

Land Use Changes, Development and Conservation in India: Case Study of Bannerghatta National Park, Karnataka*

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Abstract: The development path as pursued globally, regionally, and nationally reflects a disregard for environmental damage and its consequences. Economic growth has been achieved at the heavy cost of the environment and its sustainability. One of the reports has estimated that the total cost of environmental degradation in India at about Rs. 3.75 trillion (US\$80 billion) annually, equivalent to 5.7 % of GDP in 2009 as per the reference year for most of the damage estimates (Mani, 2014:15). This paper aims to analyze the land use changes of the Bannerghatta National Park (from hereafter BNP) and its implications on the development. In the process, the paper explores the issues of environmental conservation in the context of protected areas (PAs). The land use pattern of BNP clearly shows that there is an uneven growth of the urban periphery and an imbalance in development. Most importantly the erosion of dry/moist deciduous forest areas indicates the institutional and policy measure failures in conserving and protecting the BNP. This decreases the contribution of ecosystem services to human and animal wellbeing. The loss of biodiversity and ecological in-equilibrium is one of the major factors contributing to the animal-human conflict. The symbiotic association between the ecology, animal kingdom, and human lives is lost due to the pursuit of development which focuses exploitation of natural resources at the huge cost of the environment.

Keywords: Land Use changes, Bannerghatta National Park, Conservation, Development

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I. INTRODUCTION

The world's ecosystems are under critical stress. Over the past few decades, anthropogenic activities changed ecosystems more rapidly and extensively than in any comparable period in our history with more than 60% of the world's ecosystems already degraded (Millennium Ecosystem Assessment, 2005). We cannot afford not to, as reports such as the Economics of Ecosystems and Biodiversity have shown us. Natural and human-related stresses are degrading ecosystem goods and services locally and globally on one hand. There is good evidence that protected areas, planned as part of a larger and connected conservation network, offer practical, tangible solutions to the problem of species loss and adaptation to climate change (Hannah *et al.*, 2002). Protected areas are proving to be efficient and effective in mitigating biodiversity loss and act as a cushion to society from adverse changes in the environment and they are also critical in maintaining the ecosystem services which are vital for human existence (Dudley *et al.*, 2010).

Protected areas (from hereafter PAs) are a key tool in achieving the Sustainable Development Goals (poverty alleviation, water, food security, and environmental sustainability). According to the Global Biodiversity Outlook 3 report, it is found that the expansion of protected areas was one of the few positive indicators of environmental performance (CBD, 2010). The global protected area network is by far the most extensive natural resource management system that aims to maintain natural habitats, encompassing national parks, wilderness areas, nature reserves, and marine protected areas. While their primary objective is biodiversity conservation, protected areas also make significant contributions in maintaining other ecosystem services. By maintaining the essential ecosystem services upon which people depend, protected areas are proven "green" and cost-effective natural solutions to help address the global environmental challenges. There is growing evidence of the net benefits provided by protected areas (Lopoukhine *et al.*, 2012).

Many of the ecosystem services in general and protected areas in particular are not valued properly. Moreover, climate change is likely to worsen ecosystem degradation and reduce the efficiency of ecosystem services on the other hand (Staudinger *et al.*, 2012). Economic valuation of ecosystem services and biodiversity can make explicit to society in general and policy making in particular, that biodiversity and ecosystem services are scarce and that their depreciation or degradation has associated costs to society (Pascual, 2010). Valuation is important for a sustainable management of natural resources with an ultimate goal of human well-being (Jacobs *et al.*, 2014). Another important motivation for valuation studies has been to generate a better and more comprehensive information base for the policy formulation and decision making process. Such studies

can inform social decision mechanisms trying to cope with the allocation of scarce resources among competing demands (Turner et al, 2003).

