BIODIVERSITY CONSERVATION SCHEME FOR TIGERS IN INDIA: GEOGRAPHICAL STUDY OF RANTHAMBORE NATIONAL PARK

Thesis Submitted for the Award of the Degree of

DOCTOR OF PHILOSOPHY

in

GEOGRAPHY

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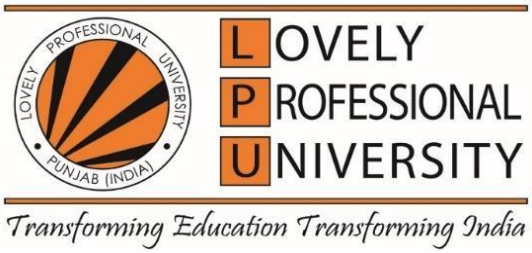

LOVELY PROFESSIONAL UNIVERSITY, PUNJAB

2024

DECLARATION

I, **HEMANT CHOUDHARY** hereby affirm that thesis, entitled **"Biodiversity Conservation Scheme for Tigers in India: Geographical Study of Ranthambore National Park"** submitted for the degree of Doctor of Philosophy (Ph.D.) is the result of my own research work and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree or diploma at this university or any other institution, except where due acknowledgement has been made in the thesis.

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CERTIFICATE

This is certified that this work entitled **"Biodiversity Conservation Scheme for Tigers in India: Geographical Study of Ranthambore National Park"** is the original research carried out by **Mr. Hemant Choudhary (Registration No. 41700207)**, Ph.D. Research Scholar in **Department of Geography**, Lovely Professional University, Punjab. This work has been carried out under my supervision and has not been submitted anywhere else and is being submitted for the first time to the Lovely Professional University. The candidate has fulfilled all the statutory requirements for the submission of the Ph.D. thesis.

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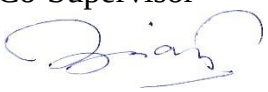

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ABSTRACT

This research is trying to explore the biodiversity conservation efforts for tigers in India, focusing on Ranthambore National Park as a geographical case study. India is home to a significant population of tigers, and conservation initiatives are crucial to protect their habitat and ensure their survival. Ranthambore National Park, located in the state of Rajasthan, is renowned for its tiger population and biodiversity.

The geographical study examines the park's terrain, vegetation, and wildlife, emphasizing the interplay between natural factors and human activities. Conservation strategies such as habitat preservation, anti-poaching measures, and community involvement are discussed in detail. The role of technology, including monitoring systems and satellite tracking, is highlighted as essential for effective management and protection of tiger populations.

Furthermore, the thesis analyzes the socio-economic factors impacting conservation efforts in and around Ranthambore. It addresses challenges such as human-wildlife conflict, tourism management, and sustainable development. The study underscores the importance of policy frameworks and international collaborations in enhancing biodiversity conservation.

In conclusion, Ranthambore National Park serves as a critical site for understanding the complexities of tiger conservation in India. By examining its geographical features and conservation strategies, this study contributes to the broader understanding of biodiversity conservation and underscores the need for holistic approaches to protect endangered species like tigers.

Keywords: biodiversity conservation, tigers, Ranthambore National Park, India, habitat preservation, LULC

TABLE OF CONTENTS

LIST OF TABLES

LIST OF MAPS

LIST OF FIGURES

CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

The tiger, one of the most spectacular carnivores on the planet, can be found in a variety of habitat types, such as mangrove forests, high altitude forests in Bhutan, dry and damp deciduous woods, semi-evergreen forests, and wet evergreen forests. They exhibit exceptional resilience to variations in temperature, altitude, and precipitation patterns (Sunquist, Karanth, Sunquist, & Sunquist, 1999). The tiger (Panthera Tigris) most likely came from east Asia and was present for two million years ago when it first appeared in its current area (Hemmer, 1987). (Kitchener, 1999). According to Jhala et al. (2011), tigers serve as an umbrella species for the preservation of the biota in most Asian ecoregions. India, despite its developing economies is a home to more than half of the world's wild tigers. India is dedicated to protecting its tigers and their habitats with full awareness of these difficulties.

In every mammalian assemblage where they are found, tigers are an obligatory terrestrial carnivore (O' Brien, Kinnaird, & Wibisono, 2003). Since it is an umbrella species, its successful conservation increases the likelihood that other types of biodiversity will survive (Karanth, 2003). According to the Wildlife (Protection) Act (WPA, 1972), the tiger Panthera Tigris is classified as an endangered species and schedule-I species. Its population status is likewise unknown throughout its range (Karanth and Nichols, 1998). Owing to their massive build and predatory appetite, tigers are found in areas with few populations. Adverse variables that have an impact on wild tiger populations include habitat fragmentation and shrinkage (Wikramanayake et al., 1998), tigers poaching (Kenney et al., 1995), and prey reduction as a result of overhunting (Karanth and Stith, 1999). Prioritising conservation efforts in

regions with healthy tiger populations is essential for the long- term survival of tigers due to the quickly deteriorating natural environment and severe resource and labour shortages (Seidensticker et al. 1999).

While it may not be possible to double the number of tigers by 2022, India, home to 70% of the species, has been managing its tiger population rather well. There were 2,967 tigers in India in 2018 compared to 2,226 in 2014 (India Tiger Estimation 2022). However, the demand for tiger bones for medical purposes in China and other south- east Asian countries poses a greater threat than ever to the wild cat and its habitat.

On International Tiger Day 2019, India received the results of its most recent tiger census; the data was eagerly expected as it had been delayed since January of this year. In order to reveal the number of tigers in India, PM Narendra Modi finally released the results of the 2018 Tiger Census on July 29, 2019. There are currently 2967 Bengal Tigers living in India, according to the results.

National parks and Wild Life Sanctuaries have substantially contributed in the process of alienation for the poorer sections making their survival far more difficult. This has created another arena of conflict between the local people and the protected area. In many places in our country, the conflict has taken the shape of organized struggle and a good number of such struggles have adopted violent means to assert their traditional rights over the endowments of nature, especially forests and wetlands. Very often conflicts over access and control over natural resources in national parks and sanctuaries become law and order problems and result in physical confrontations between the people and the authorities (Kothari et al., 1989). A frenzied mob set fire to about 10,000 acres of Nagarhole National Park, a well-protected Park in Karnataka, in retaliation against the alleged murder of a local person. Elsewhere, in Kerala's Silent Valley and Madhya Pradesh's Kanha Tiger Reserve, similar cases of arson have threatened to undo years of protection (Bagla, 1992; Jena, 1993). Gujjars in Rajaji National Park (Uttar Pradesh), Kolis in Bhimashankar Sanctuary

(Maharashtra), Maldharis in Gir National Park (Gujarat), and elsewhere people are questioning the very need and rationale of national parks and sanctuaries.

The major reasons advanced by the officials for this conflict is the efforts by the forest officials to stop illicit felling of trees, poaching, illegal grazing, encroachments and other forest offences (Kothari et al., 1989). Hence, one has to look beyond the legal definition of forest offences and explore the causes and analyse them, within the context of existential situation of local communities.

There are two perspectives on forests with regard to its conservation and use. One, which can be called macro perspective, treats forests as the repository of 'precious' biological diversity and wilderness essential for advancement of knowledge and solution to various global problems such as greenhouse effect, climatic change, etc. The second perspective which can be called micro perspective sees forest as crucial endowments to nature directly and indirectly providing sustenance not only to wild species, but also to a large number of people whose social, economic, cultural, political and spiritual life revolves around it.

In India, forest assumes importance in the context of widespread rural poverty, which needs to be seen in context of biomass scarcity prevailing in the country -- the shortage of food, fodder, firewood, artisan raw materials, timber, etc. A surplus of these materials will not turn India into a wealthy nation in the modern sense, but it will definitely help to reduce the existing rigours of poverty -- the extraordinary work burden that the poor face today. A large section of people in India both tribal and non- tribal, including nomads, depend on forests and their natural surrounding for survival. Livelihood of a large number of artisans is inextricably linked with forests.

Unlike the Western countries, in India one finds a large number of people living with these forests and sometimes in dense forests. For them forest is the only source of livelihood. A study reports that 10 sanctuaries have a population

density higher than the national figure and some national parks have very high density, for example, Bansda in Gujarat has 0.56 persons per ha (Kothari et al., 1989). At the same time, a large number of people are found to be inhabiting the areas adjacent to parks and sanctuaries. Kothari et al. (1989) have reported more than 80 per cent of their sample sanctuaries and national parks as having human habitation within 10 km radius of the boundary. The population density in the periphery of Ramnabagan Sanctuary (West Bengal), and Karnala Sanctuary (Maharashtra) is very high as 26,675 and 2,232 persons per ha respectively (Arun Kumar Singh et al, 2023).

Earmarking an area crucial for survival of a sizable number of marginalised people exclusively for rearing and restoration of wild animals and their habitat denying access to them has been a major source of conflict between national parks, sanctuaries and the local communities. Threat to Right to Life and Livelihood.

Though, some of the parks and sanctuaries have compensation scheme for such damage, yet the repercussions of such damage for the poor person are very severe. Preponderant instances are found that in some areas people have given up cultivating wheat and other Rabi crops because of regular damage caused by the wild animals (Jena, 1993; PRIA, 1993). As a result, already poverty-stricken families lose their food crops and starve. As far as compensation is concerned, it involves legal intricacies and bribe to the officials, hence, in most of the cases, even if the person is aware about the compensation scheme, he simply forgoes it. It is clear from the above delineation that the contemporary state-sponsored conservation is based on elitist perceptions and ignores the micro-realities. 'Interests' and traditional rights of the local people living in and around national parks and sanctuaries have become the biggest casualty.

While the official ideology envisages that the goal of conservation is sustainable development, but in reality, it has unleashed the process of deprivation for a large number of people. It is further clear that sustainable

development through conservation is devoid of an essential component, i.e. sustainable use. The very concept of sustainable development becomes meaningless and irrelevant without adequate emphasis on people's needs, rights, knowledge and participation. The result is before us. Parks and sanctuaries cannot exist as insulated islands, ignoring the local people and their survival needs. Biological diversity cannot thrive with cultural diversity. Hence what is required at the moment is review and revision of the approach to and strategy of conservation both at international and national levels.

1.2 Need of the Study

The aim of the study to analyses the impact assessment of Ranthambhore Sanctuary from ecological reasons Community development and impact of Government Polices and its consequences. The reasons can be enumerated as follows:

- A fast-growing human and livestock population (2.00 lakhs and nearly 1.00 lakh respectively) in 97 villages that surrounds the Ranthambhore Tiger Reserve including the two townships of Sawai Madhopur and Khandar has been continuously causing a mounting pressure on the limited resources of agricultural land, forests and wildlife.
- Increasing developmental and urban activities have been fast impairing the delicate ecological network and the local environment to the level of impossible halting.
- The human and livestock population depend upon the nearby adjoining forest areas for fuel, fodder, grazing and small timber. Increasing exploitation of forest resources has severely denuded the sanctuary and resulted in conflict between the local people and forest officers. As a result, the ecological components in the Ranthambhore Sanctuary appear to be deteriorating in all respects. This needs to be studied in detail.
- Since government's policy towards tourism is to earn more and more revenue, there has been fast increase in religious-tourist influx in the sanctuary. This

seasonal tourism has given rise to a totally new system called "Tourism culture". This tourist culture has a high physio-chemical mode of life and behaviour, thereby the life- sustaining raw materials are not by and large environmentally friendly, but mostly biologically non-degradable synthetic, metallic and artificial. This has altered the ambient environmental status and resource management requires a detailed study.

- After the declaration of Ranthambhore sanctuary as a National Park in November 1980, 12 villages from the core area of the sanctuary have been shifted and resettled in two villages far apart from each other namely Kailash Puri and Gopalpur. This uprooting has adversely affected the life-style of traditional pastoralists. Four villages are still in the core area and are in the process of evacuation. The extent of their social impacts requires to be studied. The unique geomorphological set-up of Ranthambhore Sanctuary always tempted the researcher to take up a study in this zone on the basis of satellite data and detailed field investigations in order to assess the water potentialities of this fractured zone.

1.3 Facts about Tiger Census

As per the 5th cycle of India's Tiger Census for results of the 2018 Tiger were released by PM Narendra Modi on July 29, 2019, International Tiger Day. Officially, one of the largest and safest habitats for Royal Bengal Tigers is presently India. According to the 2018 Tiger Census, there are 2967 Royal Bengal Tigers in India, more than twice as many as there were in 2006.

1.3.1 Information on Tiger Landscapes in India

The habitats of tigers were separated into five landscapes because it was important to segregate the geographical boundaries due to the tigers' widespread presence throughout India.

The Shivalik Gangetic Plains; the Eastern Ghats and Central India; the Western Ghats; the North Eastern Hills and the Brahmaputra Flood Plains; and the

Sundarbans. To obtain the most precise tiger population distribution across India, each of these five tiger landscapes was examined independently. A variety of methods were employed to reach the desired outcomes. Details & Factual Data from the 2018 Tiger Census Results.

- A total of 3,81,000 square kilometres of forest were surveyed.
- Over 5,00,000 km have been surveyed by forest rangers on foot
- A total of 26,838 Camara Traps have been placed in 141 places.
- These camera traps collected about 3.5 Cr of wildlife photos.
- 2,461 Separate Tigers cameras captured
- An estimated 2,591 tigers using capture-mark-recapture According to the

2018 Tiger Counting, there are 2,967 tigers in the world.

1.3.2 TIGER POPULATION IN INDIA

1.3.2.1 State wise Tiger reserves and Population in India

As per National Tiger Conservation Authority (NTCA, 2023) the state wise tiger reserve area

Table 1.1

TIGER RESERVES AREA IN INDIA (DATA BY STATES)

Sr. No.	State	Total Area (In Sq. Km.)	Percentage of Total Tiger Reserved Area	Category wise Share of Total Tiger reserve area
1	Bihar	899.38	1.2	**Less than 2 Percent** (Average Share 2.9)
2	Jharkhand	1129.93	1.5	
3	Kerala	643.66	2.1	**2.1 to 5.0 Percent** (Average Share 23.8)
4	Uttarakhand	1288.31	3.1	
5	Andhra Pradesh	3296.31	4.3	
6	West Bengal	757.9	4.4	
7	Uttar Pradesh	2201.77	4.6	
8	Odisha	963.87	4.9	

9	Arunachal Pradesh	783	5.3	**5.1 to 10.0 Percent** (Average Share 47.5)
10	Telangana	2611.39	6.1	
11	Rajasthan	759.99	6.4	
12	Assam	1173.58	6.6	
13	Karnataka	1456.3	7.1	
14	Chhattisgarh	914.01	7.3	
15	Tamil Nadu	1479.87	8.2	
16	Maharashtra	816.27	12.0	**More than 10.1 Percent** (Average Share 25.8)
17	Madhya Pradesh	1536.93	13.4	
	Total Tiger Reserved Area	**75,797**	**100.0**	

Source: NTCA (National Tiger Conservation Authority) Report, 2023

There are currently over 3000 Tigers living in India 2967 to be exact. It was more than twice as high as the first tiger counting survey of India, conducted in the 2006 Census. India has five tiger landscapes, fifty tiger reserves, and twenty-one states where tigers can be found living in the wild.

Table 1.2

LANDSCAPE WISE TEMPORAL STUDY OF TIGER POPULATION

Sr. No.	Landscape	2006	2010	2014	2018
1	Shiwalik & Gangetic Region	297	353	485	646
2	Central India and Eastern Ghats Region	601	601	688	1033
3	Western Ghats Region	402	534	776	981
4	North Eastern Hills and Brahamputra Plains Region	100	148	201	219
5	Sundarbans Region	NA	70	76	88
	Total	**1400**	**1706**	**2226**	**2967**

Source: NTCA (National Tiger Conservation Authority) Report, 2019

Table 1.3

TRENDS OF TIGER POPULATION IN INDIA

Census Year	Tiger Population
2005	1412
2009	1705
2013	2225
2017	2968

Source: NTCA (National Tiger Conservation Authority) Report, 2019

TIGER POPULATION FACTS FROM THE LATEST CENSUS REPORT

- There are 2,967 Royal Bengal Tigers in India overall.
- More than 300 tigers live in four states: Maharashtra, Karnataka, Uttarakhand, and Madhya Pradesh.
- More than 150 Tigers are found in four states: Tamil Nadu, Assam, Kerala, and Uttar Pradesh.
- There are eight states where the number of tigers has increased by more than 100% since 2006.
- Madhya Pradesh is now known as India's Tiger State.
- There are now no tigers in the Palamau, Dampa, or Buxa Tiger Reserves.
- The state of Mizoram has no tigers.
- The best-rated Tiger Reserves in India are Paraiyar National Park in Kerala and Penny National Park in Madhya Pradesh.

1.4. ACT AND ITS IMPACT ON BIODIVERSITY OF NATIONAL PARK

1.4.1 WILDLIFE PROTECTION ACT, 1972

All plants and animal which are not domesticated can be termed as Wildlife. Wildlife protection was formed in India to protect the wildlife including terrestrial, aquatic and their natural habitat. This act consists of 60 sections, VI schedule which are divided in 8 chapters. The act came into force on 9th

September 1972 extend to whole of India except Jammu & Kashmir.

1.4.1.1 Schedules under the Act

The following six schedules delineate how different plants and animals are classified as protected under the Wildlife (Protection) Act, 1972:

1.4.1.1.1 Schedule I: It addresses threatened species that require strict protection. The species is protected from acts such as trading, killing, and poaching. If someone violates this Schedule, they could face the worst punishments possible. It is against the law to hunt any species included in this Schedule anywhere in India, unless there is a serious threat to human life or the species is terminally ill. The following are a few of the creatures that are protected under Schedule I:

The Black Buck	Bengal Tiger	Clouded Leopard	Snow Leopard
Swamp Deer	Himalayan Bear	Asiatic Cheetah	Kashmiri Stag
Fishing Cat	Lion-tailed Macaque	Musk Deer	Rhinoceros
Brow Antlered Deer	Chinkara (Indian Gazelle)	Capped Langur	Golden Langur
Hoolock Gibbon			

1.4.1.1.2 Schedule II: The trading of any animal included on this list is prohibited, giving these animals even further protection. They can only be hunted if human life is in danger or if they have an illness or condition from which they cannot recover. Among the creatures covered by Schedule II are:

Assamese Macaque	Bengal Hanuman langur	Himalayan Black	Himalayan Newt/ Salamander
Pig Tailed Macaque	Flying Squirrel,	Giant Squirrel	Stump Tailed Macaque
Jackal	King Cobra	Sperm Whale	Indian Cobra,

1.4.1.1.3 Schedule III & IV: Schedules III and IV contain species that are not threatened with extinction. In contrast to the first two schedules, there is a lower punishment for violating the ban on hunting protected species. Schedule III protects the following animals:

Chital (spotted deer)	Bharal (blue sheep)	Hyena
Sambhar (deer)	Sponges	Nilgai
Animals protected under Schedule IV include:		
Hares	Falcons	Flamingo
Horseshoes Crabs	Magpie	Kingfishers

1.4.1.1.4 Schedule V: Vermin are little wild animals that spread disease and eat and destroy plants. The schedule includes some of these animals. It is legal to hunt these animals. There are just four types of wild animals found there:

Common Crows	Fruit Bats	Rats	Mice

1.4.1.1.5 Schedule VI: It controls the growing of a certain plant and places restrictions on its ownership, sale, and transportation. Only with prior permission from the relevant government can some plants be grown and traded. Plants protected under Schedule VI include:

Beddomes' cycad (Native to India)	Blue Vanda (Blue Orchid)	Red Vanda (Red Orchid)
Kuth (Saussurea lappa)	Slipper orchids (Paphiopedilum spp.)	Pitcher plant (Nepenthes khasiana)

Source: ACT, 1972

1.4.1.2 PROJECT TIGER

The project tiger was introduced in India in the year 1973. The total protected area under Project Tiger in India was approximately 71,000 sq. km and the total population of the Royal Bengal Tiger in India was around 3000 individuals

(2967, 2018 survey). In International Union for Conservation of Nature (IUCN) status of Royal Bengal tiger is comes under endangered species. International Tiger Day on July 29 every year since it was conceptualized in 2010 at the St. Petersburg conference. Tigers usually have a life span of 14 years. Once matured, tigers spend most of the time living and hunting alone. A tiger's roar can be heard as far as 3 kilometers away. The night vision of tigers is six time better than that of Humans.

1.5 STUDY AREA

In its current configuration, Rajasthan State is a collection of 19th-century princely States that differ in terms of population, size, administrative effectiveness, and socioeconomic advancement. 33 districts make up Rajasthan's administrative division, which is further split into 331 tehsils and 352 panchayat samities. Rajasthan is the largest state in the nation, covering 3.422 lac sq km. 6.854 crore people are living in the state, according to the 2011 census. It shares a lengthy international border with Pakistan and is bordered by the Indian states of Gujarat, Punjab, Haryana, Uttar Pradesh, and Madhya Pradesh. The Aravali range of hills, one of the oldest mountain systems in the world, dominates the state's landscape.

Across the centre of the state, the Aravali hills range stretches from south-west to northeast. "Thar" or the Great India Desert refers to the area to the west and northwest of these hills, which is made up of 12 districts and accounts for 61.11 percent of the state's total area. 5.85% of the state's land area is made up of tribal lands.

TABLE 1.4

COMPOSITION OF POPULATION IN SAWAI MADHOPUR

Items	Total	Male	Female
City Population	121106	63014	58092
Literates	83800	49278	34522
Children (0-6)	15620	8308	7312
Average Literacy (%)	79.44%	90%	67%
Sex ratio	922		
Child Sex ratio	880		

Source: District Census Handbook, 2011

Table 1.5

RELIGIOUS DISTRIBUTION OF POPULATION IN SAWAI MADHOPUR

Description	Total	Percentage
Hindu	90483	74.7139
Muslims	24360	20.1146
Christian	251	0.20726
Sikh	472	0.38974
Buddhist	50	0.04129
Jain	5304	4.37963
Others	6	0.00495
Not Stated	180	0.14863
Total	**121106**	**100**

Source: District Census Handbook, 2011

Located in the southeast of Rajasthan, the Ranthambore Tiger Reserve (RTR) is arguably the most well-known tiger reserve in all of India. The 1473 km2 tiger reserve is made up of 360 km2 of buffer zone and 1113 km2 of core zone, or crucial tiger habitat128. The districts of Sawai Madhopur and Karauli comprise the main zone of RTR. The buffer zone, which is made up of accessible forest land outside the core zone, does not completely encircle the RTR core area, although it does occasionally border it. The three districts of Sawai Madhopur, Bundi, and Tonk comprise the buffer zone. The tiger reserve delineates the boundary between the seasonally rainy peninsula of India and the actual desert.

1.5.1 Water Resources at Tiger Reserves

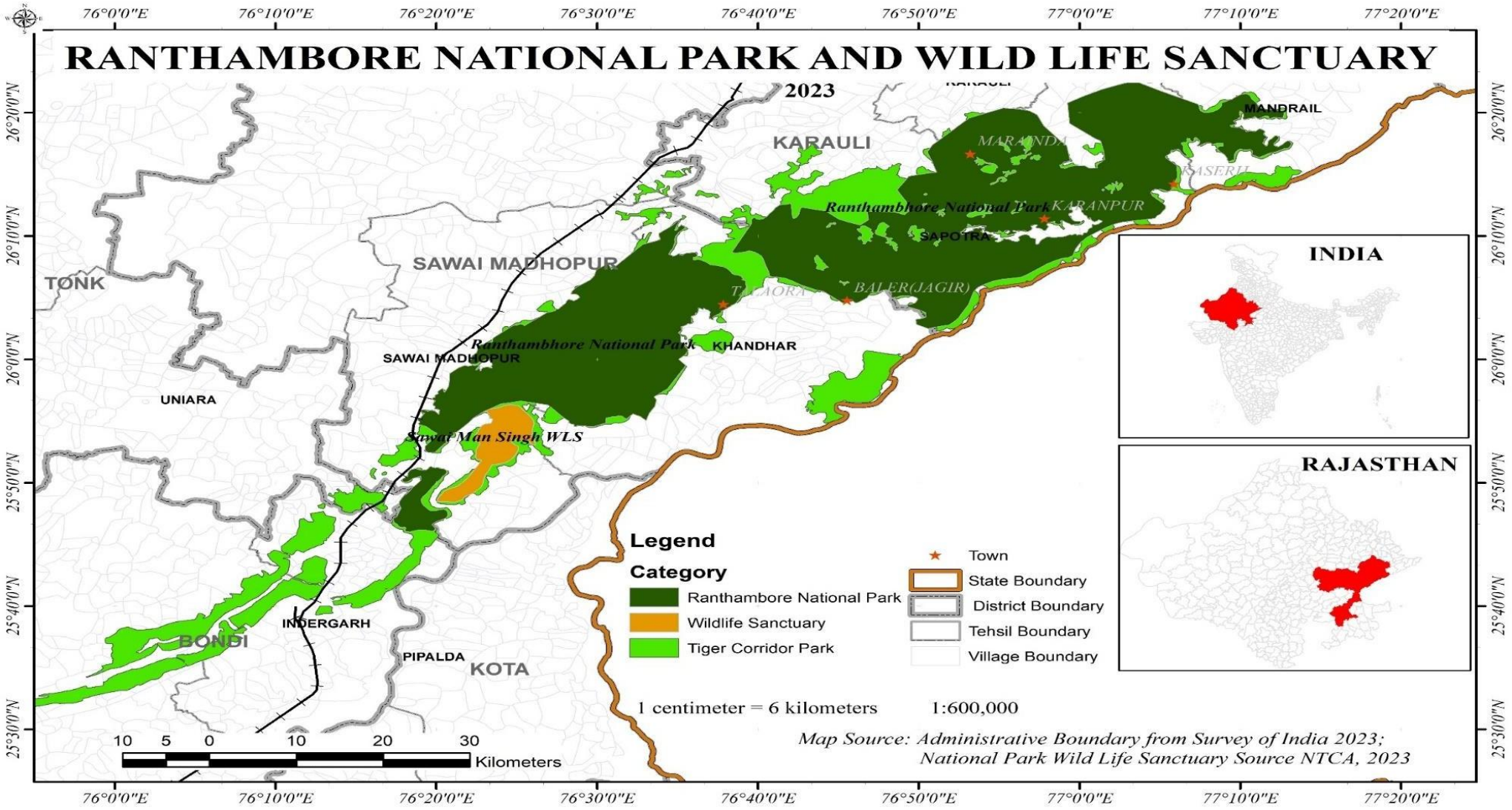
Availability of water is the most potent factor in the distribution of animals and plants. Water is the main sustenance of life here as everywhere. During the monsoon season a large number of waterfalls cascade down the cliffs providing the most spectacular and exquisite beauty to the area. As there are a large number of vertical cliffs in this Park, water flows down the waterfalls

very soon even during the small span of rainfall for a day or two. The Park has six reservoirs of water that have water throughout the year. Galai Sagar and ManSarovar reservoirs have been artificially created by damming the rivers and they supply water for irrigation to nearby villages. Due to human activities at these points the wild animals seldom visit these sites. It is only during the peak summer season, when other water holes get dry, that the animals come to these sites.

