Detailed Project Report
Bakhira Bird Sanctuary

April 2020 to March 2025

वन विभाग उत्तर प्रदेश

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Detailed Project Report

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Summary

1. The Indo-Gangetic floodplains in the state of Uttar Pradesh, harbours numerous natural and man-made wetlands. Bakhira Lake is an important oxbow Lake of eastern Uttar Pradesh, which provides wintering and staging ground for large number of migratory birds and breeding ground for resident birds. Realizing the ecological, faunal, floral, geomorphological, natural and zoological significance of the area for the purpose of protecting, propagating and developing wild life and its environment the area has been declared as Sanctuary.

2. The lake supports about 100 species of resident and migratory waterfowl, over 40 species of fish, several species of amphibians and reptiles and the smooth coated otter, Nilgai and common langur. Over the centuries the fisher folks have practiced indigenes non-detrimental fisheries methods being dependant on the lake, but with the recent hydrological changes, they claim fish population, size and diversity to have changed and declined and are resorting to unsustainable fisheries practices to obtain a minimum required catch.

3. Further, Bakhira wetland has a significant socio-economic, ecological, floral and faunal value in addition to their aesthetic values. The Management Action Plans suggested in this DPR include both Policy level and site level Management Actions keeping in view the need to safeguard the well-being of this wetland and people around.

4. The DPR is also suggests the need for capacity building to professionally manage this wetland. A special focus is given to development of proper eco-development strategies that will decrease the human dependency on the wetland resources and increase visitation of these sites through proper eco-tourism plans.

5. **Vision**: "Ecologically functional wetland of 'Bakhira Bird Sanctuary' is important biodiversity heritage of Uttar Pradesh should be conserved and emerge as a centre of excellence for eco-tourism and conservation education".

6. **Objectives**: a) Appreciate and promote the importance of integrated and sustainable management of Bakhira Bird Sanctuary (BBS); b) Promote participation of stakeholders in the management of BBS; c) Mainstream biodiversity conservation into production sectors of the region especially fisheries, tourism and agriculture; d) Effectively as well as scientifically protect, manage and monitor the biodiversity of BBS; e) Promote eco-friendly tourism that provides a rich experience for tourists, economic benefits to the local people and support to the Sanctuary; f) Develop BBS as a world class biodiversity site to promote eco-tourism and nature education.

7. **Problems**: Major portion of the sanctuary including the entire wetland area is not belongs to the State Forest Department that hindering the effective management of the Sanctuary. Altered hydrology that resulted in lack of flushing mechanism in the wetland. High nutrient rich water due to agricultural runoff and use of domestic

animals in large numbers.Poaching. Fishing during the critical period and in the critical wildlife habitats. Spreading of Phragmites, Hydrilla in the wetland. Pollution (source: sewage pollution from urbans – poor sewerage system). Lack of inter-sectoral co-ordinations in planning and development of nearby Municipal corporations. Increasing anthropogenic pressure around the Sanctuary. Lack of clarity on 'Scope of the Management Area of BBS'. Multi-stakeholders but lack of ownership and participation in conservation. Poor infrastructure of Management Authority of BBS. Poor infrastructure to promote eco-tourism, eco-development and nature education, to strengthening protection and monitoring.

Management recommendations

1. **Demarcation of boundary and settlement of ownership of land:** Entire wetland areas and other critical wildlife habitats of the Sanctuary is either owned by the private people or Gram Samaj. The Forest Department is own just 15.16 ha of land i.e. 0.52% of the total areas of the Sanctuary. Therefore, it is utmost important to acquire the sanctuary lands from both private and Gram samaj and hand over the land to the State Forest Department for the conservation of the wetland that would safeguard both wildlife and well being of people who live around the wetland forever. This is very important and ineffable step for the better management of the Sanctuary, which is critical for the conservation of this largest wetland of Uttar Pradesh and its biodiversity. Further, conservation of this wetland is very critical for the well being of the people of the region as its conservation and sustainable management would determine the water source that would be available for the people in future. Moreover, this wetland is also has the huge potential of promoting eco-tourism. In worst case scenario, if it is not possible to acquire these land from the private people and Gram Samaj then this Sanctuary may be converted into 'Community Reserve' and notify accordingly.

Wetland site	Private lands/Agriculture land	Gram Samaj land	Forest/Govt./ Others
Bakhira	(1059.14 ha)	(1819.91 ha)	(15.16 ha Reserve Forest)

2. **Spatial Planning & Zonation:** The zonation for the management of BBS is proposed under the following categories that needs to be demarcated in the field for better management.
   There are broadly four categories.

i. **Wilderness Zone**, which contain areas of high conservation values largely used by birds and fishes to breed and forage (minimum 60% of total area of the Sanctuary). Critical wildlife area of minimum 60% is being proposed as 'Wilderness Zone'' that should be inviolate areas with minimum human interventions.

ii. **Fishing Zone:** Local people may be allowed to sustainably fish in the region for their sustenance (maximum 40%) but entire the Sanctuary should be declared as 'Fishing Closed Zone' during the migratory season of birds.

iii. **Eco-tourism**, Natural Interpretation and Education Zone. Tourism Zone for the activities related eco-tourism
iv. **Eco-development Zone**: Two kilometre radius of areas around the entire Sanctuary is proposed to be demarcated as Eco-development Zone. All the villages within this 2 km radius from the Sanctuary need to be involved in the Eco-development programme with 'Micro-Plan' prepared in consultation with villagers

3. **Enhancement of effectiveness of the Management Infrastructure**:
   BBS is although one of the oldest Sanctuary notified by the Uttar Pradesh Government but there is no proper infrastructure available at present for the efficient management of Sanctuary, which is under tremendous pressure from ever-growing nearby region. Therefore, the Field Head Quarter of BBS is needs to be located at nearest township of the Sanctuary and all other Management Unit Staff placed in this Office with necessary infrastructure that includes patrolling boats (2), inflatable boats (2), boats for tourists (two 8 seaters, two 24 seaters). Four wheelers for ACF and two RFOs (One RFO for Eco-tourism and Eco-development and another RFO for Protection and Habitat Management). Research Lab with an office facility for Research Biologist and his/her staff is also required. A small all-weather jetty is required at near Bakhira for better patrolling and protection and same many also useful for eco-tourism activities.

4. **Control of eutrophication:** The entire catchment of the Bakhira lake is extensively cultivated. Historically the lake and the Rapti river used to get connected particularly during monsoon resulting in increased flushing of the lake. However, in 1987 a weir was created between the lake and the Rapti river at Churma which seriously hinders the outflow of nutrient from the lake. There is immediate need to restore the natural flushing mechanism of the lake by creating sluice on the weir and by creating new sluices to augment outflow of water from the lake particularly during monsoon.

5. **Establishment of Green belt around the Sanctuary**: It is strongly recommended to establish a green belt around the Sanctuary with native plants including tree species. It is proposed to establish a 50 m width green belt around the Sanctuary along the bank. This would prevent the soil erosion, minimise siltation, minimise flooding, act as breeding and roosting sites of resident birds, act as natural shield for birds, etc.

6. **Management of weeds and other hydrophytes**: The wetland is affected by around 12 species of aquatic weeds. With the decreasing water level on the advent of summer around 75-80% of the wetlands get covered with weeds and unwanted vegetation. It is proposed that the weed eradication programme should be undertaken by the management every summer particularly during the month of May and June. As the lake is quite big in size investing large sum of funds is unwise. In stead a strong ecodevelopment initiative could help in restoring the integrity of this wetland. Local fishermen communities and major beneficiaries should be involved in manual removal of weeds which they could use as compost. Since water hyacinth is the major problem for the lake. Control of this weed has to be taken on priority basis.

7. **Habitat management for birds**: Different types of migratory birds visit this Sanctuary during winter and several resident birds breed here. But, different birds required different kinds of habitats. Some birds are divers and require deep water for foraging, some are waders need shallow water, some forage hydrophytes, etc. Therefore, it is important to provide diversed habitats to accommodate diverse birds species. In this context, it is proposed to develop certain blocks of the water deepening to accommodate diving fish eating birds. Enough mounds are already available in the wetland therefore there is no need of further mounds.

8. **Pollution Management**: Pollution is one of the problems that is being prevailed in the area especially during the summer when the water level is low. The village Badgo and Newas located at the close proximity are discharging their effluents on the lake side. Management of pollution in the wetland area can be done by following the guidelines laid down by MoEFCC for the development of new industries/projects and for the existing industries, projects, treatment and dumping grounds in and around the area. Monitoring of the pollution levels should be according the guidelines laid down at Annexure I. The effluents from sewage should follow the Standards laid by the Ministry of Environment, Forests & Climate change, Government of India for Common Effluent Treatment Plants as per, (Environment Protection Rules, 1986) which shows the maximum concentration of elements that are permissible in the effluents meant for release after treatment. Aerators may be used to enhance the BOD of water during summer and winter to help of aquatic animal life. Moreover, de-siltation is also required at selected areas for birds especially diving and piscivores birds. Further, people around the wetland need to be educated and encouraged to avoid or minimize the use of inorganic farming and pesticide. Agriculture runoff is the most important source of pollution to the wetlands especially during winter and summer.

9. **Creation of awareness**: It is the most important step for conserving wetlands. Since Bakhira lake is under immediate threat, their conservation must be a part of development policy. This can be done effectively only by sensitising the public and planners on this issue. Awareness can be created through mass media, educational, materials and camps. Documentaries on conservation, threats to wildlife, posters on the status of different species. The need for voluntary organisations is also a must to translate the scientific ideas to general public in a way so that they can understand. To develop Sanctuary as an important tourist centre. To sensitize the local people and tourists about the wetland, flora & fauna present in the wetland, educating local people and tourist regarding wild animals and their importance in the ecosystem and to involve local people in wild life conservation. Local people should be involved in conservation programmes

10. **Strengthening Communication for Patrolling and Protection**: In order to have effective communication, mobile network should be maintained. Each staff including Range Officer should be provided with Mobile Sets. Range Officer should also be given a Landline Telephone connection so that tourists and Head Quarter can contact the local Ranger anytime.

11. **Eco-tourism activities**: Proper roads should be constructed for the tourists so they don't have any difficulty reaching the sanctuary. Proper restrooms and dormitories should be constructed for them along with proper sanitation facilities. Museum for displaying Trophies, Posters, Charts and Models should be there. Guest House for Tourist is also required and there is no accommodation available at nearby areas. Boating inside the sanctuary may be allowed but without disturbing birds and other wildlife of the sanctuary.

12. **Interpretation and Nature Education Centre**: Two interpretation Centres are proposed in phased manner. First one needs to be constructed near Bakhira town to attract tourists and local people. Once the tourist influx increases the other one can be constructed inside the sanctuary. This centre will have facilities like Library having Books and Magazines on Wild Life and related subjects, Television and VCR showing Video Films, Slide Projector for Slide Show for visitors and school children and Lecture Rooms.

13. **Establishment of Nature Trail**: Nature Trail can be organized for students and tourists for creating awareness with enjoyment. Nature walks will be organized between October to June. Bird watching and animal sighting will be integral part of nature walks.

14. **Establishment of Nature Camp**: Ideal camping sites inside the sanctuary need to be carefully chosen so that birds and other wildlife are not disturbed. These sites can be developed with required logistic facilities. Camping equipment can be provided to interested tourists on rent. These camps can also be used for school and collage going students for nature education and awareness. Further, the same camps can also be used for training frontline staff of Uttar Pradesh Forest Department towards wetland management. Bakhira being the largest wetland of Uttar Pradesh, this can be better training place for wetland management and conservation.

15. **Outreach Programmes**: Different outreach programmes are proposed to be carried out for greater publicity of this Sanctuary. For the people's awakening towards Lake Ecosystem & publicity, an awakening programme will be imparted through a programme on national days such as wet land day, wild life week, world environment day, sanctuary day etc. Film shows on birds etc on that day will be organised in Interpretation centre. A competition in schools and colleges regarding the values of sanctuary, ecology, birds etc will be held on those national days to awaken and create interest about wild life in children. A quarterly newsletter will be published. Hand bills, pamphlets will be published and distributed. Strategies to decrease consumptive use of natural resources will be developed and shared with local populations. Awareness and orientation workshops will be organised for officials of different departments and other stakeholders working in sanctuary so as to build conservation concerns into their activities. There is no bund around the Tal hence during rainy season water spreads in nearby villages. Apart from this it is not possible to go around the Tal because no road is available. In this plan Ring Bund around the Tal should be there to limit the spread of water. The bund will provide path around the Tal which will be used for patrolling and tourist ride.

16. **Management of satellite wetlands around Bakhira Sanctuary**: Indeed, BBS is a "Birders Paradise" for the people of eastern Uttar Pradesh as the Sanctuary lies on the Central Asian Flyway of the Asia Pacific Global Migratory Flyway. In that capacity, it is a staging /wintering ground for a large number of migratory waterfowl that breed in the Palearctic region. The Sanctuary had also been home of large population of cranes and wintering grounds of several migratory birds. Populations of both migratory and resident water birds have been declining in the region due to habitat degradation and disturbances. Birds known to reside within BBS most likely moving to the nearby satellite wetlands for foods. All the wetlands within 50 km radius of the Bakhira are satellite wetlands that include streams and rivers. Although, a study in this regard is needed, however, wetlands around BBS no doubt are playing a crucial role in the conservation of water birds of this region, especially during winter. Current land use patterns of this region could well be posing an added threat to these wetlands. Some of these wetlands should be declared as community or conservation reserves depending on nature educational programs and the subsequent input of local people.

17. **Sustainable fisheries management**: The fishing in the sanctuary is a small scale fishery and fishing operations are dependent on local market demand. The fishers are dependent on the wetland for their livelihood and other services. It is important to promote sustainable fisheries inside BBS to make BBS as viable breeding ground of fishes for the long term sustainable fisheries. Traditional fishing in the Fishing Zone is permitted in accordance with the law prevailing in the State. Fishing is one of the important revenue generating activity around the wetland. Water and sediment parameters indicated increase of pollution in the wetland that adversely affected fisheries resources and responsible for decline in fish catch. Inter-sectoral coordination between various sectors especially between the State Forest Department, Fisheries Department, Pollution Control Board and local governing bodies is essential for the mainstreaming biodiversity conservation into fisheries sector in the wetland region.

18. **Disaster Management**: Indian subcontinent has always been vulnerable to natural disasters on account of its unique geo-climatic conditions and floods, droughts, cyclones and earthquakes have been a recurrent phenomenon. BBS is a vulnerable Protected Area from natural disasters, particularly originating from floods. In order to respond effectively to floods, Ministry of Home Affairs has initiated National Disaster Risk Management Programme in all the flood-prone States. Assistance is being provided to the States to draw up disaster management plans at the State, District, Block/Taluka and Village levels. Awareness generation campaigns are necessary to sensitize the all the stakeholders for flood preparedness and mitigation measures. Elected representatives and officials are being trained in flood disaster management under the programme. State Forest Department can consult with Distrct Disaster Management Unit for flood preparedness and response in the Bakhira Bird Sanctuary.

19. **Research, Monitoring and Training**: It is important to build and manage a ''Knowledge Management System' of BBS for better monitoring of ecological functioning of BBS. In this context, Research and Monitoring of the biodiversity, water quality and socio-economic condition of dependent communities of BBS and surrounding

satellite wetlands is required at uniform intervals. This would ensure the ecological services of BBS to the people and also help to evaluate and review the management effectiveness of this Management Plan.

20. **Other Management Recommendations**:

a. The road that leads to the sanctuary office has to be built properly to facilitate management and visitors to approach the Sanctuary without any difficulty.
b. The villages that are present around the lake shoreline have to be well equipped with basic needs like electricity, drainage and proper sanitation.
c. There should be a Green Belt across the lake for putting less anthropogenic pressure over the water. More trees should be planted along the lake (green belt) and few trees on the islands to attract more and more birds like Asian Openbill Stork, Cormorants and Egrets.
d. Proper stay facilities should be taken care of for the tourists.
e. Phragmites patch should be left untouched because these are these are the prominent breeding ground for the water birds.
f. Household effluents should not be spilled in the lake water.
g. Village people should have a healthy relation with the forest officials so that they can tell about their problem to them. Therefore, regular meetings between villagers and management should be conducted.
h. Conduct awareness programs regularly in all villages.
i. Capacity building: Proper training of staffs should be done regularly.
j. Long-term monitoring of wildlife including birds and water qualities should be carried out regularly with help of local institutions.
k. Volunteer networks of Youths who live around the Sanctuary needs to be established to promote conservation awareness.
l. Scientific studies on the ecology of the lake and its biodiversity should be carried.
m. Improving better communication with the local people and create awareness about the condition of the lake.
n. Water should be replenished time and again. Malaria, yellow fever, dengue and filariasis are the diseases associated with stagnant water.
o. It is important to keep the Chorma bundh open during the monsoon period so that the excess nutrients from the lake could be washed away. If certain amount of vegetation goes out from the lake then it reduces the evapotranspirtion rate of this lake. It would also help to form more open-water habitat which is essential for other wildlife such as birds and turtles.
p. Uncontrolled growth of aquatic vegetation inside the submersible area should be removed during the month of May and June.
q. Negative impacts of pesticide usage needs to be imparted to the farmers through nature education.
r. It would be better to announce the period between February and April as ‘closed season’ for fishing.
s. Vaccination of all domestic cattle around the sanctuary should be done on regular basis as these animals are using the wetland area where wild animals are also occur.

