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Site Suitability for Agro-Tourism Development in Nashik District of Maharashtra State, India

Sanjay Dagu Pagar*

Department of Geography, MVP Samaj's K.R.T. Arts, B.H. Commerce and A.M. Science (K.T.H.M.) College. Nashik-2
Affiliated to Savitribai Phule Pune University, Pune
*Corresponding author: sdpagar000@gmail.com

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Abstract The main objective of the present research is to identify the potential sites for agro tourism development by using Analytical Hierarchy Process (AHP) in Nashik district of Maharashtra State. Nashik district has mythological and historical background and geographical diversity so that there are well known tourist's places such as historical places, pilgrimage places, grape wineries etc. All these factors lead to the development of the agro-tourists sites in the study area. Pimpalgaon Garudeshwar, Makhalmalabad, Belgaon Dhaga, Zarwad Bk, Vinchurgavali & Dudgaon etc. are major places which are already developed as agro-tourism centers in the study area. The various thematic layers such as slope, DEM, drainage density, average rainfall, LULC, transport density, distribution of tourists places have been applied to analyses the agro-tourists site suitability with the help of AHP analysis. The result of AHP depicted that about 46.15 percent area falls under moderately suitable category 53.19 percent under marginally suitable category for agro-tourism development in Nashik District. Only 0.086 percent of the area is highly suitable for Agro Tourism in the study area. It is located in Nashik tahsil of the study area, especially around Nashik city where most factors are favourable for agro-tourism development. Only 0.58 percent of the area falls under not suitability class which is observed North-western, northern and southern part of the study area which have steep slopes, barren land, less rainfall, less road connectivity, poor soil and very less agricultural development. For improving the status of agro-tourism industry, Maharashtra Tourism Development Corporation (MTDC), Travel Agents Association of Nashik (TAAN), Winery owners and State transport department collectively plan to boost agro tourism industry in highly and moderately suitable areas of the study region.

Keywords: *Site Suitability, Potential, Agro-tourism, Winery, Tourism Development & Regional Development*

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1. Introduction

Agriculture is the backbone of the Indian economy and the share of agriculture in Gross Domestic Product (GDP) of India is 19.9 percent in 2020-21, which indicates that agriculture is still an important sector with respects to the Indian Economy. It is widely recognized that tourism is a sector with immense potential economic development and employment generation [1]. Tourism has helped in progressing the quality of life of regional people of various destinations which also helps in promoting the distinct cultural, art and crafts of the destination which also creates an employment opportunity of the local community [2]. Agriculture and tourism are the two important sectors of the Indian economy which carry the potential of changing the position of India in the world economy [3]. The term agro-tourism emerged in the late twentieth century. It includes agricultural farms that are related to tourism [4]. Agro-tourism is an innovative agricultural activity related to tourism and agriculture both. It has a great capacity to create additional sources of income and employment opportunities for the farmers. Farmers are now enthusiastic to try newer methods away from the typified and orthodox patterns to build relations with the consumers directly and earn extra. Hence, adding on to the agricultural income with some touristic activities is bringing in new hopes and better lives [5]. The farmers should also try to establish their co-operative society for the development of agro-tourism centers. Agro-tourism may become a cash crop for the farmers in Maharashtra and also an instrument of the rural employment generation [6]. Nowadays agro tourism activities is regarded as one of the economic activity of sustainable and rural development.

Today the concept of agro-tourism has been brought direct and indirect benefits to the farmers and people of villages [7]. Agri-tourism could be an excellent alternative agri-business for farmers providing a fresh and live experience of different farm activities in agricultural practices, horticultural practices and rural experience [8] Agro-tourism authorizes new businesses and jobs on the local level [9]. The term 'Agro-Tourism' is a new face of tourism. Agro-tourism is a farm based industry that is

open to the community [10]. The goal of agro-tourism is to develop a unique product for integrated tourism that will contribute to the sustainable development of rural areas [11]. The concept of agro tourism encourages visitors to experience agricultural life in a natural setting [12]. Agro tourism is very useful for attracting visitors and travelers to agricultural areas, generally for educational and recreational purposes. Promotion of tourism would bring many direct and indirect benefits to the people [13]. Agro tourism is also supported for rural and agricultural development processes through generating employment opportunities to the farmers including farm family members and youth. Agro tourism as a distinctive field covers the rural environment with its agricultural products, processing and packaging, agro-based services, rural community and their culture and belief system [14]. Agritourism is simply diverting the tourists to rural areas, having range of agricultural activities, services and amenities in order to generate extra income to farmers [15] . Today all the tourists want to escape from the daily hectic life of cities and desire to stay in peaceful environment of rural areas enriched with farming activities [16]. Agro tourism is well developed inAustralia, Italy, Canada, United States, Philippines, Indonesia, Brazil, France, Portugal, Sri Lanka and Malaysia. In India, it is also developing, especially in states like Maharashtra, Punjab, Haryana, Andhra Pradesh, Kerala, Gujrat, Karnataka and north-eastern states of India. In Maharashtra Pune, Satara, Sindhudurg, Ratnagiri, Thane, Phalghar, Solapur, Nashik, Ahmednagar, Nagpur and Raigad are major district where agro tourism is developing since last 20 years. Additional income source for the farmers will helps to protect him against income fluctuation due to natural condition.In this regards Nashik district has a lot of potential for development of Agro tourism. Nashik District has diverse agro-climatic conditions suitable for growing different types of crops, fruits and vegetables.

