



RESEARCH ARTICLE

A GIS BASED ECOTOURISM POTENTIAL SITE SELECTION FOR PROMOTION OF TOURISM IN JUNGLE MAHAL OF WEST BENGAL

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ABSTRACT

Ecotourism is one of the fastest growing sectors in the tourism industry at present. The market for nature holidays is certainly a growing one. The World Tourism Organization (WTO) has estimated that nature tourism generates 7 percent of all international travel expenditure, the relations Eco-tourisms this is widely used today, but is rarely explain. It is often used interchangeably with others terms such as soft tourisms responsible tourisms and nature tourisms. In simple terms eco-tourisms simply means that the main motivation for travel is the desire to view eco system in their natural state. Both regarding wildlife and the original population, however, ecotourism is often taken to be more than this with its proponents requesting that is also concerned and the lives of the local people improved thought of effects of tourisms. The present study is an attempt to identify potential ecotourism sites in Jungle Mahal using Remote Sensing and GIS techniques in forest dominated area of West Bengal. GIS approach of visualization is an innovative discipline to recognize the 'Ecotourism' assessment of tourism by integrating spatial and non-spatial data. After identifying the potential sites, a demonstrative plan has been made for Ecotourism development based on locally available natural resources.

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INTRODUCTION

Ecotourism is one of the fastest growing sectors in the tourism industry at present. The market for nature holidays is certainly a growing one. The World Tourism Organization (WTO) has estimated that nature tourism generates 7 percent of all international travel expenditure, the relations Eco- tourisms this is widely used today, but is rarely explain. It is often used interchangeably with others terms such as soft tourisms responsible tourisms and nature tourisms. In simple terms eco-tourisms simply means that the main motivation for travel is the desire to view eco system in their natural state. Both regarding wildlife and the original population, however, ecotourism is often taken to be more than this with its proponents requesting that is also concerned and the lives of the local people improved thought of effects of tourisms. The present study is an attempt to identify potential ecotourism sites in Jungle Mahal using Remote Sensing and GIS techniques in forest dominated area of West Bengal. GIS approach of visualization is an innovative discipline to recognize the 'Ecotourism' assessment of tourism by integrating spatial and non-spatial data. After identifying the

potential sites, a demonstrative plan has been made for Ecotourism development based on locally available natural resources.

Study area

The study area of Jungle Mahal mainly Purulia Bankura & Paschim Midnapore is the western most 3 district of west Bengal (8602'52"E - 87022'24"E, 23036'7"N-21047'5"N on globe). Its nick name is Jungle Mahal has significant architectural and natural eco tourisms. This area upland includes which is an extension of the Ranchi plateau of Chotonagpur Region and continued of the granite- gneiss of oldest Precambrian or Achaean formation, In these area is mainly natural beauty forest cover and lovely weather help for health. Bishnupur is famous for its terracotta temple in West Bengal. The residual hills of the Ajodhya are situated in Purulia at the south-western part of the district with an average elevation of 600m. Ajodhya Hill is a treasure house of natural beauties. Bankura, Mukutmonipur and Belphari it is a blend of steep mountains splendid waterfalls, dense forests with her wildlife beauties and huge water bodies (reservoirs). It is also appropriate for educational tours from various field of study. Ajodhya hill has been declared as "Conservation Reserve" at state level by the State Wildlife Board & many Natural

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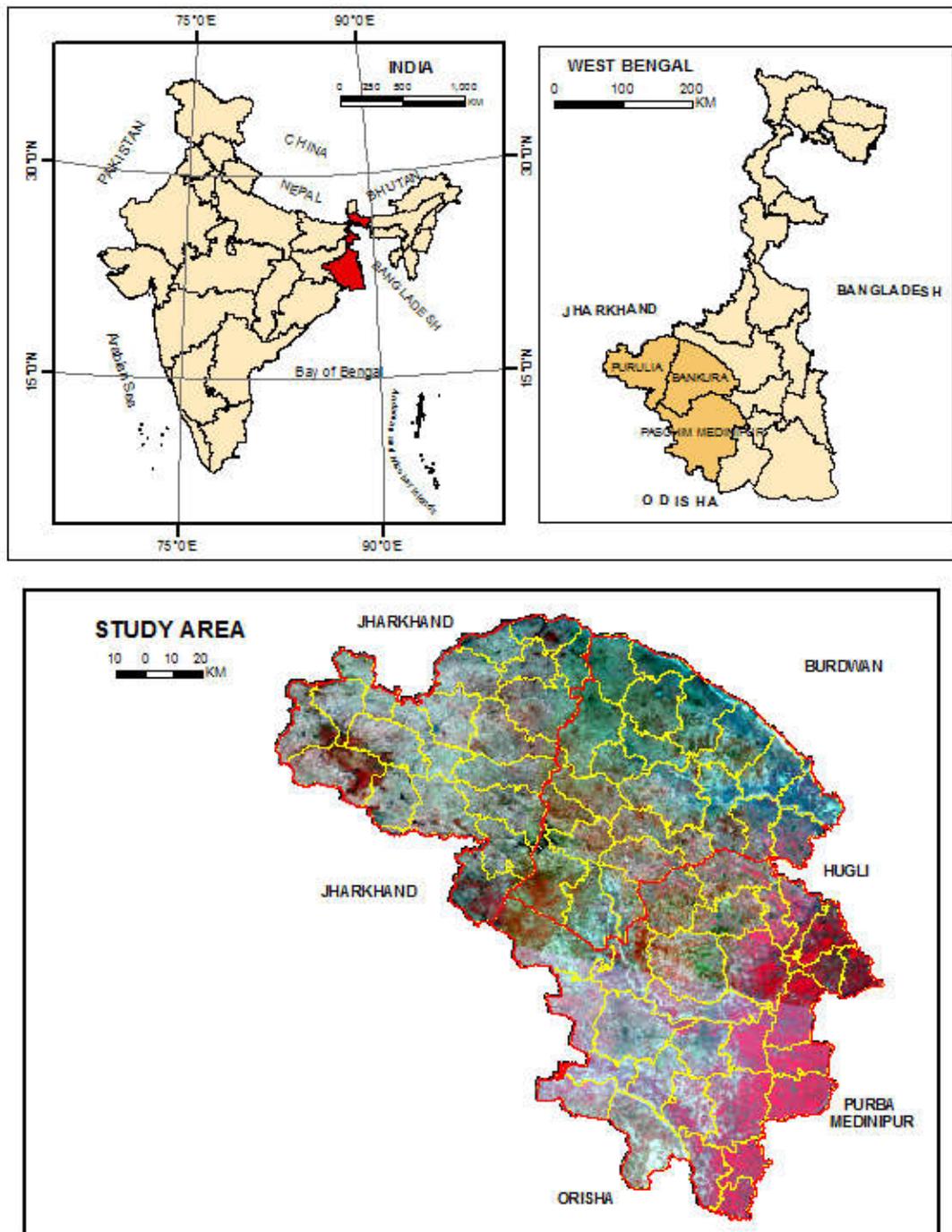


Figure 1. Location Map

heritage side many river side tourisms there is a huge potentiality of development of ecotourism. The physiographic, vegetation and local climatic variation offer an incredible opportunity to the ecotourism. The drainage system of the study area mainly controlled by the Damoder, Dwarkeswar, Kangsabati, and Subarnarekha river. Although several rivers flow across the district, 50% of the water runoff loosed due to the undulated topography. There are also several small dams like Murguma, Mokutmonipur, Panchet, Pardi, Burda, Gopalpur, which is mainly used for irrigation of agriculture field. These rivers and dams may become great tourist attractions if properly maintained.

