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Research Article

Application of Remote Sensing and GIS for Land use Compatible and Eco-Sensitive zones along Ranthambore Tiger Reserve

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ABSTRACT

The Ranthambore Tiger Reserve in Rajasthan, India's northwest, is well known for its diverse wildlife and importance as a vital habitat for the critically endangered Bengal tiger. The creation of an Eco Sensitive Zone (ESZ) surrounding the reserve has been a critical step in acknowledging the need to strike a balance between conservation and human growth. In this abstract, the concept and significance of the ESZ along the Ranthambore Tiger Reserve are examined, with an emphasis on its role in fostering a sustainable coexistence between human activity and wildlife protection. The Wildlife (Protection) Act of 1972 mandated the establishment of the ESZ, which acts as a buffer zone around the main tiger reserve region. Its main objective is to lessen anthropogenic stresses on the reserve while allowing for appropriate land-use techniques. The establishment of this area promotes cooperation between conservation objectives and the means of subsistence of nearby communities. Regulations on land use, tourism, and infrastructure development are key components of the ESZ, all of which are intended to minimise disturbances to the natural ecology. The importance of the ESZ in preserving the natural balance within and around Ranthambore Tiger Reserve is also covered in this abstract. Important wildlife migration routes, species genetic diversity, and the ecosystem's general health are all protected by the ESZ. Additionally, it is extremely important in safeguarding the local wildlife's access to water sources, which are necessary for their existence. The abstract also emphasises the socioeconomic features of the ESZ. While protecting biodiversity is of utmost importance, it is also crucial to consider the requirements of the nearby local communities. The ESZ promotes eco-friendly tourism, eco-friendly agriculture, and neighbourhood-based conservation programmes to achieve balance. These initiatives not only enhance the local population's quality of life but also encourage their participation in wildlife protection. To sum up, the creation of an Eco-Sensitive Zone within the Ranthambore Tiger Reserve represents a progressive conservation strategy that emphasises the value of coexisting with environment and humanity. The ESZ promotes the long-term survival of the region's rich flora and wildlife while promoting sustainable practises and the welfare of residents by reducing the negative effects of human activity. The importance of ESZs in contemporary conservation policies and their potential to serve as models for wildlife protection around the world are highlighted in this abstract.

Keywords: Eco Sensitive Zone (ESZ), Geographical Information System (GIS), Global Positioning System (GPS).

Introduction:

Our planet's ecosystem services are essential to its past, present, and future. But right now, global issues including climate change, environmental deterioration, overcrowding, genetic engineering, pollution, and resource depletion are expanding very quickly. Massive anthropogenic activities that encroach on the forest habitat are the cause of all these problems. As a result, the loss of biodiversity is occurring at a rapid rate around the planet (Butchart et al., 2010). Deterioration of the biodiversity is accompanied by ecosystem degradation, which has an effect on human well-being by reducing the advantages (also known as "ecosystem services") that ecosystems offer (Daz et al., 2006). According to IPCC (2006), approximately 1.86 billion tons of carbon are released each year due to changes in land use, climate change, and land resource use, with a particular impact on tropical regions. This is a significant source of carbon emissions and a contributor to climate change and global warming.

Both internal and external factors contribute to LULC, and both conventional and cuttingedge resource management techniques have an impact on it (Campbell et al., 2005). Human encroachment through urbanization, agricultural development, and other developmental activities has changed how land is used in nature. ESZs are the shock absorbers and differentiate the more and lesser conserved areas. Their effective role is to minimize the Man wild conflicts, benefit local people and provide livelihood and crop prosperity.

Nearly all biodiversity regions struggle with increasing issues like loss of open space, humanwildlife conflict, and natural vegetation. In the terrestrial environment, the process of biodiversity deterioration frequently causes uncontrolled growth of envious species of flora and wildlife.

In order for the tiger to represent the wild and the ecosystem's luck. Tiger preservation and protection helps to protect the overall wilderness ecosystem. The ecosystem's vitality depends heavily on tigers. The top carnivores in the ecosystem at the top of the food chain are tigers. The relative abundance of herbivore species within a guild may change if a top carnivore is eliminated from an ecosystem. But the status of this species is rapidly declining. We have therefore invested a million dollars in this wild animal. Because of the tiger, a symbol of our national pride, livelihoods are supported, genetic diversity is protected, rain is brought, and climate change is prevented. Consequently, the tiger received the most votes in a recent Animal Planet poll.

