Role of GIS in Determining Potential Ecotourism Sites in Northern Kerala

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INTRODUCTION

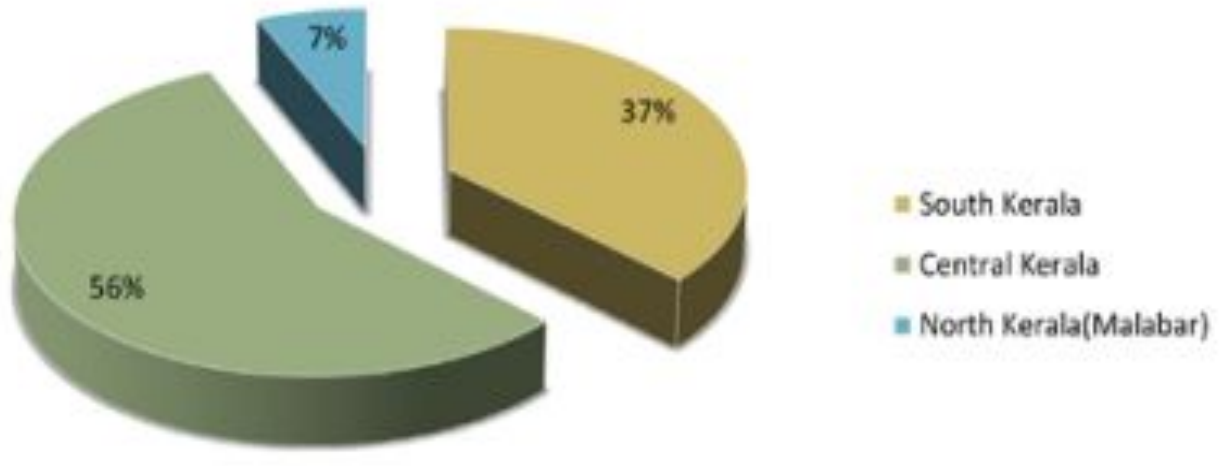
- ECOTOURISM -
  - PROMOTES INDEGENOUS CULTURE
  - CREATES EMPLOYEMENT APPORTUNITY
  - RAISES MUTUAL AWARENESS, AND CONSERVATION OF PEOPLE ABOUT ENVIRONMENT.

OBJECTIVE

- To study the present physical conditions and revenue generation of Northern Kerala along with the existing tourist spots, local communities and general accessibility of the region.

- Identify the crucial criterions and their relative importance in determining the suitability of ecotourism sites in the region.

WHY NORTH KERALA?

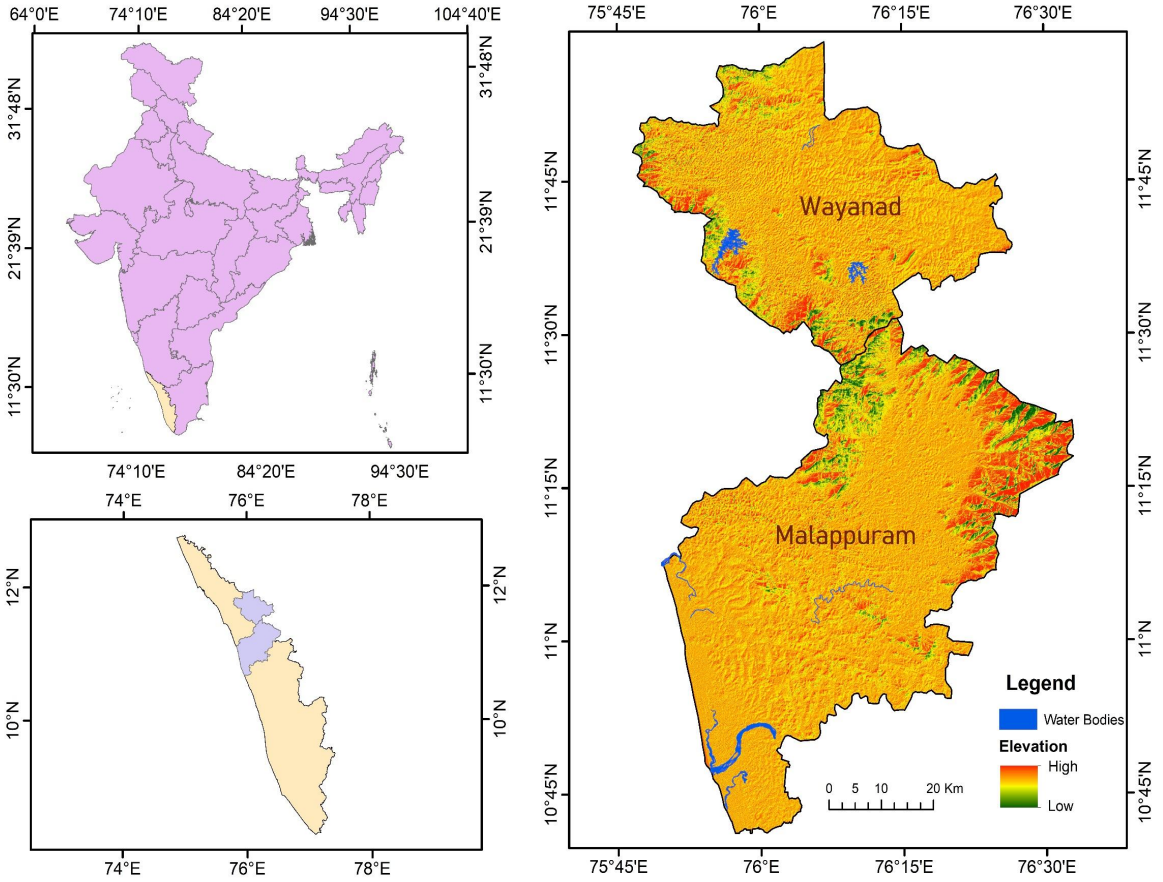


7%

Visited North Kerala in 2019 of the total arrivals of tourists to the state.

Foreign tourist arrivals region wise in 2019 (Kerala Tourism)