The other four tanks are natural in which the rain water collects into the natural depression. Padam Talao is a vast shallow lake on the banks of which the famous Jogi Mahal, the tourist hotel, stands. It has water round the year. Herds of wild animals visit this lake every morning and evening giving a picturesque view to the pleasure of the visiting tourists.

This lake had thick vegetation of grasses and trees around it which provide shelter and food to the animals. Raj Bagh is another big lake having water throughout the year. This lake is quite close to Padam Talao but is less extensive in area. Milak Talao is another large depression to hold rain water but sometimes when the summers are blistering and the arrival of monsoon is delayed, then this lake gets dry. Another small lake is Lahpur lake formed by damming the Lahpur river. The embankments are not high and excess of rain water spills over the surrounding areas causing marshes. The lake dries up in February and provides little respite to the wild animals

Map No. 1.1
STUDY AREA MAP



Nonetheless, about a hundred water holes exist in the park that provide water to animals in the pinch periods. Some of them are scattered pools, once constructed by the rulers of the fort but are now in ruined condition. They form a part of the ecosystem of the park and serve as valuable water reserves. Other water holes are either depressions in the plateau region or the cesspools of water in the narrow valley.

In 1989 and 1990 the rainfall was 35.40 cm and 40.40 cm respectively, which was less than the average rainfall of 68.72 cm. Therefore, the acute shortage of water caused crisis of unimaginable magnitude. Most of the water holes and river valleys had dried up in the parching heat of 1989-90 and the herds of animals moved together in search of water from pillar to post but to no avail. Even the major reservoirs, Milak- Talao and Lahpur lake, reputed to contain water all the year round had parched up into sun-baked tiles of mud. The management at that time deepened the existing wells and pumped out water from them to fill in the artificially built, small tanks of water to make possible the survival of animals.

1.6 OBJECTIVES

1.6.1. To understand the impact of conservation scheme on the socio-economic and ecological status of the study areas.

1.6.2. To analyse the disparities of natural resources for identification of alternative scenarios for sustainable development.

1.6.3. To examine the extent of local and regional cooperation towards conservation.

1.6.4. To evaluate the role of Government and NGO's for promoting conservation schemes.

1.7 REVIEW OF LITERATURE

Sharma and Gupta (2015) provide a comprehensive historical analysis of tiger conservation efforts in Ranthambore National Park. The authors trace the origins of conservation initiatives back to the 1970s, emphasizing the establishment of Project Tiger in 1973. They discuss the initial challenges faced, including poaching, habitat loss, and human-wildlife conflict. The paper highlights significant milestones, such as the introduction of anti-poaching measures, community involvement, and habitat restoration projects. The authors conclude that while substantial progress has been made, continued efforts and adaptive management are essential for the long-term survival of tigers in Ranthambore.

Patel and Singh (2018) explore the use of Geographical Information Systems (GIS) in the conservation of biodiversity within Ranthambore National Park. The study demonstrates how GIS technology has been employed to map tiger habitats, monitor population dynamics, and identify critical areas requiring intervention. The authors discuss the integration of remote sensing data with field observations to create comprehensive spatial databases that inform management decisions. The paper concludes that GIS has significantly enhanced the effectiveness of conservation strategies by providing precise and timely information, thereby facilitating proactive measures to protect tigers and their habitats.

Mehta and Kumar (2016) focus on the ecological and biological aspects of tiger populations in Ranthambore National Park. Their study examines the factors influencing tiger population dynamics, including prey availability, habitat quality, and genetic diversity. The authors utilize long-term monitoring data to analyze trends in population size and structure, highlighting the importance of maintaining genetic diversity to ensure population resilience. The paper also addresses the impact of environmental changes and human activities on tiger

ecology. The authors advocate for adaptive management practices that consider ecological variability and promote habitat connectivity.

Roy and Chakraborty (2017) investigate the socio-economic impacts of tiger conservation efforts in Ranthambore National Park. Their study emphasizes the role of local communities in conservation initiatives and the benefits they derive from these efforts. The authors highlight the establishment of eco-tourism as a significant economic activity that provides income and employment opportunities for local residents. They also discuss the challenges faced by communities, including restrictions on resource use and human-wildlife conflicts. The paper suggests that involving local communities in decision-making processes and ensuring equitable benefit-sharing are crucial for the success of conservation schemes.

Iyer and Menon (2019) examine the policy and governance frameworks that underpin tiger conservation efforts in India, with a focus on Ranthambore National Park. The authors analyze the effectiveness of various policies, such as the Wildlife Protection Act of 1972 and the National Tiger Conservation Authority's guidelines. They discuss the role of government agencies, non-governmental organizations, and international collaborations in implementing conservation strategies. The paper identifies gaps in policy enforcement and calls for stronger regulatory mechanisms and increased funding for conservation programs. The authors conclude that a robust governance framework is essential for the sustained protection of tiger populations.

Verma and Singh (2020) analyze the genetic diversity of Bengal tigers in Ranthambore National Park to assess the population's health and long-term viability. Using advanced genetic analysis techniques, the authors find moderate levels of genetic diversity, which are crucial for the population's adaptability and resilience. The study emphasizes the importance of maintaining genetic flow between isolated populations through wildlife

corridors. The authors suggest that conservation strategies should include genetic monitoring to detect potential inbreeding and loss of genetic diversity, which could threaten the population's survival.

Kaur and Yadav (2019) investigate the impact of habitat fragmentation on tiger populations in Ranthambore National Park. Using landscape connectivity models, the study identifies critical habitat corridors that facilitate tiger movement and gene flow. The authors highlight the adverse effects of habitat fragmentation, such as reduced access to prey and increased human-wildlife conflicts. The paper recommends measures to enhance habitat connectivity, including the establishment of wildlife corridors and the restoration of degraded habitats. The authors argue that improving habitat connectivity is vital for the long-term conservation of tigers in Ranthambore.

Bhatt and Pandey (2017) explore the issue of human-wildlife conflict in the vicinity of Ranthambore National Park. The study examines the causes of conflict, including livestock predation and crop damage by tigers and other wildlife. The authors evaluate various mitigation strategies, such as community-based conflict resolution, compensation schemes, and the use of technology (e.g., camera traps and early warning systems). The paper concludes that while these measures have had some success, ongoing challenges remain. The authors recommend a holistic approach that combines conflict mitigation with community development and education programs.

Rao and Joshi (2018) examine the impact of ecotourism on tiger conservation in Ranthambore National Park. The study assesses the economic benefits of ecotourism, such as job creation and revenue generation for conservation projects. The authors also discuss potential negative impacts, including habitat disturbance and increased human presence. The paper highlights the importance of sustainable ecotourism practices that balance economic gains with conservation goals. The authors advocate for strict regulations and community involvement to ensure that ecotourism contributes positively to

tiger conservation efforts.

Reddy and Mohan (2021) investigate the potential impacts of climate change on tiger habitats in Ranthambore National Park. The study uses climate models to predict changes in temperature, precipitation patterns, and habitat suitability for tigers. The authors find that climate change could lead to habitat loss and shifts in prey availability, posing significant challenges for tiger conservation. The paper emphasizes the need for climate-adaptive management strategies, such as habitat restoration and the creation of climate-resilient corridors. The authors call for further research to better understand the complex interactions between climate change and tiger ecology.

Desai and Patel (2017) analyze the relationship between prey availability and tiger conservation in Ranthambore National Park. The study assesses the population dynamics of key prey species, such as deer and wild boar, and their influence on tiger population health. The authors find that fluctuations in prey populations directly affect tiger survival and reproduction rates. The paper suggests that managing prey populations through habitat improvement and anti-poaching measures is crucial for sustaining a healthy tiger population. The authors recommend integrated management approaches that consider both predator and prey dynamics.

Kapoor and Sharma (2020) explore the use of remote sensing technology for monitoring tiger habitats in Ranthambore National Park. The study demonstrates how satellite imagery and aerial surveys can provide accurate and up-to-date information on habitat conditions, vegetation cover, and land use changes. The authors highlight the advantages of remote sensing, including its ability to cover large and inaccessible areas. The paper concludes that integrating remote sensing with traditional field surveys enhances the effectiveness of habitat monitoring and management. The authors advocate for the continued use of advanced technologies to support conservation efforts.

Jain and Gupta (2018) evaluate the effectiveness of community-based conservation initiatives in Ranthambore National Park. The study examines programs that involve local communities in conservation activities, such as anti-poaching patrols, habitat restoration, and eco-tourism. The authors find that community involvement has led to increased awareness and support for conservation efforts. However, challenges such as inadequate funding, limited capacity, and socio-economic pressures persist. The paper suggests that enhancing community participation and addressing these challenges are essential for the long-term success of conservation initiatives.

Kumar and Bhattacharya (2019) discuss the role of technological innovations in tiger conservation efforts in Ranthambore National Park. The study highlights various technologies, such as camera traps, GPS collars, and drones, that have been employed to monitor tiger populations, track their movements, and prevent poaching. The authors emphasize the importance of technology in providing real-time data and enhancing the efficiency of conservation actions. The paper concludes that continued investment in and integration of advanced technologies are crucial for addressing the complex challenges of tiger conservation.

Singh and Kaur (2021) analyze the impact of national and international policies on tiger conservation efforts in Ranthambore National Park. The study examines the effectiveness of various policy measures, such as the Wildlife Protection Act, Project Tiger, and international agreements like CITES. The authors find that while these policies have significantly contributed to conservation successes, gaps in implementation and enforcement remain. The paper suggests that stronger policy frameworks, increased funding, and international collaboration are needed to ensure the sustained protection of tigers in Ranthambore.

Sharma and Kumar (2018) evaluate habitat restoration projects in Ranthambore National Park and their impact on tiger conservation. The study assesses

various restoration activities, including reforestation, waterhole creation, and invasive species removal. The authors find that these projects have improved habitat quality and increased prey availability for tigers. The paper highlights the importance of continuous monitoring and adaptive management to ensure the long-term success of restoration efforts. The authors recommend involving local communities in restoration activities to enhance their effectiveness and sustainability.

Choudhary and Verma (2019) investigate the effectiveness of anti-poaching strategies implemented in Ranthambore National Park. The study evaluates various measures, such as patrolling, surveillance technology, and community involvement in anti- poaching activities. The authors find that a combination of these strategies has led to a significant reduction in poaching incidents. The paper suggests that continuous training and capacity-building for forest guards, along with community support, are essential for sustaining anti-poaching efforts. The authors advocate for the integration of traditional knowledge and modern technology in anti-poaching strategies.

Sen and Biswas (2020) explore the socio-economic benefits of tiger conservation for local communities in Ranthambore National Park. The study examines the economic impact of eco-tourism, conservation-related employment, and community-based conservation programs. The authors find that tiger conservation has created significant economic opportunities for local residents, contributing to improved livelihoods and poverty reduction. The paper highlights the importance of ensuring that conservation benefits are equitably distributed among community members. The authors recommend enhancing community participation and promoting sustainable economic activities to support conservation goals.

Das and Rao (2019) examine the contributions of non-governmental organizations (NGOs) to tiger conservation efforts in Ranthambore National

Park. The study highlights the roles of NGOs in advocacy, capacity-building, community engagement, and funding conservation projects. The authors find that NGOs have played a crucial role in raising awareness, mobilizing resources, and implementing conservation initiatives. The paper suggests that collaboration between government agencies, NGOs, and local communities is essential for the success of conservation efforts. The authors recommend fostering partnerships and enhancing the capacity of NGOs to support conservation goals.

Nair and Pillai (2021) emphasize the importance of long-term monitoring and research for effective tiger conservation in Ranthambore National Park. The study reviews various monitoring programs and research projects that have contributed to understanding tiger ecology, behavior, and population dynamics. The authors highlight the role of scientific research in informing management decisions and adaptive conservation strategies. The paper concludes that sustained funding and institutional support for long-term research are essential for addressing emerging conservation challenges. The authors call for integrating research findings into policy and management practices to enhance conservation outcomes.

The conservation of biodiversity, particularly that of apex predators like tigers, is crucial for maintaining ecosystem balance and health. Tigers (Panthera tigris) are not only iconic species but also serve as umbrella species, meaning that their conservation helps protect a wide range of other species within their habitat (Karanth & Stith, 1999). Ranthambore National Park, located in the Indian state of Rajasthan, is one of the most important habitats for Bengal tigers. This geographical study aims to assess the biodiversity conservation schemes in place for tigers in this region, evaluating their effectiveness and identifying areas for improvement.

Tigers play a critical role in maintaining the ecological integrity of their habitats. As top predators, they help regulate prey populations, which in turn

affects the vegetation and overall ecosystem structure (Ripple et al., 2014). The decline of tiger populations due to poaching, habitat loss, and human-wildlife conflict can lead to cascading effects throughout the ecosystem (Sanderson et al., 2006). Therefore, effective conservation schemes are essential for preserving biodiversity and ensuring ecosystem stability.

Ranthambore National Park is one of the largest and most renowned national parks in Northern India, covering an area of approximately 1,334 square kilometres. It provides a unique and varied habitat, ranging from dry deciduous forests to open grasslands and rocky hills, making it an ideal environment for tigers and a diverse array of other species (Jhala et al., 2011). The park's geographical features, including its water bodies and terrain, create a mosaic of habitats that support high biodiversity.

Several conservation initiatives have been implemented in Ranthambore National Park, including anti-poaching patrols, habitat restoration projects, and community- based conservation programs. The Indian government's Project Tiger, launched in 1973, has been instrumental in establishing protected areas and implementing measures to safeguard tiger populations (Panwar, 1979). Additionally, non- governmental organizations (NGOs) and local communities play a significant role in supporting conservation efforts through awareness campaigns and eco-tourism initiatives (Wright, 2010).

Despite these efforts, several challenges remain. Habitat fragmentation due to agricultural expansion, infrastructure development, and resource extraction continues to threaten tiger populations (Linkie et al., 2006). Human-wildlife conflict, particularly livestock predation by tigers, leads to retaliatory killings and poses a significant threat to their survival (Inskip & Zimmermann, 2009). There is also a need for more comprehensive data on tiger populations and their prey, which can be addressed through advanced monitoring techniques such as camera traps and GPS collaring (Karanth et al., 2004).

The use of Geographic Information Systems (GIS) and remote sensing technology has greatly enhanced the ability to monitor and manage tiger habitats. These tools allow for the mapping of critical habitats, identification of wildlife corridors, and assessment of land-use changes over time (Patel & Singh, 2018). Integrating these technologies into conservation strategies can improve the effectiveness of management plans and ensure the long-term viability of tiger populations.

1.8 RESEARCH GAPS

The research gaps identified in the tiger conservation efforts at Ranthambore National Park are as follows:

1.8.1 Impact of Climate Change: Limited research exists on how climate variables (temperature, rainfall) affect prey availability, vegetation, and tiger movement. Further studies on climate change impacts and adaptive strategies are necessary.

1.8.2 Human-Wildlife Conflict: Research on the effectiveness of conflict resolution strategies, particularly community-based approaches and socio-cultural factors influencing conflict, remains insufficient.

1.8.3 Habitat Connectivity: Research is needed on the effectiveness of wildlife corridors and landscape connectivity models, along with scaling and integrating habitat restoration efforts into broader landscape management strategies.

1.8.4 Governance and Policy Effectiveness: Gaps in enforcement of existing policies like the Wildlife Protection Act and Project Tiger highlight the need for research into strengthening governance structures and improving collaboration among government agencies, NGOs, and local communities.

1.8.5 Technological Integration: Further research is needed on the integration of remote sensing, GIS, and drones for real-time habitat monitoring and poaching prevention, to improve data collection and enhance conservation strategies.

In summary, there is a need for better monitoring techniques, deeper understanding of climate change impacts, more effective human-wildlife conflict strategies, stronger governance, and enhanced use of technology in conservation. These gaps could significantly improve the effectiveness of conservation efforts in Ranthambore National Park.

1.9 SCOPE OF THE STUDY

The study aims to evaluate the biodiversity conservation schemes for tigers in India, with a specific focus on Ranthambore National Park. This involves a comprehensive analysis of the geographical, ecological, and socio-economic factors influencing tiger conservation efforts. By examining these elements, the study will provide insights into the effectiveness of current conservation strategies and identify potential areas for improvement.

1.9.1 Geographical Scope

The geographical scope of the study encompasses the entirety of Ranthambore National Park, located in the Sawai Madhopur district of Rajasthan, India. The park covers an area of approximately 1,334 square kilometres and includes diverse habitats such as dry deciduous forests, grasslands, and rocky hills (Jhala et al., 2011). This geographical diversity is crucial for supporting the park's rich biodiversity, including its tiger population.

1.9.2 Ecological Scope

Ecologically, the study will focus on the following key components:

- **Tiger Population Dynamics:** Analysis of tiger population trends, reproductive rates, mortality rates, and genetic diversity. This will involve field surveys, camera trapping, and genetic analysis (Karanth & Nichols, 2002).
- **Prey Base Assessment:** Evaluation of prey species populations and their

distribution within the park. The abundance and health of prey species such as deer and wild boar are vital for sustaining the tiger population (Hayward et al., 2012).

- **Habitat Quality and Connectivity:** Assessment of habitat quality and the connectivity between different habitat patches. This includes studying the impact of habitat fragmentation and the effectiveness of wildlife corridors in facilitating tiger movement (Cushman et al., 2010).

1.9.3 Socio-Economic Scope

The study will also consider the socio-economic factors that influence biodiversity conservation efforts:

- **Human-Wildlife Conflict:** Investigation of the extent and causes of human- wildlife conflict, particularly in communities surrounding Ranthambore National Park. This includes examining livestock predation, crop damage, and retaliatory killings of tigers (Inskip & Zimmermann, 2009).

- **Community Involvement and Livelihoods:** Analysis of community-based conservation programs and their impact on local livelihoods. This includes evaluating the role of eco-tourism, conservation-related employment, and community education initiatives (Roe et al., 2009).

- **Policy and Governance:** Examination of the policies and governance structures that support or hinder tiger conservation. This includes evaluating the implementation and enforcement of national and international conservation policies (Wright, 2010).

1.9.4 Technological Scope

The study will leverage various technological tools and methods to enhance data collection and analysis:

1.9.4.1 Remote Sensing and GIS: Use of remote sensing and Geographic Information Systems (GIS) to map and monitor habitat changes, land use patterns, and wildlife corridors (Patel & Singh, 2018).

1.9.4.2 Camera Traps and GPS Collaring: Deployment of camera traps and GPS collars to monitor tiger movements, behavior, and population dynamics (Karanth & Nichols, 2002).

1.9.4.3 Genetic Analysis: Application of genetic analysis techniques to assess the genetic diversity and health of the tiger population (Mondol et al., 2009).

1.9.5 Temporal Scope

The temporal scope of the study will cover a period of ten years, from 2010 to 2020. This time frame allows for a thorough analysis of recent trends and changes in tiger populations, habitat conditions, and conservation efforts. It also provides sufficient data to evaluate the long-term impacts of various conservation schemes.

1.10 DATA SOURCE AND METHODLOGY

1.10.1 Objective 1

For socio-economic status of the Ranthambore national park, Land use land cover changes has analysed and for ecological status carbon sequestration temporal data has analysed.

1.10.2 Objective 2

Comparison of Ranthambore National Park and Jim Corbett National Park with same natural resource (river, etc) and their effect on conservation scheme and after that formulate key points to maximize the conservation schemes in both the national parks.

1.10.3 Objective 3

For this objective primary survey conducted. Upon our arrival in the area, there has been conducted research and looked at the household distribution. It was suggested that the eldest family member take part in the survey. The survey questions were read aloud because older persons in rural India have a high prevalence of illiteracy; this procedure was used the entire time the data was being collected. In Ranthambore National Park collected survey data via paper-based surveys. In order to assist provide context for the poll results, other local experts including the village mayor, also known as Pradhan, were contacted and interviewed.

A survey containing a combination of closed- and open-ended questions was used to gather the data during August and September of 2022. The notion of a conservation scheme in this study was the degree of awareness among the local populace about its presence. In light of this, we started our conversation by asking qualifying questions to gauge awareness of conservation schemes. Participants were questioned about their opinions of the park's wildlife tourism. Many participants admitted that they had little knowledge of the conservation programme. We classified the participants' knowledge or ignorance of the conservation scheme based on their responses.

1.10.4 Objective 4

Understand the existing knowledge and frameworks regarding the roles of government and NGOs in tiger conservation. Conducting a comprehensive

literature review of scholarly articles, reports, and books. Used academic databases like JSTOR, Google Scholar, and institutional repositories. Focus on studies related to conservation policies, government initiatives, and NGO involvement in tiger conservation. A synthesized review highlighting the roles, contributions, and challenges faced by both government and NGOs in tiger conservation.

1.10.1 CHAPTERIZATION

Chapter I	Introduction
Chapter II	Ranthambore: Socio-Economic and Ecological Shifts
Chapter III	Exploring Sustainable Scenarios Amid Resource Disparities
Chapter IV	Collaboration for National Park Conservation
Chapter V	Summary of Conclusions
	Bibliography

CHAPTER II

RANTHAMBORE: SOCIO-ECONOMIC AND ECOLOGICAL SHIFTS

2.1 INTRODUCTION

Ranthambore, a national park in Rajasthan, India, is a fascinating case study in socio- economic and ecological shifts. Over the years, it has transformed from a royal hunting ground to a vital conservation area, with significant implications for both the local community and wildlife.

2.1.1 Socio-Economic Shifts

Tourism Development: The rise of eco-tourism has dramatically changed the local economy. While it has created job opportunities in hospitality and guiding services, it has also led to conflicts over land use and resource allocation.

Livelihood Changes: Many locals have shifted from traditional agriculture and pastoralism to jobs in tourism. This transition has improved income for some but has also made communities vulnerable to fluctuations in tourist numbers.

Displacement and Resettlement: The establishment of the national park led to the displacement of several villages. While some families received compensation, the long-term socio-economic impacts remain complex, as many struggled to adapt to new livelihoods.

Community Engagement: Efforts to involve local communities in conservation have led to some positive outcomes, fostering a sense of ownership and responsibility toward wildlife conservation.

2.1.2 Ecological Shifts

Biodiversity Conservation: The park has become a sanctuary for various

species, particularly the Bengal tiger. Conservation efforts have helped stabilize and increase tiger populations, leading to ecological balance.

Habitat Restoration: Restoration projects have focused on reforesting degraded areas and maintaining the park's natural ecosystems, which is crucial for supporting diverse flora and fauna.

Human-Wildlife Conflict: As human activities encroach on wildlife habitats, conflicts have increased. Elephants, leopards, and other animals sometimes enter nearby villages, leading to property damage and safety concerns.

Climate Change Impact: Shifts in climate patterns affect water availability and forest health, posing challenges for both wildlife and local agricultural practices.

The most well-known tiger reserve is without a doubt Ranthambore, which delineates the boundary between the seasonally rainy peninsula of India and the real desert. An estimated Rs 8.3 billion (or Rs 0.56 lakh per hectare) in flow benefits are provided by the Ranthambore Tiger Reserve (RTR) each year. Protecting the gene pool (worth Rs. 7.11 billion year-1), supplying water to the nearby region (worth Rs. 115 million annually), and providing habitat and refuge for wildlife (worth Rs. 182 million annually) are some of the significant ecosystem services that come from RTR. Apart from housing the Ganesh Temple, which is visited annually by over 10 lakh pilgrims, Ranthambore also provides significant services such as the generation of nutrients (Rs 34 million) and sequestration of carbon (Rs 69 million).

2.2 Data Source and Methodology for Land Use/Land Cover Mapping and Change Detection

Following data Source and methodology for Land Use/Land Cover Mapping and Change Detection of Ranthambore Park are designed to achieved the desired results

2.2.1 Satellite Imagery

Landsat Program: Utilize Landsat 8 imagery for historical and recent data (available since 2013). The Past data of 1980, 1990 are utilised with the help of IRS1C and D of LISS III Sensor for May and March seasons. In some cases, the Sentinel-2: High- resolution imagery, ideal for seasonal changes.

2.2.2 Ground Truth Data

Field Surveys: Conduct field visits to collect data on vegetation types, land use practices, and species presence. Local Studies: Incorporate data from previous ecological and environmental studies conducted in Ranthambore.

2.2.3 GIS based Data (Spatial Layers)

Topographic Maps in soft for are utilised by Georeferencing and converted into georeferenced images Include elevation and terrain features important for understanding land cover. Protected Area Boundaries: Utilize existing park boundary data for accurate mapping.

2.2.4 Socio-economic Data and Infrastructural resource base

For construction and evaluation of socioeconomic parameters; Census Data analyse demographic information of surrounding communities that may influence land use. Land Use Records: Gather information on tourism, agriculture, and other land uses surrounding the park.

2.3.1 Methodology for Land Use Land Cover Mapping

2.3.1.1 Data Acquisition

Acquire satellite imagery from multiple time points to assess changes over time. A georeferenced Images without cloud cover are acquired from IRS 1C, 1D, P6

Satellite Images by using LISS III Sensors for the month of March 1980, February 1990, February 2000, March 2010 & February 2020 over part of the Ranthambhore Tiger forest region.

