Human Elephant Conflict and Forest Fire Susceptibility assessment using Geospatial Techniques: A Study of Muthanga Wildlife Range, Kerala.

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INTRODUCTION

Wayanad wildlife sanctuary has four regions namely Sulthan bathery, Muthanga,Kurichiat and Tholpetty.

In a survey conducted by wildlife Institute of India in 2016, 67% of elephants were found to live outside Protected areas (PAs) in India and currently it has rised to 80%.

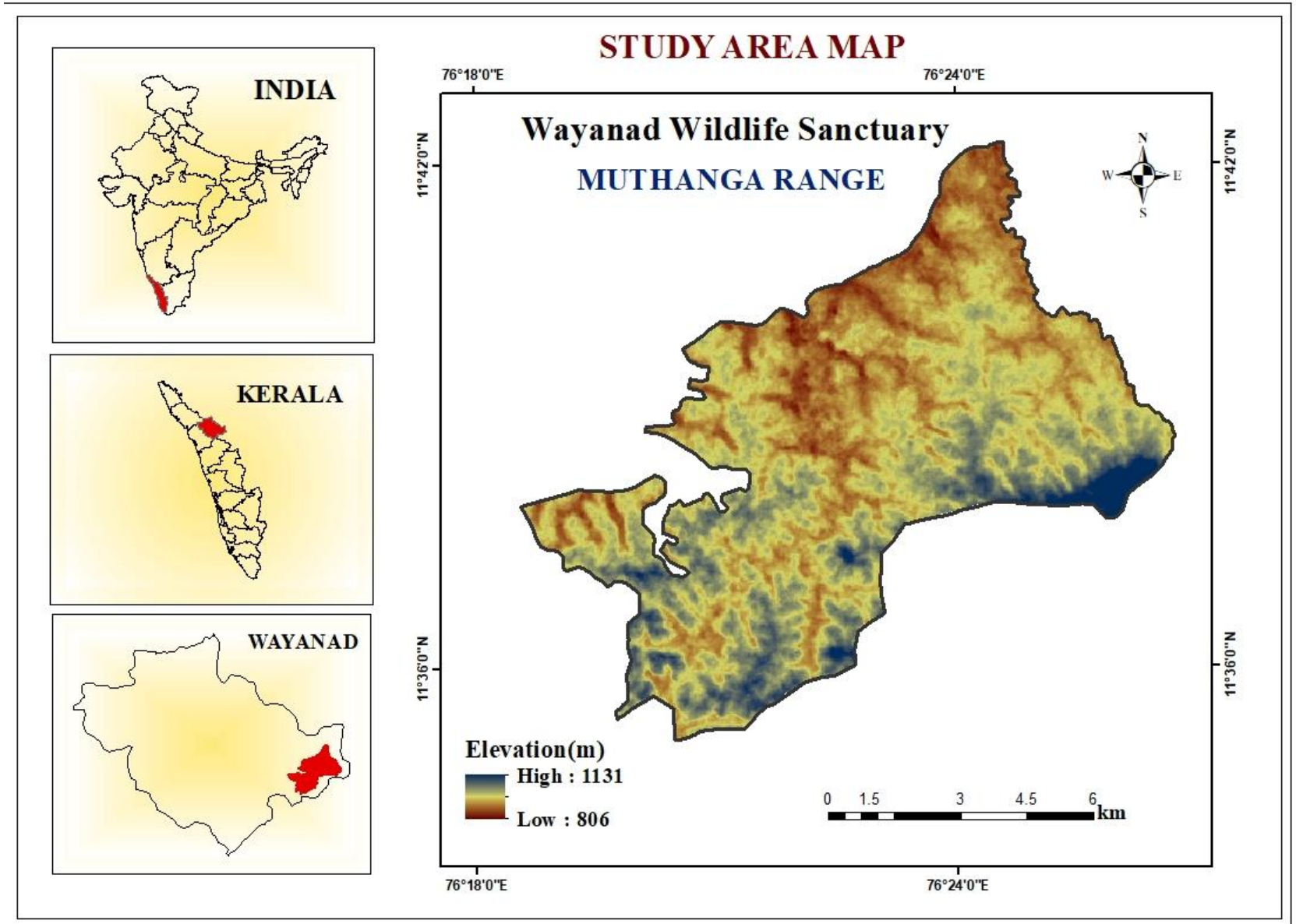
On an average more than 20 people are killed every year in wildlife attacks in wayanad as man and animals are competing.

