

**LIVING HERITAGE WALKING AND STRUGGLING IN THE VALLEYS OF ASSAM: A
CASE STUDY OF KAZIRANGA NATIONAL PARK AND TIGER RESERVE (KNPTR)**

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Abstract:

Kaziranga National Park and Tiger Reserve (KNPTR) in Assam, India, is a protected area of global prominence as it provides habitat to the largest population of the Indian One Horned Rhinoceros in the world. It is unique for its diverse human population of different cultures surrounding the national park. Every year KNPTR's grassland ecosystem encounters a battle with flood putting the life of flora and fauna in jeopardy. According to a recent study, climate change is negatively affecting fragile river ecosystems all over the world. Natural disasters, in true sense are the causes of damaging natural and human-made property. Research undertaken in Assam's KNPTR has stated that increasing frequency of extreme floods is responsible for destroying some of the world's most sensitive and valuable riverine habitat. Flood occurs frequently in the lower catchment of the Brahmaputra, where KNPTR is located. Another incredible feature is 74% of the park's area is covered by grassland, making it a unique habitat for great Indian one horned rhino. It was observed that habitat loss is one of the significant threats to the biodiversity, as flood always disrupt the natural habitat. According to the red list category of the International Union for Conservation of Nature and Natural Resources, the rhinoceros comes under the vulnerable B1ab (iii) category and hence the annual impact of the flood on the prime feeding habitat (grassland) is a matter of concern. The study is based on both primary and secondary data. The desired result outcomes reveal that year 1988 was the worst year when 1023 fauna of KNPTR died due to flood followed by 2012 flood year when 793 faunas died. Hog deer, another important species is most affected due to flood followed by Rhinoceros.

Keywords: Kaziranga National Park, flood and erosion, climate change, one horned rhino, grassland

1. Introduction

The name Kaziranga was derived from the Karbi word Kajir-a-rang, which means 'the village of Kajir' (*Kajiror gaon*) (Choudhary, 2020). The Kaziranga National Park (KNP) is one of the oldest wildlife conservancy reserves of India, first notified in 1905 and constituted as Reserved Forest in 1908 (Kotoky et al., 2009). It is spread over an area of 228.825 km² specially established for conservation and protection of the greater one horned Rhinoceros (*Rhinoceros Unicornis*). Their number was estimated at twenty pairs then (Ministry of Environment, Forest & Climate Change, GOI, 2016-19). Kaziranga was declared as Game Sanctuary in 1916 and opened to visitors in 1938. It was declared as Wildlife Sanctuary in 1950 and notified as Kaziranga National Park (KNP) in 1974 under the Assam National Park Act, 1968 with an area of 430 km² (MoEFCC, GOI, 2016-19).

A series of addition namely 1st, 2nd, 3rd, 4th, 5th and 6th addition to KNP in several stages were notified taking the total area to 915 km². The Park currently covers 430 km² and Kaziranga addition area covers 454.43 km² including the Brahmaputra River to the north and part of Mikir hills to the south (Mathur et. al., 2005). On 4 September 2020, Government of Assam approved an addition area of 30.53 km² (3053 hectares) to the KNP. From around 885 km², the park's area has now increased to 915 km² with these new additions (Assam Tribune, November 11, 2020). The KNP and its addition areas are spread over the four districts of Assam namely Golaghat, Nagaon and Sonitpur and newly created Biswanath district and form a conservation complex with the Karbi Anglong hills in

the south (MoEFCC, GOI, 2016-19). The Kaziranga National Park has on its north the mighty river Brahmaputra. The entire stretch of which from Golaghat district boundary on the east to Kaliabhomora bridge on the river towards the west has been constituted into the 6th addition to KNP. Afterwards, contributing to the already existing area of the park in the north bank (MoEFCC, GOI, 2016-19).

Flood is a common phenomenon between the people of Assam as it has been occurring in the state since the long time as Assam is the most flood prone state in the country (Roy, 2020). The continuous population explosion along with change in land use and land cover (LULC) have intensified flood hazard (Saikia, 2009). The reason is that Brahmaputra River is highly unstable and changes its course over a period of time (Mathur et al., 2005). Every year the state used to face the problem of flood during the monsoon season (MoEFCC, GOI, 2016-19). The deluge has encircled the vast area of KNP which is renowned as the UNESCO's world heritage site in 1985 (Yadava, 2014). Birdlife International has declared it an important Bird Area, there are dramatic pictures of rhinoceros walking through the streets, are easily apparent (Patnaik et al., 2019).