STUDY AREA



Wayanad District, also called the **Green Paradise.**

Malappuram is a **distinct with hilly terraced tract**

Total Area - **2132 kmsq.**

South west edge of the peninsular shield of India

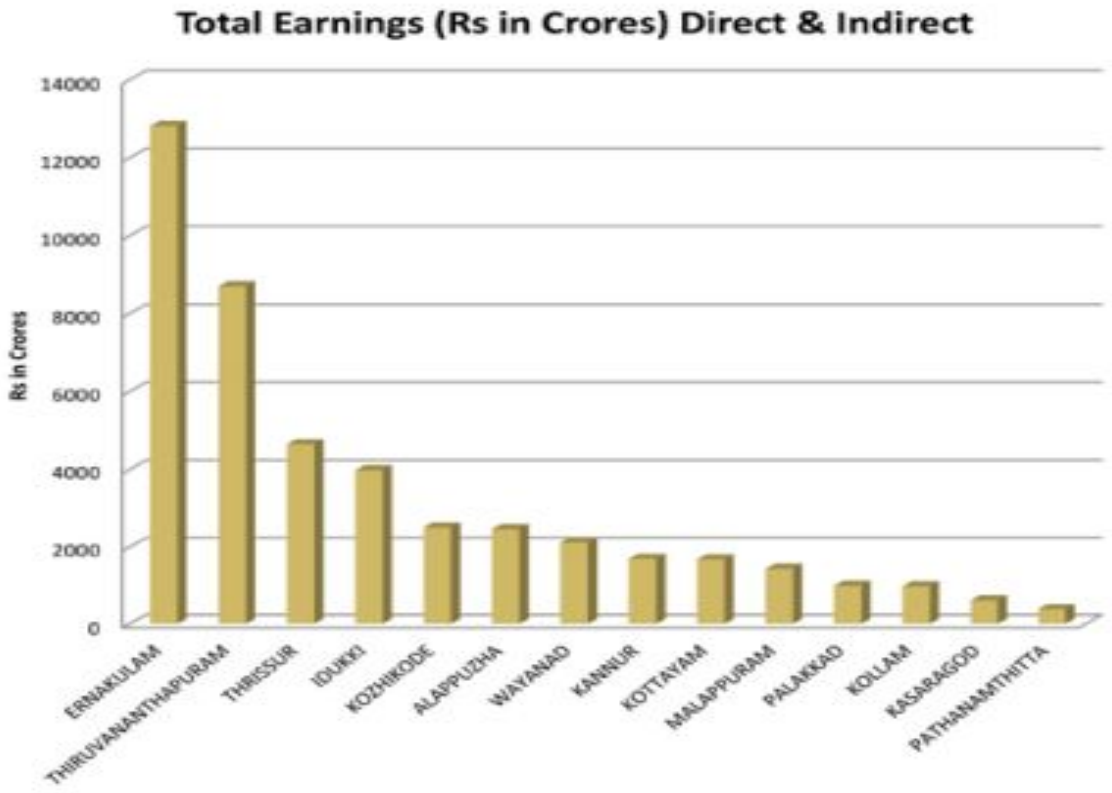
Western Ghats. Coast Lines, A semi dense hilly forests

Elevations above mean sea level range between **700-2100 m**

District comprises **132 villages**

Total earnings from tourism district wise in 2019 (Kerala Tourism)

STUDY AREA



Wayanad and Malappuram has one of the Lowest revenues from tourism, but holds good potential.

Less than 2000 Cr

Total earnings from tourism district wise in 2019 (Kerala Tourism)

DATA

Thematic Layers used for evaluating the potential sites for Eco-Tourism and their data sources	
Thematic Layers	**Data Sources**
Slope	SRTM DEM, 30m, https://urs.earthdata.nasa.gov
Land Cover Land Use	ESA Sentinel 2 image, 10m, https://livingatlas.arcgis.com/landcover
Community Villages	Google Earth/ Reports on Tourism from Kerala/Open Street Maps
Tourist Spots	Google Earth/ Kerala Tourism/ 20 Year Perspective plan final Report of Kerala
Roads	ArcGIS Hub / Google Earth
Urban Centres	Google Earth/Open Street Maps

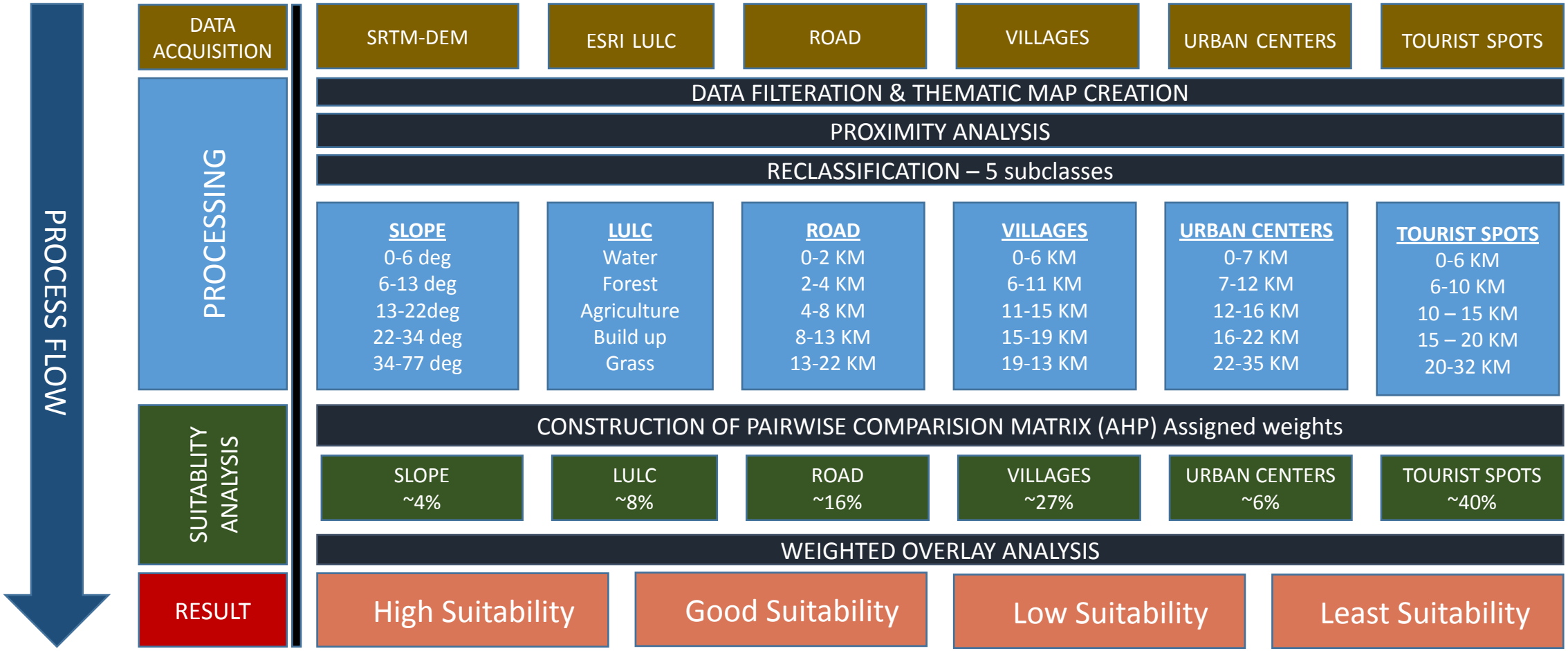
- Slope
  - ➢ flat and less steep areas , accessible & suitable for growth.
  - ➢ Plain region have less biodiversity. ~ 30^{o} suitable for trekking. Small hills and waterfalls major attractions.
- Road Networks
  - ➢ More probable to visit places with easy accessibility.
  - ➢ Noise pollution, traffic - very high proximity is less suitable. Many prefer solitude travel.
- Community villages
  - ➢ Major component of ecotourism. Preserves culture of the community.
  - ➢ Mutually beneficial as it promote growth of community. Less build ups protects the environment.