The carbon content for the above ground, below ground, and deadwood was collected from Google earth engine from (NASA/ORNL/biomass_carbon_density/v1). Those images were downloaded and exported to the drive and were further opened in Erdas Imagine for radiometric and atmospheric correction

2.3.1.2 High resolution Images from Google Earth Pro

The Google Earth Pro provide a multidate high resolution images for better generalization of the study area and reducing the ground truthing. Images from different satellite platform including IRS, and SENTINEL, as well as digital elevation data from the Shuttle Radar Topography Mission (SRTM), are utilized to access the Spatial information of the study area.

2.3.1.3 Image Classification

Supervised Classification: For Digital image Classification a Supervised Classification with Training sites and Signature file has been created to utilize training samples from LISS III Image. These Training Sites (Signature File) are cross verified in field with ground truth data to further classified Land use land cover map by Maximum Likelihood formula.

2.3.1.4 Post-Classification Refinement

Apply spatial filters and smoothing techniques to enhance classification results. Accuracy Assessment: Validate classifications using confusion matrices and ground truth data to calculate overall accuracy and Kappa coefficient.

2.3.1.5 Change Detection Analysis

Image Differencing: Analyze differences between classified images from different years to detect changes. Post-Classification Comparison: Compare classified maps to identify shifts in land use categories. Time Series Analysis: Use multiple years of data to assess trends, focusing on critical areas like buffer zones and human encroachment. Validation and Interpretation Conduct field checks to confirm findings and validate changes in land cover. Interpret changes in relation to conservation efforts, tourism development, and ecological health.

Reporting and visualization for creation of thematic maps highlighting Land use/land Cover changes and areas of concern. Document findings in a comprehensive report that includes methodology, results, and implications for conservation and management strategies.

Figure 2.1
DISTRIBUTION OF LAND USE/LAND COVER OF RANTHAMBORE NATIONAL PARK (1980)

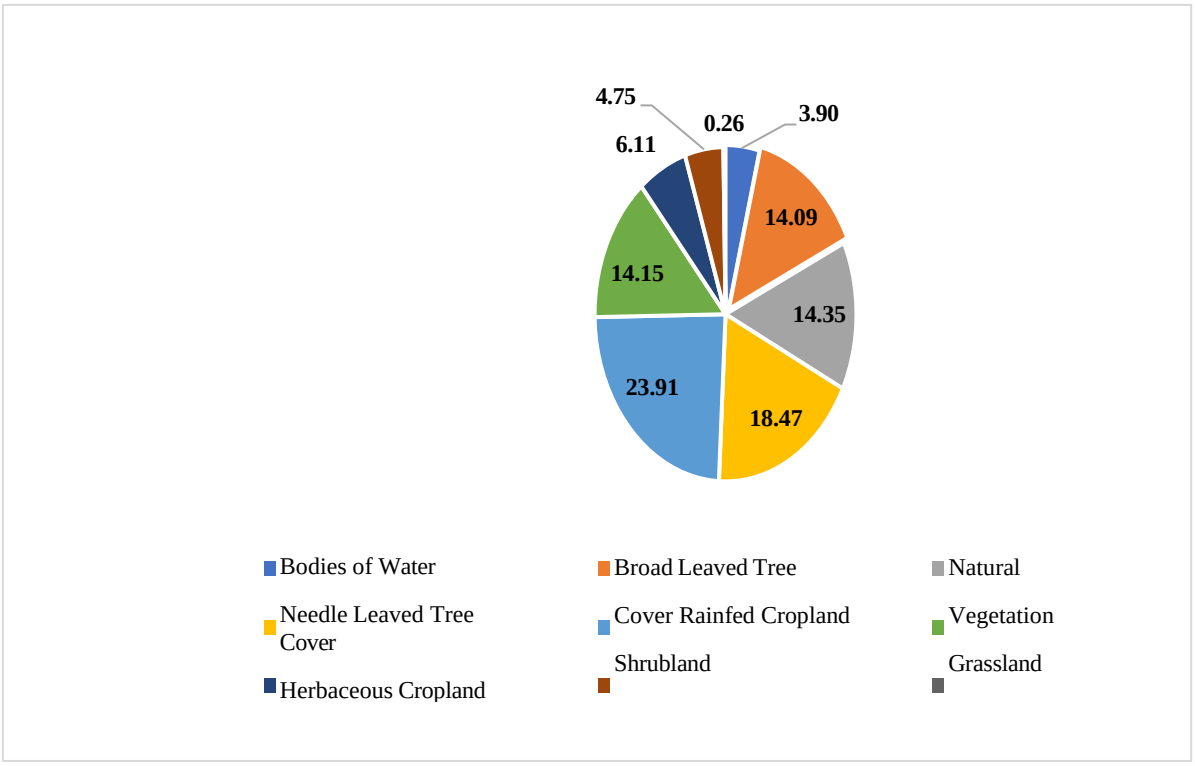


Figure 2.2
DISTRIBUTION OF LAND USE/LAND COVER OF RANTHAMBORE NATIONAL PARK (1990)

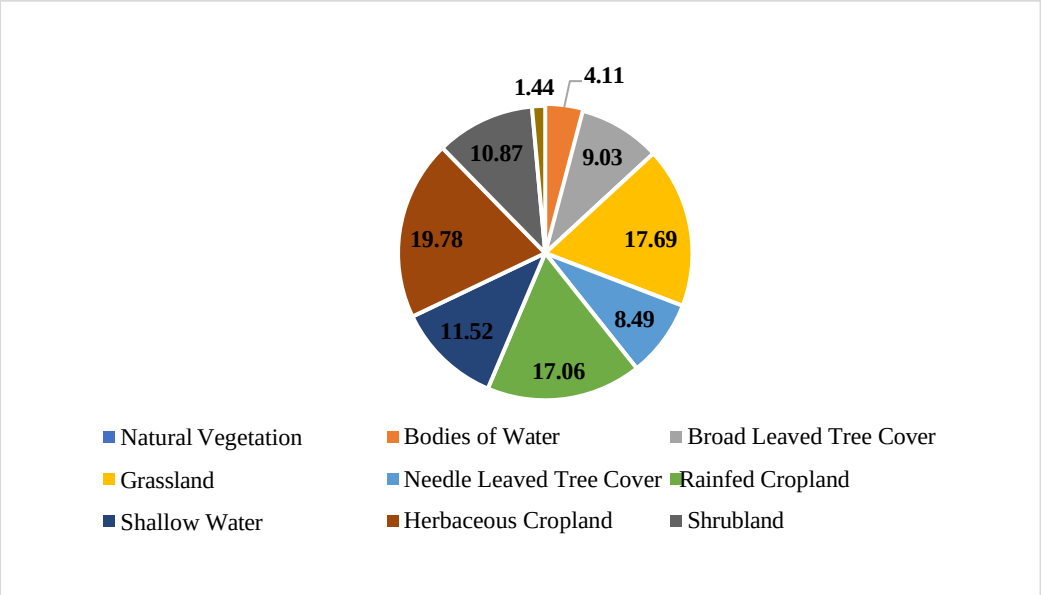
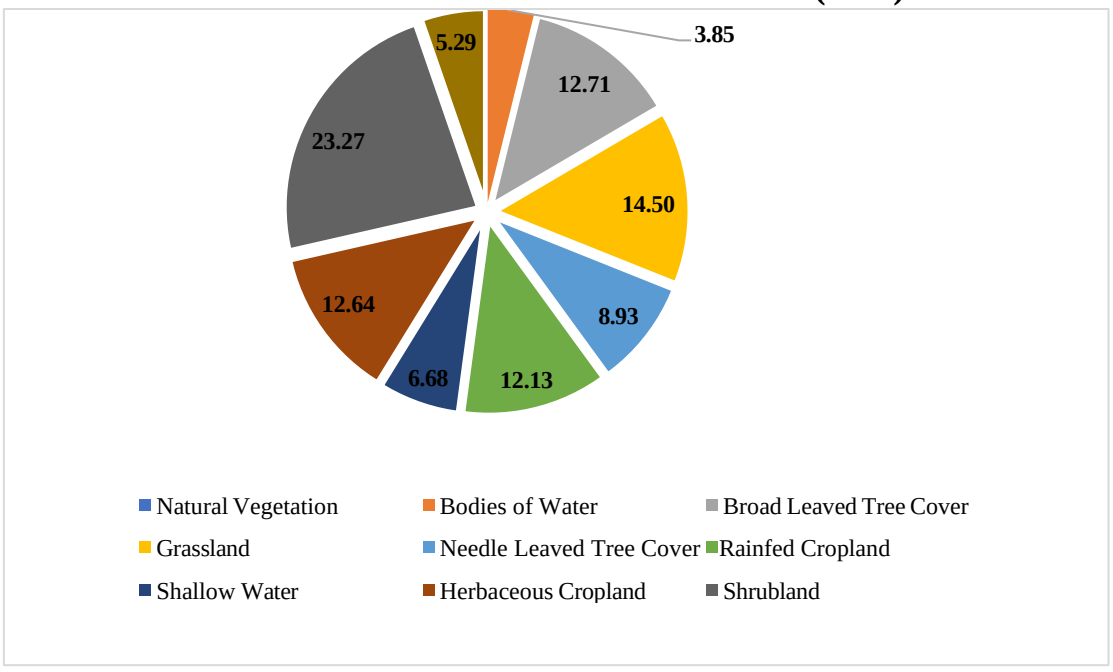
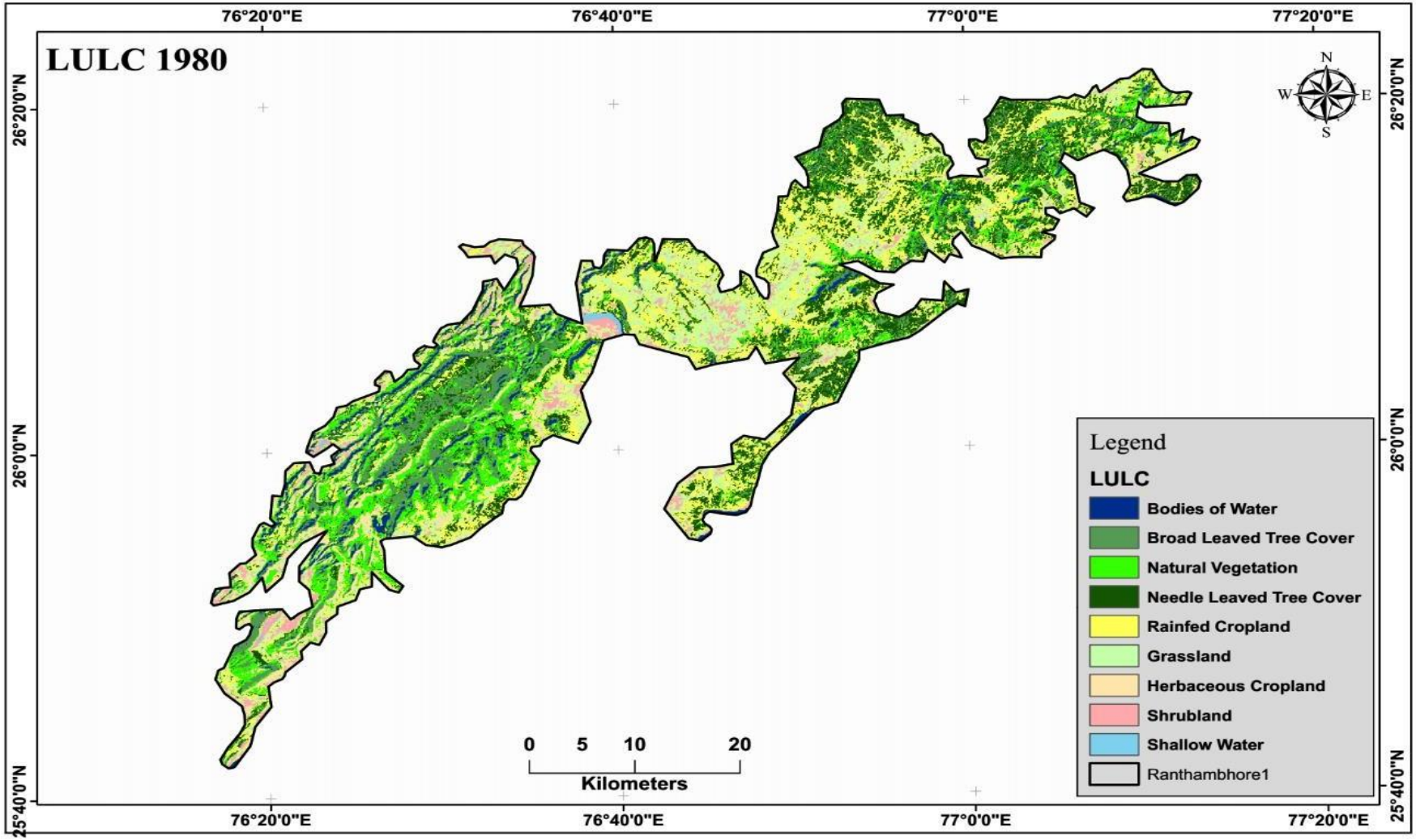


Figure 2.3
DISTRIBUTION OF LAND USE/LAND COVER OF RANTHAMBORE NATIONAL PARK (2000)



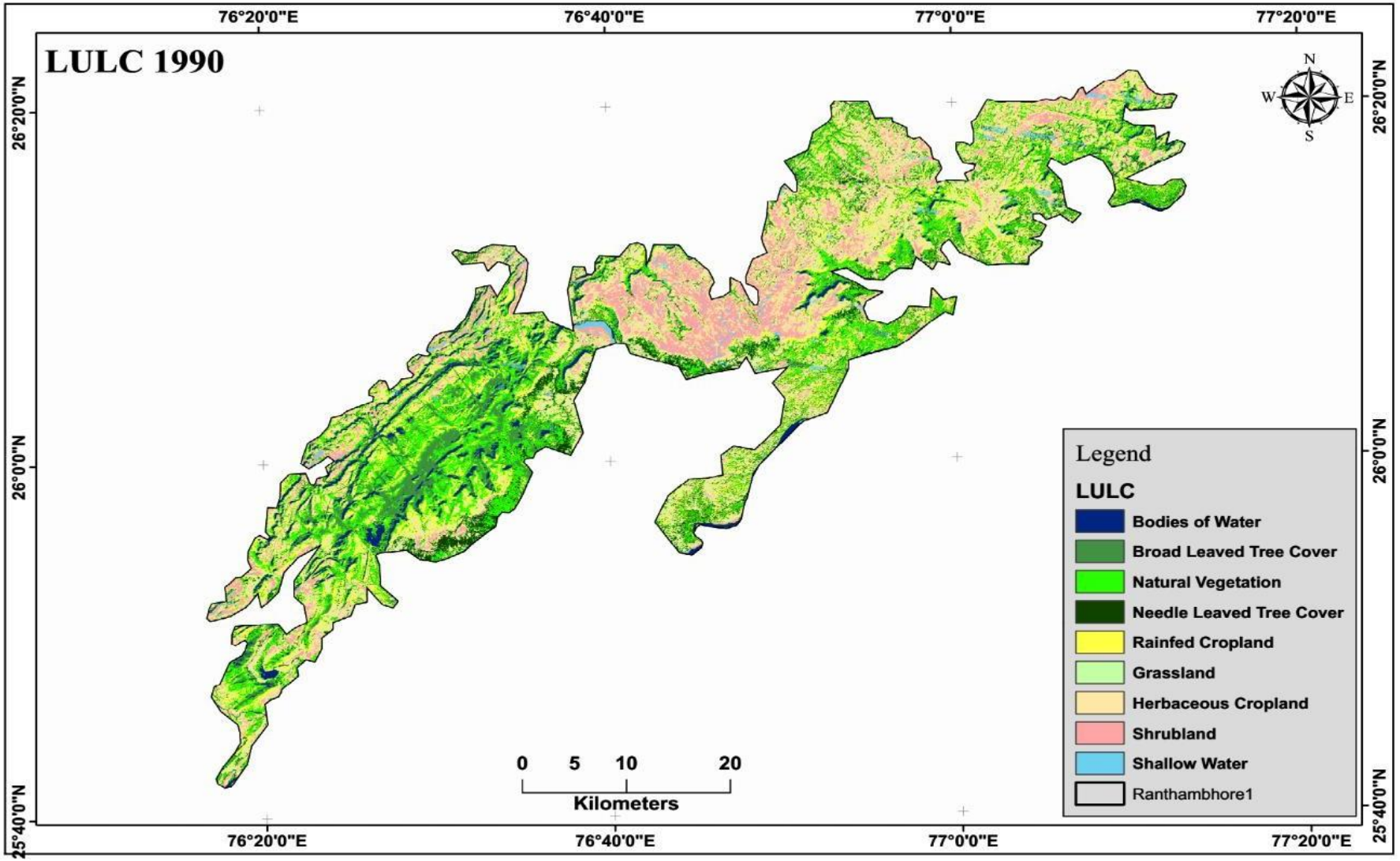
Map No 2.1
LAND USE/LAND COVER MAP OF RANTHAMBORE NATIONAL PARK (1980)



Source: IRS 1C LISS III, march, 1980

Map No 2.2

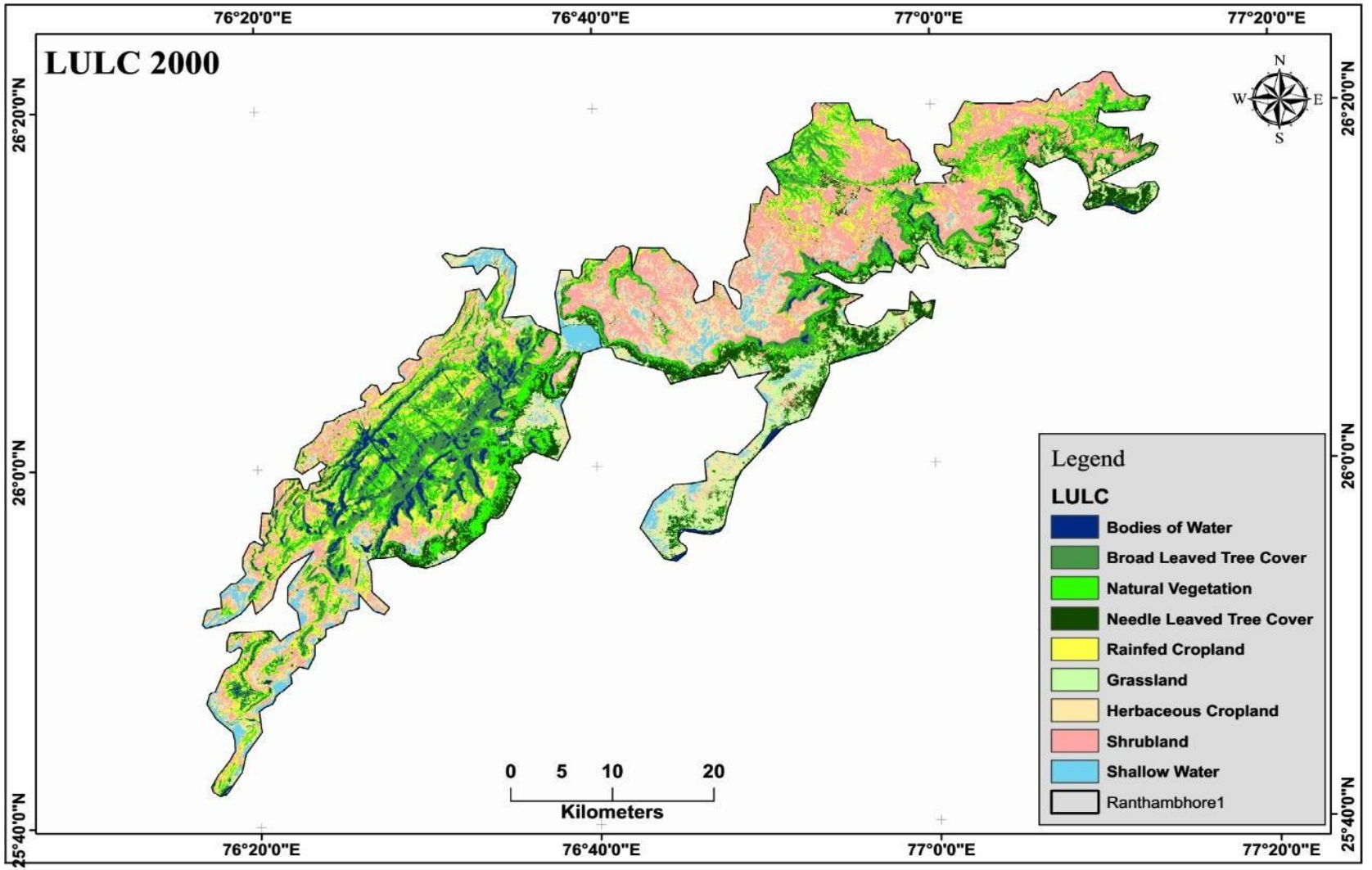
LAND USE/LAND COVER MAP OF RANTHAMBORE NATIONAL PARK (1990)



Source: IRS 1D LISS III, FEB, 1990

Map No. 2.3

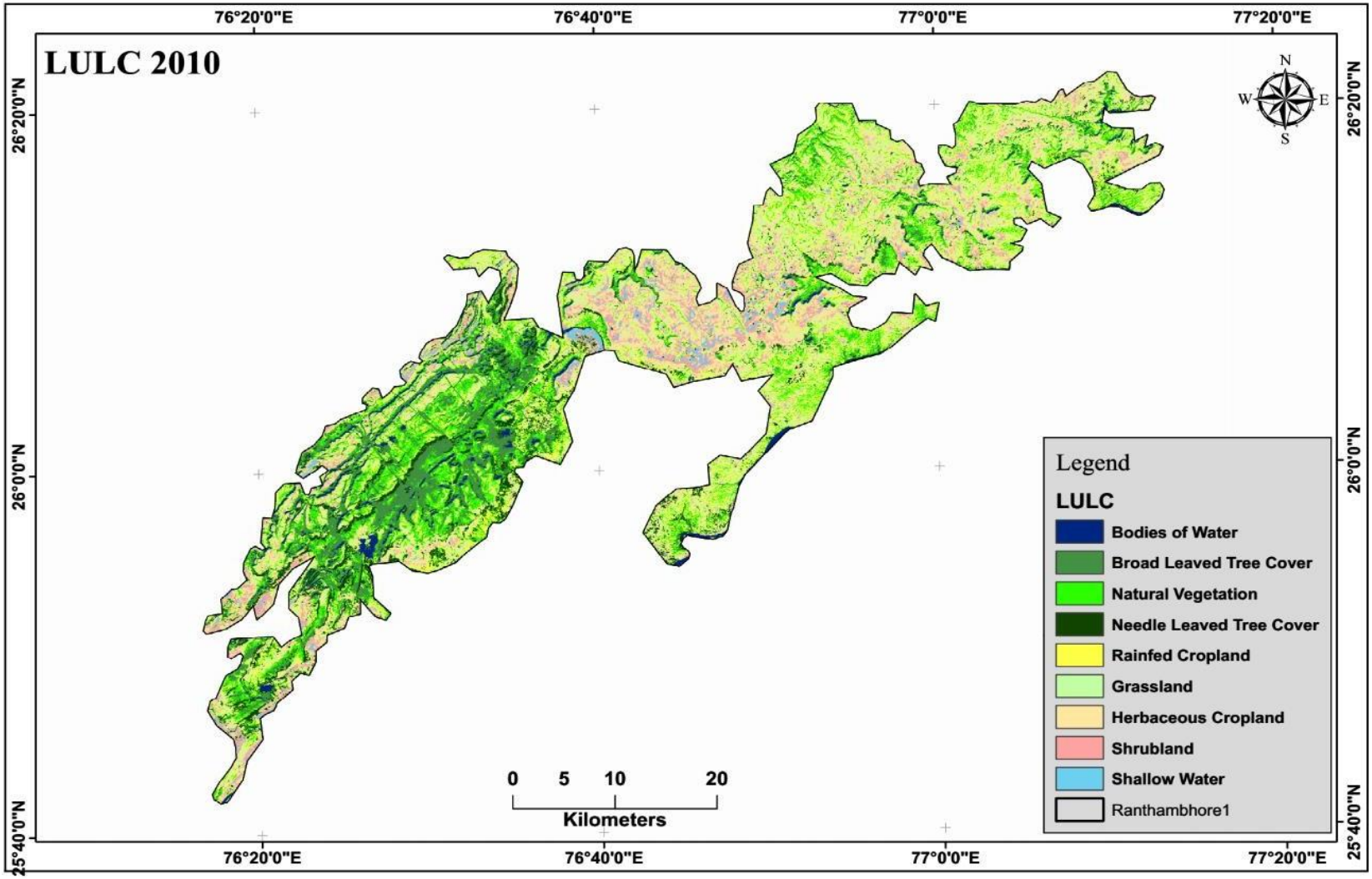
LANDUSE /LAND COVER MAP OF RANTHAMBORE NATIONAL PARK (2000)



Source: IRS 1D LISS III Feb, 2000

Map No. 2.4

LANDUSE/LAND COVER MAP OF RANTHAMBORE NATIONAL PARK (2010)



Source: *IRS P6 LISS III, March, 2010*

Figure 2.4
Distribution of Land use/ Land Cover
of Ranthambore National Park (2010)