Kaziranga has a very fragile ecosystem, where on one hand the annual flood waters of the river Brahmaputra bring nourishment, leading to a very high productive biomass (Valdiya, 1999). On the other hand, the phenomenon of erosion takes away a lot of valuable and prime habitat. Kaziranga so far has lost more than 84 km² of its prime habitat to the river Brahmaputra (MoEFCC, GOI, 2016-19). The grassland, floodplains, and floodplain lakes (known locally as *beels*) of Assam provide ideal habitat for a wide variety of species of flora and fauna (Mathur et al., 2005). Today, many of these are endangered and have had their habitat limited to small areas within the state most notably KNP (Kotoky et al., 2005).

2. Study Area

Kaziranga National Park (KNP) is known globally for its conservation of one-horned Indian Rhino (*Rhinoceros Unicornis*), it is a habitat for several migratory birds and endangered species (Hussain et al., 2012). The KNP (Fig. 2.1) is situated in Golaghat, Nagaon and Sonitpur and newly created Biswanath districts of Assam (92°50' E and 93°41' E to 26°30' N and 26°50' N). The Park is approximately spread over an area of 40 kilometres in length from east to west and 13 kilometres in breadth from north to south (Heinen and Shrivastava, 2009). The mighty Brahmaputra River in the north and Karbi Anglong hills in the south make a unique ecosystem for development of wide varieties of flora and fauna. Other than, one horned Rhinoceros, it is also home for a variety of wildlife such as Wild Buffalo, Hog Deer, Elephant, Swamp Deer, Sambar, Tiger, etc (IUCN Conservation Outlook Assessment, 2017).

3. Objectives

Objective of the study is to find the impact of climate change and poaching on the biodiversity of the Kaziranga National Park and Tiger Reserve (KNPTR).