The flourishing of tiger ecosystem services is correlated with the vulnerability of the tiger landscape, which is dependent on physical and socioeconomic factors. If the vulnerability of the land resources is high, the flourish of the tiger ecosystem services is very low, but if the vulnerability of the land resources is low, the flourish of the tiger ecosystem services is high in these areas, which is a sign for contributing ecosystem services of all categories, such as supporting, reserving and conserving.

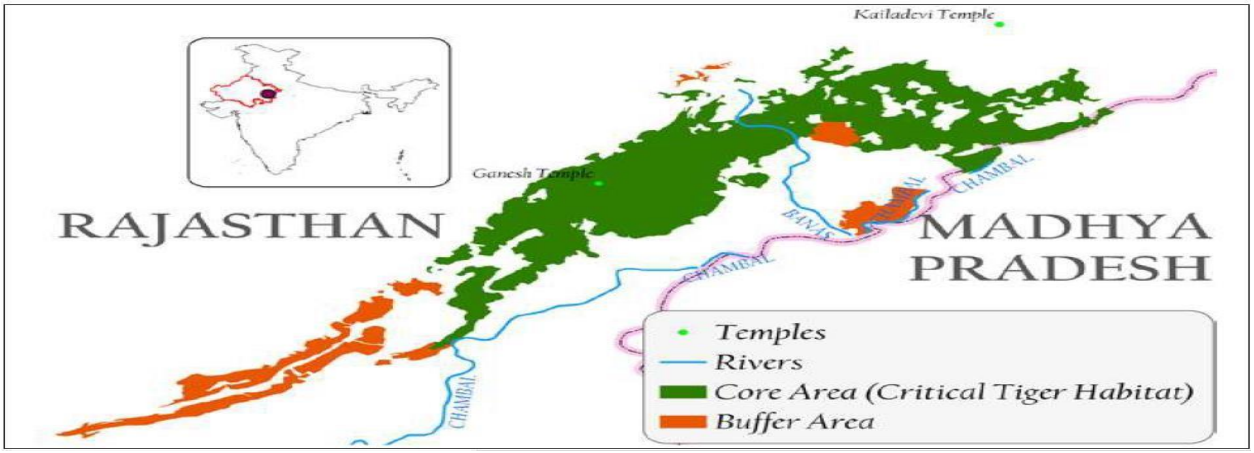
Objectives of the study:

To analyse the LULC of Ranthambore Tiger Reserve across the years. To observe the vitality of Eco Sensitive Zones along the Ranthambore Eco Sensitive Zone.

Study Area:

Rajasthan State, in its present form, was conglomeration of 19 princely States and 3 Chief ships which varied in size, population, administrative efficiency and socio-economic development. Administratively Rajasthan is divided into 33 districts, which are further sub-divided into 331 tehsils and 352 panchayat samities. The area of 3.422 lac sq. kms. of Rajasthan makes it the largest state in the country. The population of the state, according to 2011 census, is 6.854 crores. It has a long international frontier with Pakistan and its adjacent to the state of Punjab, Haryana, Uttar Pradesh, Madhya Pradesh and Gujarat. The topography of the state is dominated by the Aravali range of hills, one of the oldest mountain systems in the world. The Aravali hills range runs from south-west to north-east through the heart of the state. The region of the west and north-west of these hills comprising 12 districts and spreading in 61.11 percent of the total area of the state is known as Great India Desert, the "Thar" The tribal area in the state constitutes 5.85% of the state's land mass. With a population of 5.67 % of the total population of the state

Arguably the most popular tiger reserve in India, Ranthambore Tiger Reserve (RTR) is situated in the south-eastern part of Rajasthan. The tiger reserve spans 1473 km2 (1113 km² of core zone or critical tiger habitat and 360 km² of buffer zone). The core zone of RTR is spread over 2 districts, viz. Sawai Madhopur and Karauli. The buffer zone does not circumscribe the core area in RTR but adjoins it in places and consists of available forest land outside the core zone. The buffer zone falls is spread over 3 districts, viz. Sawai Madhopur, Bundi and Tonk. The tiger reserve marks the transition zone between the true desert and seasonally wet peninsular India.



