

CONSERVATION OF AN URBAN WETLAND AT BASAI, GURUGRAM

Submitted

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

**MASTER OF ARCHITECTURE
(LANDSCAPE)**

By

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Declaration

I, Taveshi Prakash, Scholar No.2017MLA016 hereby declare that the thesis entitled Conservation of an Urban Wetland at Basai, Gurugram, 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 bonafide 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.

19-05-2019

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Certificate

This is to certify that the declaration of Taveshi Prakash is true to the best of our knowledge and that the student has worked under the guidance of the following panel.

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1 Introduction

1.1 Background

Basai currently a 315 ha large wetland in Sector 101 and 104 of Gurugram, situated about 8 km east of Sultanpur National Park in Haryana. It lies in the Central Asian Migratory flyway. It links the northern most breeding grounds in Russia to the southernmost wintering grounds in west and south asia, Maldives and the british Indian ocean territory. It is one of the major migration routes for birds flying from Europe, Central Asia to Indian subcontinent during winter.

It is an important part of a **larger wetland complex** comprising Najafgarh drain (Sahibi river basin), Basai Wetland and Sultanpur National Park along with wetlands in Jhajjar District (Dhigal village), together forming a large ecosystem for migratory birds as well as resident birds.



Figure 2: Google image showing relationship between Basai, Najafgarh and Sultanpur National Park Source: Google earth

1.1.1 Basai as an IBA?

Basai wetland has been recognized an Important Bird Area (IBA) by the Bird Life International.

IBAs are sites of international importance which hold significance for both birds and other biodiversity.

IBAs are declared if they fulfill any one of the following international criteria:

- Presence of globally threatened bird species,
- Restricted range bird species (with breeding range less than 50,000 square kilometres)

- Biome restricted bird species and
- Large congregations of birds- above 20,000 in number. The criteria for identifying IBAs are followed in the same manner the world over.

1.1.2 Criteria for declaring Basai wetland as IBA.

- It is home to several schedule species, both resident as well migratory species.
- It has more than 1 percent global biogeographic population of bar-headed geese that come from Tibet and other countries. More than 1100 bar-headed geese come to Basai.
- It has congregations of more than 20,000 birds each year. It has 10,000 waders of 36 species.

IBA classification is recognised in India by MOEFCC and Basai wetland features on the MOEFCC ENVIS portal of Wildlife Institute of India.

Basai wetland is recognised as an Important Bird Area by the Bombay Natural History Society (BNHS), Wildlife Institute of India (WII) and SACON (Salim Ali Centre for Ornithology and Natural History) which are also ENVIS centers for the Ministry of Environment Forest and Climate Change. It is also identified as a Key Biodiversity Area by the International Union for Conservation of Nature.

1.1.3 How does Basai qualify to be a wetland.

Basai Wetland falls within the definition of "wetlands" under the Wetlands "Conservation and Management) Rules, 2017. That definition reads as follows:

Wetland means an area 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, but does not include river channels, paddy fields, human-made water bodies/tanks specifically constructed for drinking water purposes and structures specifically constructed for aquaculture, salt production, recreation and irrigation purpose. (Ramsar Convention , 1971)

- As per Ramsar Convention

1.1.4 How does the IBA criteria relate to the identification of Ramsar sites under the Ramsar Convention

The Ramsar (or Wetlands) Convention defines a wetland as “an area 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 6m” (Article 1).

Article 2.1 of the Convention also states that “the boundaries of each wetland may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than 6 m at low tide lying within the wetlands, especially where these have importance as waterfowl habitat”.

The criteria for identifying wetlands of international importance under the Ramsar Convention, as adopted at the Conference of the Parties on 7 May 1999, fall into eight categories.

There is a strong relationship between the Ramsar categories for waterbirds and the IBA criteria. The IBA criteria A1, A4i and A4iii which are equivalent to Ramsar criteria 2, 5 and 6 were used for identifying IBAs. It has been used for both non-breeding populations of waterbirds and for breeding concentrations of some congregatory species.



