

# Climate Change And Biodiversity – A Case Study of Keoladeo National Park

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**ABSTRACT:** Keoladeo National Park, located in the State of Rajasthan, is an important wintering ground of Palaearctic migratory waterfowl and is renowned for its large congregation of non-migratory resident breeding birds. A green wildlife oasis situated within a populated human-dominated landscape, some 375 bird species and a diverse array of other life forms have been recorded in this mosaic of grasslands, woodlands, woodland swamps and wetlands of just 2,873 ha. This 'Bird Paradise' was developed in a natural depression wetland that was managed as a duck shooting reserve at the end of the 19th century. While hunting has ceased and the area declared a national park in 1982, its continued existence is dependent on a regulated water supply from a reservoir outside the park boundary. The park's well-designed system of dykes and sluices provides areas of varying water depths which are used by various avifaunal species. Due to its strategic location in the middle of Central Asian migratory flyway and presence of water, large congregations of ducks, geese, coots, pelicans and waders arrive in the winter. The park was the only known wintering site of the central population of the critically endangered Siberian Crane, and also serves as a wintering area for other globally threatened species such as the Greater Spotted Eagle and Imperial Eagle. During the breeding season the most spectacular heronry in the region is formed by 15 species of herons, ibis, cormorants, spoonbills and storks, where in a well-flooded year over 20,000 birds nest.

**KEYWORDS:** Keoladeo National Park, Rajasthan, wetland, threatened, species, migratory, wintering site, endangered

## I. INTRODUCTION

Climate change describes global warming—the ongoing increase in global average temperature—and its effects on Earth's climate system. Climate change in a broader sense also includes previous long-term changes to Earth's climate. The current rise in global average temperature is more rapid than previous changes, and is primarily caused by humans burning fossil fuels. Fossil fuel use, deforestation, and some agricultural and industrial practices increase greenhouse gases, notably carbon dioxide and methane. Greenhouse gases absorb some of the heat that the Earth radiates after it warms from sunlight. Larger amounts of these gases trap more heat in Earth's lower atmosphere, causing global warming.

The Keoladeo National Park is a wetland of international importance for migratory waterfowl, where birds migrating down the Central Asian flyway congregate before dispersing to other regions. At time of inscription it was the wintering ground for the Critically Endangered Siberian Crane, and is habitat for large numbers of resident nesting birds. Some 375 bird species have been recorded from the property including five Critically Endangered, two Endangered and six vulnerable species. Around 115 species of birds breed in the park which includes 15 water bird species forming one of the most spectacular heronries of the region. The habitat mosaic of the property supports a large number of species in a small area, with 42 species of raptors recorded. This is the only park in India that is completely enclosed by a 2 m high boundary wall that minimises the possibilities of any encroachment and biotic disturbances, but there is no possibility of a buffer zone. As the wetlands of Keoladeo are not natural, they are dependent on the monsoon and on water pumped in from outside, traditionally provided from the "Ajan Bandh" reservoir. The water shortage caused by the erratic rainfall in the region is being addressed by initiating two large water resources projects that will

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bring water from permanent water sources in the region. There has been some concern expressed over possible air and water pollution effects from the adjacent city of Bharatpur, but these effects are unknown at present.

Through eco-development activities in the surrounding villages, the grazing of cattle within the park has been minimised and the local communities are also engaged in participatory resource conservation, which includes removal of invasive alien species. Keoladeo attracts many visitors who are taken for bird watching in bicycle rickshaws by trained local guides from surrounding villages, which provides additional livelihoods as well as reduces noise pollution. A recently started conservation programme for the 27 satellite wetlands surrounding this park has further enhanced the protection of the migratory waterfowl arriving in the Central Asian flyway to winter in Western India. The property has effective legal protection under the provisions of Wildlife (Protection) Act, 1972 and Indian Forest Act, 1927. The site is managed by the Rajasthan Forest Department with the support of local communities and national and international conservation organizations, and a management plan has been developed for the protection and management of the property. The major threats to the property are the water supply (both quantity and quality); invasive vegetation (*Prosopis*, *Eichhornia*, *Paspalum*); and inappropriate use of the property by neighbouring villages. These issues are being dealt with through the management plan, and two projects have been developed to bring a permanent solution to the water crisis. Invasive alien species have been removed through cooperative arrangements with the surrounding populations. The 2 m high boundary wall that surrounds the park virtually eliminates the threats of poaching or pollution, and there is no encroachment or habitations inside the park. Noise pollution from the adjoining Bharatpur city and National Highway are minimal. Due to stringent legal environmental regulations in India, all proposed developmental activities have to be subjected to a stringent environmental assessment process.