2. Study Area

Nashik District is located in the northern part of Maharashtra State. It lies between 19° 33` to 20° 53` North latitude and 73° 15’ to 75° 16’ East longitude. Nashik District has an area of 15,530 Sq.k.m. Location of the study area is shown in Figure 1.

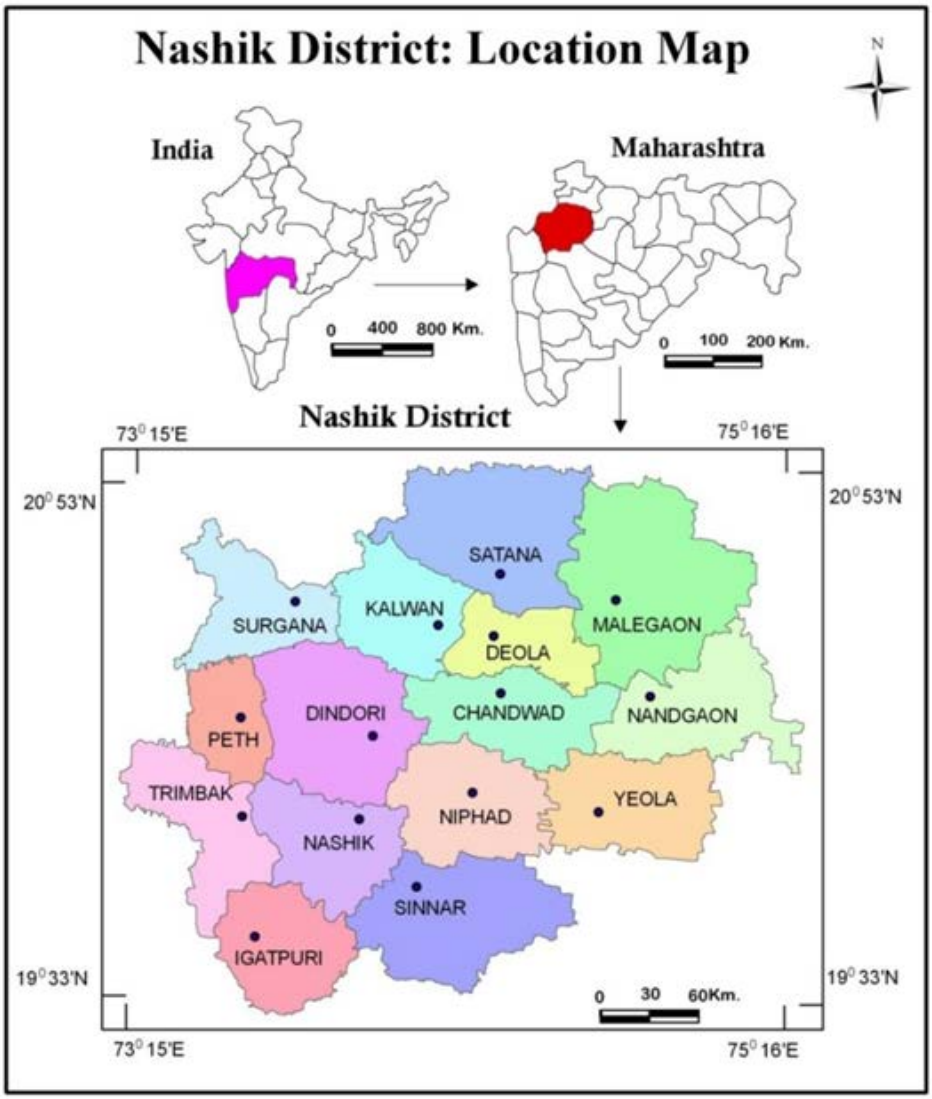

Figure 1. Location Map of Study Area

This landlocked districts bounded by Dhule district in the north, Jalgaon district to the east, Aurangabad districts in the south-east, Ahemadnager district in the south, and Thane and Palghar districts in the south- west and Dangs district of Gujarat state in the north-west. Physiographically, the district is divided into three divisions' viz. the hilly, Godavari basin and Girna basin. The entire Nashik district is underlain by the basaltic lava flows. Godavari and Girna are two major rivers flowing through the district. The Western Ghats stretches from north to south across the western portion of the district. The Sahyadri mountain range is located in western part of the district. Administrative wise, the district has 4 sub-divisions namely Nashik, Malegaon, Niphad and Kalwan. The Nashik district consists of 15 tehsils. There are also 25 towns and 1919 villages in the District. The climate of the district is generally dry except during the monsoon season. The average annual rainfall of the district as a whole is 1034.5mm. The rainfall decreases gradually from western to eastern part of the district. The summer season is moderately hot and the temperature varies from 36°C to 40°C. The air is humid during the monsoon season and is generally dry during the rest of the year. The total length of all roads is 18792 kms and the total length of railway route in the district is 271 kms. in the study area. The winter season is the best period for visiting in the. The months of September to January are the best periods to visit the tourist places of the study area.

3. Data and Methodology

The Digital Elevation Model (DEM) was generated from SRTM data. Drainage and slope maps were prepared from SRTM DEM using ArcGIS Spatial Analyst module. The rainfall map was prepared using the data obtained from the Indian Meteorological Department (IMD) gauge stations. Here the TRMM data is used to prepare the rainfall distribution map. Drainage density maps were generated using the density tool in the GIS environment. Landsat 8 OLI (Path: 147, Row: 046) dated 10 May 2021 has been applied for the land use analysis. Supervised classification method and maximum likelihood Algorithm were employed to detect the LULC types. Error matrices are often used to assess the accuracy by comparing the relationship between ground truth data and classified results [17]. Producer's accuracy and user's accuracy calculations were based on error matrices. 1458 Polygons for Landsat OLI were randomly selected to assess classification accuracy. The overall accuracy was 87.74%.