Figure 2: Bar headed geese at Basai



Figure 3: Sarus cranes at Basai

(Source of images : Mr. Pankaj Gupta)

1.1.5 Threats to Basai wetland

1. Unsustainable development and urbanization

A part of the land of the Basai wetland has been earmarked for the development of a Construction and Demolition Waste Treatment Plant and work had commenced without any authorisation under the C&D Rules. This could have been averted if the said wetland had legal protection under the Wetland Rules, 2017 which prohibits development of a C&D Waste Treatment Plant under its rules.

The Master plan of Haryana, 2031 assigns the land of basai wetland under public utilities.

2. Invasive species- *Eichornia crassipes*, *Leuceana leucocephala*

3. Pollution - Treated sewage water, drainage and run-off from fertilized crops and pesticides used in industry introduce nitrogen and phosphorous nutrients and other

toxins like mercury to water sources. These chemicals can affect the health and reproduction of species, posing a serious threat to biological diversity.

4. Fishing farming is taking place in an area over 50% Basai wetland. Birds, including Storks, egrets, cranes, herons and cormorants, grey-headed swamphen often get entangled in the nets used by farmers and suffer injuries. Reeds used by birds for nesting are also removed.

Fish farmers are illegally rearing African Catfish which has been banned across the country as the carnivorous fish poses a threat to local breeds.

Known locally as African Mushi, the African catfish (*Clarias gariepinus*) is a carnivorous species introduced in India without official sanction.

It is native to Africa where it is found in fresh water lakes or ponds, rivers, swamps and urban sewage systems. As a part of aquaculture African catfish was introduced all over the world in 1980. It is voracious variety that feeds on living and dead matter of aquatic animals or even small birds. It can survive in poorly oxygenated water and breeds fast and this gives it an edge over other native species.

As water from Basai goes to Najafgarh drain that ultimately flows into the Yamuna the fish poses a huge threat to ecology of the area where the river flows.

If necessary the legal steps of conserving the wetland are not taken; the wetland will disappear soon.

1.1.6 Scope and Limitation

The main focus of this thesis is to conserve the ecology of the area by reattaining the water level to provide better habitat for the waterfowls and other birds. This is done by mitigating the disturbance from the immediate context and purifying the water coming in the site. Provide a planting strategy to reinvigorate the present scenario and provide hideouts to the birds for breeding and roosting while providing buffers around the site to ensure any external disturbances.

2 Literature review

2.1 Wetland

A wetland is a place where the land is covered by water, either salt, fresh or somewhere in between. Marshes and ponds, the edge of a lake or ocean, the delta at the mouth of a river, low-lying areas that frequently flood—all of these are wetlands.

2.1.1 Function of wetlands

The wetlands are highly productive ecosystems which support rich biodiversity and provide a wide range of ecosystem services such as

- storage of rain water
- purification of water
- mitigation of floods
- erosion control
- ground water recharge
- microclimate regulation
- aesthetic enhancement of landscapes supporting many significant recreational, social and cultural activities

2.1.2 Types of wetland

Some of the types of wetland include:

Marine - Coastal lagoon, coral reefs, seagrass beds and rocky shores.

Estuarine- Mangrove swamps, deltas and tidal marshes

Lacustrine- Along lakes

Riverine- Along the streams and rivers

Palustrine (marshy) - Marshy, bogs and swamps

2.1.3 Threats to wetland

The obliteration of wetlands has been causing a serious concern as these are one of the most productive habitats on this planet. They do cater to high concentrations of several species animals, mammals, birds, fish and invertebrates.

Cities will have to spend more money to treat water for their citizens if it were not for the wetlands. Floods are more devastating to nearby communities, storm surges

from hurricanes can penetrate farther inland, animals are displaced or die out, and food supplies are disrupted, along with livelihoods.

