

**PLANNING FOR ECO TOURISM AND ITS INTEGRATION IN
DEVELOPMENT OF WETLAND FOR KABAR TAL, MANJHAUL,
BEGUSARAI**

*Submitted
In partial fulfilment of the requirements for
the award of the degree of*

**MASTER OF ARCHITECTURE
(LANDSCAPE)**

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2017MLA003



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Declaration

I **Shubham Kaushal**, Scholar No.:**2017MLA003** hereby declare that the thesis entitled **Planning For Eco Tourism And Its Integration In Development Of Wetland For Kabar Tal, Manjhaul, Begusarai** submitted by me in partial fulfilment for the award of **Master of Architecture (Landscape)**, in **School of Planning and Architecture, Bhopal**, India, is a record of bona fide work carried out by me. The matter embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

07th April 2019

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Certificate

This is to certify that the declaration of **Shubham Kaushal** is true to the best of my knowledge and that the student has worked under the guidance of the following panel.

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“What we do to our Landscape, we ultimately do it to ourselves.”

- Anonymous

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1 CONTEXT

1.1 Introduction

Kabar Tal is the biggest oxbow lake in Asia covering an area of 68 (Sumit Anand, 2013)00 hectares in Begusarai district of Bihar. Kabar Tal is ecologically one of the most important wetlands in the state and South East Asia. Kabar Tal is a product of successive meandering regime of three to four different rivers which are, River Burhi Gandak, River Bagmati, River Bainti and River Balan. The Lake hosts 106 species of resident Bird and around 60 species of Migratory birds for 3-5 months of a year. The Wetland came into limelight when famous Ornithologist and Scientist Salim Ali Jubba came for a visit in early 1970s. Here he tagged few of the Birds and when these Birds were found in Siberia, this established the importance of the lake. The lake is economically important for the area as it yields two tonnes of fish every day and is major source of water for irrigation in the area.

Later on in 1986, the then Prime Minister Rajeev Gandhi declared the lake as a Protected Area and later on in 1989 it was declared as a Bird Sanctuary. Kabar Tal of late has drawn national and international attention and the union government has identified it among The Wetlands of National Importance in 2002 by the Ministry of Environment, Forest and Climate Change; the only one with this designation in Bihar. By 2006 lake got completely dried up and the depressed area got completely converted into agricultural land. In 2010 Deputy Chief Minister of Bihar visited the site and he announced revival of the lake by reviving a dead Harsine stream by connecting it to a network of oxbow lakes which in turn was connected to Burhi Gandak.

1.2 Aim

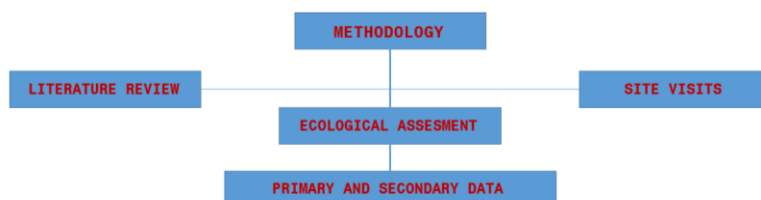
Planning For Eco-tourism And Integrated Development with Wetland Management & Vernacular Landscape Conservation of Kabar Tal Bird Sanctuary.

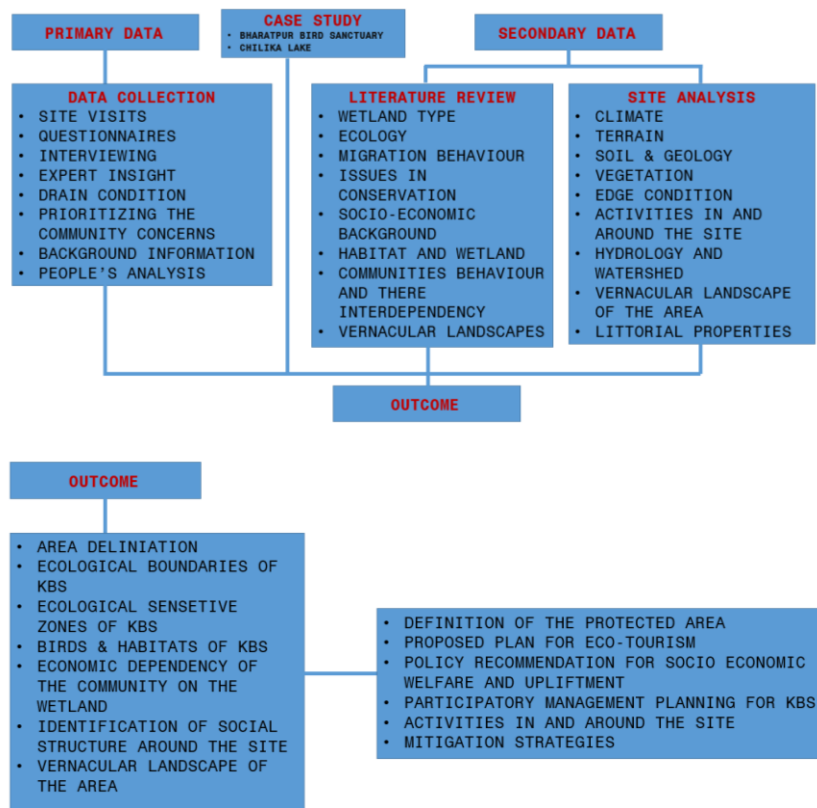
1.3 Objective

- The main objectives of this study will be-
- To understand the ecology of the wetland.
- To determine the ecological boundary of Kabar Tal wetland system.
- To prepare a master plan for ecotourism development. Landscape assessment of cultural and vernacular landscape of the area.
- To create a network of tourist and cultural spaces.
- To study and propose planting strategies which enhance bird population in the bird sanctuary and the surrounding areas.
- To identify land suitable for ecotourism and educational area.
- To identify the scopes of participatory management planning for Kabar Tal Bird Sanctuary.

1.4 Methodology

- The study is based on collection of data from different sources, categorically the data is collected as,
- The primary data, and
- The secondary data
- These data has been collected from various sources such as journals, books, internet and other published and unpublished works. Parameters to be kept while going forth the study will be,
- Qualitative Parameters, and
- Quantitative parameters.





1.5 Need for Study

- Soil and water pollution is one of the major threat to the site. This is leading to eutrophication.
- Encroachment is a major issue.
- Extensive fishing is one of the main reason of disturbance in the ecosystem of Kabar Tal. Every day there is a catch of 4-6 tonnes of fishes.
- Extensive grazing in the nearby vegetated areas. Even the lake is a major source of food for humans, the cattle and is the major source of fish fodder for the nearby artificial lakes in the area.
- Extensive irrigation and anthropogenic factors has led to shrinkage of the lake. In 1984 and 2002 the lake area decreased by 500 hectares. It is the major source of water for irrigation in the nearby farms.

- This wetland is the major source of income for the major villages and the communities around the lake.

1.6 Scope and Limitation

- The main focus of this thesis is to delineate the boundary of the sanctuary.
- The main focus is to conserve the ecology of the area will be by retaining the water level.
- Planting strategy to reinvigorate the present scenario and provide hideouts to the birds for breeding and roosting.
- Create awareness in terms of the sensitivity of the situation related to the current pattern of various birds habitat.
- Major part of the site will be dealt by strategies for participatory management planning.

2 Literature Study

2.1 Wetlands

Wetlands are areas of shallow water up to 3m depth whether they are rivers, tanks, ditches, lakes, swampy lands and coastal areas of the seas and oceans. (Mandal, 2010)

Ramsar Convention on Wetlands define wetlands as: "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters". (convention)

Wetlands have three characteristics and these serves as general definitions: (Marsh)

- The presence of water on the surface, usually relatively shallow water, all or part of the year
- The presence of distinctive soils, often with high organic, contents that are clearly

different from upland soils.

- The presence of vegetation composed of species adapted to wet soils, surface water and or flooding.

2.1.2 Wetlands Types

Every country in the world have a wetland of some or the other typology, some are seasonally aquatic and some are seasonally terrestrial. Some of the type of wetlands include;

- Marine – coastal lagoons, coral reefs, Seagrass beds and rocky shores.
- Estuarine – mangrove swamps, tidal marshes and deltas
- Lacustrine – along lakes
- Riverine – along rivers and streams
- Palustrine (Marshy) – marshes, bogs, and swamps.



2.1.2 Importance of Wetlands

- Wetlands are natural water purifier. Bacteria, plants and animals present in the wetland are natural filters. They absorb the minerals and gasses dissolved in the water.

- Wetlands are habitat spaces for many species. Birds, animals, fishes, planktons, plants and sometimes humans are largely dependent on wetland and its resources.
- Wetlands acts as sponge during floods and can absorb huge amounts of flood water reducing the damage caused by the floods. Riverine wetlands plays a vital role in absorbing the floods.
- Wetlands are a recreational spots. It is an open up space for the people. Activities like hiking, camping, bird watching, fishing, boating are some major activities that happen in these waterbodies.
- Wetlands provide many educational activities as it is a major site for various research works, birders, aquaculture, water management etc.
- Wetlands have their own micro watershed. It even stores water in acute dry seasons and feeds the nearby areas by releasing the stored water.
- Wetlands checks soil erosion as it enhances the vegetation quality of the area. It reinforces the soil. Wetlands also provides us with many medicinal plants.
- Wetlands absorbs large amount of carbon and other greenhouse gases. It plays an important role in checking climate change.
- In spite of such great services these wetlands provide yet they are under continuous threat due to various anthropogenic activities. Wetlands are being encroached. Excessive fishing and poaching has caused disturbance in the food chain causing threat to various species.

2.1.3 Wetland Function and Food Web

Green plants use the sun's energy to convert inorganic (non-living) minerals to organic (living) plant tissue. This process is known as photosynthesis. At the first level of production of organic material the process is called primary production and is accomplished only by those microorganisms that contain chlorophyll. Plant species common to wetlands have high levels of primary production. Estimates of the primary production of wetlands are as high as 4-6 tons per acre per year. Wetlands productivity rivals or surpasses the most productive farmlands (Tiner, 1984). Animals that feed directly on plant material are called primary consumers. However, few animals eat wetland vegetation and most of the plant material becomes detritus. Detritus is partially

decomposed plant material. In wetlands systems, some or most, of the material is exported to the estuary. Many types of microorganisms grow on the detritus. The tiny plants and animals which populate the detritus increase the value of the detritus as food for estuarine organisms. The detritus is consumed by many animals including crabs, fish and shellfish. The consumers digest the microorganisms growing on the detritus. However, the detritus is only partially broken-down and passes through mostly undigested. The detritus is repopulated with microorganisms and the process is repeated. The higher level consumers in the process are those that feed on the detrital consumers. Examples of higher level consumers are shorebirds, finfish and mammals including humans.

2.1.4 Threats to Wetlands

Wetland values are increasingly facing several anthropogenic pressures. The rapidly expanding human population, large scale changes in land use / land cover and burgeoning development projects and improper use of watersheds has all caused a substantial decline of wetland resources of the country. Absence of reliable and updates information and data on extent of wetlands, their conservation values and socioeconomic importance has greatly hampered development of policies, legislation administrative interventions by the state.

2.1.5 Causes of Detrition of Wetlands

Dense human population in catchments, urbanisation, and various activities has resulted in over exploitation of wetland resources, leading to degradation in their quality and quantity. Now, there is increasing concern to conserve and restore perishing wetlands and endangered habitats to achieve ecological sustainability. As per one of the studies, wetlands in our country are disappearing at a rate of 2% to 3% every year. Some of the major threats to wetlands are as given below:

- Urbanization- increasing developmental pressure for residential, industrial and commercial Facilities.
- Anthropogenic activities- unplanned urban and agricultural development, industries, road construction, impoundment, resource extraction and dredge disposal.

- Agricultural Activities- conversion of wetlands for paddy fields; construction of a large number of reservoirs, canals and dams; diversion of streams and rivers to provide for irrigation.
- Deforestation- removal of vegetation in the catchment leading to soil erosion and siltation.
- Pollution-unrestricted dumping of sewage, solid wastes and toxic chemicals from industries and households.
- Salinization- over withdrawal of groundwater has led to salinization.
- Aquaculture- pisciculture and aquaculture ponds.
- Introduced Species- exotic introduced plant species such as Water Hyacinth and Salvinia clog waterways and compete with native vegetation.
- Climate change- increased air temperature; shifts in precipitation; increased frequency of storms, droughts, and floods; increased atmospheric carbon dioxide concentration; and sea level rise.
- Draining and land filling
- Over- exploitation of fish resources
- Pollution
- Agricultural production and residues, industrial wastes reach wetlands
- More than 1/2 of the world's remaining wetlands have been destroyed in the 20th century, especially in developing countries by the demands of industrialisation.
- 1/3rd of Indian wetlands has already been wiped out or has been severely degraded.

2.1.6 Wetland Conservation and Management

'Value' is an anthropocentric concept as it depends upon the perception or judgment of the human society about the usefulness of something. The goods and services provided by an ecosystem are then considered as values. All values are derived from the functions performed by an ecosystem. All wetlands perform certain functions and hence, have some values. Sometimes, these functions and values are considered interchangeably. It must be stressed however that all kinds of wetlands do not perform all possible functions, and therefore do not have similar values. The functions depend upon the location, size and various ecosystem, characteristics of the wetland, and also upon the nature and degree of human intervention. Functions of an ecosystem are ecological attributes

resulting from the interaction between its physical, chemical and biological components. These interactions result in the creation of a variety of niches, which are occupied by various organisms thus providing a habitat to plants, animals and microorganism, is an ecosystem function. Besides the foregoing quantifiable and consumptive values, wetlands also have an important non-consumptive value.

Wetlands that are on the Ramsar list of International importance often provide habitat for wild life whose value is not expressed in monetary terms but whose aesthetic and biological diversity value is nonetheless recognized world -wide.

In view of understanding the utility of wetlands, the attempt made by the Ramsar authority as well as the strategy evolved by the scientists and other agencies are covered in this chapter. The legal, scientific, economic and cultural values of wetlands are the central issues being addressed.

