability of the proposed model. Future research could compare this approach with other FMCDM methods like

FTOPSIS and FAHP. (Clark et. al. 2000) strongly points out that the software is just assisting components in project management. There are

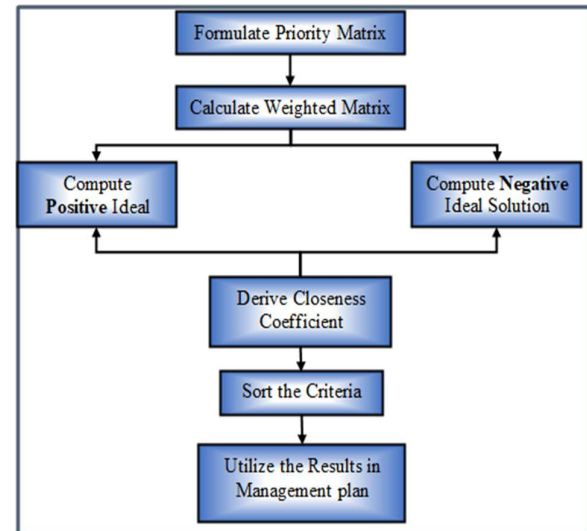


Figure 3: TOPSIS workflow diagram

four dimensions are highlighted ( i. e) Project planning which aligns with the organization's strategy, Project Portfolio Management which is about managing and prioritizing, Competencies like skills, content expertise, and human performance management and the last dimension mentioned is Human Performance Environment, which provides necessary resources, setting clear expectation, effective feedback mechanisms. To deliver a good project, a balanced approach to software tools as well as a well-structured framework is essential.

(Bhatt et al. 2018) Employment opportunities created by tourism spot at Garhwal Himalayas is discussed in detail, and potential tourist attraction spots are highlighted opportunities for local communities. (Masiero et al., 2012) Price sensitivity factors are listed concerning specific properties in local communities. Selective impact factors from the literature are chosen for the study are as follows:

Societal Impact (C1), Destination Significance (C2), Economic Impact (C3), Awareness of Solid Waste Management (C4), Infrastructure (C5), Planning and Management (C6), Product Marketing (C7), Knowledge of Renewable Energy (C8), Source of Income and Employment (C9). Societal impact denotes the Socio-Cultural implications of a particular place, e.g., Pilgrimage plays a leading role when comparing trekking and sightseeing categories. Destination Significance represents the importance of the site, and followed by factors are assigned ranks based on statistics department of Tourism, Uttaranchal.

## Methodology:

Multi-Criteria decision-making system (MCDM) is one of the systematic approaches to make a better decision. There are many MCDM techniques like Analytical Hierarchical Processing, TOPSIS, Min-Max, Fuzzy Intuitionistic algorithm, etc. The study utilizes TOPSIS, which can be expanded as "Technique for Order Preference by Similarity to Ideal Solution" (Triantaphyllou and Chi-Tun 1996).

The significance of TOPSIS is to rank the given attributes based on given criteria and priority, and it can handle multiple criteria for each feature. Although several decision-making algorithms are available, the ability of TOPSIS to handle numerical priority values makes it outperform. As an initial step, the factors (C1 to C9) are mapped with theme categories (A1 to A5) as stated in the literature review section. This mapping is done by assigning priority values based on literature and relevancy between factors and categories. For instance, Product marketing criterion is given high priority and given maximum score when Rural Area tour as product marketing is required to be focused at rural markets to promote the attraction of tourists. In this way, all the criteria

are mapped meticulously with different categories. They can be found in table 1 below.

Table 1: Priority matrix

	A1	A2	A3	A4	A5	A5
C1	3	1	2	3	3	2
C2	4	4	5	5	3	1
C3	3	4	3	2	3	5
C4	4	3	5	5	3	4
C5	4	2	1	3	1	4
C6	2	5	4	3	3	2
C7	3	3	1	4	3	5
C8	2	1	1	1	2	3
C9	4	3	2	3	4	5

The theme categories are Adventure sports (A1) Pilgrimage (A2) Nature (A3) Sightseeing (A4) Health and Relaxation (A5) Rural Area tour (A5)

In the next step, Weighted normalized matrix ( $d$ ) is created using equation (1); corresponding elements ( $d_{ij}$ ) are represented with their row (i) and column (j).

$$d_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \quad (1)$$

where  $i \in M$  and  $j \in N$

Positive Ideal Solution ( $P^*$ ) and Negative Ideal Solution ( $P^-$ ) are calculated with the help of point distance measurement formula as stated in equations (2a) and (2b). The negative ideal solution finds the difference between Zero Matrix and Weighted normalized matrix ( $wd^*$ ), whereas Positive Ideal Solution finds the difference between unit matrix and Weighted normalized matrix ( $wd^-$ ).

$$P^+ = \{wd_1^+, wd_2^+, \dots, wd_n^+\} \quad (2a)$$

$$P^- = \{wd_1^-, wd_2^-, \dots, wd_n^-\} \quad (2b)$$

This principle assumes that the matrices are points and plotted in a line graph. The difference between the points and '0' and the difference between '1' and matrix points are calculated and presented as Positive and Negative Ideal Solution. These positive and Negative matrices are used to find the closeness coefficient, which determines the closeness of the values concerning the resultant point. Closeness Coefficient (*CC*) or Relative Closeness values ranges from '0' to '1'.

$$CC = \frac{D_i^-}{D_i^+ + D_i^-} \quad \text{where } i \in M \quad (3)$$

The '*D*<sup>+</sup>' Values are the summation values of Positive Ideal Solution for each criterion, and '*D*<sup>-</sup>' Values are the summation values of Negative Ideal Solution for each criterion.