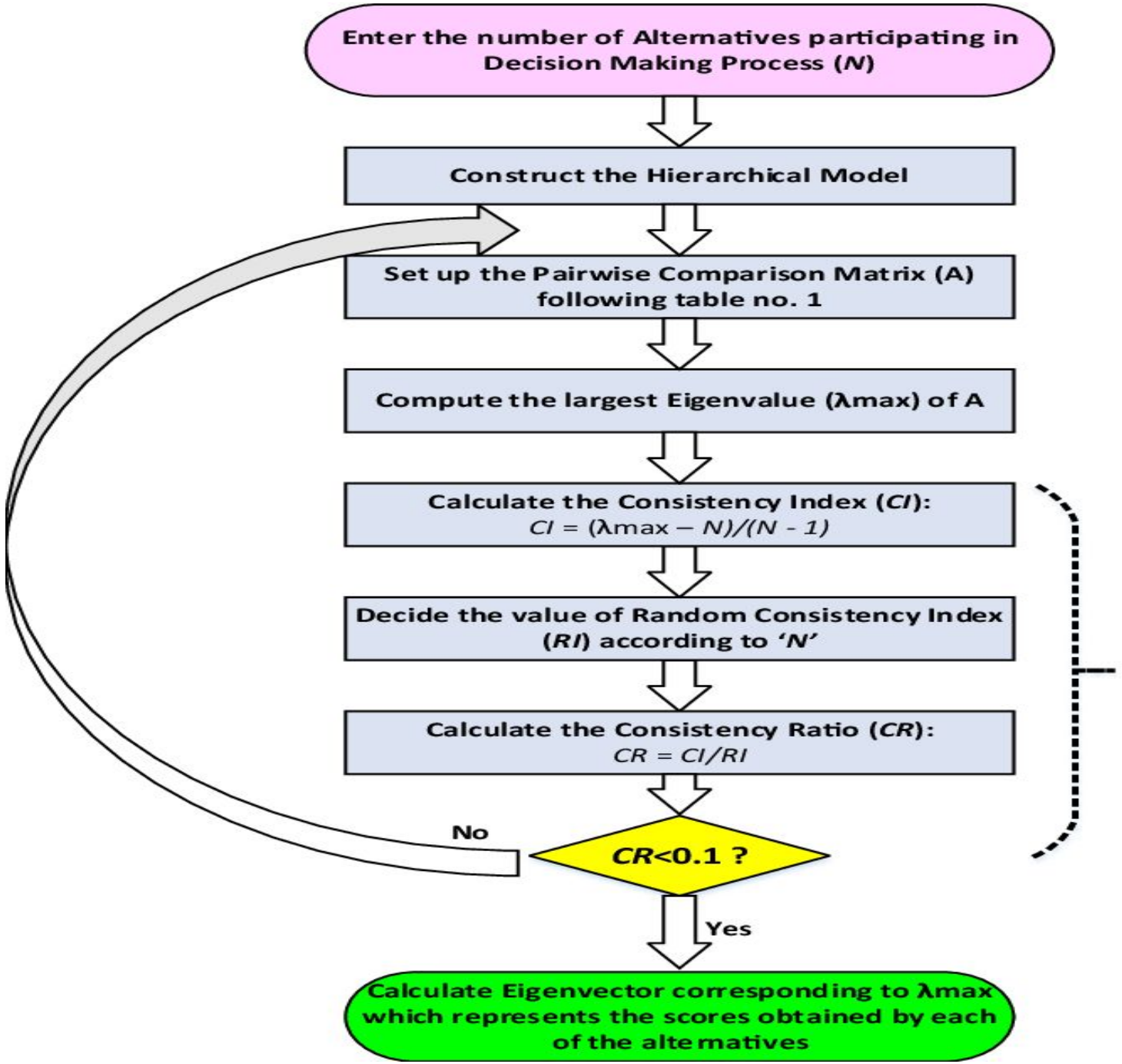
- Land use land cover
  - 5 classes. More possibility near forest and waterways.
  - Urban areas are less suitable for growth.

- Tourist Spots
  - More probability for the development of ecotourism.
  - Increased tourist influx in existing spots.
  - Easily accessible.

- Urban Centres
  - Should be at a moderate distance from the spots.
  - Promotes the community village services.

SITE SUITABILITY PROCESS FLOW





AHP

- The Analytic Hierarchy Process (AHP) was established by Thomas Saaty in the 1970s
- It is a method which uses mathematics and psychology for analyzing complex choices by assigning weights
- AHP with GIS-RS has powerful mapping and identification advantages.
- AHP has built in checks and balances to ensure that we arrive at logical-coherent solutions.

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Slope	LULC	B	2
1	3		Road Proximity	B	5
1	4		Urban Centres	B	2
1	5		Community Villages	B	5
1	6		Tourist Spots	B	7
1	7				
1	8				
2	3	LULC	Road Proximity	B	3
2	4		Urban Centres	A	3
2	5		Community Villages	B	5
2	6		Tourist Spots	B	5
2	7				
2	8				
3	4	Road Proximity	Urban Centres	A	3
3	5		Community Villages	B	3
3	6		Tourist Spots	B	2
3	7				
3	8				
4	5	Urban Centres	Community Villages	B	4
4	6		Tourist Spots	B	5
4	7				
4	8				
5	6	Community Villages	Tourist Spots	B	3
5	7				
5	8				

The AHP consists of three steps:

1) hierarchy formation

2) pairwise comparisons - use Saaty's scale

3) verification of consistency

Pair-wise comparison of all thematic layers are the inputs, relative weights of thematic layers were the output.

Intensity of importance	Definition
1	Equal importance
3	Weak importance of one over another
5	Essential or strong importance
7	Demonstrated importance
9	Absolute importance
2,4,6,8	Intermediate values between the two adjacent judgments

- The normalized weight of different thematic layers and consistency ratio (CR) are then calculated.
- CR is the ratio between the consistency of a given evaluation matrix and the consistency of a random matrix (1.24) , here CR is **7%** , **λ** max is 6.39 .
- According to the obtained hierarchy of weights from AHP, **Tourist spots > Villages > Road > LULC > Urban > Slope**