The Keoladeo National park, a World Heritage Site which was previously the private duck shooting preserve of the Maharaja of Bharatpur, designated as bird sanctuary on 13 March 1956 and a National Park on 10<sup>th</sup> March 1982 was included in the World Heritage List in 1985. It was also notified as Ramsar Site in October 1981. Keoladeo National Park consists of an area of 2873 hectare (28.73 sq.kms). It has flat patchwork marshes in the Gangetic plain, artificially created in 1850. Normally, water is fed into the marshes twice a year from inundations of the Gambhir and Banganga rivers, which are impounded on arable land by means of a artificial dam called Ajan Bund, to the south of the park. For most of the year, the area of wetland is only 1,000ha. In a semi-arid biotype, the park is the only area with much vegetation, hence the term 'Ghana' meaning 'thicket' is also used for it. The park was the last known wintering ground in India of the western population of Siberian crane *Grus leucogeranus*. During the winter of 1984-85, a decade-high total of 41 birds had visited the Park. However, the numbers have been steadily decreasing and in the winter of 1993 and 1994, none were observed. In 1996, four birds wintered in the Park, and in 1997 two adults and young birds were seen. Thereafter, a pair was observed in the year 2001- 02, after which there have been no sightings so far. The park's location in the Gangetic Plain makes it an unrivalled breeding site for herons, storks and cormorants and an important wintering ground for large number of migrant ducks. The most common waterfowl are gadwall, shoveler, teal, tufted duck, painted stork, white spoonbill, darter warblers, babblers, bee-eater. Several other threatened avifauna species are also found, including Dalmatian pelican, spot-billed pelican, lesser and greater adjutants, Baer's pochard, cinereous vulture. In addition to birds, both migratory and resident, the Park has a population of primates, small carnivores like Bengal Fox, Jackal, etc and ungulates like blackbuck, Chital etc.

## Migratory Birds

A total of 375 species of birds including Siberian cranes visited the Park in the early days, out of which 111 were migratory species and 264 were resident species.

## Decrease in number of birds

One of the most important reasons for the decrease in the number of migratory birds visiting Keoladeo National Park is the shortage of water in the park. The main sources of water to the park are a temporary reservoir, viz, the Ajan dam that gets water from the River Gambhir. The construction of Panchana dam across the river Gambhir has added to the misery. Other major management related problems also mar the situation. Keoladeo National Park has a dynamic and fragile ecosystem. The source of water, its quantity and quality

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are major factors affecting the wetland of the Park. Water scenario is the most crucial factor for the survival of wetland. Water from the Ajan Dam is supplied by the irrigation department to the park and to nearby agricultural fields. The time of releases of water to the park is vital for growth of aquatic plants, breeding of heronry species and the overall seasonality of factor in survival of wetlands. The years 1997, 2000, 2001, 2002 and 2004 were drought years. With harnessing of river Gambhir at Panchana dam in district Karauli, the water supply to Ajan dam has been further curtailed. Availability of water to the park is an issue of concern.

The Annual Requirement of water to maintain the wetland character of the Keoladeo National Park is about 14 million cubic feet water. As per the report of Water Resource Department of Government of Rajasthan, the Park has a maximum storage capacity of about 550 million cubic feet of water. A study conducted by Late Dr. Salim Ali and Dr.V.S. Vijayan, estimated the requirement of annual water supply in the range of 14 million cubic meter, i.e, about 493 million cubic feet of water, balance requirement is met by rainfall over the National Park. The water problem in the Park began after the drought in 2000, 2001, 2002 and 2004 caused water scarcity in the Park. The construction of the Panchana dam across the river Gambhir during the years 2003-04 had compounded the water problem in the park. As the capacity of the Panchana dam, initially designed in the year 1979, for storing 610 million cubic feet of water was raised to store 2100 million cubic feet of water. This has led to a situation, where very little water flows down stream of the dam. The Park has suffered in the last couple of years due to disrupted coupling of 'Ajan-Keoladeo' connections. The past years have been years of drought and therefore the required quantity of water from the Ajan dam could not be made available to Park. During the year 2006, the monsoons also failed causing lot of damage.