2.1.4 Wetland conservation

WWF, various government sectors, NGOs and several other organizations have been relentlessly pursuing the drive to preserve / conserve and protect wetlands for over forty years now with the help of Ramsar Convention

Ramsar convention is one its type international treaty that is devoted to a single type of ecosystem. Over 476,000 acres of wetland have been protected so far through this treaty. Their services have been saved and conserved for future generations to come.

2.2 Avifauna

2.2.1 Bird ecology

Ecology is defined as the relationship of organisms with each other and to their physical environment. 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 co-exist. There are main aspects of ecology of birds

Feeding ecology: There are varieties of food that are preferred by bird seg flowers, berries, seeds, nectar, 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. Bird's are able to exist in the same habitats by having different food preferences and not compete with one another for food. 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 dangers.

2.2.2 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.

2.2.3 Types of habitats for Avi-fauna

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

2.2.4 Bird Habitat

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

Food includes fruits, grains, seeds, nectar-producing flowers, nuts, insects, fish reptiles and other birds.

Water: Any source offering water for drinking or bathing, including rivers, swamps, lakes, streams and oceans.

Canopies of trees providing shelter or coniferous trees, shrubbery, caves or rock niches, overhanging banks, snags.

Nesting sites: Hollow trees, burrows, nesting boxes, birds houses vegetation to support nests and suitable nesting material.

Migration: Birds migrate to move from sites of less availability of food and less chances of survival to better availability of food hence better chances for survival. The areas that offer better foraging and nesting sites are preferred.

Birds nesting in the Northern Hemisphere part of the world migrate northward in the spring due to harsh winters over there to take advantage of increasing populations of insect, plants and abundance of nesting sites. Supply food and availability of insects goes down as winters approach because of low temperatures. Hence, the birds start to move southern hemisphere again. To escape the harsh winters is a motivating factor but many species, including hummingbirds, can't survive harsh temperatures as long as supply of food is available.

2.2.5 How habitat loss affects birds

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

Transforming natural habitats by clearing the fields for agricultural uses.

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 reasons of habitat loss.

Polluting activities such as mining, oil runoffs etc also damage the habitats

Natural disasters can also damage habitats through likelihood of such event is less but these events are also considered for the habitat loss.

In order to survive, organisms have to adapt to the changes. Birds in the similar manner can also adapt to the changes in habitat over the period of the 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.

2.2.6 Bird ecology in India

India recorded with 1301 variety of species comes off as one of the richest habitats provider in the bird for avi-fauna with around 14% of the world's birds.

India lies between 3 bio-geographic zones- Indo Malayan, Agro-tropical and palearctic which makes India surprisingly rich in avifauna and this can be attributes to its diverse topography, habitats and climate zone.

The india 13 bio-geographical regions can be demarcated as per bird ecology:

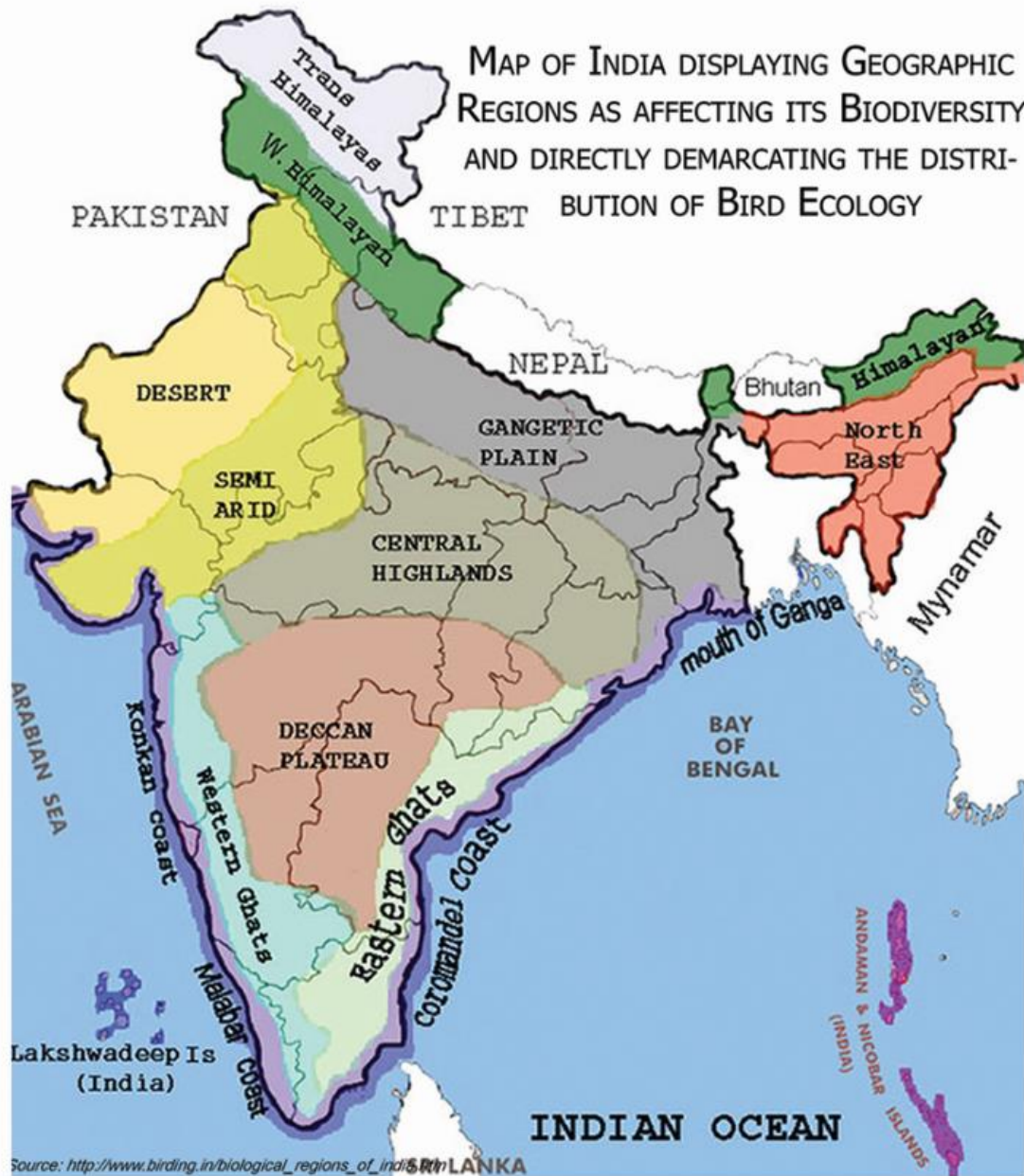


Figure 4: India map showing geographic regions as per avi-faunal variety

3 Bird Habitat

3.1 Habitat Map

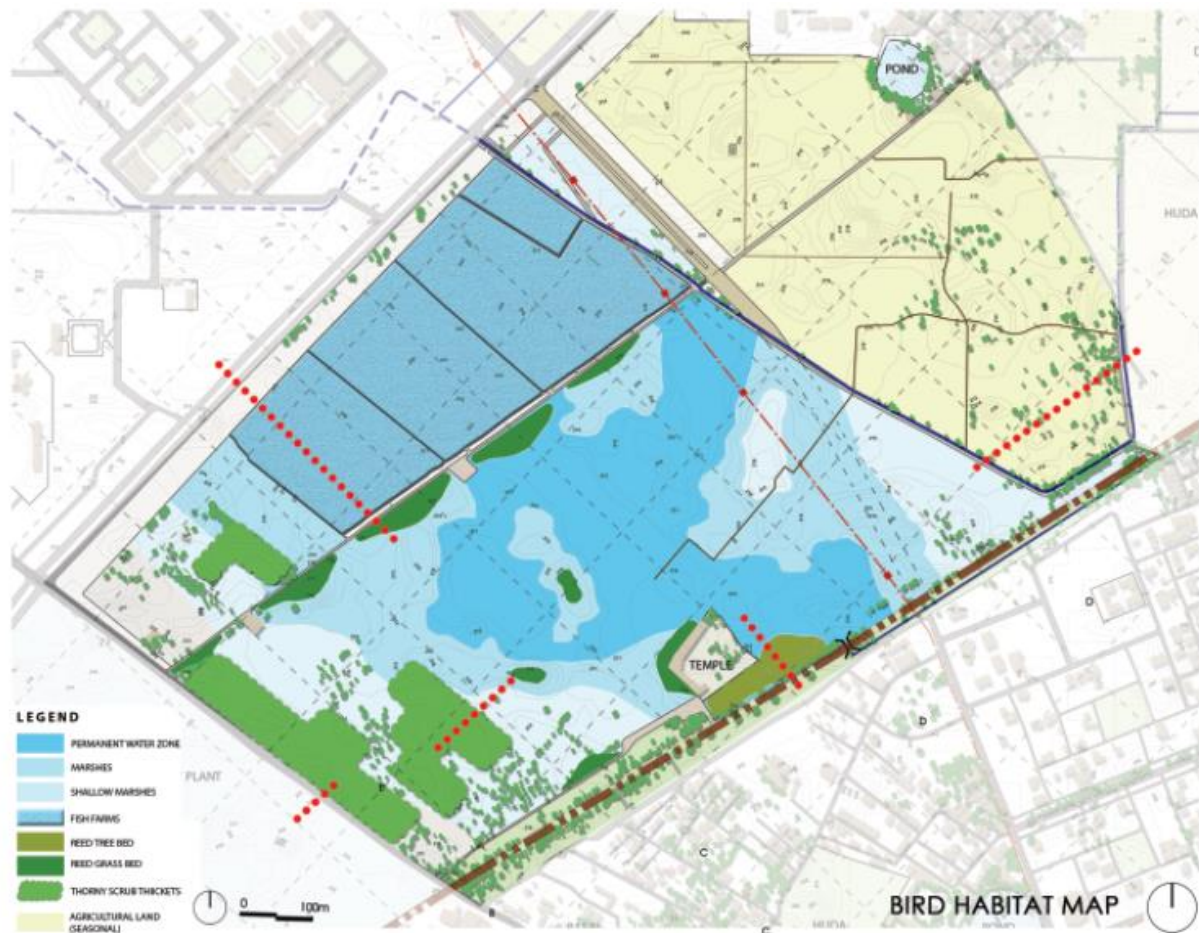


Figure 5: Bird Habitat map

Basai is a seasonal inland wetland which shows different habitats and caters to variety of birds. The site consists of zones that vary seasonally depending on the level of water.

3.1.1 Permanent water zone -

This zone attracts many waterfowls and other species that depend on the deep waters, the zone does not have any particular vegetation over surface but is a feeding area because of various fishes and under water vegetation.

3.1.2 Marshes -

The area the major attraction part of the wetland as it sustains majority of the bird population. Various other bird depend on this area for their food as hydrophilic vegetation is in abundance here and nearby hideouts provide shelter from prey, even the main food the insects and worms and fishes are also available.

3.1.3 Shallow marshes-

This zone is formed immediately after the monsoons, this provides how various edges species and shallow water birds and field birds. The area during winter is the major attraction for some species as it generates new vegetation which provide food for the birds and insects.

3.1.4 Fish farms

Omnivorous fish is reared which is harmful for small birds but predator birds can hunt african catfish and when this fish are fed chicken pieces, black kites can be clearly seen hovering above this area in large numbers.

3.1.5 Reed patch (grasses)

These are formed as succession from young reeds colonising open water or wet ground through a gradation of increasingly dry ground. Reed beds on aging build up a considerable litter layer that slowly rises above the water level and eventually provides land for scrub or woodland invasion. Reed beds remove pollutants from grey water. Reed grasses such as Typha, Phragmites and Arundo are present on site.