1.1. Research Context

Globally, the development and its path have become synonymous with the exploitation of natural resources. This is clearly visible in developing countries and the centralized planning process. In the process of natural resource extraction, industrial expansion, and infrastructure development the accounting of natural wealth and its economic implications have not been adequately documented. The intangible nature of many of the benefits derived from ecosystem services and the different values attached to biodiversity make it challenging to define these monetarily and have them reflected in national accounting. However, through concerted efforts made nationally over the last several years, this gap is reducing significantly (Govt. of India, 2014:9). The development path as pursued globally, regionally, and nationally reflects disregard to environmental damage and its consequences. Economic growth has been achieved at the heavy cost of the environment and its sustainability. One of the reports has estimated that the total cost of environmental degradation in India at about Rs. 3.75 trillion (US\$80 billion) annually, equivalent to 5.7 % of GDP in 2009 as per the reference year for most of the damage estimates (Mani, 2014:15).

One of the missing links in the existing literature on measuring GDP is insufficiency in not taking into account of natural wealth and capital. Valuation fills this gap and enhances the robustness of the measurement and national accounting of GDP. Economic valuation of natural resources makes the GDP accounting more meaningful, purposeful and better indicator for the growth prospects of the country. Valuing biodiversity and its services to human wellbeing enhances the economic potentials of natural resources exploitation and revenue generation. Economic valuation of biodiversity and natural resources finds its rationality in accounting the costs of ecosystem services rendered to mankind through multiple sectors. India's economic growth would have been much higher by capturing the economic benefits of ecosystem services.

Objective of the Paper

It aims to analyse the land use changes of the Bannerghatta National Park (from hereafter BNP) and its implications on the development. In the process, the paper explores the issues of environmental conservation in the context of protected areas (PAs). The issues emerging are contextualised to the specific case of Bannerghatta National Park (BNP) of Bengaluru, Karnataka State

2. Brief Profile of Bannerghatta National Park (from hereafter BNP)

The BNP came into existence in the year 1974 with an initial area of 106.83 sq. km by Government of Karnataka. The BNP got its name from a village by name Bannerghatta which is a historical pilgrimage Centre. Initially BNP comprised of 2 reserve forests spread over Bangalore urban and Bangalore rural districts. The total area of the park later increased to the present 260.51 sq. km by adding three more reserve forests from the Kanakapura range of Ramanagara Division, which comprises of 157.77 Sq.km in the year 2011. The BNP is situated barely 22 kms from this city and faces urban related pressures. Set in this backdrop, we analyze valuation as an instrument to conserve the environment in the context of Karnataka State.

This Protected area is situated 22 km south of Bangalore and is thronged by people all round the year. This park sprawls across Bangalore Urban, Bangalore Rural and Ramanagaram districts of Karnataka state and has a very irregular boundary line of about 59kms in length and width varies from 0.3 to 13.8 km. This National park's highest peak is Bilikal Betta and Dodda Ragihalli Betta which has an altitude of 1075 and 1035m respectively above mean sea level. Rayatmalhole is the lowest range of BNP, which is 700 m above mean sea level. BNP and the hills inside the BNP mostly constitute Granite sheet rocks. The present BNP comprises 13 reserve forests.



Figure 1: Location of BNP

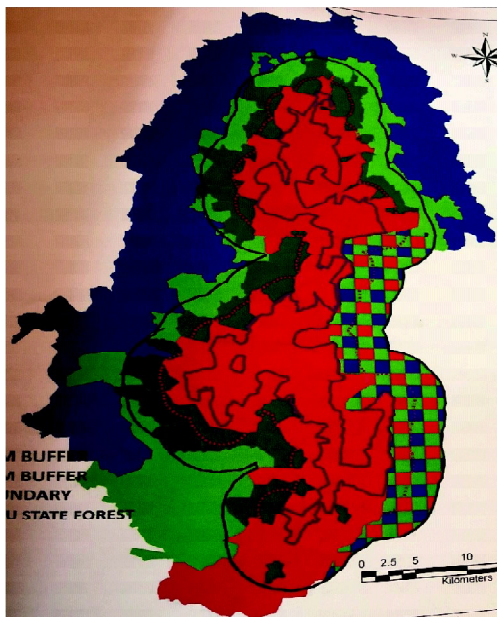
Source: Department of Forests and Environment, Government of Karnataka