Source: Arc GIS

It is the only complete dry deciduous Anogeissus pendula forest in India with the greatest single area. There are currently more than 86 tigers living in the Ranthambore Tiger Reserve. Tiger protection provides stakeholders with a wide range of ecosystem benefits related to the land. Along with being the most popular tiger reserve, Ranthambore also denotes the region between the actual deserts and the seasonally wet peninsula of India.

The Ranthambore Tiger Reserve (RTR) is projected to generate flow benefits worth 8.3 billion rupees ($0.56 lakh/hectare) yearly. RTR provides significant ecological services including gene-pool conservation (7.11 billion year-1), water provision to the surrounding area (115 million year-1), and habitat and refuge for wildlife (182 million year-1). Aside from hosting the Ganesh Temple, which receives about 10 lakh pilgrims annually, Ranthambore also generates the 34 million year-1 cycle of nutrients and the 69 million year-1 sequestration of carbon. (Source: Value+ Approach Economic Valuation of Tiger Reserves in India, January 2015).

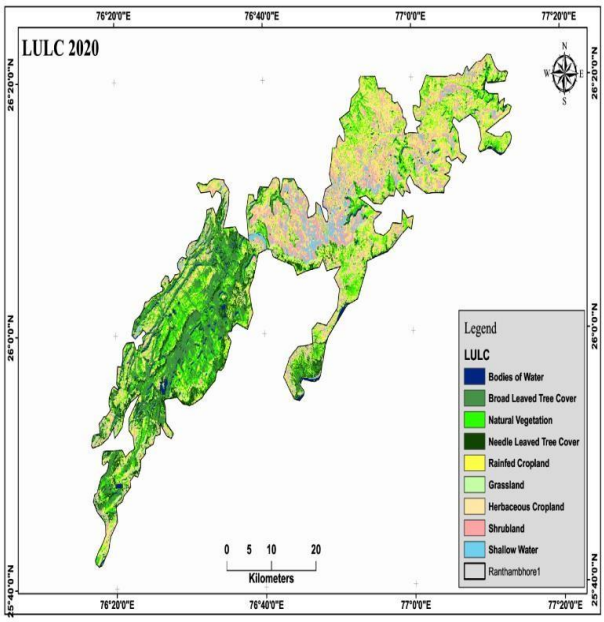
Research Methodology:

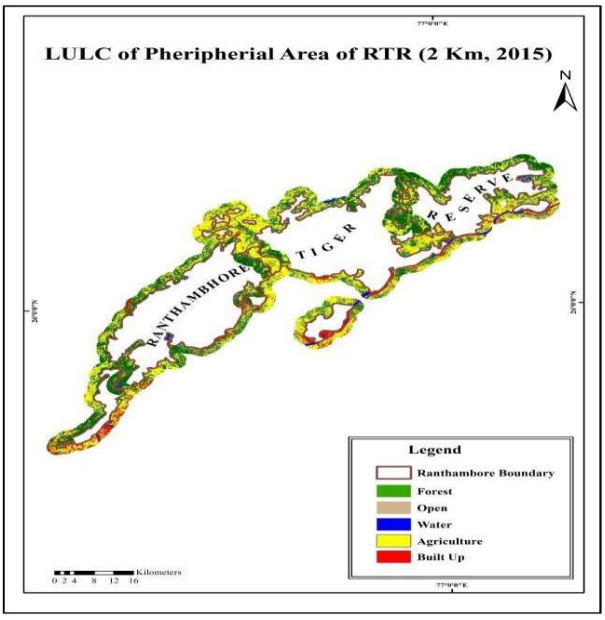
Available related literature collected from varied sources including websites, libraries, personal collections, gazetteers and manuscripts etc. will be consulted. Data Collection (including primary and secondary along with different outcomes), classification and tabulation, use of quantitative techniques and analysis of data, Cartographic representations and interpretation of facts with their critical analysis will be carried out. The participatory social research tools (Ashford and Patkar 2001) were used for data collection that allows greater flexibility and comfort levels among the respondents. The survey tools used for data collection were Household questionnaires (HHQ), Focus Group Discussion (FGD) and Key Informant Interviews (KII). Application of Remote sensing images and Geographic information system (GIS) were also considered to analyse LULC and the ESZs distribution.