## Water Scarcity

The major reasons attributed for the water scarcity in the Park are increase in the storage capacity of Panchana dam from 610 cubic feet to 2100 million cubic feet thereby allowing very little flow of water downstream. Added to this are failure of monsoon, breach in the canal and river system, leakage of water through the damaged sluice gates, transmission losses like seepage, evaporation and percolation and illegal lifting of water from the channels by farmers. The major effects of water scarcity can be seen in various forms. Over the years, the habitat quality has degraded significantly. Invasion of weed species has outpaced the reclamation efforts resulting in invasion of *Prosopis* in all the ecosystems of the Park. Increase in anthropogenic pressures resulting in people-park conflicts. The other major management problem being faced in the Park is the invasive species growth. *Prosopis juliflora*, an obnoxious weed has invaded the entire park and this has adversely affected the habitat of woodland, grassland and lakes. Further, the presence of feral, i.e. undomesticated cattle also poses a management problem to the park. Feral cattle generate biotic pressure over the feeding ground of herbivores and these also become a cause of spreading/transmission of certain cattle diseases to the animals. To mitigate the water problem in the Park, the state government has taken some long term and short term measures. Deep bore wells have been dug up at important points. To meet the annual water requirement of the park of about 550 million cubic feet, two strategies have been worked out. Firstly, the State Government has completed the Chiksana canal project which would provide about 200 million cubic feet of water to the Park. This project has been completed at an estimated cost of Rs. 41 lakhs. The second step is regarding Govardhan drain Project. The total project cost proposed by the State Government is Rs. 65.00 crores. The Project envisages channelisation of water from Govardhan drain and is expected to meet water deficit in the park during July-September months. The park will get water through diversion and lifting of floodwater of Yamuna River. The project also envisages diversion of water during monsoon through underground pipes with lifting arrangements over a length of 16 km from the off-take point of Govardhan drain near Santruk village. This project proposal has been submitted to Planning Commission by the State Government. An expert team from Planning Commission along with representative from the Ministry visited Bharatpur. The team had recommended release from Anja Bund and Bees Mora to meet 50% of the water requirement of Keoladeo National Park, channelise surplus floodwater from Govardhan drain to meet the water deficit, cost of the project may be met through Additional Central Assistance to be released by the Planning Commission and Cost for operation and maintenance for the remaining 4 years be shared equally 50% each by the Ministry of Environment and Forests and the Government of Rajasthan.

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## Chambal- Dholpur- Bharatpur Water Supply Project

This is basically a Public Health Engineering (PHE) drinking water project for people of Bharatpur. As per the conditions laid down by the Indian Board of Wildlife certain quantity of water is to be made available to the Park. Under this project the Chambal water will be brought to this park through an 8- km, long pipeline after pumping at two stations. This water will be capable of providing enough fishes to the piscivorous birds resulting in the formation of breeding colonies during lean monsoon periods as well. This project would provide about 310 million cubic feet water to the Park every year for the first four years and 62.5 million cubic feet of water every year four years. The Government has released Rs 212.30 lakhs from 2002 to 2009 to mitigate water problems under the Centrally Sponsored Scheme "Integrated Development of Wildlife Habitats". In addition to this, all technical support is being provided by the Government. Additional efforts have been taken to Restore the world heritage status. An externally aided project has been undertaken titled "World Heritage Bio-diversity Programme for India: Building Partnerships to Support UNESCO's World Heritage programme". The project is an outcome of a planning grant received from the UNESCO & United Nation Foundation (UNF) and was developed under the guidance of Project Steering Committee. The total period of the project is 10 years with two phases, viz, Phase-I four years and Phase –II of six years. The project is to be undertaken in four world Heritage Sites of India, Kaziranga National Park, Manas National Park, Nanda Devi National Park, and Keoladeo National Park. The main focus of the Project is on strengthening capacity for effective management; site level Management policies and Governance; enhancing the role of local communities in conservation of biodiversity; enhancing habitat connectivity; restoration of lost attributes; enhancing habitat connectivity; restoration of lost attributes and research & monitoring and identification of potential World Heritage Bio-diversity sites. Missions of the UNESCO- World Heritage Centre, Paris and IUCN, had visited the Manas National Park & Heritage Site, Assam in February 2008, and another had visited the Keoladeo National Park, Bharatpur, Rajasthan to look into the conservation programmes of the Heritage Sites.