Summary of Management Actions and Budget (April 2020 to March 2025)

Sl. No.	Actions	Year-wise Budget (Rs in Lakh)					
		I	II	III	IV	V	Total
I	**Establishment of Management Unit (Strategies)**						
a.	Constitution of a Management Plan Implementation and Review Committee						
b.	Periodic meetings of Management Plan Implementation and Review Committee	0.5	0.5	0.5	0.5	0.5	2.5
c.	Demarcation of Boundaries	5					5
d.	Establishment of ACF and RFOs Office						0
e.	Patrolling boats (2)	50					50
f.	Inflatable boats (2)	50					50
g.	Boat for tourists (two 8 seaters)	50					50
h.	Four wheelers for ACF and two RFOs and Research Biologist.	20					20
i.	Construction of floating Jetty (one) for tourists and staff boats	25					25
j.	Construction of approach road to the Sanctuary from the Main road	200	10	10	10	10	240
II	**Wildlife Tourism, Interpretation and Conservation Education**						
a.	Website of BBS (www.BBS.org)						0
b.	Strengthening the wetland biodiversity interpretation centre at Bakhira	20	1	1	1	1	24
c.	Development of two watch towers for patrolling and tourism	20					20

d.	Establishment and management of nature trails and boat routes	25	5	5	5	5	45
e.	Establishment of Nature camps and other logistic facilities for Tourists/visitors at Bakhira	500	50	50	50	50	700
f.	Establishment of Nature camps for school and college students with accommodation facilities for minimum 20 students	20	2	2	2	2	28
g.	Preparation and printing of awareness materials (Sanctuary Brochure, Checklist of Birds, Checklist of key fauna, Plant identification guide, Posters	1	1	1	1	1	5
h.	Organising Outreach Programs	2	2	2	2	2	10
i.	Establishment of Environmental clubs in schools and colleges	0.5	0.5	0.5	0.5	0.5	2.5
j.	Establishment and maintenance of Audio-Visual Facilities	5	0.25	0.25	0.25	0.25	6
k.	Establishment of Bathing ghats for villagers and visitors	50					50
l.	Establishment of fountains	50	1	1	1	1	54
m.	Lighting, park benches and seats	50	0.5	0.5	0.5	0.5	52
III	**Pollution and Habitat Management (Cost to be estimated by Forest Department in consultation with SPCB & Fisheries department)**						
a.	Establish small scale sewage water treatment plants in villages around the Sanctuary	50	2	2	2	2	58

b.	Efficiently implement guidelines laid down by MoEFCC for the development of new industries/projects and for the existing industries, projects, treatment and dumping grounds in and around the area.	1	1	1	1	1	5
c.	Monitoring of the pollution levels should be according the guidelines laid down by the Uttar Pradesh pollution control board	1	0.5	0.5	0.5	0.5	3
d.	Aeration of wetlands with aerators during summer and winter						
e.	Solid waste management	5		5		5	15
f.	De-siltation of wetlands at selected points for birds	10		10		10	30
g.	Develop the Sanctuary area is plastic free zone	1				1	2
h.	All sewage and industrial waste waters should be treated at the source itself within 50 km radius of BBS						
i.	De-weeding of invasive plants	5		5		5	15
j.	Establish a 100 m Green belt (with planation of native tree species) along banks to protect and maintain near-stream vegetation that attenuates the release of sediment into stream channels	50	5	5	5	5	70
a.	All satellite wetlands around 50 km radius of BBS should be declared as plastic free						
b.	Reclaim and restore satellite wetlands around BBS (within 50 km radius) through proper restoration techniques	10				10	20

c.	Continuous monitor these wetlands, their properties and ecology in every season	2	1	1	1	2	7
d.	Stock enhancement of commercial fishes, crab and prawns may be carried out in these wetlands without disturbing the birds and other biodiversity of the region	5		5		5	15
e.	Promote Bird watching and nature walk programs in these satellite wetlands	10	1	1	1	1	14
IV	**Long Term Conservation of Birds**						
a.	Regularly monitor the populations of birds	2		2		2	6
b.	All the villages along the boundary of BBS should be brought under the Eco-Development Programme	50	50	50	50	50	250
c.	Development of network of 'Green Cops/ Friends of Bakhira Sanctuary' comprising school and college students	2	2	2	2	2	10
d.	Study the ecology and behaviour of certain migratory and breeding birds of BBS	25	5	5	5	5	45
e.	Habitat management for water birds of both migratory and resident	50	50	50	50	50	250
V	**Sustainable Fisheries Management Plan (Cost to be calculated by Forest Dept with Fisheries Dept)**						
a.	Periodic Consultative dialogues and meetings with primary stakeholders (fishers) and State Fisheries Department	0.5				0.5	1

b.	Mapping and demarcation of fishing zone inside the BBS through participatory and discussions with local communities	5					5
c.	Promote sustainable fisheries through awareness programs	0.5		0.5		0.5	1.5
d.	Ranching of suitable candidate species needed for stock enhancement inside BBS and their spill over would be fished	5				2	7
e.	The alternative livelihood opportunities such as aquaculture with native species						0
f.	Involvement of fishing communities in ecotourism activities						0
g.	Awareness programs should be organized for minimizing catch of juveniles using slightly increased mesh size	0.5	0.5	0.5	0.5	0.5	2.5
VI	**Disaster Management**						
a.	Preparedness of District Disaster Management Team for BBS						
b.	Shaping or strengthening of bund at vulnerable floods points of the Lake to protect property and life of villagers	100				100	200
VII	**Climate Change Adaptation Plan**						
a.	Conservation of Eco-Sensitive Zone of BBS	1	1	1	1	1	5
b.	Involving local communities in the management and minimize pressure on resources of BBS	1	1	1	1	1	5

c.	Building on existing good practices in natural resource management						
d.	Adaptive management approaches						
e.	Integrating ecosystem-based adaptation with wider adaptation strategies						
f.	Communicating and educating	1	1	1	1	1	5
VIII	**Research, Monitoring and Training**						
a.	Establishing a Research and Monitoring Centre (RMC) at BBS	10					10
b.	Avifaunal monitoring	2	2	2	2	2	10
c.	Fish diversity monitoring	2	2	2	2	2	10
d.	Habitat Monitoring	2	2	2	2	2	10
e.	Socio-economic monitoring	2	2	2	2	2	10
f.	Water and sediment quality monitoring	2	2	2	2	2	10
g.	Preparation of Periodic monitoring reports	0.5				0.5	1
h.	Appointment of Research Biologist and supporting staff	5	5.5	6	6.5	7	30
i.	Capacity building for in-house research and monitoring	1	1	1	1	1	5
j.	Community involvement in research and monitoring	5	5	5	5	5	25
IX	**Sustainable Eco-Development Plan for Community Involved Livelihood Generations**						
a.	Awareness and extension	5	5	5	5	5	25
b.	Spearhead Teams Activities	10	10	10	10	10	50
c.	Capacity building	5	5	5	5	5	25

d.	1. Development of 'Village Conservation and Development Plans' (or Micro Planning)	50					50
e.	The eco development programme at village level will have to be steered through Eco development committees and micro plans.	100	100	100	100	100	500
f.	Chain link fencing (at selected areas to protect critical wildlife habitat from cattles)	50					50
X	**Organisation and Administration (Cost to be estimated by Forest Department)**						
a.	Development of Management Unit (One ACF, Two RFOs, 6 Foresters and 14 Forest Guards)						
b.	Reorganization of Beats/blocks						
c.	Vehicular/boat infrastructure development:	100	10	10	10	10	140
d.	Constitution of a 'Management Plan Implementation and Review Committee'						
e.	Settling the land ownership of BBS	Cost of the land as per the UP Government Rule					
						Grand total	3447

1. Introduction to the Bakhira Bird Sanctuary

Bakhira Bird Sanctuary (BBS), established in 1980, is the largest natural floodplain wetland in the Sant Kabir Nagar district, which is a part of the Basti division in eastern Uttar Pradesh. The sanctuary is under administrative control of Sohagibarwa Wildlife division, Maharajganj. The sanctuary forms the largest natural floodplain wetland of India, spanning an area of 28.9421 km^2. It was declared a bird sanctuary in 1990 by the Govt. order 822/14-3-60/1989, dated 14/5/1990. The sanctuary is named after the small township 'Bakhira', located adjacent to the lake. It forms an important wintering and staging ground for a number of migratory waterfowls and proffers a critical resource of breeding grounds for resident birds. Additionally, the sanctuary is also important for indigenous fish fauna and provides multifaceted ecosystem services to the local communities (Fig. 1).

Fig.1 A view of Bakhira lake, surrounded by agricultural pastures

1.1 City/Town around proximities

The sanctuary is located 44 km west of Gorakhpur city and the lake is surrounded by about 108 villages within 5 km radius. The nearest town to the sanctuary is Khalilabad (23.5 km) (Fig. 2). The Bakhira tal extends its boundaries over gram samaj land, agricultural land and reserve forest of Khalilabad (compartment no. 5). Geographically, the sanctuary is located between 26.30'N to 27.30'N latitude and 82.17'E to 83.30'E longitude.

1.2 Nearest road network

The BBS is connected via road and rail, majorly through Khalilabad. The nearest road network to the Sanctuary is the Mehdawal road. The sanctuary can be accessed via Gorakhpur-Khalilabad road (35km) followed by Khalilabad-Bansi road (17km). Another way to access the sanctuary is Gorakhpur- Sahjanwa road (20 km) followed by Sahjanwa-Jaswal road (23 km) and 3 km further from Jaswal village.

Fig.2 A view of Khalilabad market and road connecting the town to the Bakhira bird sanctuary

2. Description of the area

The sanctuary is located in Sant Kabir Nagar district. It consists of Bakhira Tal extending over gram samaj land and agricultural land and reserve forest of Khalilabad Compartment No.5. The sanctuary extends from 26.30'N to 27.30'N latitude and 82.17'E to 83.30'E longitude. BBS is spread over an area of 28.94 sq. km and was declared a bird Sanctuary in 1990 by the Govt. order 822/14-3-60/1989, dated 14/5/1990.

Fig. 3 Scenic view of Bakhira bird sanctuary proffering suitable habitats for the migratory birds

The lake is a rich ecosystem with diverse flora and fauna, which includes algae, other small hydrophytes, small aquatic animals such as snails, insects and many varieties of fish species (Fig. 3 & 4). The lake thus provides an ample food resource for the migratory birds. The migratory birds cover long distances of over 5000 km to arrive at the Bakhira lake from Tibet, China, Europe and Siberia. They are specifically winter migrants and start arriving in Bakhira from the month of October and can be spotted until March whence they start returning with the onset of summer. The sanctuary is thus providing a promising platform for the ecotourism based revenue generation in winters. However, large number of resident birds such as moorhen, water-hen, etc breed in the lake.

2.1 Location details:

District	**Sant Kabir Nagar**
Block	Bakhira
Panchayat	Bakhira
Village	Bakhira
Forest division	Sohagibarwa Wildlife Division
Forest Range	Maharajganj
Geographical coordinates	N26°55.678’ / E083°07.324’

Fig.4 Bakhira wetland with diverse habitat to harbour varieties of flora and fauna

2.2 Water sources

Bakhira lake is rich water source and a perennial water body which covers an area of 1,582.35 ha (Fig. 5). It inundates about 1,296.64 ha. more in monsoon season, thus extending the total water area up to 2,878.99 ha. The lake forms a meandering connection to the Rapti river and is elliptical in shape, which is approximately 13 km in length (east to west) and 4 km in average width with a perimeter of about 44 km. During monsoons,

water from nearby areas drains into the lake which starts receding post-monsoon with highest shrinkage in summers. The average depth of lake in monsoon goes upto 7 m while in summer, it is reduced upto 1-2 m. The lake is surrounded by agricultural land and villages which put pressure upon the resources of the lake. The wastewater from nearby villages further flows into the lake through gulleys and nalas. The excessive water during the monsoons is drained into Rapti by the irrigation Department through a barrage situated at Chorma nala, established in 1980.

3. Boundaries

BBS is under administrative control of Sohagibarwa wildlife division, Maharajganj. The boundaries of the sanctuary are as follows:

3.1 North

The northern boundary of the sanctuary ranges from the southeastern limit of Sailgarh village to southern limits of the villages Gorapar, Terhava, Malai and Bodhara. Further, it ranges from south-western limit of Khalilabad compartment No. 5 to its northern limit, which traverses through the south eastern limits of village Bodhara.

3.2 East

The eastern boundary ranges from south-eastern limits of Bodhara village to the south-western limits of village Ghurapali.

3.3 South

The southern boundary ranges from the village of Ghurapali, Sonbarasa, Govindpur, Kotia, Nevas, Mohnag to the northern limits of Barhago, Dhankhiriya, Tetaria, Chilwankheer, Mahala, Surajkot, Sanichara, Mehrikhurd and Mehrikala.

3.4 West

The western boundary ranges from the north-eastern limits of Mehrikala village to the east Bakhira, Ladua, Mahuwa and Dhodhaya.

4. Water

4.1 Inlet

Water from nearby villages flow down into the lake through gulleys/nallas. Various other nallas drain their water into the Bakhira lake viz. Ghaghara nallah, Nevas (26°52'36.4"N; 083°08'46.2"E), Baraka Ghaghra nallah, Govindpur (26°52'12.7"N; 083°09'05.8"E), Baraipar nallah (26°54'40.9"N; 083°05'39.3"E), Vandah nallah, Bakhira (26055'41.9"N; 083005'16.4"E) and Van Rakshak Chauki, Dhaurapar (26°56'36.7"N; 083°06'05.0"E). The major water source for the lake use to be the nearby River Rapti. Historically, there was connection between Rapti and a portion of river stretch got disconnected and became an oxbow lake i.e. Bakhira.

4.2 Outlet

Bakhira lake drains into River Rapti (near Pali Block, Gorakhpur) through the Eastern Chorma nala (26°50'00.1"N; 083°13'25.4"E). The excessive water in the rainy season is drained into the River through a gate situated at Chorma Nala by irrigation department established in 1980. Furthermore, the water is also drained out through two canals at Nevas and Dhodha for irrigation of agricultural crops.

Fig.5 Bakhira lake as a rich water resource to support local communities

4.3 Drainage System

As the lake is adjacent to River Rapti, during monsoon surplus water due to rain is drained out into the river and in turn helps local agricultural land in better crop production. Additionally, the Bakhira lake is also drained by the Eastern Chorma nala (26°50'00.1"N; 083°13'25.4"E) into Rapti near Pali Block, Gorakhpur. The water is also drained out through two canals at Newas and Dhodhya for irrigation of agricultural crops. The drainage follows the general slope and relief features of the region. The sanctuary has two main river systems viz. the Ami river system and the Rapti river system. Both of which ultimately form the part of the Greater Gangetic System.

4.4 The Rapti

Rapti, is one of the major rivers of the region, which rises in the foothills situated north of Behraich district. Traversing a distance of about 130 km, the river enters northern portion of the Gonda district and then touches the district Sant Kabir Nagar in the north-west. The

river forms a short boundary between Sant Kabir Nagar and Gorakhpur. Rapti has a considerable volume of water in the rainy and winter seasons and carries huge amount of alluvium with it. The deposits made by the river in its bed as well as basin are silty in nature, locally called 'Bhat', due to its relatively high fertilities. There are numerous tributaries especially those on the left bank of Rapti River, of which, Ami forms a major tributary.

4.5 The Ami

It is one of the chief tributaries on the right bank of Rapti. The Ami is a stream which originates at Sohanara traversing about 125 km before its confluence with Rapti Sohagaura near Kauriram in the Gorakhpur district. As it stands, the river is under high pollution pressures form the industrial effluents, majorly by the paper mill at Khalilabad, apart from other small-scale inductries.

5. Geology, Rock and Soil

The geology of the land is reflective of two layers of Quartenary Sediment deposited in the past. Therefore, the area has been a major floodplain. Soil in the area is a mixture of sand and clay, with a comparatively higher percentage of clay. The entire land in the BBS is formed by the soil brought out by Ghaghra and its tributaries which generally is plain and fertile like plain area of Ganga-Yamuna located in north of Ghaghra. Generally, water flow is from north-west to south-east. The soil of the eastern part which is closed to the district Gorakhpur, is slightly calcareous. This area is mostly situated in north plain of Ganga-Yamuna, and in the north of Saryu River. Therefore, the whole land and its soil is very fertile and is fit for agriculture.

5.1 Terrains/Altitude

The terrain of the area is almost plain having average height of 100m above mean sea level.

5.2 Geology

A sizable part of Bakhira is under Ganga Plain. It lies in inter- fluvial belt of river Ami in the south and Rapti in the north-east. The region is underlain by quaternary alluvium comprising of various grades of gravel and clay. It was eroded from the Himalayas by the rivers and the monsoons. Geomorphologically and geologically the alluvium of the district can be classified into two groups, the older alluvium and the newer alluvium plains.

5.2.1 Older Alluvium

The older alluvium was formed in the middle Pleistocene age, and generally occupies high ground which is not affected by floods during the rainy season. It is also known as 'Bhangar' is more clayey in composition and is generally dark in colour. It comprises the low valley of the Ami in south, extending to its tributary of Rapti River.