Bannerghatta biological park (BBP) was carved out of BNP in the year 2002 with an area of 730 hectares. This is situated in the northernmost part of BNP and close to the Bangalore city. BBP comprises of the zoo, Butterfly Park and safari which is established for the purpose of tourism. BNP was declared as Ecologically Sensitive zone (from now on ESZ) in 2016 with an initial area of 266 sq. km. The BNP has a buffer zone of 5 km. The regions in BNP and the buffer zone are segregated into ESZ1, ESZ2, ESZ3 and ESZ4. The following table gives a gist of ecological sensitive zones of the BNP. This was followed by the graphical representation of the ESZ of BNP.

Table 1: Ecologically Sensitive Zones of BNP

<i>Ecologically Sensitive Zones of BNP</i>	<i>AREA (sq. kms)</i>	<i>No of Villages</i>
ESR 1	635.90	69
ESR 2	264.36	78
ESR 3	303.43	79
ESR 4	564.78	176
Total	1768.47	402

Source: Department of Forests and Environment, Government of Karnataka

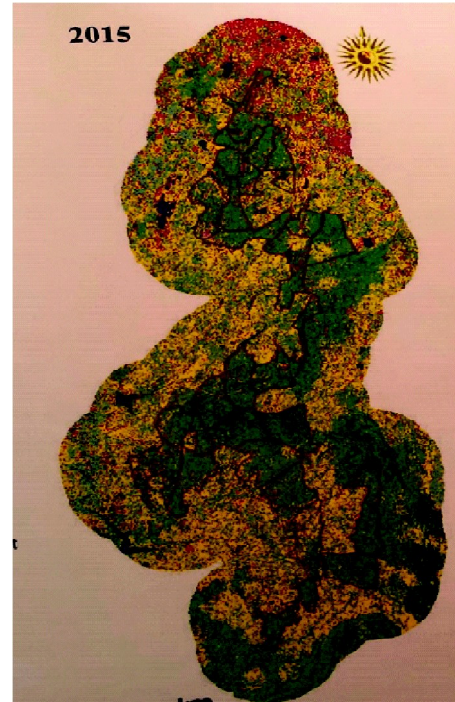


In the figure, the area in red represents ESZ1 and the line in purple in the boundary line of actual core BNP. The area is dark green is the ESZ2 and light green area consists of ESZ3. The pink dotted line is 2 kms buffer zone for BNP. The black line is the 5km buffer zone line The area in blue which is the outermost area of BNP is ESZ4. The checked area is the Tamil Nadu state forest.

Figure 2: Ecological sensitive zones of BNP

Source: Department of Forests and Environment, Government of Karnataka

In the map, the areas in green area the forested lands and agricultural patches can be seen in yellow color. The area outside BNP and in buffer zone is dominated by agricultural patches. This wasn't the case with BNP in the year 1973 as in that year the entire map was green showing that it was purely a protected area dedicated for forests. This map of 2015 shows the sad state of affairs of BNP with all kinds of encroachments happening on its premises. The areas in purple are the mining areas, it's unfortunate to see few mining areas in the core area as well though it's strictly a highest conservation region. The areas in dark green are moist deciduous forests and those in light green are dry deciduous forests. Those in brown color are grasses and shrubs. Light blue areas in the buffer zone represent horticulture areas; most of buffer zone horticulture is being practiced. The red parts in the map show build up area and this can be observed in the northern region close to Bangalore city. From this, one can deduce that the city is spreading slowly into the protected zones of BNP.



