A GIS Based Ecotourism Infrastructure Planning for Promotion of Tourism in Jungle Mahal of West Bengal

Srikanta Bhaya* and Abhisek Chakrabarty

Department of Remote Sensing and GIS, Vidyasagar University, Midnapore, West Bengal, India

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- tourism this is widely use today, but is rarely explain. It is often used interchangeably with others terms such as soft tourism responsible tourism and nature tourism. In simple terms eco tourism simply means that the main motivation for travel is the desire to view eco system in their natural state. Both in terms of 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 tourism. 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.

Keywords: Ecotourism; Natural eco system; Potential sites; Land use land cover determine; Elderly tourism

Study Area

The study area of Jungle Mahal mainly Purulia Bankura and Paschim Midnapore is the western most 3 district of west Bengal (860252'E – 8702224'E, 230367'N-210475'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 600 m. Ajodhya Hill is a treasure house of natural beauties. Bankura, Mukutmonipur and Belhari 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 and many Natural 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 (Figure 1).

The drainage system of the study area mainly controlled by the Damodar, Dwarkeswar, Kangsabati, and Subarnarekha river. Although several rivers flow across the district, 50% of the water runoff loosened due to the undulated topography. There are also several small dams like Murguma, Mukutmonipur, 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 [1-3].

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 [4].

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 Pisal, Mahua (Bassia Latifolia), Palash (Butea frondosa), Kend/ Kendu (Dios – pyros), Mango (Mangifera indica), Shimul (Bombax malabaricum), Kadam (Antherochilus 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.
Figure 1: Location Map.
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 tourism infrastructure [5].

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 parts 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 26°C 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 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, last 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 [6-8].

Review of Literature

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 et al. (Remote sensing and GIS based ecotourism planning: A case study for western Midnapore, West Bengal, India) discussed various aspect of ecotourism planning in West Midnapore. They considered that ecotourism is impotent for the environmental conservation and 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 eco-tourism development [9-11].

Ologun et al. discussed for tourism potentials in Nigeria to beautified sustainably, the necessary infrastructure and enabling environment and information on tourism which will attract tourist must be available. Enabling environment in this case requires 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 tourism development.
3. To identification of existing potential tourist spots in jungle mahal and their classification based on
4. Fluctuation of high relative relief
5. High altitude with dense to moderate forest coverage
6. Identify determination factor for eco tourism site selection.
7. 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 tourists, tourist Ashram tourist, circuit map to show its linkage to other place of tourist interest, do and don’t 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 described in below Table 1.

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.

| Sensor | Satellite | Path | Row | Date of Pass |
|-------|-----------|------|-----|--------------|
| Oli (operation land imager) | Landsat-8 | 145 | 44 and 45 | 25 Feb 2015 |

Table 1: Satellite Data specifications.
Ancillary data

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

Table 2: Ancillary Data.

Methodology

Collection of satellite images

LANDSET-8 of 2015 has been collected and IKONOS (1.0 m) 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 distracts 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 color composite imageries on the basis of tone or color, 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.

Road network mapping

From National Highway to Trekking Routes in the forest all are to be digitized from toposheet or land use map and 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 (E)

Keeping in mind the basic thirsts of an Eco tourist, ecotourism potential sites will be selected based on eight criteria:

- (El) The spot must be above an elevation of 500 m 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 Eco tourists, therefore Mauzas with very low population density are preferred.
- (Rc) All the spots must be connected by roads.
- (Fl) There should have some food and 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.

Ep=\sum (Eli+Vdi+Wbi+Spi+Pdi+Rci+Fl+i+Li)

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 thirsts of an ecotourism, ecotourism potential sites are selected based on eight criteria: 1) The spot must be above an elevation of 500 m 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 Eco tourists, 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 [12].

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)

- (Rt): 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.
(Fc): To feel in lap of nature and for adventure also, there must be dense to moderate forest cover. Tree clad area are moderately important.

(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 and 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

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...

\[ EP = \sum (WiCVi) \]

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 and 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

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

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 (Figure 2). The areal extends of various land use /land cover in the study area are given in the Tables 2 and 3 (Figure 3).

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. After the weight overlay operation being compel the suitable 37 zones (Figure 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 and 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 distract Bankura Purulia, and Paschim Medinipur were found to be appropriate for Eco tourists. It is noteworthy that 16 zones are inside Purulia and 9 zones are Bankura, 11 zones are Paschim Midnapore district (Figures 4 and 5; Tables 4 and 5).

Zone 1: It covers some part of manbazer II Block of Purulia distract with a relative relief range of 120-702 m. 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 to be required this zone is haridi is nature beauty attractive to tourist.

Zone 2: This zone covers adjoining part of barabar in Purulia district. This region Bhulukhkal, 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 cover that increased tourist attraction. There is only one teashop near the road crossing. Here no nature bungalow and a guest house situated with lodging facilities. Immediate required.