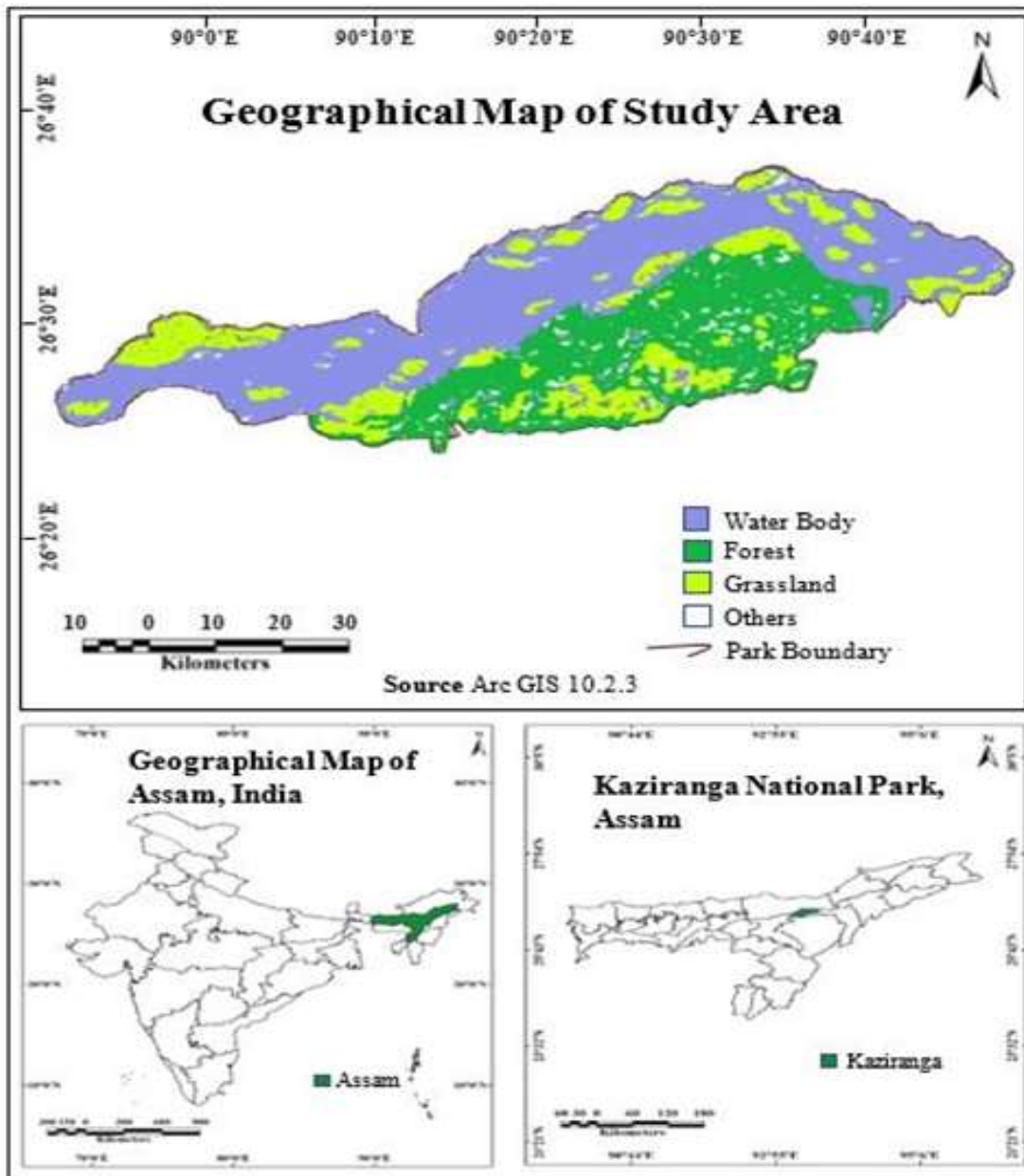


Fig. 2.1 Locational Map of Kaziranga National Park, Prepared by Author, 2021

4. Research Methodology

Every scientific study adopts its own methodology to analyse a particular problem. The present study is concerned with Kaziranga National Park (KNP) which is located in four districts of Assam. It includes Golaghat, Nagaon, and Sonitpur, and newly created Biswanath district lies in the Brahmaputra valley, with a view to investigating the impact of climate change and its effect on the biodiversity of the National Park in the last 50 years.