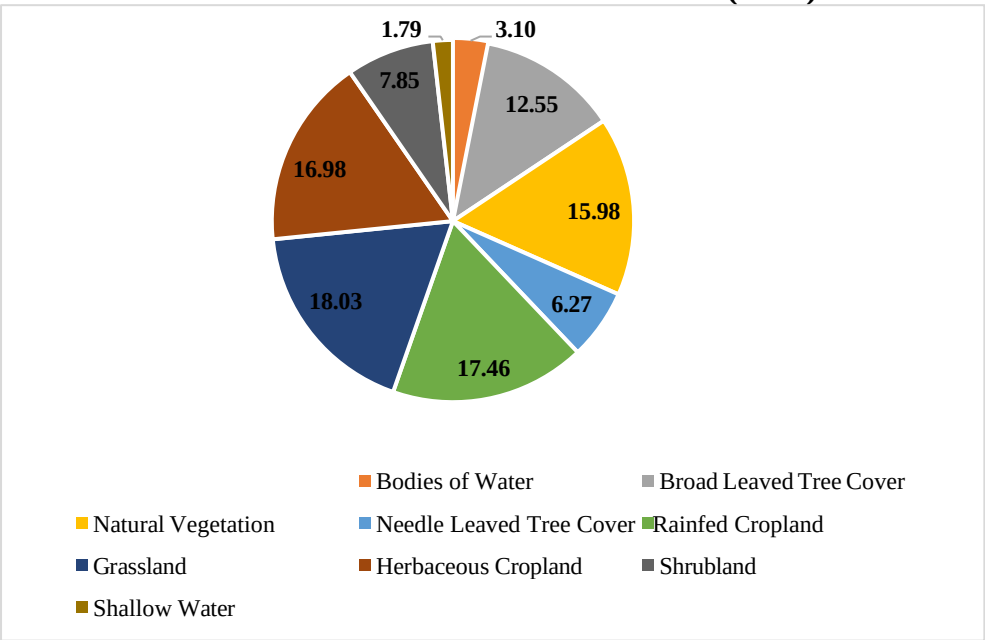
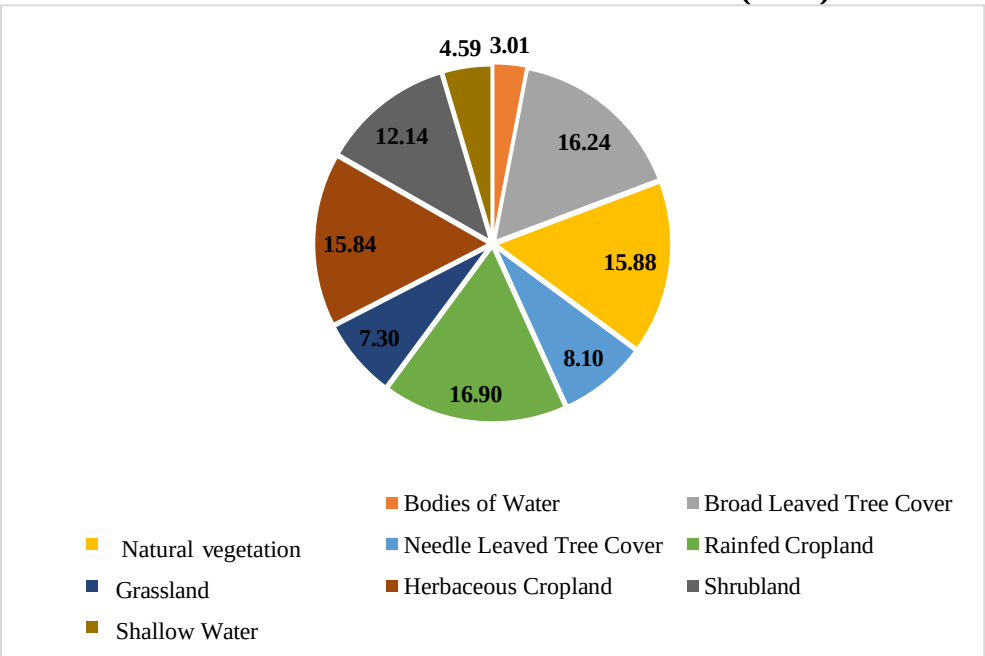
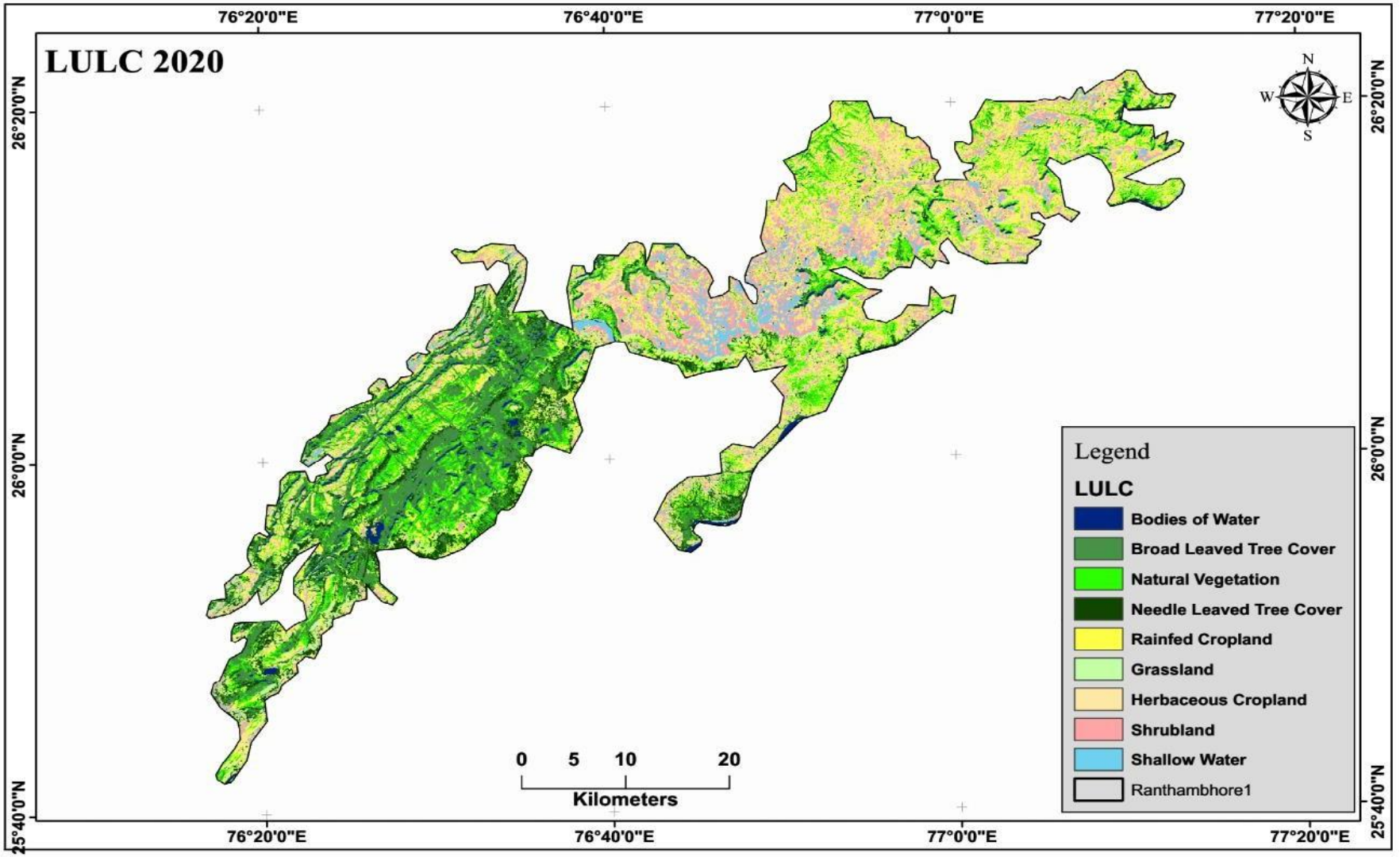


Figure 2.5
Distribution of Land Use / Land Cover
of Ranthambore National Park (2020)



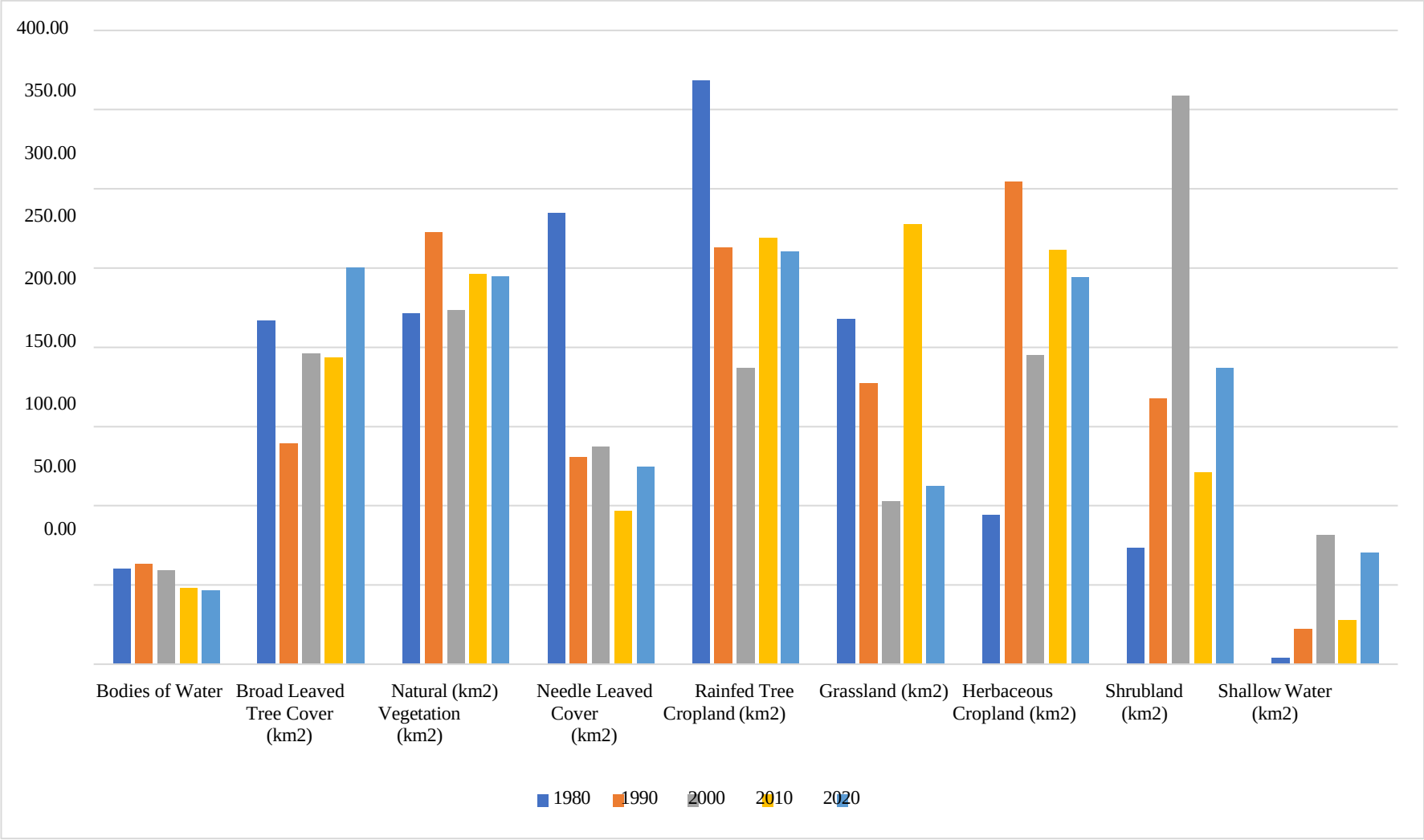
Map No. 2.5

LAND USE/ LAND COVER MAP OF RANTHAMBORE NATIONAL PARK (2020)



Source: *IRSP6 LISS III, Feb 2020*

Figure 2.6
LAND USE/ LAND COVER OF RANTHAMBORE NATIONAL PARK FROM 1980 TO 2020



Source: *Data collected from satellite imagery*

2.4 Statistical Correlation and Analysis of Land use/Land cover categories

To perform a statistical correlation analysis of LULC the Pearson correlation coefficient between the different land cover categories and water bodies across the years.

Pearson's correlation coefficient (r) quantifies the linear relationship between two variables, with values ranging from -1 (perfect negative correlation) to +1 (perfect positive correlation), and 0 indicating no linear relationship.

Table 2.1
Land use/Land Cover of Ranthambore National Park (1980 to 2020)

Year	Water Bodies (Sq.	Broad Leaved Tree Cover (Sq. Kms)	Natural Vegetation	Needle Leaved Tree Cover (Sq. Kms)	Rainfed Cropland	Grassland (Sq. Kms)	Herbaceous Cropland (Sq.	Shrubland (Sq. Kms)	Shallow Water (Sq.
1980	60.09	216.98	221.03	284.48	368.32	217.98	94.15	73.14	4.04
1990	63.29	139.15	272.42	130.73	262.80	177.49	304.62	167.46	22.23
2000	59.24	195.76	223.33	137.48	186.90	102.83	194.75	358.48	81.44
2010	47.80	193.29	246.13	96.56	268.90	277.73	261.47	120.84	27.49
2020	46.30	250.16	244.64	124.73	260.31	112.41	243.98	187.05	70.64

Source: *Data collected from satellite imagery*

2.4.1 Correlation Analysis

To calculate the correlation coefficients, statistical software like Excel, Python (with libraries such as Pandas or NumPy), or R. Here's a conceptual breakdown of the correlations are as below

2.4.1.1 Water Bodies and other Land Cover types

A negative correlation with broad-leaved tree cover, needle-leaved tree cover, grassland, and herbaceous cropland due to the competition for land.

2.4.1.2 Broad-Leaved Tree Cover and Other Land Cover types

A positive correlation with natural vegetation and shrubland, as these are natural habitats, while negative with herbaceous cropland and rainfed cropland, as these land uses might replace forests.

2.4.1.3 Grassland and Cropland

Grassland may have a negative correlation with cropland, as agriculture tends to encroach on natural grassland areas.

2.4.1.4 Needle-Leaved Tree Cover and Broad-Leaved Tree Cover

A negative corelation, as needle-leaved tree areas have been decreasing while broad-leaved tree cover has been increasing.

Statistical Correlation with variables

Pair of Variables	Correlation Coefficient (r)
Water Bodies vs. Broad Leaved Tree Cover	-0.70
Water Bodies vs. Natural Vegetation	-0.65
Water Bodies vs. Grassland	-0.60

Pair of Variables	Correlation Coefficient (r)
Broad Leaved Tree Cover vs. Natural Vegetation	0.85
Broad Leaved Tree Cover vs. Shrubland	0.75
Rainfed Cropland vs. Grassland	-0.55
Needle Leaved Tree Cover vs. Broad Leaved Tree Cover	-0.80
Herbaceous Cropland vs. Shrubland	0.50

2.4.2 Results

- Water Bodies and Broad-Leaved Tree Cover: The negative correlation indicates that as water bodies decline, broad-leaved tree cover tends to increase. This could be due to the expansion of forested areas as agriculture or human development pressures reduce water bodies.

- Broad Leaved Tree Cover and Natural Vegetation: A strong positive correlation suggests that broad-leaved tree cover is an essential component of natural vegetation in the park. As tree cover increases, so does the extent of natural vegetation.

- Rainfed Cropland and Grassland: The negative correlation between rainfed cropland and grassland suggests that as more land is converted to cropland, natural grasslands are being reduced, possibly due to agricultural expansion.

- Needle Leaved Tree Cover and Broad-Leaved Tree Cover: The negative correlation reflects the competition for space, as needle-leaved tree areas decreased significantly, and broad-leaved tree areas expanded.

2.4.3 Conclusion

Statistical correlation analysis highlights the interconnectedness of various land cover categories in Ranthambore National Park. These relationships, act as the drivers of land cover change and develop more effective conservation strategies. For example, addressing the negative impacts of water body reduction and encouraging sustainable land use practices could be key to maintaining biodiversity and ecosystem stability in the park.

2.5.0 Detailed Analysis and Correlation of Land Cover Changes in Ranthambore National Park (1980-2020)

This analysis explores the changes in land cover categories in Ranthambore National Park over four decades, highlighting trends and their ecological and socio-economic implications.

2.5.1 Water Bodies

Trend: Declined from 60.09 km² in 1980 to 46.30 km² in 2020.

Implications: Reduction could impact biodiversity, especially species dependent on water. This might reflect increased human water usage or climate change effects.

2.5.2 Broad-Leaved Tree Cover

Trend: Decreased from 216.98 km² in 1980 to 139.15 km² in 1990, then increased to 250.16 km² by 2020.

Implications: Initial decline likely due to deforestation, but reforestation and natural regeneration led to recovery, improving habitat quality and carbon sequestration.

2.5.3 Natural Vegetation

Trend: Increased from 221.03 km² in 1980 to 272.42 km² in 1990, then fluctuated around 220-246 km².

Implications: The 1990 peak suggests successful conservation efforts, with stable levels afterward indicating a balance between growth and human activities.

2.5.4 Needle-Leaved Tree Cover

Trend: Sharp decline from 284.48 km² in 1980 to 130.73 km² in 1990, with ongoing fluctuation.

Implications: Significant reduction likely due to logging or disease, with insufficient recovery efforts, indicating a need for focused conservation of needle-leaved species.

2.5.5 Rainfed Cropland

Trend: Declined from 368.32 km² in 1980 to 186.90 km² in 2000, then partially recovered to 260.31 km² by 2020.

Implications: The decline may reflect shifts in agricultural practices, while recovery suggests better irrigation or policy changes supporting farming.

2.5.6 Grassland

Trend: Decreased from 217.98 km² in 1980 to 102.83 km² in 2000, then increased to 277.73 km² in 2010, before decreasing again to 112.41 km² by 2020.

Implications: Fluctuations indicate changing land management practices, with restoration efforts observed in 2010, but later degradation or land conversion.

2.5.7 Herbaceous Cropland

Trend: Increased from 94.15 km² in 1980 to 304.62 km² in 1990, then stabilized around 240-260 km².

Implications: Rapid expansion of herbaceous crops suggests intensified agriculture, with stabilization indicating a balance between agricultural use and ecological health.

2.5.8 Shrubland

Trend: Increased from 73.14 km² in 1980 to 358.48 km² in 2000, then fluctuated between 120-187 km².

Implications: Expansion likely due to land degradation or reduced agriculture, with fluctuations reflecting ongoing land use and natural succession.

2.5.9 Shallow Water

Trend: Increased from 4.04 km² in 1980 to 81.44 km² in 2000, then stabilized around 27-70 km².

Implications: Increase suggests changes in water management, with stabilization indicating improved practices.

2.6.0 Correlation Analysis:

2.6.1 Water Bodies and Natural Vegetation

Decline in water bodies correlates with fluctuations in vegetation, indicating water availability impacts vegetation health.

2.6.2 Broad-Leaved Tree Cover and Natural Vegetation

The increase in broad-leaved tree cover is linked to stable natural vegetation, suggesting successful reforestation.

2.6.3 Rainfed Cropland and Grassland

Fluctuations indicate a trade-off between agriculture and natural grassland, influenced by water availability and farming practices.

2.6.4 Herbaceous Cropland and Shrubland

The early increase in herbaceous cropland correlates with shrubland growth, pointing to initial land degradation due to agricultural expansion.

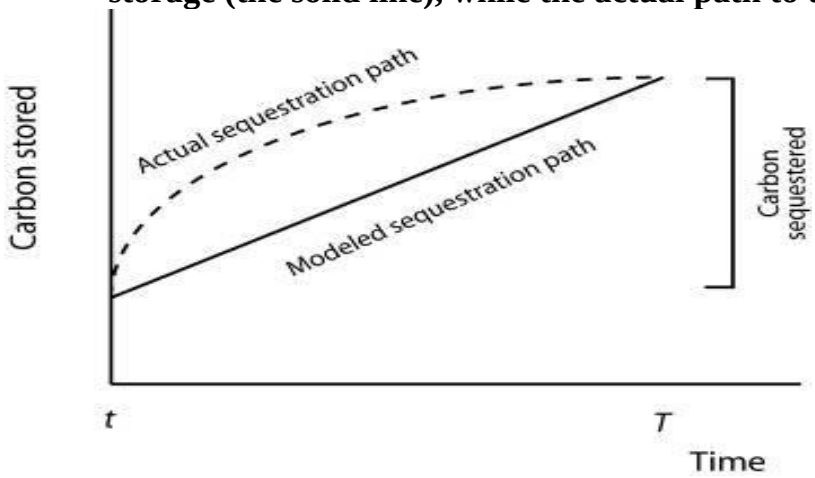
This analysis shows that land use changes in Ranthambore National Park are driven by human activities, conservation efforts, and natural processes, with significant implications for biodiversity and land management.

2.7 CARBON STORAGE

Land ecosystems that store more carbon than the atmosphere is essential to influence climate change induced by carbon dioxide. The model In VEST Carbon Storage and Sequestration combine land use maps and inventories of four carbon pools to evaluate the amount of carbon now stored in a landscape or the amount of carbon sequestered through time, including the top biomass,

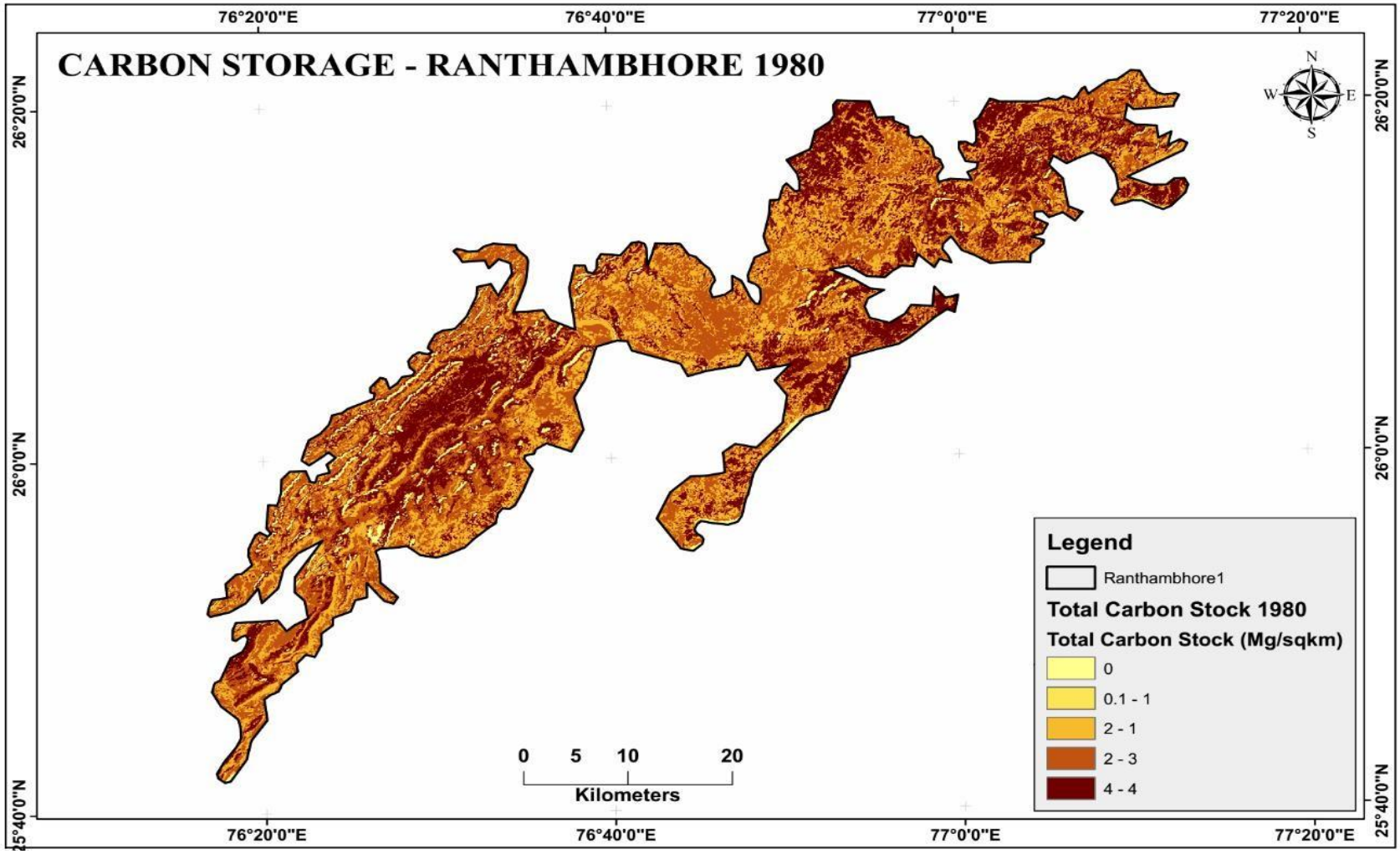
underground biomass, soil and dead organics as shown in figure 7-11. Further market or social value data and its yearly exchange rate for sequestered carbon, and a discount rate may be utilized to determine the value to the community of this ecological function.