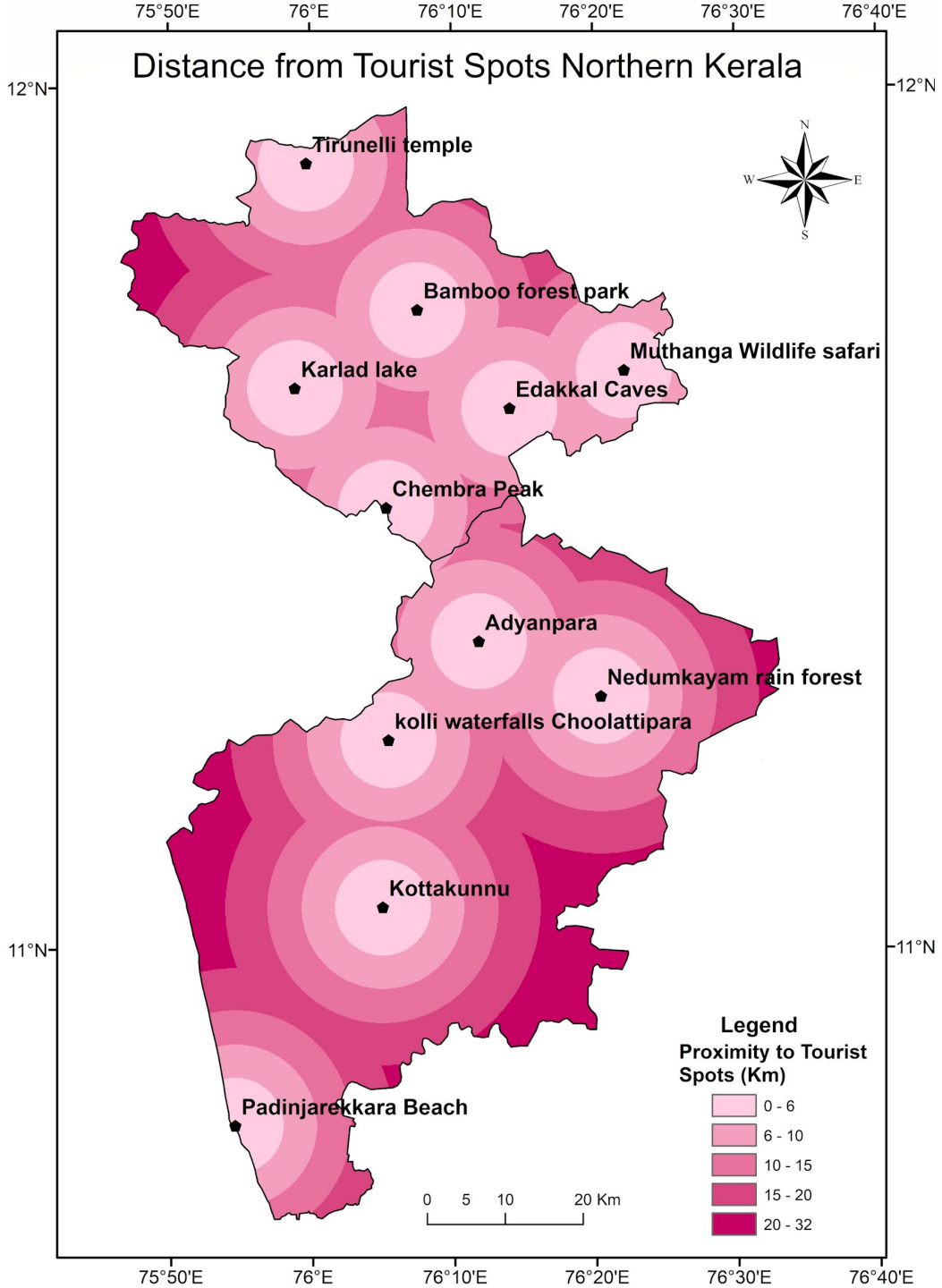
Criteria	RGMM	+/-
Slope	3.90%	1.00%
LULC	8.00%	3.20%
Road Proximity	16.70%	5.60%
Urban Centers	5.80%	2.20%
Community Villages	27.20%	12.40%
Tourist Spots	38.40%	13.70%
α= 0.1		CR =7%

LULC	Road Proximity	Urban Centres	Community Villages	Tourist Spots	0	0	0	0	normalized principal Eigenvector
2	3	4	5	6	7	8	9	10	
1/2	1/5	1/2	1/5	1/7	-	-	-	-	3.91%
1	1/3	3	1/5	1/5	-	-	-	-	8.06%
3	1	3	1/3	1/2	-	-	-	-	16.54%
1/3	1/3	1	1/4	1/5	-	-	-	-	5.66%
5	3	4	1	1/3	-	-	-	-	26.91%
5	2	5	3	1	-	-	-	-	38.91%

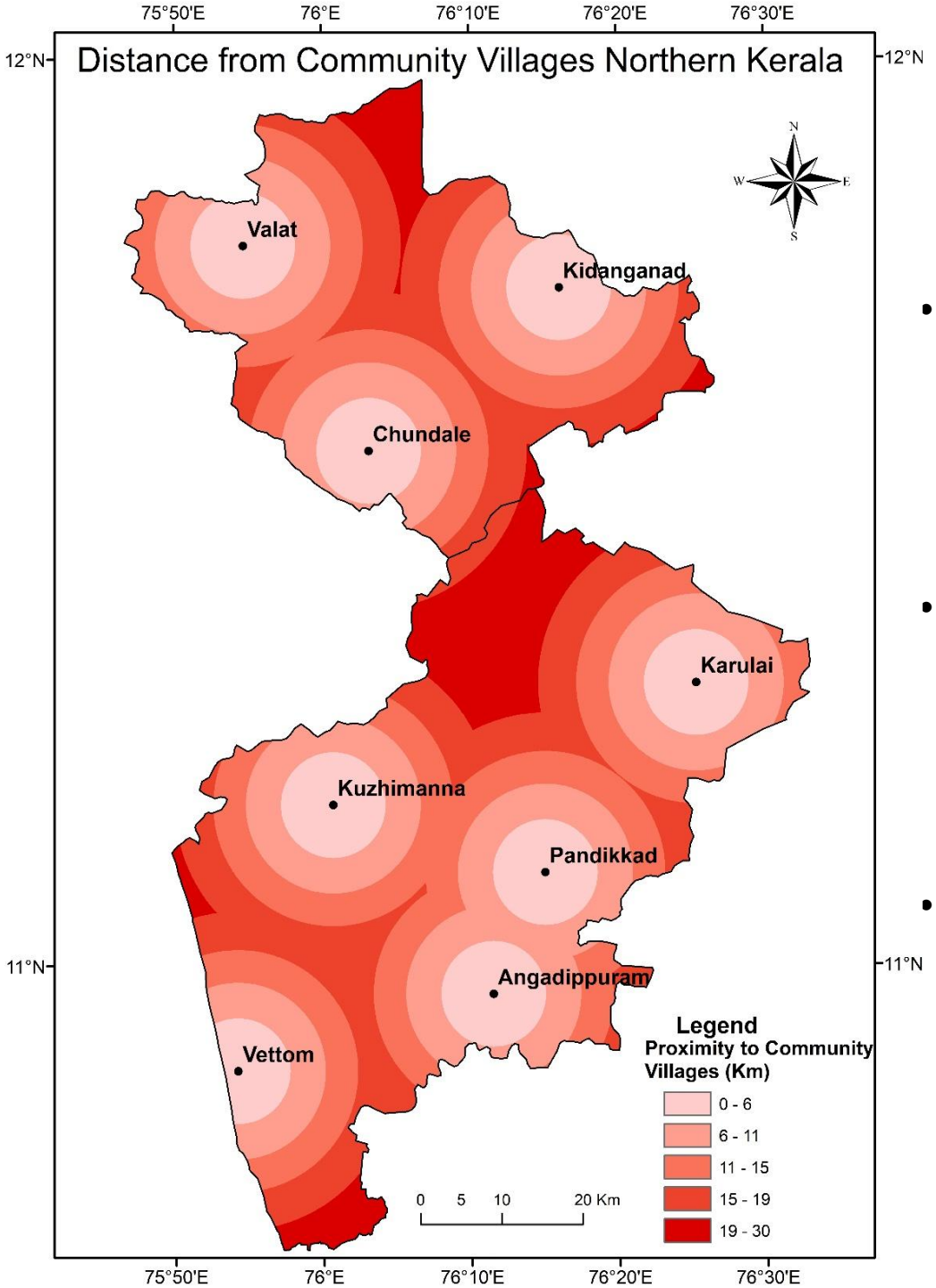
Factors	Category Class	Assigned Scale in Weighted Overlay	Factors	Category Class	Assigned Scale in Weighted Overlay
Slope	0-6 deg	4	Urban Centers	0-7 KM	3
	6-13 deg	4		7-12 KM	3
	13-22 deg	3		12-16 KM	3
	22-34 deg	2		16-22 KM	2
	34-77 deg	1		22-35 KM	2
LULC	Water	3	Community Villages	0-6 KM	5
	Trees/ Vegetation	4		6-11 KM	5
	Agriculture	2		11-15 KM	4
	Build Up	1		15-19 KM	3
	Grass	2		19-30 KM	2
Road Network	0-2 KM	4	Tourism spots	0-6 KM	5
	2-4 KM	3		6-10 KM	4
	4-8 KM	2		10-15 KM	3
	8-13 KM	1		15-20 KM	2
	13-22 KM	1		20-32 KM	1