5.2.2 Newer Alluvium

The newer alluvium is also called younger alluvium plain, and is flat to gently sloping, slightly undulating land surface. It is produced by extensive deposition of unconsolidated sand, silt, and clays that belong to the upper Pleistocene to the recent age. The deposition took place adjacent to the flood plain, along the river channels. Newer alluvium covers the lower height.

5.3 Soils

Soil is one of the most important natural resource that determines the agricultural productivity and growth of vegetation in an area. The sanctuary comes under middle Gangetic plain region in the eastern Uttar Pradesh. The soils of the area are highly calcareous (pH 7.8) and are very similar to alluvial soil that comprises of sand, gravel, and clay in different proportion. The texture of the soil is clay loam (82.69%), sandy loam (72.96%), sandy clay (41.26%) and diara soil (14.64%). Sandy types of soils are found along the high bank of Ghaghara. In the eastern region these soils are locally known by different names like Bhat, Banjar, Mant and Dhuh. Bhat soil (sandy loam) is found in low laying areas of the district which have high lime in content. In the Kachhar of Burhi Rapti there is strip of Bhat soil which is characterized by great fertility. Dhuh soil is found near riverbanks and is subject to inundation; it is a phosphatic deficient belt. A narrow belt of Terai runs through the northern most part of the district. The fertility status of the soil of the district indicates low Nitrogen and Phosphorous, and medium potash (K) content.

5.4 Agriculture

The maximum area around the lake is agricultural land. According to National Agricultural Research Project (NARP), the sanctuary comes under North Eastern Plain Zone (U.P. 8) which is in the Middle Gangetic Plain Region (IV), categorized by the Planning Commission of India. The climate and soil of the district are suitable to produce nearly all the agricultural crops which are grown in the plain (Fig 6.) The major crops cultivated in Bakhira are wheat, paddy, and sugarcane. The land-use land cover categories of Bakhira is given in Fig. 7, 8 & 9.

Fig. 6 Agricultural fields around the lake

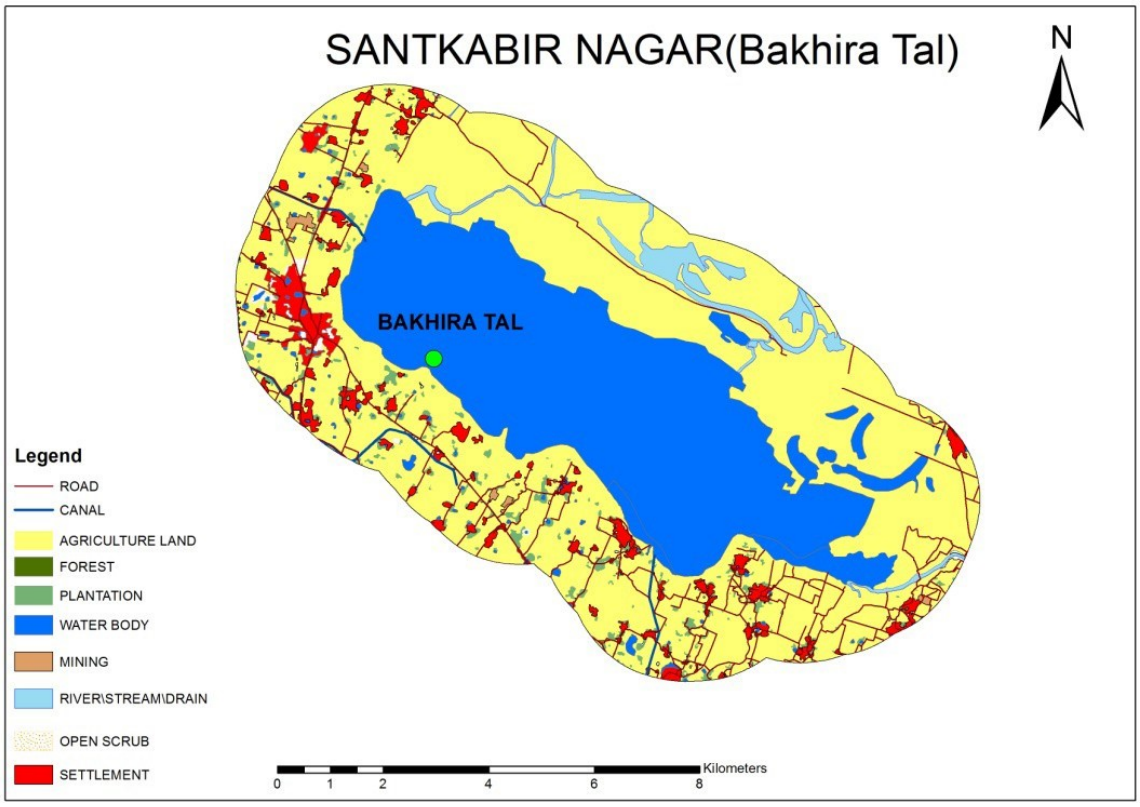

Fig. 7 Bakhira tal with land-use categories of its surrounding landscape

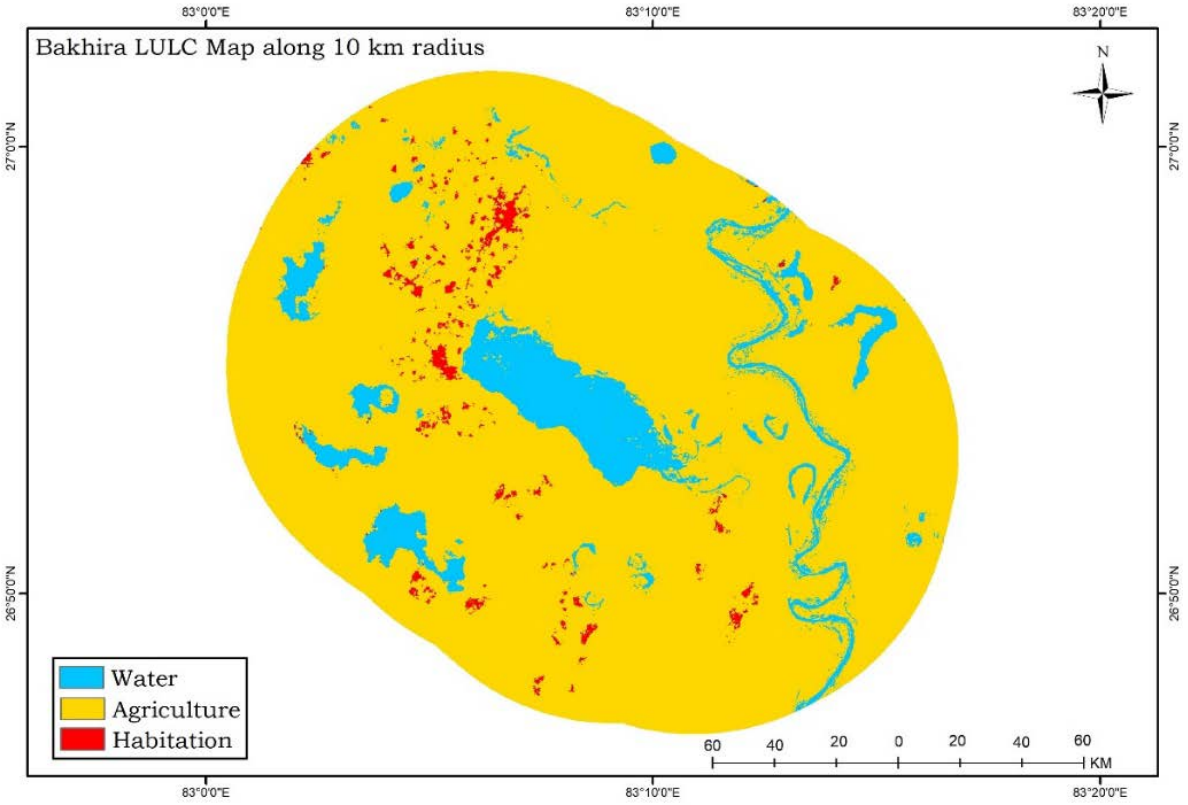

Fig.8 Land cover and land use map of Bakhira Bird Sanctuary along 10km radius of the lake.

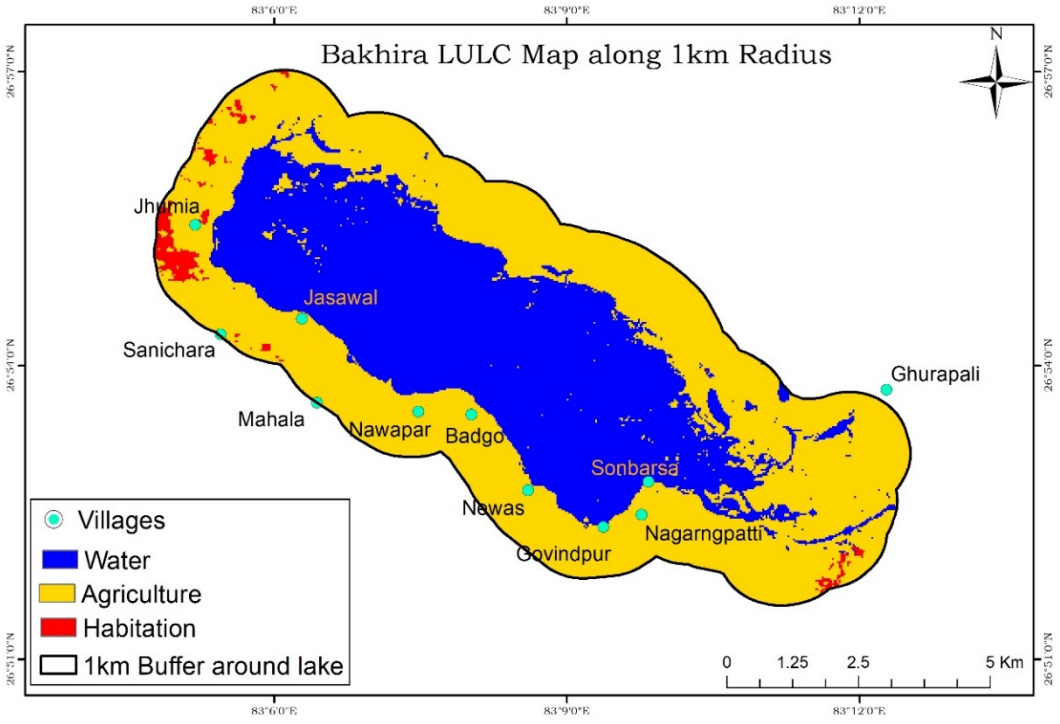

Fig.9 Land cover and land use map of Bakhira Bird Sanctuary along 1km radius of the lake

6. Climate

Climate form an important part of the physical environment of a landscape, which not only influences various aspects of human life but also determines the lifestyle, culture and food habits of the people. In the eastern part of Uttar Pradesh, the climate is sub-humid, similar to that of other plain areas in the state. Summer season starts from mid-March and extends till onset of monsoon in June-October. May and June are the hottest months of the year, where warm and dry westerly wind blows in summer. Winter extends from November to February. In the months of December and January effect of frost and fog is seen. It is also characterised by a rhythmic change of seasons, which are caused by the south-west and north-east monsoon. The climate of the area may be categorised into four distinct seasons.

1. The Cold Weather Season (November to February)
2. The Hot Weather Season (March to Mid-June)
3. The Season of Rains/ south-west monsoon Season (Mid-June to October)
4. Transition or post monsoon Season (October to Mid-November)

Most of the rainfall of the district (92%) occurs with the onset of south-west monsoon that takes place by the middle of June and continues till the end of September. The period corresponds with a higher temperature and very high relative humidity. May is the hottest month and January is the coldest month with minimum temperature. In the month of November, the belt of high pressure extends from north-west India that also covers the entire region of Uttar Pradesh.

6.1 Rainfall

About 92% of rainfall takes place in the monsoons ranging from June to September. The highest rainfall is in the month of July (Fig 10). Winter rains occur in the months of January and February. There is no effect of snow in the sanctuary. Occasionally, hailstorms are also witnessed in the area. south-west monsoon is solely responsible for heavy rains in the months of summer. Some rainfall is also received in winter due to western disturbance before the onset of monsoon. This rain is important for the Rabi crops especially wheat. The average annual rainfall of Bakhira is 110.6mm.

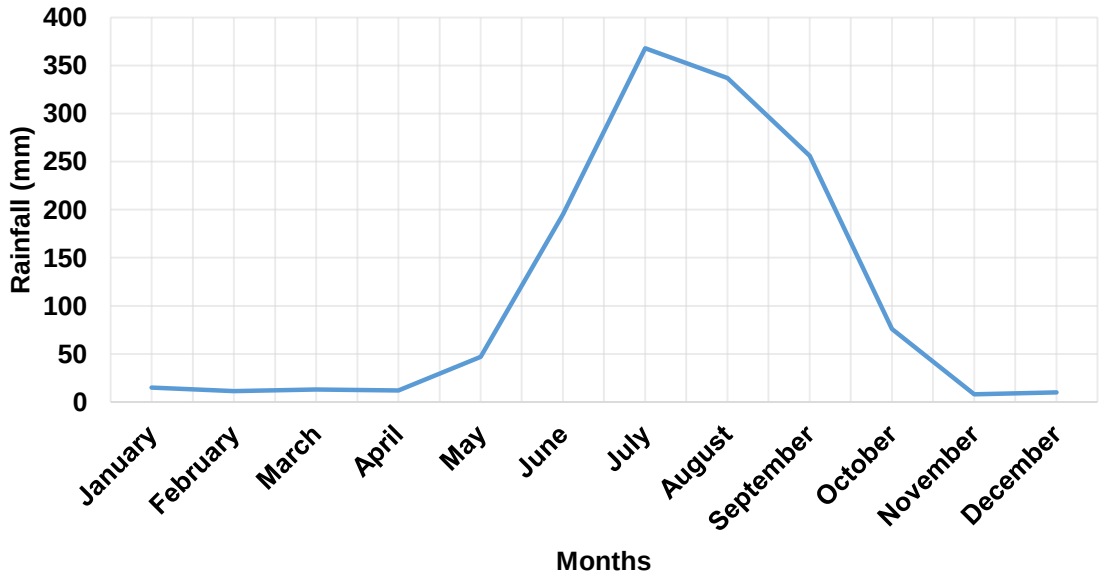

Fig.10 Average annual rainfall received by the Bakhira sanctuary

6.2 Temperature

Temperature forms another important element of climate in a region. May is the hottest month with the temperature reaching as high as 47°C. With the onset of monsoons, the temperatures begin to drop in the night but day temperatures continue to be high (Fig. 11). January is coldest month. During the winter season, the mean minimum temperature is recorded about 9°C and mean maximum is 23°C, while during the summer season the minimum is about 25°C and mean maximum is about 44°C. The mean annual temperature of the district is 25°C (Table 1). The average annual temperature of Bakhira was 25.54°C

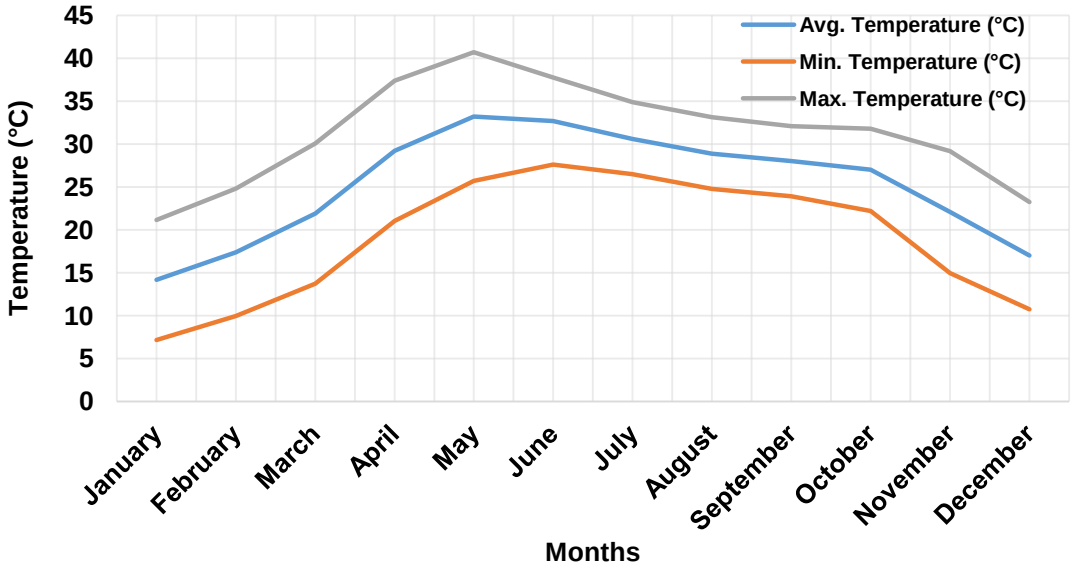

Fig.11 Annual average temperature in the Bakhira sanctuary

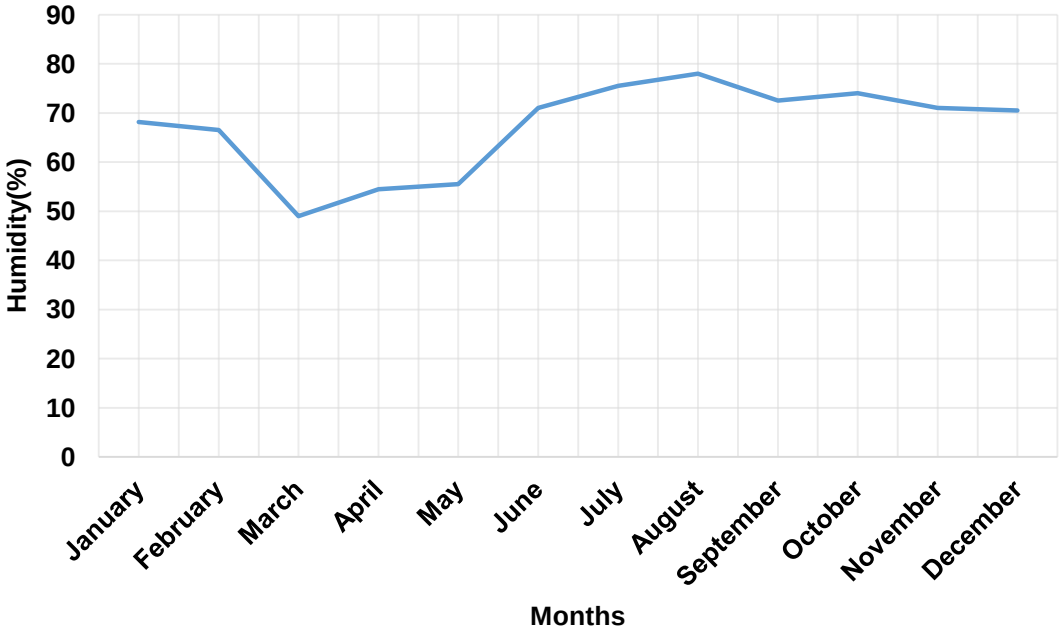

Fig.12 Annual average humidity in the Bakhira sanctuary

6.3 Humidity

The air is relatively dry during the winters and first half of the summers. During the period of south-west Monsoon (June to September) the air is very moist and has a high relative humidity of about 75% (Fig. 12). Thereafter, the humidity starts decreasing and is low in January. In the south-west monsoon and the post monsoon seasons the relative humidity is high, being above 70%. The average annual humidity of Bakhira is 67.17%

