

IMPACT OF STONE QUARRYING ON ENVIRONMENTAL DEGRADATION IN BANNERGHATTA NATIONAL PARK, USING GIS AND REMOTE SENSING TECHNIQUES

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Abstract

The Bannerghatta National Park (BNP) is mainly comprised of tropical mixed dry deciduous forest, grasslands and rocky patches, Located in southern India. It is situated 22 km south of Bangalore city. Established in 1971, the BNP represents an area of 256 km². BNP is surrounded by stone quarries in all direction which have been operational since many years. The effects of such quarrying operations on the jungle and its inhabitants are disastrous. The destruction caused by these operations is wide-spread and permanent. The distribution and spread of quarries from 1970s to 2015, the problems arising because of its effect on vegetation, forest ecosystem, biological diversity and solid waste are discussed in this paper. Quarries are seriously degrading water, air, soil quality, vegetation and forest ecosystem as a whole. Villages and agricultural lands coming under the influence are severely affected. Health and wellbeing of the villagers are also compromised. The study discusses the effects of quarrying operations on the adjacent forest. All the active and abandoned quarrying in and around BNP are analyzed using GIS and Remote Sensing.

Keywords: Environment, Quarrying, Rocks, Health and degrading water, air and soil quality.

Introduction

We Humans are encroaching upon the grasslands at an ever increasing rate. As per the 2011 census the population of Karnataka was 6,11,30,704 (Primary Census abstract 2011) which translates into 319 persons per square kilometer. This growing population is placing a huge demand on the already depleted nature. Grasslands, forests, agricultural lands and lake beds are rapidly being converted into townships without proper planning or scientific advice. Large scale quarrying operations are eating into the remaining patches of grasslands, forests, lakes, pasture and agricultural lands. Well protected areas like Bannerghatta National Park have no respite.

Although BNP is mostly dry deciduous forest, grasslands occupy a significant part of it. These grasslands are home to a good population of Elephants and Gaurs. Other herbivores like Sambar, Chital, Barking Deer, Wild boar and Hares are a plenty. This rich prey base sustains carnivores like Tiger, Leopard, Dholes, Jackals, Indian Grey Wolf and Civets.

Bannerghatta National Park was founded in 1971 and was declared as a national park in 1974. It is spread over an area of 256 sq. km. Located just 22 km south of the Bangalore city, it is one among the few places in the world where wilderness is preserved so close to a metropolitan city.

Although no quarrying or large scale development should exist within 10 km from the borders of any national park, (The Supreme Court of India 2012) BNP is plagued with innumerable stone quarries which have been operational since ages. The grasslands are being destroyed which is directly harming the wild animals. It is causing irreversible damage and polluting the water sources, air, soil quality and biodiversity as a whole.

The explosives are creating a havoc on all the aspects of the forest and its inhabitants. The loud explosions are causing sound pollution which travels 4 to 5 km from its source causing panic and disorientation among the animals.

Geology of the area under study

The study area is undulating with high hillocks, the oldest formation of rocks revealing crypto crystalline to coarse granites and complex gneiss. The rocks are light to dark grey or whitish muscovite granite gneiss or biotic granite gneiss which varies considerably from place to place in structure, texture and appearance. According to the fineness or coarseness of the constituent grains and the relative abundance or scarcity and mode of deposition of the darker Ferro minerals, their complex gneiss masses have been styled “peninsular gneiss”. The gneiss exposures in this region are yielding good slab stones and size stones.

The soil on the upper regions is red and gravelly. The soil in the valleys is sandy loam and is formed with finer particles of the decomposed rocks washed down and deposited during rains. The soil layer is shallow on hill tops and deep in valleys and low lying areas, two types of soil are found in the Bannerghatta National Park. Red soil generally deep or shallow, mixed with metamorphic forms of rocks in undulating grounds. Sandy loams in valleys.

Study Area

The Bannerghatta National Park (BNP) lies between $12^{\circ} 21'$ and $12^{\circ} 50'$ North latitude and between $77^{\circ} 32'$ and $77^{\circ} 38'$ East longitude. The BNP area has been divided into four Wildlife ranges, viz, Bannerghatta Wildlife Range, Harohalli Wildlife Range, Anekal Wildlife Range and Kodihalli Wildlife Ranges for the convenience of administration.