The Ramsar Convention preamble recognizes the “fundamental ecological functions of wetlands as regulators of water regimes and as habitats supporting a characteristic flora and fauna, especially Water fowl”. The ambitious aim of the Convention is “to stem the progressive encroachment on and loss of wetlands now and future” and to support wetland conservation “by combining far-sighted national policies with coordinated international action”. The Contracting Parties are bound by three main groups of obligations which, consistently with Ramsar’s very broad definition of wetlands, apply equally to inland and coastal wetlands and water systems. They are as follows;

- Site-specific measures: To designate one or more suitable wetlands of international importance for inclusion in the list of wetlands of importance.(Art.2), to promote the conservation of listed wetlands(Art.3.1) and to establish nature reserves on wetlands and provide adequately for their widening. (Art.4.1);
- Non-Site -Specific: To formulate and implement their planning so as to promote, as far as possible, the “wise use” of wetlands in their territory (Art.3.1);
- International cooperation: To consult with other parties about implementing obligations arising under the convention in respect of trans boundary wetlands,

Shared watercourses and coordinated conservation of wetland flora and fauna (Art.5); Article.4 generally requires parties to encourage wetland research, to endeavour to increase water fowl populations on wetlands and to promote the training of personnel. The combination of localized, general and international measures is of particular interest. Whereas area-based conservation mechanisms were already well established in international and national law, the open-ended concepts of wise use and multifaceted trans boundary cooperation were more pioneering.³ The National policy and practice

towards the conservation of wetlands varies from one Country to the other. Some Countries, which have ratified the Ramsar

Convention, have no legally backed definition of wetlands, whilst the Countries like Spain and Uganda have incorporated the Ramsar definition into national legislation without any modification. Costa Rica has recently modified the Ramsar definition to reflect the predominance of coastal wetlands and mangrove ecosystem. The Ramsar Convention's Strategic Plan 1997-2002, adopted by the COP in 1996, provides a clear conceptual frame work and ordered structure for the next phase of implementation. Its Mission statement for the convention-"the conservation and the wise use of wetlands by National and International co-operation as a means to achieving Sustainable Development throughout the World '-is intended to anchor Ramsar firmly with in the body of more modern environmental instruments founded on the concept of Sustainable Development. Under the Ramsar Convention on Wetlands, the two concepts of wise use and site designation are fully compatible and mutually reinforcing. The Contracting Parties are expected to designate sites for the List of Wetlands of International Importance, "on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology" (Article 2.2). The Contracting Parties to "formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory" (Article 3.1) Ramsar COP3 (1987) defined wise use of wetlands as "their sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem".⁴ The Strategic Plan (at COP6 (1996) and COP8 (2002) equate) adopted "wise use" with sustainable use. Contracting Parties to the Convention also recognize that wetlands, through their ecological and hydrological functions, provide invaluable services, products and benefits enjoyed by, and sustaining, human populations. Therefore, the Convention promotes practices that will ensure that all wetlands, and especially those designated for the Ramsar List, will continue to provide these functions and values for future generations as well as for the conservation of biological diversity.

2.1.7 Guidelines for management planning for Ramsar sites and other Wetlands

Designed to complement the Ramsar management planning guidelines adopted by Resolution, this guide has been developed by WWF in association with Ramsar's Scientific & Technical Review Panel (STRP) in response to a request by Ramsar COP8 for the preparation of a simple "field guide" to wetland management planning. Wetland management planning: a guide for site managers provides those responsible for on-the-ground management of Ramsar sites and other wetlands with a simple aide memoire summary of key issues and activities to remember and apply in the various different

stages of the management planning process. The guide is arranged in a series of colour-coded sections designed to facilitate easy look-up when a manager is dealing with a particular aspect of the process. The guide is organized in the following sections:

- Introduction
- The need for management planning,
- Essentials of management planning
- Successful wetland management planning,
- Knowing the wetland and its values
- Setting management objectives,
- Achieving management objectives and
- Closing the planning loop.

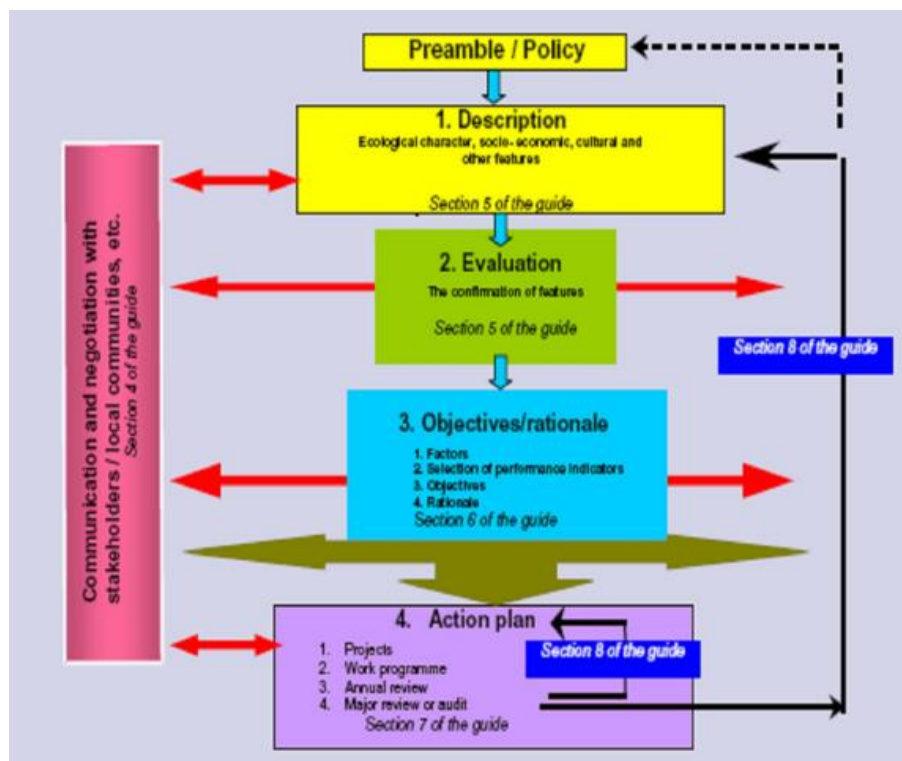


Figure 1 Ramsar guidelines

(Source: Ramsar Hand books16: Managing wetlands)

2.1.8 General Guidelines

- Wetlands are dynamic areas, open to influence from natural and human factors. In order to maintain their biological diversity and productivity (i.e., their ‘ecological character’ as defined by the Convention), and to permit the wise use of their resources by people, an overall agreement is essential between the various managers, owners, occupiers and other stakeholders. The management planning process provides the mechanism to achieve this agreement.
- The management plan itself should be a technical document, though it may be appropriate for it to be supported by legislation and in some circumstances to be adopted as a legal document.
- The management plan is part of a dynamic and continuing management planning process. The plan should be kept under review and adjusted to take into account the monitoring process, changing priorities, and emerging issues.
- An authority should be appointed to implement the management planning process, and this authority should be clearly identified to all stakeholders. This is particularly important on a large site where there is a need to take account of all interests, users, and pressures on the wetland, in a complex ownership and management situation.
- Although conditions vary at individual wetlands, these guidelines may be applied worldwide. The guidelines provide a conceptual background to, and framework for, wetland management planning and an outline of the main sections of a management plan. It is emphasized that the guidelines do not provide a prescription for the detailed contents of a complete management plan itself, which will be a much more detailed document and should be prepared at regional or local level. [“Ecological character is the combination of the ecosystem components, processes and benefits/services that characterize the wetland at a given point in time.” (Resolution IX.1 Annex A).]

- A management plan, and the management planning process, should only be as large or complex as the site requires. The production of a large, elaborate and expensive plan will not be possible, and certainly not justifiable, for many sites. The size of a plan, and (perhaps more importantly) the resources made available for its production, must be in proportion to the size and complexity of the site, and also to the total resources available for the safeguarding and/or management of the site. Thus for small uncomplicated sites, brief,

The components of the Total Value of a wetland

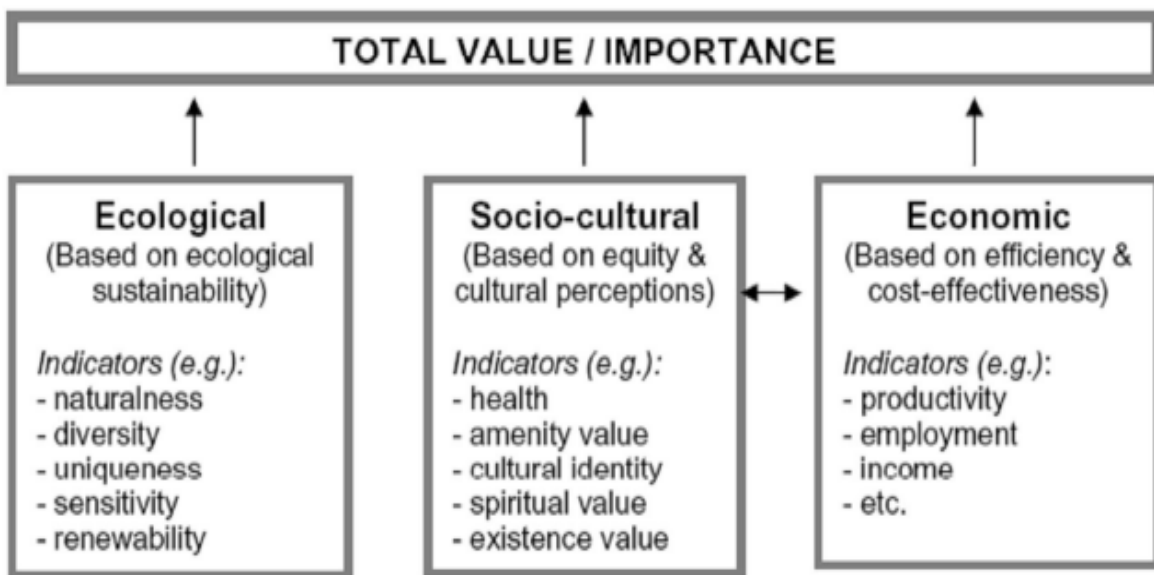


Figure 2 values of wetlands

(Source: Ramsar Technical Report No.3 CBD Technical Series No.27)

2.2 Ecotourism

According to the World Conservation Union (IUCN), the Ecotourism is defined as:

"Environmentally responsible travel to natural areas, in order to enjoy and appreciate nature (and accompanying cultural features, both past and present) that promote conservation, have a low visitor impact and provide for beneficially active socio-economic

involvement of local peoples." (<https://greenlivingideas.com/2015/11/13/what-is-ecotourism/>, n.d.)

Ecotourism is maintaining the tourism in natural areas without compromising the need of conserving the environment and making it more sustainable.

As per The International Ecotourism Society,
"Ecotourism is now defined as *responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education*" Education is meant to be inclusive of both staff and guests." (Society, n.d.)



Figure 3 Attributes of Ecotourism

2.2.1 Principles of Ecotourism (Jacobus Franciscus KoensCarel Dieperink, 08 October 2009)

- It is about uniting the communities in order to minimize the negative impacts on environment and make the tourism sustainable.
- Ecotourism should be environmental friendly and socially and culturally responsible.
- Providing economic benefits for the local communities involved, by introducing the alternative employment and other direct income opportunities.
- Creating public awareness about the need to protect and conserve the environment and respecting the local culture.
- Introducing the alternative, low impact and environment friendly facilities.

(Jacobus Franciscus KoensCarel Dieperink, 08 October 2009)

2.2.2 Importance of Ecotourism in India

India being a reserve country of natural beauty like mountains, oceans, natural forests, valleys, architectural monuments and archaeological sites offers various tourism options all across the country. Tourism in India due to its varied geography is classified into four major parts:

- a) North Indian Tourism,
- b) West India Tourism
- c) South Indian Tourism
- d) East Indian Tourism

Each part offers several different tourist destinations to enjoy the nature in the most pristine way.

Presently, tourism is one of the largest service industries in India. The GDP of the country is expected to grow at the rate of approximately 8.0 percent yearly in the period of 2013-2023.

The WTO and UNEP (United Nations Environment Program) recognize five key challenges for sustainable tourism and they are: -

- Managing the progressive increase in the growth rate of international tourist arrivals by 2020.
- Climate change, as increase in tourism will contribute more towards the global warming.
- Poverty abatement mainly in rural areas where tourism can provide only a small number of augmentation options.
- Support from tourists regarding conserving and protecting the environment; and
- Issues regarding health and safety of tourists. (Sodhganga, n.d.)

2.3 Vernacular Landscapes

According to the Cultural Landscape Foundation “landscapes that evolved through use by the people whose activities or occupancy shaped those landscapes. Through social or cultural attitudes of an individual, family, or a community, the landscapes reflect the

physical, biological, and cultural character of those everyday lives. “ (THE CULTURAL LANDSCAPE FOUNDATION, n.d.)



Figure 4 vernacular landscapes of india

2.4 Avifauna

2.4.1 Bird Ecology

Ecology is defined as the relationship of organisms with each other and to their physical environment that surrounds them. The balance between birds and other organisms is very delicate as the effects of any change is never restricted to single species but can affect the entire ecology balance and food chain.

The ecology of birds suggests their behaviour in the particular environment as how they coexist with other organisms.

There are two main aspects of ecology of birds.

1) Feeding Ecology: There are variety of food that are preferred by birds. E.g. Flowers, berries, seeds, nectars, fish, worm, crab, mouse, reptiles or even another bird. The type of food preferences can be easily identified by the shape of the bird's beak. Birds are able to exists in the same habitats by having different food preferences and not compete with one another for food.

2) Breeding Ecology:

Birds require a place to build a nest, they need enough food for themselves and their young. Moreover, they also need to protect their young from predators or other sources of danger.

Season-

The breeding time of a bird depends on the favourable chances of their offspring to survive. It generally coincides with the time period when food is abundant.

2.4.3 Types of Habitats for Birds

There are different types of habitats which support different types of birds and other wildlife. These habitats include forests, grasslands, wetlands, deserts, oceans, tundra, urban and suburban.

2.4.2 Bird Habitat

A bird requires food, water, nesting sites and shelter for its survival. These may differ according to the different types of species.

- Food includes fruits, grains, seeds, nectar-producing flowers, nuts, insects, fish, reptiles and other birds.
- Water: Any source available for drinking or bathing, including rivers, swamps, lakes, streams and oceans.
- Shelter: tree canopy of deciduous trees or coniferous trees, shrubbery, caves or rock niches, overhanging banks or snags.
- Nesting Sites: Hollow trees or snags, burrows, nesting boxes, bird houses, vegetation to support nests and suitable nesting material.

Seasonal change of habitats by birds is termed as migration. It may occur by switching between two different habitats or two similar habitats that may be far from one another or in different locations. (Sodhganga, n.d.)