Source: *Ibid*

Figure 3: Landscape of BNP

3. DYNAMICS OF LAND USE CHANGES OF BNP

3.1. Land Cover Changes and its impact on Ecosystem in BNP

Land is the vital resource for the industrial development and human advancement. Land availability and land use change is the most visible sign of changing dynamics of land cover in the protected areas. Spatial and temporal analysis of land use changes in BNP provides inputs for the better management of land within the biodiversity areas. The following figure shows the pattern of land use changes over a period of time within BNP region and its buffer zone.

From the above Fig. 1, the following changes in the BNP have been observed. These changes made an impact on BNP ecosystem and its services and disservices. The aim is to trace the changes in the context of ecological economics intertwined with the environmental resource economics. The extent of land in terms of dry deciduous forest has increased from 34.4 % in 1973 to 40.7% in 2015. Dry deciduous forests are an important source of ecosystem services such as wood, fiber, teak, water supply and quality and are critical in carbon cycling process. The increase in the dry

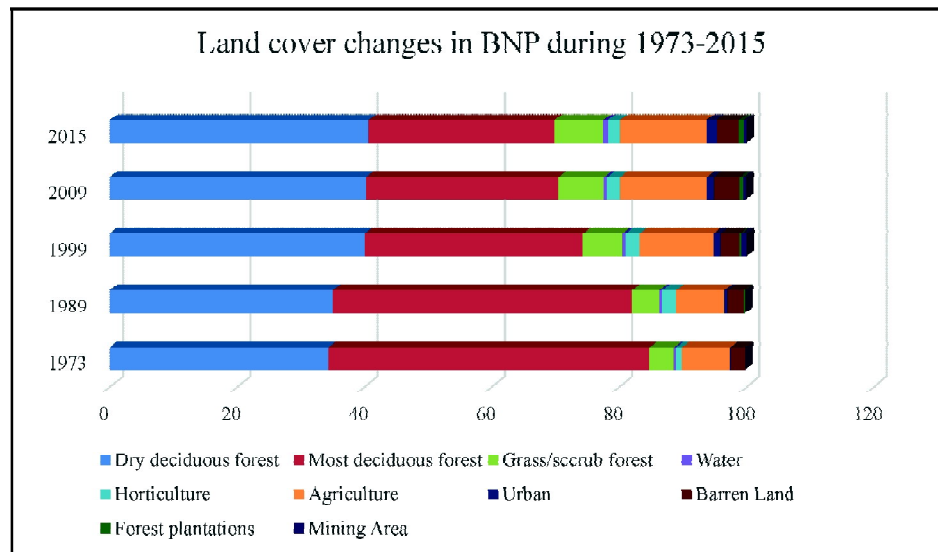


Figure 4: Land cover changes in BNP during 1973-2015

Source: EMPRI, Bangalore

deciduous forests has huge economic potential. Reduction in the temperate forest decreases the efficiency of carbon cycling and declines the ability of forests to rekindle the carbon-oxygen cycle. There is a decline in the extent of moist deciduous forest from 50.4% in 1973 to 29.2% in 2015 in BNP region.

The transformation of moist deciduous forest to grass/scrub forest is reflected in the increase of grass/scrubs in the BNP region from 3.9% in 1973 to 7.7% in 2015. This is corroborated by the fact that in Karnataka the scrub forest density is improved as reported by the India State of Forest Report, 2017 (GoI, 2017). The increase in the water content from 0.3 % in 1973 to 0.7 % in 2015 indicates the increase in the agricultural and allied activities such as horticulture in the vicinity of BNP region. Loss of forest ecosystem and vegetation incurred loss of revenue and biodiversity inducing local climatic change in the Bengaluru. It must be noted that agricultural activities in the vicinity of the BNP have increased from 7.6 in 1973 to 13.6 in 2015. Increase of agricultural activities in BNP contributes for the ecosystem disservices such as forest fires, overgrazing, crop damage and human-animal conflict.