Climate: Tourism as its development highly depends on the weather condition on an area. The climate of the jangle Mahal area has resemblance with that of the chotonagpur plateau. The

atmosphere of the region is tropical, moist and sub-humid. The climate of the area especially in the upland tracts to the west is much drier than the eastern or southern part. Purulia is one of the drought prone districts of West Bengal. The study area has a tropical monsoon climate this tract experiences three seasons in a year. It has a subtropical climate nature and is characterized by high evaporation and little precipitation. Relative humidity varies from 20 to 99 % climatologically the months of March to June are extremely hot, the rainy season is oppressively humid and October to February months are the best and most comfortable period for tourist.

These Jungle Mahals area tourisms depend on natural forest. This area is covered predominantly with Sal of coppice origin on an average 60% area is covered with Sal and the rest is covered with plantation on, scrub jungles and bushes. The

natural vegetation to jungle mahal area is essentially arboreal. It has how wavered, been cleared and degraded or replaced by shrubs bushes meadow and cultivation fields to such an extent that this statement has little practical significance today. The tract to the west is lateriferous, undulating and even hilly' and possesses a flora closely approximating to that of Choto Nagpur some parts are entirely waste while other parts contain jungles of small Sal, Kusum, and Piasal, Mahua(Bassia Latifolia), Palash (Butea frondosa), Kend/Kendu (Dios-pyros), Mango (Mangifera indica), Shimul (Bombax malabaricum), Kadam (Anthocephalus cadamba), which yields valuable wood is fairly abundant. The jungle mahals a land of topical moist deciduous forests (characterized by lofty buttressed trees rising to 40 meters to from the top canopy)

Education is essential for human emancipation and social development. It contributes to better health, higher productivity, greater income, human freedom, capability and esteemed living, increased participation in community life. Education is the single best development investment and a powerful instrument to develop an economically prosperous society. jungle mahal is the one of the backward area of West Bengal in terms of economy and human development. And it is a tribal area. The literacy rate is this area 62.64% as per Census 2011. Literacy is even lower in case of female, which is only. so education economic is the vary importance part of the this area tourisms infrastructure.

Origin of research problem: Forest covered plateau hills of Purulia, Bankura and West Medinipur District of West Bengal are part of the 'Jungle Mahals', i.e. tropical dry deciduous forest of chotonagpur Region and most occupied by tribal population. Mountainous landscape and dense forest cover have made many part of region inaccessible by road and thus missing in medical and educational services. Though the climate of this region is very severe average rainfall is 1286 mm, with annual mean temperature 26⁰c but high evaporation and infiltration losses caused agricultural drought. This collected over year and had weakened the economy of the area. In 'Combined Mission for Sustainable Development'(1993) Govt. of India known that 152 districts of India are backward district. Among them one of most significant district, Purulia are identified from West Bengal. Taking advantage of physical and economic handicap an organized group of social and political activities called Left Wing Extremists committing violence and keeping the people of jungle Mahals under threat. The plans of action of LWE include criminal takings, Kidnapping, lasting on railway tracts, burning, lootings and paramilitary warfare inside forests. Their targets are mostly cadres and local level leaders of ruling party of state and security force personnel. They operate in a planned manner from remote and inaccessible tribal and rural area.

Insubordination of local population being the main problem, government security forces with all its muscle power and intelligence network had not been completely succeed to stop these extremist activities. To get the support and connection of local people in anti-terrorism operations, the government first should strive to improve lack in forest villages by placing income-generating plans. Economic and social improve will automatically bring the awareness, and villagers will naturally act against any kind of upheaval, which could be harmful to their earnings. The physical environment of this region is not suitable for intensive agriculture and inexpert tribal people will also not be chosen by the modern industry. This taking into

account their skill level as well as the environmental rules, employment of ecotourism in forest villages may be the best income, generating Activity in this region and it is also environmental.

Review of literature: Buckeye Obadiah James (Application of GIS ecotourism development decision) in their study observed in Uganda's National Park for eco-tourism development. He expressed that employment in tourism sector, India of his study area as under :- The finding on economic impact show that tourism has opened new employment opportunities of then an equivalent expansion in other sectors of economy. He shows that 219000 people are currently driving their livelihood from ecotourism in Uganda. Banerjee U.K., Kumari Smriti, Paul S.K and Sudhkar. (Remote sensing & GIS based ecotourism planning : A case study for western Medinipur, West Bengal, India 2006). They discuss various aspect of ecotourism planning in West Medinipur. They considered that ecotourism is impotent for the environmental conservation & economic development. They choose forest dominated area of Western Medinipur. To identify the eco-tourism potential zone and they discuss a demonstrative plane for eco-tourism development base on locally available natural source. Their view to conserve and the maintain the biological richness of the areas as well as economic up-liftmen of the local people by providing employment and opportunities in the field of ecotourism development. Ologun J.A.A, Taaiwo, O.Adeofun, Here they discuss for tourism potentials in Neigiria to beutifisied sustainably, the necessary infrastructure and enabling environment and information on tourism which will attract tourist must be available. Enabling environment in this case refers to all the parameters required to make complete tour, such as good road, functional telecommunications, and good accommodation adequate security. Information on the existence of attractions sites and these infrastructure must be available to tourists and the general public this means that raw data on tourist sites and infrastructures has to be gathered ,processed, structured ,then stored and organized in a such way it is easily retrievable from storage. A geographical information system, GIS is best for these exercises since it makes it possible to view and use both data types together. This paper discusses the practical role of GIS in developing tourism potentials in Nigeria. GIs also proved to be an indispensable for decision making.

Objectives of the study: Ecotourism development and growth of the economic condition of back log people of jungle mahal area as the only objective. The current study area is undertaken with the following aims

- 1) Producing a land use/ land cover map of the study area using 2015 LANDSAT image
- 2) To, assess the spatial distribution of others facility likes- transport network accommodation facility which helps made for eco tourisms development.
- 3) To identification of existing potential tourist spots in jungle mahal and their classification based on Fluctuation of high relative relief High altitude with dense to moderate forest coverage
- 4) Identify determination factor for eco tourisms site selection.
- 5) Assessing probable impact of terrorism on ecotourism in jungle mahal

Planning for ecotourism development like as Tourist cottages/rest houses, green hotels and restaurant, public convenience facilities, watchtower for over viewing scenic beauties, tourist information Centre, tourist guide map, detail map of the ecotourism destination, thermal health tourism, tourist Ashram tourist, circuit map to show its linkage to other place of tourist interest, do and don't broad medical facilities and communication facilities etc.