Table 1 Monthly Maximum (Max) Minimum (Min) and average (Avg.) temperature, monthly average rainfall and Humidity in Sant Kabir Nagar District (Source: Meteorological Department, Government of India

Months	**Temperature in ^{0}C**			**Rainfall**	**Humidity**
	Max	Min	Avg	(cm)	(%)
January	21.17	7.14	14.17	1.5	68.15
February	24.8	9.96	17.38	0	66.5
March	30.08	13.72	21.9	1.3	49
April	37.38	21.06	29.22	1.2	54.5
May	40.73	25.7	33.22	4.7	55.5
June	37.87	27.6	32.74	19.5	71
July	34.91	26.48	30.69	36.8	75.5
August	33.13	24.78	28.96	33.7	78
September	32.11	23.9	28.01	25.6	72.5
October	31.8	22.21	27.01	7.6	74
November	29.18	14.97	22.08	0.8	71
December	23.26	10.76	17.01	0	70.5

7. Village Description

The village Bakhira, on the name of which the sanctuary is known, is located adjacent to the lake along with as many as 108 villages surrounding the lake within the 5 km radius (Fig. 13 & 14). The major villages include Sailgarh, Gorapar, Terhava, Malai, Bodhara, Ghurapali, Sonbarsa, Govindpur, Kotia, Nevas, Mohnag, Barhago, Dhan Khiriya, Tetaria, Chilwan Kheer, Mahala, Surajkot, Sanichara, Mehri Khurd, Mehri Kala, Bakhira, Ladua, Mahuwa and Dhodhaya. These villages were managing this Lake before the constitution of Sanctuary. They used to give fishing contract in the Lake. Most of the inhabitants of these villages are fishermen, who from a long time have been earning their livelihood from fishing. People also use its water for irrigation and grazing. These traditional practices form a hurdle in achieving the objectives of the sanctuary.

Fig.13 A village in proximity of the lake

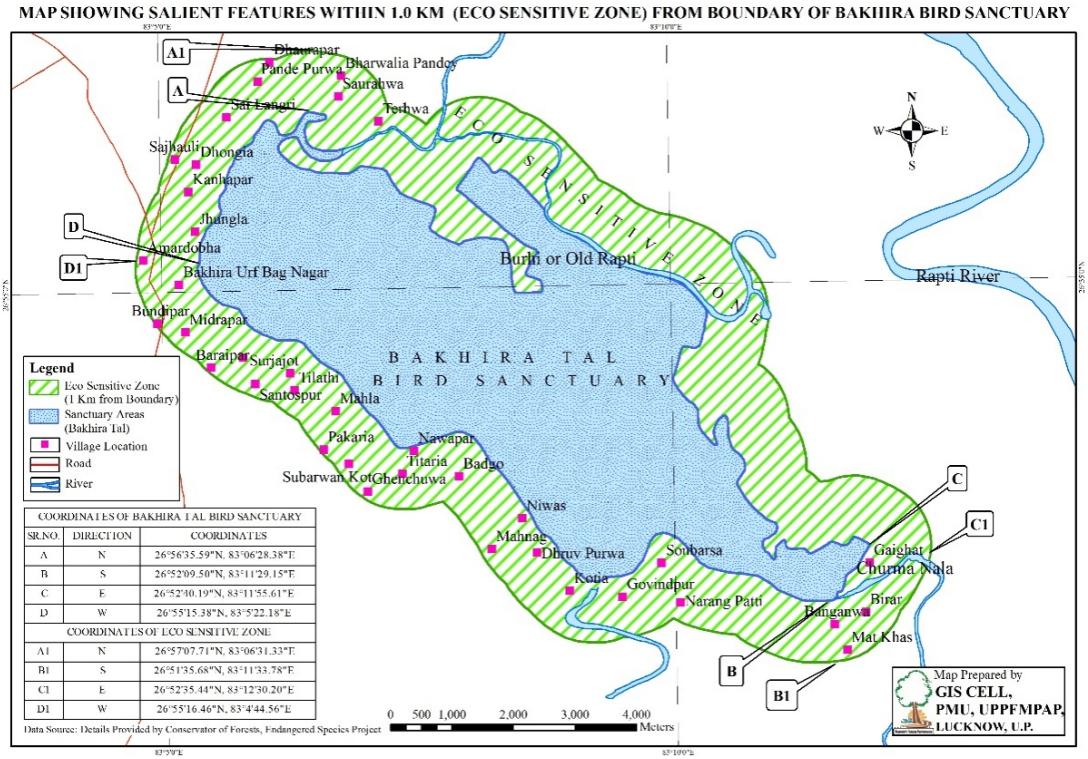

Fig.14 Map showing salient features within 1km (Eco Sensitive Zone) of the boundary of Bakhira Bird Sanctuary

8. Statement of Significance

Bakhira is one of the important wetlands for migratory birds of the Central Asian Flyway. A large number of birds use this wetland for passage as well as for wintering. Moreover, this wetland also accommodates large number of resident birds to breed (Fig. 15). Further, this wetland is important for the livelihoods of people around it by providing water for domestic and agriculture use, fish, and other resources from the wetland. Wetlands are productive ecosystems which play vital role in supporting the biodiversity, flood control, water purification and storage during dry seasons. They are also known as “biological supermarkets” because of availability of extensive food chains and rich biodiversity that they support by providing unique habitats or home for a huge diversity of flora and fauna such as birds, mammals, fishes, frogs, insects, and plants.

Fig. 15 Sarus crane in an agricultural field adjacent to Bakhira lake

Bakhira Lake is a critical oxbow lake which provides wintering and staging ground for large number of migratory birds and breeding ground for resident birds. Realising the ecological, faunal, floral, geo-morphological, natural and zoological significance of the area for the purpose of protecting, propagating and developing wildlife and its environment, the area has been declared as sanctuary. The lake constitutes habitat for a variety of flora, fauna and other aquatic life. It also acts as an important life support system by recharging aquifers and hydrological regime. The lake is adjacent to Rapti River in monsoon surplus water due to rain, is drained out in river. Depth of water in

monsoon goes up to 7 meter and in summer it diminishes upto 1-2 meter. So the lake has the potential to harbour many species of aquatic flora & fauna with large number of avifaunal species.

9. History of the Management

Going through the pages of history, the present district of Sant Kabir Nagar was known in ancient time as Kosala (Koshala) who formed a major part of the great Mahajanpadas and was ruled by the Ikshvaku, who were also called Suryavanshis. During the reign of Ramachandra, the glory of Koshala Empire reached its apex, which is also credited with the establishment of Ram Rajya, an ideally lawful state. However, the Koshala Empire soon came into conflict with the Magadha's during the time of Ajatashatru and was thus finally annexed and incorporated into the Maghadhan Kingdom which was the most powerful among the 16 Mahajanpadas. The Koshala, being an old name of the area around Sant Kabir Nagar district also remained under the possession of Guptas and were followed by Gurjara Pratiharas and Ghadvalas. The District came under the sway of Muslim rule both under the sultans of Delhi and the Mughal kings. In 1394, the sultan Nasiruddin Mohamad Tughlaq, was appointed the Wazir, Malik Sarwar Khawaja Jahan, as governor of this area as a separate zone with the headquarter at Jaunpur and the area remained under the effective control of his successors till 1479 when the whole area was taken over by the Bahlol Lodhi. It was probably around this period that Mahatma Kabir Das, well known poet and philosopher lived at Maghar and played a vital role in carrying the message of Bhakti and made a strong plea for Hindu-Muslim unity.

The area around the district Sant Kabir Nagar played an important role in the modern period of India's Struggle for Independence which is generally traced from the revolt of 1857. During the non-cooperation movement launched by Gandhi, the district remained sensitive and had come into prominence as a centre of political activities mainly due to its association with the neighbouring district of Gorakhpur which attained the national attention for its Chaura-Chauri incident. Before understanding rural-urban continuum in Sant Kabir Nagar district, it is necessary to have a look on the physical and socio-economic background of the study area as it influences the agricultural activities, movements of goods and people, flow of knowledge, ideas and culture. The district extends from 26°30' north latitudes to 27°10' north latitudes and 82°45' east longitudes to 83°15' east longitudes. The geographical area encompasses 1646 square kilometres.

9.1 History of Bakhira

Previously, Bakhira Lake was known as "Moti Lake", barring which, no record regarding the past history of the lake is available. The BBS consists of tal area, gram samaj land, private land and small patch of degraded jamun forest. The villagers residing in villages around Sanctuary have been using this lake for fishing, irrigation, bathing and grazing their cattle on periphery during low water level period in summer. In the past Lake was used to be managed by land management committee of these villages, who managed the fishing contracts. People of the village used to fish in the lake and hunt the resident and migratory birds before the constitution of sanctuary. However, until now, no management

plan has been established for this sanctuary. Works were being carried out on the basis of annual plan of operation, so no assessments are possible. This is the first scientific management plan based on which the proposed prescriptions are to be carried out.

9.2 Threats

Wetlands are facing tremendous anthropogenic pressures due to the rapid urbanization which leads to reduction in the native species populations, which eventually get locally extinct. There is a closer relationship between the distance to human-built structure and bird habitats. Closer the human structures to bird's habitats, fewer will be the abundance of different bird species. It causes a negative effect on biodiversity, especially in term of habitat fragmentation and loss, the extermination of native and migratory bird species. The local people are dependent to a large extent on the lake. So, threats such as fishing and illegal poaching are major. Cattle grazing in large numbers, cause further disturbances in Bakhira, apart from the frequent movements by villagers through the area to approach their agricultural crop fields. Use of chemicals and pesticides by the farmers, further are making the situation grave.

9.3 Poaching

With incidents of poaching still being reported from the wetland especially of birds, proper vigilance and monitoring is warranted to curb poaching.

9.4 Removal of NTFP

There is no significant tree cover within the sanctuary. Removal of NTFP (non-timber forest products) is still in practice. People in the surrounding villages are found to extract grasses for their household uses, livestock and for fuel.

9.5 Unsustainable resource use

Even after the creation of sanctuary, activities like fishing, grazing, bird hunting etc. is still in practise. There is a fair degree of opposition due to ban on their traditional rights. There is an insignificant tree cover within the Sanctuary, and grass cutting is still going on a great pace. Maximum portion of the lake is polluted due to overfishing and other activities. Another major problem arises due to the construction of a barrage. The barrage is situated in the inlet area 'Chorma Nala' (N 26°49'58.95"/ E 083°13'25.17") where water enters the lake from the river Rapti which is the only source of the water of Bakhira Wetland. The barrage acts as a barrier to river connectivity, thus placing the natural hydrological replenishment of the lake at stake, thereby posing a major threat to the species.

9.6 Pesticide

Most of the fishes of Bakhira lake are under Least Concern (LC) category and two species (*Wallago attu* and *Alia coila*) of order Siluriformes in Near Threatened (NT) category in

the present study. Recent estimates of global biodiversity suggest that 20% of all freshwater species are extinct, endangered or vulnerable (Maclean and Jones, 1995). Vijayan et al. (2004) reported high concentrations of pesticides in fishes of the wetlands of Uttar Pradesh, which was higher than the maximum residue limits as suggested by Food and Drug Administration (Vijayan et al., 2004). Concentrations of pesticides in fishes of the wetlands of Uttar Pradesh was also higher than the maximum residue limits as suggested by Food and Drug Administration (Vijayan et al., 2004). Wetland environments are thus experiencing serious threat to both biodiversity and ecosystem stability.

9.7 Livestock Grazing

People residing in the surrounding villages have been grazing their cattle on the periphery of the lake. Since the settlement process has not yet been completed, their grazing rights remain unsettled. After completion of settlement, proceeding grazing will be permitted as per settled rights.

9.8 Status of infrastructure

Conditions of basic infrastructure in the areas around the lake are poor. Accessibility to the Lake is poor; therefore, the road that leads to the sanctuary office must be built properly. There is no proper accessibility to the sanctuary office side because of the narrow unmetalled roads. The villages that are present on the lake shoreline must be well equipped with basic amenities like electricity, drainage and proper accessibility. Since there is no bund across the lake, there is a lot of involvement of local people on and around the lake for various natural resources. Henceforth anthropogenic pressure over the water is a big problem.

Watch towers are also not in good condition. Proper reconstruction is waranted for the surveillance of illegal activities that are going around the lake. The lake also lacks proper trails so that patrolling can be done time and again. The people that are dependent upon the lake are the poorest because there is no proper water for fishes. Despite their understanding on the resources, they are forced to overuse it to meet their family needs. Pollution is a prominent problem that is being prevailed in the area. The village Badgo and Newas located in close proximity are discharging their effluents on the lake side. The sanctuary office that is located on the shore of Bakhira Lake, also has no proper facilities. The sanitary conditions are also very unhygienic. Proper maintenance has not been done for quite some time.

9.9 Fire

Fire has not been a problem in this area, but strict vigilance is required. Slash-and-burn agriculture (Fig. 16), also called fire-fallow cultivation, is a farming method that involves the cutting and burning of plants in a field to create an area called a ‘swidden’. The method begins by cutting down the old crops and woody plants in an area. According to a villager in Newas, they burn their fields to remove plants that are already growing and to help the plants that are about to come up. These burns are often used to improve the health

of the field. However, some news of houses burning due to fire has been recorded during the field visit.

Fig.16 Slash-and-Burn agriculture practices around the lake

9.10 Eco-Tourism

Presently tourism is very limited. This is because of the requirement for infrastructure development and broad publicity of the biodiversity of the sanctuary to attract tourists in the area. Nonetheless, the area is quite promising from tourism point of view.

10. Present scenario of Bakhira Bird Sanctuary

10.1 Avifaunal biodiversity

Biodiversity is the variability of organisms in a particular area and its quantitative estimation is an important aspect of ecology. Grimmett et al., (1998) pointed out that the Indian subcontinent harbours about 1300 species out of more than 9000 species of birds in the world. Birds are reported as ideal bio-indicator that may disclose the condition of the ecosystem (Fig. 17). Wetlands are facing tremendous anthropogenic pressures (Prasad et al., 2002) due to the rapid urbanization which leads the native species to become and finally extinct in a specific region (Godefroid, 2001). There is a closer relationship between the distance to human-built structure and bird habitats. Closer the human structures to bird's habitats, fewer will be the abundance of different bird species (Rottenborn, 1999). It causes a negative effect on biodiversity, especially in term of habitat fragmentation and loss, the extermination of native and migratory bird species (Mackinne, 2002). The increase of human disturbances towards these ecosystems causes threats to avian biodiversity. Jorvinen and Vaisenen (1978) and Bowden (1990) revealed that an assessment of diversity and abundance of water bird species serve as a good indication of the health of environment in a particular ecosystem.

Fig.17 Red avadavat in the grassland habitats

A study was conducted in the months of April-May in BBS across a total of 82 sampling points 250 m apart, at every 5-8 minutes,. At each sampling point, the birds were counted in a 100 m radius. In total, 40 families of birds were recorded, forming 72 species, out of which 56 were terrestrial species and 16 were aquatic species. Out of the total species, three species were under Vulnerable (VU) category (Lesser adjutant stork, Sarus crane and Woolly necked stork), one as Near Threatened (NT) (River tern) and one as Endangered (EN) (Steppe eagle) (Fig. 18, 19 & 20). The result of the study showed that maximum species of birds were resident (R) with the least number of species as resident migrant (RM). Due to high nutritional value and productivity; it provides a long stretch of feeding and breeding ground for a large number of migratory and resident wader species.