Table 1. Thematic layers for site suitability of Agro-tourism and their data source

Thematic Layers	Data Source
Slope (Degree)	SRTM DEM Year (30 meter resolution)
DEM	SRTM Year (30 meter resolution)
Drainage Density	Landsat 8 OLI sensor Satellite image (scale) Path: 147, Row: 046 retrieved on 10th May 2021
Average Rainfall (mm)	IMD Rainfall Data, 1976-2013 Interpolation methods
Types of Soil	National Soil Resource Beauro
Transport Density	Road map of PWD Department, Nashik District Map (2011 to 2021)
LULC	Landsat 8 OLI sensor Satellite image (scale) Path: 147, Row: 046 retrieved on 10th May 2021
Other Tourists Places	Tourist Guide Map of Nashik District (2018)

Source: Computed By Researcher, 2021.

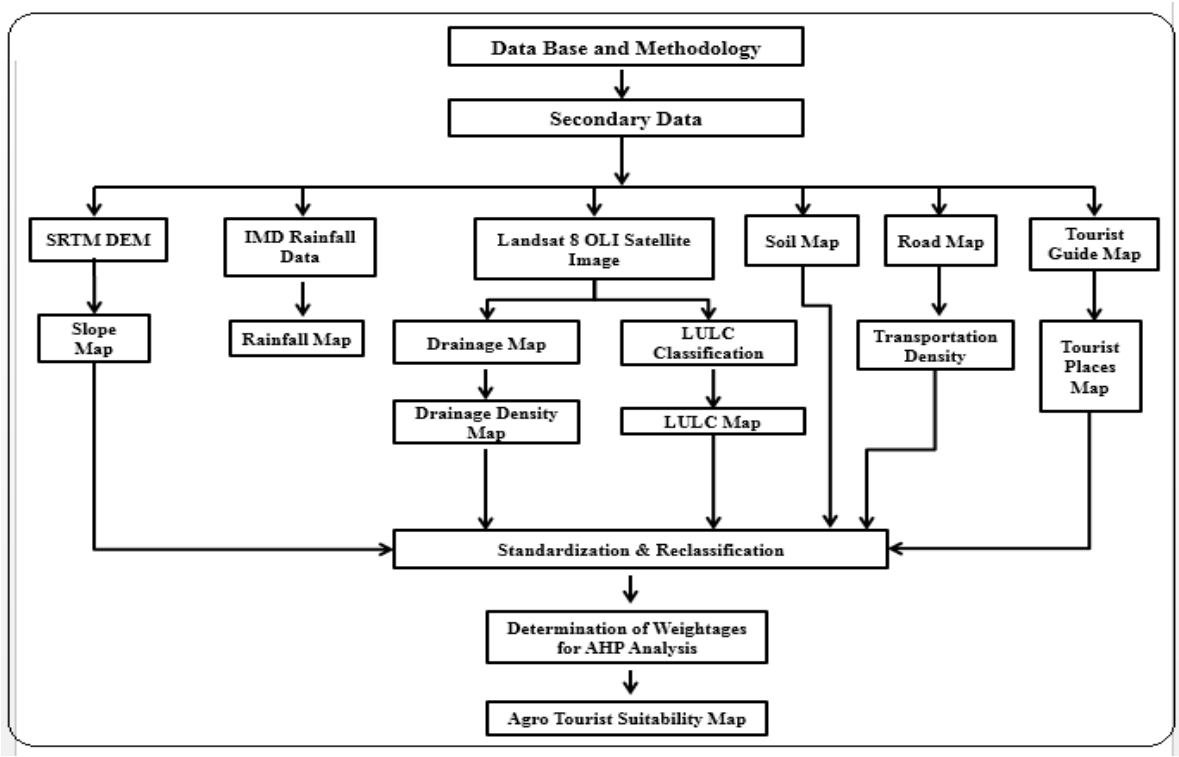

Figure 2. Schematic representation of the Methodology

The AHP method is one of the multi-criteria decision-making (MCDM) methods which are commonly used in land suitability analysis [18,19]. The AHP helps decision makers find one that best suits their goal and their understanding of the problem. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions [20]. GIS based weighted overlay method is applied to these 8 thematic layers to derive the site suitability map of agro tourism sites. The AHP method was applied to determine the relative importance of all selected factors. The process of site suitability is very useful for identification of the appropriate locations as per our requirement to implement of our planning. Table 1 shows the used thematic layers and their sources.

Methodology which is used for this research work is shown in Figure 2. Finally weightage for each criterion were calculated by using AHP and after that weighted overlay was done to generate the site suitability map for agro-tourism.

4. Results and Discussion:

Agro-tourism is a business conducted by a farmer for the enjoyment and knowledge of the people, to promote the products of the land and generate additional income from farms [21]**.** Agro-tourism is increasingly recognized as an important strategy that can contribute to agricultural development through diversification of farming activities and providing opportunities to rest, relax, enjoy and study about farming for the visitors [22].