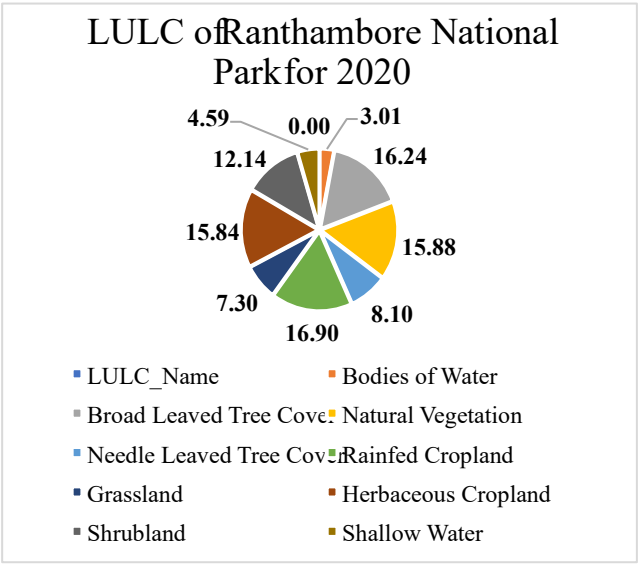
RESULT AND DISCUSSION

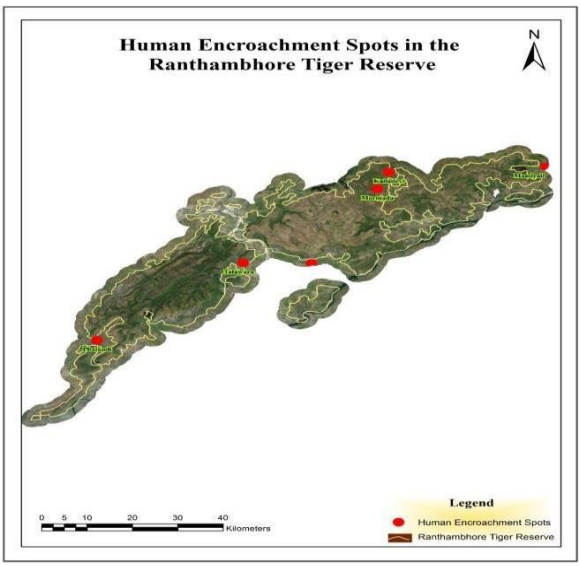
Tigers, their prey, and a prodigious quantity of biodiversity may all be found in the Ranthambhore Tiger habitat and the ESZs alongside. Through ecosystem services including water harvesting, carbon sequestration, plant genetic resources, food security, medicinal plants, and possibilities for community based sightseeing, they also contribute to human health both locally and worldwide. Many of these advantages both directly and indirectly enhance human welfare and the future of the planet.

There are more than 86 tigers in the research region, and nearly 2 million people depend on these ecosystem services directly or indirectly for their living. The main sources of livelihood are created by tiger ecosystem services in Ranthambhore. According to the findings, both the core and periphery are experiencing significant human intrusion due to hurried development efforts and weak ESZs.









Environmental vulnerability in Ranthambhore is greatly maneuvered by changes in land use and cover. Although the terrain is distinctive, man-made and natural processes are always accelerating towards the harsh land ecosystem. The southern side of RTR is experiencing LULC, particularly human encroachment, which is happening quickly from buffer zones to core areas. This is because Khandar town is becoming semi-urbanized and small villages are expanding into this area. According to the findings, the Kaila Devi wildlife sanctuary and the Ranthambhore national park have different growth rates. On the northern side, Sawai Madhopur, the district headquarters, has a built-up area and serves as a significant service hub for the area.

Due to the expansion of the food markets in terms of demand and supply in the nearby areas, the dissemination of new agro-technology, unlawful encroachment on public land resources, and the rapid expansion of unsustainable farming, the extension of agriculture services is rapidly rising. These are the primary causes of the agriculture services' geographic expansion, which is concerning the Ranthambhore Tiger Reserve's biodiversity. The development of prosopis juliflora plants is also affecting the vegetation of Ranthambhore. Prosopis Juli flora is rapidly dispersing into Ranthambhore National Park, Sawai Mansingh Sanctuary, and Kaila Devi Sanctuary. In the next ten years, the area covered by this species is anticipated to treble. Despite the lack of coppicing, the regrowth from seeds is raising questions. It is one of the environmental risks to the resources of the land.