Data Used

To achieve the objectives of the persons study the following satellite data products, ancillary data and software were used. Satellite imagery LANDSET- 8 data of 25th February pertaining to the study area was used from USGS, USA. The specification of the satellite and its products are describe in bellow table

Table: Satellite Data specifications

SENSOR	SATELLITE	PATH	ROW	DATE OF PASS
Oli (operation land imager)	Landsat-8	145	44&45	25 feb 2015

An essential parameter used in the study –Relative relief was derived from the *ASTER* (Advanced Space borne Thermal Emission and Reflection Radiometer) DEM that was obtained from USGS USA.

Ancillary Data

Soil Map	NBSS
Topo sheet	Survey of India
Others data	Google
IKONOS imagery	Google Earth
Census Data	Census of India

Methodology

Collection of satellite images

LANDSET-8 of 2015 has been collected and IKONOS (1.0m) data from GOOGLE EARTH are also consulted for Mapping or place mark purpose.

Collection and study of collateral data

Along with the digital satellite data some collateral information are also collected and consulting for procuring a good accuracy level. In this respect Survey of India (SOI) topological maps, land use map (DPMS) of 3 districts Form Nation Atlas Thematic Mapping Organization (NATMO), ASTER images form GLCF Socio-economic data form Census of India.

Land use /Land cover Mapping

Visual interpretation of geocoded false colour composite imageries on the basis of tone or colour, texture, pattern, relative brightness etc. For delineation of different land use categories ERDAS/IMAGINE software package or other suitable image processing GIS software may be used to get more precise information on the basis of DN values. The entire area except the water bodies may be classified by supervised technique using maximum likelihood classifier.

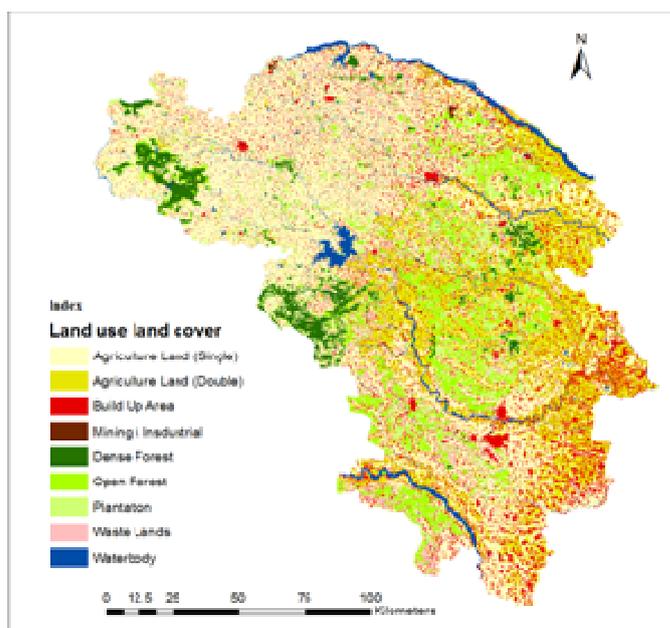


Figure 2. Land use Land cover

Table: Land use Land cover Area

Land use & Land cover	Total area (Sq km)	Area in percentage (%)
Agriculture Land (Double Crop)	4254.89	18.84
Agriculture Land (Single Crop)	9536.60	42.22
Build Up Area	2630.74	11.65
Build Up Area (Mining / Industrial)	45.71	0.21
Dense Forest	869.17	3.86
Open Forest	2007.033	8.86
Plantation	1193.95	5.29
Waste Land	1250.09	5.53
Water Body	800.75	3.54
Total	22588.93 sq km	100

Road network mapping

From National Highway to Trekking Routes in the forest all are to be digitized from toposheet, District Map, Satellite Images and landuse map and Google Earth wherever not available in the map.

Preparation of the Digital Elevation / Terrain Model (DEM / DTM)

DEM will be generated by digitizing the contour of the toposheet and adding elevation data, or it could be directly obtained from SRTM data. Thematic maps on elevation, relative relief and slope will be prepared based on this model.

Potential site selection for ecotourism (Ep): Keeping in mind the basic thirsts of an ecotourist, ecotourism potential sites will be selected based on eight criteria:

- (E1) The spot must be above an elevation of 500m and near the edge of the hill, that tourist can have a bird's eye view of the downstream plain.
- (Vd) To feel in the lap of the nature and for adventure also, there must be dense to moderate forest cover.
- (Wb) There should be a river, dam or other water bodies near the spot.

- (Sp) Fertile agricultural lands are to be avoided only barren lands and forest-fringes are to be used.
- (Pd) Solitude is always a major demand of the ecotourists, therefore Mauzas with very low population density are preferred.
- (Rc) All the spots must be connected by roads.
- (Fl) There should have some food & lodging facilities, but these could be buildup latter also.
- (L) To develop ecotourism infrastructure (Tourist cottages / rest houses, green hotels and restaurant, public convenience facilities, Tourist Information center, camping ground etc.) there must be at least 200 ha. of level ground, preferably under forest cover.

- (Fc): To feel in lap of nature and for adventure also, there must be dense to moderate forest cover. Tree clad area are moderately importance.
- (Pd): Solitude is always a major demand of tourists, therefore Block with very low population density
- (Rc): All the spot must be connected by road.
- (Fl): There should have some food & lodging facilities but could be build up later also
- (L): To develop ecotourism infrastructure (tourist cottage /rest house, green hotels and restaurant, public convenience facilities, Tourist Information center, camping ground etc.) there must be at least 200 ha of level ground, preferably under forest cover

$$EP_i = \sum (EI_i + Vd_i + Wb_i + Sp_i + Pd_i + Rc_i + Fl_i + L_i)$$

Where weightage (i) = 1,2,-----n.

These criterions are to be taken as the parameters to evaluate the areas of high ecotourism potential. For this purpose a 'Weighted Sum Overlay Analysis' method will be adopted. The input in the form of ARC/GIS coverage will be assigned relative weightage in accordance to its influence/importance in decision making based on expert opinion, and each other class in the individual coverage will be ranked according to its potential of being for being developed for ecotourism.

Potential site selection and required infrastructure:

Keeping in mind the basic thrusts of an ecotourism, ecotourism potential sites are selected based on eight criteria: 1) The spot must be above an elevation of 500m or near the edge of the hill, that tourist can have a bird's eye view of the downstream plain. 2) To feel in the lap of the nature and for adventure also, there must be dense to moderate forest cover. 3) There should be a river, dam or other water body near the spot. 4) Fertile agricultural lands are to be avoided only barren lands and forest-fringes are to be used. 5) Solitude is always a major demand of the ecotourists, therefore Mauzas with very low population density are preferred. 6) All the spots must be connected by roads. 7) There should have some food and lodging facilities, but these could also be buildup latter. 8) To develop ecotourism infrastructure (tourist cottages / rest houses, green hotels and restaurant, public convenience facilities, tourist Information center, camping ground etc.) there must be at least 200 hec of level ground, preferably under forest cover. Zones, which meet these criteria, were considered suitable for eco-tourism development. For suitability analysis, Land use - land cover map, DEM (Digital Elevation Model for altitude and relative relief), Population density map, Road network map and other public and tourist utility maps of the area were used Keeping in the mind the basic thirsts of a tourist, ecotourism potential sites are selected based on these criteria.