Bird counting was carried out during early morning from 6 am to 9 am with the help of binoculars and cameras. Covering one side of the lake, a length of 12-13km, point count survey for birds has been plotted. The habitat included partially marshy, dry and arid agricultural field. A significant stretch of the shore was found to be covered by lotus and water hyacinth, making the area unsuitable for boating or fishing. Water plants like reeds and *Phragmites spp.* have mostly occupied the lake. The depleted ecosystem has shifted the Sarus cranes from the lake area into the agricultural fields causing major economic losses and antagonism between farmers and birds. During the survey, it was observed that the villages Mahala, Badgo, Newas, Nawapar, Govindpur, Sonbarsa, Sanichara, Jayaswal, Ghoorapali, Nawapar and Narangpatti mostly depend on the lake's water for their survival and sustainability. The Bakhira wetland is provides ample of food items, sufficient water supply throughout the year and thus proffers breeding and nesting grounds for large number of migratory and resident waders. However the wetland is facing severe anthropogenic pressures viz. habitat destruction by soil erosion, sedimentation and extension of crop fields, water pollution and eutrophication, apart from trapping and hunting of birds

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Fig.18 Sarus cranes in the shoreline habitats of the Bakhira lake

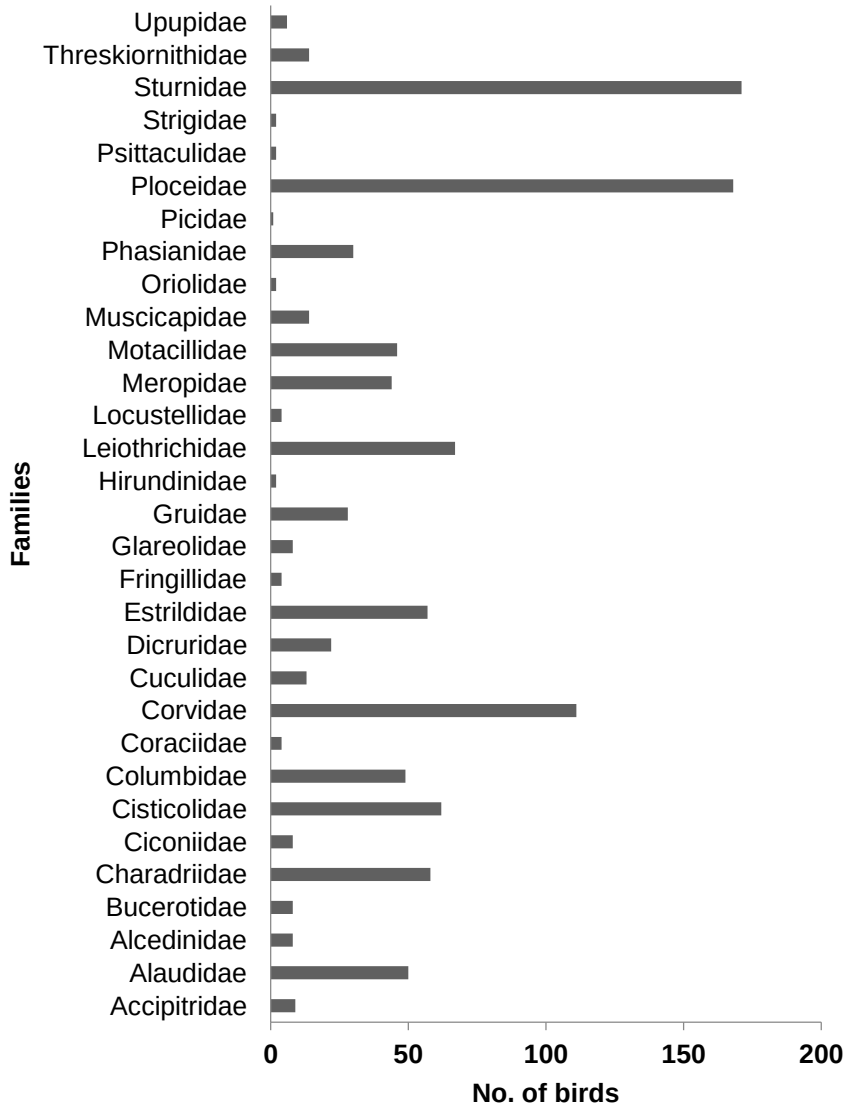


Fig.19 Status of terrestrial bird families in Bakhira Bird Sanctuary

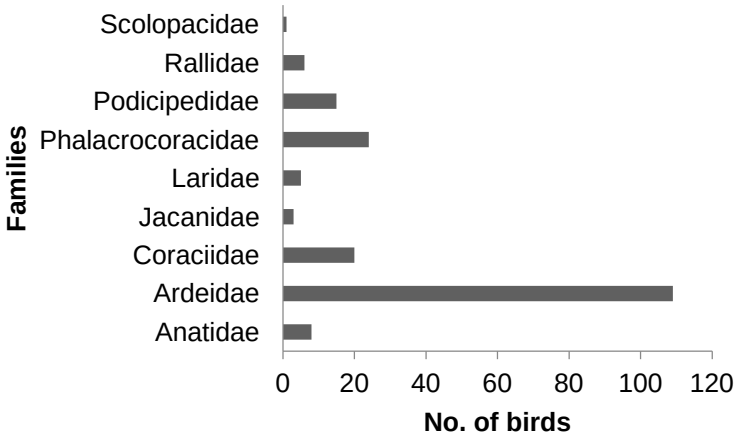


Fig. 20 Status of aquatic bird families in Bakhira Bird Sanctuary

10.2 Ichthyofauna

A monitoring on icthyofaunal diversity conducted during the summer (April-May) season (Fig. 21), resulted in a total of 22 species belonging to 15 genera, 11 families and 7 orders. Maximum number of species were recorded from the family Cyprinidae (7species), followed by, Ailidae, Heteropneustidae and Siluridae (5 species each) (Fig. 22 & 23). Out of the total species collected, 20 species were listed as Least Concern while two species (*Wallago attu, Ailia coila)* were listed under Near Threatened category as per IUCN.

10.3 Fishing Activities

The local communities have been utilizing the lake for fishing through gill nets, indigenous traps and iron rods. Gill nets of various sizes (1 cm × 1 cm, 1.5 cm × 1.5 cm) are placed in the lake at night time which were then retrieve back in the early morning hours. The yield from the single gill net is about 1kg small fishes. For large size fishes they are found to use iron rods for indigenous fly fishing.

Fig.21 Villagers collecting fish from their gill nets placed overnight in the lake

10.4 Threats to Biodiversity

Maximum portion of the lake is polluted due to activities like bathing, washing clothes etc. Almost 95% Bakhira lake is covered with aquatic weed which is an ecological indicator of very poor water quality and habitat loss. Water hyacinth and other weeds (Fig. 24) hinders the growth of the aquatic plants (Fig. 25) and submerged vegetation, on decomposition they absorbs oxygen resulting in the de-oxygenation, which cause death of fishes and water ducks, apart from reducing the effective area available for the movement. Another major problem arises due to the construction of barrage (Fig. 26). The barrage is situated in the inlet area (Chorma nala) where water enters into the lake from the river Rapti which is the only source of the water of Bakhira Wetland. The

barrage acts as a barrier to river connectivity by altering natural flow which is a leading threat to aquatic species. Disruption in the natural flow regimes result in physical, chemical and biological changes of the lake.

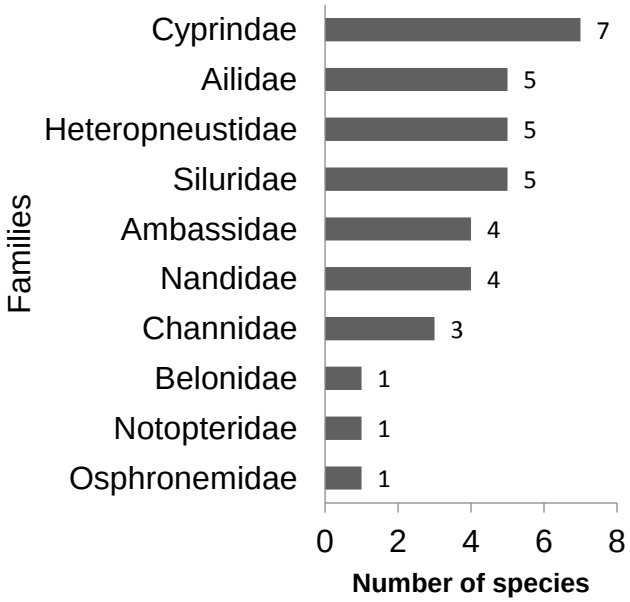


Fig.22 Number of fish species per family

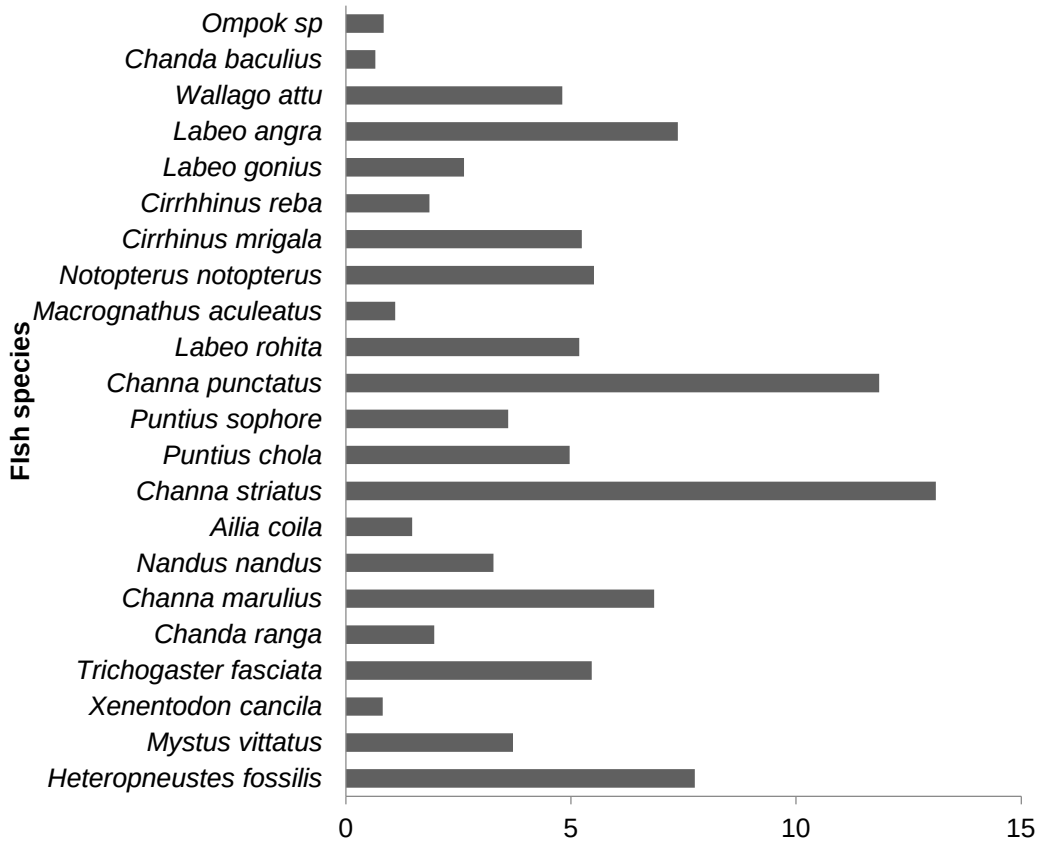


Fig.23 Daily catch (%) for different fish species in the Bakhira lake

Fig.24 Profuse growth of weeds and grasses in the lake

Fig.25 Lotus is collected from the lake as it has a high market value

Fig.26 Barrage at Chorma Nala

10.5 Lake Water Use and Primary purpose for rejuvenation:

The sanctuary is surrounded by villages from all sides among which 11 villages are depending on lake. Most of the inhabitants of these villages are fisherman who had been earning their livelihood from fishing. Apart from fishing the villagers residing in those villages have been using this lake for irrigation, fuel wood collection, collecting fodder *Eichhorina crassipes* (Jal Kumbhi), *Lemne minor* (Narkat) bathing and grazing their cattle on periphery during low water level period in summer. During summer season as the water level decreases (2.0-2.2ft depth) and the fish production is less those village people collect Lotus flower (*Nelumbo nucifera*) for their livelihood.

10.6 Water quality of the wetland

10.6.1 Physio-chemical parameters

The physiochemical parameters of the wetland was measured during the summer (April-May) season. The average water temperature was recorded 25.2±0.2 °C and the pH was measured 7.8±0.7. The BOD and COD (mg/l) of the water was measured 6.5±2.41 and 7.6±4.06 respectevely. The total suspended solids TSS (mg/l) was measured 22.0±0.34, nitrogen (mg/l) 6.72±0.09, phosphorous (mg/l) 0.39±0.01 and conductivity (µS/cm) 0.2±0..

11. General Ecological Features Including Flora and Fauna

11.1 Forest types

The sanctuary is dominated by tropical dry deciduous forests, the area around the Bakhira lake has very less tree cover, mostly dominated by grasslands or agricultural crops. In the private lands, species like *Dalbergia sissoo*, *Ficus spp., Azadiracta indica, Mangifera indica* and *Acacia arabica* etc was recorded.

11.2 Main Tree Species

The dominant tree species of the Bakhira sanctuary includes Kanji *(Pongamia pinnata),*Gular *(Ficus glomerata)*and Sihor *(Strablus asper)*(Fig. 27).

11.3 Grasses

The dominant grasses of the sanctuary includes narkat *(Phagmites karkua,* karis *(Saccharam sponaneoum)*and retwa *(Selerostachya fusca)* (Fig. 28).

11.4 Weed infestation / Invasive species:

The lake is heavily infested with aquatic weeds like *Ipomaea aquatica, Eichhorhia crassipes, Hydrilla verticillata, Ceratophyllum demersum, Nymphoides spp.,Elecharis spp., Jussieua repens, Vallisneria spiralis, Potamageton crispus, Naja spp., Spirodela polyrrhiza, Chara spp., Spirogyra spp., Oedogonium spp., Nitella spp., Eichornia and*

Aurundo donax which have affected fishery of the lake. Large patches of *Cannabis sp.* weeds are also found to be profusely growing the sanctuary.

Fig.27 Gular *(Ficus glomerata)* tree is a dominant species of BBS

Fig. 28 *Phragmites* spp. form a dominant grass in the BBS

11.5 Mammals of the wetland

A total of five mammalian species were recorded which are resident to the area (Table 2). Nilgai can be commonly seen (in the agricultural fields surrounding the wetlands (Fig. 29)

Table 2 Mammalian species recorded during the survey

Sl no.	Common Name	Scientific Name	Order	Family	IUCN Status
1.	Indian Hare	*Lepus nigricollis* (F.Cuvier, 1823)	Lagomorpha	Leporidae	LC
2.	Indian Grey Mongoose	*Herpestes edwardsi* (É. Geoffroy Saint-Hilaire, 1818)	Carnivora	Herpestidae	LC
3.	Wild Boar	*Sus scrofa* (Linnaeus, 1758)	Artiodactyla	Suidae	LC
4.	Golden Jackal	*Canis aureus* (Linnaeus, 1758)	Carnivora	Canidae	LC
5.	Nilgai	*Boselaphus tragocamelus* (Pallas, 1766)	Artiodactyla	Bovidae	LC

Fig. 29 Nilgai are a common sighting in the agricultural fields surrounding the Bakhira lake

11.6 Socio-cultural aspects of biodiversity (Present Scenario)

The surrounding village inhabitants are mostly farmers and fisherman who earned their livelihood from fishing and agriculture, and daily-earning. Furthermore, the low-lying agricultural land is submerged into lake, when water recedes, the villagers sow seeds for agricultural crops, however the yield is insufficient for their livelihood (Fig. 30 & 31). The increasing population of the local community is concerning for their settlement process. The use of chemical fertilizers and insecticides for better agricultural production is in practice among the local communities. The process of dry land farming is common in the area due low rainfall it has received in the past 20 years. The water level has depleted drastically and is a serious concern for the villagers dependent for their livelihood on fishing.

Fig.30 A household in the Bakhira village

Fig.31 A group of villagers in Bakhira

Fig. 32 Grass collection the local communities is common in the wetland

Fig.33 A thatched house made of *Phragmites* grass

Fig.34 A view of the dried area at the Chorma nala

The people residing in the villages use narkat and grass wood for making food and mats for the roof of their houses (Fig 32, 33). The narkat grasses serve a great help in making other household materials like mats. Additionally, local communities use the wood grasses of narkat, gone, durba, teena and dons for hut thatching, fuel and fodder. Men and women are both engaged in this activity and use boats to haul large bundles of grasses on a regular basis.

Some villages around the lake lack good water facilities for drinking and other household and sanitation facilities. Though most of the houses have proper sanitation facilities, yet the supply of water is poor, owing to a dropped down water table (Fig. 34). Since no fishing activities are possible due to lack of water these people are dependent upon wheat cultivation in the adjoining areas of the lake by which they earn their livelihood. The daily income of the people residing in these villages is meagre. Most of the families in the villages are joint families; however, some are nuclear.