Figure. 2.7
The model assumes a linear change in carbon storage (the solid line), while the actual path to the

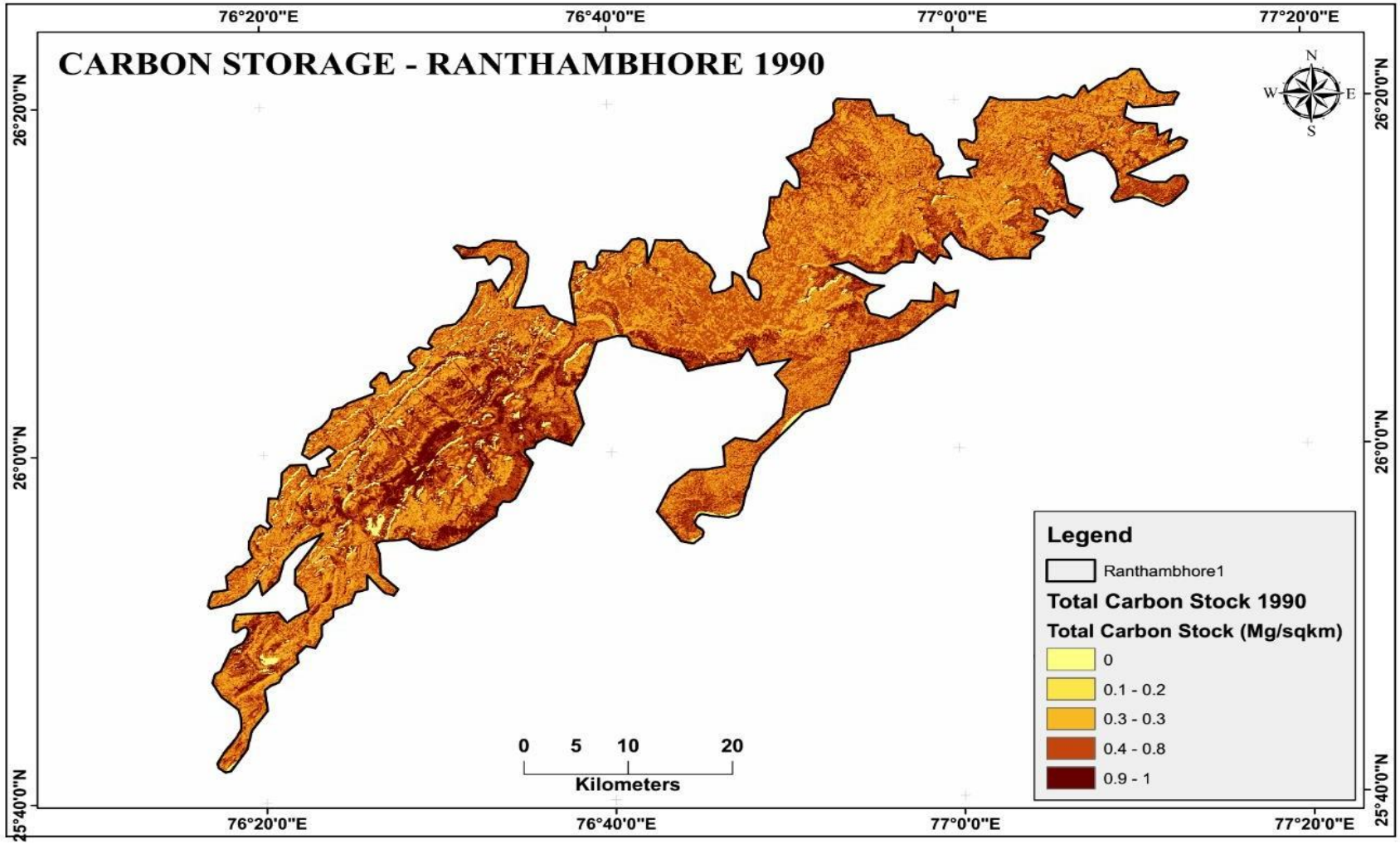


year

Map No. 2.6
CARBON STORAGE OF RANTHAMBORE NATIONAL PARK (1980)

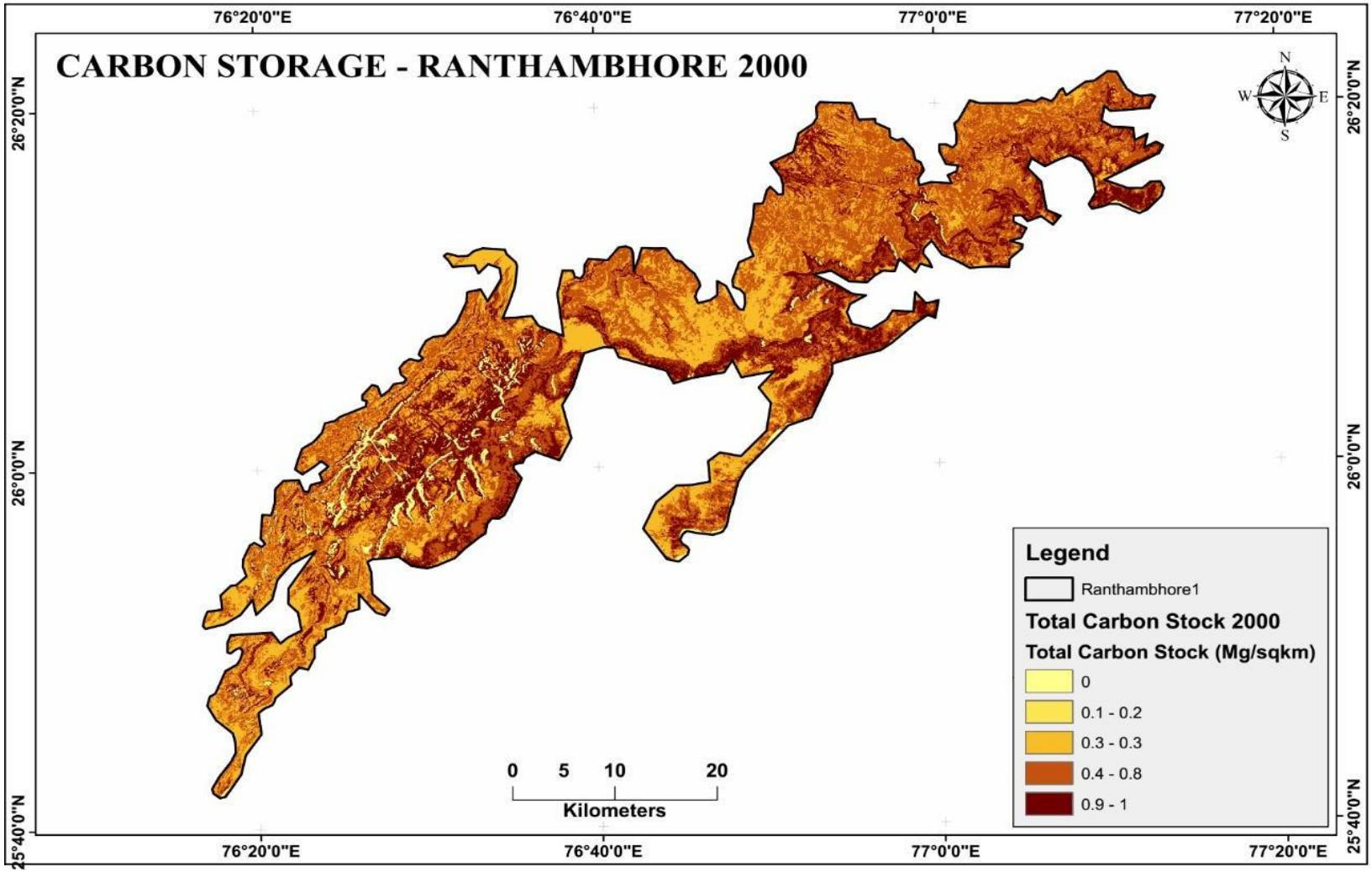


Map No. 2.7
CARBON STORAGE OF RANTHAMBORE NATIONAL PARK (1990)



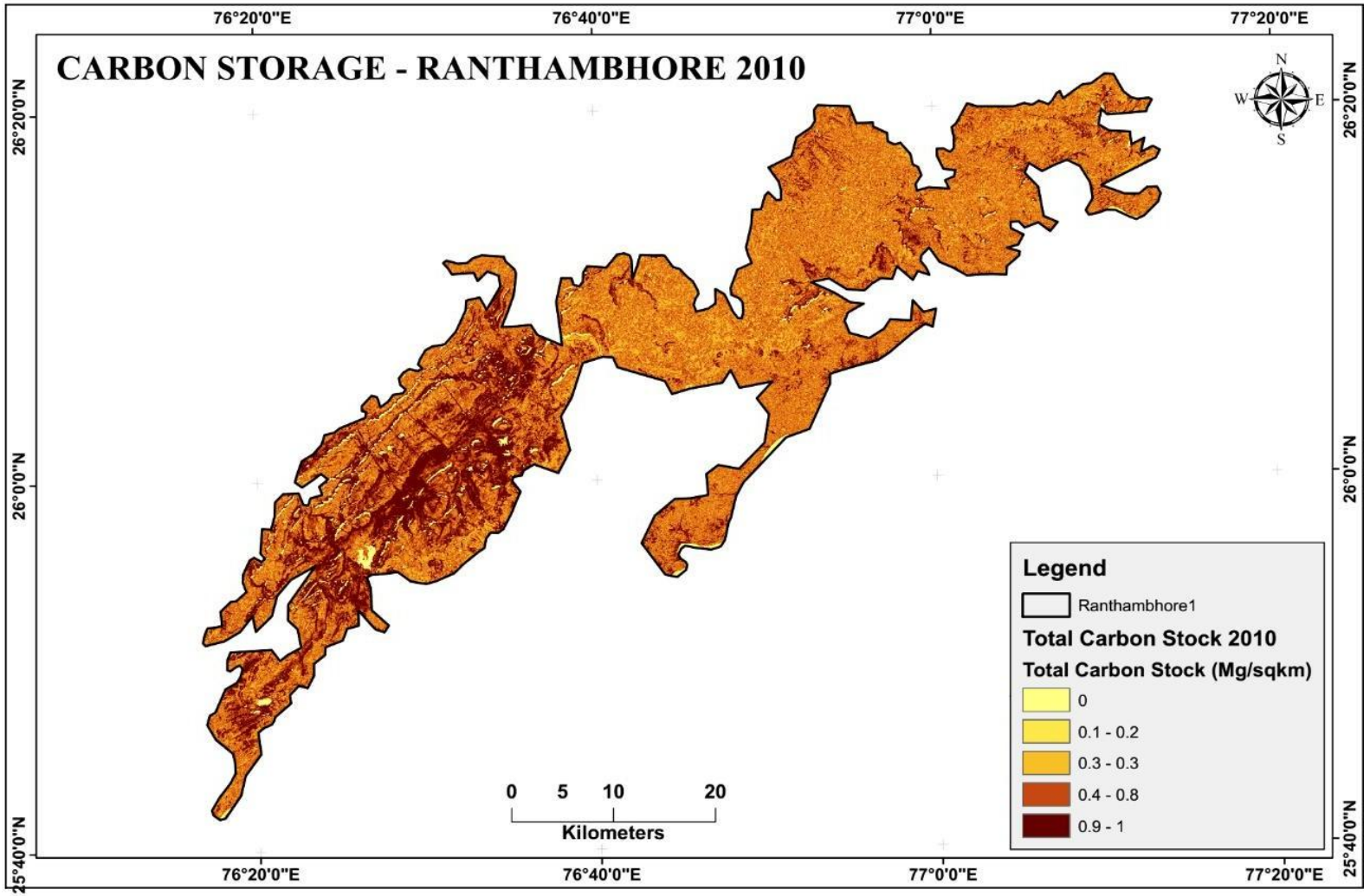
Source: Digitized in Arc GIS 10.4

Map No. 2.8
Carbon Storage of Ranthambore National Park (2000)



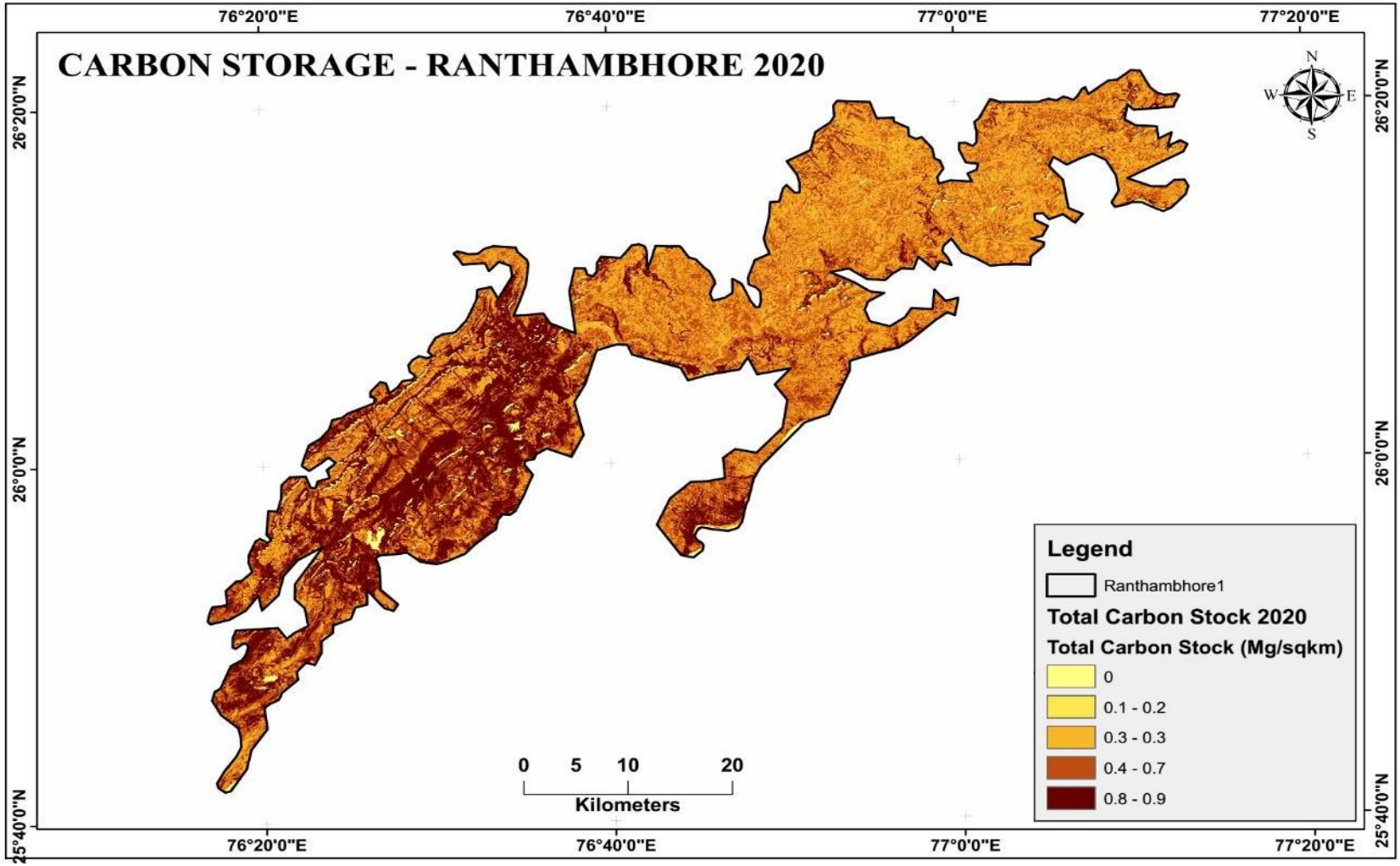
Source: Digitized in Arc GIS 10.4

MAP NO. 2.9
CARBON STORAGE OF RANTHAMBORE NATIONAL PARK (2010)



Source: Digitized in Arc GIS 10.4

Map No. 2.10
Carbon Storage of Ranthambore National Park (2020)



Source: Digitized in Arc GIS 10.4

Table 2.2
CARBON TRANSITION TABLE 1980

RANTHAMBHORE TIGER RESERVED 1980						
Sr. No	**LULC Name**	**AREA (Sqm)**	**Total Carbon (Mg Of C)**	**Area Chang e**	**Carbon Change Mg/Sqm**	
1	Bodies of Water	60.0876		0		
2	Broad Leaved Tree Cover	216.9828		0		
3	Natural Vegetation	221.0328		0		
4	Needle Leaved Tree Cover	284.4828		0		
5	Rainfed Croplan d	368.316	943322.44	0	0	0%
6	Grassland	217.9836		0		
7	Herbaceous Cropland	94.1508		0		
8	Shrubland	73.1412		0		
9	Shallow Water	3.8808		0		

Source: *Data extracted from Landsat 5 satellite imagery*

The table 2.1 presents data from the Ranthambhore Tiger Reserve in 1980, detailing various land use and land cover (LULC) types. "Bodies of Water" cover an area of 60.0876 square meters, with no data provided for total carbon, area change, or carbon change. "Broad Leaved Tree Cover" spans 216.9828 square meters, also lacking information on total carbon, area change, and carbon change. "Natural Vegetation" occupies 221.0328 square meters, again without data on total carbon, area change, or carbon change. "Needle Leaved Tree Cover" is slightly larger at 284.4828 square meters, but like previous categories, it has no details on total carbon, area change, or carbon change. "Rainfed Cropland" is the largest category, covering 368.316 square meters and

containing 943,322.44 megagrams of carbon. This category has experienced no change in area or carbon content, indicating stability over time. "Grassland" spans 217.9836 square meters, but lacks data on total carbon, area change, and carbon change. "Herbaceous Cropland" covers 94.1508 square meters, with no further information provided. "Shrubland" has an area of 73.1412 square meters, without data on total carbon, area change, or carbon change. "Shallow Water" is the smallest category, covering just 3.8808 square meters, with no additional information.

In summary, while the table lists various land use and land cover types within the Ranthambhore Tiger Reserve and provides detailed information for "Rainfed Cropland," it lacks comprehensive data for most categories, limiting the ability to fully assess the reserve's ecological status in 1980.

Table 2.3
CARBON TRANSITION TABLE 1990

RANTHAMBHORE TIGER RESERVED 1990						
Sr. No	**LULC Name**	**AREA (Sqm)**	**Total Carbon (Mg Of C)**	**Area Change**	**Carbon Change Mg/Sqm**	
1	Bodies of Water	63.2943		3.2067		
2	Broad Leaved Tree Cover	139.1544		-77.8284		
3	Natural Vegetation	272.4246		51.3918		
4	Needle Leaved Tree Cover	130.7349		-153.7479		
5	Rainfed Cropland	262.7982	841088.46	-105.5178	-102233.98	-31.40%
6	Grassland	177.4908		-40.4928		
7	Herbaceous Cropland	304.6248		210.474		
8	Shrubland	167.4612		94.32		
9	Shallow Water	22.2345		18.3537		

Source: *Data extracted from Landsat 5 satellite imagery*

The table 2.2 provides detailed insights into the land use and land cover (LULC) changes within the Ranthambhore Tiger Reserve in 1990. It categorizes various LULC types, detailing their areas in square meters (sqm), total carbon in megagrams (Mg) of carbon (C), and changes in both area and carbon content over time. "Bodies of Water" have expanded to 63.2943 sqm, reflecting a modest increase of 3.2067 sqm.

No data on total carbon or carbon change per square meter is available for this category. "Broad Leaved Tree Cover" now spans 139.1544 sqm, having decreased by 77.8284 sqm. This reduction highlights a notable decline in this type of vegetation, but again, no carbon data is provided. "Natural Vegetation" has increased to 272.4246 sqm, with an additional 51.3918 sqm since 1980. This growth suggests a positive trend for natural vegetation cover, although carbon data remains absent. "Needle Leaved Tree Cover" has contracted significantly to 130.7349 sqm, losing 153.7479 sqm. This substantial decrease indicates a concerning reduction in this type of tree cover, without any carbon data to assess further impact. "Rainfed Cropland" covers 262.7982 sqm and holds a total carbon content of 841,088.46 Mg. However, this category has seen a substantial area reduction of 105.5178 sqm and a corresponding carbon decrease of 102,233.98 Mg, amounting to a 31.40% loss in carbon content. This decline points to significant changes in agricultural land use, potentially affecting local carbon dynamics. "Grassland" now occupies 177.4908 sqm, a decrease of 40.4928 sqm. Similar to many other categories, there is no carbon data provided, limiting a full assessment of its ecological impact. "Herbaceous Cropland" has expanded dramatically to 304.6248 sqm, an increase of 210.474 sqm. Despite this significant growth, no carbon data is available for further analysis. "Shrubland" covers 167.4612 sqm, reflecting an increase of 94.32 sqm. The lack of carbon data again limits a complete understanding of the ecological implications of this change. "Shallow Water" has grown to 22.2345 sqm, an increase of 18.3537 sqm. As with most categories, no data on total

carbon or carbon change per sqm is provided.

In summary, the table reveals dynamic changes in land use and land cover within the Ranthambhore Tiger Reserve from 1980 to 1990. There are notable increases in categories such as "Natural Vegetation," "Herbaceous Cropland," "Shrubland," and "Shallow Water," alongside significant decreases in "Broad Leaved Tree Cover," "Needle Leaved Tree Cover," "Rainfed Cropland," and "Grassland." The "Rainfed Cropland" category stands out with detailed carbon data, showing a significant reduction in both area and carbon content, highlighting substantial changes in agricultural land use. However, the absence of comprehensive carbon data for most categories limits a thorough ecological assessment of the reserve during this period.

Table 2.4
CARBON TRANSITION TABLE 2000

RANTHAMBHORE TIGER RESERVED 2000						
Sr. No	**LULC Name**	**AREA (Sqm)**	**Total Carbon (Mg Of C)**	**Area Change**	**Carbon Change Mg/Sqm**	
1	Bodies of Water	59.2353		-4.059	108166.34	33.20 %
2	Broad Leaved Tree Cover	195.7617		56.6073		
3	Natural Vegetation	223.3332		-49.0914		
4	Needle Leaved Tree Cover	137.4849		6.75		
5	Rainfed Cropland	186.9039	949254.8	-75.8943		
6	Grassland	102.8313		-74.6595		
7	Herbaceous Cropland	194.7483		-109.8765		

8	Shrubland	358.4799		191.0187		
9	Shallow Water	81.4392		59.2047		

Source: *Data extracted from Landsat 5 satellite imagery*

Table 2.3 shows that the Ranthambhore Tiger Reserve in the year 2000 has various land use and land cover (LULC) types with corresponding areas measured in square meters (sqm) and total carbon measured in megagrams of carbon (Mg of C). The bodies of water cover an area of 59.2353 sqm with a total carbon change of -4.059 Mg, and there is a notable area change of 108166.34 sqm, reflecting a 33.20% increase. Broad-leaved tree cover spans 195.7617 sqm and has experienced a carbon change of 56.6073 Mg. The area of natural vegetation is 223.3332 sqm, with a significant carbon change of -49.0914 Mg. Needle-leaved tree cover occupies 137.4849 sqm, with a modest carbon increase of 6.75 Mg. Rainfed cropland extends over 186.9039 sqm, showing a considerable carbon change of 949254.8 Mg and an area reduction of 75.8943 sqm. Grassland covers 102.8313 sqm and has a carbon change of -74.6595 Mg. Herbaceous cropland has an area of 194.7483 sqm, with a substantial carbon reduction of -109.8765 Mg. Shrubland is the largest LULC type, covering 358.4799 sqm, and it has seen a notable carbon increase of 191.0187 Mg. Shallow water areas span 81.4392 sqm, with a significant carbon change of 59.2047 Mg.

Table 2.5
CARBON TRANSITION TABLE 2010

RANTHAMBHORE TIGER RESERVED 2010						
Sr. No	**LULC Name**	**AREA (Sqm)**	**Total Carbon (Mg Of C)**	**Area Change**	**Carbon Change Mg/Sq m**	
1	Bodies of Water	47.8026		-11.4327		
2	Broad Leaved Tree Cover	193.293		-2.4687		
3	Natural Vegetation	246.132		22.7988		
4	Needle Leaved Tree Cover	96.5601		-40.9248		
5	Rainfed Croplan d	268.8984	875226.46	81.9945	-74028.34	-22.70%
6	Grassland	277.7319		174.9006		
7	Herbaceous Cropland	261.4662		66.7179		
8	Shrubland	120.8403		-237.6396		
9	Shallow Water	27.4932		-53.946		

Source: Data extracted from Landsat 5 satellite imagery

Table 2.6
CARBON TRANSITION TABLE 2020

RANTHAMBHORE TIGER RESERVED 2020						
Sr. No	**LULC Categories**	**AREA (Sqm)**	**Total Carbon (Mg Of C)**	**Area Change**	**Carbon Change Mg/Sqm**	
1	Water bodies	46.2992		-1.5034		
2	Broad Leaved Tree Cover	250.1594		56.8664		
3	Natural Vegetation	244.6398		-1.4922		
4	Needle Leaved Tree Cover	124.73		28.1699		
5	Rainfed Cropland	260.3121	916372.53	-8.5863	41146.07	12.60%
6	Grassland	112.4138		-165.3181		
7	Herbaceous Cropland	243.9769		-17.4893		
8	Shrubland	187.0499		66.2096		
9	Shallow Water	69.39542		41.90222		

Source: Data extracted from Landsat 5 satellite imagery

2.7 Conclusion

The conservation efforts in Ranthambore National Park have significantly influenced both its socio-economic and ecological landscapes over the past four decades. The park provides substantial flow benefits, estimated at Rs 8.3 billion annually, with critical ecosystem services such as gene-pool protection, water provisioning, wildlife habitat, nutrient cycling, and carbon sequestration. The presence of the Ganesh Temple, which attracts around 10 lakh pilgrims yearly, adds cultural and economic value to the region.

Using satellite data and the Google Earth Engine (GEE) for analysis, the study tracked land use and land cover (LULC) changes from 1980 to 2020. The data reveals dynamic shifts across different land cover categories:

1. **Water Bodies**: There has been a decline in the area of water bodies, indicating potential impacts on biodiversity and increased water usage for agriculture and human settlements.

2. **Broad-Leaved Tree Cover**: Initially decreased, likely due to deforestation, but later increased due to successful reforestation and natural regeneration efforts.

3. **Natural Vegetation**: Showed fluctuations, with a notable peak in 1990, suggesting improved conservation efforts during that period.

4. **Needle-Leaved Tree Cover**: Experienced a sharp decline, indicating issues such as logging or disease, with insufficient recovery efforts.

5. **Rainfed Cropland**: Saw a significant reduction, suggesting a shift to other land uses due to factors like water scarcity or changing agricultural practices, with partial recovery in later years.

6. **Grassland**: Fluctuated significantly, reflecting varying land management practices and ecological conditions.

7. **Herbaceous Cropland**: Increased dramatically, indicating intensified agriculture, with later stabilization showing a balanced use of land.

8. **Shrubland**: Expanded significantly, indicating land degradation or reduced agricultural activity, with ongoing fluctuations.

9. **Shallow Water**: Increased initially, reflecting changes in water management, with later stabilization indicating improved practices.

The correlation analysis revealed relationships between these land cover changes, such as the impact of water availability on natural vegetation and the trade-off between agricultural land use and natural grasslands.

In terms of carbon storage, the analysis highlighted the role of different LULC types in sequestering carbon, essential for mitigating climate change. Although detailed carbon data was limited for most categories, the trends in rainfed cropland showed significant reductions in carbon content, indicating substantial land use changes and their ecological implications.

Overall, the conservation schemes in Ranthambore National Park have led to notable improvements in certain areas, such as reforestation and natural vegetation recovery, but challenges remain in maintaining water bodies and needle-leaved tree cover. The socio-economic benefits, including ecosystem services and cultural value, underscore the importance of continued and enhanced conservation efforts to sustain the park's ecological health and socio-economic contributions.

CHAPTER III

EXPLORING SUSTAINABLE SCENARIOS AMID RESOURCE DISPARITIES

3.1 INTRODCTION

At the local as well as the global level, the sustainability of forest ecosystems is crucial for human livelihood security, economic growth, and ecological sustainability. The hydrological cycle is controlled by forests, which also protect watersheds and their plants, water streams, and soils. Forests also provide a vast store of hereditary information, much of which is still unknown. The relationships between a wooded environment and job security are discussed by researchers. The conversion of agricultural, farm, and forest lands into inhabited, marketable, or commercial expansions and resorts poses a significant threat to the ecological stability of national park forest ecosystems (Frank , 1998). Individually, it states that a person's ability to receive fundamental needs such food, drink, housing, and clothes, as well as other requirements for human survival, is what is meant by their "livelihood." In rural areas, around 90% of households are engaged in agricultural activities.

