

ASSESSING SPATIO-TEMPORAL TRANSFORMATION IN THE LANDSCAPE OF KAZIRANGA NATIONAL PARK, ASSAM, INDIA (1914-2016)

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ABSTRACT

The Kaziranga National Park has undergone tremendous landscape transformation over the years and faced with several issues, the most being nature-induced issues of flood, erosion, siltation caused by the river Brahmaputra. Besides, there are many man-induced issues like poaching, habitat degradation and encroachment in peripheral areas that makes park management challenging. During this study, an endeavour has been created to accentuate the historical evolution and administrative jurisdiction of the Park landscape and to assess the landscape transformation in the core area of the Park over the years. The changes within the core area were determined for the year 1914, 1967 and 2016 by using Geospatial technology. Spatial data for the first two sets are derived from topographical maps of Survey of India along with Google Earth images for 2016. The study reflects vital changes in the core area in terms of grassland, woodland, water bodies, wetlands and sandbar. Correct habitat management of the core area is crucial to conserve and protect the wildlife of the park.

Key words: Habitat management, historical evolution, landscape transformation

Cite this Article: Alexis Pinheiro and Prasanta Bhattacharya, Assessing Spatio-Temporal Transformation in the Landscape of Kaziranga National Park, Assam, India (1914-2016), *International Journal of Advanced Research in Engineering and Technology*, 11(10), 2020, pp. 507-515.

<http://www.iaeme.com/IJARET/issues.asp?JType=IJARET&VType=11&IType=10>

1. INTRODUCTION

Evolution of the modern concept of protected areas can be dated back to the setting aside of Yellowstone National Park in the United States of America in 1872 (Child,1992). Protected areas, especially national parks are formalized for territorial protection of outstanding natural phenomena or cultural relicts. Although individual nations designate their own national parks differently and have different priorities, there is a common idea; the conservation of wild nature for posterity and as a symbol of nation pride and to preserve the unique landscape. In Assam, the local people living near the forested areas traditionally inherit the idea of protecting wildlife and nature. The idea of seeing nature as part of their life continues till western ideas of commodity culture intruded to this part of the world under the British colonial rule. Extensive and uncontrolled use of forest products was an interesting paradigm shift to native, nature friendly ideas in the initial phase of British regime. Large virgin forest cover were replaced by tea gardens, wooden sleepers were used to lay new railway lines in the state and remaining forests provided refuge to wild animals and big games that satisfy the need of hunting spree of British, and the idea of game reserve came into being (Saikia ,2009). Such excessive exploitation later on led to the idea of the need for conservation, even amidst some sensitive colonial administrators. The British formalized the idea of conserving areas for protecting forests and wildlife assets. The forests of Assam, especially *Sal* forest of Kamrup and Goalpara districts in particular were inspected by Dr. Brandis, the then Inspector General of Forest in 1862. In pursuance of his advice it was considered necessary to adopt measures for preservation of forests. Thus the idea of conservation was conceived. So, steps were taken to increase reserved forests without losing time (Department of Forest, Assam). As the animals were becoming rare in such pockets and other areas of the state, some of such pockets were promoted to wildlife sanctuaries and subsequently to national parks in the post independent era. Kaziranga is the first National Park of north-eastern part of India, that came into existence in 1974, mainly to protect Rhinos (*Rhinoceros unicornis*) and its habitat and subsequently able to prove as an important habitat for the conservation of tiger and also emerged as an important tourist destination of the region. Unfortunately, the rapid natural and anthropogenic changes has resulted in rapid landscape transformation each within and peripheral elements of the protected area. The sole escaping way of such dilemma lies in effective management of the protected areas with an appropriate institutional framework that can maximize the ecological benefits and sustain the habitat of Rhinos and other wildlife.

1.1. The Study Area

Kaziranga National Park lies between latitudes 26°34'N to 26°46'N and longitudes 93°08'E to 93°36'E. It is spread over the jurisdictions of Nagaon and Golaghat districts in Assam with mighty Brahmaputra River on the North and verdant Karbi Anglong hills on the South. The flat expanse of fertile, alluvial soil, which forms by erosion and is deposited by the Brahmaputra River is a peculiarity of the park. The total area of core zone of Kaziranga is 429.93sq.km. The adjoining Panbari RF and Kukurakata RF, each with an area of 7.65 sq km & 15.93 sq km respectively, are also a part of the overall management of the Kaziranga National Park. Thus, the total area of Kaziranga becomes 882 sq km.



