

Geo-Spatial Mapping of Sustainable Geo-Resource Management: A Case Study of Ranthambore Tiger Reserve, India

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1. Introduction

Natural georesources are the foundation of the human lifecycle. We are using these varied natural resources in different ways to satisfy our needs and deeds. However, natural resources are not substantially available for human consumption and both non-renewable and renewable resources are limited. Therefore people should be economical with their natural resources in a sustainable manner.

In many parts of the world, we are using natural resources in an unsustainable manner and creating a huge gap between demand and supply and then we talk about security, after we discuss on security, which is an unsuitable way. The degradation and destruction of natural resources are mainly due to over-use or a non-adapted use of these resources (Förch and Schütt 2005).

The connection between man and the environment has been established in early history itself. Human beings live in the realm of nature and interact with it continuously. The effect of nature is in the form of the air we breathe, the water we drink, the food we eat, and the flow of energy and information. Any alteration in the ecosystem cannot only result in devastating effects but can also pose a threat to the human species.

Meanwhile “geo-resources” denotes all geological capitals that are used by humankind, such as groundwater, mineral resources, energy production, underground space for construction and storage, and the surface geology and landscape. In this space, humankind continuously encroaches resources from top to bottom, which affects the whole environment ecosystem, because they are directly and indirectly connected.

Sustainable environment conservation can lead to a better development of ecosystem services as well as community development (Armatage 2005). The ecosystem services are defiantly mitigated for climate change such as conserving the habitat, water quality, quality of life, global carbon cycle, economic growth, demographics, agriculture, and forest products, regional and planning policies through tiger conservation practices.

The Ranthambore Tiger Reserve has more than

60 tigers and about 0.5 million people directly or indirectly interdependent on tiger ecosystem services. Tiger conservation practices influence both environmental quality and the quality of life of native people. Alterations in habitat, water and air quality would contribute to the environmental, social and economic aspects of local communities.

In biodiversity, tigers play pivotal roles in regulating and maintaining ecological equilibriums. In India, tiger species are living in high mountains, semiarid areas, mangrove swamps, and grasslands; these are the main habitats for a thriving population of tigers. In the present context, global climate change has an indirect consequence of tiger species and their habitat.

It is seen that a healthy number of tiger species means automatic conservation of biodiversity. There is a growing need to take prominent initiatives towards conservation of tiger species and other wild species as there are every day man-tiger conflicts, unnatural death of tigers, water scarcity in protected areas and other wildlife issues. The sustainable ecosystem services are provided a valuable framework for analyzing and acting on the linkages between local to global communities and their man-environment relationships, so that it will be more fruitful and sustainable for human well-being and the future Earth.

Therefore, my focus is on community development through biodiversity conservation and a climate change mitigation approach, possible through a capacity building program, maximum public participation, development of an indigenous community, as well as restoration of the corridor, corridor planning etc. (Leach et al. 1999). Therefore my concept is based on the community development model of geo-resource management (Kellert et al. 2000).

Hence, it will prepare one consensus and vision for sustainable development which is more holistic, inclusive and ecological in its approach (Grimble and Wellard 1997). The main outcomes of ecosystem services provide a valuable framework for analyzing and acting on the linkages between local to global scales and their man-environment relationships so that it is more fruitful for human well-being and the future Earth.