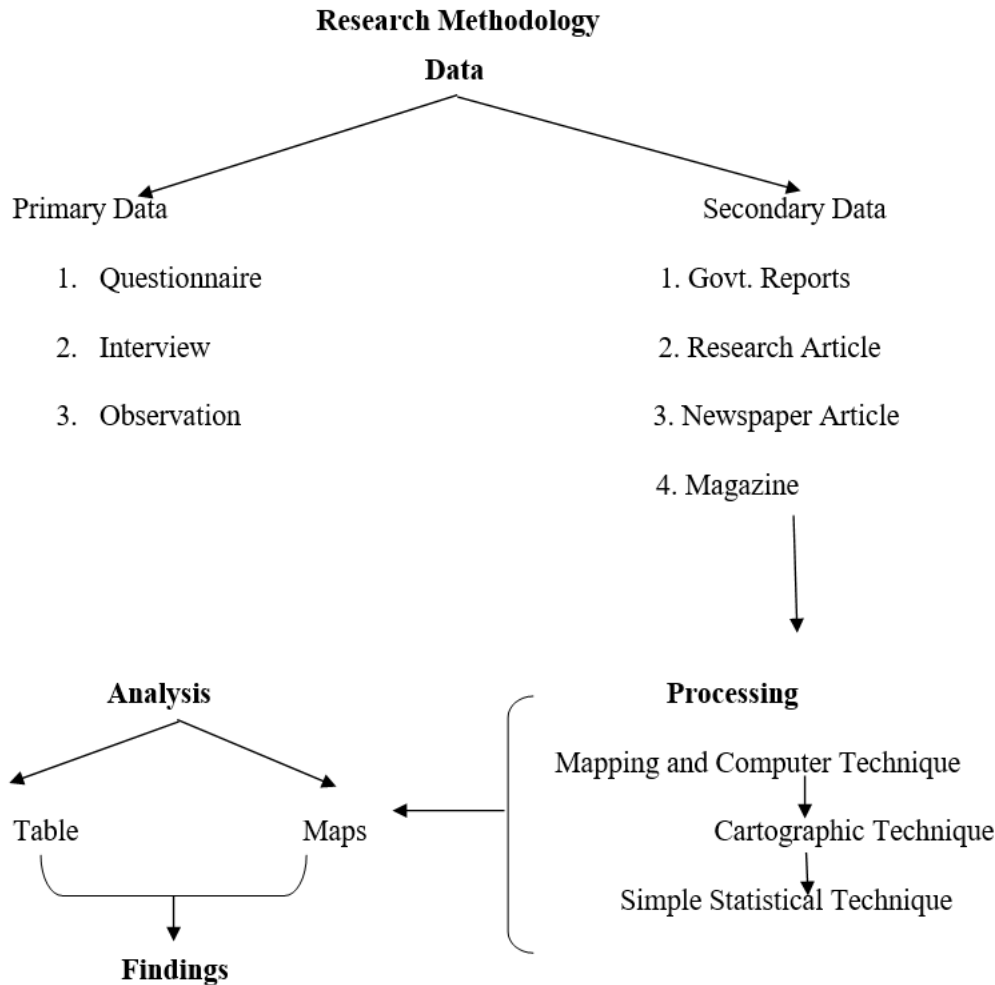


Fig. 4.1 Graphical Description of Data Sources and Research Methodology (Prepared by Author, 2021)

The study is based on both primary survey and secondary data (Fig. 4.1). In order to fulfil the objective of the paper, the primary data has been collected through discussion and interview with the forest officials of KNP and with the local people who are inhabited in the periphery of the park with the help of questionnaire. Focused group discussions with management staff and villagers, provided information on the current situation. The problems associated with climate change which leads to frequent flood in every year lead to dying of animals in the park was also raised. Stratified Random Sampling (SRS) method has been done for selection of interviewees.

The secondary data has been collected from the Directorate of KNP, Forest Department, Government of Assam, published news items, reports, and articles in newspapers, magazines, and article from journals. A graphical representation of tabulated data has been done to enhance the merit of research work, flow charts, line graph, were constructed. Mapping and graphical presentation work with the help of Microsoft Excel and ArcGIS 10.3 software have been used.

5. Result and Discussion

5.1 Impact of Climate Change on Biodiversity of the National Park

The ecology of Kaziranga is dependent on the variations in annual river flow and climate-induced changes could have a major effect on the parks ability to maintain biodiversity over time. However various models have been developed to predict the possible effect of climate change (Manabe et.al., 2004). One of the participants replied that an increase in water levels have been registered and thus, possibly flooding is likely in the park. A climate change scenario using UKTR results (a high-resolution transient climate change experiment carried out by the Hadley Centre in the

UK) revealed that the peak of the Brahmaputra is increasing by 13%. It follows a 6°C global mean temperature rise (Mirza et.al.,2003). Which leads to increase flood and erosion in the study area.

In Assam, the analysis is based on data collected from 6 stations for temperature and 12 stations for rainfall (Table 5.1). The analysis indicates that the mean temperature in the state has increased by +0.01°C/year. There is also an increase in seasonal temperature across seasons with pronounced warming in post monsoon and winter temperature. The annual rainfall has also decreased by -2.96 mm/year during the same period (Table 5.1).

During the same period, the average annual rainy days have decreased by 1.61, 0.58 and 0.14 days in the district of Golaghat, Nagaon, Sonitpur and Biswanath district where the KNP and its additions are located. The intensity of rainfall over the years have increased, but the frequency of the number of days rain happen has declined. The area initially suffers from the rain deficit and within one or two days later the area inundated under water. The cases of extreme rainfall are increasing while the number of rainfall days are decreasing over the years and which is the clear-cut impact of climate change on the flood (Table 5.1). The condition of water crisis is increasing in the flood affected areas and occurrence of drought has become frequent over the years.

Table 5.1: Climate Trend in Assam between 1951 and 2010

Temperature	Annual	Winter	Summer	Monsoon	Post Monsoon
Mean Max Temperature (°C/Year)	+0.02	+0.01	No Trend	+0.01	+0.02
Mean Min Temperature (°C/year)	+0.01	+0.02	+0.01	+0.01	+0.02
Mean Temperature (°C/Year)	+0.01	+0.01	No Trend	+0.01	+0.02
Rainfall (mm/Year)	-2.96	+0.08	-0.56	-2.19	-0.75

Source Ministry of Environment, Forest, and Climate Change, GOI, 2011-13.