Figure 1 Location map of the study area

1.2. Objectives of the study

The present work emphasizes to work on the following objectives:

- To understand the historical evolution and the change in spatial extent of the park from administrative and conservational perspective.
- To classify the constituents of the Park landscape and assess the landscape transformation of the core area of the park over the years

2. MATERIALS AND METHODS

Geo-database of different layers of information was generated from the Survey of India (SOI) topographical maps bearing topographic sheet nos. 83F/2, 83F/5, 83F/6, 83F/9 and 83F/10 surveyed on 1913-14, 1914-15, and published in 1916 under Brigadier C.G. Lewis and Colonel Sir S.G. Burrard, both being the then Surveyor General of India. Also topographical maps surveyed in 1963, 1967-68 and published in 1972-73 under Dr. Hari Narain and Brigadier J.S. Paintal respectively both being the then Surveyor General of India were taken into consideration. To depict the recent change in the land-cover Google Earth images of 2016 were taken tile wise, mosaic, stitched, geo-referenced and cropped. Sketch maps and reports of Forest Department were also consulted to generate the historic spatial data for the study. For assessing the land cover change of the core area of the Kaziranga National Park, three maps were prepared considering the year as 1914, 1967 and 2016 using Arc GIS software environment to measure areas under different categories of landscape constituents. Visual as well as digital image interpretation technique was employed for delineating different land-cover classes and calculating the change in area under 5 general categories, viz. grassland, forest, wetland, sand and river, which was supported by field investigation and GPS survey.

3. RESULTS

3.1. Historical evolution of the conservation status of the Park landscape

The history of Kaziranga National Park (or KNP) dates back to 1st June 1908 when it was first declared as a Reserve Forest. It was subsequently upgraded to a Game Sanctuary in 1919, a Wildlife Sanctuary in 1950 and finally a National Park in 1974. In 1985, UNESCO inscribed Kaziranga National Park in the list of Natural World Heritage Sites. In 2005, it was declared as Elephant Reserve and in the same year Kaziranga celebrated centenary and emerged as the

century's one of the greatest conservation success story. In 2007, it evolved into a Tiger Reserve and in 2010; northern range at Biswanath was opened.

3.2. Spatial extent of the Park

The spatial extent of KNP has changed over the years from administrative and conservational perspective. It was made to protect the wildlife population of the Great One-Horned Rhino whose population was dwindling because of active poaching. The erosion of river Brahmaputra in the northern side of the park and change of course leads to regular floods necessitated the authorities to look for additional areas to provide corridor and shelter to the Rhinos and other animals to cross over to the Karbi Anglong hills to the south. The spatial extent of KNP has been increasing since 1905 from 232 sq.km area when it was proposed to be declared as Kaziranga Reserve Forest, to 429.93 sq. km when it was declared as Kaziranga National Park in 1974. Later on the extent of the park has further increased with six new additions including some new areas of Golaghat, Nagaon and Sonitpur districts of Assam to 859.42 sq. km. and KNP have evolved into Tiger Reserve in 2007 encompassing a total area of 1030.34sq.km with Tiger and Rhinoceros as main flagship species (Table 1).

The Six areas that have been added to the existing National Park include - 1st addition Burapahar (43.79 Sq.Km., notified on 28/05/97), 2nd addition Sildubi (6.47 Sq.Km., preliminary notified on 10/07/85), 3rd addition Panbari reserve forest (0.69 Sq.Km., preliminary notified on 31/05/85), 4th addition Kanchanjuri (0.89 Sq.Km., notified on 13/06/85), 5th addition Haldibari area (1.15 sq.km., preliminary notified on 13/07/1985) and the 6th addition Panpur Reserve forest and entire stretch of Brahmaputra river on the north (376 Sq.Km., notified on 07/08/99). Besides these, the reserved forests of Panbari and Kukurakata reserve Forest are also under the administration of Kaziranga National Park. Proposed additions under Tiger Reserve further include Bagser Reserve Forest, Laokhowa Wildlife Sanctuary and Burachapori wildlife Sanctuary along with the existing area covering a total area of 1030.34 sq. km.(Table 1). Out of the 6 additional areas, 1st and 4th additional areas are fully in possession of the park authorities duly handled over by civil jurisdiction. But, 2nd, 3rd, 5th and 6th additional areas are yet to be formally taken over by authorities (Government of Assam, 2014).