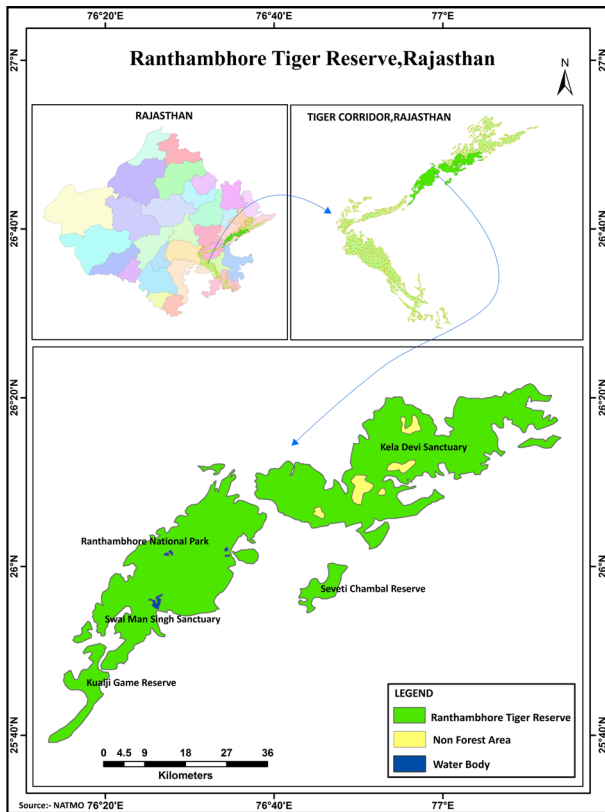


Figure 1: Location Map of Ranthambhore Tiger Reserve

2. Study Area

In India, the Tiger corridor of Ranthambhore is located amid latitudes $25^{\circ}52'071''$ N to $26^{\circ}33'713''$ N to longitudes $75^{\circ}85'84.0''$ E to $77^{\circ}02'48.0''$ E at the intersection of the Aravalis and Vindhyan mountains (Fig. 1). The corridor ensures a tiger habitat in an area of 6741.73 km^2 and it is home to over 60 tigers. Especially the core area of the corridor is well known in Ranthambhore, of which the habitat is 1113.36 km^2 and the buffer area is 297.92 km^2 (Fig. 1). It is a total geographical area of 1411.28 km^2 . The Ranthambhore is a hotspot of tiger population and marks the transition zone between the real deserts and seasonally wet peninsular India. It is connecting from Keoladeo, Van Vihar, Ranthambhore, Sawai Mansingh, Ramgarh, Jawahar Sagar, and Dara sanctuaries. As per the biogeography classification (Rodgers & Panwar, 1988), it falls in 4 B (Semiarid zone and Gujarat-Rajwara biotic province).

3. Research Methodology

The research methodology is summarized in Fig. 2.

4. Results and Discussion

The geo-resources of the Ranthambhore Tiger Reserve provide an abundance of natural and cultural services. Land, water, soil, plants and animals, with particular natural resources affect the quality of life

for both present and future generations of Ranthambhore. Geo-resource management deals with the many ways in which people and natural landscapes are connected (Holling and Meffe 1996). It brings together land-use planning, water management, biodiversity conservation, and the future sustainability of geo-industries. Geo-resource management issues are complex as they involve the geological cycle, ecological cycles, hydrological cycles, climate, human beings, animals, plants and biogeography etc. In this paper, numerous approaches are included such as Top-down, Bottom-Up, Adaptive management and Precautionary approach. Finally, all approaches are integrated within a sustainable manner framework.

Ranthambhore tiger reserve consists of two parts, viz., 'a core or critical tiger habitat' and 'a buffer or peripheral area'. Section 38V 4(i) of the Wildlife (Protection) Act, 1972 (hereinafter referred to as WPA, 1972) explains Core or Critical Tiger Habitats (CTH), identified based on scientific and objective criteria (Fig. 3), as "areas of National Parks and Sanctuaries to be kept inviolate for tiger conservation, without affecting the rights of the Scheduled Tribes and Other Traditional Forest Dwellers". It is notified as such by the State Government, in consultation with an Expert Committee constituted for the purpose (Fig. 3).

Section 38V 4(ii) of the WPA, 1972 explains 'buffer' or 'peripheral area' as "consisting of the area peripheral to the critical tiger habitat or core area, where a lesser degree of habitat protection is required to ensure the integrity of the critical tiger habitat, providing supplementary habitat for dispersing tigers, besides offering scope for the coexistence of human activity (Prain 2006)."

The map of relief and slope of Ranthambhore is showing mostly rugged, hilly and rough land topography area. The formation of the ground is intimately related to the Great Boundary Fault. The hills to the NW of this fault are typical for Gwalior and lower Vindhyan and are considered by ridges on one side and a gentle slope on the other side (Fig. 4).