One of the important changes in the landscape of the BNP is seen from the rate of urbanization. The rate of urbanization is growing rapidly from 0.1 % in 1973 to 1.6 % in 2015. The expansion of urban space in the protected areas exert huge pressure on the ecosystem services. This pressure in the wake of the scarcity of natural resources

to augment the needs of the growing population and the needs of the Bangalore city especially water supply and air quality. Another ecosystem disservice indicator is seen in terms of increase in the barren land. The transformation of the forest ecosystem land to barren land is vital to understand the frequency of ecosystem changing into unused land. From 1973 to 2015, the forest plantation was 0.0 to 0.8 %. Social forestry programs and awareness about environment, biodiversity conservation may have contributed to the increase of forest plantations. Mining activities in the vicinity of BNP show an increasing trend between 1989-99 and declined since 2000-15. To illustrate, in 1999 the mining is about 0.8 %, which has come down to 0.4 % in 2015. The decline in mining activities in the post neo-liberal period may attributed to the regulatory, environmental policy framework, laws and institutional mechanisms.

The land use changes in the BNP region impacted the ecosystem in following ways,

- Decrease in the economic output of provisioning services such as wood, fiber, teak as shown by the decline in the moist deciduous forest levels
- Affected the carbon-nitrogen biophysical processes which in turn influence local climate
- Increase in the agricultural activities have contributed for the ecosystem disservices such as forest fires, over grazing and human-animal conflict
- Mining activities have brought the debate on the development vs. environment or environmental resource economics vs. ecological economics to the mainstream discourse specially in the context of growing emphasis on growth through the use of economic efficiency of natural resources
- Land diversion for the developmental goals is creating ecological imbalance thereby affecting the bio-geological cycle of the BNP

From the above Fig. 4, the following changes in BNP with 5km buffer have been observed. These changes made an impact on BNP with 5km buffer which consist of ecologically sensitive region (ESR1, ESR2, ESR3 and ESR4) ecosystem and its services and disservices. Forest degradation is the most visible change that has taken place in the BNP with 5km buffer zone. The extent of forest land in terms of dry/moist deciduous forest has decreased from 26.6 % in 1973 to 18.7 % in 2015. Both these temperate forests contribute ecosystem provisioning services such as food, crop production, wood, fiber, teak, fresh water supply and quality, minor forest produce (MFP) and are critical in carbon sequestration. The decline in the % of these forest areas has reduced the revenue prospects of the BNP. The economic inefficiency of the BNP with 5km buffer has influenced the ecological imbalance. Due to this the prospect