The increase of flood and erosion in the park area due to climate change has led to decrease the area of grassland through the years from 492.6 km² in 2002 to 322.9 km² in 2013. The shrinking of grassland has happened due to habitat's degradation, fragmentation, overgrazing etc (Goswami, 2020).

Natural calamities like earthquake also impacted on the habitat of Kaziranga National Park. Due to strong earthquake in 1897 and 1950 of 8.7 Richter Scale magnitude, the course of river changed (Nayak and Panda, 2016). Particularly, the earthquake of 1950 raised Brahmaputra River's bed level at Dibrugarh by at least 3 meters. It leads to an increased flood and erosion potential of the river (Nayak and Panda, 2016). In the aftermath of the great earthquake of 1950, potential damage, intensity, and frequency of floods have increased significantly. In the study area, around 12 major floods occurred during 1950 to 2010. After that, almost every year, major floods occurred in the area and multiple reasons are responsible for it (Fig. 5.1 and 5.2). Out of all, climate change plays an important role for the heavy and frequent flood in the region. The study area experienced major floods in the year 1954, 1962, 1972, 1977, 2004, 2007, 2008 and 2012 with a reduction of 68.23 km² in the study area between 1999 to 2019 (Map 5.1). In 2004, Sonitpur district encountered two devastating floods impacting flora, fauna and human habitat in the park region of KNP.

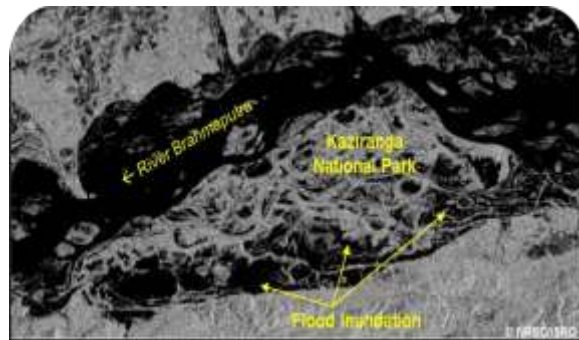
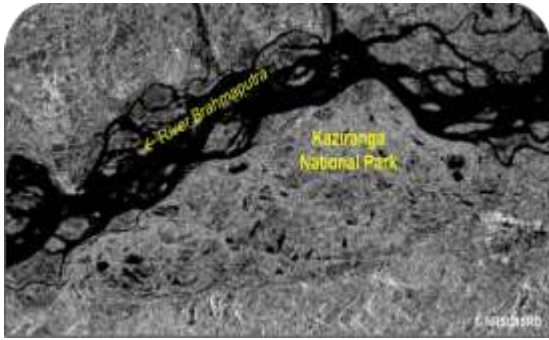
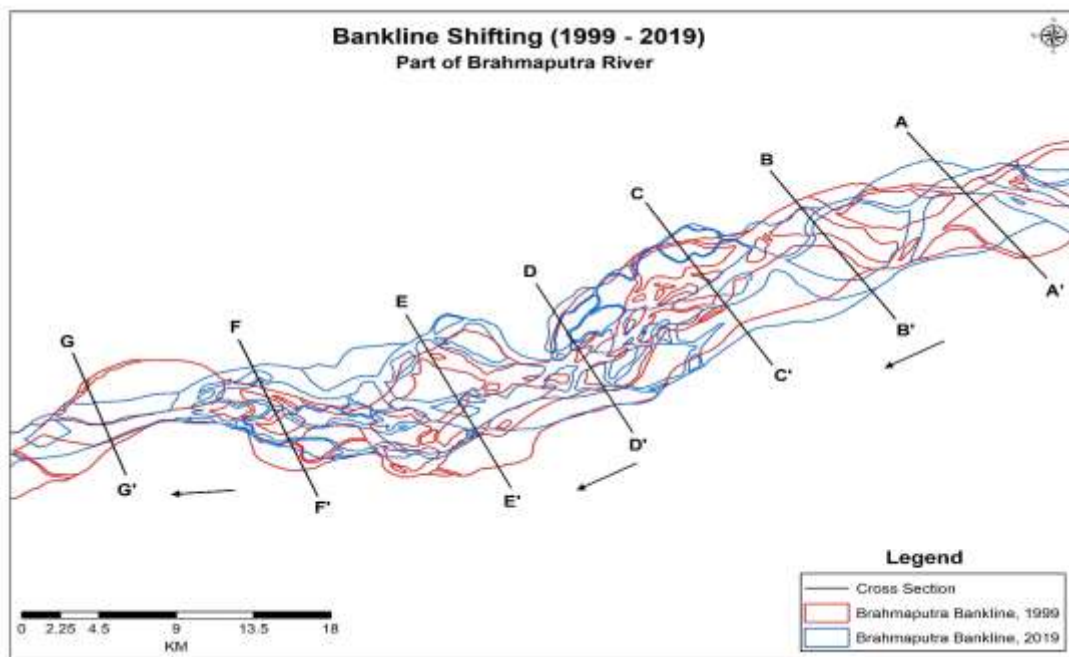