### Result and discussion:

According to Table 2, resultant matrix of closeness coefficient values, Awareness of Solid waste management should be at the top of the focus in tourism to preserve continuous growth. Source of Employment and Income generation should be the next priority as it helps the economy move forward in getting foreign currencies by attracting international tourists. Destination significance is in the third place as the advertisement and publicity of particular sight has to be done to promote tourism. Economic impact criteria can be defined as assessing the economic impact as the next area to be focused on. Product Marketing and Planning & management lie in the fifth place to be focused as there are already fair disaster planning and mitigation procedures are in practice. So these

criteria require average attention. In the last three positions, Infrastructure, Societal Impact, Knowledge of Renewable energy are listed. Infrastructural development (i. e) Increase the number of constructions infrastructures, especially in the hilly region, is deadly (Rana, 2013), and it is not advisable for the local communities. Societal impact may not be assessed frequently as the tourist spots in Uttarakhand are not human-made hotspots. The knowledge of renewable energy is at the bottom of the list as it requires meager importance. The assessment is only limited to the tourist spots of Uttarakhand. The scope of the work is to make similar impact assessments through India and suggest management plans to climb up the excellent position in tourism globally.

Table 2: Criteria sorted according to Closeness Co-efficient values

Criteria	C-Coefficient
C4	0.455
C9	0.415
C2	0.398
C3	0.340
C7	0.332
C6	0.268
C5	0.253
C1	0.206
C8	0.084

### Conclusion:

There are several parameters to be focused on to develop tourism in a country as tourism is one of the booming sectors. These parameters are considered to index world countries to rank their performance globally. This case study focuses on providing suggestions to improve critical factors of tourism in Uttarakhand, India. Some significant factors are listed, and they are prioritized using a



Multi-Criteria decision-making system called TOPSIS. The results suggest that awareness of solid waste management and employment opportunities & source of income are to be focused more, and this assessment framework is limited only to specified study areas.

## References:

- Bansal S. P and Amit Gangotia, "Perception of Tourist: A case study of Uttarakhand," International Journal of Hospitality & Tourism Systems, Volume 3(1), 55-63, 2010.
- Chandra Prakash Kala, "Ecotourism and Sustainable Development of Mountain Communities: A Study of Dhanolti Ecopark in Uttarakhand State of India." Applied Ecology and Environmental Sciences 1, no. 5 (2013): 98-103. DOI: 10.12691/aees-1-5-5.
- Chaghooshi, A., Arab, A., & Dehshiri, S. (2016). A fuzzy hybrid approach for project manager selection. Decision Science Letters, 5(3), 447-460.
- Abbas Mardani, Ahmad Jusoh, Khalil MD Nor, Zainab Khalifah, Norhayati
- Zakwan & Alireza Valipour (2015) Multiple criteria decision-making techniques and their applications – a review of the literature from 2000 to 2014, Economic Research-Ekonomska Istraživanja, 28:1, 516-571, DOI: 10.1080/1331677X.2015.1075139
- Dhiraj Pathak, Indu Tiwari, Shashi K Tiwari TOURISM IN UTTARAKHAND: AN INTROSPECTION, International Journal of Advance Research in Science and Engineering, Vol. No.6, Issue No.05, May 2017.
- Evangelos Triantaphyllou and Chi-Tun Lin, Development and evaluation of five fuzzy multi-attribute decision-making methods, International Journal of Approximate Reasoning 14(4):281-310, May 1996, DOI: [10.1016/0888-613X\(95\)00119-2](https://doi.org/10.1016/0888-613X(95)00119-2).
- Masiero L, J.L. Nicolau, Price Sensitivity to Tourism Activities: Looking for Determinant Factors, Tourism Economics, Quaderno n. 11-01, August 2012.
- Naresh Rana, Sunil Singh, Y. P. Sundriyal and Navin Juyal, Recent and past floods in the Alaknanda valley: causes and consequences, Current Science, Vol. 105, No. 9, 10, November 2013.
- Pandey B W and Abhay Shankar Prasad, Anthropogenic Impact on Hydrological Hazards, Landslides and Soil Erosion in Alaknanda River Basin of Garhwal Himalaya, Uttarakhand, India Geoanthropogenic Environment An appraisal, 110-126.
- Vaibhav Bhatt, Shivam Prakash Bhartiya, Rashmi Dhodi And Rakesh Dhodi, Impacts of Nature Tourism in a Destination: A case Study of Bhilangana Valley in Garhwal Himalaya, South Asian Journal of Tourism and Heritage, January 2018, Vol. 11, No. 1
- Vishwambhar Prasad Sati, Indian Council of Social Science Research Report - The Alaknanda Basin (Uttarakhand Himalaya): A Study on Enhancing and Diversifying Livelihood Options in an Ecologically Fragile Mountain Terrain. 2017
- De Lone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. Information systems research, 3(1), 60-95.
- Clark, C. W. (2000). Software packages do not manage projects—people do! Paper presented at Project Management Institute Annual Seminars & Symposium, Houston, TX. Newtown Square, PA: Project Management Institute.