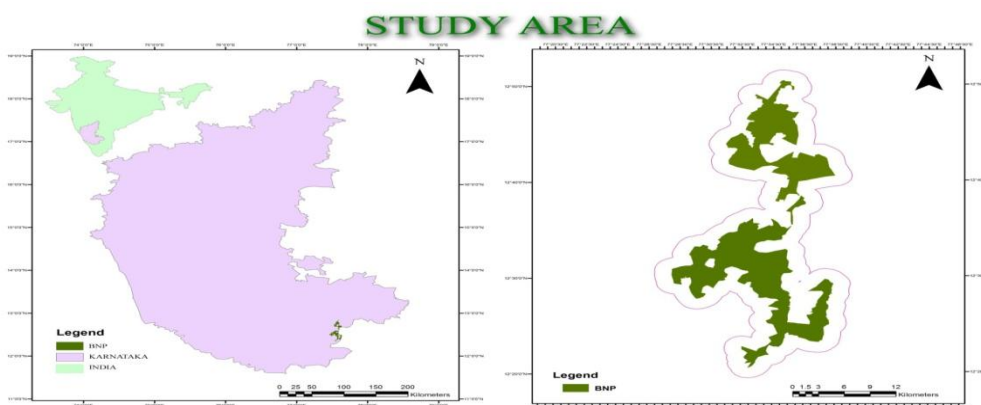


Figure 1. Study Area.

Data Used

Primary data collected from BNP Buffer Zone Villagers and Karnataka Forest Department. Satellite images collected from USGS website. Toposheets collected from the Geological Survey of India in 1:50,000 Scale.

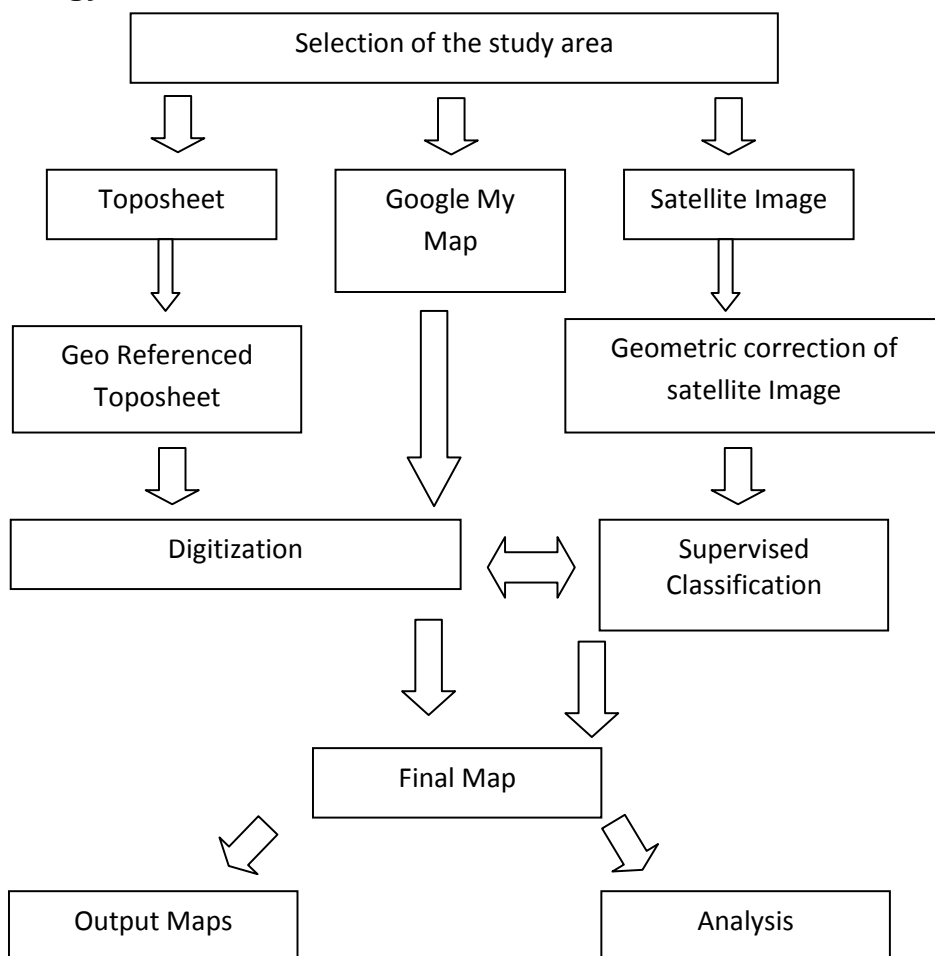
Table 1. Database Used for LU/LC Mapping of BNP.