2.4.4 How Habitat Loss Affects Birds

Habitat destruction and fragmentation are the major threats for the birds. The activities that may impact habitat includes:

- Transforming natural habitats by clearing the fields for agricultural use

- Logging and forest harvesting for fuel, fodder or wood that removes mature vegetation
- Modernization of urban areas that may include development of houses, industries, roads, wind turbines or any other similar activities.
- Climate change is also one of the reason of habitat loss.
- Polluting activities such as mining, oil runoffs etc also damage the habitats.
- Natural disasters can also damage habitats though likelihood of such events is less but these events are also considered for the habitat loss. (convention) (convention)

In order to survive, every organism have to adapt to the changes. Birds in the similar manner can also adapt to the changes in habitat over the period of time and may shift to more suitable locations. In some cases, changes in the habitat may even be beneficial and can encourage the growth of plants that may support different bird species.

2.4.5 Bird Ecology in India

India with over 1301 variety of species (Clements, 5th ed.) makes itself one of the richest bird areas in the world with around 14% of the world's birds.

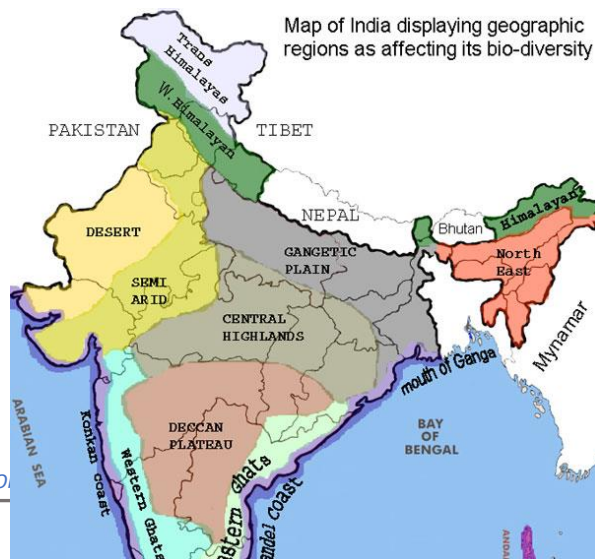
India lies between three biogeographic zones- Indo-Malayan, Afro-tropical and Palearctic which makes India surprisingly rich in avifauna and this can be attributed because of the diversity in the topography, habitats and climate zones. Thus, this makes India, a paradise for bird watching.

The Indian birds are categorized into 25 groups called 'Orders', which are further sub-categorized into 'Families', 'Sub-families' and 'Genera'.

~ In India 13 bio-geographical regions can be demarcated as per Bird ecology:

Trans Himalayan,

- Western Himalayas,
- Eastern Himalayas,
- Desert,
- Semi-arid,
- Gangetic plain,



- Central India,
- Deccan Plateau,
- Western Ghats,
- Eastern Ghats,
- North East,
- Coasts,
- Lakshadweep islands, and
- The Andaman Nicobar Islands

3 Study area: Wetlands of North Bihar

North Bihar is located in Bihar in between River Ganges in South and the Border of Nepal in North. On western side is Champaran and Gopalganj and the eastern boundary is marked by Purnea and Katihar. Most of this region has been formed by falling remnants of last phase of Tethys Sea towards south of Himalayas. This got occupied by rivers coming from Himalayas in North. Some of the major rivers are R. Kamla, R. Kosi, R. Mahananda, R. Balan, R. Jibacch, R. Bhuthi Balan, R. Bagmati, R. Kareh, R. Budhi Gandak and R. Gandak.

These Rivers are a part of Vast Lacustrine Gangetic Trough called as Indo-Brahm River through.

The Wetlands are formed there due to high flood, high rainfall and plain having less variation of relief.

These are structured wetlands found in the area of tectonic disturbances and extremely meandering river courses.

Entire North Bihar Plain which lies in north of River Ganga is an alluvial plain with minor slopes towards Ganga in south and the lowlands of R. Kosi belt in Middle Eastern part.

The significant features in the area are the levee deposits and sand bars along the river banks and marshy depressions known as Chaur. Slope of the plain is from north-west to south-east. Average slope is approximately 8m per 100km.

Due to changing courses of rivers and high silt deposition different types of geographical formations come into existence. Chours, Taals, Katti, Beel, Khor etc are different types of formations in the region. This form saucer like structures which holds water even during summers and also contributes in keeping the water table up, for the region.

These are major source of fishes and fodder for the area.



Figure 6 some of the wetlands of North Bihar

3.1 Floods in North Bihar

Bihar is India's most flood-prone State, with 76% of the population in the north Bihar living under the recurring threat of flood devastation. According to some historical data, 16.5% of the total flood affected area in India is located in Bihar while 22.1% of the flood affected population in India lives in Bihar. North Bihar is fed by various Himalayan Rivers and these Rivers bring huge amount of silt which keeps on changing the landscape of North Bihar. Due to these deposition of silt, rivers at times changes its route and this brings floods in other parts of the area. Due to heavy rain during Monsoons in Lower Himalayas in Nepal Region at times these rivers swells and breaks its banks to flow in different directions. Due to gentle slope and plains it affects a major part of North Bihar. Rivers like Kosi, Bagmati, Gandak, Burhi Gandak, Kamla and Balan are major rivers which flows from Himalayas down and falls into River Ganga at various places. Kosi River is known as “Sorrow of Bihar” as it has brought various floods in history. Floods of 1987, 2007 and 2016 were one the worst Disasters that Bihar has been through. These Rivers can change their course up to 30km in every ten years. These changing routes leaves pockets of land locked waterbodies which is known ox-bow lakes and are also known as Chuars or Taal

in local language. These Waterbodies are one of the best habitats and forms a group of wetlands which serves various purposes to nature and to mankind. Some of the major wetlands are Kabar Tal at Begusarai, Baraila Tal at Muzhafarpur, Kusheshwar Sthan at Katihar, Gogabil in Katihar and Mokama Taal in Patna.

3.2 Begusarai

Begusarai District is one of the thirty-eight districts of the Indian state of Bihar. The city of Begusarai is its administrative headquarters and is part of the Munger Division.

Begusarai district occupies an area of 1,918 square kilometres.

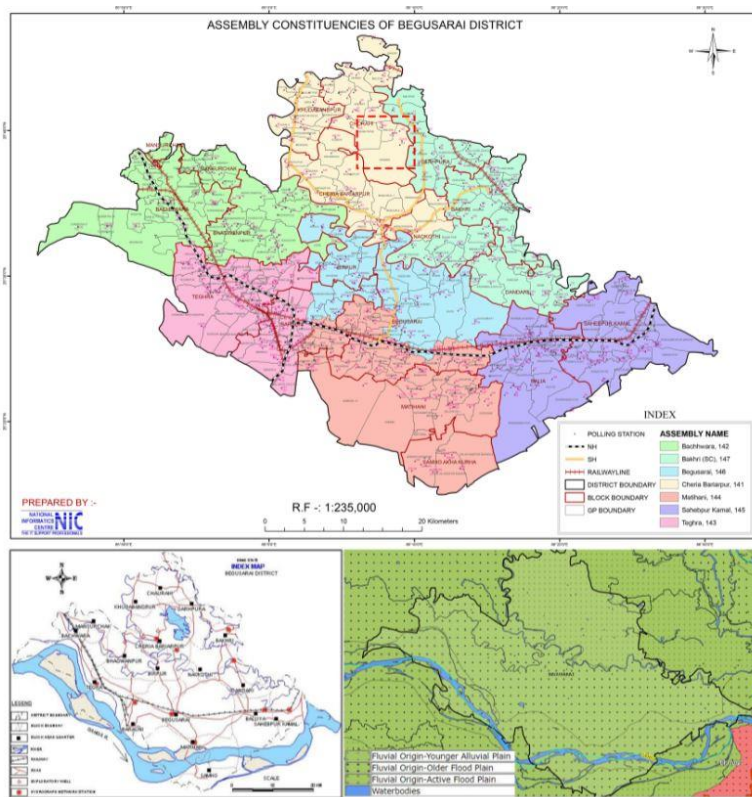
In 2006 the Indian government named Begusarai one of the country's 250 most backward districts (out of a total of 640). It is one of the 36 districts in Bihar currently receiving funds from the Backward Regions Grant Fund Programme (BRGF).

According to the 2011 census Begusarai district has a population of 2,970,541. Begusarai has an Industrial area at Barauni which also has one of the major Oil Refineries of India. Barauni also houses leather and fertilizer factory.

Begusarai is an agriculture dependent state where eighty percent of the total population is dependent on agriculture. The neighbouring districts are Munger, Samastipur, Khagariya and Patna.

Kabar Tal Lake has a spread over eleven percent of the total geographical area of Begusarai and one of the major contributor to fisheries.

Figure 7 political and geographical map of Begusarai



3.3 Burhi Gandak

The district has two rivers flowing through it- Burhi Gandak and Ganga. Burhi Gandak River is one of the important tributaries of the Ganga River which originates from Chautarwa chaur near Bisambharpur in the district of West Champaran in Bihar. The river now is augmented by contribution from some hilly rivers, rising from the foot hills of Himalayas in Nepal.

The important left bank tributaries, joining this river are the Masan, the Belor, the Pandai, the Sikta, the Uria, the Tilawe and the Tiur etc. and the right bank as the Kohara, the Dhanauti and the Noon-Balan etc.

Burhi Gandak is a forgotten track of Gandak River which shifted its route towards west and now flows through Vaishali District and falls into Ganga at Patna-Sonpur.

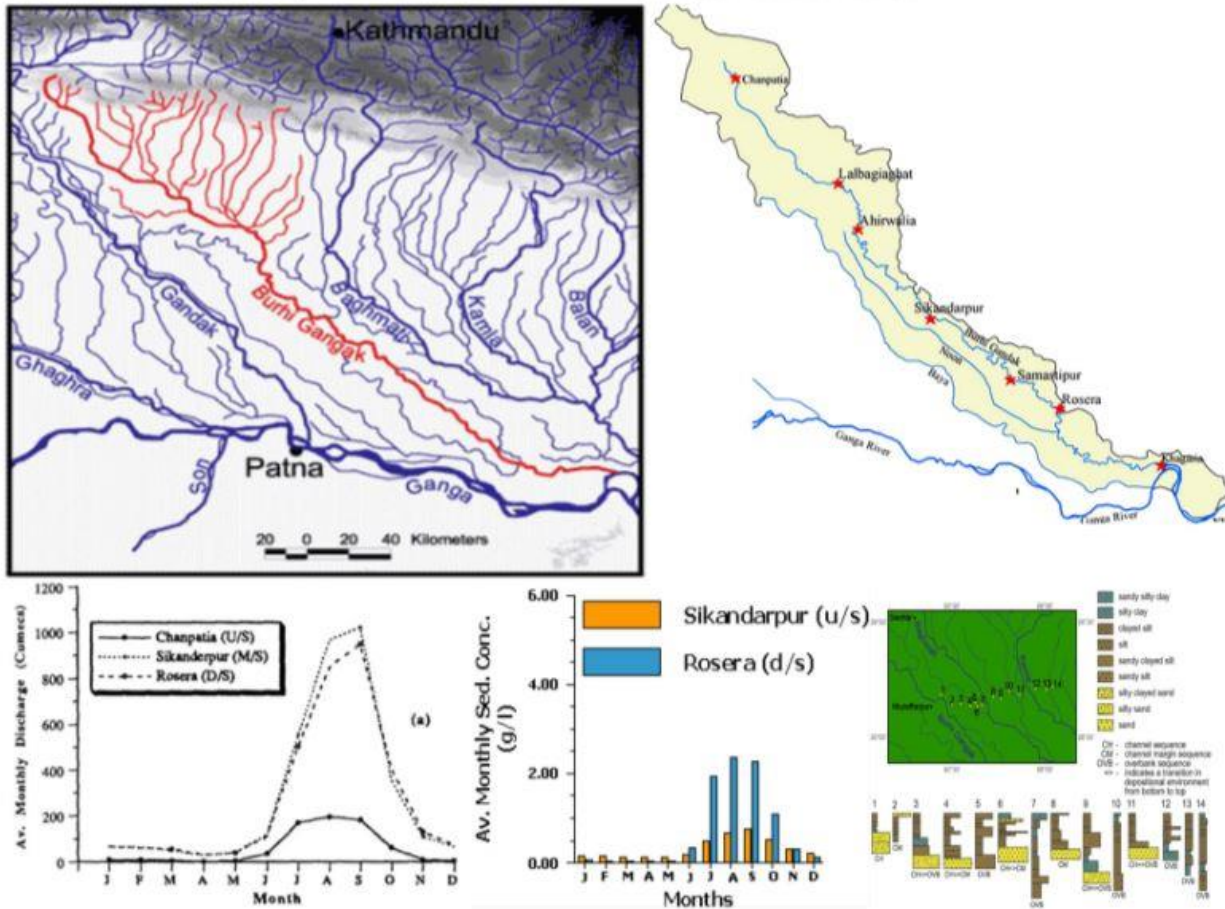


Figure 8 basin, tributary, siltation, and water quantity of the river

4. Site and surrounding

4.1 Jaimangla Garh Temple

The Jaimangla temple and the Jaimangla fort on the bank of the Kabar Lake are known for their historical importance. A number of relics

Belonging to remote past have been excavated from the area. The excavations include Terracotta utensils, Glazed ware, Iron sickle, and other articles belonging to Post Sunga period. Several coins of Tughlaq dynasty were also excavated from the area. Apart from the above, several cannon balls are recovered from the fort area.



Figure 9 Jaimangla Garh Temple complex

4.2 Jaimangl Garh Village

It is a Harijan Village with around 3000 people living in it in around 450 families. All these families are of Fishermen, Boats men and Mushahars.

The village has a school and two circuit houses to facilitate the village and the bird sanctuary.



Figure 10 Jaimangal Garh Village

4.3 Jaimangl Garh Village approach road

Jaimangal Garh is connected to Manjhaul Garhpura SH with an approach road. The road has a Cooperative Dairy Cold Store. For the first 1 km it passes through farmlands after which there is a small village. After this village there are series of Brick Kilns. The approach road then passes through Kabar Lake to reach Jaimangal Garh Island.



Figure 11 approach road charecter

4.4 Lahar Ghat and Guwavari Ghat

Two major Chatth ghats located at the site are- one at Jaimangla Garh and other one by the state highway connecting Khanjahanpur and Paror. Both these Ghats are manually stepped and cleaned before Chatth by the local people as a contribution towards the mega festival.