Agro tourism is a recent offshoot of the tourism sector that has grown up to be a potential business in its own space [23]. The concept of agro-tourism came into existence in Australia 65 years ago, since then its popularity has spread in other countries first in European countries, then America and Asian sub-continent. India being an Agrarian country there is wide scope for the development of this new type of tourism ‘agro-tourism’. Agro tourism can be defined as a range of activities, services and amenities provided by farmers and rural people to attract tourists to their area in order to generate extra income for their business [24]. In India Maharashtra, Punjab, Haryana, Andhra Pradesh, Kerala, Gujrat, Karnataka and Tamilnadu are major states where various factors are very favourable for development of agro-tourism. In Maharashtra, Nashik has also vast scope for the development of agro-tourism activity.

4.1. Digital Elevation Model (DEM) and Slope

The digital elevation model (DEM) is a representation of continuous elevation values over a topographic surface by a regular array of z-values, referenced to a common vertical datum. DEMs are typically used to represent the bare-earth terrain, void of vegetation and manmade features. On the basis of DEM it is observed that most maximum part of the study area has height between 500 meter and 700 meter (Figure 3) whereas northeastern and extreme northwestern parts have height less than 500 meter. An area having height from 300 meter to 700 meter is suitable for agriculture activity but the area which has more than 700 meter height is not suitable for agriculture and agro-tourism. Most of the part of study area has gentle to moderate slope which is good for agricultural development in the study area. Only extreme north, south part and western parts of the study area have very steep slope (Figure 4), which is not suitable for both agriculture and agro-tourism in the study area.

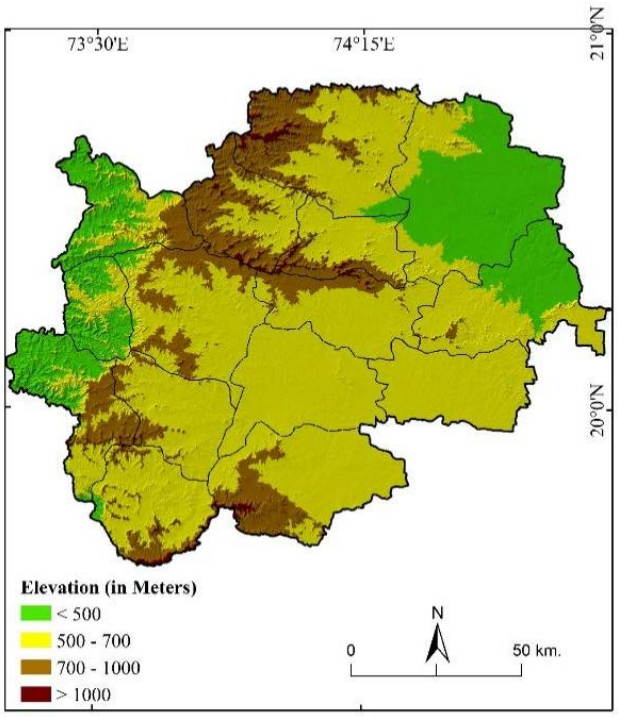

Figure 3. Digital Elevation Model (DEM)