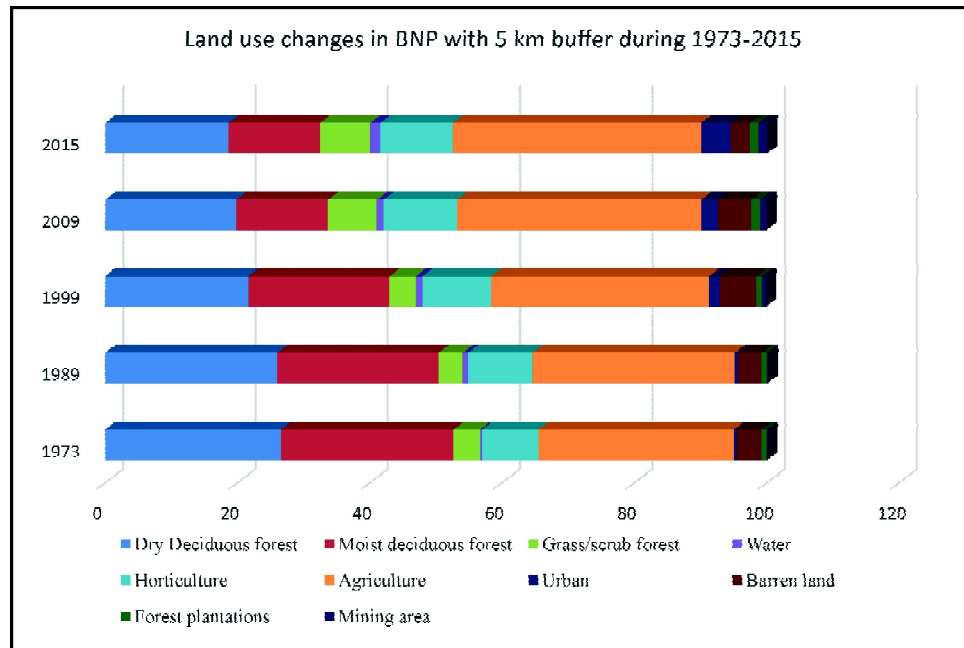


Figure 5: Land cover changes in BNP with 5km buffer during 1973-2015

Source: EMPRI, Bangalore

of ecosystem services such as provisioning, regulating and cultural are severely affecting the human and animal kingdom. The decrease in the forest area in BNP buffer zone dislocates the wildlife animals out of their habitat. It has disturbed the relationship of wildlife with natural habitat, contributing to their wilderness. This has serious consequences on human-animal conflict. Degradation of forests, especially in the protected areas threatens the BNP buffering capacity to render ecosystem services, to maintain ecological equilibrium.

The transformation of dry/moist deciduous forest to grass/scrub forest is reflected in the increase of grass/scrubs in the BNP region from 4.0 in 1973 to 7.6 % in 2015. The increase in the water content from 0.3 % in 1973 to 1.5 % in 2015 indicates the increase in the agricultural and allied activities such as horticulture in the vicinity of the BNP with 5km buffer region. The increase of horticultural activities from 8.5 % to 11 % in 2015 reflects the changes in the buffer zone of the BNP. Loss of vegetation, habitat, and biodiversity is inducing local climatic change in the Bengaluru along with the irreparable damage to the ecological sensitive zone of the BNP. The agricultural activities in the buffer zone of the BNP have increased from 29.6% in 1973 to 37.5% in 2015. Increase of agricultural activities in BNP has

contributed for the ecosystem disservices such as forest fires, overgrazing, crop damage and human-animal conflict.

One of the important changes in the landscape of the BNP is seen from the rate of urbanization. The rate of urbanization is growing quickly from 0.4 % in 1973 to 4.5 % in 2015. The expansion of urban and peri-urban space into the buffer vicinity of the BNP is exerting huge pressure on the ecosystem services. This pressure in the wake of the scarcity of natural resources augmenting the needs of the growing population of Bangalore city especially water supply and air quality. Social forestry programs and awareness about environment, biodiversity conservation may have contributed to the increase of forest plantations. Mining activities in the vicinity of the BNP buffer zone have shows increasing trend since 1973. In 1973 the mining activities were taking place in small quantities, i.e., 0.1 % in 1973 to 1.3% in 2015. Although mining in the buffer zone of the BNP is prohibited, however illegal mining is rampant. The pursuit of mining, especially against the laws and mining regulations is threatening the very existence of the BNP. Mining in the ESR1, ESR2 regions endangering the rich biodiversity and making ecosystem dysfunctional in rendering the various services to the human well-being. To illustrate, in 1999 the mining is about 0.8 %, which has come down to 0.4 % in 2015. The mining activities in the post economic reforms period have increased in the BNP buffer region, creating ecological disturbance to the city.

The land use changes in the BNP region impacted the ecosystem in following ways,

- Dry/moist forest degradation directly affecting the economic output of provisioning services such as wood, fiber, teak and carbon sequestration, carbon-oxygen cycle and other biophysical processes
- Gradual transformation of forested areas into agricultural land and use of forest land for other purposes such as industrial, residential complexes and infrastructural development has affected the resiliency of the BNP
- Increase in the agricultural activities have contributed for the ecosystem disservices such as forest fires, over grazing and human-animal conflict
- Mining activities in the buffer zone are threatening the ecological sensitive region of the BNP.