In Wayanad Wildlife Sanctuary there has been an increase in Elephant population from 2002-2010 (521-713).

OBJECTIVES of Study

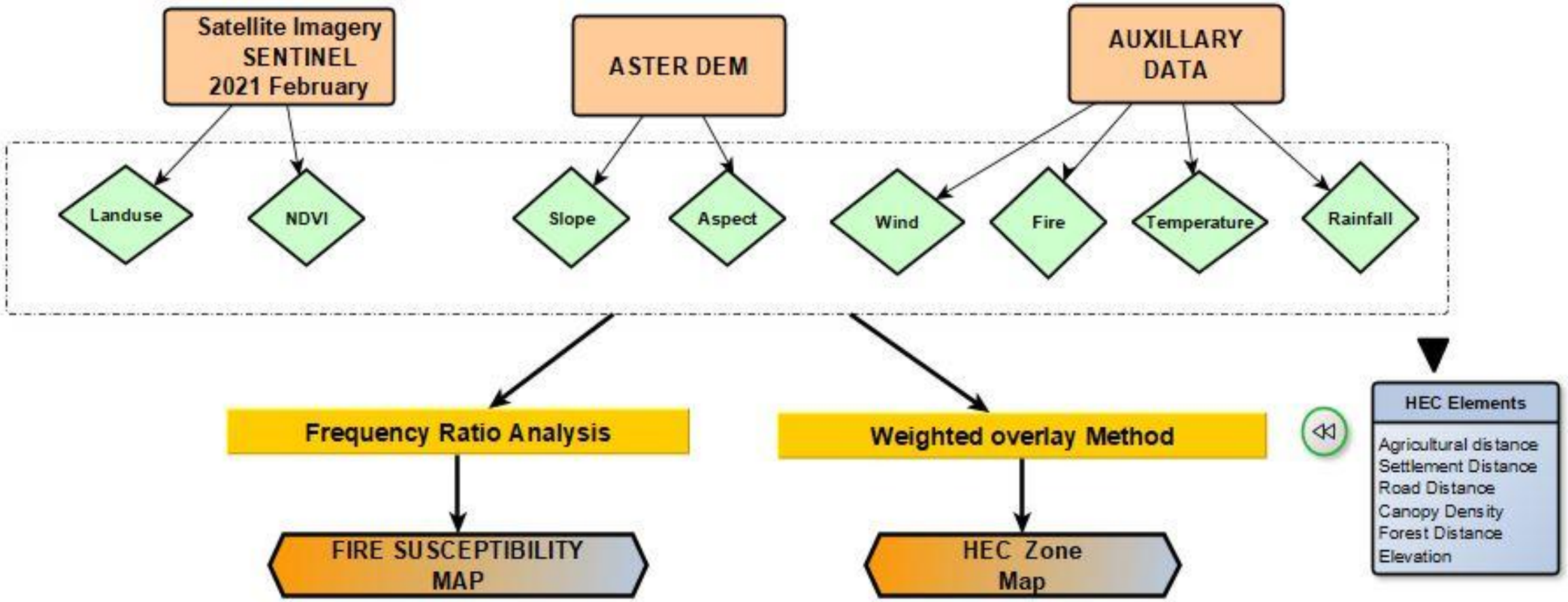
- To investigate the Forest Fire susceptibility of Muthanga forest range using Frequency ratio model.

- To analyse the Human elephant Conflict areas.



- StudyArea-Muthanga Wildlife Range
- Area-87.13 km^2
- Longitude -76°22'28.17"E
- Latitude-11°40'2.66"N
- Drainage-Noolpuzha,Kabani
- District -Bathery Taluk,Wayanad.