Satellite	Path/Row	Date	Data type & Bands
LANDSAT 1	154 / 051	27, Feb, 1973	Digital (4, 5, 6, 7)
LANDSAT 7	144 / 051	16, Mar, 2000	Digital (4,5,6,7,8)
LANDSAT 8	144/51	13, Jan, 2015	Digital (4,5,6,7,8)

Objectives

To demarcate quarrying areas in and around BNP. To evaluate the causes of environmental problems. To assess the effects of quarrying on the environment. To assess present vegetation status in and around BNP.

Methodology



A study area is selected. The borders are clearly identified and digitized using Arc GIS and Google My Maps. Landsat Satellite Image from 1973, 2000 and 2015 are studied and the study area is classified and described.

Results and discussion

There has been a drastic change in land use/ cover in BNP after 1970s. Between 1973 and 2000 25.85% of the forest cover had decreased by 4.84% due to unchecked logging, collection of firewood and timber. Between 2015-16 the forest cover has increased by 2.08% as seen in the below map.

Grasslands formed a significant part of this dry deciduous forest. Satellite images of 1973 show the grasslands occupied 51.24% of BNP. Most of which were situated in the northern side and buffer zones. These grasslands were a haven for animals like Indian jackal, Indian Grey Wolf, Sloth Bear, Hyenas, and Vultures etc. By the year 2000 almost 4.22% of the grasslands had depleted. At present grasslands are found only in the buffer zones with the exception of few tiny fragments found within the borders of BNP. In 2015 the vegetation cover has improved slightly.

Bangalore city is growing at an ever increasing pace. Fast growing areas like Kalkere, Gottigere, Bannerghatta and Jigani have occupied 2.06% of the Buffer zones at present. The close proximity to the city and its markets is an important factor because of which the population living in the buffer zones are into agriculture. Agricultural activities which was at 16.85% in 1973 has increased significantly by the year 2000. And there has been a decrease of 6.94% in the year 2015. Depleting water bodies and relocation to city in search of employment are the major factors. As of now urban development has gained significant momentum in approx 2.05% of the buffer zone area.