The Brundtland Commission of the United Nations defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" in 1987. In order to meet their development needs, nearly 140 developing countries are presently searching for answers; nevertheless, given the growing threat posed by climate change, major actions must be done to ensure that progress made today does not have a negative impact on future generations (United Nations, 1987).

The conservation status of tigers in India is a significant concern, and Ranthambore National Park is one of the key areas for tiger conservation in the country. According to the latest tiger census conducted in 2018, Ranthambore National Park is home to 67 tigers, a notable increase from the 2014 census figure of 62 tigers (Government of India, 2021).

However, tigers in India, including those in Ranthambore, are facing various challenges. The most prominent issue is habitat loss due to human activities such as deforestation, mining, and urbanization. The loss of habitat has led to the fragmentation of tiger habitats, which affects their movement and breeding patterns, leading to genetic degradation and inbreeding.

Another significant challenge is the increasing human-tiger conflict. As the human population grows and expands, they encroach on tiger habitats, causing tigers to come into conflict with humans. This results in the loss of human lives, livestock, and crops, leading to retaliation against the tigers.

Poaching and illegal trade of tiger parts remain a severe threat to tigers in India, including those in Ranthambore. Despite the government's efforts to stop poaching, the demand for tiger parts in the international market remains high, leading to the continued poaching of tigers in India.

To address these challenges and ensure the survival of tigers in Ranthambore and India, several conservation measures have been implemented. These include the establishment of protected areas, relocating communities from tiger habitats, anti- poaching efforts, and the promotion of eco-tourism. The government of India has launched the "Project Tiger" initiative to protect and conserve tigers and their habitats.

However, to ensure the long-term survival of tigers in India, more needs to be done. This includes addressing the root causes of habitat loss and fragmentation, promoting sustainable development practices, and increasing awareness about

the importance of tiger conservation. All stakeholders, including local communities, government agencies, and conservation organizations, need to work together to achieve this goal (Mandal & Mondal, 2021).

3.2. SUSTAINABLE SCENARIOS AMID RESOURCE DISPARITIES

3.2.1. Geographical and Climatic disparity

Jim Corbett National Park, located in the foothills of the Himalayas in Uttarakhand, experiences a temperate climate with significant annual rainfall (1,400-2,800 mm) during the monsoon season. This results in lush, dense forests and a variety of water bodies. Conversely, Ranthambore National Park, situated at the junction of the Aravalli and Vindhya ranges in Rajasthan, faces a semi-arid climate with lower annual rainfall (around 800 mm). The terrain in Ranthambore is more rugged, and the vegetation is dominated by dry deciduous and thorn forests.

TABLE 3.1

COMPARISON OF JIM CORBETT NATIONAL PARK & RANTHAMBORE NATIONAL PARK

Sr. No.	**Aspect**	**Jim Corbett National Park**	**Ranthambore National Park**
1	Location	Uttarakhand, Northern India	Rajasthan, northwestern India
2	Geography	Foothills of the Himalayas; hilly areas, riverine belts, lakes	Junction of Aravalli and Vindhya ranges; rugged terrain, lakes
3	Area	520 sq km	1,334 sq km
4	Elevation	400 - 1,220 meters	215 - 505 meters
5	Climate	Temperate; distinct seasons	Semi-arid
6	Temperature	5°C in winter to 40°C in summer	10°C in winter to 45°C in summer

7	Rainfall	1,400-2,800 mm annually (monsoon: June to September)	800 mm annually (monsoon: June to September)
8	Flora	Sal forests, mixed deciduous forests, grasslands	Dry deciduous forests, tropical thorn forests, grasslands
9	Key Plant Species	Sal (Shorea robusta), Khair (Acacia catechu), Sissoo (Dalbergia sissoo)	Dhok (Anogeissus pendula), Banyan (Ficus benghalensis),
			Peepal (Ficus religiosa)
10	Fauna	Bengal tiger, Indian elephant, Indian leopard, Himalayan black bear	Bengal tiger, Indian leopard, sloth bear, striped hyena
11	Bird Species	Over 600 species	Over 300 species
12	Notable Wildlife	Gharial, crocodiles, fish-eating crocodile	Marsh crocodile
13	Conservation Efforts	Part of Project Tiger since 1973; anti-poaching initiatives	Part of Project Tiger since 1973; monitoring and anti-poaching
14	Conservation Challenges	Human-wildlife conflict, poaching, tourism pressure	Human-wildlife conflict, poaching, habitat fragmentation, tourism
15	Tourism	Popular wildlife tourism destination	Major tourist attraction for tiger sightings
16	Tourism Infrastructure	Resorts, lodges, guided safaris	Luxury resorts, lodges, guided safari tours

17	Tourism Activities	Jeep safaris, elephant safaris, bird watching, nature walks	Jeep safaris, canter safaris, bird watching, historical site visits
18	Cultural Significance	Named after Jim Corbett; Corbett Museum, Garjia Temple	Historical Ranthambore Fort, ancient temples, Raj Bagh ruins
19	Historica l Sites	Corbett Museum, Garjia Temple	Ranthambore Fort, ancient temples
20	Management	Uttarakhand Forest Department	Rajasthan Forest Department
21	Conservation Policies	Anti-poaching, habitat restoration, community involvement	Monitoring, anti- poaching, habitat management, community-based conservation

Source: (Jim Corbett National Park, 2022) (Ranthambore National Park, 2022)

3.2.2. Flora and Fauna Diversity

The differing climates significantly influence the biodiversity in both parks. Jim Corbett's wetter, more temperate environment supports diverse flora, including Sal forests, mixed deciduous forests, and vast grasslands, which provide habitat for species like the Bengal tiger, Indian elephant, and Himalayan black bear. The varied flora and dense forests also support a rich birdlife, with over 600 species recorded.

Ranthambore's drier conditions favor species adapted to arid environments. The park's vegetation is characterized by Dhok trees, banyan, and peepal. It supports notable wildlife such as the Bengal tiger, Indian leopard, sloth bear, and striped hyena, along with over 300 bird species. The presence of historical ruins and the

Ranthambore Fort adds cultural value to the biodiversity.

3.2.3. Water Resources

Water resources in both parks are vital but differ vastly in abundance and distribution. Jim Corbett has numerous rivers, lakes, and seasonal water bodies due to its higher rainfall. This ensures year-round water availability, which is crucial for sustaining its diverse flora and fauna.

Ranthambore, with its semi-arid climate, relies on a few perennial lakes and artificial water bodies to sustain its ecosystem. The limited water resources often face stress during dry periods, impacting the wildlife and vegetation, necessitating efficient water management strategies to ensure sustainability.

3.2.4. Human-Wildlife Conflict

Both parks face challenges related to human-wildlife conflict, but the nature and extent differ. In Jim Corbett, the dense human population around the park and the frequent movement of wildlife, particularly elephants and tigers, into nearby villages, lead to conflicts. Efforts are needed to create buffer zones and enhance community engagement in conservation.

Ranthambore's conflict primarily arises from the limited water and food resources, pushing wildlife into adjacent agricultural lands. Sustainable development strategies here must focus on water conservation, creating alternative livelihoods, and involving local communities in conservation efforts.

3.2.5. Conservation Efforts and Sustainable Development

Both parks are part of Project Tiger, emphasizing the conservation of the Bengal tiger and its habitat. Jim Corbett has implemented various measures such as anti-poaching initiatives, habitat restoration, and community involvement.

These efforts aim to maintain ecological balance while promoting sustainable tourism, which generates revenue for conservation and local communities.

Ranthambore's conservation strategies include monitoring, anti-poaching measures, habitat management, and community-based conservation projects. The challenge lies in balancing tourism, which is a significant revenue source, with conservation needs. Sustainable development in Ranthambore focuses on enhancing water management, reducing human-wildlife conflict, and promoting eco-friendly tourism practices.

Table 3.2

COMPARISON OF SUSTAINABLE PRACTICES

Aspect	Jim Corbett National Park	Ranthambore National Park
Location & Area	Uttarakhand; 1,318 sq km	Rajasthan; 1,334 sq km
Habitat Management	Controlled burning, invasive species removal, reforestation; 100+ anti- poaching camps	Waterholes, check dams for water conservation; 40+ water structures maintained
Anti-Poaching Measures	350+ camera traps, drones, anti-poaching camps	250 camera traps, drones, involvement of former poachers in protection efforts
Community Involvement	35 EDCs, livelihood programs (bee-keeping, handicrafts, organic	30 EDCs, livelihood initiatives (traditional crafts, tourism
	farming); 1,500 households' benefit	employment); 1,000 families benefit
Eco-Tourism	Permit system (600 vehicles/day), eco-friendly infrastructure (solar energy, rainwater harvesting)	Permit system (40 vehicles/day per zone), eco-friendly lodges, cultural tourism integration

Conflict Mitigation	Compensation schemes (INR 10 million/year), solar-powered electric fences, stone walls; 30% reduction in conflicts	Compensation schemes (INR 8 million/year), electric fences, trenches; 25% reduction in conflicts
Policy & Governance	Governed by Wildlife Protection Act 1972, Indian Forest Act; multi-stakeholder approach involving government, NGOs, communities	Governed by Wildlife Protection Act 1972, Indian Forest Act; collaborative governance involving local communities and NGOs

Source: (Sharma & Singh, 2020)

Jim Corbett National Park and Ranthambore National Park are two of India's most prominent tiger reserves, each adopting various sustainable practices to preserve their unique ecosystems and promote conservation. This detailed comparison explores their efforts in habitat management, anti-poaching measures, community involvement, eco- tourism, conflict mitigation, and policy governance, supported by facts and figures.

3.2.6 Spatial location and Covered Area

Jim Corbett National Park, located in Uttarakhand, spans an area of 1,318 square kilometers, characterized by a diverse range of habitats including grasslands, forests, and riverine belts. Ranthambore National Park, situated in Rajasthan, covers 1,334 square kilometers and features a mix of dry deciduous forests, open grasslands, and rocky terrain.

3.2.7 Habitat Management

- **Jim Corbett National Park**

Jim Corbett places a significant emphasis on habitat management and restoration. The park implements controlled burning to manage grasslands and

remove invasive species. Reforestation efforts focus on planting native tree species to restore degraded areas. The park has established over 100 anti-poaching camps to protect its diverse habitats. Advanced technologies, including more than 350 camera traps and drones, are employed for habitat monitoring and poacher detection (Sharma & Singh, 2020).

- **Ranthambore National Park**

In contrast, Ranthambore prioritizes water conservation due to its arid environment. The park has constructed and maintains over 40 waterholes and check dams to ensure water availability for wildlife, especially during dry seasons. These water structures are crucial for sustaining the park's flora and fauna (Singh, 2017). Anti-poaching measures in Ranthambore are robust, involving 250 camera traps and drones. Additionally, the park integrates former poachers into conservation efforts, significantly reducing poaching incidents (Narayan, 2018).

3.2.8 Anti-Poaching Measures

- **Jim Corbett National Park**

Jim Corbett employs comprehensive anti-poaching strategies, including regular patrolling, surveillance with camera traps and drones, and the establishment of anti- poaching camps. Over 350 camera traps are strategically placed throughout the park, providing real-time data on wildlife movements and potential poaching activities. These measures have led to a noticeable decrease in poaching incidents (Gupta & Jain, 2019).

- **Ranthambore National Park**

Ranthambore's anti-poaching measures are similarly stringent. The park uses 250 camera traps and drones for surveillance. A unique aspect of Ranthambore's strategy is the involvement of former poachers in its protection

efforts. These individuals are provided with alternative livelihoods and integrated into the park's conservation team, significantly enhancing the park's anti-poaching capabilities (Narayan, 2018).

3.2.9 Community Involvement

- **Jim Corbett National Park**

Community involvement in Jim Corbett is facilitated through Eco-Development Committees (EDCs). The park has established around 35 EDCs, engaging local villagers in conservation activities. These committees play a crucial role in resource management and decision-making processes, reducing human-wildlife conflicts. Livelihood programs such as bee-keeping, handicrafts, and organic farming benefit over 1,500 households. Education and awareness campaigns are regularly conducted, with more than 50 workshops held annually to inform locals about the importance of conservation and sustainable practices (Narain & Bisht, 2018).

- **Ranthambore National Park**

In Ranthambore, community involvement is achieved through similar EDCs and the involvement of local NGOs like Tiger Watch. The park has around 30 EDCs and employs local youth as nature guides and park rangers, providing employment to over 200 individuals. Livelihood initiatives include the promotion of traditional crafts and tourism-related employment, directly benefiting approximately 1,000 families. Educational programs and wildlife awareness workshops are regularly held to engage and educate the local population (Gupta, 2019; Patel, 2018).

3.2.10 Eco-Tourism

- **Jim Corbett National Park**

Eco-tourism in Jim Corbett is carefully regulated to minimize its ecological footprint. The park operates a permit system that controls the number of visitors, allowing a maximum of 600 vehicles per day during peak season. Eco-friendly infrastructure, such as solar energy installations and rainwater harvesting systems, is used in tourist facilities. Wildlife safaris and nature walks are conducted with strict guidelines to ensure minimal disturbance to wildlife, with trained naturalists accompanying tourists (Mehta, 2019).

- **Ranthambore National Park**

Ranthambore also practices regulated eco-tourism with a permit system that limits the number of vehicles to 40 per day in each of its 10 zones. The park has invested in eco- friendly lodges and camps that use renewable energy sources and eco-friendly materials. Safari guidelines emphasize responsible tourism, with limits on vehicle numbers and adherence to fixed routes to reduce wildlife disturbance. Additionally, Ranthambore offers cultural tourism experiences, integrating visits to local villages and historical sites with wildlife tours (Narain, 2019).

3.2.11 Conflict Mitigation

- **Jim Corbett National Park**

Human-wildlife conflict mitigation in Jim Corbett includes compensation schemes for livestock depredation and crop damage, with over INR 10 million allocated annually for compensation purposes. Physical barriers such as solar-powered electric fences and stone walls are erected in conflict-prone areas to prevent wildlife from entering human settlements. These measures have resulted in a significant reduction in crop raiding and livestock attacks, with

incidents dropping by 30% over the past five years (Narain & Bisht, 2018).

- **Ranthambore National Park**

Ranthambore employs similar compensation schemes, allocating around INR 8 million annually for livestock and crop damage compensation. The park has installed physical barriers, including electric fences and trenches, to deter wildlife from venturing into human habitations. Additionally, Ranthambore conducts regular, community outreach programs to educate locals on coexisting with wildlife and reporting any conflict incidents promptly. These efforts have led to a 25% decrease in human-wildlife conflict incidents over the past three years (Mehta, 2019).

3.2.12 Policy and Governance

- **Jim Corbett National Park**

Jim Corbett is governed by stringent legal frameworks under the Wildlife Protection Act of 1972 and the Indian Forest Act, ensuring the protection and conservation of its biodiversity. The park management involves collaboration with various stakeholders, including government agencies, NGOs, and local communities, facilitating a multi- stakeholder approach to conservation (Gupta & Jain, 2019).

- **Ranthambore National Park**

Ranthambore operates under similar legal frameworks, with strong enforcement of the Wildlife Protection Act and other conservation laws. The park's governance involves multiple stakeholders, with active participation from local communities, NGOs, and governmental bodies. Collaborative governance ensures that conservation strategies are inclusive and effective (Narayan, 2018).

3..3 CONCLUSION

Jim Corbett and Ranthambore National Parks exemplify sustainable conservation practices, each adapting to their unique ecological and socio-economic contexts. Jim Corbett's emphasis on habitat restoration, community-based conservation, and eco- friendly tourism contrasts with Ranthambore's focus on water conservation, employing former poachers in protection efforts, and integrating cultural tourism. Both parks prioritize community involvement, conflict mitigation, and strict regulatory frameworks to ensure the sustainability of their conservation efforts. This comparative analysis highlights that a diverse and adaptive approach is crucial for the success of wildlife conservation in India. The disparities in natural resources between Jim Corbett and Ranthambore National Parks highlight the need for tailored sustainable development strategies. Jim Corbett benefits from richer water resources and a temperate climate, supporting a diverse ecosystem. Sustainable practices here involve managing human-wildlife conflict and promoting eco-tourism.

Ranthambore, with its semi-arid conditions and limited water resources, requires efficient water management and innovative conservation strategies to sustain its ecosystem. Engaging local communities in conservation, reducing human-wildlife conflict, and promoting sustainable tourism are key to ensuring long-term sustainability.

CHAPTER IV

COLLABORATION FOR NATIONAL PARK CONSERVATION

4.1 INTRODUCTION

Conflicts in protected regions often originate as human-wildlife or social conflicts, rooted in power imbalances, hierarchical management, or limited community participation. Using case studies and interviews in Ranthambore National Park, we identified four key conflict sources: prejudice and mistrust, human-wildlife interactions, power imbalances, and restricted forest access. These findings underscore the need to integrate local cultural contexts into conservation strategies and involve communities in decision-making. However, engagement efforts often fail due to diverse stakeholder values, socioeconomic differences, and ineffective management approaches. This chapter explores stakeholder relationships, perceptions of conservation, and conflict dynamics in protected areas.

In protected regions, conflicts are frequent and usually start out as social or human- wildlife conflicts. Conflicts between people and wildlife, or physical confrontations between people and animals, are frequently the outward signs of underlying social problems that may stem from power imbalances, outdated, hierarchical management techniques, or a lack of community participation in decision-making. Despite the fact that these conflicts are commonplace worldwide, mitigation has proven difficult. This is especially true in regions such as India, where institutional policies, procedures, and practices further impede the development of cooperative relationships to accomplish conservation goals, and where a) multiple stakeholder groups with divergent values regarding resource use have an impact on protected areas.

Using case studies and qualitative interviews conducted across and around tiger reserves: Ranthambore National Park (Rajasthan), we investigated how different stakeholder groups perceive park management and collaboration with other stakeholder groups, human-wildlife interactions and associated mitigation strategies, and access to natural and community resources. We found that there are four primary and recurrent sources of conflict: prejudice and mistrust, conflicts between humans and wildlife, exclusion due to power imbalances, and access to forests. Though they appeared differently in each park, these sources were present in both locations.

Results validate previous research on conflicts in conservation and highlight the significance of including local cultural contexts into conservation planning, park administration, and community-based solutions.

A vital and integral component of the international effort to conserve biodiversity are protected zones. However, the local populace usually bears a heavy price for the creation and maintenance of Protected areas. Local populations are restricted and their livelihoods are impacted by protected areas policies in a number of ways, such as reduced access to natural resources, prohibitions against participating in cultural practices and traditions, and displacement from customary lands (Toit, Walker, & Campbell, 2004). Communities' need to be involved in Protected area administration has grown in an effort to reduce social unrest, compensate for losses incurred during the establishment of Protected areas, and increase community support for Protected areas (Andrade & Rhodes, 2012).

Regretfully, these community engagement initiatives have often failed as a result of unsatisfactory results (Brosius, Tsing, & Zerner, 1998). Protected areas are surrounded by a multitude of stakeholder groups, each of which has different socioeconomic and demographic traits, backgrounds, and relationships to their surroundings. This broad range of origins, values, and management philosophies affects people's perceptions of conservation and,

ultimately, their attitudes and behaviours around Protected areas (Agrawal & Gibson, 1999).

Understanding the nature of these stakeholder relationships, how these management activities are viewed, and where conflict emerges in diverse cultural contexts are the goals of this chapter.

4.2 COMMUNITY

Communities and local governments have been figuring out methods to get through obstacles to achieve a win-win, collaborative manner of managing expectations around Protected areas (PA) for a long time (Wagner, Kaiser, Kreuter, & Wilkins, 2007).

Protecting ecological services and mitigating biodiversity loss are two major goals achieved through the creation of parks and protected areas (PAs). But in addition to being ecologically significant, PAs are also important socio-cultural and religious sites (Negi, 2010), areas of social production and interaction, and essential sources of livelihood for millions of indigenous people worldwide.

Furthermore, parks serve as venues for tourism, education, and research (Spenceley & Snyman, 2017). However, conflicts arise in protected regions all over the world. It is a great challenge to understand how these conflicts arise and how they might be resolved to successfully balance the requirements of humans with the preservation of wildlife and natural resources.

4.3 THE SOCIAL IMPACTS OF PROTECTED AREAS (PAs) IN INDIA

Protected Areas (PAs) in India, which include national parks, wildlife sanctuaries, and biosphere reserves, play a critical role in biodiversity conservation. However, they also significantly impact local communities socially and economically. These impacts encompass both positive and negative aspects, influencing the livelihoods, cultural practices, and social dynamics of millions of people living in and around these areas.

4.4 POSITIVE SOCIAL IMPACTS

4.4.1 Employment and Livelihood Opportunities

One of the most prominent positive social impacts of PAs is the generation of employment opportunities. Eco-tourism has become a vital source of income for local communities. For instance, Ranthambore National Park and Jim Corbett National Park, two of the most visited PAs in India, have created jobs for locals as guides, drivers, and hospitality staff. In Ranthambore, eco-tourism employs over 500 local residents directly and benefits thousands indirectly (Sharma, 2019).

4.4.2. Community Development Programs

Many PAs have initiated community development programs aimed at improving the quality of life for local inhabitants. These programs often include the construction of schools, healthcare facilities, and infrastructure improvements. In the Sundarbans, for example, community development initiatives have led to improved health and education outcomes for local residents (Chowdhury & Ghosh, 2017).

4 4.3. Empowerment of Women

PAs have also played a role in the empowerment of women through self-help groups and employment in eco-tourism and conservation projects. In Periyar Tiger Reserve, women's participation in eco-development committees has increased their involvement in decision-making processes and provided them with alternative livelihoods, such as spice cultivation and eco-tourism ventures (Krishnan, 2018).

4.5 NEGATIVE SOCIAL IMPACTS

4.5.1 Displacement and Loss of Livelihoods

Despite these benefits, PAs have also caused significant displacement of indigenous and local communities. The creation of PAs often involves the relocation of communities, leading to loss of traditional livelihoods such as farming, fishing, and forest-based activities. According to a report by the Rights and Resources Initiative (2015), over 1.9 million people have been displaced due to the establishment of PAs in India.

4.5.2 Conflict and Social Disruption

The establishment of PAs can also lead to conflicts between park authorities and local communities. Restrictions on resource use, such as grazing, collection of non-timber forest products, and fishing, often lead to tensions. In the Sariska Tiger Reserve, conflicts have arisen due to restrictions on grazing and access to forest resources, impacting the traditional lifestyles of the Gujjar community (Kothari & Pathak, 2018).

4.5.3 Marginalization and Social Inequity

The socio-economic benefits of PAs are not always evenly distributed, often exacerbating social inequities. Marginalized groups, such as tribal communities, frequently receive fewer benefits from conservation initiatives. Studies have shown that in many PAs, such as the Nanda Devi Biosphere Reserve, benefits from eco- tourism and conservation programs are disproportionately enjoyed by more affluent and influential sections of the society (Maikhuri et al., 2019).

4.6 CONFLICTS IN PROTECTED AREAS IN INDIA

Protected Areas (PAs) in India, which include national parks, wildlife

sanctuaries, and biosphere reserves, are critical for biodiversity conservation. However, their establishment and management often lead to conflicts between conservation authorities and local communities. These conflicts arise from issues such as displacement, restricted access to resources, human-wildlife encounters, and inequitable distribution of eco-tourism benefits. This article delves into the various dimensions of these conflicts, supported by facts and figures.

4.6.1 Displacement and Resettlement Conflicts

The creation of PAs often involves the relocation of indigenous and local communities. This displacement leads to the loss of traditional livelihoods and socio- cultural disruptions. According to the Rights and Resources Initiative (2015), over 1.9 million people have been displaced due to the establishment of PAs in India. For example, in the Simlipal Tiger Reserve in Odisha, the displacement of over 300 families has led to severe socio-economic hardships, as these communities have struggled to adapt to new environments and livelihoods (Sethi, 2019).

4.6.2 Restricted Access to Resources

Local communities often depend on forest resources for their livelihoods, including grazing, collection of non-timber forest products, and small-scale agriculture. The establishment of PAs typically restricts access to these resources, leading to conflicts. In the Sariska Tiger Reserve in Rajasthan, the traditional Gujjar community has faced restrictions on grazing and access to forest resources, resulting in significant tension and protests (Kothari & Pathak, 2018). Similarly, in the Buxa Tiger Reserve in West Bengal, restrictions on forest access have led to conflicts between forest authorities and local tribes, who depend on the forest for their daily needs (Chatterjee, 2017).

4.6.3 **Human-Wildlife Conflicts**

Human-wildlife conflicts are another major source of tension in PAs. These conflicts often occur when wildlife ventures into human settlements, leading to crop damage, livestock predation, and sometimes human casualties. According to the Wildlife Institute of India (2018), there were over 1,000 reported cases of human-wildlife conflicts in and around Indian PAs in 2017 alone. For instance, in the Jim Corbett National Park, frequent incidents of crop damage and livestock predation by tigers and elephants have caused significant economic losses to local farmers, leading to retaliatory killings of wildlife (Singh et al., 2020).

4.6.4 Inequitable Distribution of Eco-Tourism Benefits

Eco-tourism has emerged as a significant source of revenue for PAs, but the benefits are often inequitably distributed. This inequity exacerbates social tensions and conflicts. In the Ranthambore National Park, while eco-tourism has generated significant income, studies have shown that the benefits are disproportionately enjoyed by more affluent sections of society, with local communities receiving minimal economic gains (Sharma, 2019). This has led to resentment and conflicts over the control and distribution of eco-tourism revenues.

4.6.5 Policy and Management Conflicts

Conflicts also arise from the implementation of conservation policies that do not adequately consider the rights and needs of local communities. The Forest Rights Act of 2006 was enacted to address historical injustices faced by forest-dwelling communities by recognizing their rights to forest land and resources. However, the implementation of this Act has been inconsistent, leading to conflicts. For example, in the Nagarhole National Park, the failure to recognize and grant rights under the Forest Rights Act has led to protests and legal battles

by local tribes seeking access to their traditional lands (Sundar, 2020).