Table 1 Extent of Kaziranga National Park with Tiger Reserve (1974-2007)

Name	Area(in sq.km)
Kaziranga National Park	429.93
Six additional areas	429.49
Panbari Reserve Forest	7.65
Kukurakata Reserve Forest	15.93
Bagser Reserve Forest	33.67
Laokhowa Wildlife Sanctuary	70.13
Burhachapori Wildlife Sanctuary	44.06
Total	1030.34

Source: Environment and Forest Department, Govt. of Assam, 2007

3.3. Landscape Constituents of Kaziranga National Park

The core area of Kaziranga National Park is spread over an area of 429.93sq.km in the floodplains of river Brahmaputra. It harbours the World's largest population of one horned Rhinoceros, Wild Buffalo and the Swamp Deer. There is a significant change in the land-cover of KNP since 1914 to 2016 and altogether 12 sq. km area has been eroded from 429.93

sq. km due to the bank line erosion of river Brahmaputra in the northern and north-eastern front (Table 2 & 3 and Fig.2, 3 & 4).

Table 2 Area under different land-cover class (1914-2016)

Land use/ land cover class	1914		1967		2016	
	Area in sq.km	Area %	Area in sq.km	Area %	Area in sq.km	Area %
Grassland	243.36	58.17	252.52	60.32	221.91	52.99
Woodland / dense forest	137.41	32.85	116.74	27.89	108.22	25.85
Beels/wetlands	18.72	4.48	38.14	9.11	43.55	10.40
River/water body	10.95	2.62	6.92	1.65	24.92	5.95
Sandbar	6.13	1.47	4.30	1.03	20.16	4.81
Settlements	1.73	0.41	-	-	-	-
Total	418.3	100	418.6	100	418.7	100

The study reveals that the area under forest (woodland) has gradually decreased since 1914-2016. The park authority maintain ideal grassland habitat for rhinoceros by selective burning of the woodland. However, grassland component increased from 1914-1967 but reduced gradually from 1967-2016. This necessitated the park authority to add subsequent additional areas to the parks to meet the need of increasing number of animals especially Rhinos whose population increased from (75 in 1905 according to World Wildlife Fund for Nature- India to 2329 in 2013 as per Government of Assam, 2014). Increasing areas under river and water bodies along with subsequent increase of sand features in the north and north eastern part indicate flood induced problems associated with the park.

Table 3 Net change in the area of landscape constituents of KNP, 1914-2016

Land use/ land cover class	1914	1967	2016	Net change in area		Net change in area	
				1914-1967		1967-2016	
	Area in sq.km	Area in sq.km	Area in sq.km	Area in sq.km	Area %	Area in sq.km	Area %
Grassland	243.36	252.52	221.91	+9.16	+3.76	-30.61	-12.12
Woodland/ dense forest	137.41	116.74	108.22	-20.67	-15.04	-8.52	-7.29
Beels/ wetland	18.72	38.14	43.55	+19.42	+103.73	+5.41	+14.18
River/ Water body	10.95	6.92	24.92	-4.03	-36.80	+18	+260.11
Sandbar	6.13	4.30	20.16	-1.83	-29.85	+15.86	+368.83
Settlement	1.73			-	-	-	-
Total	418.3	418.6	418.7				

3.4. Landscape transformation: Causes and consequences

The wetland consists of small lakes or *beels* which is the lifeline for the animals in the park (Fig.2, 3 & 4). As the National Park is on the flood plains of river Brahmaputra, it gets flooded every year leaving behind heavy deposits of silt which subsequently reduces the size of the wetlands and thereby reducing its water holding capacity.



Figure 2 Status of Land use/land-cover, 1914

The dynamic nature of the river Brahmaputra and constant erosion and creation of new sandbars locally known as *chapor* are common phenomenon. The maximum erosion of the river has been seen on the north and north-eastern part of the core area.



Figure 3 Status of Land-cover, 1967

Out of the plant species available in KNP, there are a few namely, *ekora*, *lokosa* and others that are preferred by the Rhinos and other herbivores. Such tall grasses not only provide shelter to all types of animals but also help them in breeding. But the grasslands are diminishing day by day. The main reasons are successive flood eradicating grassland, increase in the numbers of *Bombax ceiba (simul)* trees, invasion of a shrubby herbaceous plant - *Mimosa invisa* which creeps on grassland results in ecological degradation of the natural habitat (Government of Assam ,2014).