Fig. 5.1: Kaziranga National Park Before flood (Adopted from NRSC/ISRO, 2020)

Fig. 5.2: Kaziranga National Park During flood (Adopted from NRSC/ISRO, 2020)



Map 5.1: Bankline migration of river brahmaputra due to erosion in the study area (By author)

5.2 Consequences of Floods in Kaziranga National Park

Floods are common during the monsoon in the study area, varying from 5 to 19 floods per season (Mathur et. al., 2005). The Park has the largest grassland area left in the region and stretches about 50 km along the south bank of the Brahmaputra (Mathur et. al., 2005). The annual river flood replenishes the wetlands and allow the grassland areas to flourish, apart from the causing severe erosion. Satellite data indicates a loss of more than 51 km² between 1967-68 and 1998-99 (Mathur et.al., 2005). Floods have also caused significant animal deaths (Table 5.2). According to environmentalist Apurba Ballav Goswami “*The flood situation in Assam is extremely serious, especially in the Kaziranga National Park (KNP). The frequency of flood in Kaziranga has increased in the last couple of years*”.

According to the Line Transect data of April 2012, the animal's casualty caused by floods stood at around 1% of the total population. The Hog Deer, whose population is estimated at 40-50 thousand, saw the highest casualty among the wild animals with a count of 512 (Srivastava, 2012). Then, there is a loss of habitats which may cause these animals to venture out of their reserved areas into human establishments making them vulnerable to poachers and human-animal conflict. The Park is home to about 60% of the world population of the Indian one horned rhinoceros (*Rhinoceros Unicornis*) and Buffalo (*Bubalus arnee*). It has only viable eastern swamp deer (*Cervus Duvaucelii*) population in the north-eastern region, about 400 animals (Mathur et.al., 2005). Its major conservation success has been the increase in number of rhinoceros. In 1972, the population of

rhinoceros was 670, increased to 1552 in 1999 and numbers are still increasing to 2413 in 2018 (Table 5.3) (Mathur et.al., The Hindu, 7th April 2018 and The Print, 18th July 2020). Assam has the largest number of Indian one horn rhinoceros in the world where the rhinoceros census is conducted in every three years. There is an increase of 12 rhinoceros from the 2015 estimates. In 2015, it was 2401 (The Hindu, 7th April 2018).

Table 5.2: Number of animal death due to flood in Kaziranga National Park (from 1988- 2020).

Name of Animal	Flood Year						
	1988	1998	2012	2016	2017	2019	2020
Rhino	38	103	15	17	31	12	1
Elephant	3	2	4	NA	NA	1	NA
Wild Water Buffalo	NA	23	NA	3	8	NA	NA
Wild Pig	NA	19	NA	NA	NA	NA	NA
Sambar	NA	15	NA	6	16	9	NA
Hog Deer	950	473	178	166	282	101	41
Swamp Deer	NA	NA	9	9	NA	6	NA
Wild Boar	30	7	NA	11	NA	9	3
Hog Badger	NA	NA	NA	2	NA	NA	NA
Python	NA	NA	NA	1	NA	NA	NA
Porcupine	NA	NA	NA	1	NA	NA	NA
Others	2	8	1	NA	NA	3	NA
Total	1023	650	793	250	361	204	96