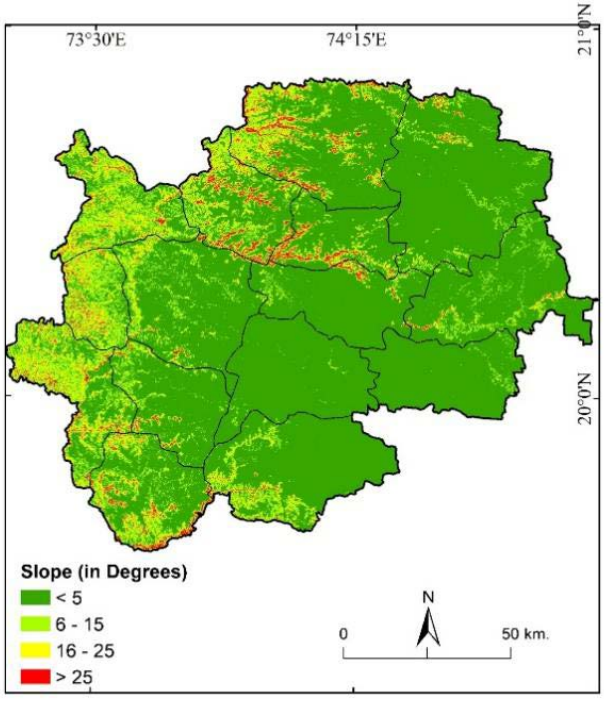

Figure 4. Nashik District: Slope

4.2. Drainage Density & Rainfall

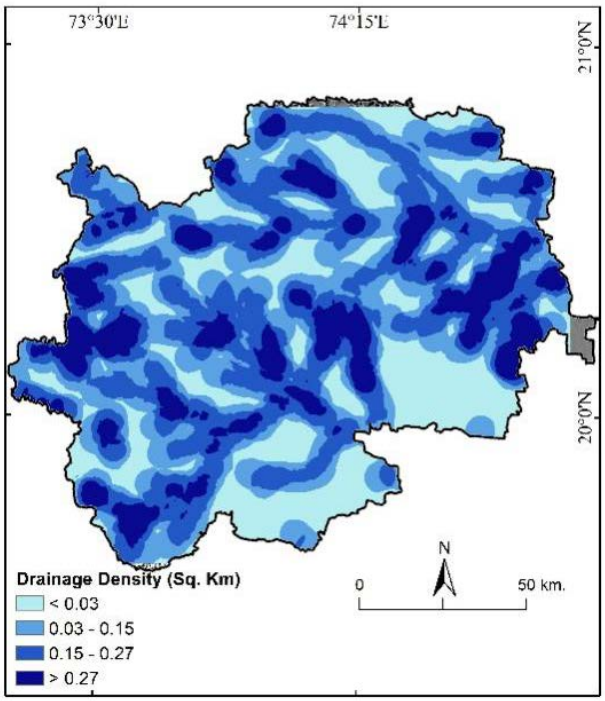

Figure 5. Nashik District: Drainage Density

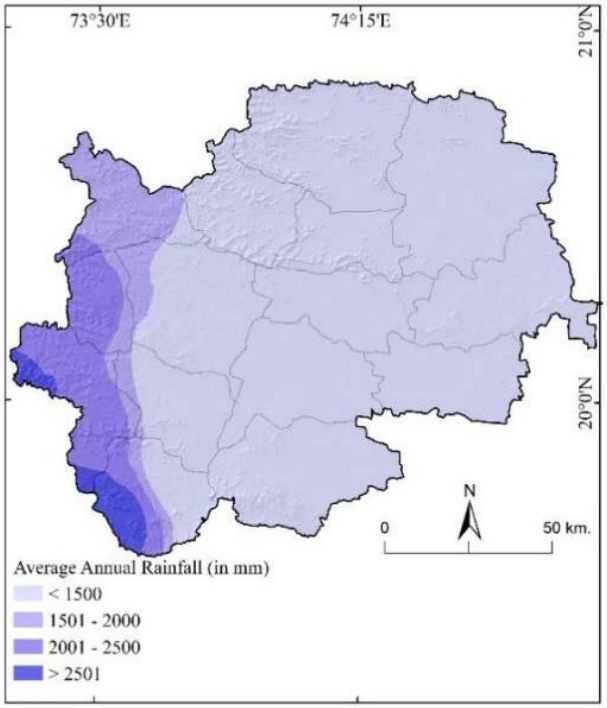

Figure 6. Nashik District: Rainfall

Drainage density is defined as the closeness of spacing of stream channels. It is a measure of the total length of the stream segment of all orders per unit area. In Nashik District drainage density is comparatively high in the central part and south eastern part of the study area. Figure 5 depicts the drainage density of the area under study. Dams and lakes are mostly located in Dindori, Igatpuri and Nashik Tehsils, the area under study which is a very important source of water for agricultural development. In the area under study, the rainfall decreases gradually from western to eastern part of the district which is shown in Figure 6.

4.3. Soil and LULC

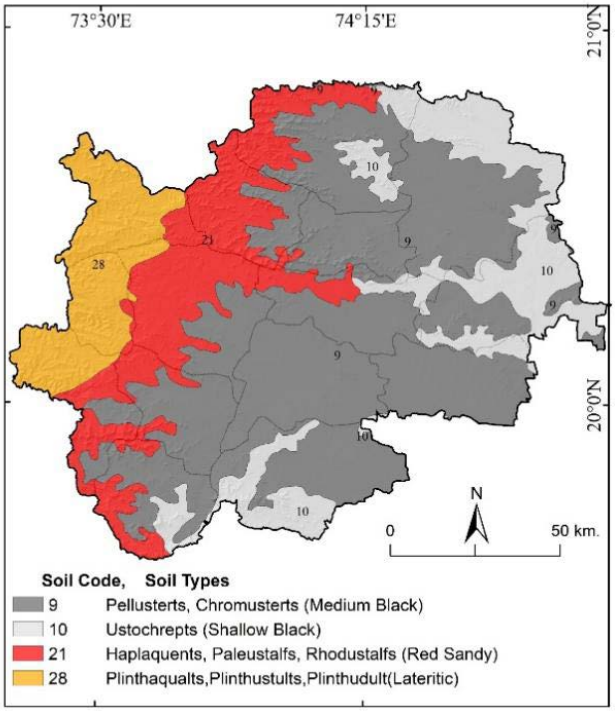

Figure 7. Nashik District: Types of Soil

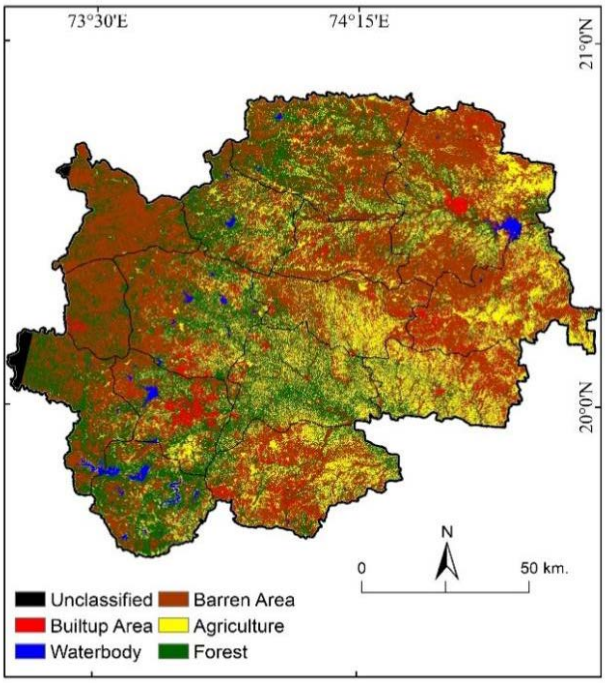

Figure 8. Nashik District: LULC

Soil also plays in agricultural development of the region, which is a very important factor for development of agro tourism. Medium and shallow black soils are useful for the growth of various crops. In the study region central and eastern parts have black fertile soil (Figure 7), which

is very important for development of crop diversification and agro tourism. Landuse and land cover maps play a vital role in planning, management and monitoring site suitability for various programmes at local, regional and national levels. For determining the site suitability of agro-tourism the classification of LULC have been taken into consideration. In the study area near about 21.10 percent land is under agriculture which is very useful for development of agro-tourism which is mainly observed in Nashik, Niphad, Dindori, Deola, Satana, Malegaon and Yeola tehsils of the study areas (Figure 8). Areas which have under barren land and built up are not useful for the development of agro tourism.