Potential site selection for Ecotourism (EPS)

- (Rr): The spot must have a high relative relief and edge of hill, that tourist can have a bird's eye view of downstream plain and scenic beauties.
- (Wb): There should be a river, dam or water bodies near to spot.
- (Lu): Land use/land cover pattern of study area which is consider as Fertile agricultural lands are to avoid only barren land and forest-fringes are to be used.
- (Sc): The spot must be importance soil characteristic.

These criterions are to be taken as the parameters to evaluate the areas of high ecotourism potential. For these purpose a 'a weighted sum overlay analysis has been made with all the thematic raster layer that allows a linear combination of probability weights of each thematic raster map(EP) with individual capability value(CV).

Mathematically, this can be defined as...

$$EP = f(Rr, Wb, Fc, Sc, Sp, Pd, Rc, Fl, L)$$

Where EP is Ecotourism potential site, Rr is Relative relief, Fc is Forest coverage(mainly dense to moderate), Wb is River, dam, water bodies, Sp is waste and barren land, Pd is population density, Rc is Road connectivity, Sc soil Characteristics Fl is food & lodging facility is ecotourism infrastructure.

In this context we can say $EPS = \sum WiCVi$

With $\sum Wi = 100$

Where EP is Ecotourism potential map value, Wi is probability value of each thematic map that is theme weight and CVi is the individual capability value of each thematic map that is class weight.

The above equation can be written as

$$EPS = \sum WiCVi \\ = (22*CVRr) + (19*CVWb) + (12*CVLu) + (13*CVSc) + \\ (11*CVPd) + (9*CVRc) + (14*CVFc)$$

Land use /Land cover Mapping

The OLI image of February 2015 covering the study area was classified to obtain land use/land cover of the area. Satellite data were clipped in to Jungle Mahal area (Purulia, Bankura, and Paschim Medinipur). An unsupervised classification was performed to obtain the land use/ land cover information classes for the major land use. The areal extends of various land use /land cover in the study area are given in the table

Weight value overly analysis

Site selections for promotion and development of ecotourism

A weighted overlay analysis approach was adopted to identify the suitable site for ecotourism development of the study area.

Raster Layer Overlay Analysis for Eco Tourism Potential Zone

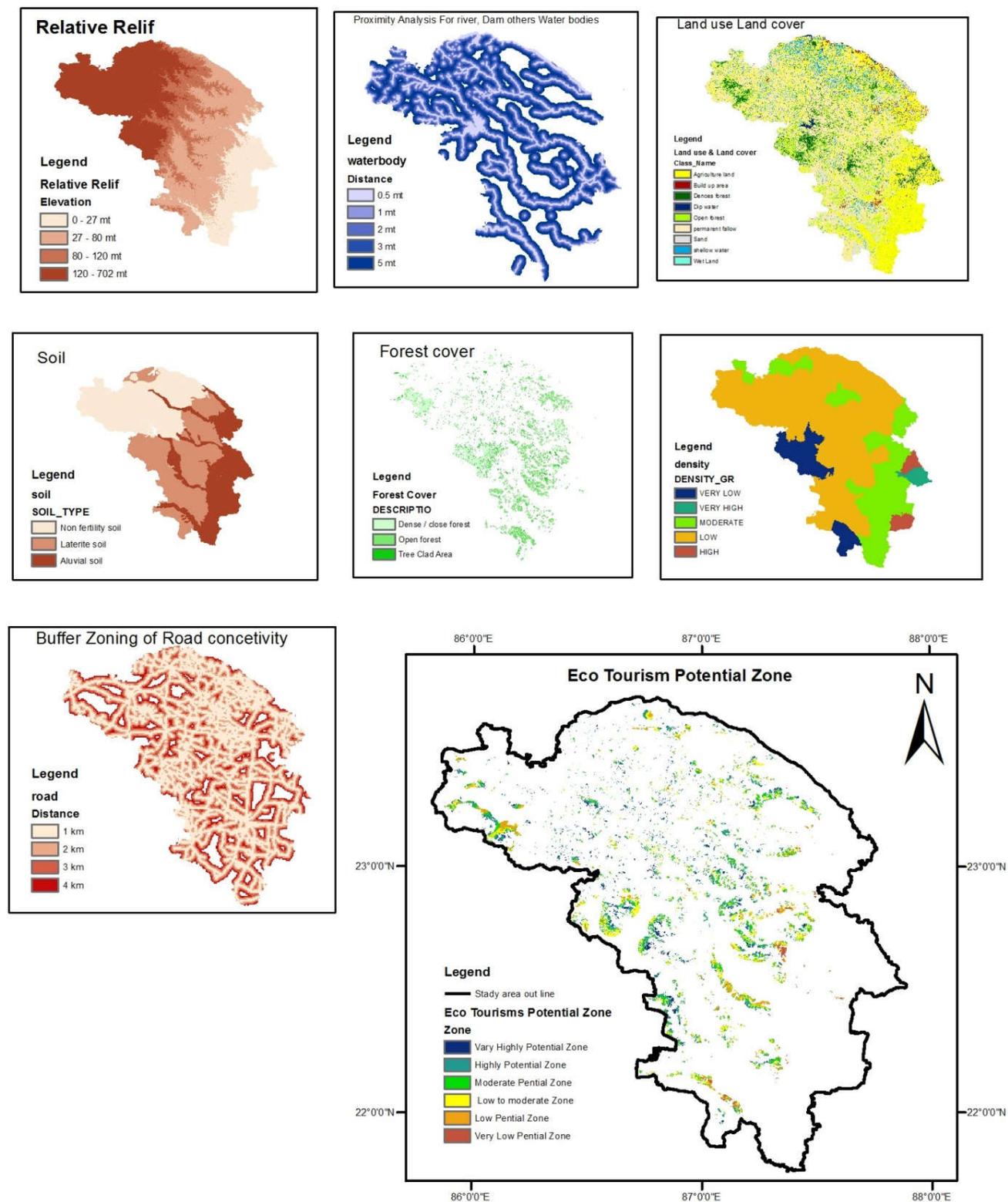


Figure 3. Overlay Analysis of Different Layer for Tourism Potential Zone

Weight value overly analysis

S.No.	Layer	Class	Theme weight	Class weight	How much potentiality
1	Elevation	120-702 m	22	9	Much potential
		80-120m		8	Much to Moderately potential
		80-27		7	Moderate potential
		0-27		3	Low potential
2	River, Dam & Water body	500m	19	9	River sites are highly important for scenic beauty or bottling
		1 km		8	Tributary distributaries are also important for their scenic beauty
		2 km		6	Very important for summing pull & bottling
		3 km		2	Low potential
		5 km		1	Very Low potential
3	Land use	fallow land	12	8	Low dense forest important for ecotourism
		Agriculture field		0	Avoid
		Other		2	Not so potential
4	Soil characteristic	Laterite soil	13	9	Highly potential
		Non fertility soil		8	Moderate
		Aluvial soil		0	Avoid
5	Population Density	Very low	11	9	Very Highly potential
		Low		8	Highly potential
		Moderate		4	Moderate to low potential
		High		2	low potential
		Very High		1	Very low potential
6	Road connectivity	1 km	9	8	Highly potential
		2 km		6	Moderate
		3 km		4	low potential
		3-4km		2	Very low potential
7	Forest cover	Open forest	14	8	Vary importance for eco tourisms
		Clad tree		6	Moderately importance
		Dense forest		4	Low potential