Figure 12 Lahar Ghat character

4.5 Farmlands and Orchards

The site is surrounded by farmlands where major cash crops are Sugar Cane, Maize, Mustard, Linseed, wheat, etc. The area has Orchards of Mango, Litchi and Papaya which constitutes 70 percent of the total planted area.

S. R.	Crops	Croping area(manjaul subdivision),hec		Cropping area(begusarai subdivision)	
1.	KarifArhar	650	1020	1300	1940
2.	Karifurad	200		450	
3.	Kharif other pulse	170		190	
4.	Oil seed		680		440
5.	Till	90		40	
6.	Sunflower	90		200	
7.	Andi	500		200	
8.	Rabi wheat	8500	16455	18500	32770
9.	Rabi macca	6000		9500	
10.	Rabi Gram	70		400	
11.	Rabi masur	130		750	
12.	Rabi mater	80		490	
13.	Rabi other pulses	45		160	
14.	Rabi mustered	1500		2650	
15.	Rabi tisi	100		250	
16.	Rabi sunflower	30		70	

Source:Distric Agricultural Office (Begusarai)



Figure 13 farmland character

4.6 Planted Forest and Riparian Woodland

After being declared as a bird sanctuary in 1989 all the uplands around the site was planted with Sheesam, Kadamba, Jamun, Peepal, Pakhud, Pilkhan, Arjun, Tumri and Goolar. The Plantations by now has grown into its full form and the area is quiet dense and is a reserved forest area of the Sanctuary. These trees are riparian plants and can sustain water logging and flood.



Figure 14 riparian area character

4.7 Harsine Stupa

A Ruin of stupa was found when villagers were extracting mud from the banks of Harsine River made of terracotta bricks. The stupa belongs to Gupta period and the inscriptions found says that one of the Buddhist councils were held on the banks of Bagmati due to the presence of water and food resources.

5. Issues on and Around the Site

5.1 Shrinkage of the Lake

Lake area is shrinking due to siltation, water being extracted for irrigation and agriculture. It has been analysed from satellite images that wetland area of Kabar Lake has reduced. Kabar Lake wetland has been shrinking at an abnormally higher rate, as revealed by remote sensing image taken in 1988 and 2010. Lake area shrunk from 9000ha to 6600ha from 1988 to 2010. (Sumit Anand, 2013)

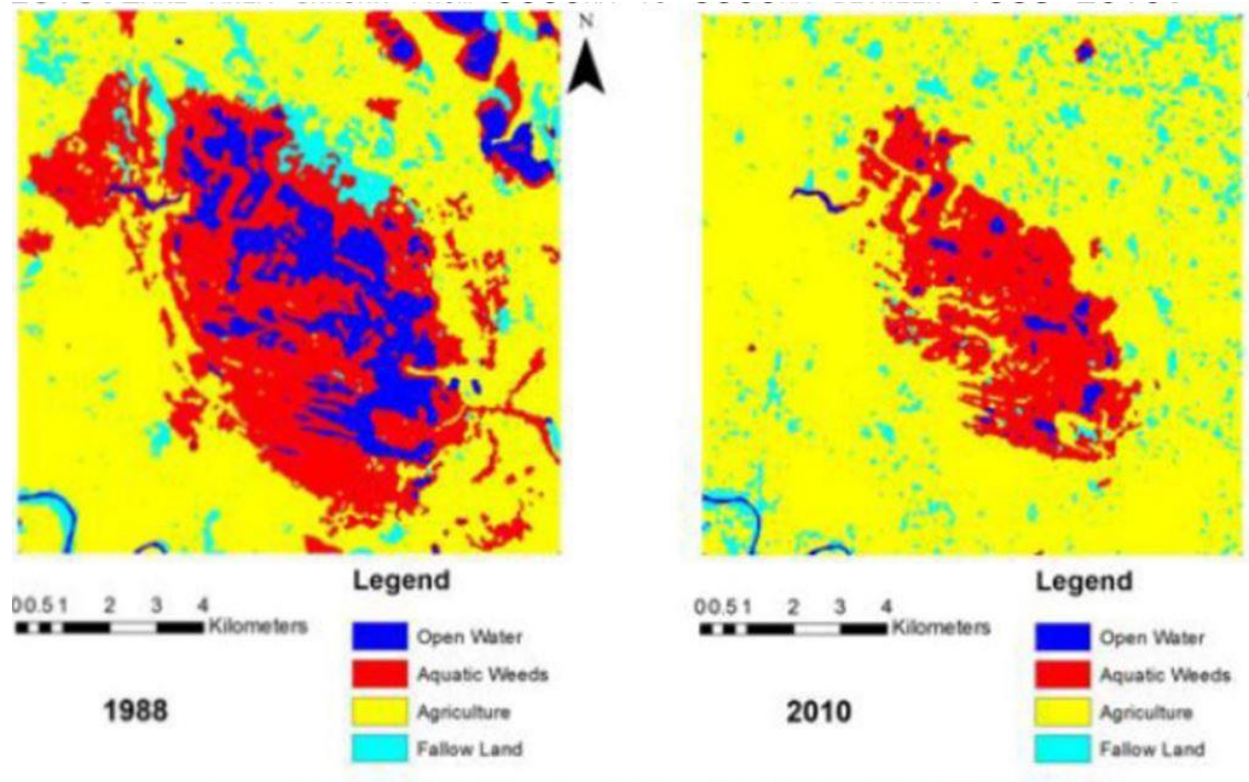
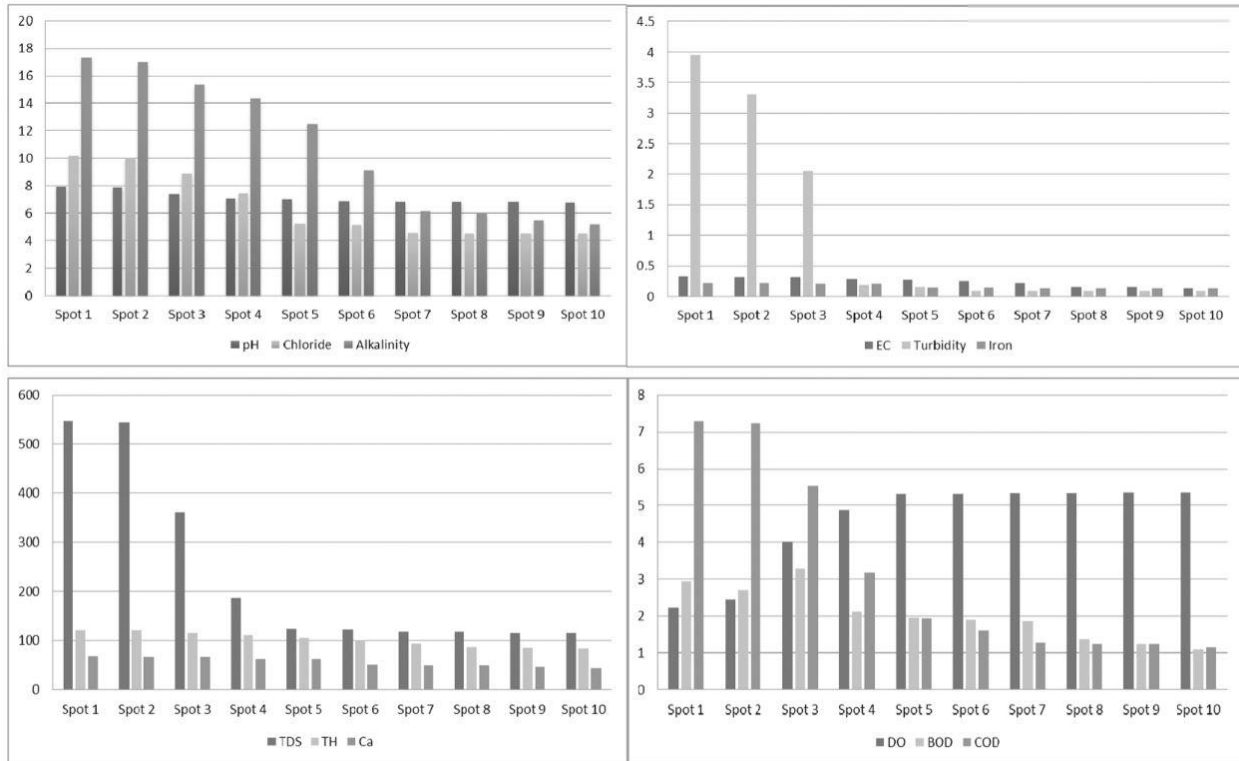


Figure 15 shrinkage map

5.2 Pollution and Eutrophication

Eutrophication is increasing day by day due to the chemical fertilizers and pesticides being used in the nearby farmlands, which comes to the lake with the surface runoff during monsoons.

Affluent from nearby brick kilns and Barauni Oil refinery and Barauni leather and fertilizer industries is one of the major reasons of increasing dissolved pollutants in the lake.



SOURCE: JOURNAL OF PHARMACOGNOSY AND PHYTOCHEMISTRY 2017; 6(5): 2630-2633

Figure 16 graphs showing pollution levels

5.3 Excessive fishing

Excessive fishing and extraction of other aquatic species like snails, crabs and tortoise has disturbed the ecology and food chain of Kabar Tal.

According to Animal and Fisheries Department Fish Production has increased from 3000MT to 12000MT every year from Begusarai District and Kabar Tal has a share of 22% of the total yield. This has caused threat to several species of Fishes, Tortoise, Snails, Crabs and Birds.



Figure 17 images showing fishing exploitation

5.5 Excessive extraction of water for irrigation

Water need for Cheriabariarpur and Karor in Begusarai is 1809cum/year till 2025 as per CGWB. The water is being either supplied through tube wells or from the lake.

Excessive intake from the lake during summers leads to shrinkage of the lake which is very difficult to reclaim until next flood.



Figure 18 images showing water usage

5.6 Out Migration

The area remains flooded for three months every year and during this time there is no work for agricultural labours who migrate to Norther India to work in fields. This causes migration of people which was around five lakhs in the previous year and is being increased with the rate of 1.5 lakh every year. No job and lack of higher education causes migration of people.

Most of the households have senior citizen, kids and women in the house as men moved out due to unavailability of jobs and higher education in the area. The whole day's activity involves women's active participation whether it be farming, collecting fodder and fuel. Women are the one who takes the lead and socialize. All of this has created a misbalance of gender dependent work, social setup and fragmentation of families in the area.

5.7 Lack of awareness

Lack of education on the dependent community is one of the major reasons for the threatening situation of the Lake. Instead of being a National Protected Area people are exploiting the resources.

6 Site Analysis

6.1 Vegetation Analysis

BEGUSARAI DISTRICT HAS A VEGETATION TYPE OF DECIDUOUS TYPE. KABAR TAL HAS CHUNKS OF PLANTED FOREST ON THE UPLANDS. THE LAKE HAS THICK WETLAND VEGETATION ALL AROUND AND EVEN IN THE WATER AREAS. NEARBY VILLAGES ARE HIGHLY DEPENDENT ON THESE VEGETATION. THE AREA IS SURROUNDED BY FALLOW LANDS AND FARMLANDS WHICH IS ALSO DEPENDENT ON THE LAKE FOR IRRIGATION. FALLOW LAND ARE USED FOR PADDY CULTIVATION. SUGARCANE AND PADDY ARE THE TWO MAJOR CASH CROPS. THE AREA ALSO EXCELS IN PRODUCTION OF FRUITS AND VEGETABLES.

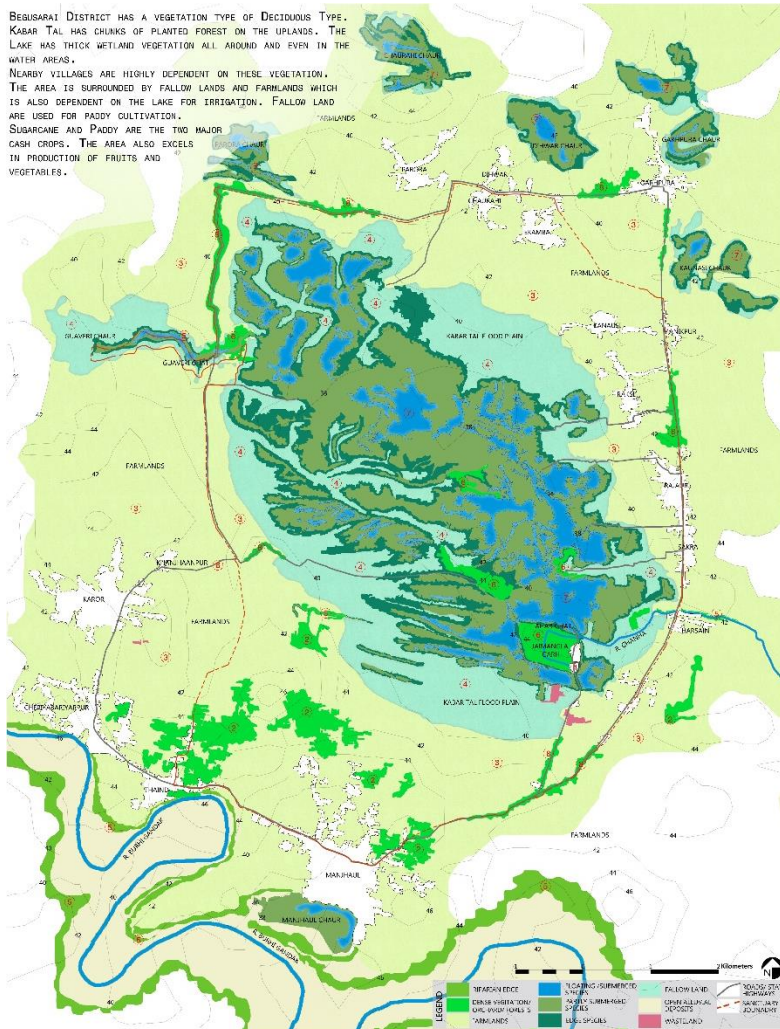


Figure 19: Vegetation distribution map

The vegetation type of the area is dry deciduous type. The vegetation character differs from place to place and according to the soil condition, availability of water, moisture content and water level and even according to the use of the place.

The area is mostly covered with agricultural farmlands and marsh area vegetation in lower contours which remains partially submerged for two to three months of the year. The lake has partially submerged, floating and submerged species of plants. The vegetation has various uses in day to day life and livelihood of

the local people for example- Harvesting Lotus (puraini) leaves for Bhojpatra, Phragmite (Larkatiya) for fodder and as a building material, Sacchrum Grass(Moonj or Kush) for making mats and local handicrafts for which Anga region is famous for which is known as Sikiya Kala or Kushiya kala, Bamboo and Palms are use as building materials and one another handicraft is fan made of leaves from Todi palm. Fishing nets are made from bamboo, synthetic nets are not used in the area. Apart from these Teak and Gamhar supplies wood for construction of boats and houses. Foxnuts (Makhana), water chestnut (Paniphal Singhada), Water Caltrop (Saurkhi), various medicinal herbs, fish fodder is also extracted from the lake which are one of the major part of the food in the area. These are

certain ethnobotanical uses of the vegetation of the area.