4.4. Other Tourist Places and Transportation Density

In Nashik district some tourist places are already well developed, especially religious places. Therefore some infrastructure for tourism is also available, which is a very important useful factor for development of agro tourism. There are 8 agro tourism centers, 33 wineries and other 66 tourism places are available (Figure 9) in the study area. Transportation is another important factor which plays very important role in the development of agro tourism.

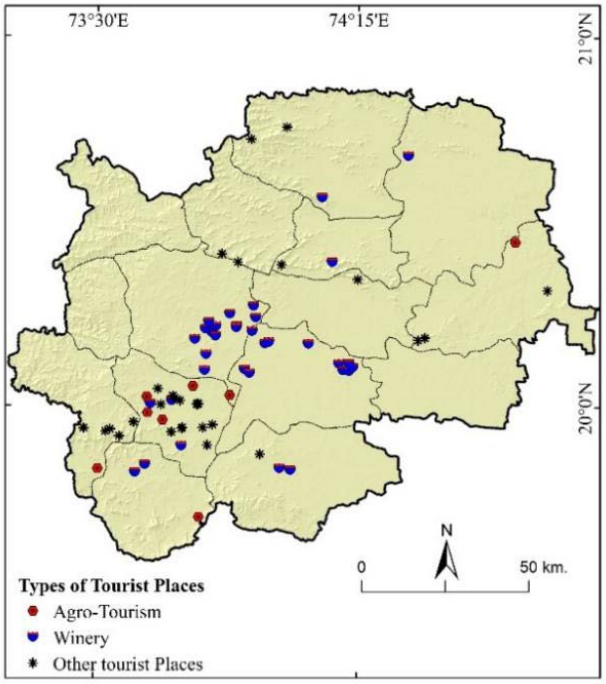

Figure 9. Nashik District: Tourist Places

A transport system acts as a bridge between places of tourist origin and destination. It opens out a region by providing an access to its tourist places [25]**.** The study region has national highways, state highways and district roads. Nashik city is well connected with major cities of India. Total length of railways is 331 kilometers in study region. Three rail routes are available in the study area, namely, Mumbai-Bhusaval, Manmad-Daund and Manmad-Secunderabad. There are two national highways, namely, Mumbai-Agra and Pune-Nashik. Mumbai-Agra national highway (N.H.3) enters (Figure 10) Nashik district from Igatpuri and runs in northeast direction within study region. Nashik Airport is located at Ozar Mig, 20 kilometres, northeast of the city of Nashik. It is well connected with Ahmedabad, Belgaum, Delhi, Hyderabad, Kandla and Pune. The density of transportation is found more in central, south and northeast parts in study region. Road connectivity of Nashik, Igatpuri, Niphad, Malegaon and Nandgaon tehsils is good, which is a supporting factor for agro-tourism development in the study area.

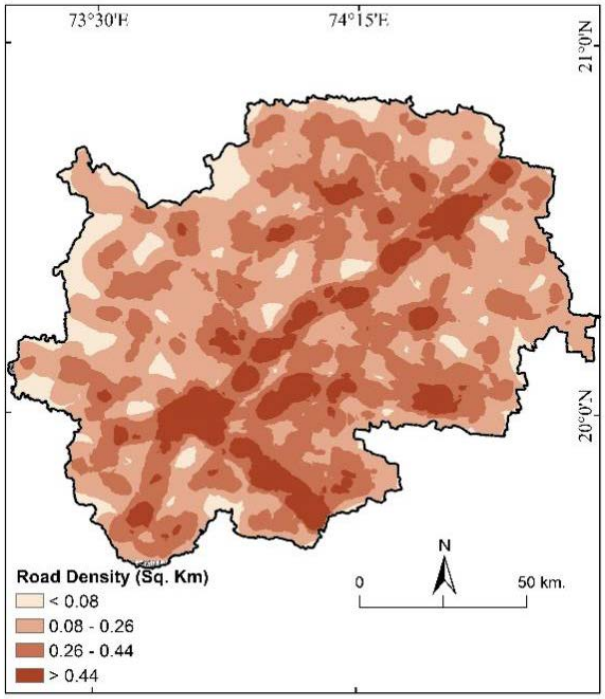

Figure 10. Nashik District: Transportation Density

4.5. Analytical Hierarchical Process (AHP)

AHP is used to find out the suitable sites for agro tourism and this technique was proposed by Satty (1990). The AHP method allows assessing the geometric mean followed by allotting a normalized weight to various parameters for finalizing the decision process. In this study, the AHP pairwise matrix was developed by input values of scale weights of parameters based on direct or indirect relationship.

4.6. Determination of Score

Several researchers and experts have assigned the score for criterion from 1 to 4 based on land qualities, favourable conditions and limitations for agro tourism centers. In the present study, the scores are assigned on the basis of favourable condition of agro tourism centers, field work, expert's opinion, land quality and factors related to agro-tourism.