An unfavorable situation for the relationship between humans and the environment is the ongoing change that LULC and the ESZs is causing in Ranthambhore's physical and socioeconomic surroundings. Due to the necessity for basic necessities, the shortage of land resources, "No Go Zone areas," etc., development activities

are increasingly taking place close to protected areas. In order for some locations to be more vulnerable than others, certain pockets of forest habitat. However, in the end, they are reducing Ranthambhore's biodiversity.

SWOT Analysis of Eco Sensitive Zones of Ranthambore Tiger Reserve

Strengths of ESZ along Ranthambore National Park

Strengths	Weight	Score	Weighted score
Shock absorber and protecting 1700 sq km area for 86 tigers (app.)	0.12	4	1.48
Ensured undivided water security from Banas and Chambal rivers	0.06	4	0.24
Geomorphic fortification letting the entry through limited points thus ensuring safety	0.04	3	0.12
Creation of masonry wall near the western periphery of the reserve	0.03	3	0.09
National park is almost free from cattle pressure, fuel wood collectors, lopping and tree felling activities	0.02	3	0.06
TOTAL			**1.99**

Table Weakness of ESZ along Ranthambore Tiger Reserve

Weakness	Weight	Score	Weighted score
Patchy, scattered and small E S Zone	0.09	1	0.09
Intense biotic pressure	0.04	2	0.08
Lack of alternative livelihood for villagers	0.04	1	0.04
Systematic and planned efforts to elicit the support of local people	0.04	1	0.04
Lack of long term planning for habitat improvement and treating the relocated land	0.03	1	0.03
Increase in tourism and human interference in habitats	0.02	2	0.04
Misuse, mismanagement of forest resources	0.06	1	0.06
TOTAL			**0.38**

Table Opportunities at ESZ along Ranthambore Tiger Reserve

Opportunities	Weight	Score	Weighted score
Ideal for initiating other biodiversity projects	0.1	4	0.4
Opportunity of learning from best practices across other TRs	0.04	3	0.12
Scope of working with international organizations for conservation	0.06	4	0.24
Higher possibility of increase in number of tigers	0.07	3	0.21
Opportunity of getting support from locals and NGOs	0.04	3	0.12
Increasing governmental support in project Tiger and conservation strategies	0.04	3	0.12
Opportunity to gain more land in the core by relocating villages	0.03	4	0.12
Effective monitoring of tiger population growth	0.05	3	0.15
TOTAL			**1.48**

Table Threats for ESZ along Ranthambore Tiger Reserve

Threats	Weight	Score	Weighted score
Poaching and other wild related crimes	0.05	2	0.1
Man wild conflicts	0.09	1	0.09
Less participation from locals in conservation	0.06	1	0.06
Psychological and social threats	0.05	2	0.1
Impact on pastoral farming and other occupations	0.08	1	0.08
TOTAL			**0.43**

CONCLUSION:

The greater sustainable development of land ecosystem services in Ranthambhore can result from tiger species restoration. Resources are supplied to several scientific, policy, planning, or management reasons through the sustainable development of land. There are many different demands in each of these categories. Including socioeconomic inventories, water inventories, land use inventories, and inventories of the forest. The purpose of the research is to understand how tiger management regulates and monitors for LULC and vice versa by ESZs, as well as how tiger existence contributes to land ecosystem services and flourishing ESZs.
As a result, the geographical, social, economic, and political factors that control the growth and decline of the terrestrial ecosystem have been found. The study examined the tiger reserve's current management strategy and will propose a better management plan for protecting tigers in the reserve vis a vis development of ESZs.
The quality of living and the environment are both impacted by tiger protection. Environmental, social, and economic concerns related to stakeholders in a protected area include changes in habitat, water and air quality, and the quality of life. Habitat, water quality, quality of life, the global carbon cycle, population expansion, economic growth, demography, agricultural and forest products, regional and planning, and policies have all been automatically safeguarded by the state of land resources. The study's ultimate goal is the sustainable development of Ranthambhore's land resources with ESZs and tiger habitat areas. Land resources should be handled in the future with a focus on sustainable development for all parties involved, maximum public participation, work on community development, inclusive and comprehensive corridor development, and restoration of the forest ecosystem. The primary result of the Tiger Ecosystem Service is the provision of a useful framework for examining and acting on the connections between local residents and other stakeholders and their environment. Finally, improved tiger conservation may result in more sustainable development of ecological services provided by land and the ESZs reaching to their maximum benefits with proper LULC demarcations in the reserve.

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