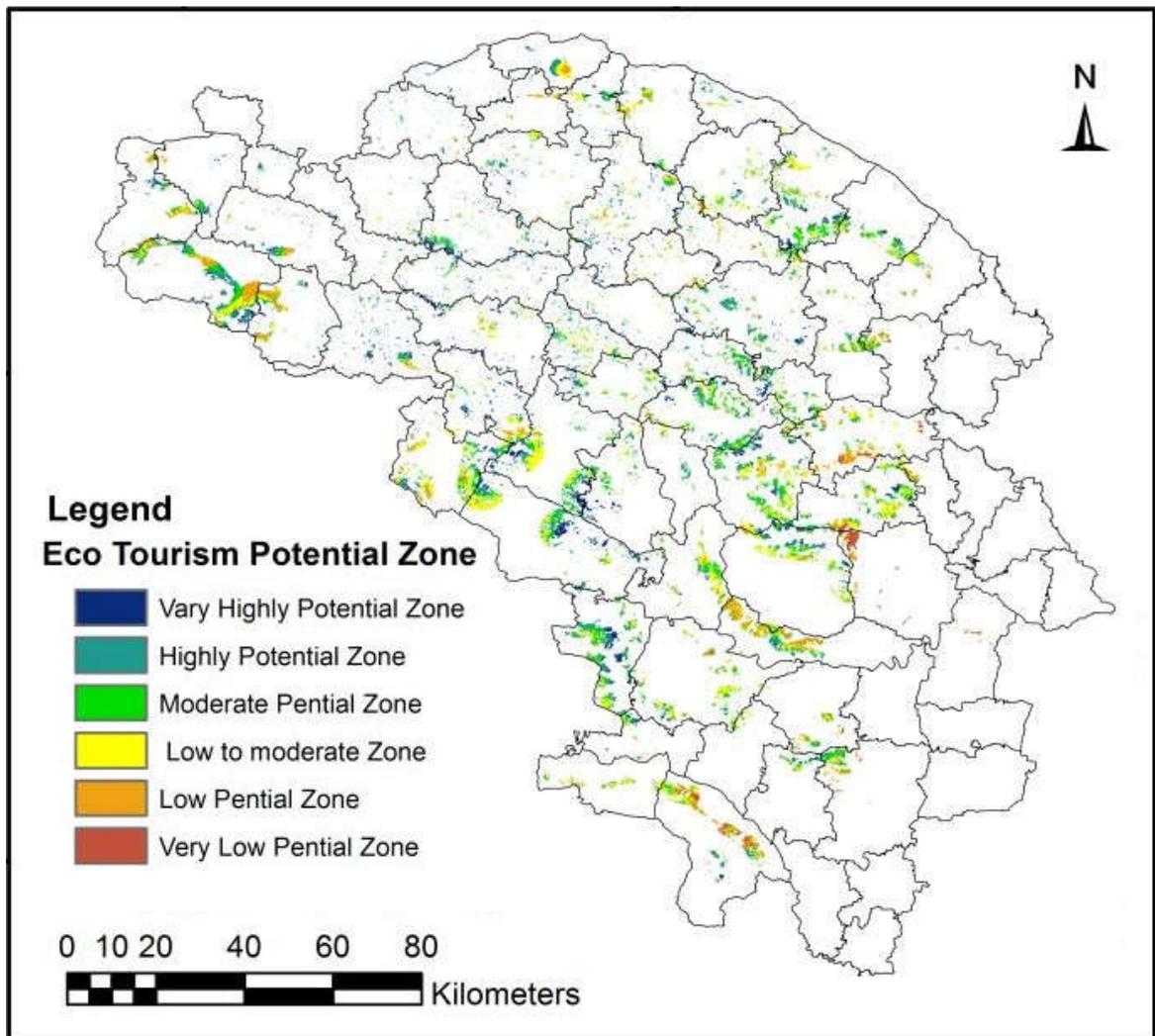


Figure 4. Suitable Zoning Map for Ecotourism Development with Future Tourist Spot