11.7 People dependency

The sanctuary has a total of 108 villages along 5 km radius of the lake. Among these villages the survey was done in 11 villages that are completely and partially dependent on the lake, namely Sanichara, Mahala, Badgo, Narangpatti, Sonbarsa, Govindpur, Ghurapali, Jasawal, Nawapar, Jhumia and Newas. The present study was carried out during summer (April-May) season to find out the dependent villages and the percentage of dependent families from each village (Table 3). A total of 320 families were surveyed, among which 173 are fishermen families and 147 families are dependent on agriculture and other purposes like grass, fodder and lotus collection (Fig. 35, 36, 37 & 38).

Table 3 Percentage dependency on fishing, agricultural and other purposes

Village	Dependency on fishing (%)	Dependency on agriculture and other purposes (%)
Sanichara	4.69	2.81
Mahala	14.49	5.07
Badgo	3.33	2.77
Newas	13.36	5.26
Govindpur	16.94	13.7
Sonbarsa	5.92	3.83
Narakpatti	5.37	3.30
Ghurapali	3.68	5.11
Jhumia	8.82	2.94
Jaswal	8.18	18.23
Nawapar	2.81	3.58

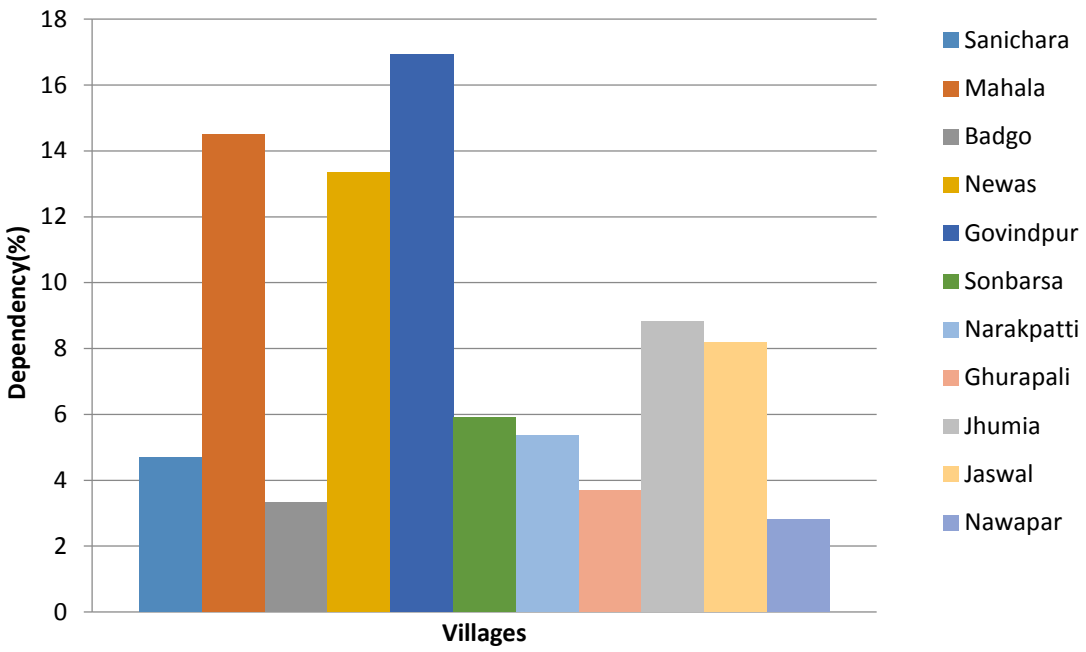


Fig.35 Percentage of fishing dependency assessed in 11 villages around the BBS

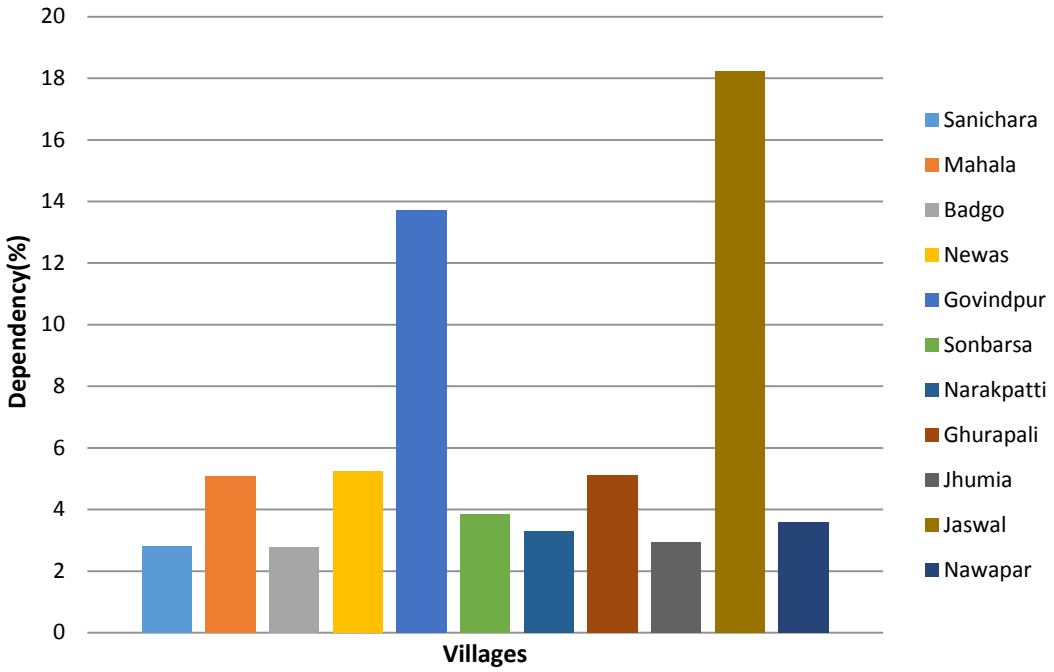


Fig.36 Percentage of agricultural dependency assessed in 11 villages around the BBS

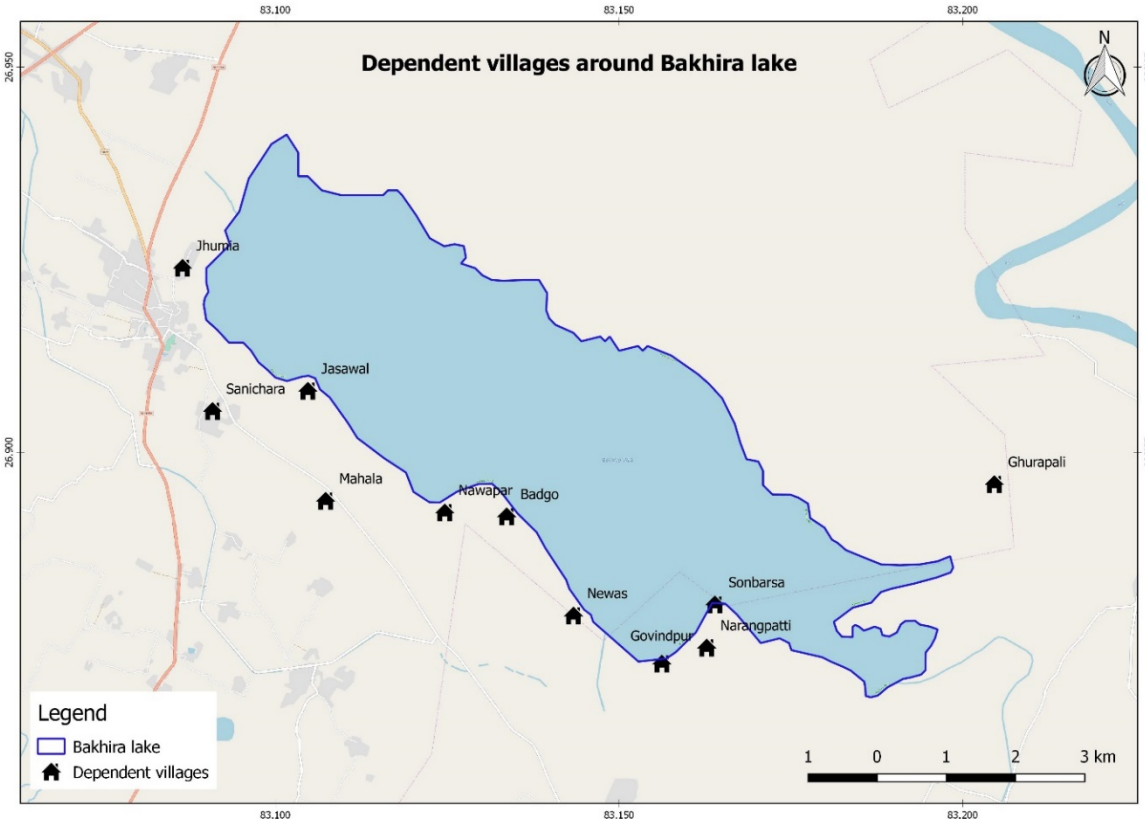


Fig.37 Location of the dependent villages around Bakhira Lake

Fig.38 An unmetalled road in a village of the BBS

12. Management Strategies for Bakhira Bird Sanctuary

The Indo-Gangetic floodplains in the state of Uttar Pradesh, even after suffering a drastic land use pattern changes since India's independence, harbours numerous natural and man-made wetlands. Bakhira Lake is an important oxbow Lake of eastern Uttar Pradesh which provides wintering and staging ground for large number of migratory birds and breeding ground for resident birds. Realising the ecological, faunal, floral, geomorphological, natural and zoological significance of the area for the purpose of protecting, propagating and developing wild life and its environment the area has been declared as Sanctuary. Bakhira wetland has a significant socio-economic, ecological, floral and faunal value in addition to their aesthetic values. Due to heavy anthropogenic pressure and unsustainable resource utilization patterns, combined with destructive harvesting methods and round the year abstraction of water, their hydrological and ecological processes are gradually being destroyed and these "Resource renewal hotspots" are gradually vanishing. The Management Action Plans include both Policy level and site level Management Actions keeping in view the need to safeguard the well-being of these wetlands. The DPR is also suggests the need for capacity building to professionally manage this wetland. A special focus is given to development of proper eco-development strategies that will decrease the human dependency on the wetland resources and increase visitation of these sites through proper eco-tourism plans.

The only Protected Area of the country that safeguards a palco-river channel, Bakhira jheel is the prehistoric bed of the river Rapti. The site is not just a bird sanctuary but a geological site of national importance. Located in the Gorakhpur and Sant Kabirnagar district of Eastern Uttar Pradesh, this large lake was declared a Bird sanctuary in 1990. The hydrology of the lake has also changed due to closure of the outflow from the lake by construction of the Churma nala. This has made the lake a lentic wetland from a lotic one. With no flushing mechanism in existence, the lake is now covered with some unwanted growth of aquatic macrophytes and weeds. The removal of water through canal lift further impacts the hydrology.

Yet, the lake supports about 100 species of resident and migratory waterfowl, over 40 species of fish, several species of amphibians and reptiles and the smooth coated otter, Nilgai and common langur. Over the centuries the fisher folks have practiced indigenes non-determental fisheries methods being dependant on the lake, but with the recent hydrological changes, they claim fish population, size and diversity to have changed and declined and are resorting to unsustainable fisheries practices to obtain a minimum required catch.

The management actions will therefore, needs to be focused to inventorisation of resources, ecological processes, existing and probable threats and developing mechanisms that will prevent detrimental factors. The management also needs to look at prospects that will benefit the local inhabitants and the economy and place the site in the tourism resource map of the region, which is already famous as the birth place of Sant Kabir Das, Gorakhnath temple and close to the birth place of Gautam Buddha at Lumbini, only 90

km away from Gorakhpur. The wetland PA urgently needs integration in the regional development plan of the districts.

13. Vision

Ecologically functional wetland of 'Bakhira Bird Sanctuary' is important biodiversity heritage of Uttar Pradesh should be conserved and emerges as a centre of excellence for eco-tourism and conservation education

14. Objectives

- Appreciate and promote the importance of integrated and sustainable management of Bakhira Bird Sanctuary (BBS).
- Promote participation of stakeholders in the management of BBS.
- Mainstream biodiversity conservation into production sectors of the region especially fisheries, tourism and agriculture.
- Effectively as well as scientifically protect, manage and monitor the biodiversity of BBS.
- Promote eco-friendly tourism that provides a rich experience for tourists, economic benefits to the local people and support to the Sanctuary.
- Develop BBS as a world class biodiversity site to promote eco-tourism and nature education.

15. Problems

- Major portion of the sanctuary including the entire wetland area is not belongs to the State Forest Department that hindering the effective management of the Sanctuary.
- Altered hydrology that resulted in lack of flushing mechanism in the wetland.
- High nutrient rich water due to agricultural runoff and use of domestic animals in large numbers.
- Poaching.
- Fishing during the critical period and in the critical wildlife habitats.
- Spreading of *Phragmites*, *Hydrilla* in the wetland.
- Pollution (source: sewage pollution from urbans – poor sewerage system).
- Decline of fish diversity and fish catch.
- Lack of inter-sectoral co-ordinations in planning and development of nearby Municipal corporations.
- Increasing anthropogenic pressure around the Sanctuary.
- Lack of clarity on 'Scope of the Management Area of BBS'
- Multi-stakeholders but lack of ownership and participation in conservation.

- Poor infrastructure of Management Authority of BBS.
- Poor infrastructure to promote eco-tourism, eco-development and nature education, to strengthening protection and monitoring.

16. Management Recommendations:

16.1 Demarcation of boundary and settlement of ownership of land

Entire wetland areas and other critical wildlife habitats of the Sanctuary is either owned by the private people or Gram Samaj. The Forest Department is own just 15.16 ha of land i.e. 0.52% of the total areas of the Sanctuary. Therefore, it is utmost important to acquire the sanctuary lands from both private and Gram samaj and hand over the land to the State Forest Department for the conservation of the wetland that would safeguard both wildlife and well being of people who live around the wetland forever. This is very important and ineffable step for the better management of the Sanctuary, which is critical for the conservation of this largest wetland of Uttar Pradesh and its biodiversity. Further, conservation of this wetland is very critical for the well being of the people of the region as its conservation and sustainable management would determine the water source that would be available for the people in future. Moreover, this wetland is also has the huge potential of promoting eco-tourism. In worst case scenario, if it is not possible to acquire these land from the private people and Gram Samaj then this Sanctuary may be converted into 'Community Reserve' and notify accordingly. Later, manage this wetland as 'Community Reserve' with partnership of communities who has stake on this Sanctuary.

Wetland site	Private lands/Agriculture land	Gram Samaj land	Forest/Govt./ Others	Encroachment
Bakhira	✓ (1059.14 ha)	✓ (1819.91 ha)	✓ (15.16 ha Reserve Forest)	✓

Although the boundaries of the Sanctuary are well defined in the notification but it is not visible on the ground. Therefore, it is important to demarcate boundaries of Sanctuary to prevent any kind of illegal trespassing and encroachment after settling the land-ownership issues. All swamp habitats around the Sanctuary should be brought under the Eco-Sensitive Zone of the BBS.

1. Spatial Planning & Zonation

The zonation for the management of BBS is proposed under the following categories that need to be demarcated in the field for better management.

There are broadly four categories.

1. **Wilderness Zone**: which contain areas of high conservation values largely used by birds and fishes to breed and forage (minimum 60% of total area of the

Sanctuary). Since there is no proper demarcation of zones, there is no enough control on exploitation of various bio-resources inside the Sanctuary. Therefore, critical wildlife area of minimum 60% is being proposed as 'Wilderness Zone'' that should be inviolate areas with minimum human interventions. This zone is presently having high potential to support breeding, roosting and nursery grounds for the aquatic, and avian biodiversity. Stock enhancement of commercially important fishes, research and monitoring are only activities allowed inside the 'Wilderness Zone'

2. **Fishing Zone**: Local people may be allowed to sustainably fish in the region for their sustenance (maximum 40%) but entire the Sanctuary should be declared as 'Fishing Closed Zone' during the migratory season of birds.
3. **Eco-tourism**: Natural Interpretation and Education Zone. Tourism Zone for the activities related eco-tourism
4. **Eco-development Zone**: Two kilometre radius of areas around the entire Sanctuary is proposed to be demarcated as Eco-development Zone. All the villages within this 2 km radius from the Sanctuary need to be involved in the Eco-development programme with 'Micro-Plan' prepared in consultation with villagers.

19.2 Enhancement of effectiveness of the Management Infrastructure:

BBS is although one of the oldest Sanctuary notified by the Uttar Pradesh Government but there is no proper infrastructure available at present for the efficient management of Sanctuary, which is under tremendous pressure from ever-growing nearby region. Therefore, the Field Head Quarter of BBS is needs to be located at nearest township of the Sanctuary and all other Management Unit Staff placed in this Office with necessary infrastructure that includes patrolling boats (2), inflatable boats (2), boats for tourists (two 8 seaters, two 24 seaters). Four wheelers for ACF and two RFOs (One RFO for Eco-tourism and Eco-development and another RFO for Protection and Habitat Management). Research Lab with an office facility for Research Biologist and his/her staff is also required. A small all-weather jetty is required at near Bakhira for better patrolling and protection and same many also useful for eco-tourism activities.

19.3 Control of eutrophication

The entire catchment of the Bakhira lake is extensively cultivated. Historically the lake and the Rapti river used to get connected particularly during monsoon resulting in increased flushing of the lake. However, in 1987 a weir was created between the lake and the Rapti river at Churma which seriously hinders the outflow of nutrient from the lake. There is immediate need to restore the natural flushing mechanism of the lake by creating sluice on the weir and by creating new sluices to augment outflow of water from the lake particularly during monsoon.