FLOW CHART


Satellite Imagery
SENTINEL
2021 February
ASTER DEM
AUXILLARY
DATA
Landuse
NDVI
Slope
Aspect
Wind
Fire
Temperature
Rainfall
Frequency Ratio Analysis
Weighted overlay Method
HEC Elements
Agricultural distance
Settlement Distance
Road Distance
Canopy Density
Forest Distance
Elevation
FIRE SUSCEPTIBILITY
MAP
HEC Zone
Map

Dataset Table

Dataset	Filetype	Data Type	Details	Source
Sentinel Imagery	*Geotiff*	*Raster*	*Landuse* *NDVI*	*USGS Earth Explorer*
DEM	*GeoTiff*	*Raster*	*Slope* *Aspect* *Elevation*	*Earth data NASA gov.in*
Geology ***Geomorphology*** ***soil***	*shapefile*	*vector*	*Physiography of study area*	*Bhukosh*
WindSpeed data	*Geotiff*	*Raster*	*Wind speed(m/s)*	*Global Wind Atlas*
Temperature data	*Geotiff*	*Raster*	*Temperature (Celcius)*	*USGS Earth Explorer (MOD11A2 V6)*
Rainfall data	*CSV*	*Vector*	*Rainfall(mm)*	*IMD (Indian Meteorological Dept.)* *No. of stations: 3 (Ambalavayil, Vythiri, Kuppadi)*
Firedata	*CSV*	*Vector*	*Firepoints*	*Earth data NASA gov.in*
HEC data	*Field data*	*Vector*	*Location points*	*Muthanga wildlife range office*

Frequency ratio Method

The study involves analyzing Fire prone areas using FR Ratio method taking into account 14 thematic layers.
To obtain the frequency ratio (FR) for each class of the causative factors, a combination has been established between the fire points and factor map using the equation:

$$fr = \frac{N\%Firepix(a)}{N\%classpix(b)}$$

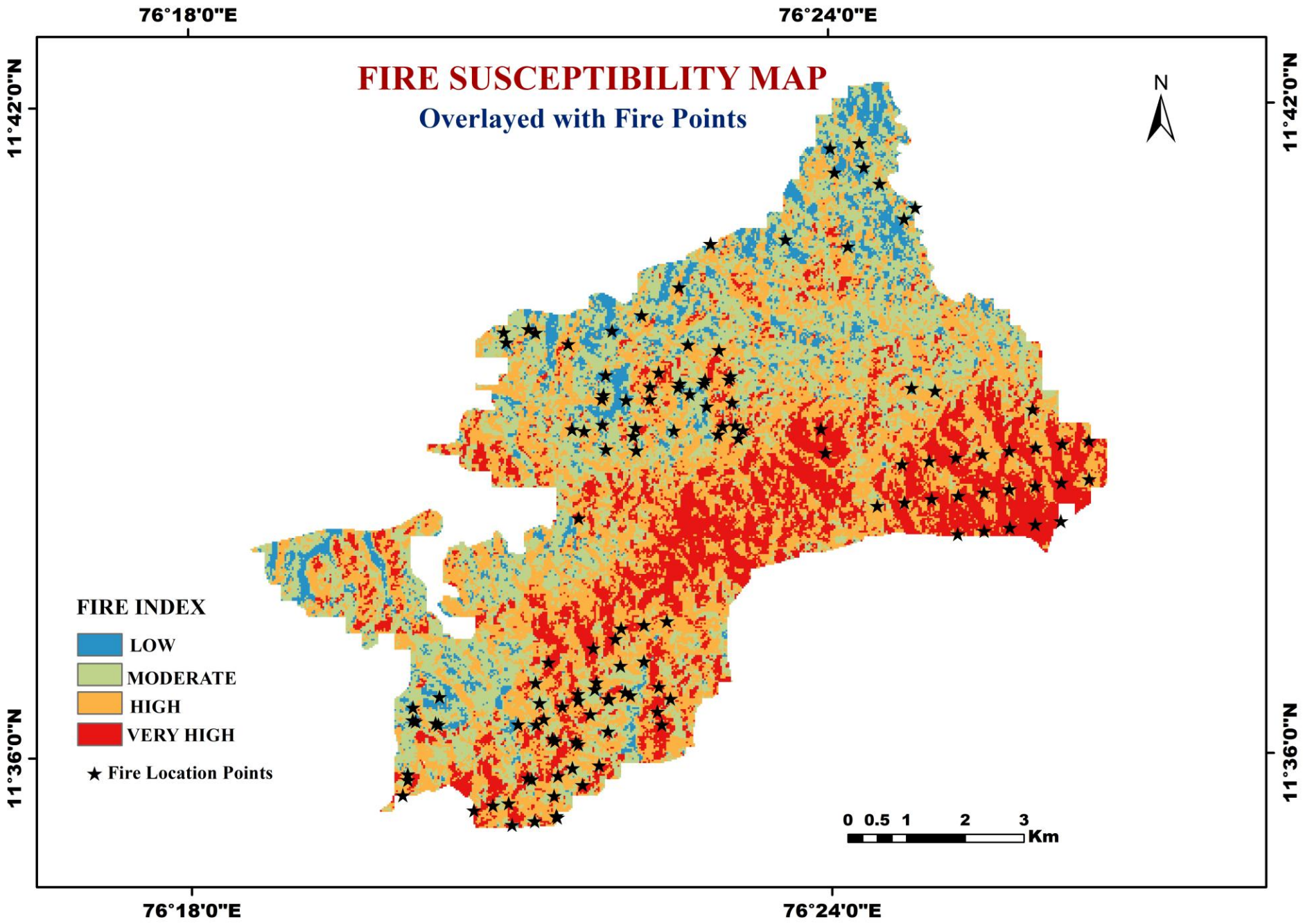
Weighted Overlay Method

The study Involves analysing HEC prone areas using weighted overlay method taking into account the following 6 thematic layers namely:

- Distance to Agriculture
- Distance to Settlement
- Distance to Road
- Distance to Forest
- Distance to canopy and
- Elevation