Figure 20 ethnobotany of the site

For the study vegetation has been classified in various parts.

Religious Areas: the area around Jaimangla Garh temple has huge, humongous and very old trees of Peepal, Banyan and Pilkhan. These are worshipped and at the same time the trees provide shade to the complex area.



Figure 21 religious are a vegetation character

Orchard Plantation: the area around has various orchards of litchi, mangoes, pahpaya, guava, etc. People lately have become keen about high yield plantation and therefore other timber varieties are also planted, namely, Mahogany, Sagwan or Sal, Poplar and Eucalyptus. At places orchards are used for apiculture.

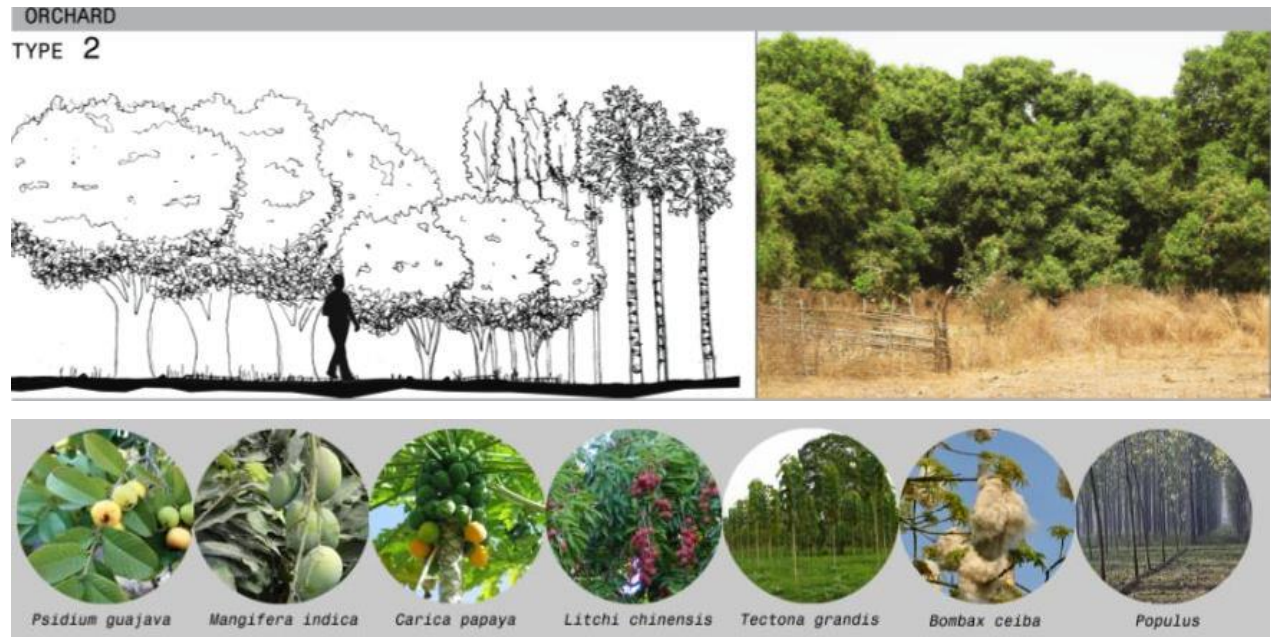


Figure 22 orchard area vegetation character

Farmlands: at upper levels the area is covered with farmlands. Major crops grown here are Sugarcane, Wheat, Maize, Mustard, Flaxseeds; Vegetables-Cauliflower, bottle guard, bitter guard, cabbage, tomato etc... The major cash crops are Maize and Sugarcane.





Figure 23 farmland area vegetation character

Fallow lands: Fallow lands are area which has water retained for at least two to three months. This area either has sugarcane and paddy fields and some of the area has natural wetland edge vegetation. Some of the areas are marshy all-round the year.



Figure 24 Fallow Land area vegetation character

Riparian Edge: riparian plants were majorly spotted by the banks of Burhi Gandak, Guwavari Ghat and by the banks of Harsine River. The area has rich vegetation and grows just beyond the flood plain of the River.

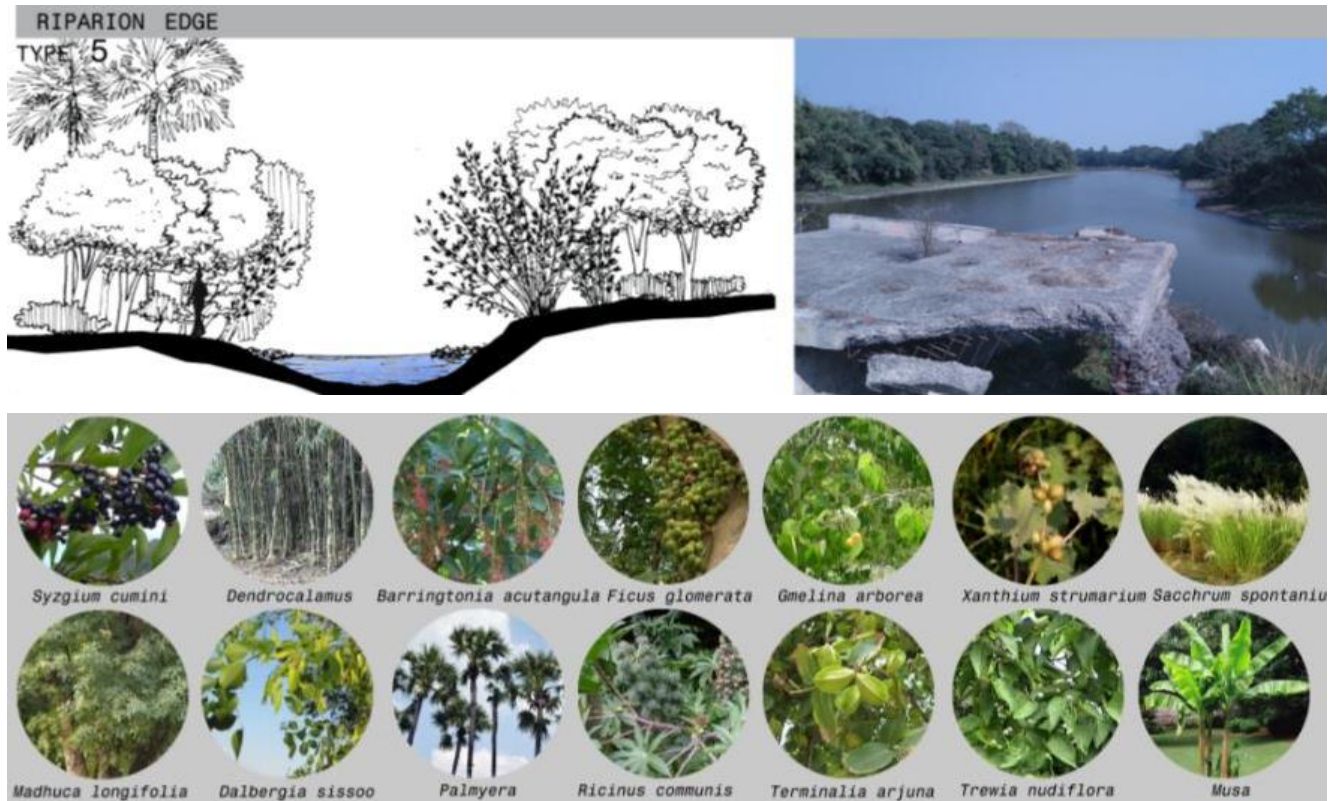


Figure 25 Riparian area vegetation character

Planted forests: certain uplands of the area were planted back in 1989 and has now grown into a complete dense planted forest. It constitutes mainly of flood resilient trees which are Jamun, Arjun, Sheesham, Tumri, Goolar, Pilkhan, Pakhar, etc.

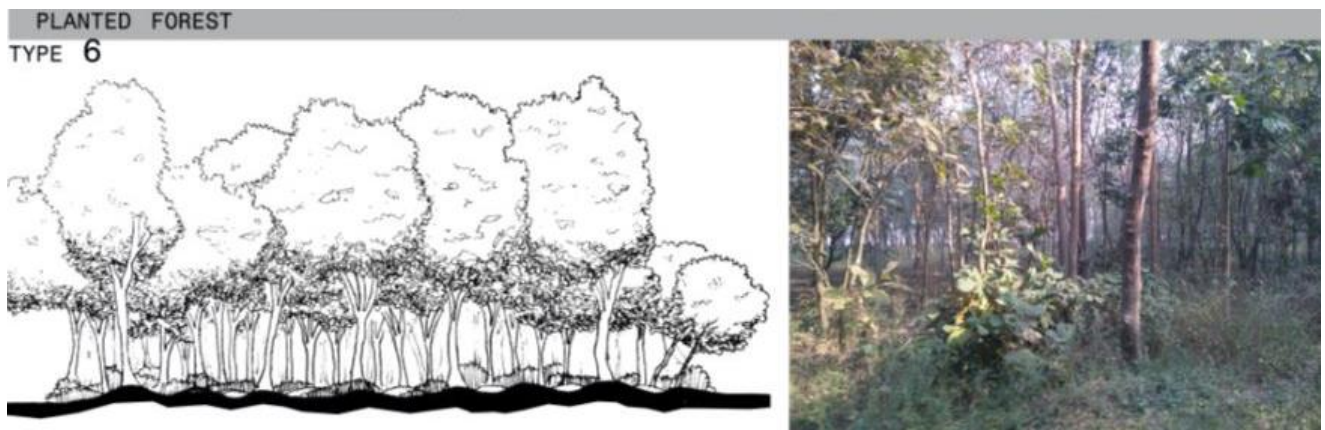




Figure 26 Planted forest area vegetation character

Lake edge and Lake: lake edge has dense vegetation of grass and riparian shrubs. Even inside the deep waters and shallow waters one can see submerged species. Phragmites is distributed in almost all the parts of the lake. These areas are rich in vegetation.

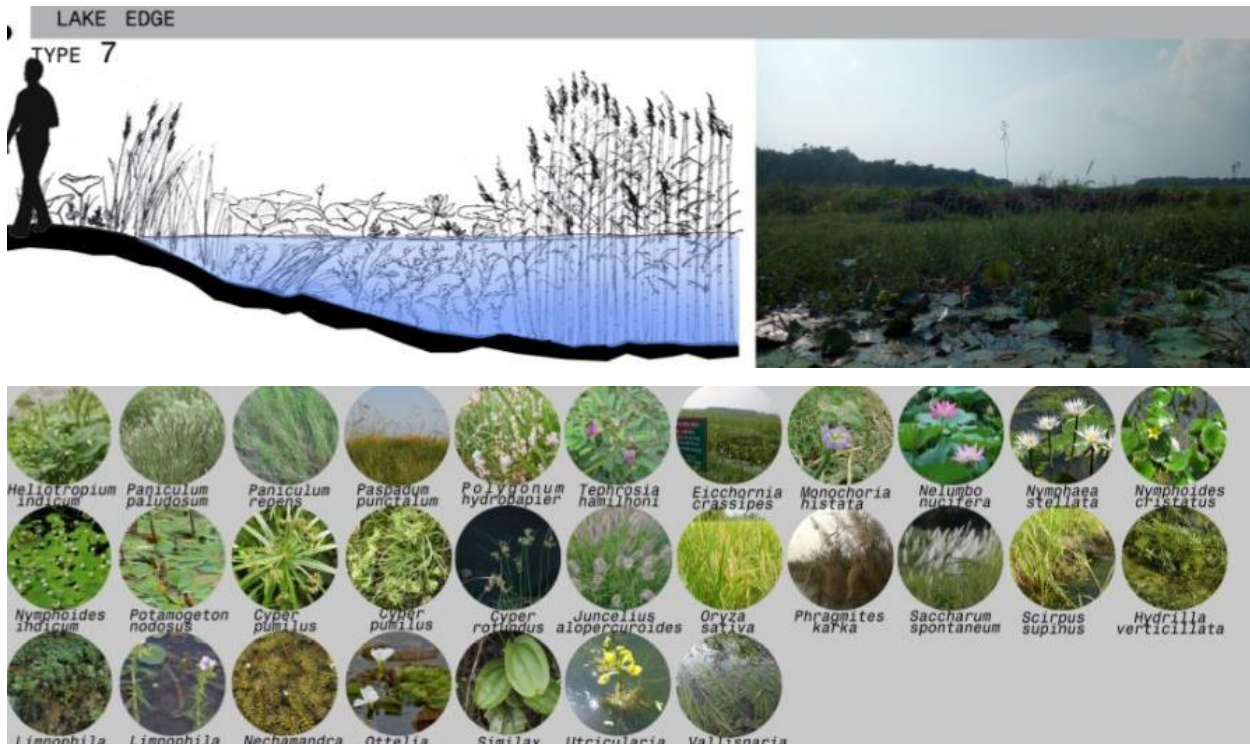


Figure 27 Edge and Lake area vegetation character

Road Side Plantation: in 1989 some of the areas on the sides of the state highway was planted by the Forest Department and they have now grown into humongous trees. These includes trees of Arjun, Copperpod, Peepal, Bel. Later in 2011-2015 many more trees were planted under Vriksha-ropan Scheme of MNREGA.