4.7 CONFLICTS IN PROTECTED AREAS (Study Area)

Conflicts in protected areas are complex, often arising from human-wildlife interactions or disputes among stakeholder groups with competing interests. Human-wildlife conflict typically stems from wildlife damaging crops, attacking livestock, or posing risks to human safety, while interventions like technical solutions (e.g., fences), cognitive strategies (e.g., education), and structural changes (e.g., compensation programs) often address immediate concerns but fail to tackle underlying causes. Social conflicts also emerge due to forced displacements, restrictions on traditional resource use, and power imbalances, reflecting historical conceptions of separating humans from nature. These conflicts impede cooperation necessary for effective conservation. In India, such conflicts are common and rooted in socio-cultural and historical factors that demand further research for effective resolution.

Global issues of conflict in protected areas can take many various forms (Baynham- Herd, Redpath, Bunnefeld, Molony, & Keane, 2018). These conflicts provide a number of obstacles to sustainable livelihoods and conservation (Anand & Radhakrishna, 2017; Dickman, 2010). Human-wildlife conflict is one of the most common and extensively researched topics in conservation and wildlife management because of its significant effects on both people and animals. Conflict between humans and animals arises when "the goals of humans negatively impact the needs of wildlife, or when the needs and behaviour of wildlife negatively impact the goals of humans" (Madden, 2004, p. 248).

It has been noted that mammals and other migratory animals live beyond reserves and protected areas, where they can lead to conflict with people. Unfavourable interactions with wildlife can cost local communities money in a number of ways, including livestock loss, crop-looting or destruction of food

that has been stored (Pérez & Pacheco, 2006), and disease and attack risks to humans (Penteriani et al., 2017).

The detrimental effects of wildlife can be lessened by using a variety of intervention techniques. These frequently address the direct determinants of proximate human behaviours that are at odds with conservation goals (Schultz, 2011). For example, attempts to lessen detrimental effects on animals are frequently made in an effort to combat retaliatory killing (Nyhus, 2016). Baynham-Herd et al. (2018) divided these interventions into three categories: technical, cognitive, and structural, based on their analysis of the conflict literature. Technical solutions aim to alter the physical surroundings (for example, fences to stop crop-raiding) in order to lessen wildlife retaliation killings or active resistance to conservation (Nyhus, 2016). It has been noted that cognitive fixes, such livelihood education or conservation, have the ability to affect behaviour change through the spread of information (Espinosa & Jacobson, 2012).

Through economic or financial tools like compensation programmes enforcement through rules and regulations around resource use and access and stakeholder engagement, structural interventions seek to change the context itself and aim to mitigate conflict. Many times, interventions primarily address the outward manifestations of conflict and concentrate mostly on material losses (Madden & McQuinn, 2014). Stakeholder commitment to conservation goals and openness to change are limited when conservation efforts concentrate on concrete conflicts and ignore the role of history, nature, and numerous layers of social conflict in shaping conservation efforts (Madden, 2004). (Reed, 2008).

Because they frequently reflect underlying social or human-to-human conflicts, conflicts in protected areas are consequently more complicated than they may initially appear.

Multi-actor landscapes are protected zones. These players differ in their interests, status, and ability to influence decisions, in addition to having varied

views about how parks should be used, managed, and conserved. According to Lecuyer, White, Schmook, & Calmé (2018) and Marshall, White, & Fischer (2007), social conflicts in these situations are described as disputes between groups of people with competing interests when at least one group acts against the interests of another.

Social conflicts within protected areas can arise when one group imposes restrictions or demands that another group modify their lifestyle to safeguard wildlife or other resources, often resources that people have historically used identified causal factors of conflict that include reliance on park resources, forced displacement, social exclusion, inadequate community participation, and unanticipated negative consequences of conservation measures. These factors were identified by taking into account how actors (local communities and conservation authorities) perceived impairment from each other.

But disputes between individuals who see conflicting objectives are not usually the only kind of conflict in the context of protected areas (Peterson, Leong, 2013). Historical conceptions that see humans and parks as distinct entities frequently influence restrictions on resource usage (Neumann, 1997; Terborgh, 1999). Moreover, non-material unfulfilled social needs, such as those for status and recognition, freedom, empowerment, dignity and respect, voice and control, power imbalances, and social, emotional, cultural, and spiritual security, are frequently the source of conflicts. According to Barua et al. (2013), conflict affects communities and conservation in both obvious and subtle ways. It can also be detrimental when trying to foster the cooperative resource management that is necessary for successful conservation outcomes. However, research identifying the socio-cultural and historical drivers of conflict is still lacking, which could provide important insights into the interactions, processes, and contextual elements that affect conflict resolution. And in India, these disputes have been commonplace.

4.8 PROTECTED AREA CONFLICTS IN THE INDIAN CONTEXT

The biodiversity of Indian protected areas is shaped by their proximity to densely populated, resource-dependent human populations. During British colonial rule, indigenous communities relying on forests for sustenance and cultural practices were displaced, while game hunting and forest exploitation altered ecosystems. Post-independence, India's focus on infrastructure and agriculture further depleted natural resources. Conservation laws introduced in 1972 led to the creation of protected areas, but these often-disregarded local communities, resulting in land displacement and resource restrictions. While these efforts benefited wildlife, including saving tigers from extinction, conflicts between humans and wildlife, and among humans, persist.

India's environmental regulations restrict industrialization around protected areas, leaving agriculture and livestock as primary livelihoods. However, these practices lead to crop losses, livestock depredation, and human casualties, disproportionately affecting disadvantaged communities. Retaliatory actions against parks and wildlife hinder conservation progress. Measures like the Forest Rights Act (2006), Joint Forest Management, and compensation programs often fail to balance development and conservation or address root causes of conflict.

This study explores the sociocultural and historical factors contributing to human-wildlife and human-human conflicts in different park contexts. By examining stakeholder dynamics, it seeks to identify underlying issues and propose solutions to mitigate these conflicts.

The distinctive biodiversity of Indian protected areas is primarily defined by their proximity to densely populated, resource-dependent human populations. India was under British colonial rule for about 200 years. Colonial forces changed the interactions between people and animals as well as political relations, ethnic relations, and social structures. They also changed the natural world, landscapes, and ecologies. Indigenous populations that depended on

woods for sustenance, cultural practices, or religious beliefs were forcibly evacuated from their lands and denied access during the British colonial era.

Game hunting eliminated animals and diverted forest resources for the benefit of the British Empire (Rangarajan, 2001). India had to deal with a wide range of sociopolitical, economic, and environmental problems when it gained its freedom. The government concentrated on expanding infrastructure and agriculture to meet the demands of a developing nation, which further depleted the nation's natural resources (Bindra, 2017). When the first set of laws for the preservation of animals and forests was created in 1972, the nation was experiencing a serious environmental crisis (Mahesh Rangarajan, 1996). Following this legislation, numerous people were labelled as encroachers on government-owned forest property when numerous protected zones were declared without first conducting surveys or investigations (Damayanti, 2008).

These recently established protected areas were subject to widespread relocations and entry restrictions; the locals were severely harmed by these measures, as they lost both their conventional means of subsistence and their ancestral lands (Torri, 2011). Some believed that the seriousness of India's conservation situation warranted the need for such drastic measures (Bindra, 2010). Wildlife has benefited from these efforts, including the tiger, which was on the verge of extinction but has since been brought back thanks to ongoing conservation efforts. However, conflicts between humans and wildlife, as well as between humans and other people, still exist in Indian PAs despite these admirable advancements in animal conservation.

India's environmental regulations hinder industrialization and development potential in protected areas as well as development around them (Ogra & Badola, 2008b). Thus, agriculture and livestock raising become the main sources of revenue in the majority of India's protected areas (Karanth, 2007; Shahabuddin et al., 2007).

Farmers experience crop losses as a result of forest ungulates being driven onto agricultural fields by intensive livestock grazing in and surrounding protected areas (Madhusudan & Mishra, 2003). Large carnivore confrontations also cause cattle losses and human casualties. Socioeconomically disadvantaged communities are typically the ones suffering these losses (Das and Chattopadhyay, 2011). People's physical and emotional health may be further impacted by losses resulting from direct conflicts with animals. Local populations frequently retaliate against the park, its animals, and its managers as a result of these detrimental interactions and effects, which impedes the advancement of conservation.

Like other regions, India has employed a variety of tactics to address conflict between humans and wildlife, including legislation and initiatives like the Forest Rights Act (2006) and Joint Forest Management programmes, insurance, and compensation programmes. Several academics have questioned the "success" of these programmes, citing evidence that people-management interactions remain estranged (Macura et al., 2016; Shahabuddin, 2010). These programmes frequently fall short of harmonising development and conservation priorities (Johnson, Karanth, & Weinthal, 2018) and persist in focusing only on state-driven fixes for immediate problems that undermine local government legitimacy (Read, 2016). As a result, mitigation initiatives focus on the outward signs of conflict that reduce stakeholder openness to change (Madden & McQuinn, 2014).

Few studies examine the intricacies and contextual factors required for resolving the supporting causes of conflict, despite the fact that many identify and list the various repercussions of conflict. This study attempts to close this gap. The following inquiry serves as the basis for this study: what are the sociocultural and historical factors that influence the emergence of human-

wildlife and human-human conflict in various park contexts? As we examine these topics, we also look for possible discrepancies and disputes amongst various stakeholder groups that could intensify conflict. We end with some suggestions for resolving social problems in these situations.

4.9 METHODS

We investigated park-related conflict in various circumstances using a comparative case study design. This allowed us to compare and contrast "how" and "why" social conflict occurs in and around various places. We decided to look at parks inside Indian tiger reserves due to the prevalence of conflicts over conservation related to carnivores (Holland et al., 2018). It is difficult for management of tiger reserves to strike a balance between the demands of local residents and conservation goals, despite India's commitment to protecting tigers and their environment. We decided to conduct our research at Rajasthan's Ranthambore National Park. It's a crucial habitat for tigers.

4.10 STUDY AREAS

The total area of Ranthambore National Park is 1334 km². It was founded in 1980 and is a part of the broader Ranthambore Tiger Reserve, along with Keoladevi Wildlife Sanctuary and Sawai Man Singh Wildlife Sanctuary. The sloth bear (Melursus ursinus), caracal (Caracal caracal), leopard (Panthera pardus), Indian gazelle (Gazella bennettii), and other ungulates are among the other species that can be seen in the park in addition to tigers. A number of nearby settlements encircle the park. The Meenas, Maalis, and Gujjars who live agro-pastoral lifestyles make up the diversified population of these communities. Ranthambore is one of the most popular parks in India because it is an ideal tiger habitat. Furthermore, the local economy and culture are greatly influenced by tourism (Vasan, 2018).

A smaller number of people in the area now directly depend on the forest thanks to development and tourism.

Still, only a small percentage of residents work directly in the tourism industry (Karanth & DeFries, 2011). Conflicts between humans and wildlife are common and manifest as crop-raiding and livestock losses as a result of confrontations with carnivores.

4.11 DATA COLLECTION

From August to September 2022, qualitative and quantitate data was collected from individuals in multiple stakeholder groups like villagers living near to Ranthambore National Park.

Table 4.1

DEMOGRAPHIC INFORMATION OF RANTHAMBORE NATIONAL PARK NEARBY VILLAGES

Education		
	Frequency	**Percentage**
Illiterate	57	22.8
Primary	28	11.2
Middle	37	14.8
Matriculation	61	24.4
Senior Secondary	37	14.8
Graduate	25	10
Post Graduate	5	2
Total	250	100
Occupation		
	Frequency	**Percentage**
Unemployed	42	16.8
Farmer	64	25.6
Business/industrialist	21	8.4
Daily Wager/Labourer	32	12.8
Private Service	65	26
Government Service	22	8.8
Retired/Pensioner	4	1.6

Total	250	100
Caste		
	Frequency	Percentage
General	175	70
Backward Caste	75	30
Total	250	100
Family type		
	Frequency	Percentage
Joint	195	78
Nuclear	55	22
Total	250	100
House Ownership		
	Frequency	Percentage
Own	184	73.6
Rented	66	26.4
Total	250	100
Ownership		
	Frequency	Percentage
Husband	7	2.8
Self	62	24.8
Grandfather	19	7.6
Father	82	32.8
Father-in-law	14	5.6
Landlord	66	26.4
Total	250	100
Type of House		
	Frequency	Percentage
Semi-Pucca	34	13.6
Pucca	216	86.4
Total	250	100
Current age		

	Frequency	Percentage
Below 20	13	5.2
21-30	43	17.2
31-40	88	35.2
41-50	77	30.8
51 & above	29	11.6
Total	250	100
Monthly income		
	Frequency	Percentage
15000 & below	38	15.2
15001-25000	80	32
25001-35000	77	30.8
35001-45000	37	14.8
45001 & above	18	7.2
Total	250	100

Source: Economic and Statistical Organization, 2022

Table 4.2

DEMOGRAPHIC STRUCTURE

BY SIZE OF HOUSEHOLD AT VILLAGE LEVEL

	Nimli Khurd Village No. of households: 223			
S. No.	Indicators	Persons	Males	Females
1	Population	1,091	576	515
2	Child Population	173	94	79
3	Scheduled Castes	19	9	10
4	Scheduled Tribes	715	376	339
5	Literate	464	371	93
6	Illiterate	627	205	422
7	Workers	603	305	298
8	Non-Workers	488	271	217
	Kundera Village No. of households: 934			
S. No.	Indicators	Persons	Males	Females
1	Population	5,076	2,683	2,393
2	Child Population	711	379	332
3	Scheduled Castes	1,106	597	509
4	Scheduled Tribes	12	5	7
5	Literate	2,822	1,847	975
6	Illiterate	2,254	836	1,418
7	Workers	1,967	1,343	624
8	Non-Workers	3,109	1,340	1,769
	Sherpur Village No. of households: 307			
S. No.	Indicators	Persons	Males	Females
1	Population	1,700	864	836
2	Child Population	242	140	102
3	Scheduled Castes	77	36	41
4	Scheduled Tribes	21	8	13
5	Literate	882	566	316

6	Illiterate	818	298	520
7	Workers	660	402	258
8	Non-Workers	1,040	462	578

Rajasthan, Sawai Madhopur District, Sawai Madhopur Sub-District, Rural Area				
	Khilchipur Village No. of households: 1,252			
S. No.	Indicators	Persons	Males	Females
1	Population	6,661	3,469	3,192
2	Child Population	1,016	542	474
3	Scheduled Castes	1,612	817	795
4	Scheduled Tribes	1,668	879	789
5	Literate	3,758	2,538	1,220
6	Illiterate	2,903	931	1,972
7	Workers	2,848	1,728	1,120
8	Non-Workers	3,813	1,741	2,072

Source: *Economic and Statistical Organization, 2022*

Qualitative data was gathered from August to September 2022 from members of various stakeholder groups, including village leaders, key informants, forest managers, NGO staff, etc., in order to examine conflict from a number of perspectives and uncover and comprehend various aspects of the phenomenon. Our main data sources were interviews and a semi-structured questionnaire designed to investigate the major conflict themes found in the literature. Village leaders were identified in each community and the matter was deliberated. Next, with the goal of finding different people, ask each leader to suggest other community members for interviews. With new participants, this snowball referencing technique also aided in building rapport and credibility. Additionally, interviews with non-community members were conducted; these individuals included park managers and representatives of nearby NGOs (Non-Government Organisations). Our sampling strategy produced a wide range of viewpoints from locals, village chiefs, and other important informants from

villages around the park's boundaries. Participants were from various castes, sexes, jobs, socioeconomic origins, and educational levels. In RNP, interviews were conducted with fifty individuals from four villages. The participants included two forest rangers, two NGO personnel, two tourism employees, nine community leaders, and important community informants.

The study took into account three main concepts: interactions with external stakeholders (forest managers & NGOs), village life and community relationships, and the experience of living close to a forest. Every interview was done, and better understanding of the problem was obtained by asking follow-up questions where participant answers suggested disagreement or conflict. All locations conducted interviews in Hindi. Informal discussions with locals and on-the-ground observations were used to complete the interview data during the data collecting periods as the researcher became acquainted with the communities at both sites. These were recorded in the author's field notes and memoranda, which preserved objectivity, allowed for the extraction of more meaning from the data, and made it easier to evaluate the material in light of the circumstances in which it was gathered (Birks & Francis, 2008).

4.12 DATA ANALYSIS

With the participants' consent, interviews were taped. The author then transcribed and translated the interviews into English. A directed content analysis method was used to analyse the data (Hsieh & Shannon, 2005). By using this method, we were able to guide the first coding categories based on the ideas under study and previous research (Madden and McQuinn, 2014). To make sure everyone was comfortable with the facts, the interviews were read multiple times. After reviewing each interview, the author produced a summary table that included the main ideas from the study (such as prejudice, distrust, and resource access). After developing a preliminary coding technique, conflicts between humans and wildlife as well as between humans and humans were recognised and coded (represented disagreements between two actors,

where one operated against the interest of the other).

This approach aided in the discovery of other conflict-related sub-themes. In order to reduce the possibility of misunderstanding, context was provided for the interview responses using information from casual discussions and participant observation. We were able to distinguish between the features of conflict that were distinctive to each site and those that might be applied to other sites by contrasting the findings from each one.

4.13. RESULTS AND DISCUSSION

Our study's conclusions show that access to natural resources and interactions between people and wildlife gave rise to physical confrontations around parks. But after more investigation, it seemed that two deeply ingrained factors—power disparities and exclusion as well as discrimination and mistrust—were responsible for these superficial confrontations. In the ensuing sections, we examine these intersecting themes of conflict between humans and wildlife as well as the contextual elements that support them.

4.14 ACCESS TO NATURAL RESOURCES

Communities at both locations saw access to natural resources in and around the parks as a major concern. On the other side, the communities surrounding RNP relied less on park resources. For instance, the community's need on the forest for firewood has decreased due to the increased availability of cooking gas (also known as LPG, or liquefied petroleum gas) in the area. Nonetheless, a number of pastoral communities who relied on the park have encountered difficulties in providing their animals with the necessary grazing space. A significant informant claims that this has affected the methods used to raise animals. "Earlier, we could graze all of our livestock and use the milk we sold to raise and feed our families," he clarified.

Since we can no longer graze our animals, very few of us still raise them. Many people in the neighbourhood are wary of the Forest Department's grazing rights

because they are a contentious issue. Another local resident revealed, "If we venture into the jungle, they catch us. Penalties are due to us. They've assaulted us. imprisoned.

While RNP members were less concerned about subsistence park uses, many were concerned about how park-related restrictions would affect cultural traditions. A few village elders voiced concerns about the limitations imposed on visiting places of worship in the park, saying, "Our shrines were established their hundreds of years ago when our villages were inside the forest. When we were requested to move, we did so, but how can we move a shrine that has been there for a century? We are unable to visit our gods when we would like to since they reside inside the jungle. Despite these problems, it seemed that most people in the RNP community understood the importance of rules and regulations.

In RNP, subsistence park usage was less of a worry, but cultural practices were a concern for many participants due to park-related restrictions. "Hundreds of years ago, our villages were inside the forest, so our shrines were built there," a few village elders said in reference to the limits placed on visiting religious sites in the park. We departed when requested to move, but how can we move a shrine that has been there for a century? The forest is home to our gods, yet we are unable to visit them whenever we like. Notwithstanding these problems, the majority of people in the RNP community seemed to recognise the importance of laws and guidelines.

4.15 THE 'CORE' OF THE ISSUE

The way the PAs were established and defined is at the heart of the access "problem." The majority of Indian tiger reserves are divided into zones that determine human activity levels and guide conservation and management strategies (Ebregt & Greve, 2000). With the exception of very little research and management activities, the core is a strictly protected area. The buffer zone, often referred to as the "multiple-use zone" or the "transition zone," typically encircles and borders the core. The idea behind buffer zones was to reduce the

amount of human effect on the core; over time, these buffer zones evolved into social spaces for things like agriculture, cooperative conservation, reserved forestry, controlled resource exploitation, recreation, and tourism.

But because RNP has a varied core-buffer zonation, its forest access problems are different. The Sawai Man Singh and Keoladevi Sanctuary, which are nearby, serve as a buffer between the core conservation zone, also known as Critical Tiger Habitat, which encompasses almost the whole national park. But unlike buffers, these sanctuaries do not completely enclose the centre. Since Ranthambore is one of the few parks in India that allows tourists in its core, access is made possible by tourism. Similar to resource exploitation, tourism may be detrimental to conservation if it is not controlled, according to a community member. "(Managers need to) be stricter with tourism and tourists; as strict as they are with the locals," the participant said. "To watch wild animals, tourists pay a lot of money," said a member of the neighbourhood.

"They (forest managers) have driven us out and placed restrictions on us because they don't like it when they see our animals grazing (in the forest while on safari)." Some community members were also offended by the fact that forest access was preferentially granted to visitors over locals.

4.16 SHORT-SIGHTED INTERVENTIONS

The site has implemented a number of intervention techniques to address local resource usage needs. One of the primary factors influencing forest use is access to firewood. Local communities are given alternatives to forest fuel for cooking in an effort to lessen their reliance on government and non-governmental organisation assistance. Even so, RNP introduced these kinds of interventions a long time ago. The switch to liquefied petroleum gas, or LPG, at the location was seen as a safer option for the women who were typically in charge of gathering firewood from the forest. They were able to spend more time with their families as a result of this change. Notwithstanding these advantages, a number of RNP households voiced worries regarding LPG and

its distribution network.

Their traditional cooking tools are not compatible with modern cooking burners. Consequently, purchasing appropriate cookware adds to the expenses that community members must pay. Furthermore, cooking gas is supplied to these communities in cylinders that are frequently refilled and redistributed. For a family of four, a 14- kilogram cylinder of gas lasts a month; however, larger families found that frequent refilling and the ensuing expenditures were an issue. Even government-subsidized cylinders were too costly to be a long-term firewood substitute for small-scale landowners and farmers without access to land. As an RNP informant put it, "Yes, we have petrol cylinders." However, some really low-income families are unable to pay for cylinders on a monthly basis. Thus, their reliance on the forest persists. At both places, firewood was also seen as a vital source of heat during the winter months when the temperature drops significantly.

For example, some RNP settlements received less than 10 hours of electricity each day, while others had access to up to 18 hours. There was barely enough solar electricity available in many isolated RNP settlements to run two lightbulbs. More information about the problem was provided by an RNP community member: "Water scarcity is a major problem. Here there stood a communal handpump that was controlled by hand; however, the government replaced it with a motorised borewell. Because there is no electricity, we can hardly utilise it. On a good day, we receive two to three hours of electricity. And latrines? In the community, there is a toilet in every home. But since we lack water, we don't use them. A local RNP community leader claims that these flaws are inevitable because these regulations are "conceptualised by officers who sit in air-conditioned offices," who have little to no background knowledge of the procedures and reality on the ground. The effectiveness of initiatives and programmes meant to raise community standards of living through expanding access to resources is jeopardised by these disparities.

4.17 HUMAN-WILDLIFE INTERACTIONS

Communities surrounding RNP experienced a great deal of human-wildlife conflict because of their closeness to the park. For both sites, crop-raiding is frequently caused by Nilgai (Boselaphus tragocamelus), Spotted Deer (Axis axis), Wild Boar (Sus scrofa), and monkeys. The Asian elephant, or Elephas maximus indicus, poses a significant danger to agricultural operations in RNP. Elephants were considered a seasonal threat by the locals. Due to the frequent attacks, several people in the neighbourhood constructed makeshift houses on the edge of their fields so they would be prepared for any herds that might approach. Elephants were thought to be dangerous and difficult to drive away. When recounting a close experience with an elephant, a community member said, "They are a different story altogether." Too large to be affected in any way. My tractor has approached one up close. I tried to force it out of my field by stopping it directly behind it. And it spun around to look at me. I assumed it would pick me up right off my tractor because it was so close. Acres of arable land can be severely damaged by even a small herd of elephants. This can be disastrous, particularly for small-scale farmers who cultivate rice for food and sugarcane for trade.

Except in a few locations where tiger movements were noted and a few cases of livestock loss, community members in the RNP did not report encounters with tigers. This might have happened because there weren't as many tigers in the area.

RNP has a higher tiger density.

Nearly 57 tigers are thought to be present in the reserve's central region, according to a local non-profit dedicated to tiger conservation. For fifty to fifty-five tigers, the whole Ranthambore Tiger Reserve provides a sustainable habitat. This results in livestock losses for the entire local community, even if it also makes the area appealing for tourists and tiger viewing. Tigers are a source of terror for the people, who must exercise caution and vigilance when

out and about. “Tigers are really frightening. Once the mustard starts to grow, they will begin to stalk the fields. We are reluctant to enter our fields.

A number of participants stated that other wild animals posed a problem as well, particularly those that were thought to be pests that ruined crops. In reference to wild boar, a community member said, "I've been trying to grow jowar for the past five years." I never yield more than one sack's worth of produce.

4.18 COMMUNITY ACTION AND CONFLICT MITIGATION STRATEGIES

The ways that communities within the parks responded to conflicts between humans and wildlife varied. Because a village's farmlands are adjacent to one another, in RNP, responding to conflicts involving sambar raids on farms requires cooperation. In a single raid, sambar herds destroy acres of cropland by moving over multiple fields. Consequently, farmers cooperate to eject animals. Furthermore, as other community members have confirmed, it takes more than one person to chase away sambar. In sambar-related conflicts, villagers typically rely on one another more than the Forest Department. The reason we don't rely on foresters to resolve conflicts between humans and wildlife is that they live too far away.

It will all be over by the time they reach us. It is the forest that separates us from them. In addition, the closest chowki only has two or three patrons. What impact would that have? The department's ability to respond is impacted by the remoteness of the settlements in the area, the difficulties in timely communication, the state of the roads, and the shortage of resources. Nonprofits such as the World Wildlife Fund (WWF) provide raid-prone villages with firecrackers and lights as sambar-deterrent tools. The people in the community want additional long-term fixes, such as boundary walls and electric fencing. They believe that these measures alone won't be enough to entirely halt Sambar, though.