## II. DISCUSSION

A severe drought caused severe harm to the park and its flora and fauna in 2007.

A proposal for water supply to Keoladeo National Park, Bharatpur was forwarded by the Government of Rajasthan seeking assistance from Planning Commission as advised and approved by the Ministry of Environment and Forests (MoEF) vide their letter dated 10.04.2008. As per the MoEF, the proposal is beyond the purview of the existing centrally sponsored scheme of the MoEF, seems to be viable and has the potential to put an end to the eternal water scarcity in Bharatpur National Park. The Keoladeo National Park is a Ramsar Wetland Site and a World Heritage Site. Due to acute water scarcity, the ecosystem of the Park has been affected badly and this has resulted in reduction in the arrival of migratory birds in the National Park. Water supply is essential for the National Park, which is a wetland and a Ramsar site facing acute shortage of water for the last few years. Currently, apart from rainfall the Park receives water from "Ajan Bund", a temporary reservoir via the Dakan canal. Through a small canal dug last year water from Khokhar Weir (Bees Mora) is also available. The total requirement of water for the Park is estimated at 14.17 million cubic meters (500 MCft). The supply from Ajan Bund is irregular and subject to the bund being full to the extent of reservoir level at 8.5 meters. During the last several years either water is not supplied or supplied insufficiently. The project had been prepared to keep in view the need for 400 MCFT of water during late July to August, for a period of 30 days to the Park which is to be had by diverting and lifting flood waters of Yamuna. The project thus covered diversion of water during monsoon through underground pipes with lifting arrangements over a length of 16 km from the off-take point of Goverdhan drain near Santruk village. The estimated cost of the project as proposed by the State Government was to the tune of Rs. 650 million. The project proposed was to channelize water from Govardhan drain to meet the water deficit of KNP during the months of July to September at the time of requirement. The major components of the project were construction of a head regulator with control gate at the drain located in the state, raw water reservoir with capacity of 13,000 m, 3 pump houses, DG sets for pumping station and laying and testing of /PCC/MS pipelines.

The most common threats to wetlands and the Keoladeo National Park are water scarcity, changing biodiversity, increasing rate of contamination, uncontrolled growth of grass, urbanization and human intervention. In this paper, an attempt has been made to study the degradation and conservation of biotic part of the park through a reaction diffusion

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modeling. The biotic part of wetland is divided into three categories good biomass, bad biomass, and bird population. Good biomasses are those species that provide food for bird population and contain floating vegetation, fishes, waterfowl and useful species. Bad biomasses contain *Paspalum distichum* and its family that affect the growth of good biomass. The interaction between good biomass and bird population is considered to be Crowley–Martin type functional response. We have presented the theoretical analysis of stability and Turing instability. With the help of numerical simulations, we have observed spatial patterns for the wetland model system. This study demonstrates that spatial heterogeneity, diffusion coefficients and per capita availability of water to bad biomass play an important role on the dynamical behavior of the model system.

The ecological health of Keoladeo National Park (KNP) has been major concerns in India as it has figured in the list of Ramsar convention. The wetlands throughout the world and their ecosystems are suffering from environmental degradation like water scarcity, changing biodiversity, increasing rate of contamination, uncontrolled growth of grass, urbanization, pollution, disruption of breeding ground, imbalance in sediment load and nutrient filtration (Ramsar Convention Secretariat, 2011). According to the Millennium Ecosystem Assessment (MEA) (MEA, 2005), wetlands deliver a wide range of ecosystem services that contribute to human well-being, such as fish and fiber, water supply, water purification, climate and flood regulation, coastal protection, recreational opportunities, and, increasing tourism. The degradation of wetlands is more rapid than that of other ecosystems. Similarly, the status of both freshwater and coastal wetland species is deteriorating faster than those of other ecosystems.

The park is manmade and totally dependent upon the monsoon, construction of dam proves to be hazardous for the water availability. Only the time dam overflows park gets the required amount of water. Roads inside the park to facilitate the tourist activity is hampering the natural phenomena of the avifauna. Urbanization in close proximity of the Keoladeo national park is hazardous for the sensitive ecosystem. Increasing number of tourist creates negative impact on the ecology. As Keoladeo National Park is home for birds the mobile towers in vicinity of this area due to increase in urbanization deteriorates the health of birds. Rise in air pollution due to the National Highway beside the park with the flow of noticeable traffic can create a problematic scenario for the national park. Many of the species does not migrate to the Kalaladeo National park. It has been noted that Siberian cranes are extinct.