Source UNEP; WWF; BBC News; The Indian Express, Aug 19, 2017; Hindustan Times; Jan 01, 2018; The Economic Times, July 19, 2019 *NA= Not Available

Table 5.3: List of Animal Census from 1972 to 2018 in KNPTR

Name of Animal	Year									
	1972	1984	1991	1993	1997	1999	2005	2008	2015	2018
Rhinoceros	670	1100	1069	1164	1250	1552	1855	2048	2401	2413
Elephant	430	NA	NA	1094	945	882	1206	1293	NA	1089
Tiger	30	NA	50	72	80	86	NA	106	118	NA
Hog Deer	NA	10,000	NA	2900	NA	5045	NA	NA	NA	NA
Swamp Deer	NA	756	635	427	NA	398	NA	681	1129	1148
Buffalo	NA	677	1090	1034	NA	1192	NA	1937	1666	NA
Pig	NA	1645	NA	NA	NA	NA	NA	NA	NA	NA
Indian Muntjac	100	NA	NA	555	NA	NA	NA	NA	NA	NA
Wild Boar	NA	NA	NA	NA	NA	431	NA	NA	NA	NA
Gaur	NA	30	NA	NA	NA	NA	NA	NA	NA	NA
Sambar	NA	NA	NA	NA	NA	58	NA	NA	NA	NA

Source Roy, 2020; Lopes, 2014 and Directorate of KNP *NA= Not Available

Like the other world heritage sites, KNPTR is not an exception and being impacted by the effect of climate change. Floods have negative effect on the park's biodiversity further several losses during heavy floods. The monsoon flooding of 1988 is state to be the most dangerous for 50 years with widespread death of animals. During 2017 floods, the park lost 361 animals which includes 31 rhinoceros, 8 wild water buffalo, 16 sambar and 282 hog deer. From the above data (Table 5.2), it has been noticed that mortality rate of Hog Deer is the highest among all the animals during flood. 1988 flood seems to be the worsts flood year where 950 hog deer died due to flood followed by 1998 flood when 473 hog deer died and in 2020, 41 died. These annual floods are likely to augment the frequency and potential intensity under climate change. In 2020, the government of Assam has decided to construct several new highlands to provide safer areas for animals to find refuge during the annual floods.

5.3: Role of Floods in Kaziranga National Park's Ecosystem

“Without the monsoon wouldn't exist. Good and bad, all in one, because without the grasses the animals probably wouldn't be there” (Winter, 2008). Floods are always assumed to bring destruction with them. But, the Kaziranga National Park in Assam proves this notion wrong and shows that flood can bring more benefits than destruction. Assam is traditionally flood prone, and the 915 km² KNPTR sandwiched between the Brahmaputra River and the Karbi Anglong Hills is no exception. Floods are necessary for Kaziranga by virtue of its ecosystem. P. Sivakumar, director, KNPTR, said that “it is a riverine ecosystem, not a solid landmass-based ecosystem. The system won't survive without water”. The entire area of Kaziranga formed by alluvial deposits from the Brahmaputra and its tributaries is centred around the river.

According to Uttam Saikia, honorary wildlife warden of Kaziranga, “this floodplain ecosystem has not only been created by floods but also feed off it”. The regenerative nature of floods helps replenish Kaziranga water bodies and maintain its landscape, a mix of wetlands, grasslands, and semi-evergreen deciduous forest (The Indian Express, July 22, 2020). The flood water also functions as a breeding ground for fish. The same fish are carried away by the receding waters into the Brahmaputra. In a way, the park replenishes the rivers stocks of fish too. The water also helps get rid of unwanted plants such as water hyacinth which collects in a huge mass in the landscape. In herbivores dominated area like Kaziranga, it is important to maintain its grassland status. If it were not for the annual floods, the area would become a woodland. Although floods can develop into social and economic disasters causing loss of life, livelihoods and infrastructure. Flooding is also a part of the natural process which creates fertile lands. Indeed, Brahmaputra valley is one of the most fertile stretches of land in India.