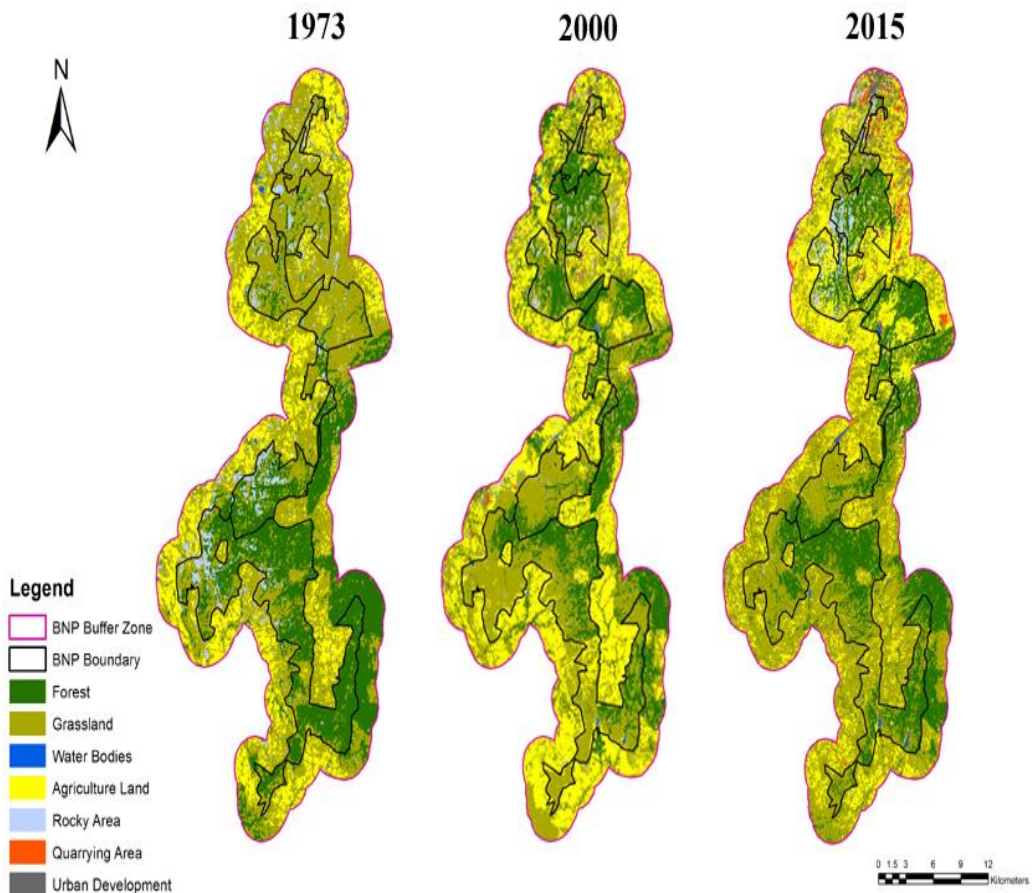
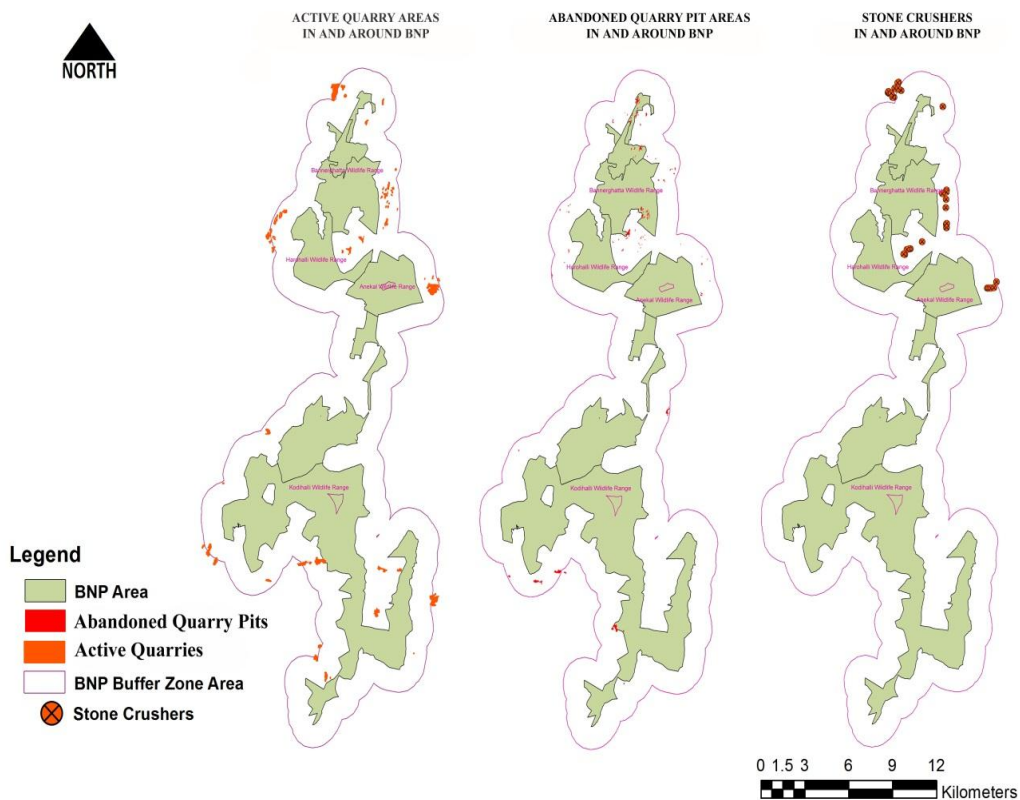


Figure 2. .Layers of various classes shows their extent in the LULC map of 1973, 2000 and 2015.

Table 3. Comparative Evaluation of Time series data 1973, 2000, and 2015 of current time.

Classified	1973		2000		2015	
	In Sq.km	In %	In Sq.km	In %	In Sq.km	In %
Quarrying Area	0.58	0.08	3.34	0.48	14.86	2.15
Urban Development	2.66	0.38	3.25	0.47	14.20	2.05
Forest	178.81	25.85	145.38	21.01	164.47	23.77
Grassland	354.45	51.24	325.28	47.02	330.06	47.71
Water Bodies	0.55	0.08	1.81	0.26	1.64	0.24
Agriculture Land	116.58	16.85	199.91	28.90	151.89	21.96
Rocky Area	38.15	5.51	12.84	1.86	14.68	2.12
Total	691.79	100.00	691.79	100.00	691.79	100.00

Figure 6. Map of Active, Abandoned Quarry pits and Stone Crushers in and around BNP for the year 2015.

Distribution of stone quarries

The forest and grasslands here support a unique biodiversity and agricultural practices which needs to be protected. Stone quarries which had occupied 0.08% of the area in 1973 had increased to 0.48% by the year 2000.

Looking at the current numbers:

Table 5. List of active, abandoned quarry pits and stone crushers for the year 2015.