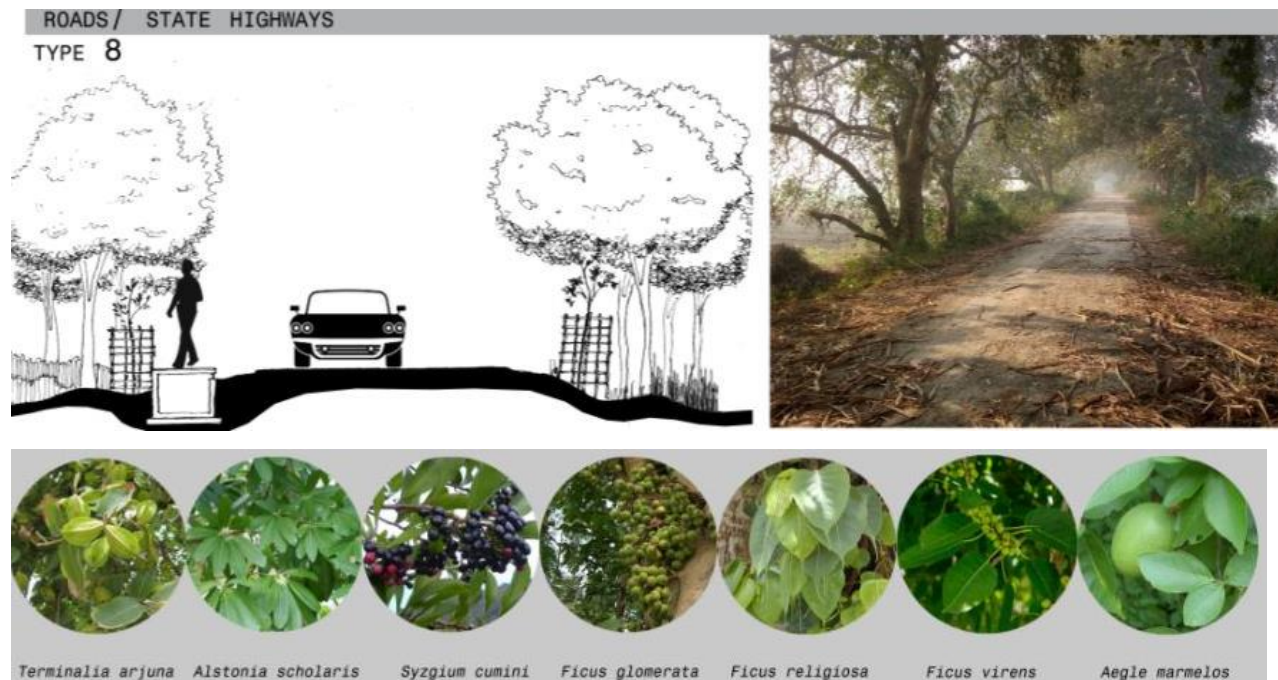


Figure 28 Highway and rRoad area vegetation character

7 Avifauna

7.1 Birds of Kabar Tal

The Kabar Tal has proved to be one of the prominent remaining habitats of migratory birds especially Black necked Stork. As per the recent census on Kabar Tal, there is an almost 50% decline in Migratory bird population.

- 80 out of 140 species recorded this year are of resident water birds, including local migratory birds
- 24 out of 56 are winter migratory water birds which includes four species of IUCN Red-listed threatened species such as Woolly-necked Stork, Painted Stork, Black-headed Ibis and Black-necked Stork.
- Some of the species spotted are Bar-headed Geese, graylag Geese, Black-tailed Godwit, Greater Flamingo, Black-winged Stilt, Common Teal, Northern Shoveler and Ruff.

Table 1 : Kabar Tal Birds list with their IUCN red listing.

SI no	SCIENTIFIC NAME	COMMON NAME	IUCN	RESIDENTIAL STATUS
1	<i>Accipiter badius</i>	Shikra	LC	
2	<i>Accipiter nisus</i>	Eurasian Sparrowhawk	LC	
3	<i>Acridotheres ginginianus</i>	Bank Myna	LC	
4	<i>Acridotheres tristis</i>	Common Myna	LC	
5	<i>Acrocephalus dumetorum</i>	Blyth's Reed-warbler	LC	
6	<i>Acrocephalus stentoreus</i>	Clamorous Reed-warbler	LC	
7	<i>Actitis hypoleucos</i>	Common Sandpiper	LC	R/WM
8	<i>Alauda gulgula</i>	Oriental Skylark	LC	
9	<i>Alcedo atthis</i>	Common Kingfisher	LC	R/WM/SM
10	<i>Amandava amandava</i>	Red Avadavat	LC	
11	<i>Anas acuta</i>	Northern Pintail	LC	WM
12	<i>Anas crecca</i>	Common Teal	LC	WM
13	<i>Anas platyrhynchos</i>	Mallard	LC	R/WM
14	<i>Anas poecilorhyncha</i>	Indian Spot-billed Duck	LC	R/LM
15	<i>Anastomus oscitans</i>	Asian Openbill	LC	R/LM
16	<i>Anhinga melanogaster</i>	Oriental Darter	NT	R/LM
17	<i>Anser albifrons</i>	Greater White-fronted Goose	LC	WM
18	<i>Anser anser</i>	Greylag Goose	LC	WM
19	<i>Anser indicus</i>	Bar-headed Goose	LC	R/WM
20	<i>Anthropoides virgo</i>	Demoiselle Crane	LC	WM
21	<i>Anthus campestris</i>	Tawny Pipit	LC	WM
22	<i>Anthus roseatus</i>	Rosy Pipit	LC	R/AM/WM
23	<i>Anthus similis</i>	Long-billed Pipit	LC	R/WM
24	<i>Anthus spinoletta</i>	Water Pipit	LC	WM
25	<i>Anthus trivialis</i>	Tree Pipit	LC	WM
26	<i>Antigone antigone</i>	Sarus Crane	VU	R/LM
27	<i>Aquila chrysaetos</i>	Golden Eagle	LC	
28	<i>Aquila fasciata</i>	Bonelli's Eagle	LC	
29	<i>Aquila heliaca</i>	Eastern Imperial Eagle	VU	WM
30	<i>Aquila nipalensis</i>	Steppe Eagle	EN	WM
31	<i>Ardea alba</i>	Great White Egret	LC	R/LM
32	<i>Ardea cinerea</i>	Grey Heron	LC	R/WM
33	<i>Ardea intermedia</i>	Intermediate Egret	LC	R/WM
34	<i>Ardea purpurea</i>	Purple Heron	LC	R/LM
35	<i>Ardeola grayii</i>	Indian Pond-heron	LC	R/LM
36	<i>Argya caudata</i>	Common Babbler	LC	R
37	<i>Argya earlei</i>	Striated Babbler	LC	R
38	<i>Argya malcolmi</i>	Large Grey Babbler	LC	R

39	<i>Athene brama</i>	Spotted Owlet	LC	
40	<i>Aythya ferina</i>	Common Pochard	VU	WM
41	<i>Aythya fuligula</i>	Tufted Duck	LC	WM
42	<i>Aythya nyroca</i>	Ferruginous Duck	NT	R/WM
43	<i>Bubo bengalensis</i>	Rock Eagle-owl	LC	
44	<i>Bubulcus ibis</i>	Cattle Egret	LC	R/AM
45	<i>Burhinus indicus</i>	Indian Thick-knee	LC	
46	<i>Butastur teesa</i>	White-eyed Buzzard	LC	
47	<i>Buteo buteo</i>	Eurasian Buzzard	LC	
48	<i>Buteo rufinus</i>	Long-legged Buzzard	LC	
49	<i>Butorides striata</i>	Green-backed Heron	LC	
50	<i>Calidris pugnax</i>	Ruff	LC	WM/PM
51	<i>Calidris pygmaea</i>	Spoon-billed Sandpiper	CR	NE
52	<i>Carpodacus erythrinus</i>	Common Rosefinch	LC	
53	<i>Cecropis daurica</i>	Red-rumped Swallow	LC	
54	<i>Ceryle rudis</i>	Pied Kingfisher	LC	R
55	<i>Chaetornis striata</i>	Bristled Grassbird	VU	
56	<i>Charadrius alexandrinus</i>	Kentish Plover	LC	R/WM
57	<i>Charadrius dubius</i>	Little Ringed Plover	LC	R/WM
58	<i>Charadrius mongolus</i>	Lesser Sandplover	LC	R/WM
59	<i>Chlidonias hybrida</i>	Whiskered Tern	LC	
60	<i>Chrysomma sinense</i>	Yellow-eyed Babbler	LC	NE
61	<i>Ciconia episcopus</i>	White necked stork	VU	R
62	<i>Cinnyris asiaticus</i>	Purple Sunbird	LC	
63	<i>Circaetus gallicus</i>	Short-toed Snake-eagle	LC	NE
64	<i>Circus aeruginosus</i>	Western Marsh-harrier	LC	WM
65	<i>Cisticola juncidis</i>	Zitting Cisticola	LC	
66	<i>Clamator jacobinus</i>	Jacobin Cuckoo	LC	NE
67	<i>Clanga clanga</i>	Greater Spotted Eagle	VU	
68	<i>Clanga hastata</i>	Indian Spotted Eagle	VU	
69	<i>Copsychus saularis</i>	Oriental Magpie-robin	LC	
70	<i>Coracias benghalensis</i>	Indian Roller	LC	
71	<i>Coracias garrulus</i>	European Roller	LC	
72	<i>Corvus macrorhynchos</i>	Large-billed Crow	LC	
73	<i>Corvus splendens</i>	House Crow	LC	
74	<i>Cuculus canorus</i>	Common Cuckoo	LC	
75	<i>Culicicapa ceylonensis</i>	Grey-head Canary-flycatcher	LC	
76	<i>Cursorius coromandelicus</i>	Indian Courser	LC	
77	<i>Cyanecula svecica</i>	Bluethroat	LC	
78	<i>Dendrocitta vagabunda</i>	Rufous Treepie	LC	
79	<i>Dendrocygna javanica</i>	Lesser Whistling-duck	LC	R/LM
80	<i>Dicrurus caerulescens</i>	White-bellied Drongo	LC	
81	<i>Dicrurus leucophaeus</i>	Ashy Drongo	LC	
82	<i>Dicrurus macrocercus</i>	Black Drongo	LC	NE

83	<i>Dinopium benghalense</i>	Black-rumped Flameback	LC	
84	<i>Egretta garzetta</i>	Little Egret	LC	R/LM
85	<i>Elanus caeruleus</i>	Black-winged Kite	LC	
86	<i>Emberiza bruniceps</i>	Red-headed Bunting	LC	
87	<i>Emberiza lathami</i>	Crested Bunting	LC	
88	<i>Emberiza stewarti</i>	White-capped Bunting	LC	
89	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	NT	R
90	<i>Eremopterix griseus</i>	Ashy-crowned Sparrow-lark	LC	
91	<i>Eudynamis scolopaceus</i>	Western Koel	LC	NE
92	<i>Eumyias thalassinus</i>	Verditer Flycatcher	LC	
93	<i>Euodice malabarica</i>	Indian Silverbill	LC	
94	<i>Falco chicquera</i>	Red-headed Falcon	NT	
95	<i>Falco peregrinus</i>	Peregrine Falcon	LC	R/WM
96	<i>Falco subbuteo</i>	Eurasian Hobby	LC	
97	<i>Falco tinnunculus</i>	Common Kestrel	LC	
98	<i>Ficedula albicilla</i>	Red-throated Flycatcher	LC	
99	<i>Ficedula parva</i>	Red-breasted Flycatcher	LC	
100	<i>Francolinus francolinus</i>	Black Francolin	LC	
101	<i>Francolinus pondicerianus</i>	Grey Francolin	LC	NE
102	<i>Fulica atra</i>	Common Coot	LC	R/WM
103	<i>Galerida cristata</i>	Crested Lark	LC	
104	<i>Gallinago gallinago</i>	Common Snipe	LC	R/WM
105	<i>Gallinula chloropus</i>	Common Moorhen	LC	R/WM
106	<i>Gelochelidon nilotica</i>	Common Gull-billed Tern	LC	R/WM
107	<i>Glareola lactea</i>	Little Pratincole	LC	R/LM
108	<i>Glareola maldivarum</i>	Oriental Pratincole	LC	R/LM/SM
109	<i>Gracupica contra</i>	Asian Pied Starling	LC	
110	<i>Grus grus</i>	Common Crane	LC	WM
111	<i>Gymnoris xanthocollis</i>	Yellow-throated Sparrow	LC	
112	<i>Halcyon smyrnensis</i>	White-breasted Kingfisher	LC	R/LM
113	<i>Hieraaetus pennatus</i>	Booted Eagle	LC	
114	<i>Hierococcyx varius</i>	Common Hawk-cuckoo	LC	
115	<i>Himantopus himantopus</i>	Black-winged Stilt	LC	R/LM
116	<i>Hirundo rustica</i>	Barn Swallow	LC	WM
117	<i>Hirundo smithii</i>	Wire-tailed Swallow	LC	R/SM
118	<i>Hydrophasianus chirurgus</i>	Pheasant-tailed Jacana	LC	R/LM/SM
119	<i>Iduna caligata</i>	Booted Warbler	LC	R
120	<i>Iduna rama</i>	Sykes's Warbler	LC	R

121	<i>Ixobrychus cinnamomeus</i>	Cinnamon Bittern	LC	R/LM
122	<i>Ixobrychus flavicollis</i>	Black Bittern	LC	R/LM
123	<i>Ixobrychus sinensis</i>	Yellow Bittern	LC	R/LM
124	<i>Jynx torquilla</i>	Eurasian Wryneck	LC	
125	<i>Lanius cristatus</i>	Brown Shrike	LC	
126	<i>Lanius isabellinus</i>	Isabelline Shrike	LC	
127	<i>Lanius meridionalis</i>	Iberian Grey Shrike	VU	
128	<i>Lanius schach</i>	Long-tailed Shrike	LC	NE
129	<i>Lanius vittatus</i>	Bay-backed Shrike	LC	
130	<i>Larus fuscus</i>	Lesser Black-backed Gull	LC	WM
131	<i>Larus ridibundus</i>	Black-headed Gull	LC	WM
132	<i>Limosa limosa</i>	Black-tailed Godwit	NT	WM
133	<i>Lonchura punctulata</i>	Scaly-breasted Munia	LC	
134	<i>Lymnocyptes minimus</i>	Jack Snipe	LC	WM
135	<i>Mareca penelope</i>	Eurasian Wigeon	LC	WM
136	<i>Mareca strepera</i>	Gadwall	LC	WM
137	<i>Merops orientalis</i>	Asian Green Bee-eater	LC	NE
138	<i>Merops persicus</i>	Blue-cheeked Bee-eater	LC	SM/PM
139	<i>Merops philippinus</i>	Blue-tailed Bee-eater	LC	R/WM
140	<i>Metopidius indicus</i>	Bronze-winged Jacana	LC	R
141	<i>Microcarbo niger</i>	Little Cormorant	LC	R/LM
142	<i>Milvus migrans</i>	Black Kite	LC	
143	<i>Mirafra assamica</i>	Bengal Bushlark	LC	
144	<i>Mirafra erythroptera</i>	Indian Bushlark	LC	
145	<i>Monticola solitarius</i>	Blue Rock-thrush	LC	
146	<i>Motacilla maderaspatensis</i>	White-browed Wagtail	LC	R
147	<i>Mycteria leucocephala</i>	Painted Stork	NT	R/LM
148	<i>Neophron percnopterus</i>	Egyptian Vulture	EN	
149	<i>Nettapus coromandelianus</i>	Cotton Pygmy-goose	LC	R/LM
150	<i>Numenius arquata</i>	Eurasian Curlew	NT	WM
151	<i>Numenius phaeopus</i>	Whimbrel	LC	WM
152	<i>Nycticorax nycticorax</i>	Black-Crowned Night Heron	LC	R/LM
153	<i>Ocyrceros birostris</i>	Indian Grey Hornbill	LC	NE
154	<i>Oenanthe fusca</i>	Brown Rockchat	LC	
155	<i>Oenanthe picata</i>	Variable Wheatear	LC	
156	<i>Oriolus kundoo</i>	Indian Golden Oriole	LC	
157	<i>Orthotomus sutorius</i>	Common Tailorbird	LC	
158	<i>Passer domesticus</i>	House Sparrow	LC	
159	<i>Passer hispaniolensis</i>	Spanish Sparrow	LC	
160	<i>Passer pyrrhonotus</i>	Sind Sparrow	LC	