Weighted Overlay Analysis integrates data from the same or distinct entities to generate new geometries with different weights for site suitability analysis**.**

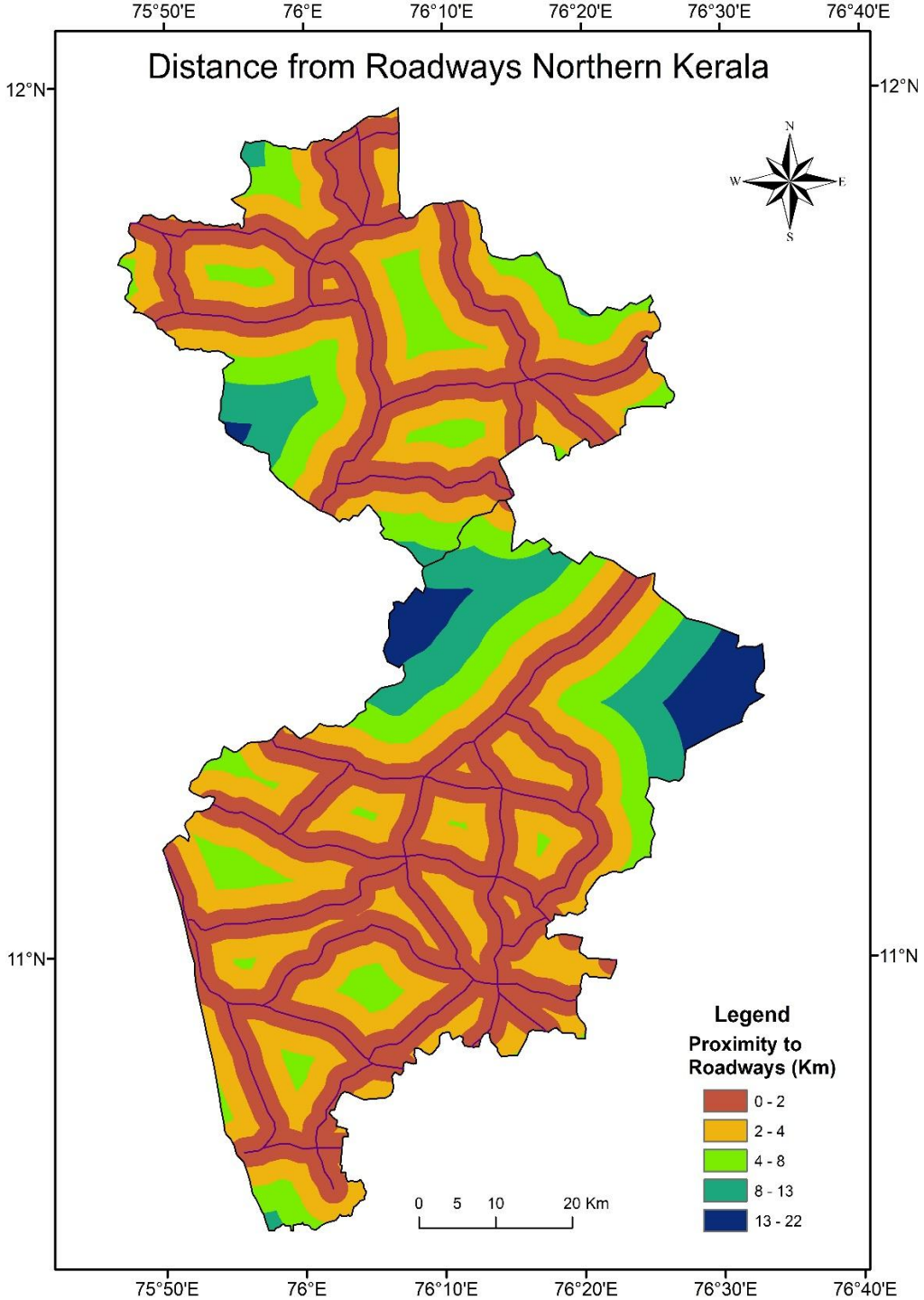
- Each raster layer is assigned a weight in the suitability analysis.
- Values in the rasters are reclassified to a common suitability scale.
- Raster layers are over layed, multiplying each raster cell's suitability value by its layer weight and totaling the values to derive a suitability value.
- These values are written to new cells in an output layer.
- The symbology in the output layer is based on these values



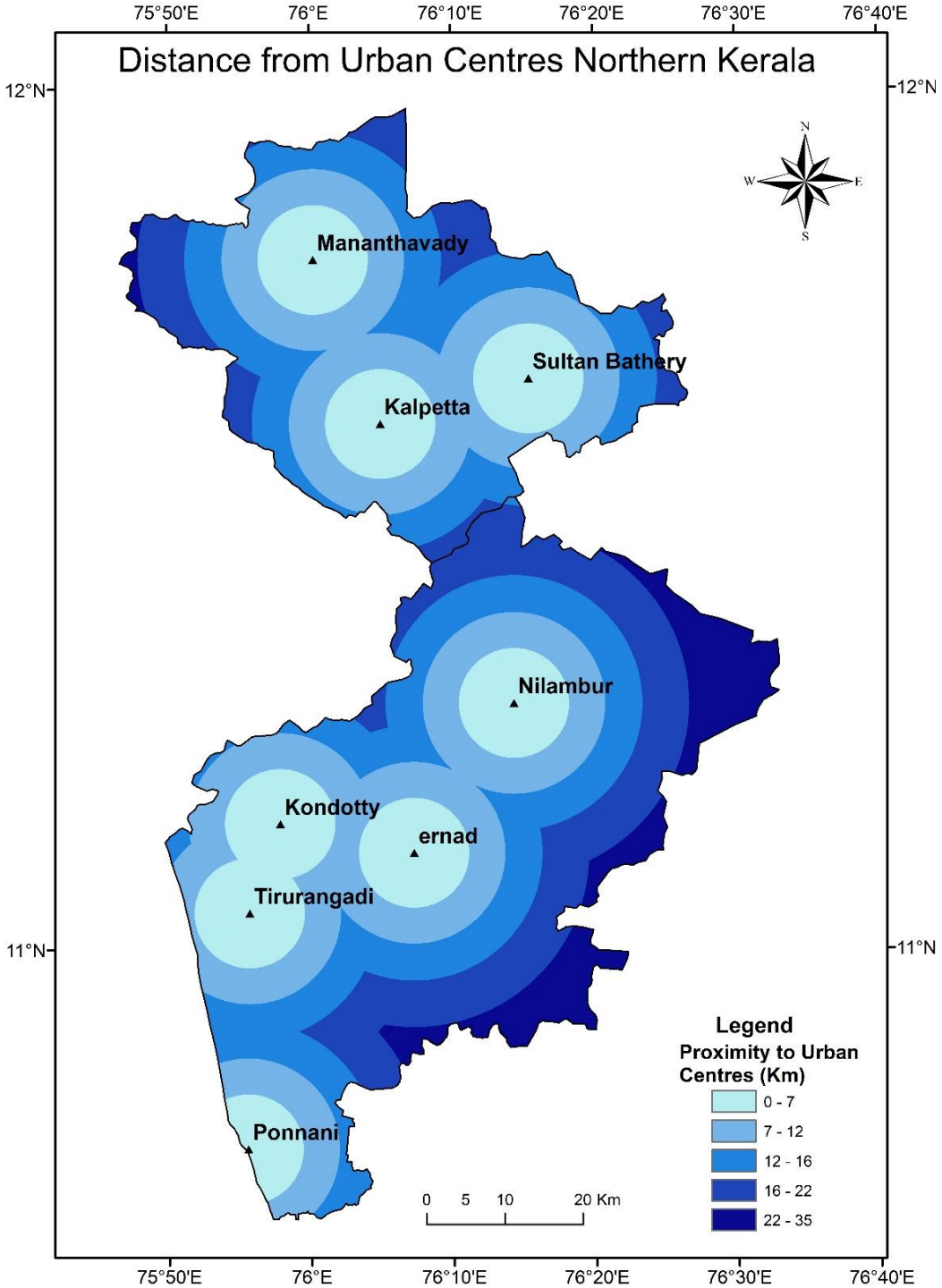
- Proximity from existing tourist spots is crucial for development of potential tourist spots in the area
- Without revenue generation and general awareness of the tourist spots, development of the sites remains difficult
- Tourists explore more starting from an existing tourist point