3.1.6 Reed patch (tree)

This zone Acacia sp. and ficus reed patch. These trees are used for perching and roosting. This is the most popular spot for nesting and breeding.

3.1.7 Thorny scrub vegetation

This zone consists of thickets of Vilaiti keekar (*Prosopis juliflora*), Babool (*Acacia nilotica*), Su-Babool (*Leuceana leucocephala*). Also it has tall dry grasses.

3.1.8 Agricultural land

Seasonal farming of wheat, maize and other vegetables are done on site. This provides food to various species of birds also Sarus craneis found to be nesting as well as foraging on agricultural land.

3.2 Seasonal diversity of species at Basai wetland

3.2.1 Winter

Basai is bird rich through the year. As winter approaches, the wetland and surrounding fields and scrubland are filled with passage, altitude and winter migratory birds. Around 7000 ducks of 18 species and 10000 waders of 36 species have been recorded here. Rail, Crakes and Warblers (*Acrocephalus*, *Phylloscopus* and *Sylvia*) also spend their winter here. The water body caters to thousands of Ducks and Geese like Greylags, Bar headed geese, Shovellers, Pintails, Gadwalls, Pochards and Teals the shallow depths are full of Ruffs, Avocet, Plovers and Stints. The surrounding fields and scrubland attracts Pipits, Larks and Wagtails as well as large birds of prey including the Imperial Eagle, Kestrel, Harriers, Buzzards and Peregrine Falcon.

3.2.2 Monsoon

The inundation of Basai Wetland during the monsoon attracts a number of Regional migratory birds that nest here. This includes Purple Swamphen, Pheasant Tailed Jacanas, Black-breasted and Streaked weavers, Bitterns (Black, Yellow and Cinnamon), Greater Painted Snipes, Water Cock and Sarus Cranes. It is also an Important feeding area for Blue-cheeked and Blue-tailed bee-eaters and Martins.

3.2.3 Summer

Due to seasonal nature of the wetland, water level drops in this season. This is the season when the resident birds like Black-headed Ibis, Purple Heron, Pond Heron, Moorhens, Cormorant, Pied bushchat, Munia and Francolins breed here.

3.3 Endangered, vulnerable and protected species

Basai Wetland is also home to Endangered birds such as: Steppe Eagle, Egyptian Vulture, Black-bellied Tern

Near threatened and Vulnerable species like Lesser Flamingo, Sarus Crane, Black necked Stork, Painted Stork, Oriental Darter, Black headed Ibis, Pallid Harrier, Northern Lapwing River Lapwing, Eurasian Curlew, Black-tailed Godwit, Curlew Sandpiper River Tern, Red-headed Falcon, Alexandrine Parakeet, Common Pochard, Marbled Teal (Marbled Duck), Woolly-necked Stork, Greater Spotted Eagle, Indian Spotted Eagle, Imperial Eagle, Ferruginous Duck.

Convention of Migratory Species (CMS): Basai Wetland is also home to birds covered under CMS such as Greater Spotted Eagle, Egyptian Vulture, Eastern Imperial Eagle, Ferruginous Duck and Marbled Duck.

Basai is home to several avian species which are rare and uncommon in the region as well as in India itself.

3.4 Functions performed by Basai wetland:

The presence of a healthy and rich avian biodiversity is a strong indicator of the health and quality of the ecosystem services of the said wetland. This particular important bird area performs all ecological operations of a functional -groundwater recharge, temperature moderation, etc.

With water tables depleting across rapidly urbanizing Gurugram, the Basai Wetland and its zone of influence has a key role in groundwater and aquifers' re-charge. It is important to note that the accumulated water in wetlands is connected to and continuous with the ground water table in the surrounding area. Hence, seepages of water from the wetlands into the subsurface can be regarded as groundwater recharge.

In the wet season, such wetlands have a significant role in flood control. Gurugram faces a major issue of water-logging during heavy monsoons when the entire city goes under water. These problems cannot be solved solely by de-silting drains and removing traffic bottlenecks. Basai Wetland, which is close to developing hubs of the Dwarka Expressway, is key to maintaining a hydrological balance during extreme weather events. It is also important to note that the presence of several bird species, is also a vital indicator of the health of the ecosystem supported primarily by the wetland.