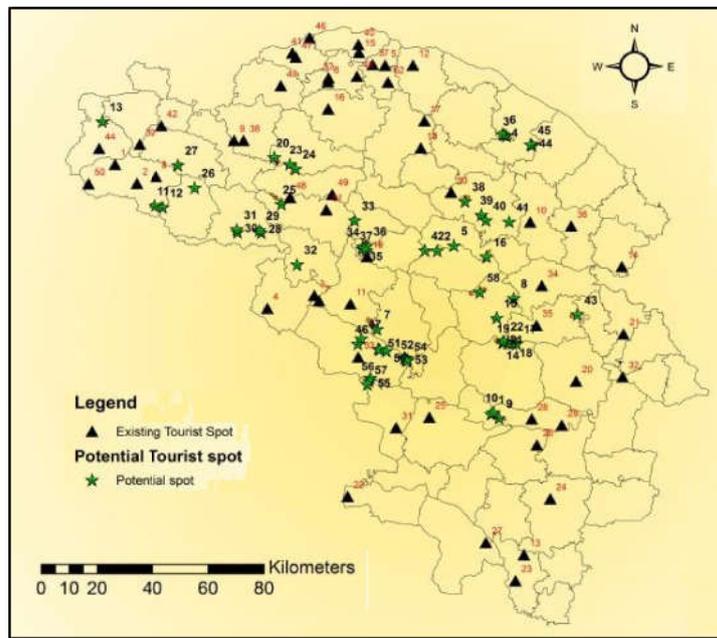


Figure 5. Existing Tourist Place with Future Tourist Place

S.No.	Criteria for site selection	Location	Relative relief (mt)	Proximity to river or dam, others water body	Infertile soil (not suitable)	Open to moderate forest	Low population density	Proper road connectivity	Food and lodging facility
1	Zone-1	Haridi	120-702	Totko nala	Excessively drained, lateritic, Coarse loamy, soil, and subject to sever erosion	Open forest	Low	metal road bad condition	Nil
2	Zone-2	Bhalukhal, sunibasa	120-702	Kuman nala		Open forest	Low	Metal road in bad condition	Nil
3	Zone-3	Agajhor, Keshbera	120-702	Nagasai nala		Open forest	Low	Bad condition metal & unmetal road	Nil
4	Zone-4	keshargaria	120-702	Hanumata nala		Open to moderately	Low	Unmetal road bad condition	Nil
5	Zone-5	Talai	120-702	Hanuman nala		Moderately forest	Low	Unmetal road bad condition	Nil
6	Zone-6	Chaunia	120-702	Sanka river		Open forest	Low	One metal road bad condition	Nil
7	Zone-7	srirampur	120-702	Nagaisai river		Open forest	Low	One metal road bad condition	Nil
8	Zone-8	Ghatusol	120-702	Tarafani river		Open forest	Very low	Metal & unmetal bad condition	Nil
9	Zone-9	Shyamnagar, Ghagra	120-702	Waterbody & bandu nala		Open forest	Very low	Un metal road bad condition	Nil
10	Zone-10	Aruri Band punisal	80-120	Dwarkeswar river		Moderately forest	Low	Well metal road but on metal bad condition	Nil
11	Zone-11	Baga Khulia	80-120	Dwarkes river		Open forest	Low	Un metal road bad condition	Nil
12	Zone-12	Shayam Nager	80-120	Dwarkes river		Open forest	Low	metal road bad condition	Nil
13	Zone-13	Krishna Singhpur	80-120	Dwarkes river		Moderately forest	Low	Un metal road bad condition	Nil
14	Zone-14	Mathaurabera, Benachapara	80-120	Machkanda jora		Open forest	Low	metal road bad condition	Nil
15	Zone-15	Dharampur, Banshol,	80-120	Machkanda jora		Moderately forest	Low	Well metal road on metal bad condition	Nil
16	Zone-16	Chakjambeia	80-120	Kasai river		Moderately forest	Low	Well metal road but on metal bad condition	Nil
17	Zone-17	Baghboda	80-120	Kasai river		Moderately forest	Low	metal road bad condition	Nil
18	Zone-18	Bhedua	80-120	Kasai river		Open forest	Low	Un metal road bad condition	nil
19	Zone-19	Jharia	80-120	Kasai river		Open forest	Low	metal road bad condition	Nil
20	Zone-20	Baraghutu, Madupara, Jambeda, Dhagara	120-702	Mukutmonipur dam		Open forest to moderately	Low	Metal road in bad condition & nonmetal road bad condition	Nil
21	Zone-21	Biradihi	120-702	Mukutmonipur dam		Open forest	Low	metal road bad condition	Nil
22	Zone-22	Kudlung	120-702	Kasai river		Open forest	Low	metal road bad condition	Nil
23	Zone-23	Keshargarh	120-702	Kasai river		Open forest	Low	Un metal road bad condition	Nil
24	Zone-24	Piralloa	120-702	Kasai river		Open forest	Low	metal road bad condition	Nil
25	Zone-25	Joratnr	120-702	Salda nala		Moderately forest	Low	Well metal road but on metal bad condition	Nil
26	Zone-26	Aiodhya site area	120-702	Kulbera nala		Dense forest	Low	metal road bad condition	Nil
27	Zone-27	Lalitala, saregasol,	27-80	Kasai river		Open forest	Moderate	Well road condition	Nil
28	Zone-28	Aguidiha	27-80	Silai river		Open forest	Low	metal road bad condition	Nil
29	Zone-29	Dabraipur	27-80	Silabati river		Open forest	Low	Metal road good & un metal road bad condition	Nil
30	Zone-30	Shanramara, Bans bandi,	27-80	Kasai river		Open forest	Low	Metal road are good	Nil
31	Zone-31	Peruabad	80-120	Kasai river		Open forest	Low	Metal road are good un matal road bad	Nil
32	Zone-32	Dulia	80-120	Kasai river		Open forest	Low	One metal road well & un metal bad	Nil
33	Zone-33	Dumur Kunda	80-120	Tarafani river		Open forest	Very low	Un metal road bad condition	Nil
34	Zone-34	PanchTakarpal, NalKhulia,	80-120	Trarafani river		Open forest	Very low	One metal road well & un metal bad	Nil
35	Zone-35	Baramsol, Domahani	80-120	Karru nala,		Open forest	Very low	One metal road well & un metal bad	Nil
36	Zone-36	Kadai Ghata	80-120	Kurru nala		Open to moderatly	Very low	One metal road well & un metal bad	Nil

After the weight overlay operation being compel the suitable 37 zones (Fig – 4) are identified in Ajodhya hill and adjoining area which have a lot of opportunity to develop the eco-tourism industry. Criteria are already present there

Suitable ecotourism potential Zone

Zones, which meet these criteria, were considered suitable for eco-tourism development. For suitability analysis, Land use - land cover map, DEM (digital elevation model for relative relief, Population density map, waterbody, Road network map soil & forest cover map and other public and tourist utility maps of the area were used. From above analysis Thirty six (36) spots in jungle mahal 3 district Bankura Purulia, & Paschim Medinipur were found to be appropriate for Eco tourists. It is noteworthy that 16 zones are inside Purulia & 9 zones are Bankura, 11 zones are Paschim Medinipur district.

Zone- 1

It covers some part of manbazer II Block of Purulia district with an relative relief range of 120-702m. This zone is near totko nala. Though the population density low of the is 339.96 persons/sq km but most of the population is concentrated in the foothills, not near the spot. A metal road from this zone passes by the spot but it is in very poor condition therefore needs immediate repairing. There is no lodging facilities are available. Simultaneously intensive forest plantation in the degraded forest patches is to be practiced. Eco tourist resort are must be required this zone is haridi is nature beauty attractive to tourist.

Zone –2

This zone covers adjoining part of barabazar in Purulia district. This region Bhalukhal, sunibasa has an moderately hilly area. This region is near to Kuman River carrying though this region. This zone have moderate population density low. this area metal road are passes by the spot but it is in very poor condition therefore needs immediate repairing. Rest of region is covered by open to moderate forest coverage that increased tourist attraction. There is only one teashop near the road crossing. Here no nature banglow and a guest house situated with lodging facilities. Immediate required.

Zone –3

This zone consisting of Agajhor, Keshbera block in Bara bazar of Purulia point of these 37 spots and situated at a relief high. This zone importance for nature bas eco tourism, conveyance facilities, tourist guide map, public convenience facilities, detail map of the ecotourism destination, tourist circuit map to show its link to other place of tourist interest 'Does' and 'Don'ts' board, medical aid facilities communication facilities etc.

Zone-4

The rest of the zone keshargaria is covered by to open forest and average relief height 120-702 mt. The whole region is exist with un-inhabitant which is suitable forest adventure. This zone is located in border of manbazer I & puncha block. And nearby hunumalta nala. This region is covered by mix forest. Some part of region road connectivity is good but not

sufficient. So need to make road metal for ecotourism development.

Zone –5

This zone is located in western part of Balarampur block in Purulia. This region is total position eco health tourism Karhlajalna and hunumalta nala is Main River of zone. Road network and communication system is very poor quality that's needs to make up. This zone is much suitable for forest adventure at now there is no lodging facility. So, some green hotel, resort, lodge is to be build up immediately.

Zone 6

The ecotourism potential zone 6 is located in Chaunia of Matha Reserve forest and Chuuni of Baghmundi block. The elevation of the region is above 510mt. Sanka River is Main River of this zone. The population density is low and road connectivity is very poor.

Zone –7

Zone is located in the Srirampur Baghmundi block of Purulia with an elevation with 480-510m This region is observed high population density than the other mouza and covered with moderate to dense forest. This place eco nature beauty tourist cottage required.