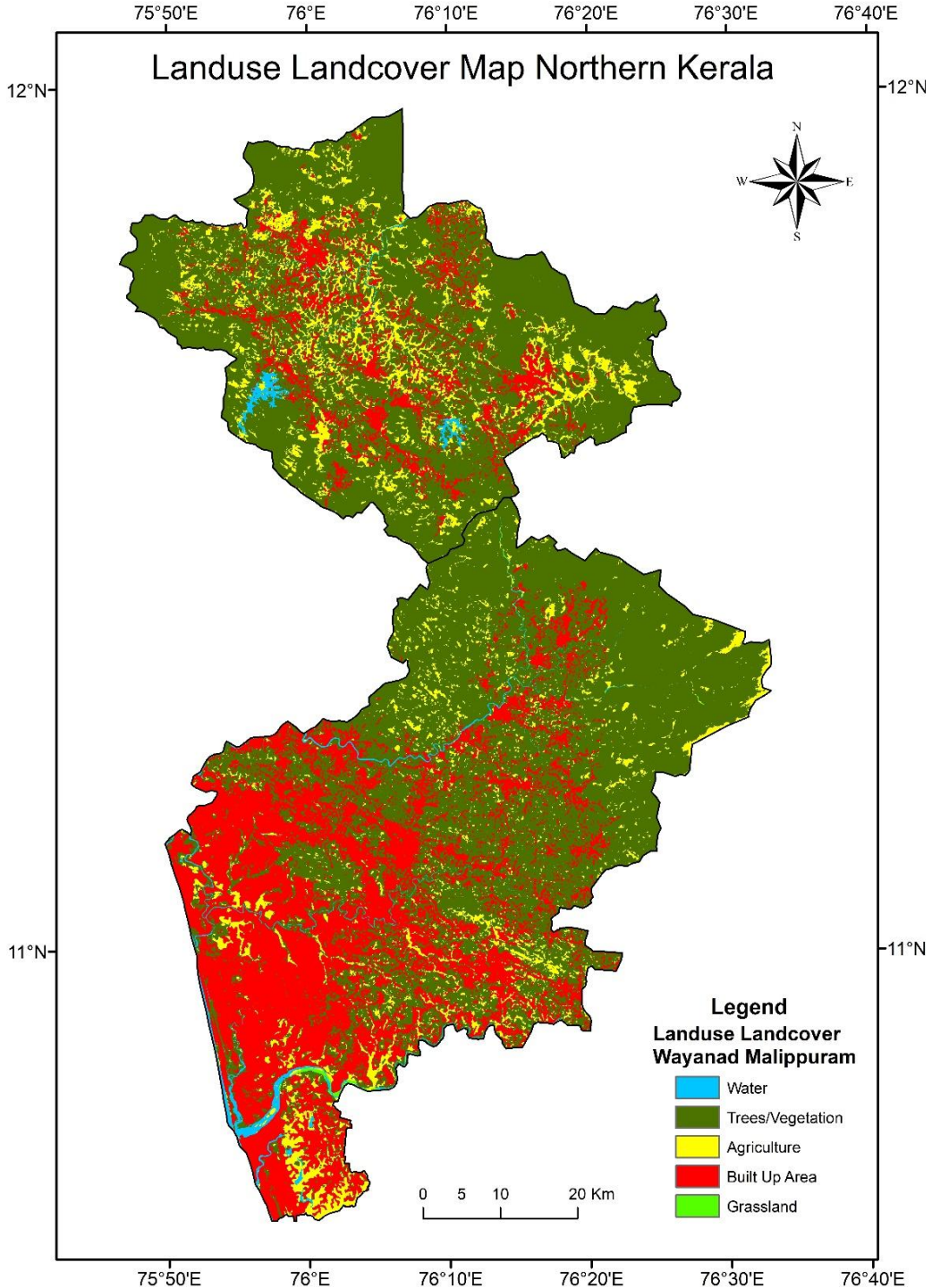
- Proximity from Community villages is of vital importance due to the backward nature of the two districts
- These will act as the cultural and natural heritage hub, local artisans as well as economic proliferation
- Development and upliftment of the local communities



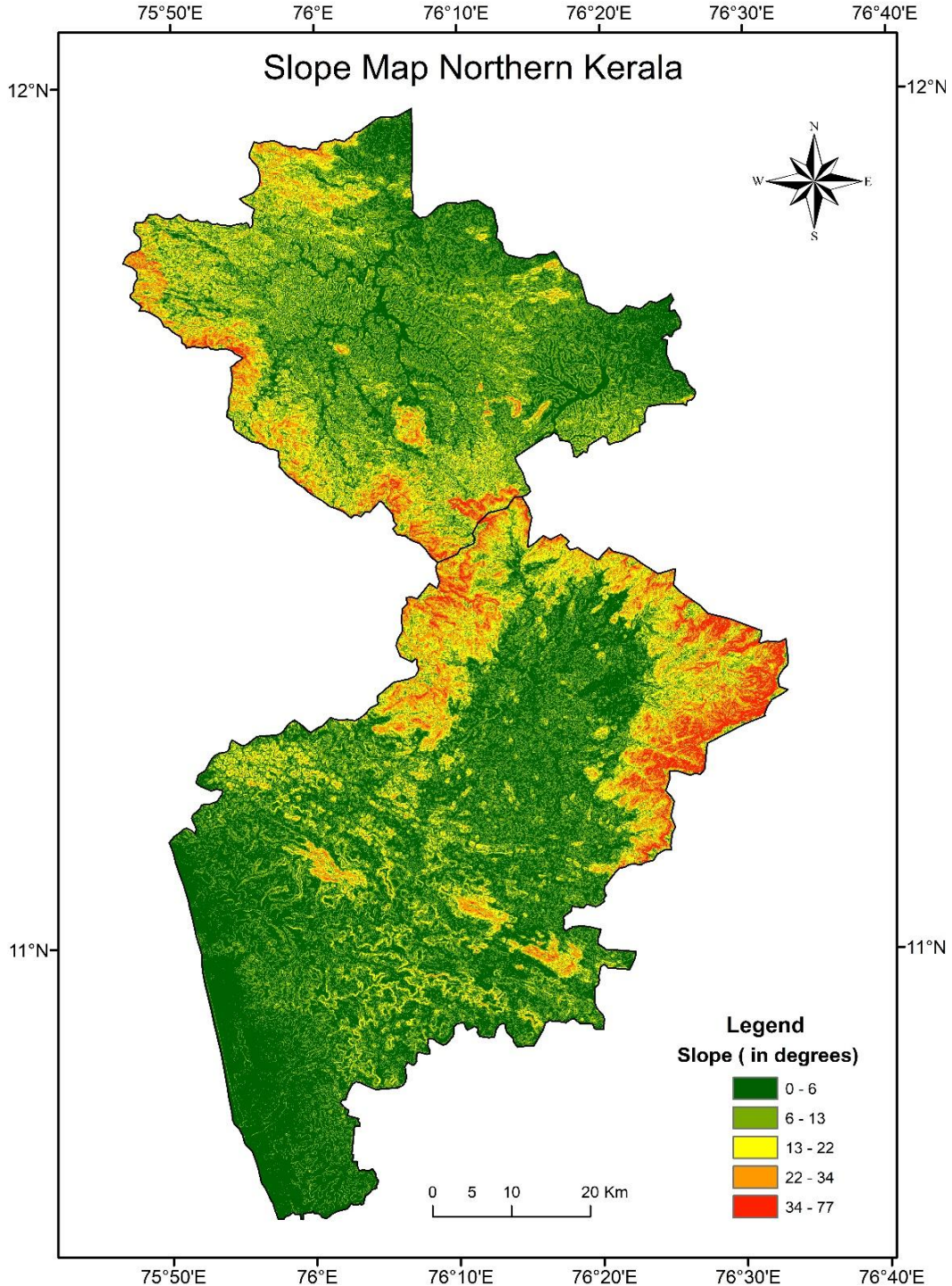
- Road connectivity is an important factor for any tourist place
- Close proximity is favorable so that tourists have more access to remote places