161	<i>Pastor roseus</i>	Rosy Starling	LC	
162	<i>Pavo cristatus</i>	Indian Peafowl	LC	
163	<i>Pelecanus onocrotalus</i>	Great White Pelican	LC	R/WM
164	<i>Pericrocotus ethologus</i>	Long-tailed Minivet	LC	
165	<i>Pernis ptilorhynchus</i>	Oriental Honey-buzzard	LC	
166	<i>Petrochelidon fluvicola</i>	Streak-throated Swallow	LC	
167	<i>Phalacrocorax carbo</i>	Great Cormorant	LC	R/WM
168	<i>Phalacrocorax fuscicollis</i>	Indian Cormorant	LC	R/LM
169	<i>Phoenicopterus roseus</i>	Greater Flamingo	LC	R/WM/LM
170	<i>Phoenicurus ochruros</i>	Black Redstart	LC	R/WM/AM

RESIDENTIAL STATUS		IUCN Red List Categories	
R	Resident	EX	Extinct
R/LM	Resident with local movements	EW	Extinct in the Wild
R/AM	Resident with altitudinal movements	CR	Critically Endangered
R/WM	Resident with winter influx	EN	Endangered
R/WM/LM	Resident with winter influx and local movements	VU	Vulnerable
WM	Winter Migrant	NT	Near Threatened
WM/R	Largely winter migrant and partly resident	LC	Least Concern
WM/PM	Winter migrant as well as passage migrant	DD	Data Deficient
NE	Not Evaluated	NE	Not Evaluated

7.2 Avifauna Habitat Mapping of Kabar Tal

The avifauna habitat mapping of the site will depend on the ecological zones of the site that the bird favors during their stay in the winter season, the mapping will depend on the bird flight radius and their approach to the parts of the wetland for feeding, roosting and even for breeding purposes for some.

The site caters a large population of the birds from the cranes to even the house sparrows but to top it all the major attraction of the site is the Black Necked Storks and Sarus Cranes which are very uncommon in this part of the region but the population have been thriving their and ever increasing along the years.

The habitats of the site and birds found in the particular zone are listed below:

Table 2: Ecological habitats with Birds found at that zone in Kabar Tal

S.No	Scientific name	Birds	
		Scientific name	Common name
1	The deep water zone (Permanent water level)	<i>Anas crecca</i>	Common Teal
		<i>Anas platyrhynchos</i>	Mallard
		<i>Anser indicus</i>	Bar-headed Goose
		<i>Ardeola grayii</i>	Indian Pond-heron
		<i>Aythya ferina</i>	Common Pochard
		<i>Bubulcus ibis</i>	Cattle Egret
		<i>Calidris pugnax</i>	Ruff
		<i>Ciconia episcopus</i>	White necked stork
		<i>Fulica atra</i>	Common Coot
		<i>Gallinago gallinago</i>	Common Snipe
		<i>Grus grus</i>	Common Crane
2	Marshes	<i>Anas acuta</i>	Northern Pintail
		<i>Anhinga melanogaster</i>	Oriental Darter
		<i>Anser albifrons</i>	Greater White-fronted Goose
		<i>Anthropoides virgo</i>	Demoiselle Crane
		<i>Ardea cinerea</i>	Grey Heron
		<i>Dendrocygna javanica</i>	Lesser Whistling-duck
		<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork
		<i>Lanius schach</i>	Long-tailed Shrike
		<i>Microcarbo niger</i>	Little Cormorant
		<i>Phalacrocorax carbo</i>	Great Cormorant
		<i>Phoenicopterus roseus</i>	Greater Flamingo
3	Shallow water/ The full supply level zone (Seasonal water level)	<i>Anas acuta</i>	Northern Pintail
		<i>Anas crecca</i>	Common Teal
		<i>Ardea cinerea</i>	Grey Heron
		<i>Ciconia episcopus</i>	White necked stork
		<i>Egretta garzetta</i>	Little Egret
		<i>Himantopus himantopus</i>	Black-winged Stilt
		<i>Hirundo rustica</i>	Barn Swallow
		<i>Mareca penelope</i>	Eurasian Wigeon
		<i>Numenius arquata</i>	Eurasian Curlew
		<i>Spatula querquedula</i>	Garganey
4		<i>Antigone antigone</i>	Sarus Crane

	High Flood Level / Littoral zone	<i>Ardea cinerea</i>	Grey Heron
		<i>Bubulcus ibis</i>	Cattle Egret
		<i>Egretta garzetta</i>	Little Egret
		<i>Grus grus</i>	Common Crane
		<i>Ploceus philippinus</i>	Baya Weaver
		<i>Recurvirostra avosetta</i>	Pied Avocet
5	Dense vegetation	<i>Anhinga melanogaster</i>	Oriental Darter
		<i>Ardea cinerea</i>	Grey Heron
		<i>Ardea purpurea</i>	Purple Heron
		<i>Ardeola grayii</i>	Indian Pond-heron
		<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork
		<i>Lanius schach</i>	Long-tailed Shrike
		<i>Merops orientalis</i>	Asian Green Bee-eater
		<i>Numenius arquata</i>	Eurasian Curlew
		<i>Ocyrceros birostris</i>	Indian Grey Hornbill
		<i>Ploceus philippinus</i>	Baya Weaver
		<i>Threskiornis melanocephalus</i>	Black-headed Ibis
6	Agricultural lands	<i>Anthropoides virgo</i>	Demoiselle Crane
		<i>Antigone antigone</i>	Sarus Crane
		<i>Aquila nipalensis</i>	Steppe Eagle
		<i>Ardea alba</i>	Great White Egret
		<i>Ardea purpurea</i>	Purple Heron
		<i>Calidris pygmaea</i>	Spoon-billed Sandpiper
		<i>Chrysomma sinense</i>	Yellow-eyed Babbler
		<i>Ciconia episcopus</i>	White necked stork
		<i>Circaetus gallicus</i>	Short-toed Snake-eagle
		<i>Clamator jacobinus</i>	Jacobin Cuckoo
		<i>Francolinus pondicerianus</i>	Grey Francolin
		<i>Merops orientalis</i>	Asian Green Bee-eater
		<i>Ploceus benghalensis</i>	Black-breasted Weaver

SI no	SCIENTIFIC NAME	COMMON NAME	IUCN	RESIDENTIAL STATUS	GEOGRAPHICAL RANGE ON THE SITE	HABITAT
1	<i>Anas acuta</i>	Northern Pintail	LC	WM		5-1, 5-4, 5-5, 5-8, 5-14, 9, 13
2	<i>Anas crecca</i>	Common Teal	LC	WM		5-1, 5-5, 5-7, 5-8, 5-16
3	<i>Anas platyrhynchos</i>	Mallard	LC	R/WM		5-1, 5-4, 5-5, 5-7, 5-14, 5-17, 15
4	<i>Anhinga melanogaster</i>	Oriental Darter	NT	R/LM		1, 5-1, 5-4, 5-5, 5-14, 9, 13
5	<i>Anser albifrons</i>	Greater White-fronted Goose	LC	WM		4, 5-4, 5-10, 9, 13, 14
6	<i>Anser anser</i>	Greylag Goose	LC	WM		4, 5-4, 5-10, 14
7	<i>Anser indicus</i>	Bar-headed Goose	LC	R/WM		5-1, 6, 14, 15
8	<i>Anthropoides virgo</i>	Demoiselle Crane	LC	WM		2, 3, 4, 5-1, 5-2, 5-4, 5-5, 5-15, 6, 8, 14, 15
9	<i>Antigone antigone</i>	Sarus Crane	VU	R/LM		4, 5-4, 5-5, 5-7, 14, 15
10	<i>Aquila nipalensis</i>	Steppe Eagle	EN	WM		2, 4, 6
11	<i>Ardea alba</i>	Great White Egret	LC	R/LM		4, 5-4, 5-5, 12, 15
12	<i>Ardea cinerea</i>	Grey Heron	LC	R/WM		1, 4, 5-1, 5-4, 5-5, 5-6, 5-7, 5-8, 5-13, 5-14, 5-15, 5-16, 5-17, 9, 12, 15
13	<i>Ardea purpurea</i>	Purple Heron	LC	R/LM		1, 3, 5-4, 12
14	<i>Ardeola grayii</i>	Indian Pond-heron	LC	R/LM		1, 5-1, 5-4, 5-5, 12, 15
15	<i>Aythya ferina</i>	Common Pochard	VU	WM		5-1, 5-4, 5-5, 5-7, 5-14, 5-16, 9, 13, 15
16	<i>Aythya nyroca</i>	Ferruginous Duck	NT	R/WM		5-5, 5-7, 13, 15
17	<i>Bubulcus ibis</i>	Cattle Egret	LC	R/AM		1, 5-1, 5-5, 14
18	<i>Calidris pugnax</i>	Ruff	LC	WM/PM		4, 5-5, 5-6, 5-7, 5-8, 9, 12, 14, 15
19	<i>Calidris pygmaea</i>	Spoon-billed Sandpiper	CR	NE		4, 12
20	<i>Chrysomma sinense</i>	Yellow-eyed Babbler	LC	NE		3, 4, 5-1, 5-4, 14, 15
21	<i>Ciconia episcopus</i>	White necked stork	VU	R		1, 4, 5-1, 5-2, 5-8, 9, 12, 14, 15
22	<i>Circus galliscus</i>	Short-toed Snake-eagle	LC	NE		1, 2, 3, 4, 8
23	<i>Clamator jacobinus</i>	Jacobin Cuckoo	LC	NE		2, 4
24	<i>Dendrocygna javanica</i>	Lesser Whistling-duck	LC	R/LM		1, 4, 5-4, 13, 14, 15
25	<i>Dicrurus macrocoerus</i>	Black Drongo	LC	NE		2, 3, 4, 14
26	<i>Egretta garzetta</i>	Little Egret	LC	R/LM		1, 4, 5-1, 5-5, 5-8, 5-14, 5-15, 9, 12, 13, 15
27	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	NT	R		1, 4, 5-4, 5-7, 9, 12, 13, 15
28	<i>Eudynamis scolopacea</i>	Western Koel	LC	NE		1, 3, 14
29	<i>Francolinus pondicerianus</i>	Grey Francolin	LC	NE		2, 3, 4, 14
30	<i>Fulica atra</i>	Common Coot	LC	R/WM		4, 5-1, 5-4, 5-5, 5-6, 5-7, 5-8, 9, 13, 15
31	<i>Gallinago gallinago</i>	Common Snipe	LC	R/WM		1, 4, 5-1, 5-4, 5-5, 5-7, 5-10, 9, 15
32	<i>Grus grus</i>	Common Crane	LC	WM		2, 4, 5-1, 5-4, 5-5, 5-7, 5-8, 12, 14, 15
33	<i>Halcyon smyrnensis</i>	White-breasted Kingfisher	LC	R/LM		1, 5-4, 12, 14, 15
34	<i>Himantopus himantopus</i>	Black-winged Stilt	LC	R/LM		4, 5-1, 5-5, 5-6, 5-7, 5-8, 5-14, 5-15, 9, 12, 13, 15
35	<i>Hirundo rustica</i>	Barn Swallow	LC	WM		2, 3, 4, 5-4, 5-4, 5-5, 5-6, 5-7, 14, 15
36	<i>Lanius schach</i>	Long-tailed Shrike	LC	NE		1, 3, 4, 5-4, 8, 14
37	<i>Larus ridibundus</i>	Black-headed Gull	LC	WM		4, 5-1, 5-5, 5-7, 5-8, 9, 12, 13, 14, 15
38	<i>Limosa limosa</i>	Black-tailed Godwit	NT	WM		4, 5-4, 5-6, 5-8, 9, 12, 14
39	<i>Mareca penelope</i>	Eurasian Wigeon	LC	WM		4, 5-4, 5-5, 5-6, 5-7, 5-8, 5-16, 9, 12, 13
40	<i>Mareca strepera</i>	Gadwall	LC	WM		5-4, 5-5
41	<i>Merops orientalis</i>	Asian Green Bee-eater	LC	NE		1, 2, 3, 5-9, 8, 14
42	<i>Microcarbo niger</i>	Little Cormorant	LC	R/LM		1, 5-1, 5-4, 5-5, 5-7, 15
43	<i>Mycteria leucocephala</i>	Painted Stork	NT	R/LM		5-1, 5-4, 5-5, 13, 15
44	<i>Numenius arquata</i>	Eurasian Curlew	NT	WM		1, 3, 4, 5-1, 5-4, 5-5, 5-6, 12, 13, 14, 15
45	<i>Ocyrocus birostris</i>	Indian Grey Hornbill	LC	NE		1, 2, 14
46	<i>Phalacrocorax carbo</i>	Great Cormorant	LC	R/WM		1, 5-4, 5-5, 5-14, 9, 13
47	<i>Phalacrocorax fuscicollis</i>	Indian Cormorant	LC	R/LM		1, 5-1, 5-5, 9
48	<i>Phoenicopterus roseus</i>	Greater Flamingo	LC	R/WM/LM		5-14, 9
49	<i>Platalea leucorodia</i>	Eurasian Spoonbill	LC	R		1, 5-7, 9, 13, 15
50	<i>Plegadis falcinellus</i>	Glossy Ibis	LC	R/WM/LM		5-1, 5-4, 5-7, 13
51	<i>Ploceus benghalensis</i>	Black-breasted Weaver	LC	R/LM		4, 5-4, 15
52	<i>Ploceus philippinus</i>	Baya Weaver	LC	R/LM		1, 3, 4, 14, 15
53	<i>Pseudibis papillosa</i>	Red-naped Ibis	LC	R/WM/LM		4, 5-1, 14
54	<i>Recurvirostra avosetta</i>	Pied Avocet	LC	WM/R		4, 5-6, 5-13, 5-14, 5-15, 12, 13
55	<i>Spatula clypeata</i>	Northern Shoveler	LC	WM		4, 5-5, 5-7, 9, 12, 13, 15
56	<i>Spatula querquedula</i>	Garganey	LC	WM		4, 5-5, 5-7, 5-8, 5-13, 9, 12, 13, 15
57	<i>Tachybaptus ruficollis</i>	Little Grebe	LC	R/LM		5-1, 5-5, 5-9, 5-14, 9, 13, 15
58	<i>Tadorna ferruginea</i>	Ruddy Shelduck	LC	WM		4, 5-1, 5-5, 5-7, 5-14, 14, 15
59	<i>Tadorna tadorna</i>	Common Shelduck	LC	WM		5-5, 9, 12
60	<i>Threskiornis melanoccephalus</i>	Black-headed Ibis	NT	R/WM/LM		1, 4, 5-1, 5-4, 5-5, 12, 13, 15