Gwalior and the lower Vidhyan tract are highly undulant except for a few small plateaus like Salwata ki Dang, Rann ki Dang and Mandook, and some small valleys like Kachida, Anatpura, Berda, Lakeda and Malik Talab. The climatic map shows semi-arid climatic conditions and is characterized by a sub-tropical dry climate with distinct cold from November to February, hot climate from March to June, and rainy season from July to September. October is a conversion period. The highest temperature (around 47°C) is recorded from May to June and the lowest (around 2°C) in December to January. The diurnal variation of

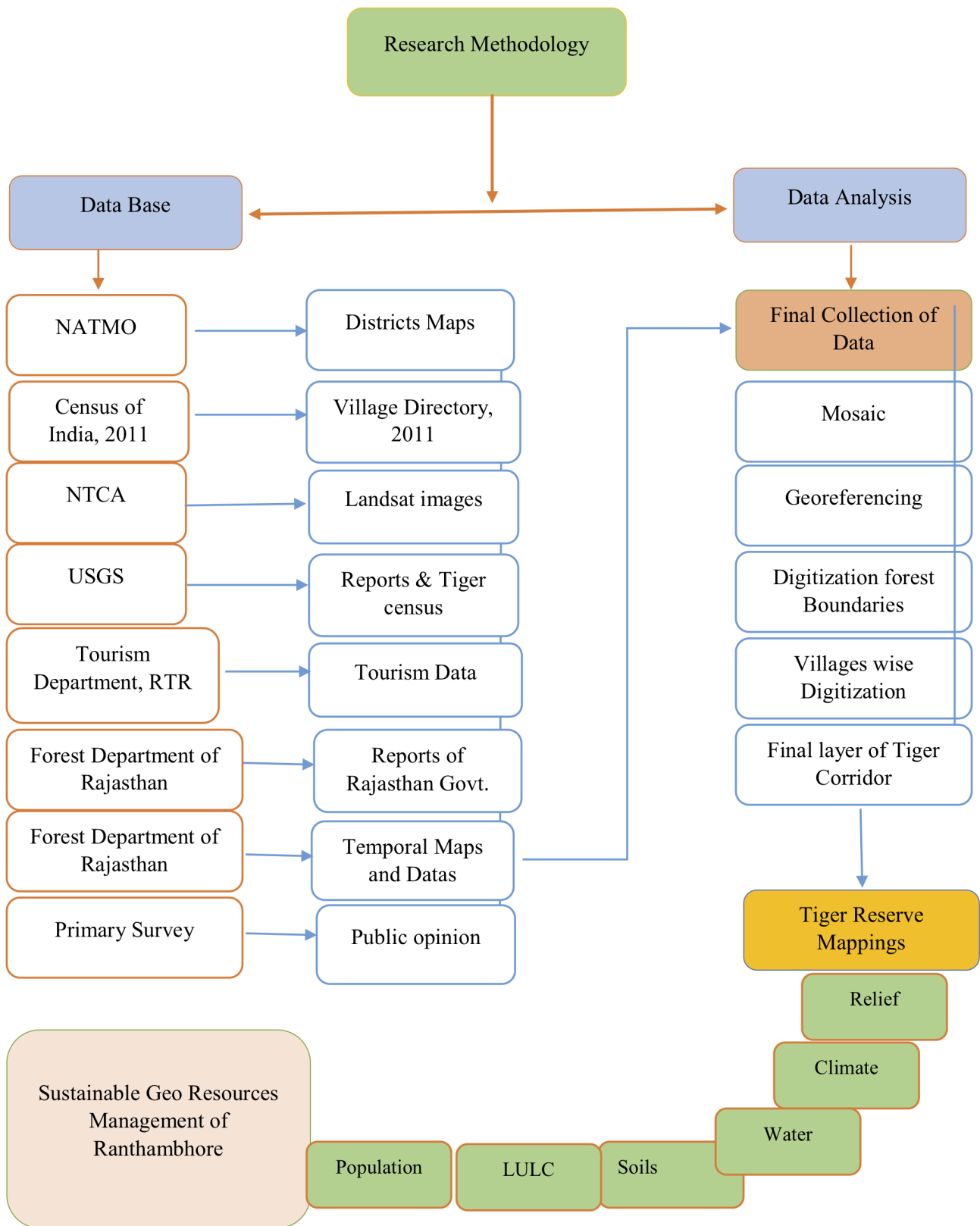


Figure 2: Research Methodology Chart (Database and Data Analysis)

temperature is high. Relative humidity on an average is 30 to 34 %. Strong wind in summer is called “Loo” (Fig. 4).