Frequency Ratio Table

Factor	Classes	No. of Pixel in class	No. of Pixel in class%(a)	No of Fire points in class	No of Fire points in class%(b)	Frequency Ratio (FR) (b/a)
Slope (degree)	<5	17479	20.63	29	21.96	1.064
	5-10	31416	37.09	51	38.63	1.041
	10-20	30767	36.32	44	33.33	0.92
	20-40	5011	5.91	7	5.30	0.89
	>40	27	0.031	0	0	0
Aspect	Flat	26	0.03	0	0	0
	N	12037	14.2	12	9.08	1.77
	NE	12695	14.98	25	18.93	1.67
	E	9863	11.64	29	21.96	2.49
	SE	8575	10.12	10	7.57	0.98
	S	9583	11.31	10	7.57	0.88
	SW	10982	12.96	23	17.42	1.77
	W	10505	12.40	12	9.09	0.96
	NW	10435	12.32	11	8.33	0.89
Elevation (m)	<850	7158	8.450904	19	14.399	14.39
	850-950	45588	53.822269	49	37.122	37.12
	900-950	27423	32.376241	52	39.399	39.39
	950-1000	3567	4.211284	10	7.5758	7.57
	>1000	965	1.139302	2	1.5152	1.51
Land use	Agriculture	3378	3.76	8		1.60
	Plantation (Eucalyptus)	5106	5.69	7	5.30	0.93
	Open Scrub	5127	5.71	12	9.09	1.58
	Dense Forest	35270	39.34	43	32.57	0.82
	Mixed Forest	40771	45.47	62	46.96	1.03
NDVI	<0.5	2060	0.69	8	6.06	2.49
	0.5-0.6	14101	0.78	10	7.57	0.45
	0.6-0.7	57203	0.92	96	72.72	1.077
	>0.7	11379	2.13	18	13.63	1.015
Geomor-phology	Pediplain	3178	3.78	8	6.06	1.60
	Denundational Hills	52624	62.63	98	74.24	1.18
	Piedmont Zone	28219	33.58	26	19.69	0.59
Lithology	Satyamangalam Gp.	10554	12.45	36	27.27	2.18
	Peninsular Gneissic	72275	85.28	94	71.21	0.83
	Charnockite Gp.	1918	2.26	2	1.51	0.66
Soil	clay	79750	95.494	5	3.78	0.03
	loam	3763	4.5055	127	96.21	21.35
Rain (mm)	<350	4606	5.434	5	3.787	0.690
	350-357	36639	43.230	45	34.09	0.784
	357-360	32977	38.909	47	35.60	0.92
	>363	10531	12.429	35	26.511	2.13
Temperature (celcius)	<24	7351	8.84	4	3.033	0.342
	24-25	26401	31.75	52	39.39	1.240
	25-26	38463	46.26	62	46.96	1.06
	>26	10920	13.13	18	13.63	1.037
Wind (m/s)	4-5	57348	68.43	83	63.35	0.93
	5-6	26244	31.46	48	36.64	1.16
	>6	81	0.09	0	0	0
Settlement (Km2)	<1	45800	54.07	90	68.18	1.26
	1-2	15351	18.12	15	11.36	0.63
	2-4	13748	16.23	5	3.78	0.23
	>4	9802	11.57	22	16.67	1.44
Road (km2)	<0.5	45941	54.24	71	53.78	0.99
	0.5-1	24578	29.02	52	39.39	1.35
	1-1.5	9022	10.65	8	6.06	0.56
	1.5-2	4036	4.76	1	0.75	0.16
	>2	1124	1.33	0	0	0
Drainage (km2)	<1	17537	20.70	9	6.81	0.33
	1-2	28263	33.36	32	24.24	0.73
	2-3	23800	28.09	59	44.69	1.59
	3-4	12248	14.46	26	19.69	1.36
	>4	2853	3.36	6	4.54	1.35


FIRE SUSCEPTIBILITY MAP
Overlayed with Fire Points
76°18'0"E
76°24'0"E
11°42'0"N
11°36'0"N
N
FIRE INDEX
LOW
MODERATE
HIGH
VERY HIGH
★ Fire Location Points
0 0.5 1 2 3
Km

Human Elephant Conflict study

THEMES	CLASS	RANK (1-4)	WEIGHT (%)
Distance to Agriculture (km)	<0.5 0.5-2 2-3 3-4 >4	4 3 2 2 1	25
Distance to Settlement (km)	<1 1-2 2-4 >4	4 3 2 1	20
Distance to Road (km)	<0.5 0.5-1 1-1.5 1.5-2 >2	4 3 2 2 1	18
Canopy Density	<0.5 0.5-0.6 0.6-0.7 >0.7	4 3 2 1	15
Distance to Forest(km)	<0.25 02.5-0.5 0.5-1.5 1.5-2 >2	4 3 2 2 1	14
Elevation(m)	<850 850-950 900-950 950-1000 >1000	3 2 2 1 1	8