The changes in the landscape of BNP are a clear case of randomized urban planning and inadequate institutional mechanisms for the preservation of ESR in BNP. The rapid urbanization process, high growth of population and scarcity of natural resources and huge pressure draws land degradation within the BNP and its buffer zone. The land use dynamics and processes BNP shows that there is a gradual decline of forest

area, biodiversity loss and ecological destruction. The changes in the sub-urban and peri-urban areas, an increase in the residential complexes, rampant encroachment of the BNP land for mining activities, commercial activities, all are driving the fast erosion of buffer zone and BNP region. The land use changes in BNP have given rise to the serious issues of conservation and development aspects. A preliminary field visit was undertaken in the month of March-April, 2018. As part of this, informal interactions were held with officials in the National park, civil society organizations, and researchers.

4. CONSERVATION ISSUES PERTAINING TO BNP

Large number of human settlements inside the park BNP was established in the year 1974 and has an area of 260sq kms. This is one of the few national parks which is close to a big city i.e. Bengaluru. This National Park houses 16 enclosure villages with about 1200 households and 77 villages in the Ecological Sensitive Zone 1, exerting huge demographic pressure on BNP and posing conservation challenge to the park management.

Extensive road system in the park- in 260.51 sq km national park there is a road network of 208 kms and this bring enormous traffic into the national park disturbing the wildlife.

Location of the National Park: BNP gives a lot of ecosystem services to the people of Bengaluru city but in return this national park faces many threats due to expanding city. Proximity to a large urban conglomerate i.e., Bengaluru City is fast engulfing its very lung space for its urban demands.

Invasive species inside the park – as per the Forest Department there is more than 30% of the national park area covered by lantana Camera and other invasive species

Livestock population in the park – the grazing pressure on the park due to livestock population in the enclosure and fringe villages is immense. Each village has a minimum of 400 livestock feeding on the forest lands.