4 Hydrology

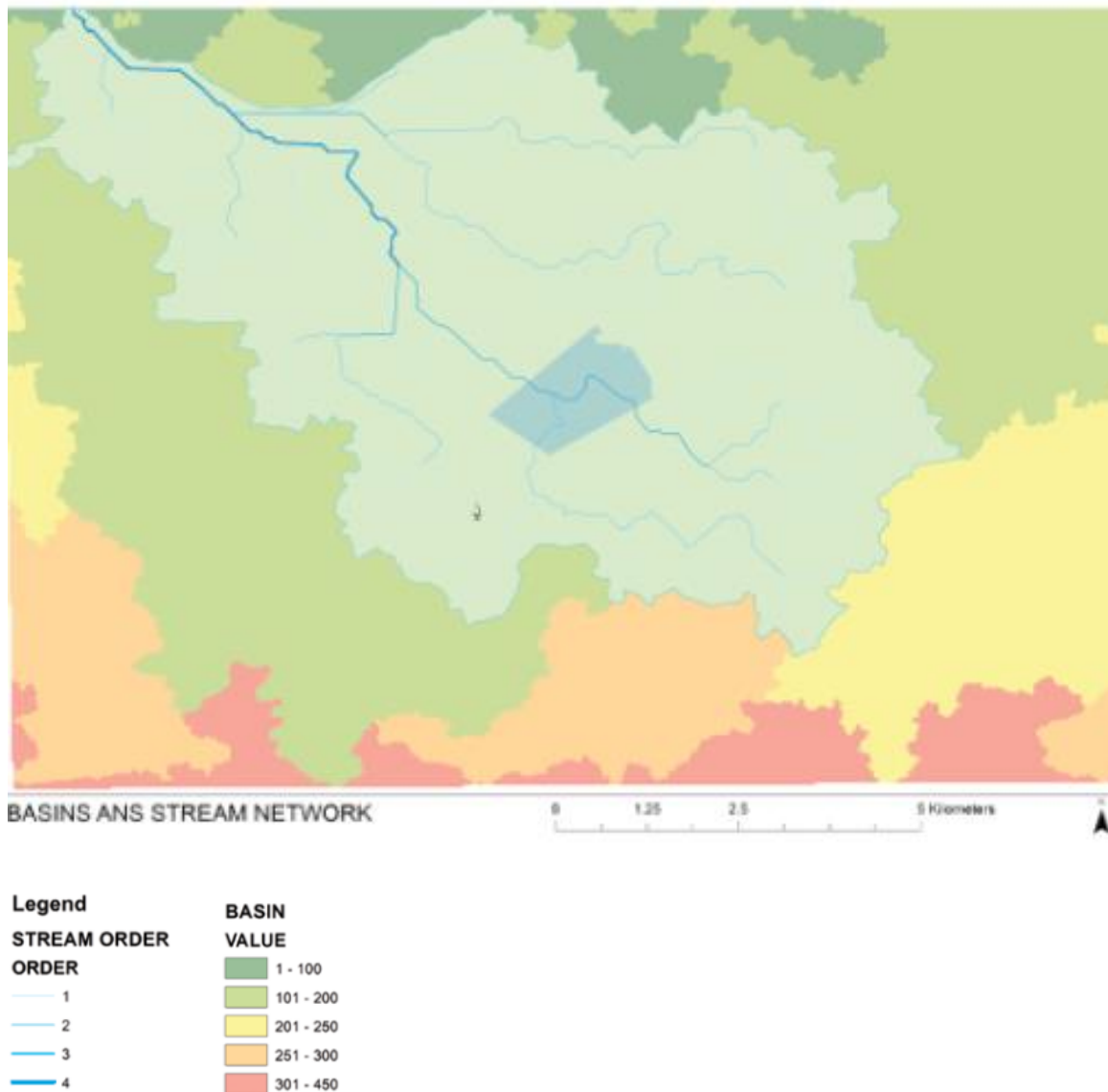


Figure 6 : Hydrology map (GIS generated)

Source of water in wetland

1. Rainfall-

2. Surface run off – Basai wetland lies in the natural catchment of the surrounding area and catches water from all four sides.