Table 2. Score assigned to each parameter to perform AHP analysis.

Sr. No.	Criteria	Class	Score	Weightage (%)
1	Slope (Degree)	< 5	4	16.5
		6-15	3	
		16-25	2	
		26	1	
2	DEM (Height in Meter)	< 500	4	13.5
		500-700	3	
		700-1000	2	
		> 1000	1	
3	Annual Average Rainfall (mm)	< 1500	1	5.1
		1500-2000	2	
		2000-2500	3	
		< 2500	4	
4	Drainage Density (Per Sq.km.)	< 0.03	1	5.0
		0.03-0.15	2	
		0.15-0.27	3	
		> 0.27	4	
5	Soil (Type)	Medium Black	4	25.3
		Shallow Black	3	
		Red Sandy	2	
		Laterite	1	
6	Transportation Density (Per Sq.km.)	< 0.08	1	13.0
		0.08-0.26	2	
		0.26-0.44	3	
		> 0.44	4	
7	Other Tourist Places	Agro-Tourism	1	10.6
		Winery	2	
		Other Tourist Places	3	
8	LULC	Build up area	1	11.0
		Water body	2	
		Forest	3	
		Agriculture	4	

Computed By Researcher, 2021.

Table 3. Nashik District: Site suitability area for Agro-tourism-2021

Sr. No.	Tahsil Name	Not Suitable	Marginally Suitable	Moderately Suitable	Highly Suitable	Total Area
1	Baglan	29.79	946.38	573.12	--	**1549.29**
2	Chandwad	--	341.35	577.87	--	**919.22**
3	Deola	--	350.26	279.29	--	**629.55**
4	Dindori	0.45	747.03	575.76	--	**1323.23**
5	Igatpuri	3.77	470.12	427.33	--	**901.23**
6	Kalwan	0.96	423.08	393.76	--	**817.80**
7	Malegaon	6.14	1205.25	684.99	--	**1896.38**
8	Nandgaon	0.80	633.66	610.84	--	**1245.31**
9	Nashik	--	270.53	518.82	13.45	**802.80**
10	Niphad	0.19	169.66	964.01	--	**1133.85**
11	Peint	1.43	447.70	43.05	--	**492.17**
12	Sinner	19.74	764.79	569.09	--	**1353.62**
13	Surgana	24.33	716.27	68.65	--	**809.25**
14	Trimbak	1.56	545.48	347.48	--	**894.52**
15	Yeola	1.17	318.75	610.04	--	**929.96**
Total Area		**90.31**	**8350.32**	**7244.11**	**13.45**	**15698.20**
		0.58 %	**53.19 %**	**46.15 %**	**0.086 %**	**100 %**

Computed By Researcher, 2021

The higher score indicates the most suitable site whereas lesser score shows less suitability for agro tourism centers.

A. Highly suitable site: Only 0.86 % land of the reviewed area is classified into the category, 'highly suitable site for agro-tourism (Figure 11 & Table 3). All these areas are located in Nashik tahasil, especially around Nashik city. Chandashi, Gangapur, Girnare, Adgaon, Madsangvi, Palase & Lakhalgaon are major villages, which are included in these area. These lands have gentle to moderate slopes, deep black soils, moderate rainfall and availability of water bodies, which are suitable for agriculture. Other major factors that are favourable for Argo-tourism are more crop diversification, nearness of Nashik city, good road connectivity and availability of various other tourist places.

B. Moderately suitable site: About 46.15 % of reviewed area is classified into the class, moderately suitable site' (Figure 11 & Table 3). Niphad, Dindori, Nandgaon, Yeola, Malegaon are major tehsils where site suitability is also good for Agro-tourism. In these areas black soil, moderate slope, agriculture activities, road connectivity, drainage density, presence of other tourist places are the major factors that are favourable for Agro-Tourism. Chandori, Saikheda, Pimpalgaon-B and Nandur-Madhameshwar (Niphad Tahsil), Ozarkhed, Janori, Jaualkevani, Khedgoan, Vani and Dindori (Dindori Tahasil) are major sites which are ideal for Agro-tourism development in this areas.

C. Marginally suitable Area: about 53.19 % of reviewed area are classified into the class, 'marginally suitable' (Figure 11 & Table 3). Most parts of Baglan (Satana), Malegaon, Dindori, Surgana, Sinner and Nandgaon are included in this class. This region has dominance of two or three parameters which are selected for analysis.

D. Not suitable Area: Only 0.58 % land of reviewed area is classified into the class, 'Not suitable site for agro-tourism (Figure 11 & Table 3). Most part of this class is from western part of study region which have poor and thin soil with steep slope, less road connectivity and agricultural development. Other patches of less site suitability are located at the extremely northern and southern boundary of Nashik district due to steep slope, barren land, less rainfall, less road connectivity, poor soil and very less agricultural development.