5.4: Scarcity of Fodder and Fear of Poaching

There is a positive correlation between flood, scarcity of fodder and poaching. Every flood is followed by ‘scarcity of fodder’ that pushes animals to southern Kaziranga in search for food (Goswami, 2016). Wildlife conservationist are concerned over the fact that the rhinoceros are more vulnerable to poaching as they stray outside the park boundary in search for food. The issue of poaching during flood was also raised in 2015 (Goswami 2016). Shortage of grass and food for the animals is one of the reasons why mortality rate is so high among small animals like hog deer and calf rhinoceros. Mortality rate of cub rhinoceros are more because they cannot swim during floods. The rhinoceros are safe, if they stay within the park since patrolling is constant as flood waters make it difficult for poachers to conduct their operation. The moment animals' step outside the park then, they come under threat. The threat is high as each rhinoceros horn fetches between ₹80 lakhs to ₹1 crore. Moreover, they can be easily shipped out of India through fragile Nagaland's border (Goswami, 2016).

Rhino poaching in Assam has reduced by 86% in past three years (The Weather Channel, September 22, 2020). Due to constant anti-poaching efforts of the State Government and forest officials, the trend of poaching in KNP started coming down. In 2016, as the number of rhinos poached in a year came down from 12 in 2016 to only one in 2019 (Fig. 6.4.1) (Times Now, Jan 4, 2020).

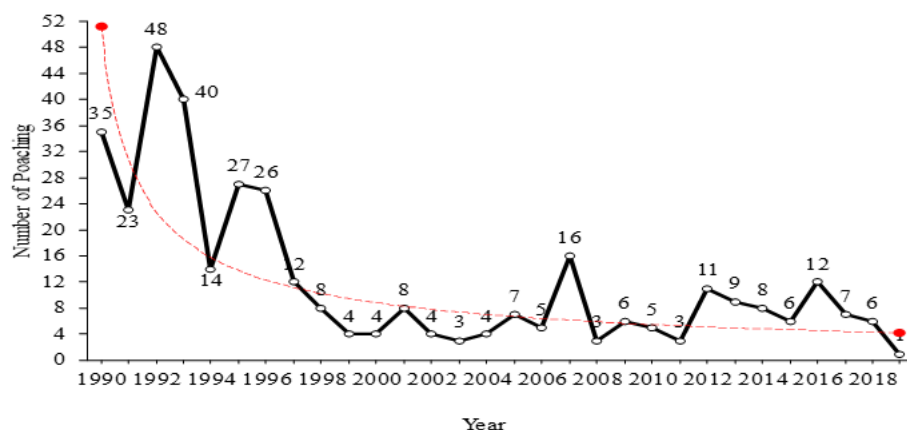


Fig. 5.3: Loss of Rhino due to Poaching from 1990 to 2019 (Adopted from Talukdar, 2000, 2002, 2003, 2006; Lopes, 2014; Report of High-power Committee on Prevention of Poaching in Kaziranga National Park, 2008; Times Now, 4 January 2020; The Weather Channel, 22 September 2020).

6. Conclusion

Risk of the National Park becoming an “Island” in a sea of development. The last one hundred years have seen some major conservation successes in Kaziranga, with population of many threatened species rising dramatically. Kaziranga is a relatively small park, and the nature of the ecosystem means that land is being lost to the floods. There have been attempts to add more land to the park. Total six additions have been done with an area of 455 km² so far. Sixth addition includes the north bank of the river Brahmaputra till Bhomoraguri bridge is now under KNP. To achieve successful conservation of KNP, there is a need of considerable effort to balance synergy between the needs of increasing wildlife populations and a range of development projects.

Measures such as identification and notification of eco-sensitive zones, reduce the speed limit (40km/sec) in the highway near to the park, construction of under passes at strategic points across the highway and preparation of flood susceptibility map for the corridor complexes. Besides, developing community-based conservation program founded on indigenous knowledge to facilitate the unhindered movement of the animals. Continuous progressive loss of habitat diversity will fundamentally, and for all intents and purposes irreversibly alter our riverine landscapes. This will be accompanied by a catastrophic loss of species who are unable to adopt to the new environments. Conservationist need to work alongside geomorphologist to look at a way in which river habitats can be managed perfectly for the future. Everyone wished to visit Assam at least once in their life as the state is designated as the power house of natural beauty but during the time of crisis like floods we have forgotten them. We all are responsible for our selfish attitude towards Assam.

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None of the authors has any conflict of interest to disclose.

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