3. Breached water channels of STP- Farmers have breached the water channel carrying supposedly treated sewage at multiple points to irrigate their crops.

4. Overflow of canal - A channel carrying treated sewage water runs across the site that joins Badshahpur drain and ultimately ends up in Najafgarh drain finally ending up in Yamuna River.



5 Water quality

| Water Quality Assessment of Basai Wetland-5.7.18 | | |
|---|----------|-----------------|
| Parameter | Near STP | Near the temple |
| Water temperature (°C) | 32.5 | 31 |
| Turbidity (NTU) | >50 | >50 |
| EC (mS/cm) | 1.81 | 3.28 |
| TDS (mg/l) | 1010 | 1772 |
| pH | 6.7 | 6.8 |
| Dissolved Oxygen (mg/l) | 2.1 | 1.8 |
| Total Hardness (mg/l) | 280 | 560 |
| Ammonia (mg/l) | >3 | >3 |
| Nitrate (mg/l) | <10 | <10 |
| Phosphate (mg/l) | >1 | >1 |
| Chlorides (mg/l) | 248.15 | 850.80 |

The tests were conducted by WFF in August 2018 and the results of the water quality assessment of Basai wetland depicts degraded water quality. High values of turbidity in the water samples indicate high levels of suspended or colloidal solids in the water. Usually the wetlands record much lower values of turbidity as the stagnation of the water in wetland causes the suspended solids to settle down, however since the Basai wetland is receiving fresh inputs of sewage on a daily basis, high values of turbidity has been recorded in the water samples collected from Basai. High values of electrical conductivity and increased concentrations of total dissolved solids indicate high concentration of dissolved inorganic salts in the water.

Low concentrations of dissolved oxygen indicate the presence of high concentration of the organic matter in the water, which depletes oxygen in the water column values of biochemical oxygen demand (BOD) oxygen are very harmful for the aquatic life oxidized rapidly to nitrite and nitrate in presence of oxygen, however in the samples collected from Basai wetland, the concentration of ammonia has also been recorded on the higher side, indicating anoxia coupled with regular inputs due to the infl effluent into the wetland.

Detergents are the main source of phosphates in raw sewage, most significant limiting factors in inland freshwaters. handedly responsible for eutrophication in wetlands. Therefore the high concentrations of phosphate in the water samples indicate eutrophic status of quality analysis of the wetland reveals highly degraded water concentration of all the parameters in the water samples substantially lower

than what is expected in raw sewage. Typha, Phragmites and Eichhornea therefore indicates a very important ecosystem using natural processes being rendered by this wetland.

6 **Vegetation community**

Basai wetland is a swathe of marshy swamp land.

Wetland vegetation that grows in water is adapted to a growing in soil that is at least periodically flooded with water. Wetland plants are called as hydrophytes.

This vegetation provides food and habitat for various species that survive in or near water resources, such as algae, macro invertebrates, amphibians, fish and birds. Some of wetland plants augment the quality of water by the uptake of various nutrients, metals and various other contaminants. Wetland vegetation also stabilizes the shorelines from erosion and mitigates the impacts of flooding.

Several human induced disturbances alters the wetland regime and cause shift in plant communities. Different plants show different levels of tolerance to different stress factors. Species that are more tolerant of these disturbances might invade the wetland.

e.g. *Eicchornia crassipes*

Varying depth and quantity of water over the year; results in different submergence of areas during various seasons. Owing to monsoons wetland expands post monsoons and this results in various aquatic vegetation in the area.

Based on water depth, the wetland has the following plant zones:

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