### III. RESULTS

There must be a balance between available oxygen and the demand for it. Fishes, plants and aerobic bacteria all require oxygen for respiration. For the aquatic life, available oxygen means dissolved oxygen from the air plus oxygen produced by aquatic plants, algae, and phytoplankton as a by product of photosynthesis. *Paspalum distichum* and its family are the dominated species in Keoladeo National Park that deplete the oxygen and affects the survival of other species of floating vegetation, fishes and waterfowl, etc. Researchers studied the impact of hydrological changes on the biodiversity of KNP and their impact on ecotourism and suggested that some action should be taken by Government for maintaining the healthy and compatible ecological system for migratory birds. Species which are key players for an aquatic body are macrophytes, fishes and birds. The aquatic macrophytes are grouped into three categories, emergent, submerged and floating. Submerged aquatic vegetation (SAV) is an important source of oxygen which provides food and shelter for fish, shellfish and invertebrates. The DO, BOD and COD concentrations are varied in the ranges 3.3–4.8 mg/l, 0.24–3.48 mg/l and 7.5–34.16 mg/l respectively. The physio-chemical and biological parameter for KNP such as the hydrogen-ion concentration (pH), turbidity, electrical conductance, salinity, TSS and TDS were found to be in ranges 7.6–7.9, 2.15–38.4 NTU, 867–1358 mg/l, 160–205 mg/l, 27.5–49.16 mg/l and 492–674.66 mg/l respectively.

Keoladeo national park (KNP) is one of the world heritage sites situated in Bharatpur, Rajasthan, India. This man made park was declared as national park in 1981 and spread in about 28.73 km<sup>2</sup>; 11 km<sup>2</sup> is covered by marshes and the rest is covered by scrubland and grassland. This famous avifauna sanctuary hosts almost thousands of birds especially in winter season. Wetlands provide critical habitat for waterfowl including ducks, egrets, geese and migratory birds. The fauna includes more than 350 species of birds which include 42 species of raptors and 9 species of owls, 27 species of mammals, 13 species of reptiles, 7 species of amphibians, 58 species of fishes and 71 species of butterflies, more than 30 species of dragonflies and more than 30 species of spiders inhabit the park. KNP is often referred as Birds Paradise due to the abundance of the birds. The deepest zones of the wetland park was characterized by floating marsh during the 1980 and involved submersed species like *Hydrilla verticillata*, floating-leaved species such as *Nymphaoides*

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*cristatum* and grasses such as *Paspalum distichum*, all species with very low root biomasses. From last decade, the number and variety of migratory birds used to come in KNP has been decreasing continuously due to deprived ecology which is very serious concern. It has been observed that population of Siberian crane reduced sharply which were 100 in 1970, was two in 2002 and completely absent after 2004. Migratory birds are main attraction of ecotourism. Diversity as well as the tourism are affecting due to this serious concern of decreasing number of migratory birds. Biological invasions are currently regarded as a major threat to biodiversity and agriculture all over the world, often resulting in huge economic losses (Petrovskii and McKay, 2010). Due to uncontrolled expansion of the *Eleocharis plantagenia*, *Paspalum distichum*, *Typha angustata* and *Vetiveria zizanoides* communities, KNP experienced considerable change in whole character.

Several theoretical works and field studies on this park has been done by Beth A. Middleton and her co-workers. Middleton and Van der Valk (1987) studied the food habitats of *Greylag* and *Barheaded* geese and suggested that geese choose more nutritious food prior to migration or to breeding. Later on in 1992, they constructed goose management plans for *Greylag* and *Barheaded* geese over wintering in the Keoladeo National Park and other parts of Northern India. Middleton also prepared a brief survey report on the vegetation status of the Keoladeo National Park and suggested that the hydrologic fluctuation drives vegetation change in monsoonal wetlands.