Zone -8

This region is located in Ghatuol boder of Raipur & Ranibund block in Bankura. The relative relief is moderately and low population density that is very low. Most of the region is covered by open forest.

Zone 9

This zone is the mostly importance site for eco tourism is located in Binpur-II in paschim midinipur. This zone Ghagra & shamnager with an nature bas hilly area of the region is also very low population density. Moderately well road condition but nonmetal road are bad condition its immediate repairing and tis area appropriate for eco tourist cottage and nature bas eco tourism and its area low density population.

Zone –10

Area is positioned in the suitable place Aruri Band punisal onda of block in bakura with an elevation with moderately. This region is near to Dwarkeswar river carrying though this region. this region is observed low population density than the other mouza and covered with moderate to open forest. This place eco nature beauty tourist cottage required. Metal and unmetal road in very poor condition therefore needs immediate repairing. This place eco nature beauty tourist cottage required.

Zone –11

Zone is sited in the suitable place Baga Khulia onda of block in Bankura with an elevation with moderately. This region is near to Dwarkeswar river carrying though this region. this region is observed low population density than the other mouza and covered with moderate to open forest. This place eco nature

beauty tourist cottage required. Metal and unmetal road in very poor condition therefore needs immediate repairing. This place eco nature beauty tourist cottage required

Zone –12

Zone is positioned in the suitable place Shayam Nager onda of block in Bankura with an elevation with moderately. This region is near to Dwarkeswar river carrying though this region. this region is observed low population density than the other mouza and covered with moderate to open forest. This place eco nature beauty tourist cottage required. Metal and unmetal road in very poor condition therefore needs immediate repairing. This place eco nature beauty tourist cottage required

Zone –13

Zone is positioned in the suitable place Krishna Singhpurin of onda block in Bankura with an elevation with moderately. This region is near to Dwarkeswar river carrying though this region. this region is observed low population density than the other mouza and covered with moderate to open forest. This place eco nature beauty tourist cottage required. Metal and unmetal road in very poor condition therefore needs immediate repairing. This place eco nature beauty tourist cottage required

Zone –14

Region is located in the suitable place Mathauraberia, Benachapara of Barjora block in Bankura with an elevation with moderately. This region is observed low population density than the other mouza and covered with moderate to open forest. This place eco nature beauty tourist cottage required. Metal and unmetal road in very poor condition therefore needs immediate repairing. This place eco nature beauty tourist cottage required.

Zone –15

Area is located in the suitable place Dharampur, Banshol, Majuddagara of Barjora block in Bankura with an elevation with moderately. this region is observed low population density than the other mouza and covered with moderate to open forest. This place eco nature beauty tourist cottage required. Metal and unmetal road in very poor condition therefore needs immediate repairing. This place eco nature beauty tourist cottage required.

Zone –16

This zone consisting Chakjambeia place of block in Taldangra of Bankura point of these 37spots and situated at moderate relief. This region is near to Kasai River carrying though this region. This zone importance for nature bas eco tourism, conveyance facilities, tourist guide map, public convenience facilities, detail map of the ecotourism destination, tourist circuit map to show its link to other place of tourist interest 'Does' and 'Don'ts' board, medical aid facilities communication facilities.

Zone-17

The rest of the zone Baghboda is nearest suitable place covered by to open forest and average relief hight 120-702 mt. situated at boder of khatra, Taldandra & Simlapal block in Bankura

distract. The whole region is exist with un-inhabitant which is suitable forest adventure and nearby kasai river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone-18

The break of the zone Bhedua is nearest suitable place covered by to open forest and average relief hight moderately. Situated at boder of Taldandra & Simlapal block in bunkura distract. The whole region is exist with un-inhabitant which is suitable forest adventure and ner by kasai river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient .So need to make road metal for ecotourism development.

Zone-19

The time out of the zone Jharia is nearest suitable place covered by to open forest and average relief hight .The whole region is exist with un-inhabitant which is suitable forest adventure. This zone is located in border of khatra, Taldandra & Simlapal block in bunkura distract and nearby Kangsabati river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient .So need to make road metal for ecotourism development.

Zone- 20

It covers some part of Khatra Block of Bankura distract. This zone is near by the kangabati reserver mukutmonipur Dam in Kangsabati River. Identify the nearest tourisms potential place Baraghutu, Madupara, Jambeda, Dhagara Though the population density low . A metal road from this zone passes by the spot but it is in very poor condition therefore needs immediate repairing. There is no lodging facilities are available. Simultaneously intensive forest plantation in the degraded forest patches is to be practiced. Eco tourist resort are must be required this zone Baraghutu, Madupara, Jambeda, nature beauty attractive to tourist.

Zone- 21

It covers some part of Hirabandh, Manbazar I Block of Bankura distract. This zone is near by the kangabati reserver mukutmonipur Dam in Kangsabati River. Identify the nearest tourisms potential place Biradihi.its place may be attractive tourist place Though the population density low. A metal road from this zone passes by the spot but it is in very poor condition therefore needs immediate repairing. There is no lodging facilities are available. Simultaneously intensive forest plantation in the degraded forest patches is to be practiced. Eco tourist resort are must be required this zone Biradihi nature beauty attractive to tourist.

Zone- 22

Zone is located in the Srirampur Hura and Purulia-I, Punch block of Purulia with an elevation hilly region is observed low population density than the other mouza and covered with moderate to dense forest. This place eco nature beauty tourist cottage required. This zone Kudlung are nearby Khansabati river must be tourist spot required.

Zone- 23

Zone is located in the Keshargarh Hura & Punch block of Purulia with an elevation hilly region is observed low population density than the other mouza and covered with moderate to dense forest. This place eco nature beauty tourist cottage required. This zone Keshargarh are nearby Khansabati river must be tourist spot required.

Zone- 24

Zone is located in the Piralloa hilly area Hura and Punch block of Purulia with an elevation hilly region is observed low population density than the other mouza and covered with moderate to dense forest. This place eco nature beauty tourist cottage required. This zone Piralloa are nearby Khansabati river must be tourist spot required.

Zone-25

The area of the zone importance tourist spot may be Joratnr is covered by to open forest and hilly region. The whole region is exist with un-inhabitant which is suitable forest adventure. This zone is located in border of Jhaldha block in Purulia district and nearby salda nala. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone-26

The area of the zone is covered by to open forest and hilly region of Aiodhya site area. The whole region is exist with un-inhabitant which is suitable forest adventure. This zone is located in border of Asra block in Purulia district. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone-27

The break of the zone Lalital, saregasol, Khas Jangal Trailok yapur is nearest suitable place covered by to open forest and average relief height moderately. Situated at border of medinipur block in Paschim Medinipur. The whole region is exist with un-inhabitant which is suitable forest adventure and near by kasai river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone-28

The break of the zone is Aguidiha nearest suitable place covered by to open forest and average relief height moderately. Situated at Garbeta-III block in Paschim Medinipur. The whole region is exist with un-inhabitant which is suitable forest adventure and near by silai river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone-29

The break of the zone is nearest Dabrajpur suitable place covered by to open forest and average relief height moderately. Situated at Garbeta-III block in Paschim Medinipur. The whole

region is exist with un-inhabitant which is suitable forest adventure and near by silabati and Kansabati river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone-30

The break of the zone is nearest Shanramara, Bans bandi, Khudimai, Tidangari, Jatra, Gheso sol suitable place covered by to open forest and average relief height moderately. Situated at border Garbeta-III, Garbeta -II & Salbani block in Paschim Medinipur. The whole region is exist with un-inhabitant which is suitable forest adventure and nearby Kansabati river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone-31

The break of the zone is nearest Peruabad suitable place covered by to open forest and average relief height moderately. Situated at border Garbeta-II, block in Paschim Medinipur. The whole region is exist with un-inhabitant which is suitable forest adventure and nearby Kansabati river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone-32

The break of the zone is nearest Dulia suitable place covered by to open forest and average relief height moderately. Situated at border Garbeta-II, block in Paschim Medinipur. The whole region is exist with un-inhabitant which is suitable forest adventure and near by Kansabati river. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development.