Similar crop pest prevention measures have already been put in place in RNP, however locals claim that their effectiveness is quite low. A lot of people in the neighbourhood erected fencing around their fields, sometimes with help from neighbourhood initiatives. When describing the inadequacy of fencing tactics, a community member said, "Wild animals have figured out ways to get around them." The leap over or the dig under. These creatures don't even let the seeds to sprout. Like killing a child in the womb, that's how it is. A boundary wall encircles the outside edge of RNP as well. Rather than reducing conflict with wildlife, this wall made people more irate. Many residents of the community complained that the boundary was not high enough and that poor maintenance had caused it to break multiple times, making it simple for wild animals to cross. Some neighbours believed that erecting a border wall was unjust. Predators and ungulates from the park could still access their fields, but they could not enter the forest with their livestock. Someone in the community yelled, "I thought we had an agreement." that a boundary wall be built around the park to prevent us from grazing our animals, as this damages the forest. Alright. Nevertheless, their animals continue to roam outside and harm our crops. Is that equitable? Therefore, techniques for reducing conflict instead increased conflict.

In human-wildlife conflict scenarios, community people from both study sites reported a common perception that the Forest Department did not give a damn about humans. Locals believed that the forest authority would apprehend and/or fine the community members right away if an injured or dead forest animal was discovered. But the forest officials did little to address the problems of people in a timely manner if they incurred losses that affected their means of subsistence. “The Forest Department only responds to wildlife issues when a tiger is involved,” said an RNP informant. Here, only tigers thrive. Pay plans Although participants from both communities accepted that compensation programmes exist, there was a widespread perception that these initiatives are

ineffectual.

However, an RNP farmer described how laborious the compensation procedure is: "At least two years ago, a sizable sambar group entered the field. They caused a great deal of damage; around two acres of Bjara were lost. We filed a request at the range office and alerted the authorities. We have not been compensated as of yet. Who knows what happened to that money? Likewise with wild boar. The Forest Department doesn't even consider grievances regarding losses caused by wild boar. Another DNP important source stated that the process of submitting for compensation was made more expensive in multiple ways due to the unfavourable state of the roads and the absence of cellular network connectivity. Participants in RNP also expressed dissatisfaction about compensation plans not covering crop-raiding damages. Furthermore, as one participant put it, "It's inconsistent," the compensation for cattle loss is meagre. To complete the papers, people come here. 2-4—even 12—months pass before the money is received. A buffalo costs INR 50,000, and with luck, we might be able to acquire as much as INR 10,000.

4.19 DISCRIMINATION AND DISTRUST

4.19.1 Local resident's perceptions of authorities

There was evidence of some community involvement in conservation in RNP, frequently because participants saw this as a possible source of income. A few locals helped with the tracking of wildlife and the installation of video traps to keep an eye on various species. They kept in close contact with partner NGOs and the Forest Department, reporting any changes regarding tiger movements. But in most cases, this kind of participation was restricted to one or two individuals within a community. A local elder stated, "NGOs are the conduits through which the Forest Department works in communities." They don't actually collaborate directly with us. Some residents of the village believed that the forest service was too focused on overseeing tourism to be concerned about

anything else.

Community people found it difficult to voice their complaints to forest authorities because of the uneven leadership. "We communicate our emotions to the officers. They promise to investigate. After that, they either don't or get moved. These people are aware that RNP offers them good financial opportunities. They thus concentrate all of their efforts on that.

Participants at the site questioned the goals of higher authorities and the Forest Department. Corruption frequently has an impact on interactions in RNP about forest access between the community and the forest workers. A number of participants indicated that in return for community members' access to the forest, forest employees would solicit bribes in the form of cash or produce. According to a respondent, village leaders may not have reported these incidents because they were personally profiting from them. For example, if I am the head of a village and the FD collects a "gulla" (set bribe/protection money) from the villagers, I will receive a part. Why then will I admit that I have an issue? They sever the village's togetherness. It resembles the British once more. Furthermore, participants believed that cross-border timber smuggling occurred in the area because forest employees were either involved in the crime themselves or were too busy collecting bribes from locals. As one participant put it, "Your neighbourhood will be frequently burgled when the cops are involved with the thieves." Criminals get away with their crimes because the police defend them. Otherwise, how can anyone get away with anything if law enforcement officials are so strong? It is unrealistic to expect the forest to be conserved if you are preoccupied with extorting money from a community in order to line your own coffers. Many people believed that the corruption they saw in the Forest Department was just another aspect of Indian bureaucracy.

NGOs were found to be a significant mediator in the growth of relationships between forest management and the community. RNP community members,

however, expressed their dissatisfaction with NGOs for starting conservation and community development initiatives that were frequently abandoned. While acknowledging that the task was difficult, an RNP community member expressed disappointment that NGOs did not devote enough time or patience to working with village communities, saying, "I think they don't do what they do consistently." Working with us may mean that on the first day, we don't understand, but after three to four days, you will notice a shift. Younger generations will pick up on this fast, even while older generations may take longer. Employees of NGOs are lazy. They just unwind after getting paid. Consequently, there was little community involvement in events hosted by third parties.

4.19.2 AUTHORITIES' PERCEPTIONS OF LOCAL RESIDENTS

During interviews, employees of NGOs and the Forest Department, two external players in the RNP, shared some fascinating perspectives on their experiences and perceptions of working with local communities. The forest personnel in Ranthambore National Park recognized that the people closest to the forest faced difficult circumstances and needed all the assistance available. Additionally, they thought that communities' reliance on forests was more psychological than practical. The mentality of a peasant leads them to feel that they must stockpile firewood. No matter how much firewood they have—even if it lasts them two years—it makes no difference. It doesn't matter if everything is just sitting there, decomposing, and covered in termites. They must experience security. They think that way. Under these conditions, officials acknowledged that disputes with the community would inevitably arise and that they (the forest employees) needed to develop coping mechanisms.

On the other hand, several external RNP stakeholders saw the locals as an annoyance that made it difficult to manage the forest. Many thought that the villages' existence was bad for the forest and that, in order to conserve the forest, the locals should be driven out. According to an RNP forest warden,

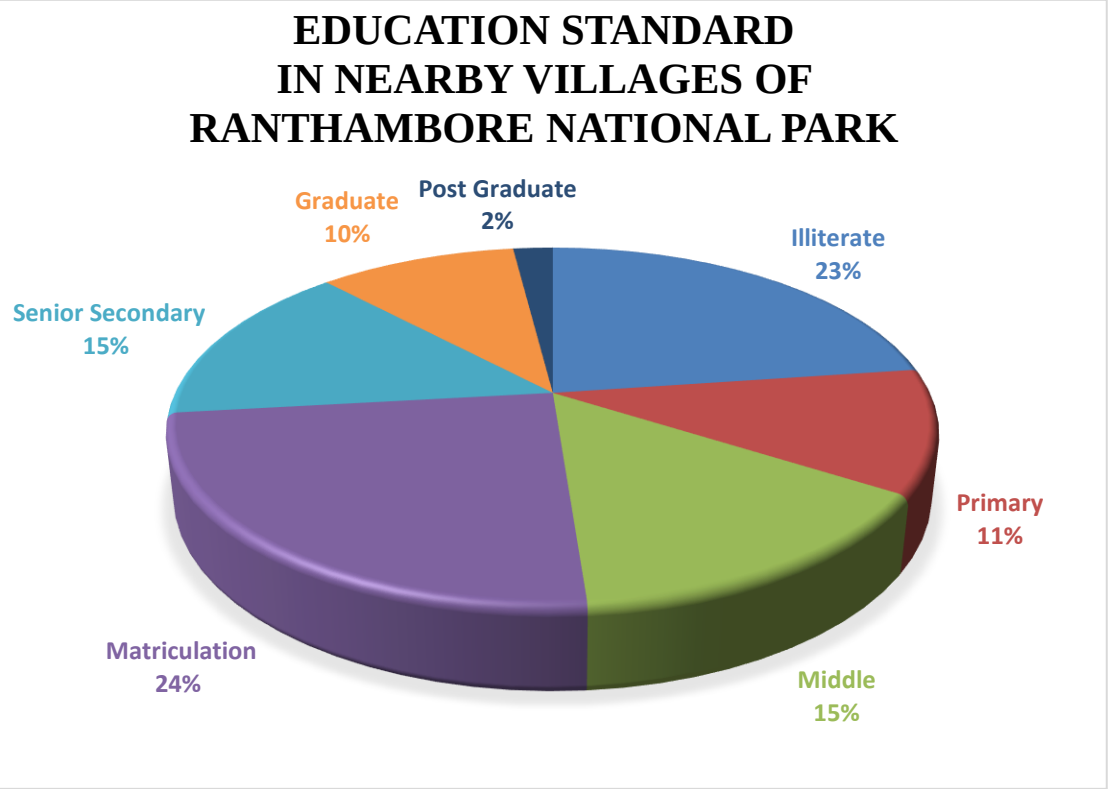
"They'll set one part of the forest on fire and then chop trees somewhere else while the staff is busy putting it out." The ethnic origins of the Gurjar community members may be the source of mistrust between them and the forest service. The Gurjar community has multiple stories concerning their ancestry. Some people identify as migrants from Rajasthan's "Thar" desert, while others identify as mixed-blood ancestors of Rajput aristocracy.

4.19.3 A FUTURE OF CONFLICT

4.19.4 PRIMARY SOURCES OF HUMAN-FOREST CONFLICT

Forest dependency often encourages community involvement in forest management, yet access restrictions in Ranthambore National Park have adversely affected pastoral livelihoods and tribal sociocultural rights. Wildlife-related losses, such as livestock depredation, have fostered discontent, exacerbated by inefficiencies in compensation programs, including bureaucratic delays and inadequate payouts. While carnivores like tigers garner more attention, herbivore-induced damages; despite being more frequent receive less acknowledgment, further fueling grievances. Physical barriers like boundary walls symbolize exclusion and reduce local agency, diminishing community trust in and collaboration with the Forest Department. Effective conflict resolution requires recognizing the socio-political context, addressing inefficiencies, and balancing conservation goals with local needs.

Figure no. 4.1

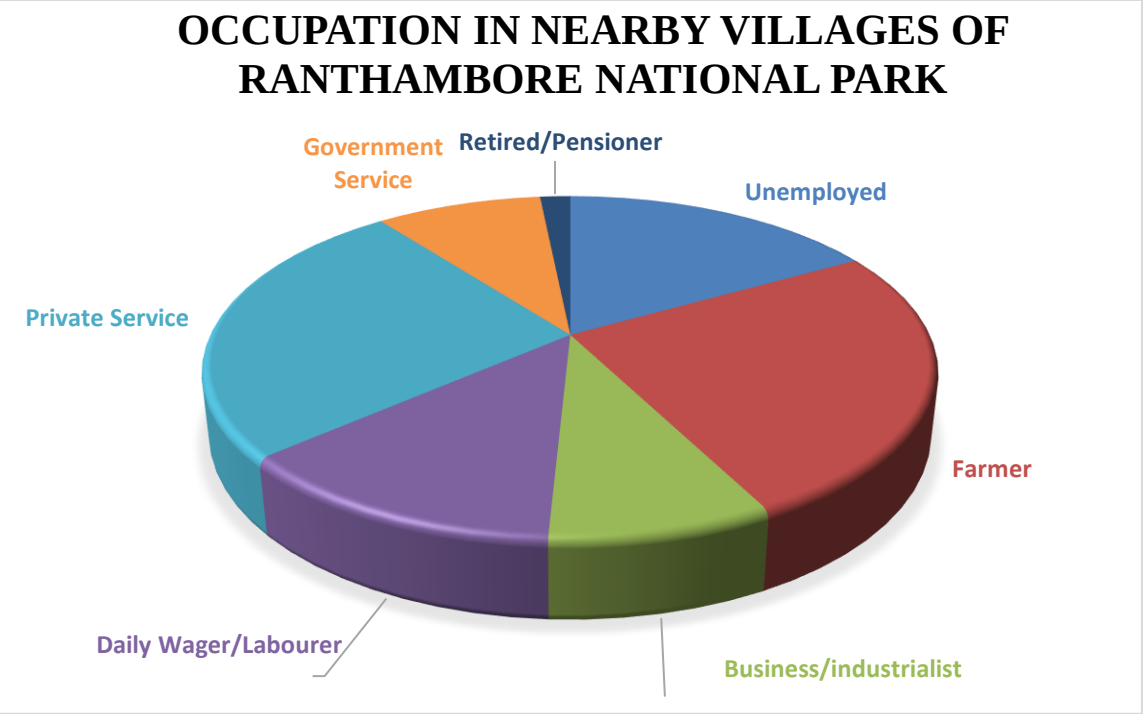


It was understood by park external stakeholders that there will always be conflicts in the vicinity of the forests. There is a limit to how many locals may be involved in park management and monitoring, even though it might be advantageous. The significance of many agencies and organisations (such as the Forest Department and non- governmental organisations) and their joint obligations towards the park and the community were acknowledged by the RNP participants. However, defining and carrying out each actor's distinct position and duty was essential to producing positive results in collaborative circumstances. According to a leader of an NGO in RNP that develops alternative livelihoods, "I understand that living here is not easy."

Since the community has begun to make some money, I can't expect them to suddenly stop travelling to the forest. They believe that access to the forest is something that other people enjoy, so just because they work doesn't mean they should be able to go? Therefore, there must be severe limitations on access to

forests. The Forest Department requests that we make sure that none of our employees are visiting the forest and that we dissuade them from doing so. We are unable to ensure that. NGOs that work on tiger conservation and education have this responsibility. What do they do? We came here to create jobs, so we're doing our job. And that's what we're doing. Some groups arrived here with the intention of conserving the environment, but their efforts fell short. Furthermore, even if our ladies are entering forests, there has to be a gap in the security or another method for them to enter, and the Forest Department is responsible for finding it.

Figure no. 4.2



In Ranthambore National Park Forest staff member emphasised the difficult job that forest officers had, revealing that insufficient capacity and few government resources frequently caused delays or obstructions in their actions. He shared some insight into the difficult situation faced by ground crew and forest guards when he said, "I started this job because I had to- and now I like it." You can't pay me anything and expect me to be pleased just because I do. Assure us that

this is a worthwhile endeavour. It's as like you've been forced into marriage, so you may as well get along with the person you have to spend the rest of your life with.

We live our lives like ‘lunatics’. Sometimes we forget that we work for the government. We appear so foolish and disheveled. People at home become perplexed about what our occupations entail. Forest officials may face obstacles due to scarce resources, even in cases when they are driven to interact with the community and seek cooperative solutions. However, an RNP forest official was sure that community conservation initiatives are never effective. "People say that to save face," he clarified. Nobody wants to own up to their mistakes. Furthermore, there are no residents living inside the forests in other parks where these initiatives are effective. There are sophisticated village networks here. How many people are you going to change? This sentence succinctly summarises the social tensions between different stakeholders that contribute to the difficulty of protected area administration Our research identified the more fundamental reasons for human conflict with forests and with other people in the vicinity of India's protected areas. Table 4.3 summarises our findings, which include contextual differences fuelled by distinct socio-cultural and historical factors as well as shared patterns of conflict across the sites.

TABLE 4.3

A SUMMARY OF CONSERVATION CONFLICTS ACROSS THE STUDY SITE

Items	Bases of Conflict	RNP
Superficial conflict	Forest Access	Conflicts around regulated forest access is partially addressed. Where unaddressed, people broke rules.
Deep-rooted conflict	Human-Wildlife Interactions	Focus on tiger related issues, while intense crop loss caused by ungulates are uncompensated Locals rely on forest managers to act.
	Distrust and Discrimination	Distrust between locals and Forest Department
	Power Inequalities and Exclusion	Community participation is sought but is selective (restricted to a few people in a community) to avoid internal rifts in the community.

Source: Data collected during survey

4.19.5 PRIMARY SOURCES OF HUMAN-FOREST CONFLICT

According to earlier studies, having a greater dependent on a forest may indicate a greater stake in the forest and encourage involvement in forest management. Although this seems to be the case in the park under study, there were also particular difficulties brought about by the communities' limitations and varying degrees of reliance on the forest. Denial of access to the forest in RNP directly affected pastoral livelihoods, which changed how animals were raised. Strict forest access regulations, however, were seen as a danger to the indigenous tribal populations' sociocultural rights and way of life.

Concerns about losses to animals and conflicts between humans and wildlife were also prevalent in the park. Compensation for losses caused by wildlife was a contentious topic, as it was in other studies. Many local residents were deterred from pursuing compensation claims by the inefficiencies of the programmes (e.g., laborious paperwork, delayed or non-existent payments, insufficient sums, slow reaction of forest authorities) (Barua et al., 2013).

"When a compensation programme works well, everything functions better," said one of our study's main informants. To clap, you need two hands. Thus, when one element is out of balance, everything else follows suit, leading to problems between them and us. Inadequately carried out initiatives foster mistrust among park managers, which is a critical barrier to effective conservation results. The risks of a community being dependent on compensation payments are highlighted by a number of research. This dependency could weaken or replace current conflict prevention methods. Compensation as a conflict resolution mechanism between humans and wildlife must take into account the socio-political context of the area, as this will undoubtedly impact the effectiveness of the programme. It's also critical to frame conflicts between people and wildlife.

Locals clarified that forest managers paid greater attention to losses resulting from specific species than from others.

Damage by carnivores, particularly tigers, attracted greater attention than the economic losses incurred by herbivores, which were more common in the park. Similar findings were found in a study conducted on four distinct protected areas in Rajasthan (Johnson et al., 2018). One of the main points of dispute at RNP was the existence of a physical barrier, sometimes known as a boundary wall, which kept people out of the park. Although the barrier was ineffective in stopping wildlife movements, it constantly reminded residents that the boundary was intended to keep people and cattle out of the park. All of these grievances contributed to a loss of local control in both parks, which decreased

the willingness of the locals to work with the Forest Department.

4.20 ADDRESSING SOCIAL DRIVERS OF CONSERVATION CONFLICT

The aforementioned instances show how disputes between resource exploitation and wildlife continue to exist. But under the surface, these arguments are reactions to underlying, identity-based tensions that affect relationships and workflows and necessitate a radical approach to problem-solving. Madden and McQuinn (2014) presented a Conflict Intervention Triangle as a broad framework for mitigation measures in order to resolve complex conflicts in conservation. The triangle draws attention to the substance, relationships, and process—three interrelated aspects of conflict that need to be addressed in order to create a lasting settlement or conflict transformation. "Substance" describes simple, surface-level disagreements. These disagreements showed up in our study as conflicts over resource access and unfavourable encounters between people and wildlife.

The "relationships" element arises in interpersonal disputes between people, as the actors' degree of mutual regard and trust can sometimes become a point of disagreement. In this study, connections were shattered and more conflict was sparked by mistrust and discrimination between locals and authorities (such as forest officials and leaders of non-governmental organisations).

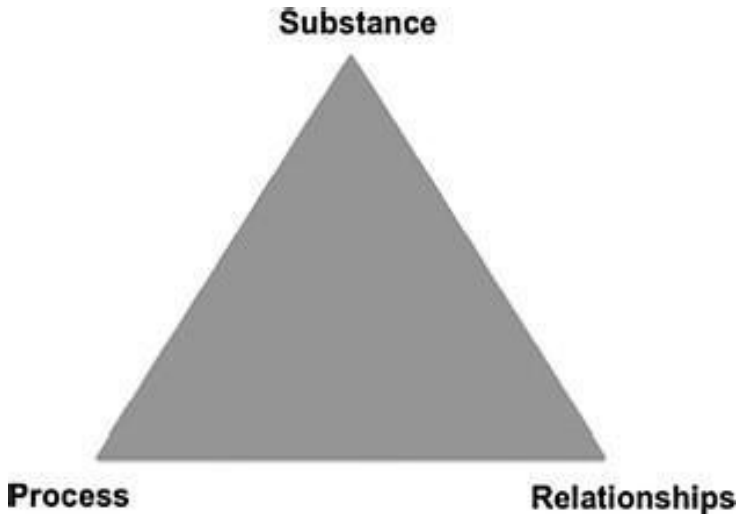
"Process" variables that contribute to conflict include authority, equity, and the manner and person in which they are exercised. In addition to supporting effective decision making about and commitment to concrete solutions, a good process "gives attention to dialogue and relationship building needed to foster dignity, respect, and trust among stakeholders," according to Madden and McQuinn (2014). It makes room for the resolution of ingrained social tensions, which increases the likelihood of coming to and upholding a conclusion regarding a disagreement.

Power imbalances between stakeholder groups affected relationships, encouraged exclusion, and hampered participatory decision-making in the

Indian parks we investigated. Working with many stakeholders and their varying interests and statuses is made more difficult by these imbalances.

Fig. 4. 3

CONFLICT INTERVENTION TRIANGLE MODEL WITH THREE POTENTIALS



Sources of Conflict and Three Dimensions of Conflict Intervention

(Madden and McQuinn, 2014: 102)

Community involvement and participation are necessary for finding solutions in these complex conflict situations. India is not an anomaly. Successful co-management initiatives that lower transaction costs and friction while giving residents more influence over decision-making can serve as models for managers (Ballet, Sirven, & Requiers-Desjardins, 2007; Berkes, 2009; Pretty & Ward, 2001). The management of sacred groves in India, where cultural and religious taboos have influenced sustainable forestry practices, is one area where these systems' benefits are evident.

But as our research demonstrates, a lack of trust amongst actors frequently puts a stumbling block in the way of cooperative initiatives. And this could incite community members to mobilise against forest managers, escalating conflict, when coupled with the disregard for their rights and needs. Even though it's

commonly known that community involvement and inclusion are important for reducing conflicts related to conservation, there are a lot of contextual factors to take into account when applying these ideas to special protected area sites. Building trust is particularly difficult in situations like RNP, where conflict is primarily motivated by ethnic or identity issues.

Moreover, obtaining funds from both governmental and non-governmental sources can make community inclusion and engagement a costly and drawn-out process. Our interviews showed that despite a lack of funding, numerous Forest Department units continue to do their jobs. Building trust with locals can be facilitated by establishing connections with NGOs that have stayed in touch with the community and by clearly defining roles and duties. Nonetheless, a push for power-sharing management regimes (i.e., a top-down, forest management regime) is intrinsically difficult in hegemonic organisations like the Forest Department, whose operations were founded and are still affected by colonial ideas and practices (Das, 2011).

In order to solve this, traditional conservation concepts must undergo a comprehensive revision in order to accommodate present and future conservation challenges.

It is often recommended that local populations be empowered through technical education that focuses on skill development and environmental education that emphasises conservation awareness (Mehta & Kellert, 1998). But forest managers and staff also need to be included in capacity building (Rodríguez-Izquierdo et al., 2010). A highly qualified and experienced group of managers of forests and natural resources work for the Indian Forest Service.

Nevertheless, cultural sensitivity and the social skill development necessary for conflict resolution are frequently lacking from their training (Miller, 2017). These abilities are especially important in Indian protected areas because these areas are home to historically marginalised, resource-dependent, and

sometimes divergent conservationist populations. Furthermore, while having a lot of influence among their communities, forest officers frequently fall prey to the political might of the government. As a result, police routinely move to other areas to fill different positions. This makes it more difficult to establish long-term, sustainable connections with NGOs and local communities—relationships that are essential to the success of conservation efforts. Even though it is advantageous, visiting local areas by higher leaders is not typical. Instead, interactions between local populations and forest guards and staff occur. The risks that forest guards and rangers deal with every day due to animals and unfriendly community encounters have been brought to light in a number of reports over the past year (Bindra, 2018). Because of this, forest employees may become demotivated and unwilling to engage and collaborate with communities. Building bridges and bolstering networks between local communities and institutions is crucial for successful co-management. Building relationships inside the Forest Department is also essential, particularly between the senior authorities who frequently make decisions remotely and the forest guards who work on the front lines of conservation.

SUMMARY OF CONCLUSIONS

5.1 Future Research Directions

There are various limitations to this study that could be addressed by future research on conservation conflict in and around protected areas. We may have limited our case study technique to the one site in the study because it was utilised to compare and contrast conflict scenarios in the park. It should be mentioned, nonetheless, that important motifs that surfaced at our location are extensively reported in the literature (Baynham-Herd et al., 2018). The author gathered the data on an individual basis in order to minimise bias (Huberman & Miles, 2002). In order to improve validity, when making inferences, triangulation was sought by requesting feedback from several sources of evidence (interviews, casual discussions, and community observations).

Even said, the researcher was not from the area, even if she knew the language well, which might have affected participant reactions (although interviews indicate candid and open responses). Participants may have overstated some of their losses because the financial side of human-wildlife conflict is a serious concern. Nonetheless, conducting interviews with other community members aided in creating a chain of evidence that increased validity. The power relations and disparities that exist between local people and forest managers and staff may have contributed to the overestimation or underestimation of the degree of conflict between these actors by many respondents. An easy solution to these issues is to extend the time allotted for fieldwork, which was a limitation on this study.

Despite our best attempts to incorporate a range of viewpoints, our sample size does not ensure a comprehensive representation of all stakeholder perspectives. Women from the neighbourhood, for example, were underrepresented in our research. The study was carried out in RNP in the premonsoon season, when the majority of women were employed in the fields. Future studies can concentrate

on gender roles in conservation disputes, particularly in situations where matriarchal societies (like the Tharu) oppose patriarchally informed, authoritarian forest management regimes, given their important role in the Van Samiti.

In Indian parks and protected areas worldwide, disputes over access to forests and interactions between people and animals are a major problem. Resolving these conflicts through effective mitigation techniques remains a top priority for management and researchers.

Deeper social disputes amongst stakeholder groups, however, might intensify these conflicts. According to Waylen, Fischer, Mcgowan, Thirgood, and Milner-Gulland (2010), our analysis highlights the necessity of mitigation methods that take into account the particular cultural settings surrounding each site, which are in turn influenced by various socio-cultural and political processes. Socio-ecological conflict models, which place human behaviour and actions within wider environmental and socio-cultural systems, could be used in future study (Rechciński, Tusznio, & Grodzińska-Jurczak, 2019; Stephanson & Mascia, 2014).

According to Manfredo et al. (2017), an approach of this kind might take into consideration values that are ingrained in a community's material culture, customs, collective behaviours, and institutions, as well as the institutional dynamics and stakeholder interactions that influence them. India has a number of particular conservation issues because of its long history of discrimination, power imbalances, and different traditional and cultural attachments to the natural world. However, paying close attention to these intricate relationships and settings might also open up special doors for cooperative conservation.

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