Zone 3: This zone consisting of Agajhor, Keshbera block in Barabazar 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 m. The whole region is exist with un-inhabitant which is suitable forest adventure. This zone is located in border of manbazer I and 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 tourisms

| Land use and 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** |

Table 3: Land use Land cover Area.
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 Chumi of Baghmundi block. The elevation of the region is above 510 m. 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 Sirirampur Baghmundi block of Purulia with an elevation with 480-510 m. 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 Ghatusol border of Raipur and 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 important site for eco tourism is located in Binpur-II in Paschim Midnapore. This zone Ghagra and shamnager with a nature has hilly area of the region is also very low population density. 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 10: Area is positioned in the suitable place Arur 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 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 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 Chakjambea place of block in Taldangra of Bankra point of these 37 spots and situated at moderate relief. This region is near to Kasi 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 height 120-702 m situated at border of khatra, Taldandra and Simlapal block in Bankura district. 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 height moderately. Situated at border of Taldandra and Simlapal block in bunkerua district. 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 19:** The time out of the zone Jharia is nearest suitable place covered by to open forest and average relief height. The whole region is existing with un-inhabitant which is suitable forest adventure. This zone is in border of khatra, Taldandra and Simlapal block in bunkura district 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 tourism potential place Baraghatu, 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 are 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 Baraghatu, 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...
| Sl 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, subject to severe erosion | Open forest                 | Low                    | metal road bad condition | Nil                    |                        |
| 2     | Zone-2 Bhalkuk, sunibasa   | 120-702  | Kuman nala           | Open to forest                              | Open forest                 | Low                    | Metal road in bad condition | Nil                    |                        |
| 3     | Zone-3 Agajhore, Keshbera  | 120-702  | Nagasai nala         | Low                                         | Open forest                 | Low                    | Bad condition metal and nonmetal road | Nil                    |                        |
| 4     | Zone-4 Kesheargaria        | 120-702  | Hanumata nala        | Low                                         | Open to moderately          | Low                    | Unmetal road bad condition | Nil                    |                        |
| 5     | Zone-5 Talai               | 120-702  | Hanuman nala         | Low                                         | Moderately forest           | Low                    | Unmetal road bad condition | Nil                    |                        |
| 6     | Zone-6 Chaunia             | 120-702  | Sanka river          | Low                                         | Open forest                 | Low                    | One metal road bad condition | Nil                    |                        |
| 7     | Zone-7 Srimampur           | 120-702  | Nagaisai river       | Low                                         | Open forest                 | Very low               | Metal and unmetal road bad condition | Nil                    |                        |
| 8     | Zone-8 Ghatusol            | 120-702  | Tarafini river       | Low                                         | Open forest                 | Very low               | Unmetal road bad condition | Nil                    |                        |
| 9     | Zone-9 Shyamnagar, Ghagra  | 120-702  | Waterbody and bandhu nala | Low                                         | Open forest                 | Very low               | Metal road bad condition | Nil                    |                        |
| 10    | Zone-10 Aruri Band punisal | 80-120   | Dwarkeswar river     | Low                                         | Open forest                 | Low                    | Well metal road but on metal road bad condition | Nil                    |                        |
| 11    | Zone-11 Baga Khulia        | 80-120   | Dwarkes river        | Low                                         | Open forest                 | Low                    | Metal road bad condition | Nil                    |                        |
| 12    | Zone-12 Shyam Nager        | 80-120   | Dwarkes river        | Low                                         | Open forest                 | Low                    | Unmetal road bad condition | Nil                    |                        |
| 13    | Zone-13 Krishna Singhur    | 80-120   | Dwarkes river        | Low                                         | Moderately forest           | Low                    | Metal road bad condition | Nil                    |                        |
| 14    | Zone-14 Mathaurabaria, Benachapara | 80-120 | Machkanda jora       | Low                                         | Open forest                 | Low                    | Unmetal road bad condition | Nil                    |                        |
| 15    | Zone-15 Dharampur, Banshol, | 80-120  | Machkanda jora       | Low                                         | Open forest                 | Very low               | Metal road bad condition | Nil                    |                        |
| 16    | Zone-16 Chakjambiea        | 80-120   | Kasai river          | Low                                         | Open forest                 | Very low               | Metal road bad condition | Nil                    |                        |
| 17    | Zone-17 Baghoda            | 80-120   | Kasai river          | Low                                         | Open forest                 | Low                    | Metal road bad condition | Nil                    |                        |
| 18    | Zone-18 Bhedua             | 80-120   | Kasai river          | Low                                         | Open forest                 | Low                    | Unmetal road bad condition | nil                    |                        |
| 19    | Zone-19 Jharia             | 80-120   | Kasai river          | Low                                         | Open forest                 | Low                    | Metal road bad condition | Nil                    |                        |
| 20    | Zone-20 Baraghuladu, Madupara, Jambeda, Dhagara | 120-702 | Mukutmonipur dam     | Low                                         | Open forest to moderately   | Low                    | Metal road in bad condition and nonmetal road in bad condition | Nil                    |                        |
| 21    | Zone-21 Biradhi            | 120-702  | Mukutmonipur dam     | Low                                         | Open forest                 | Low                    | metal road bad condition | Nil                    |                        |
| 22    | Zone-22 Kudlung            | 120-702  | Kasai river          | Low                                         | Open forest                 | Low                    | Metal road bad condition | Nil                    |                        |
| 23    | Zone-23 Keshargarh         | 120-702  | Kasai river          | Low                                         | Open forest                 | Low                    | Metal road bad condition | Nil                    |                        |
| 24    | Zone-24 Pirialoa           | 120-702  | Kasai river          | Low                                         | Open forest                 | Low                    | Metal road bad condition | Nil                    |                        |
| 25    | Zone-25 Jorabr             | 120-702  | Salda nala           | Low                                         | Moderately forest           | Low                    | Metal road bad condition | Nil                    |                        |
| 26    | Zone-26 Aodhya site area   | 120-702  | Kulbera nala         | Low                                         | Dense forest                | Low                    | Metal road bad condition | Nil                    |                        |
| 27    | Zone-27 Lalitasal, saregasol, | 27-80   | Kasai river          | Low                                         | Open forest Moderate        | Low                    | Well road condition       | Nil                    |                        |
| 28    | Zone-28 Aguidihra          | 27-80    | Silai river          | Low                                         | Open forest                 | Low                    | Metal road bad condition | Nil                    |                        |
| 29    | Zone-29 Dabraipur          | 27-80    | Silabati river       | Low                                         | Open forest                 | Low                    | Metal road good and unmetal road bad condition | Nil                    |                        |
| 30    | Zone-30 Shanramara, Bans bandi | 27-80   | Kasai river          | Low                                         | Open forest                 | Low                    | Metal road are good       | Nil                    |                        |
| 31    | Zone-31 Peruabad           | 80-120   | Kasai river          | Low                                         | Open forest                 | Low                    | Metal road are good       | Nil                    |                        |
| 32    | Zone-32 Dulia              | 80-120   | Kasai river          | Low                                         | Open forest                 | Low                    | One metal road well and unmetal road | Nil                    |                        |
| 33    | Zone-33 Dumur Kunda        | 80-120   | Tarafani river       | Low                                         | Open forest                 | Very low               | One metal road well and unmetal road bad | Nil                    |                        |
| 34    | Zone-34 Panch Takarpal, NalKhul, | 80-120 | Trarafani river     | Low                                         | Open forest                 | Very low               | One metal road well and unmetal road | Nil                    |                        |
| 35    | Zone-35 Baramsol, Domahani | 80-120   | Kuru nala            | Low                                         | Open to moderately          | Very low               | One metal road well and unmetal road | Nil                    |                        |
| 36    | Zone-36 Kada Ghata         | 80-120   | Kuru nala            | Low                                         | Open to moderately          | Very low               | One metal road well and unmetal road | Nil                    |                        |