Zone 33

This zone is the mostly importance site for eco tourism is located in Binpur-II in paschim midinipur. This zone Dumur Kunda with a nature bas moderately hilly area. Of the region is also very low population density. Its near by tarafani river. Moderately well road condition but non-metal road are bad condition its immediate repairing and this area appropriate for eco tourist cottage and nature bass eco tourism and its area low density population.

Zone 34

This zone is the mostly importance site for eco tourism is located in Binpur-II in paschim midinipur. This zone PanchTakarpal, NaKhulia, Balikal, Gaira with a nature bas moderately hilly area of the region is also very low population density. It's nearby Tarafani River. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development. And this area appropriate for eco tourist cottage and nature bass eco tourism and its area low density population.

Zone 35

This zone is the mostly importance site for eco tourism is located in border of Jambini & Binpur-II in paschim midinipur.

This zone Baramsol, Domahani with an nature bas moderately hilly area of the region is also very low population density. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development. And tis area appropriate for eco tourist cottage and nature bass eco tourisms and its area low density population.

Zone 36

This zone is the mostly importance site for eco tourisms is located in boder of jambini & Binpur-II in paschim midinipur. This zone Kadai Ghata with an nature bas moderately average elevation area of the region is also very low population density. This region is covered by mix forest. Some part of region road connectivity is good but not sufficient. So need to make road metal for ecotourism development. And this area appropriate for eco tourist cottage and nature bass eco tourisms and its area low density population.

Planning for Ecotourism infrastructure in the study area

From the above result, the ecotourism planning can be done which can bring development of the underdevelopment back log tribal people of jungle mahal and seditious activity prone area by employing the local people as well as by infrastructure development. Ecotourism being truly a form of environmentally conscious tourism and only pursuits of remote pristine locations but also it can be sustainable with continuous capacity to safeguard natural environment as the very basis of tourism attraction. It should also provide and maintain quality of tourist experience and satisfaction as well as benefit to the local people in this area:

Ecotourism is increasingly being advanced as a strategy to help address economic and social problems in local communities, and as an appropriate and effective tool of environmental conservation. The full and effective participation of local communities in the planning and management of ecotourism is, however, rarely a feature of ecotourism projects. At best, ecotourism projects tend to aim for the involvement of local people, and at worst, ecotourism projects can ignore the issue of local participation completely. Such projects frequently fail after a relatively short period of time (Garrod, 2003).

Therefore following strategies could be adopted to involve local people in ecotourism planning and management in Ajodhya hills. To fulfil this purpose, there is needed to be following some guidelines which are highlighted bellow:

- Sustainable development of ecotourism requires the balance between three elements the tourists, people and the host community. Therefore, a management level Government should involve local people along with NGO and private organization.
- Involvement of local administration (e.g. Gram Panchayet) in selection of site for ecotourism development.
- Generally the ecotourism destination is developed in eco-fragile area, which has time specific attraction. The duration of visit and activity pattern of the tourist should be decided by implementing authorizes to maintain natural harmony.
- Social forestry and Participatory Forest Management (PFM) in the site to rejuvenate the degraded forests and encourage wildlife tourism

- Conservation and management of community / government degraded forests in lieu of usufruct right of fuel wood, fodder and non-timber forest products (NTFP).
- All the employees of the hotels / guesthouses from manager to housekeeper should be local people and employment of women are also encouraged.
- Employing aged and experienced people as guides in local tours and forest safari and as night guards in the hotels and camping grounds.
- Formation of co-operative societies to produce agro-horticultural and animal products in the prescribed lands and run the canteen / restaurants in the tourist spots through those.
- Providing training and equipments to the local clubs / associations to develop mountaineering institutes for tourists.
- To create a suitable eco tourism destination it is very essential to make the place peaceful from deadly us activity engaging the tribal people in much creative and developmental activity by giving them proper study and tanning.
- Along with this there is also need for publicity and advertisement of ecotourism destinations, Environmental group accreditation (tour operator) and adequate funding to maintain the environmental quality of the potential ecotourism destinations.
- Encouraging folk cultures by including them in tour packages (e.g. Chhau dance, in guesthouses).
- Providing loans to local youths to purchase eco-friendly vehicles for tourist transportation and tour operation.
- Tourist cottages/rest house, green hotels, and restaurant, public convenience facilities, Tourist Information Centre, conveyance facilities, Tourist guide map, public convenience facilities, Detail map of ecotourism destination. Tourist circuit map to show its like to other place of tourist interest, Do and don't board, medical aid facilities, communication facilities etc are to be developed.
- In the action area there is lack of approach road to visit this place. For this purpose few non metallic road has been designed as a loop, which can be utilized by tourists as trail walk along the dense and open forest zone.
- Communication facilities likes' bus service, tele-communications service etc which are now present now these have to be modified.
- It is very essential to highlight about the infrastructural development in existing and future eco-tourism spot in national and international level.

Conclusion

Eco-tourism development is visualized as a development tool – not just in promoting tourism growth but also in reducing poverty particularly in the rural areas. though poverty is widespread and pervasive, it is even more acute in the mountain areas. Economic pursuits in those areas are limited to agriculture, livestock and trans-boundary trade. All these activities suffer from low productivity, and are subsistence oriented. Eco -tourism is expected to engage them in the higher productivity areas by linking to commercial process, and marketing chain extending beyond borders. It may be authorized that jungle mahal will appear as an ideal ecotourism

destination where thousands of local people could be employed. Apart from planning for ecotourism infrastructure ideas will be gained on what are areas should be afforested immediately, where expansion of settlement and cultivation should be restricted, instead of large-scale cultivation, thrust area will be forestry and forest based economic activity like agro forestry, horticulture, sericulture, aquaculture, animal husbandry etc. the yields will meet the demand of tourists as well as the local; people. The beauty and mystery of the world have attracted the human mind. People don't find any urge in their mundane day to day busy life. For that they want to some relaxation spending few times with beauties of nature. From above study it is seen that the major portion of jungle mahal have sufficient amount of natural resource to develop the ecotourism. Expressing the natural beauties to the world not only it will bring a new area for West Bengal tourism but also tribal people of jungle mahal will see the new path for socio-economic development having behind the unsocial activity.

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