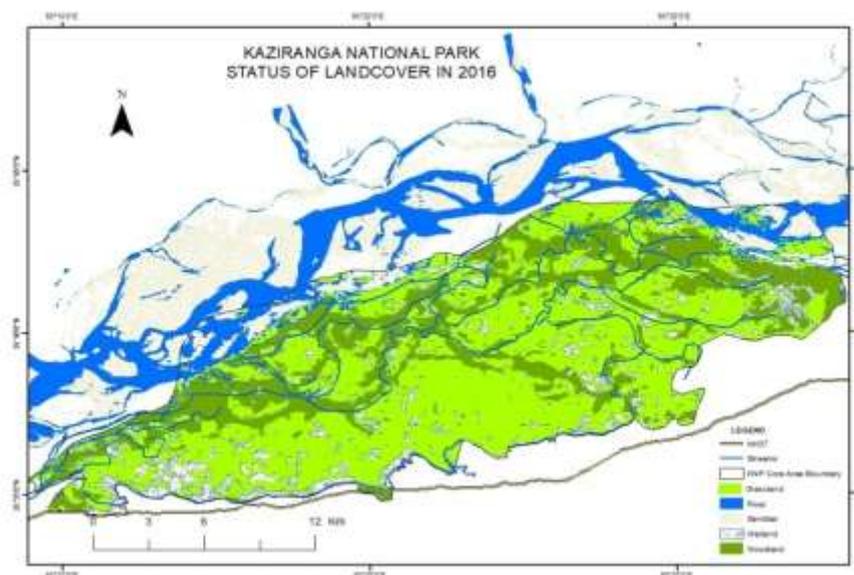


Figure 4 Status of Land-cover, 2016

An increase in the population of wild buffaloes put further pressure on these vegetation due to overgrazing. Deposition of sand in short grass growing areas has also degraded the suitability of such areas for the herbivores. The settlements were observed only in the year 1914 and were completely absent in the year 1967 and 2016. Based on the correspondence made with the park officials, some temporary huts constituting 1.73sq.km area of forest communities were present (Table 2&3 and Fig.2) inside the habitat boundary in the early period. Those huts were eventually evicted keeping in mind the importance of wildlife conservation and the villagers shifted to the *char* (accretion of River Island) areas of north. But present actual habitat area is kept completely without any human habitation.

3.5. Management of land-cover in the core area

Although, the population of all the mega herbivores have increased manifold over the years, however to sustain the effective environment space, it is essential that timely management and maintenance of the habitat needs to be done effectively. The necessary facet of management in Kaziranga is to take care of the grassland by preventing invasion of trees. This is achieved primarily through annual burning of grasslands to discourage the growth of tree sapling. The operation also helps in enhancing the biological process of coarse grasses by facilitating growth of new grass that attracts the herbivores. Another management practice adopted in Kaziranga is the uprooting of tree saplings to forestall invasion of tree into the grassland. As the wetlands are an integral part of ecosystem in Kaziranga, restricted de-siltation works of water bodies have been executed for last many years. Some serious efforts such as *Mimosa* removal, removal of water hyacinth have conjointly been created in the recent past. With the onset of dry season; bunds are also constructed in some of the *Beels* (water bodies) to retain water to draw in numerous species of migratory avifauna. Some highlands are created within the Park to provide shelter to the animals during high flood (Government of Assam, 2014). However, a lot of such highlands with larger dimension need to be created to provide shelter to the animals during flood.

4. DISCUSSION

The rising human population, tourism development and the growing demands for socio-economic development have put pressure on the natural habitat like Kaziranga, both directly

and indirectly. National Highway 37 that traverse through the southern boundary of the park is a major hindrance for the movement of animals increasing the risk of poaching and incidents of animal killing due to vehicular movement during road crossing. There is also a large scale encroachment in the additional areas that are not in full possession of KNP authorities. Mushroom growth of settlement, houses, resorts, *dhabas* (road side eating establishment) and multistoried building in the periphery of KNP have put further stress on the natural habitat. Thus, there is an urgent need for sustainable development by selecting strategies for maintaining a balance between economic activity and the pristine ecological setting. Immediate attention ranging from planning, financing, manpower development, involvement of local communities for conservation, timely management of habitat both in the core and buffer areas along with anti-poaching measures are vital and the need of the hour.

5. CONCLUSION

It is evident from the study that the land-cover of KNP has experienced vital change over the years. The core area is the actual habitat of Rhinoceros and other wildlife species that makes habitat management crucial. Habitat management needs to be given special emphasis by setting up long term plans followed by short term action plans to maintain the sustainability of the core area of the park. Bank line erosion of the river Brahmaputra, in the northern side of the area needs to be addressed urgently by collaborating with various Governmental, Non-Governmental or International organizations thereby adopting scientific methods and contemporary technological solutions. The landscape transformation in the peripheral area of KNP, especially in its southern front, that mostly emerged from tourism and associated development, needs adoption of controlled development policy and implications of nature-first policy in the overall development agenda.

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