Table 5: Ecotourism potential zone.
Figure 3: Overlay Analysis of Different Layer.
potential place Biradihi, its place may be attractive tourist place. Though the population density is low. A metal road from this zone passes by the spot but it is in very poor condition therefore needs immediate repairing. There are no lodging facilities 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 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 Keshgarh 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 existed with uninhabitant which is suitable forest adventure. This zone is located in border of Jhaldha blocking Purulia distraict 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 existed with uninhabitant which is suitable forest adventure. This zone is located in border of Asra block in Purulia distraict. 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 Lalitasal, saregasol, Khas Jangal Trailok yapur is nearest suitable place covered by to open forest and average relief height moderately. Situated at border of Midnapore block in Paschim Medinipur. The whole region is existed with un-inhabitant which is suitable forest adventure and nearby kasal 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 Midnapore. The whole region is existed with un-inhabitant which is suitable forest adventure and nearby 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 Dabraipur 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 nearby 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, Tiday ungari, Jatara, Gheso sol suitable place covered by to open forest and average relief height moderately. Situated at border Garbeta-III, Garbeta-II and Salbani block in Paschim Midnapore. The whole region is existed 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 Perubad suitable place covered by to open forest and average relief height moderately. Situated at border Garbeta-II, block in Paschim Midnapore. The whole region is existed 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 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 33: This zone is the mostly importance site for eco tourisms is located in Binpur-II in Paschim Midnapore. This zone Dumur Kunda with a nature bas moderately hilly area. Of the region is also very low population density. Its nearby 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 tourisms and its area low density population.

Zone 34: This zone is the mostly importance site for eco tourisms is located in Binpur-II in Paschim Midnapore. This zone Panch Takarpal, Nal Khulia, 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 tourisms and its area low density population.

Zone 35: This zone is the mostly importance site for eco tourisms is located in border of Jambini and Binpur-II in Paschim Midnapore. 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 this 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 border of Jambini and Binpur-II in Paschim Midnapore. This zone Kadai Ghata with a 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 [13,14]. 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 below:

- 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 Panchayat) in selection of site for ecotourism development.
- Generally, the ecotourism destination is developed in ecofragile 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 equipment’s 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 development 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 like bus service, telecommunications 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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