19.4 Establishment of Green belt around the Sanctuary:

It is strongly recommended to establish a green belt around the Sanctuary with native plants including tree species. It is proposed to establish a 50 m width green belt around the Sanctuary along the bank. This would prevent the soil erosion, minimise siltation, minimise flooding, act as breeding and roosting sites of resident birds, act as natural shield for birds, etc.

19.5 Management of weeds and other hydrophytes

The wetland is affected by around 12 species of aquatic weeds. With the decreasing water level on the advent of summer around 75-80% of the wetlands get covered with weeds and unwanted vegetation (Fig. 39). It is proposed that the weed eradication programme should be undertaken by the management every summer particularly during the month of May and June. As the lake is quite big in size investing large sum of funds is unwise. Instead a strong ecodevelopment initiative could help in restoring the integrity of this wetland. Local fishermen communities and major beneficiaries should be involved in manual removal of weeds which they could use as compost. Approximately Rs. 5-6, 00,000 could be spared for this purpose every year. Since water hyacinth is the major problem for the lake .Control of this weed has to be taken on priority basis. More than 75% of the total lake has been infested with his plant. Although this weed is known to act as water purifier as it absorbs nutrients and heavy metals. Its death and decay within the wetland can lead to re-entry of these chemicals causing Eutrophication. Even after the removal of these plants they reappear again after 3-4 months' time. So the weed clearing has to be carried out accordingly. However biological methods of weed control being the best method.

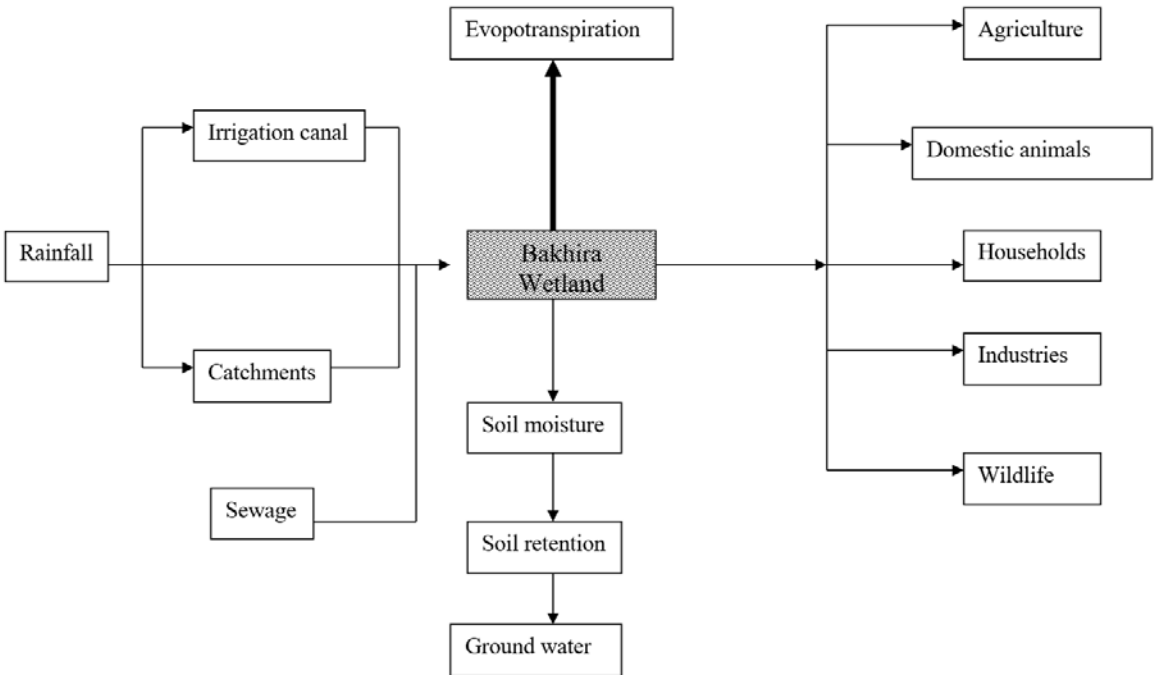


Fig. 39 Schematic representation of water balance of wetland

19.5 Habitat management for birds:

Different types of migratory birds visit this Sanctuary during winter and several resident birds breed here. But, different birds required different kinds of habitats. Some birds are divers and require deep water for foraging, some are waders need shallow water, some forage hydrophytes, etc. Therefore, it is important to provide diverse habitats to accommodate diverse bird species. In this context, it is proposed to develop certain blocks of the water deepening to accommodate diving fish eating birds. Enough mounds are already available in the wetland therefore there is no need of further mounds.

19.6 Pollution Management:

Pollution is a prominent problem that is being prevailed in the area especially during the summer when the water level is low. The village Badgo and Newas located at the close proximity are discharging their effluents on the lake side. Management of pollution in the wetland area can be done by following the guidelines laid down by MoEFCC for the development of new industries/projects and for the existing industries, projects, treatment and dumping grounds in and around the area. Monitoring of the pollution levels should be according the guidelines laid down at Annexure I. The effluents from sewage should follow the Standards laid by the Ministry of Environment, Forests & Climate change, Government of India for Common Effluent Treatment Plants as per, (Environment Protection Rules, 1986) which shows the maximum concentration of elements that are permissible in the effluents meant for release after treatment. Further, people around the wetland need to be educated and encouraged to avoid or minimize the use of inorganic farming and pesticide. Agriculture runoff is the most important source of pollution to the wetlands especially during winter and summer.

19.7 Creation of awareness:

It is the most important step for conserving wetlands. Since Bakhira lake is under immediate threat, their conservation must be a part of development policy. This can be done effectively only by sensitising the public and planners on this issue. Awareness can be created through mass media, educational, materials and camps. Documentaries on conservation, threats to wildlife, posters on the status of different species. The need for voluntary organisations is also a must to translate the scientific ideas to general public in a way so that they can understand. To develop Sanctuary as an important tourist centre. To sensitize the local people and tourists about the wetland, flora & fauna present in the wetland, educating local people and tourist regarding wild animals and their importance in the ecosystem and to involve local people in wild life conservation. Local people should be involved in conservation programmes

19.8 Communication-

In order to have effective communication, mobile network should be maintained. Each staff including Range Officer should be provided with Mobile Sets. Range Officer should also be given a Landline Telephone connection so that tourists and Head Quarter can contact the local Ranger anytime.

19.9 Eco tourism activities-

Proper roads should be constructed for the tourists so they don't have any difficulty reaching the sanctuary. Proper restrooms and dormitories should be constructed for them along with proper sanitation facilities. Museum for displaying Trophies, Posters, Charts and Models should be there. Guest House for Tourist is also required and there is no accommodation available at nearby areas.

19.10 Interpretation Centre –

Two interpretation Centres will be constructed in phased manner. First one will be constructed near Bakhira town to attract tourists and local people. Once the tourist influx increases the other one will be constructed inside the sanctuary. This centre will have facilities like Library having Books and Magazines on Wild Life and related subjects, Television and VCR showing Video Films, Slide Projector for Slide Show and Lecture Rooms.

19.11 Establishment of Nature Trail –

Nature Trail will be organized for students and tourists for creating awareness with enjoyment. Nature walks will be organized between October to June. Bird watching and animal siting will be integral part of nature walks.

19.12 Establishment of Nature Camp –

Ideal camp sites inside the sanctuary will be selected. These sites will be developed and required facilities will be created. Camping equipments will be provided to interested tourists on payment. These camps can be used for school and collage going students for nature education and awareness. Further, the same camps can also be used for training frontline staff of Uttar Pradesh Forest Department towards wetland management. Bakhira being the largest wetland of Uttar Pradesh, this can be better training place for wetland management and conservation.

19.13 Outreach Programmes –

Different outreach programmes will be carried out for greater publicity of this Sanctuary. For the people's awakening towards Lake Ecosystem & publicity, an awakening programme will be imparted through a programme on national days such as wet land day, wild life week, world environment day, sanctuary day etc. Film shows on birds etc on that day will be organised in Interpretation centre. A competition in schools and colleges regarding the values of sanctuary, ecology, birds etc will be held on those national days to awaken and create interest about wild life in children. A quarterly newsletter will be published. Hand bills, pamphlets will be published and distributed. Strategies to decrease consumptive use of natural resources will be developed and shared with local populations. Awareness and orientation workshops will be organised for officials of different departments and other stakeholders working in sanctuary so as to build conservation concerns into their activities. There is no bund around the Tal hence during rainy season water spreads in nearby villages. Apart from this it is not possible to go around the Tal because no road is available. In this plan Ring Bund around the Tal should

be there to limit the spread of water. The bund will provide path around the Tal which will be used for patrolling and tourist ride.

19.14 Management of satellite wetlands around Bakhira Sanctuary:

Indeed, BBS is a "Birders Paradise" for the people of eastern Uttar Pradesh as the Sanctuary lies on the Central Asian Flyway of the Asia Pacific Global Migratory Flyway. In that capacity, it is a staging /wintering ground for a large number of migratory waterfowl that breed in the Palearctic region. The Sanctuary had also been home of large population of cranes and wintering grounds of several migratory birds. Populations of both migratory and resident water birds have been declining in the region due to habitat degradation and disturbances. Birds known to reside within BBS most likely moving to the nearby satellite wetlands for foods. All the wetlands within 50 km radius of the Bakhira are satellite wetlands that include streams and rivers. Although, a study in this regard is needed, however, wetlands around BBS no doubt are playing a crucial role in the conservation of water birds of this region, especially during winter. Current land use patterns of this region could well be posing an added threat to these wetlands. Some of these wetlands should be declared as community or conservation reserves depending on nature educational programs and the subsequent input of local people.

19.15 Sustainable fisheries management:

The fishing in the sanctuary is a small scale fishery and fishing operations are dependent on local market demand. The fishers are dependent on the wetland for their livelihood and other services. There would be fishing restriction inside BBS to make BBS as viable breeding ground of fishes for the long term sustainable fisheries in the wetlands provided the Government acquire all wetlands from private people and Gram samaj. Traditional fishing in the Fishing Zone is permitted in accordance with the law prevailing in the State. Fishing is one of the important revenue generating activity around the wetland. Water and sediment parameters indicated increase of pollution in the wetland that adversely affected fisheries resources and responsible for decline in fish catch. Inter-sectoral coordination between various sectors especially between the State Forest Department, Fisheries Department, Pollution Control Board and local governing bodies is essential for the mainstreaming biodiversity conservation into fisheries sector in the wetland region.

19.16 Disaster Management

Indian subcontinent has always been vulnerable to natural disasters on account of its unique geo-climatic conditions and floods, droughts, cyclones and earthquakes have been a recurrent phenomenon. At the global level, there has been considerable concern over natural disasters. Even as substantial scientific and material progress is made, the loss of wildlife and its habitat due to disasters seems to not decrease. BBS is a vulnerable Protected Area from natural disasters, particularly originating from floods. In order to respond effectively to floods, Ministry of Home Affairs has initiated National Disaster Risk Management Programme in all the flood-prone States. Assistance is being provided to the States to draw up disaster management plans at the State, District, Block/Taluka and Village levels. Awareness generation campaigns are necessary to sensitize the all the

stakeholders for flood preparedness and mitigation measures. Elected representatives and officials are being trained in flood disaster management under the programme. State Forest Department can consult this National Disaster Risk Management Programme for flood preparedness and response in the Bakhira Bird Sanctuary.

19.17 Research, Monitoring and Training

It is important to build and manage a ‘’Knowledge Management System’ of BBS for better monitoring of ecological functioning of BBS. In this context, Research and Monitoring of the biodiversity, water quality and socio-economic condition of dependent communities of BBS and surrounding satellite wetlands is required at uniform intervals. This would ensure the ecological services of BBS to the people and also help to evaluate and review the management effectiveness of this Management Plan

19.18 Other Management Recommendations:

- The road that leads to the sanctuary office has to be built properly. There is no good accessibility of the office side because of the narrow, zig-zag and kuchha roads.
- The villages that are present on the lake shoreline have to be well equipped with basic needs like electricity, drainage and proper accessibility.
- Proper cleaning of lake should be done on regular basis. The rich fauna of the area are getting badly affected due to the unfit condition of the lake.
- There should be a Bund across the lake for putting less anthropogenic pressure over the water.
- Parks, nature trails, garden, rehabilitation centres and gardens should be made to beautify the area for the tourist attraction.
- Proper stay facilities should be taken care of for the tourists.
- Proper *Phragmites* patch should be left untouched because these are these are the prominent breeding ground for the water birds.
- More trees should be planted along the lake and in the islands to attract more and more birds like Asian Openbill stork, Cormorants and Egrets.
- Household effluents should not be spilled in the lake water.
- Village people should have a healthy relation with the forest officials so that they can tell about their problem to them. Therefore, regular meetings between villagers and management should be conducted.
- Conduct awareness programs regularly in all villages
- Capacity building: Proper training of staffs should be done regularly.
- Long-term monitoring of wildlife including birds and water qualities should be carried out regularly with help of local institutions.

- Volunteer networks of Youths who live around the Sanctuary needs to be established to promote conservation awareness.
- Scientific studies on the ecology of the lake and its biodiversity should be carried.
- Improving better communication with the local people and create awareness about the condition of the lake.
- Water should be replenished time and again. Malaria, yellow fever, dengue and filariasis are the diseases associated with stagnant water.
- It is important to keep the Chorma bundh open during the monsoon period so that the excess nutrients from the lake could be washed away. If certain amount of vegetation goes out from the lake then it reduces the evapo-transpiration rate of this lake. It would also help to form more open-water habitat which is essential for other wildlife such as birds and turtles.
- Uncontrolled growth of aquatic vegetation inside the submersible area should be removed during the month of May and June.
- Negative impacts of pesticide usage needs to be imparted to the farmers through nature education.
- It would be better to announce the period between February and April as ‘closed season’ for fishing.
- Vaccination of all domestic cattle around the sanctuary should be done on regular basis as these animals are using the wetland area where wild animals also occur.

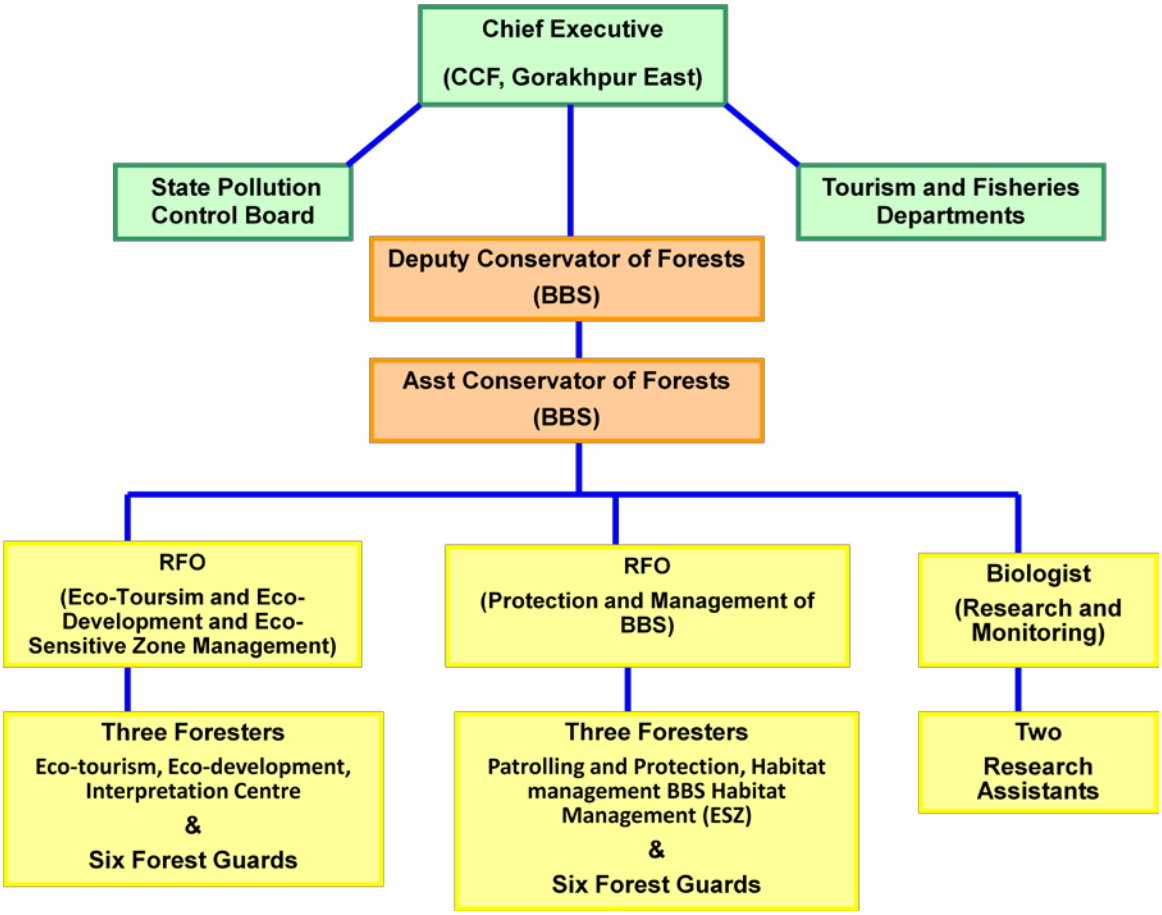
Organization and Administration

To implement, administer and review the management activities of BBS the Uttar Pradesh State Government has already placed an administrative setup. However, with the experience gained from the administrative mechanism in place, it is proposed that a new model organizational structure for the administration of the BBS for the successful management of BBS which is close proximity with one of the most populated Cities of India (Gorakhpur). The suggestion is based on the rational that unlike terrestrial protected areas, which are under the administrative control of one agency i.e. Forest Department, wetlands resources are common property resources and activities therein are control by a multitude of stakeholder's agency.