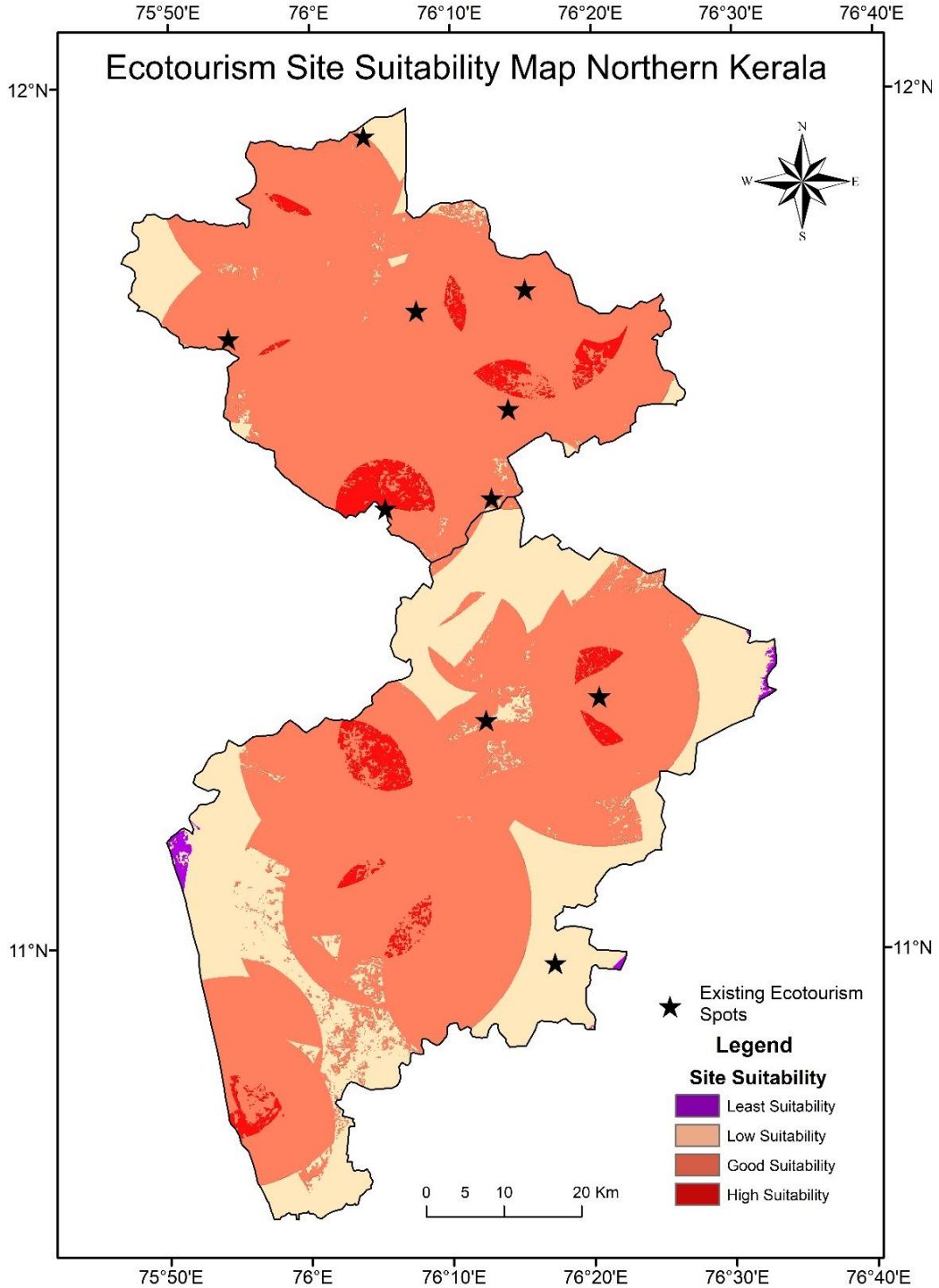
- Most are municipality town centers
- Proximity from urban centres is required for tourist lodging, regrouping and buying equipment etc.
- Close proximity is not desirable



- Mostly open forested region along the fringes of Wayanad
- Built up region in Malippuram is mostly rural area with few Municipality towns
- Around 70km coast in Malippuram with backwaters present in the southern coast