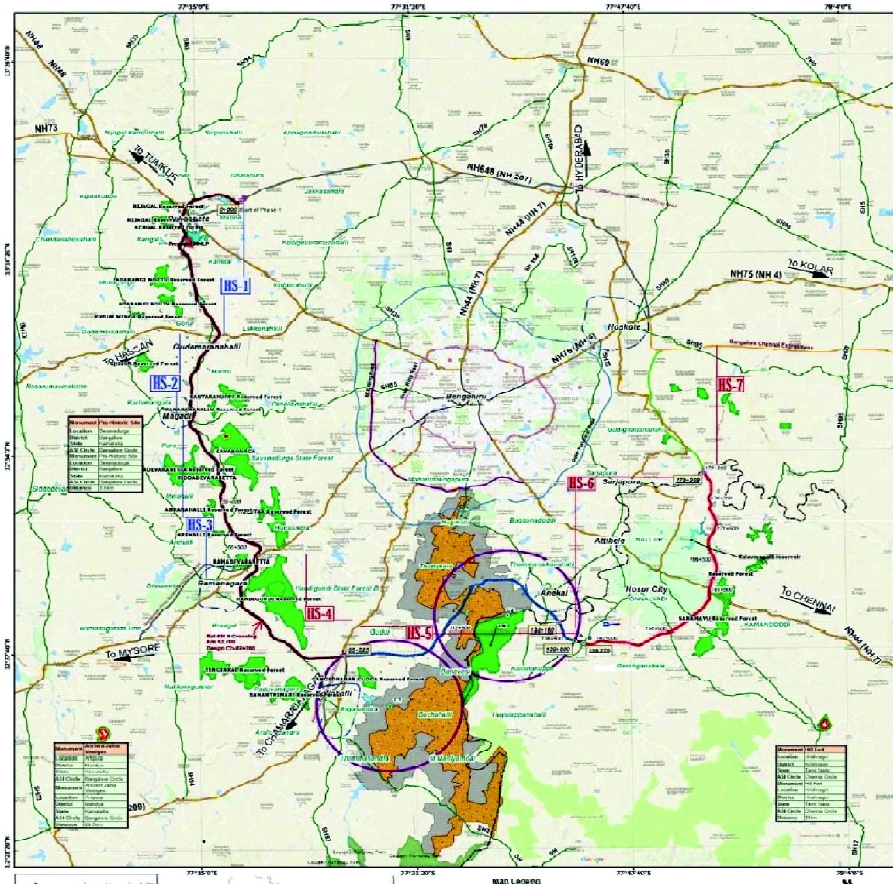
Forest fires during the summer months

Human Wildlife Conflict- year on year the wildlife conflict cases are on a rise in BNP with a total of 3863 cases of crop loss, cattle kill, human injury and death, property loss etc for the years 2016- 2021 (till march) costing the Forest Department 1.8940454 Crores in Indian rupees as compensation payment in the last 5 years. 8 elephants died in BNP as a result of Human- Wildlife conflicts in the last 7 years.

Reduction of ESZ- The Union Ministry of Environment, Forest and Climate Change, through a gazette notification reduced the ESZ from 268.96 square kilometers to 168.84 square kilometers without proper research backing.

Satellite Town Ring Road (STRR)

Satellite Town Ring Road (STRR) which is a project to connect 7 towns encircling Bengaluru city by National Highway Authority of India (NHAI) through KRDCCL will be cutting BNP for 7 km stretch that too in the core area which also happens to be the key elephant passage. The passage is called Mahadeshwara- Karadikkal passage which connects the forest in Tamil Nadu side to BNP. This will take 19 Hectares of core forest land which is already facing encroachment issues on all sides and the passage is too narrow already for movement of about 200 elephants annually. Another 7 km will be built through the draft eco-sensitive zone around the park.



Metro line extension till Bannerghatta Village: The metro line is being extended till the BNP zoo to facilitate more visitors to visit Bannerghatta Zoo unmindful of the fact that this falls in the Ecological Sensitive Zone. This will lead to more influx of people to the already fragile zone of BNP.

5. CONCLUDING OBSERVATIONS

In the light of field observations in BNP and the issues related to environmental conservation of it infers that valuation is critical in conserving the environment and instrumental in formulating policies with regard to land use changes and promoting sensitiveness among humans to the environment and its sustainability. The land use pattern of BNP clearly shows that there is an uneven growth of the urban periphery, imbalance in development. Most importantly the erosion of dry/moist deciduous forest area indicates the institutional and policy measure failures in conserving and protecting the BNP. This decreases the contribution of ecosystem services to the human and animal well being. The loss of biodiversity and ecological in-equilibrium is one of the major factors in contributing the animal-human conflict. The symbiotic association between the ecology, animal kingdom and human lives is lost due to the pursuit of development which focuses exploitation of natural resources at the huge cost of environment.

The ineffective implementation of legislations such as Biodiversity Act, Forest Rights Act and allowing of mining in the prohibited, protected areas of BNP is threatening the Bengaluru city's water, weather and climate change. The increase in the levels of air pollution is directly attributed to the loss of forest area which absorbs carbon from the environment to release oxygen. Effective implementation of the existing laws that protects the national parks is critical in sustaining the environment. In order to have this there must be a convergence of the different agencies and institutions to function in a cordial manner. To illustrate, in the case of BNP the forest, mining, environment and urban development ministries have to coordinate each other to conserve the BNP.

As a final word, there is a necessity to rethink the model of development pursued in India and globally also. Otherwise, we the human beings may draw ourselves into the realm of natural disasters and the consequences of climate change and global warming, which are the outcomes of degradation of the forest ecosystem. The rethink on the model of development, we have to begin with valuing the environment and forest ecosystems. Environmental valuation should not be mistaken as mere economic valuation as monetary part of the valuation is only a part of what ought to be envisaged when one is trying to value ecosystems and their services (Dendoncker et al, 2013). Valuation in this context is not just putting a price tag, but an estimation or appreciation of worth or meaning. The economic methods of valuation provide a necessary congenial atmosphere for the policy makers to conserve the protected areas in an efficient and effective manner.

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