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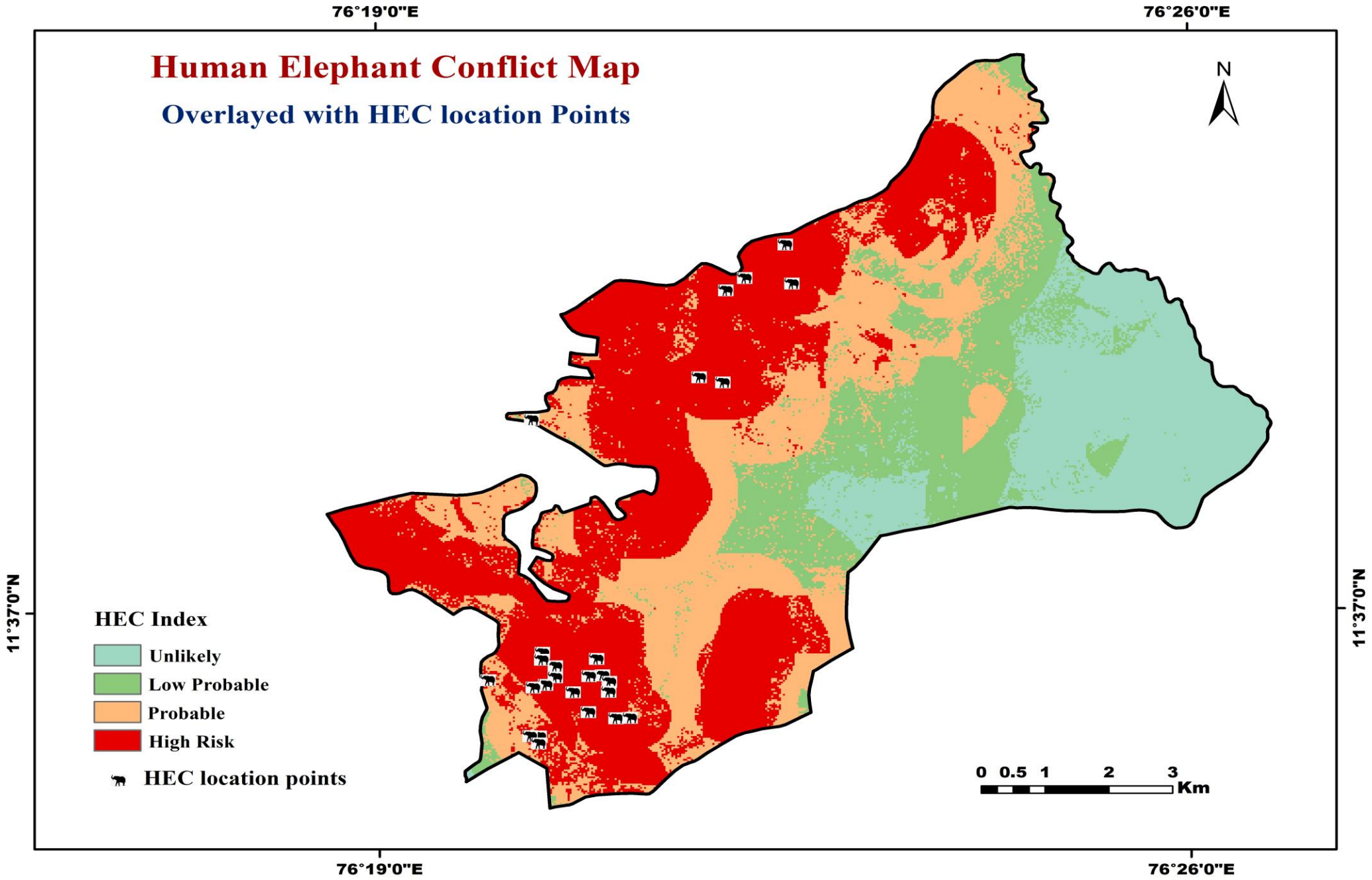
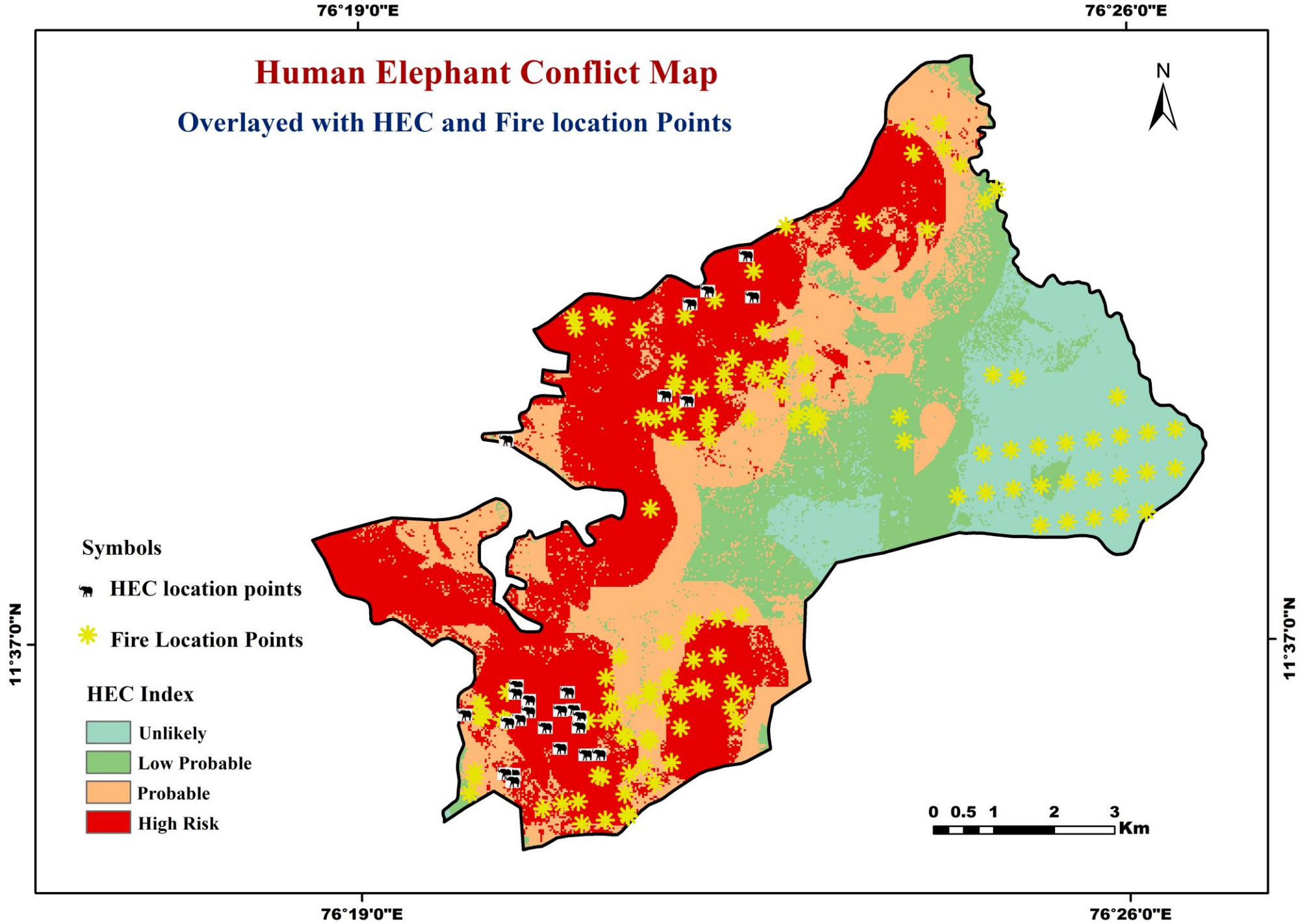

Human Elephant Conflict Map
Overlayed with HEC location Points
76°19'0"E
76°26'0"E
11°37'0"N
N
HEC Index
Unlikely
Low Probable
Probable
High Risk
HEC location points
0 0.5 1 2 3
Km


Human Elephant Conflict Map
Overlayed with HEC and Fire location Points
N
76°19'0"E
76°26'0"E
11°37'0"N
Symbols
HEC location points
Fire Location Points
HEC Index
Unlikely
Low Probable
Probable
High Risk
0 0.5 1 2 3
Km

Conclusion

•The map highlights **areas of high Human-Elephant Conflict (HEC)**, particularly concentrated in the central and western regions.

•**Fire incidents overlap significantly with high-risk conflict zones**, indicating added environmental stress in these areas.

•**High-risk zones** are likely linked to **human settlements, agricultural expansion, and elephant movement corridors**, requiring focused management.

•These insights point to the need for **targeted mitigation efforts**, including conflict prevention measures and community engagement.

•**Integrating fire management and conflict reduction strategies** will be crucial for protecting both wildlife and local communities.