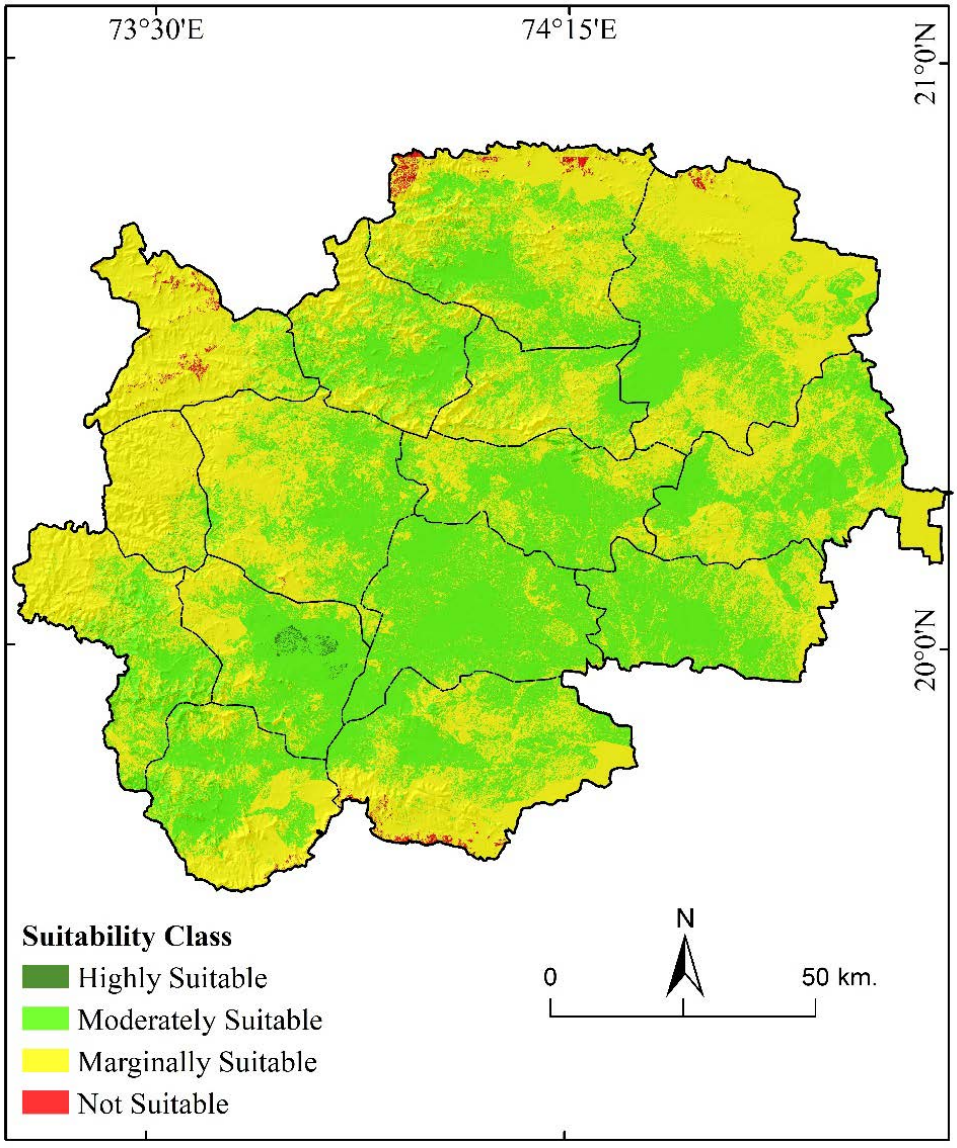

Figure 11. Classes of site suitability for Agro-Tourism

5. Conclusion

Geospatial methods are more suitable for mapping the various thematic maps as well as to find out the suitable sites for agro-tourism in the Nashik district of Maharashtra state of India. The AHP techniques is one of the techniques to classify the agro-tourism suitable sites into highly, moderately, marginal and not suitable sites in the study area. The result of AHP depicted that about 46.15 percent area of the study area is moderately suitable area and it is mostly observed in Niphad, Dindori, Nandgaon, Yeola & Malegaon tehsils of Nashik district. 53.19 percent area is marginally suitable for agro-tourism development and it is observed in Satana, Sinner, Surgana and some part of Nandgaon and Malegaon tahsils and located in the central, eastern, south-eastern and southwestern part of the study area. This is a challenge to the local people how this moderately and marginally suitable area can be converted into the best suitable and moderately suitable area by taking into consideration the various aspects of the agro-tourism activities with the active participation of the local people and youngsters. Due to the diversified characteristics of the study area, this district has less than 1 percent area is highly suitable for agro- tourism and it is situated in Nashik tehsil of the study area, especially around Nashik city. It is also observed that the study area has only 0.58 percent area which is not suitable for the agro-tourism sites and it is observed North-western, northern and southern part of the study area which have steep slope, barren land, less rainfall, less road connectivity, poor soil and very less agricultural development.

The economy of the study area is predominantly agrarian, but the income from agriculture activity in not too much. In order to increase the contribution of agriculture, the existing agricultural activities must be strengthened. For this purpose, agro tourism can be boon. Grape Park Resort (Near Gangapur Dam), availability of various wineries and Wine Park (Vinchur, Niphad), Sahyadri farm (Mohadi, Dindori), Good transportation network and good road connectivity (Nashik Road and Manmad Railway station, Ozar Air Port), Accommodation facilities (MTDC Nashik and various hotels and restaurants in Nashik city) are the important factors that are definitely useful for developing agro tourism in study area.

The study helps the decision makers and planners in the tourism sector to make a preliminary choice while considering planning. For development of agro-tourism industry, Maharashtra Tourism Development Corporation (MTDC), Travel Agents Association of Nashik (TAAN), Winery owners and State transport department collectively plan to boost agro tourism industry in highly and moderately suitable areas of the study region. Presently, the urban population has been going for agro-tourism as a way of relief from the daily routine of big cities. Urban tourists from Mumbai, Pune, Jalgaon and Aurangabad could visit agro-tourist units of the study area, which will be an important factor for development of agro-tourism industry in Nashik district.

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