In Ranthambhore, geomorphologic characteristics have a unique pattern. In this area, there is much topography such as rocky, forest, ravine, rivers, reservoirs, and sandy areas. These landforms are a composite of numerous rocks and minerals. Ranth-

ambhore Tiger Reserve terrain is mostly formed by Pre-Cambrian metamorphic, igneous, and sedimentary rocks belonging to pre-Aravali Vindhya. Pre-Aravali rocks units, quartzites, micashochs geneuses, and migmatites cover the north-eastern part of the tiger reserve between Lalsot and Karauli. The rocks of the Vindhya super group are characterized by the Kaimur, Rewa and Bhandar group, and consist

ADMINISTRATIVE DIVISION OF RTR

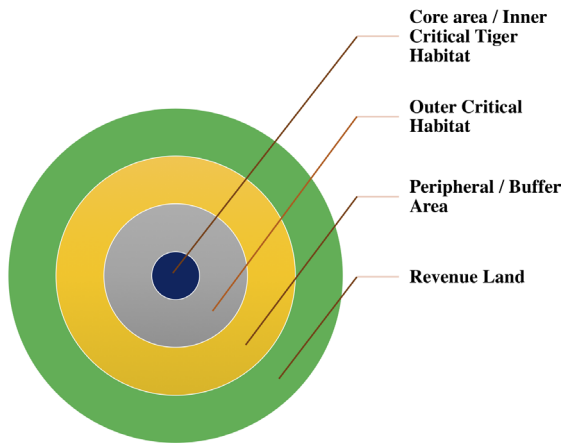


Figure 3: Administrative Division of Ranthambhore Tiger Reserve

mainly of various types of sandstones, and limestones. The geologic structure of the Ranthambhore Tiger Reserve area has a strong influence on the soil types, which in turn also determines the vegetation type. In these particular areas where quartzite forms the uppermost strata, the soil is impoverished and unhealthy for agricultural land. These areas have a very thin layer of coarse-grained soil in the slate and shale areas of Gwalior areas and the soils are fine clayey and shallow. Ranthambhore soils have very little fertility due to numerous physical and man-made

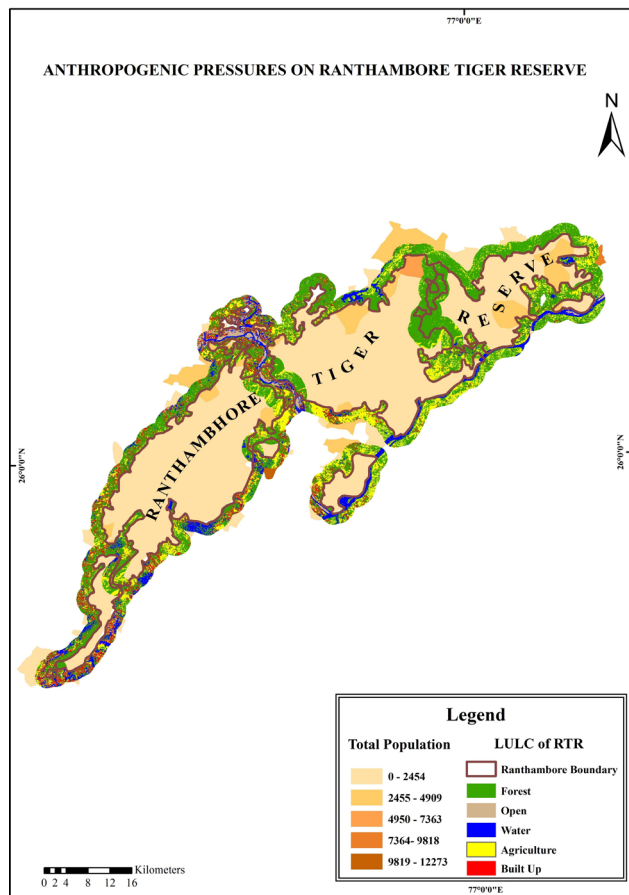


Figure 4: Anthropogenic Pressures on Ranthambhore Tiger Reserve.