Table of Active, Abandoned Quarries pits and Stone Crushers in and around BNP						
		Active Quarry Areas		Abandoned Quarry Pit Areas		Stone Crushers
S.I No.	Range Names	No. of Quarries	Area (Acres)	No. of Quarries	Area (Acres)	No. of Crushers
1	Bannerghatta WR	22	431	76	650	22
2	Harohalli WR	13	222	16	189	6
3	Anekal WR	6	69	8	97	5
4	Kodihalli WR	17	602	7	143	0
	Total	58	1324	107	1079	33

The total quarry area occupies 2.15% of BNP and the surrounding buffer zone. A total of 165 quarries occupying 14.86sq.km have been identified. 58 currently active quarries are located in the buffer zones. Stone crushers can be found in 33 locations. The remaining 107 quarries are dormant/abandoned and are mostly found inside the borders of BNP.

Effects of stone quarrying on the environment

Scientific Investigation of the effects of quarrying using Remote Sensing, GIS and from the people living near the forest shows the extent of the damage on the environment.

Let's describe them here:

Impact on the Water

BNP and its surrounding areas receive an average of 700mm of rainfall every year. The hillocks and rocky outcrops act like sponge, feeding the rivers, streams and ponds in the forest and recharging the water table.

These hillocks which are essential for the year round supply of water are being destroyed by the quarries. The streams passing near such quarries are contaminated by fine dust, quarrying waste etc. Such contamination along with the drastic changes in landscape are killing the water sources, thus adversely affecting the aquatic creatures and the bio diversity as a whole.

Impact on the Atmosphere

BNP's northern part is mainly comprised of granite/gneiss type of rocks, which are well suited for producing construction quality pebbles and stones. And as a result many of the stone quarries can be found in these parts. A total of 33 stone crushers are currently operational.

The fine dust produced by these stone crushers mix with the air, polluting the atmosphere. The detonation of powerful explosives along with the large convoy of load carrying trucks and other vehicles travelling to and from these quarries release poisonous gases like Sulfur

Dioxide (SO₂), Oxides of Nitrogen, Carbon Monoxide (CO), volatile organic compounds and Lead into the atmosphere.

It is adversely affecting the health and well being of the people residing near such areas. Birds/animals in the surrounding forests are affected too. People especially children are subjected to respiratory, Neurological and Cardiovascular problems. Wheezing and Cancer is not uncommon.



Impact on Flora and Fauna

The ill effects of quarrying operations in the 14.86sq.km of BNP is reaching the inhabitants of the forest through water, air and sound.

The fine dust entering the atmosphere from stone crushers spread more than 1km from the source and it can easily spread for more than 2km during summer. This is a major cause of respiratory diseases and Cancer. The fine dust settling on the vegetation hinders photosynthesis and growth while the dust settling on the flowers deter pollinators from doing their role.

The tremors sent by the regular detonation of powerful explosives crack walls and damage properties, sometimes leading to loss of life or limb. Animals and birds are disorientated by the loud explosion, forcing them to flee from the region.

Impact on the landscape

Stone quarries end up drastically changing the landscape of the region. Water sources are altered, soil quality is depleted. Beautiful hillocks, forest and grasslands are disappearing fast. Rich and beautiful landscape is turned into an eye sore. The abandoned quarry pit in the buffer zones are quickly turned into dumping sites for the garbage from the city, spreading diseases in humans and animals alike.

Conclusion

The growth in population is putting huge pressures on the natural resources. The spread of agricultural land to feed the ever increasing demand for food is depleting the lakes, grasslands and pasture land in and around BNP at an unprecedented scale. The land use / cover has changed drastically between 1973 and 2015.

More than 180 species of birds, 100+ Butterflies, 70+ spiders, 20+ Frogs, Tiger, Leopard, Dhole, Jackal, Indian Grey Wolf, Civet, Bats, Gaur, Elephants, Chital, Sambar, Barking deer etc occupy BNP. Unless the quarrying operations in and around BNP/ buffer zones are stopped their chances of survival looks bleak.

This study can assist the Forest department, Department of Land Resources, Ministry of Environment Forest and Climate Change, Karnataka Biodiversity Board, Department of Forest, Ecology & Environment (Govt. Of Karnataka), Rural and urban planners or can help to understand the environment better.

Suggestions

As per the Supreme Court rule, 2012 it has issued an order to keep Quarrying and any other activities harming environment 10 kms away from national parks & wildlife sanctuaries. In connection to this, in reality the again said rule cannot be implemented because there are highly congested residential areas like JP Nagar in and around BNP.

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