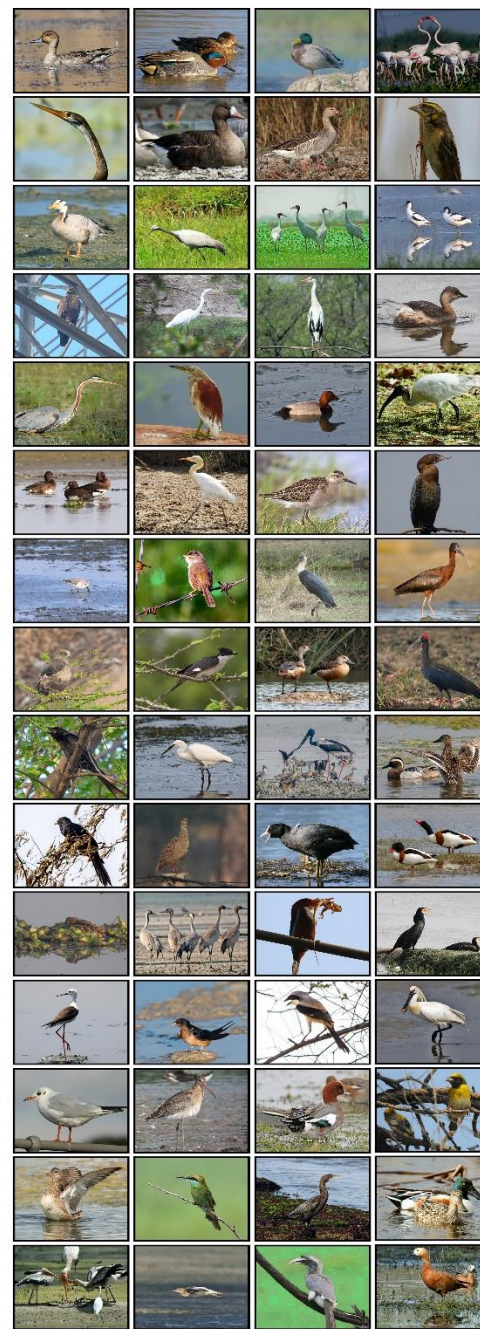


Figure 29 Relatin of Birds With Vegetation

8 Activity Mapping

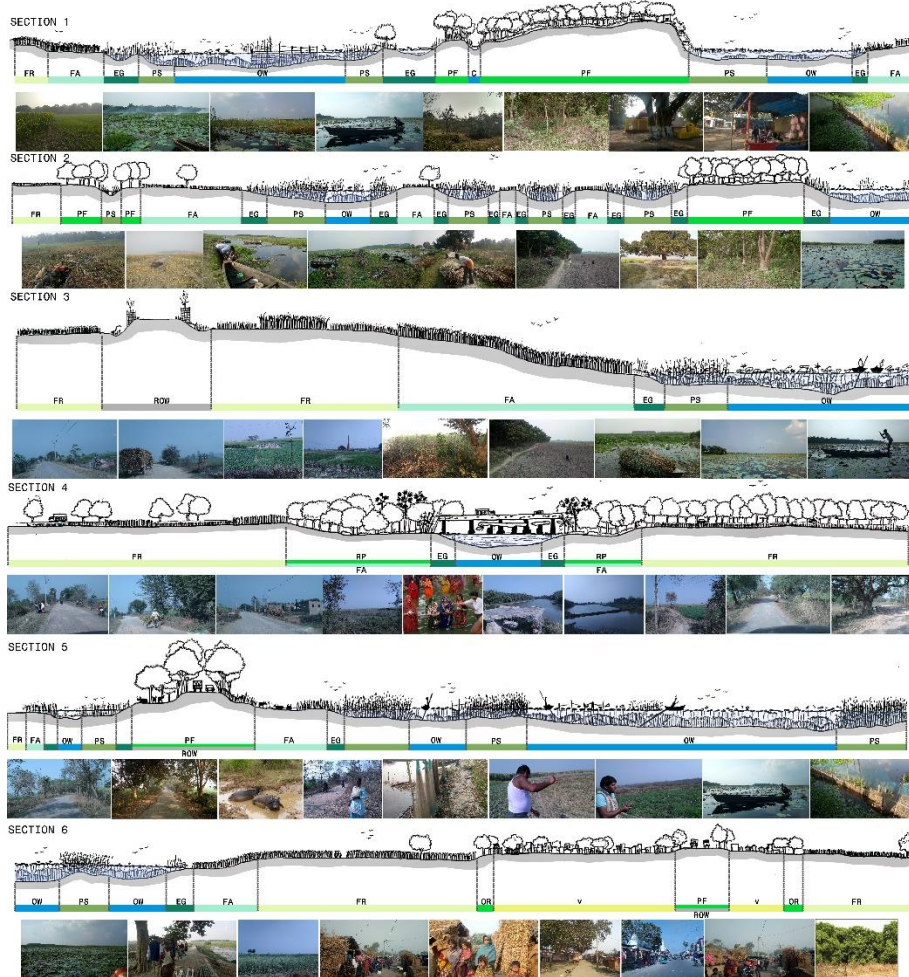


Figure 30 Section showing Vegetation Character and Activities around the Lake

The site is a productive landscape and offers a spill over space for various activities. The Dendritic pattern around the site is a hub of various activities like Manufacturing of Boats, Jhinhor (boating), fishing, net weaving, grazing, fodder and fuel wood collection, various other handicraft work, farming, fishing, Bird watching, camping, Chatth. Orchard around the site is one

other major activity hub.

Jaimangla Garh Temple is another major activity zone. Here People come to worship their deity Jaimangla Devi. Village fairs, Kirtan, Yagya (Jaga), Picnic, Marriage ceremony, etc. The temple complex has other temples of Shiva, Hanuman, Sita & Ram and a Navgraha Temple.

Villages around are majorly into farming, Fishing, Pomology, Apiculture, Cattle Raring and other activities like Handicraft work. Major handicraft work here constitutes of Kushiya Kala or Sikiya Kala, Majusha Art work, Lakh Handicrafts and bangles, Bamboo baskets, making fan (beeni) from bamboos and Palm Leaves and Bhojpatra from

Puraini (lotus) Leaves.

8.1 Festivals that Depends on Water Water bodies

Chatth: One of the most Major Festivals in Bihar and is considered as Mahaparva (mega-festival). This takes place twice in a year- Chaiti Chatth that happened during Chaitra (March-April) and the main one that happens in Kartik (October- November). The four day Festival starts with Nahay Khay where the devotees have to take bath in nearby water bodies or rivers and the collect water to make offering for the rest of the day from these waterbodies. Second Day is celebrated as Kharna when Devotees offer Kheer and Sohari Roti to the deity Chatthi Maiya. Third day is Sandhya Argha when everybody gathers by the waterbodies and rivers and offer prayers, partially immersed in water, to the setting sun after taking bath. Same Process is repeated the next day with the Morning sun.

Holy Baths: Poornima Snan and Somvati Amavasya Snan are the major festivals when people come to bath in these waterbodies. Poornima Snan happens on full moon days like- Guru Poornima, KArtik Poornim, Kushi Poornima, etc.

Bihula Bishahri: on the occasion of Bihula people come to bathe by the rivers and worship the snake lord Bishahri and Bihula.

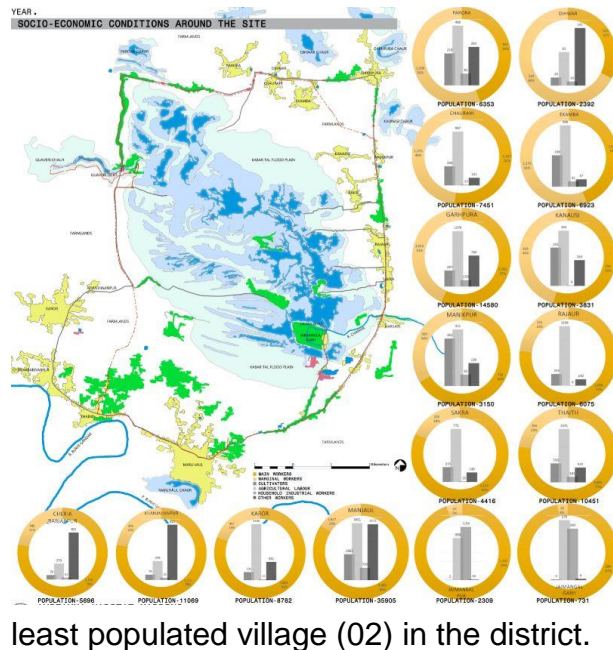
Jhinjhor: Jhinjhor takes place on full moon nights, when women from nearby villages boat to other nearby villages and gather to celebrate by exchanging food singing folklores, folk songs and meeting their relatives in nearby villages. This happens for three to four days around full moon nights. This does not occur during floods.

Cremation: Cremation in Hindu religion happens on the banks of waterbodies.

Sama Chakeba: it is a widely celebrated festival of Anga region when brothers and sisters celebrate each other's relation. According to the folklore Sama is Krishna's Daughter and Chakeba is Krishna's son. They make idols of Sama, Chakeba and Chugla. Sama Married Love of her Life and Chugla according to the folklore complained to Krishna. Krishna Cursed her Daughter and Sama and her Husban got converted into birds. Chakeba Freed them from this curse. The festival is celebrated for a month during

Kartik month, when all the brothers and sisters walk upto the waterbodies to extinguish fire being lit on Sama. Brothers extinguish the fire symbolizing that they will always protect their sisters.

9 Socioeconomic



Begusarai 16th in terms of population (29,70,541) and 27th in terms of area (1,918 sq.km.) in the state of Bihar.

In terms of population per sq.km. Begusarai is the 5th densely populated district in the state with 1,549 persons per sq.km as against the state's 1,106.

Majhau (under Cheria Bariarpur C.D. Block) is the most populated village (35,905) and Garh (under Garhpura C.D. Block) and is the least populated village (02) in the district.



Figure 31 Graphs showing Socioeconomic Distribution of the area

Begusarai is one of India's 250 most backward districts (source: Ministry of Panchayat Raj). It receives its funds from BRGF for its development

Bihar has maximum population below poverty line (BPL)-40% of the total population. It tops in the list of BIMARU States in India with largest service sector (55%) and least in industrial sector (32%). Rest of the population is indulged in agriculture (source: World Bank Report-2018, Telegraph-11/11/2018).

Figure 32 population and work class distribution in villages

Out Migration is one of the major consequence of this Poverty. Begusarai lies in Kosi Region and is affected by floods which is another major cause of poverty and displacement. Kosi region every year has an outmigration of around 5 lakh people every year with increasing 1.5 lakh population of out migrant every year.

9.1 Spatial Analysis

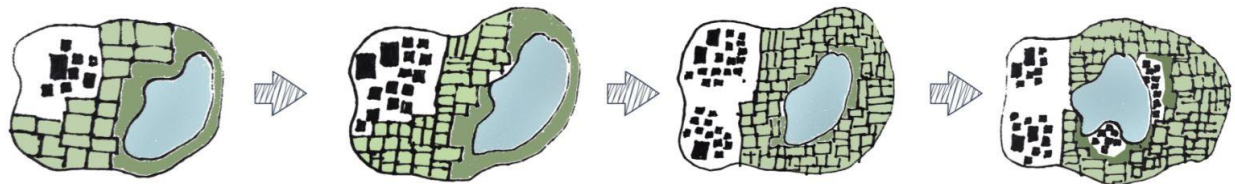


Figure 33 Spatial analysis Character

Earlier farms used to be bigger and agricultural workers and the landlord used to live along side by side in same villages.

As generations moved ahead villages started getting populated and farms got divided into smaller farmlands.

Villages expanded and so the farmlands. Lands were reclaimed for agricultural purposes. Villages expanded and so the farmlands. Lands were reclaimed for agricultural purposes. Social factors like racism and untouchability lead to settlement of labourers into separate villages near to the farmlands. Areas near the lake were apt for settlement due to availability of resources and water.



Figure 34 Economical Gains of Wetland and its distribution round the year



Figure 35 Interviews of the people talking about outmigration

Apart from the lake Jaimanglagarh Temple is the major tourist attraction. Guaveri Ghat, Harsine Stupa and Garhpura Indigo Movement are the other potential tourist circuits around the lake.

People from Jaimagal Garh, Jaimangalpur, Manjhaul and Paror has maximum number of handicraft workers.

Apart from fishing, crabs, snails and some medicinal plants are also harvested from the lake.

Agriculture is the major income source of the area.

Out migration is a major issue at the place and at most of the places Women will be working in the fields as well as home.

10 Conclusion

Whole study suggests that the area has a productive culture, Productive Vernacular Landscape systems and their own Management Practises, a cultural integrity and a very productive thought system and even instead to that poverty, frequent floods, outmigration, illiteracy and lack of awareness the area has still remained one of the backward regions of the state.

The people here need an upliftment in their socio-economical structure which strengthens

their economy keeping the cultural and vernacular systems intact. For this a special system/ prototype of Krishi and Pakshi Veehar should be proposed which enhances the bird habitat as well as the life of the people dependent on the landscape.

Strategies has been further described with the proposed Comprehensive Landscape Development Plan and the Proposal at Jaimangla Garh by bringing in healthier management practises and Economical restructuring.

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