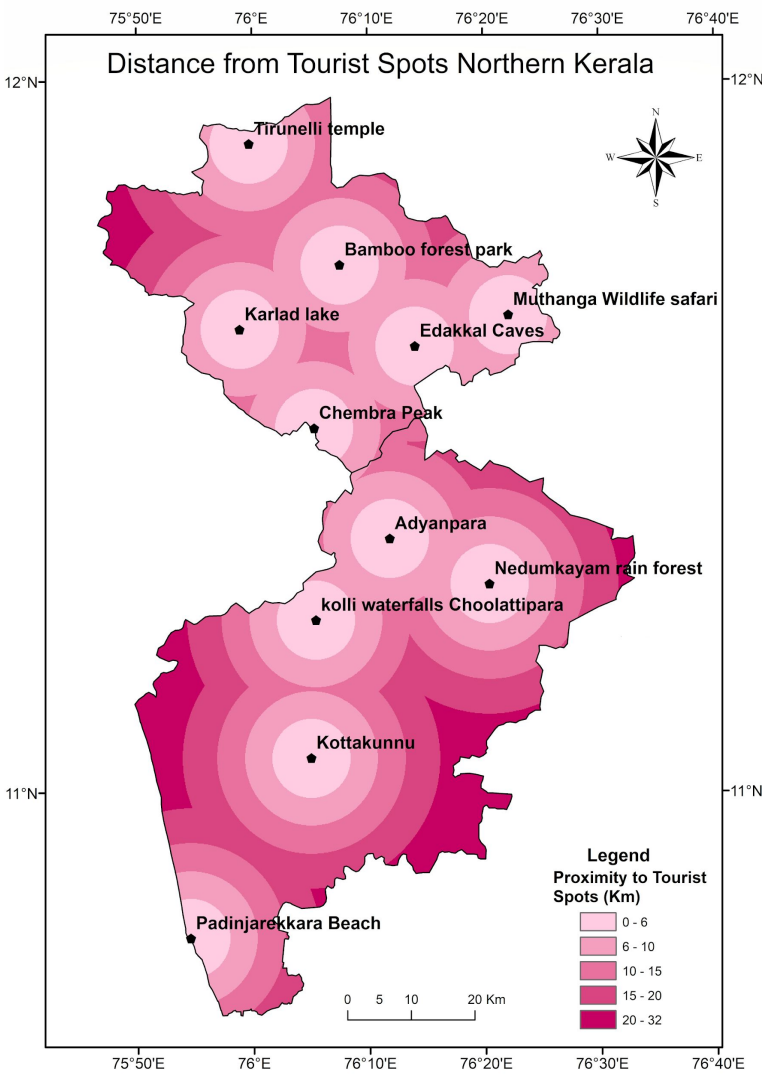


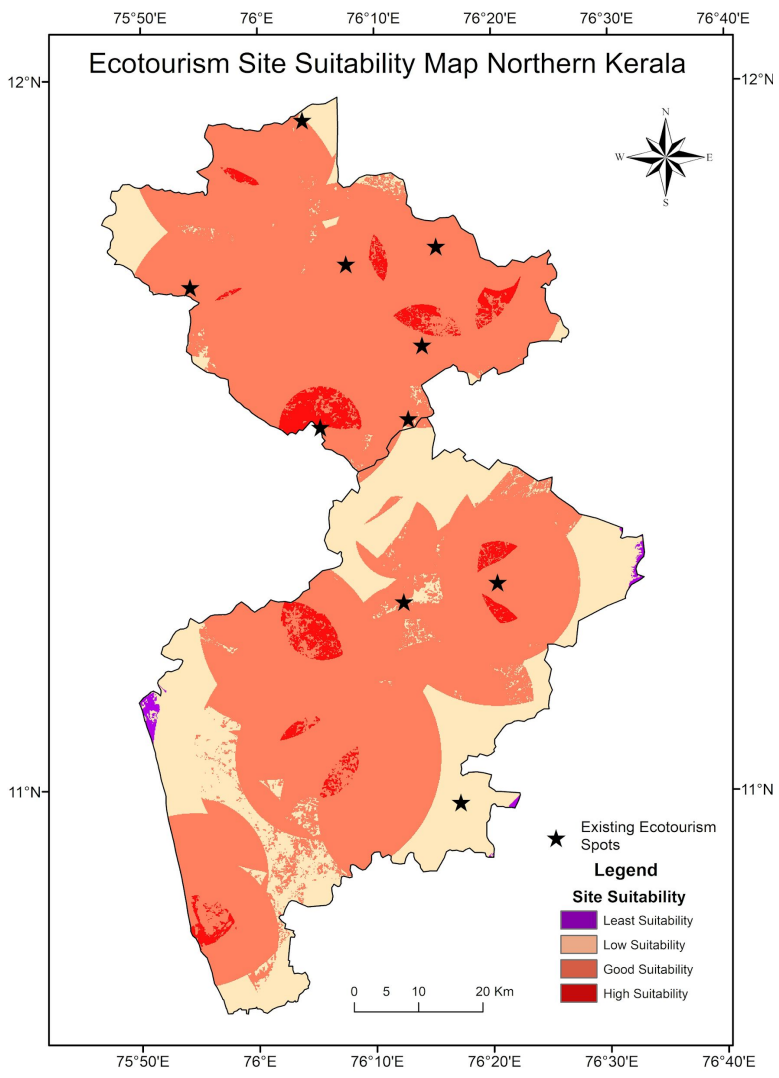
- Average to high slope in some parts along the south and west of Wayanad
- Generally low slope with average to very high slope in the eastern part of Malippuram

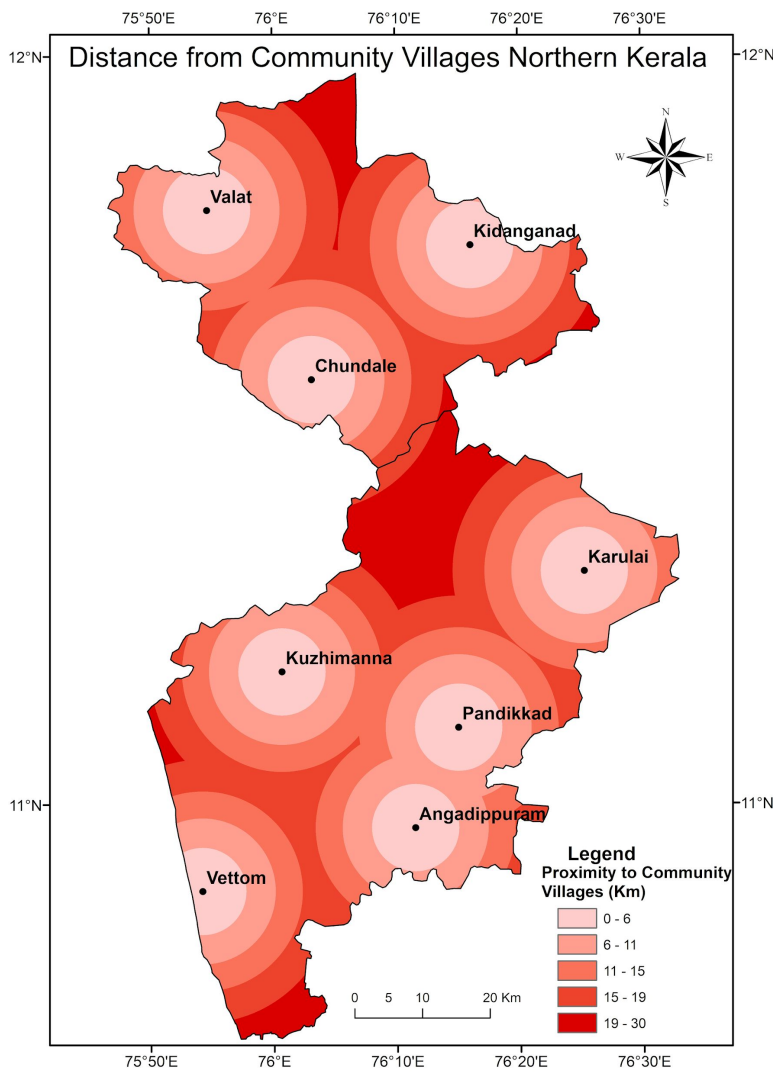


- Patches in dark red are the highly suitable zones
- Marked spots are existing and proposed Ecotourism spots by Kerala tourism
- Results show immense potential for both districts especially for Wayanad. Area roughly coming under High suitability zone is around 200 sq. km with 3500 sq. km under Good suitability zone.

Conclusion







Characteristic relationship between the factors that were expected to be the case (proximity to tourist spots, community villages, forest cover and road connectivity)