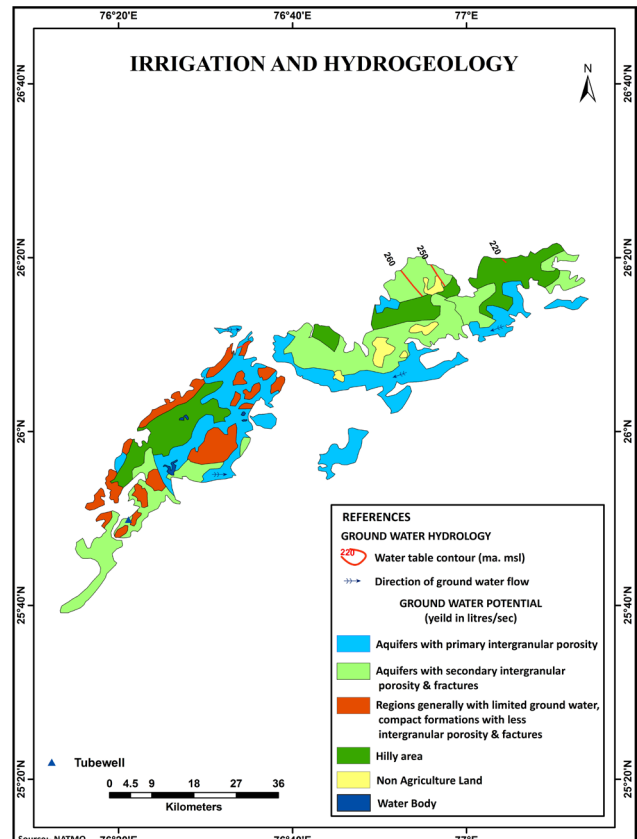


Figure 5: Map of Irrigations & Hydrology of Ranthambhore Tiger Reserve.

causes.

Ranthambhore area has good water availability due to the mountain region and unique topography as well as a forest ecosystem. But at some locations governments and forest staff created artificial pond structures through water conservation methods, which are very fruitful for wild animals, plants and groundwater ecosystems (Fig. 5).

The Ranthambhore area has natural assets as well as cultural assets that are conserved through sustainability. It has a UNESCO cultural site, archaeological sites, Tiger Safari, Rural Tourism and other recreational sites. They are all sites attractive for tourism, which contributed much in comparison to other services in Ranthambhore areas (Fig. 6). However, geo-resources are used too much and encroachment by human intervention is unhealthy for the ecosystem. Numerous challenges of the Ranthambhore area, with a lot of people surrounding the tiger by safari and forest cutting. Grass cutting is not allowed in the areas reserved for “No Go Zone Area” or Eco-Sensitive Zone. Therefore local people cannot build own houses and development activities in such zones, a limitation of development activities that may harm quality of life. Other areas are reserved to prevent forest wildlife and creating a start-up for geo-resources management (Fig. 7).

IMAGES OF CULTURAL RESOURCES OF RTR

UNESCO Cultural site



ASI Historical Site



Clean Tiger School



Wildlife painting at SWM Railway Station



Figure 6: Images of Cultural Resource, Ranthambhore Tiger Reserve.

5. Conclusions

Conservation of the tiger habitat is very important for the sustainable development of the Ranthambhore areas. The area is a reserve for tiger breeding and flourishing as well as for other wild animals. But nowadays, we are devoting millions of dollars for

the tiger conservation program because the tiger is an umbrella species. Its conservation automatically ensures the conversation of flora and fauna and the entire ecosystem. The strength of the Ranthambhore Tiger Reserve is in its iconic natural capital, biodiversity and attractive beauty, therefore the region can

CHALLENGES OF RTR

Tourism Pressure



Old Occupation



Movement of Local people



Condition of House in Core areas.



Figure 7: Challenges and Issues of Ranthambhore Tiger Reserve)

provide a wide range of ecosystem services in terms of supporting, provisioning, regulating and cultural services (Soni 1999).

Cultural services are strongest among all of them. At present, the growing demand for these services has put an immense burden on the ecosystem of Ranthambhore, as well as other tiger landscapes that are significantly undervalued in national and global agendas. As a result, degradation, fragmentation, human-wildlife conflicts and loss of natural habitats, depletion of prey animals, and poaching to supply a large illegal global trade in their body parts have pushed wild tigers and their landscapes to the brink of extinction (Karanth et al. 2004). These threats are alarming for biodiversity and human wellbeing.

Therefore, we should work on sustainable development of tiger landscapes, because the ecosystem services defiantly mitigate for climate change such as conservation of habitat, water quality, quality of life, global carbon cycle, economic growth, demographics, agriculture, forest products, regional and planning policies through sustainable practices.

Eventually, "saving tigers is our test, if we pass, we get to keep the planet" (Marjorie Stoneman Douglas). Tiger conservation is contributing to the increase of carbon storage and sequestration (Velmourougane et al. 2014), poverty alleviation, watershed protection, natural hazard regulation, sustaining food security and agriculture services of Ranthambhore areas. That is possible through maximum public participation, to the community development program, and the development of a holistic, inclusive, and sustainable method, which is sustainable for all stakeholders.

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