More than 200 research publications are available from this Park. Findings of these studies have helped the management to take certain important conservation measures, for example, acquiring required water from the Ajan Bund, control of feral cattle, creation of boundary wall around the Park etc. Nevertheless, there are still several gaps in the research activities of the Keoladeo Ghana National Park, which need to be plugged. For example; 1. Study on seed-bank of the Park. A study aimed to investigate the carrying capacity and minimum ecological requirement of seeds of both plants and fishes of the Park is required to be carried out. 2. Bharatpur is one of the fast developing towns in Rajasthan and drastic changes in the land use pattern have been observed around the Park, which might have an adverse impact on the biodiversity of the Park. There is a need to study the landuse changes around the Park with special focus on the intensification of agriculture and use of organic fertilizers. 3. Although, mammals of the Park had been studied in the past. A study aimed to investigate the co-existence and resources partitioning of major herbivores such as nilgai, sambar, chital, and feral cattle needs to be carried out. This would provide the information which could help the management of habitat and population of these species in KNP in the present contest. 4. Though studies on Sarus Crane, Vulture and Python have been carried out, it is necessary to continuously monitor their populations and habitats for their long term conservation inside the Park 5. Several thousands migratory birds visit this Park during the winter and hence this place provides an excellent opportunity for bird ringing and monitoring. This would help to study the impact of global climate change, avian influenza etc on global bird communities and their migration. 6. KNP also provide an opportunity to study the epidemiology of avian influenza in India, which needs to be studied. 7. Continuous monitoring of water quality and pollutants levels inside the Park is to be carried out to monitor the health of aquatic ecosystem. A study of 'Economic evaluation of KGNP' and its ecological goods and services needs to be initiated. 9. Creation of research data-base and analysis on research-management interface is required. 10. Aquatic-terrestrial habitat relationship: Due to changing climate and landuse pattern the habitat relationship between aquatic and terrestrial ecosystems of the Park needs to be studied. There is a possibility of encroachment of aquatic ecosystem by the terrestrial ecosystem due to drought or scarcity of water. 11. Impact Assessments studies related to landuse level, hydrology and water regime, impact of infrastructure development, ground water removal, increasing visitors etc are also required. 12. Impact of wild and feral mammalian herbivores on the management of invasive species in the Park needs to be studied. It is expected that introduced animals inside the Park may be dispersing the seeds of invasive species. 13. Identification of indicator species and its ecology needs to be studied for the long term conservation of the Park. 14. Changes in vegetation pattern and soil quality due to ongoing invasive species eradication programme also need to be studied. 15. A study on catchment area evaluation needs to be carried out to understand the landuse pattern and its impact on the Park environment. 16. Assessment and Inventorization of tourism resources for diffusing increasing tourism pressure from KGNP 17. Role of KGNP in carbon sequestration also required to be assessed. 18. A greater emphasis on the Socio-economic studies and economic evaluation which is lacking at present needs to be studied. 19. Continuous monitoring of biodiversity needs to taken up for the long term conservation of Park. This data would help the PA Management to take corrective measures.

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## IV. CONCLUSIONS

Recent research suggests that the types of environmental changes predicted in climatic models are now taking place. Studies of many animals and plants that show significant alterations in range or behaviour find that the most consistent explanation for these is climate change. Global warming is also linked to observed impacts such as coral bleaching and melting glaciers. Such changes are taking place widely and as a result, global warming is already impacting protected areas. These impacts may necessitate a fundamental rethinking in the approach to protection. Protected areas are rooted in the concept of permanence: protection works best as a conservation tool if the area remains protected for the foreseeable future. Protected area agencies have rightly resisted attempts to move protected area boundaries or de-designate protected areas for periods of time. But under climate change, species for which a particular protected area was established may no longer survive there. Some protected areas—for instance in coastal, arctic and montane regions— may disappear altogether in their current form. The current extinction crisis is likely to become more intense as environmental conditions change and fluctuate at an unnatural rate. Keoladeo National Park, near Agra, is a wetland area famous as one of the few wintering sites of the highly endangered Siberian crane (*Grus leucogeranus*). It was created as a duck shoot by manipulating a small existing area of wetland and then later declared a national park and World Heritage site. The park is dependent on fresh input of water during each monsoon. Other demands on water have increased and droughts have become more regular, leading to serious water shortages; in the 2003 season, water levels are damagingly low

While the expansion of city it is very important to identify the regions which can be developed and does not harm the buffer space or core areas of the protected landscapes. Many National Parks are facing the problems of construction of roads and activity zones in the buffer areas which eventually harm the core areas of protected landscapes. Strategies should be developed for the tourist activities, number of tourist should be restricted. In case when buffer zone can't be provided as development is in vicinity to the national park some regulations should be formulated so that the biodiversity does not get affected out of it.

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