1. Staff required: Integrated Management of BBS required a dedicated Team to implement this Management Plan. In this regard, it is proposed to create a BBS Management Unit. Field level Management Unit of BBS lead by one DFO, one ACF, Two RFOs (One for Eco-development, Eco-tourism and Nature Education; One for Protection and Management of BBS). Each RFO should be supported with three Foresters i.e. 6 Foresters required for the better management of BBS and its ESZ (one Forester each for Eco-tourism, Eco-development, Interpretation Centre, Patrolling and Protection, Habitat management and Habitat Management (ESZ)). Fourteen Guard level staff are also required to strengthen the field level frontline staff to implement this DPR. Further, one Research Biologist is required for 'Research and Monitoring' Activities of BBS and ESZ. All these staff would working under the coordination of CCF (Gorakhpur East).
2. **Reorganization of Beats/blocks:** At present there are no proper demarcation of beats that have been established by the Forest department in the sanctuary area. There is a requirement to establish them at least two access points so that activities that occur in the sanctuary and eco sensitive zone are monitored and regulated regularly by the guards appointed and are reported to the range forest officer regularly in the prescribed format.
3. **Vehicular/boat infrastructure development:** There should be sufficient four wheeler and boats for patrolling and monitoring purposes and also take care of required Eco-development, training and awareness programs as prescribed in the Management Plan.
4. Constitute a 'Management Plan Implementation and Review Committee'. The committee is responsible for carrying out the Management Effectiveness Evaluation of BBS at regular interval at least once in every three years and if require the Management Plan may be reviewed and adopted as per the MEE findings.
5. It is proposed to establish 'BBS Management Authority' not only for unified control and management of all activities of the Sanctuary and Eco-Sensitive Zone but also for better coordination and synergy with all other stakeholders agencies who will play an important role in the management of Sanctuary. The new Authority in such a situation will have better co-ordination between the management of the BBS and other suggested sociologist, biologist, fisheries and tourism officials to deal with human dimensions, research and monitoring unit, fisheries and eco-tourism aspects as well as eco-compatible and sustainable marine resource utilization activities. This kind of an authority structure is suggested since such models of common property resource harbouring protected

areas are successfully being managed in India as well as outside e.g. Chilka Development Authority in Orissa and Loktak Development Authority in Manipur, both of which are RAMSAR wetland sites and the authorities are chaired by the respective Chief Ministers of the State. While it is suggested that the Chief Executive of the suggested BBS Management Authority will be a Chief Conservator of Forests (Gorakhpur East), the Chairperson of its Governing Council be the Chief Minister/Chief Secretary of Uttar Pradesh State.

Proposed Administrative setup of BBS Management Authority



Management Plan Implementation and Review Committee of BBS

It is suggested that the implementation and activities of this Five Year Management Plan be reviewed at an interval of three years and corrective measures included for implementation for the next three years phase. A management plan implementation review committee has been suggested with following members:

Chief Wildlife Warden	- Chairman
Chief Conservator of Forests, Gorakhpur East	- Vice Chairman
Representative from MoEFCC, GOI	- Member
Member Secretary, UPSBB	- Member
Director, Uttar Pradesh Fisheries Department	- Member
Director, Tourism Department	- Member
Director, UP State Pollution Control Board	- Member
Director, CIFRI	- Member
Representative from WII	- Member
Representatives from Panjayat Raj (two members)	- Member
DCF, BBS	- Member Secretary

Annexure I

PROTOCOL FOR MONITORING OF BIODIVERSITY AND HABITAT OF BAKHIRA BIRD SANCTUARY

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	**Fair (Score: 2)**	**Good (Score: 3)**
1.	**ECOSYSTEM INTACTNESS**					
1.1	Upland land use change	The land use practices in the adjacent land have a strong influence on the health of wetlands. High human activities and encroachments in the surrounding lands indicate low connectivity and disturbed ecosystem. Encroachment causes loss of riparian vegetation, floodplain, and catchment and negatively affects ecosystem value.	Assessment of land use through village survey, participatory mapping, secondary information from local governance bodies such as revenue department, *Panchayat*. Assessment of land use through high resolution remote sensing images and observations in field.	Urban or rural land use/encroachment within 100 m of the wetland boundary and intensive human activities.	Rural land use outside 200 m with moderate human activity Or Urban land use outside 500 m of the wetland boundary with moderate human activity	Rural land use with buffer of around 500 m of the boundary of the wetland with negligible human activities
1.2	Extent of catchment and watershed remaining under natural vegetation cover	The natural capital in terms of biodiversity and its intactness would ensure sustainability and higher resilience against anthropogenic and natural functional degradation.	Assessment of secondary data from Forest departments. Examination of survey of India maps, higher resolution remote sensing images and onsite field observations.	< 50% area remaining under natural vegetation cover	50-70% area remaining under natural vegetation cover	70-100% area remaining under natural vegetation cover

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
1.3	Habitat connectivity	Connectivity among surrounding aquatic, riparian and forest habitats in the floodplains and catchment and well as inter and intra-basin connectivity. Connectivity enhances habitat variability, biodiversity value and buffers habitat alteration.	Assessment of land use through village survey, participatory mapping. Examination of survey of India maps, higher resolution remote sensing images and onsite field observations.	Connectivity with other wetland/river, forest and grassland disrupted wholly. Or Linear connectivity between upstream and downstream of a river or stream disturbed by barriers without Environmental Flow and Fish passes	Connectivity exists only in rainy season otherwise no connectivity with other wetland/river/forest. or Linear connectivity between upstream and downstream of a river or stream disturbed by barriers but with MEF and Fish passes	Connectivity with other wetland/river, forest and grassland exist. or Linear connectivity between upstream and downstream of a river or stream undisturbed by barriers
1.4	Dykes and roads in or around the wetland	Dykes, roads and railway track in or along the wetlands cause loss of connectivity and hamper water flow from the catchment.	Field observations. Secondary information from concerned government agencies.	Dykes, roads and railway track without any culvert or bridge crisscross the wetland which obstructs free water flow.	Dykes, roads and railway track with adequate culvert or bridge crisscross that allows free water flow.	Free flow from the catchment to the wetland without dykes, roads etc. in-between.
1.5	Siltation rate	Siltation is common when surrounding land	Bathymetry.	Major silt deposit in the wetland	Minor silt deposits but there is no	No reduction in wetland area or

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
		or catchment has been cleared/disturbed, especially in areas with a steep gradient. It significantly reduces the depth of the water column.		causing a general reduction (>5%) of wetland area or average depth or hydroperiod.	significant reduction (<5%) in wetland area or average depth or hydroperiod in last 20 years.	average depth or hydroperiod due to siltation in last 20 years.
1.6	Width of the drawdown zone	Greater width of the area between shoreline and upland provides buffer from shock.	Examination of survey of India maps and higher resolution remote sensing images and field surveys.	Drawdown zone perceived or actual declination of more than 25% or disturbed due to other land use in last 10 years.	Drawdown zone perceived or actual declination of about and less than 25%-, or disturbed due to other land use in last 10 years.	Negligible/ No change in the drawdown zone in last 10 years.
1.7	% Littoral zone (shallow water zone <2 m)	A measure of intactness of the wetland as this zone is most productive.	Examination of survey of India maps and higher resolution remote sensing maps and field surveys. Bathymetry.	Littoral zone (shallow water zone <2 m), perceived or actual reduced by more than 25% or got disturbed due to other land use in last 10 years.	Littoral zone (shallow water zone <2 m) perceived or actual, reduced by about or less than 25% or got disturbed due to other land use in last 10 years.	Negligible/ No reduction in the original littoral zone in last 10 years.
1.8	Water withdrawal in the surrounding upland	May affect wetland hydro-period over time and accelerate wetland loss.	Examination of irrigation and other water withdrawal facilities/activities through field surveys and secondary	Withdrawal of water increased in the upland areas due to	Withdrawal of water remained constant in the upland areas due	Withdrawal of water declined in last 10 years due to alternate

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	**Fair (Score: 2)**	**Good (Score: 3)**
			information.	urbanization and agricultural expansion in last 10 years. More bore wells were installed.	to urbanization and agricultural expansion in last 10 years. Number of water abstractions remained fairly constant.	sources.
1.9	Water withdrawal from the wetland	May affect wetland hydro-period and flow/depth in rivers/wetlands.	Examination of irrigation and other water withdrawal facilities/activities through field surveys.	Withdrawal of water increased from wetland due to urbanization, agricultural expansion and other development activities in last 10 years. More pump sets were installed.	Withdrawal of water remained constant from wetland in last 10 years. Number of bore wells and water abstraction remained fairly constant.	Perceived or actual withdrawal of water declined in last 10 years due to alternate sources such as canal and creation of water tanks.
2.	**HYDROLOGICAL INTEGRITY**					
2.1	Flow fragmentation	Connectivity barriers such as dams and barrages reduce flow and fragments wildlife population.	Examination of Survey of India maps and higher resolution remote sensing images, field survey.	Presence of barriers in upstream. Flow regime almost negligible to low during dry seasons.	Presence of barriers with fish passes and adequate environmental flow.	No barriers exist.
2.2	Environmental water	The quantity of water	Monitoring of flow, water	Water	Water	Flow regime is

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
	availability	that is needed for sustained functioning of wetland and rivers and which enable continuity of its ecological services.	depth and wet area with depth and flow gauge.	circulation/flow within or from and to wetland is negligible to low during lean season.	circulation/flow within or from and to wetland is moderate (>30%) during the lean season.	intact.
2.3	Hydrological connectivity with floodplain, catchment and other wetlands/ rivers/tributaries	Undisturbed connectivity between wetland and catchment is critical for survival of wetland.	Monitoring inlet and outlet of wetland and its connectivity with catchment using Survey of India map and remote sensing data and site survey.	Substantial change in inflow and outflow of water between catchment and wetland and vice versa.	Moderate change in inflow and outflow of water between catchment and wetland and vice versa.	No change in inflow and outflow of water between catchment and wetland and vice versa.
2.4	Intra-basin hydrological connectivity	Undisturbed intra-basin connectivity or lateral connectivity in wetland and river is critical for diurnal and seasonal migration of aquatic biota and their life history strategies.	Field survey and secondary data based assessment of existing numbers of impoundments/dams/barrages in the basin and calculation of percentage habitat affected/cut off.	<60% habitat laterally connected	60-80% habitat laterally connected	>80 % habitat laterally connected
2.5	Water depth	Natural seasonal depth variations provide habitat variability and support biodiversity. Any deviation would cause change in hydro-period, habitat loss and biodiversity loss.	Depth gauge, sonar. Consultation with local communities.	Substantial change (>25% deviation from the average flow/depth of last 10 years) in flow regime or water depth.	Moderate change (<25% deviation from the average flow/depth of last 10 years) in flow regime or water depth.	Negligible change in flow regime or water depth.

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
3.	**WATER QUALITY**					
3.1	Visible water pollution	Lowering of water transparency, greenish/greyish colour, obnoxious odour are indicators of pollution. Presence of floating waste debris also indicates lowly aesthetics and poor health of wetland.	Site level inspection based on observer's perception. Sechhi Depth for water transparency assessment	Pungent odour in water, brownish colour, floating solid non-biodegradable waste, sewage/industrial effluent discharge	No odour, greenish/greyish colour, floating macrophytes	No odour, no colour, very few floating macrophytes
3.2	Algal bloom	Affects dissolved oxygen (DO) level available for ecological processes and affects aesthetic value.	Fluorometer and site level inspection based on Phytoplankton abundance survey.	Accumulation of microalgae layer>1 cm thick is evident.	Accumulation of microalgae layer 0.1 to 1 cm thick is evident.	Accumulation of microalgae layer<0.1 cm thick is evident.
3.3	Extent of pesticide, herbicide, inorganic manure used in the surrounding agricultural area	Increased pesticide residue and heavy metals in the water and sediment may lead to bioaccumulation and environmental toxicity. Major pesticides and major Heavy Metals to be analyzed as prescribed in IS: 10500: 2012	Survey of agricultural land surrounding wetlands and rivers, Pesticide analysis by Gas chromatography-Mass spectrophotometry (GC-MS) Heavy metal analysis by Atomic absorption Spectrophotometry (AAS).	Pesticide use in more than 25% of the catchment area. Presence of pesticides and Heavy Metals more than the permissible limits as described in IS: 10500: 2012	Pesticide use in <25% of catchment area. Presence of pesticides and Heavy Metals JUST within the permissible limits as described in IS: 10500: 2012	Negligible (<10%) pesticide used in the catchment. Presence of pesticides and Heavy Metals very less than the permissible limits/Not Detected (ND) as described in

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
						IS: 10500: 2012
3.4	Water Quality Criteria	The Water Quality Criteria (WQC) is indicator of the physio-chemical water quality in natural waterbodies The WQC A represents Drinking Water Source without conventional treatment but after disinfection; WQC B represents Outdoor bathing (Organised); WQC C represents waterbody for Drinking water source after conventional treatment and disinfection; WQC D represents waterbody for Propagation of Wild life and Fisheries; and WQC E represents water to be used for Irrigation, Industrial Cooling, Controlled Waste disposal.	The sampling and analysis should be done as prescribed in IS: 3025- Part I (1987).	WQC D or E. pH between 6.5 to 8.5, Dissolved Oxygen 4mg/l or more, Free Ammonia (as N) 1.2 mg/l or less Or pH between 6.0 to 8.5, Electrical Conductivity at 25°C micro mhos/cm Max.2250, Sodium absorption Ratio Max. 26, Boron Max. 2mg/l	WQC B or C Total Coliforms Organism MPN/100ml shall be 500 or less, pH between 6.5 and 8.5, Dissolved Oxygen 5mg/l or more, Biochemical Oxygen Demand 5 days 20°C 3mg/l or less Or Total Coliforms Organism MPN/100ml shall be 5000 or less, pH between 6 to 9, Dissolved Oxygen 4mg/l or more, Biochemical Oxygen Demand	WQC A. Total Coliforms Organism MPN/100ml shall be 50 or less, pH between 6.5 and 8.5, Dissolved Oxygen 6mg/l or more, Biochemical Oxygen Demand 5 days 20°C 2mg/l or less.

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
					5 days 20°C 3mg/l or less	
3.5	Trophic Status	Nutrients such as nitrogen and phosphorus tend to be limiting resources in standing water bodies, so increased concentrations tend to result in increased algae and macrophyte growth, followed by corollary increases in subsequent trophic levels. Higher Trophic state best represents cultural eutrophication.	Assessment of Carlson's Trophic State Index (TSI) based on chlorophyll pigments/ total phosphorus/ Secchi depth. The parameters may be analysed as per IS: 10500: 2012.	Eutrophic	Mesotrophic	Oligotrophic
3.6	Ecological health assessment through Benthic macro-invertebrates	Biological Water Quality Classes were developed by CPCB on basis of response of benthic macro-invertebrates towards physio-chemical water quality. This Biological Water Quality Criteria (BWQC) provides	Filed survey by following "Bio-monitoring Protocol" by CPCB	BWQC D or E, Heavy to Severe Pollution	BWQC B or C, Slight to Moderate Pollution	BWQC A, Clean water

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
		comprehensive idea about anthropogenic alteration of inland freshwater ecosystems.				
4.	**BIOTIC COMMUNITY – FLORA**					
4.1	Free floating invasive species (% wetland area)	Affects native biotic communities	Ocular estimation	>50% of the wetland is colonized by weeds/ invasive species	Some weed incursion into the wetland resulting from edge colonization, however >50% of the wetland remains FREE of weeds/ invasive species.	No weeds/ invasive present in the wetland.
4.2	Rooted invasive species (% wetland area)	Affects native biotic communities	Plot method (1 m x 1 m)	More than 50% wetland area covered with weeds or invasive plants.	Some weed incursion into the wetland resulting from edge colonization and/or incursion from roads and tracks, however >50% of the wetland remains free of weeds.	Less than 5% of the wetland and its boundary is affected by weeds.
4.3	% floodplain area covered with native	Affects native biotic communities	Ocular estimation	<50% area covered with	50-70% area covered with	.>70% area covered with

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
	vegetation			native vegetation	vegetation.	native vegetation.
4.4	% shorerline area covered with vegetation	Indicates wetland integrity	Ocular estimation	No vegetation or 50% of shore vegetation degraded.	Less than 25% shore vegetation degraded.	Intact and no degradation of shore vegetation.
5.	**5. BIOTIC COMMUNITY – FAUNA**					
5.1	Vertebrate – Richness and abundance of native fish species	Indicates intactness of site specific native biotic community	Netting, fish traps where possible. Secondary data from fishermen on % fish catch and survey of local fish market.	Decreasing trend in native species	Stable	Increasing trend in native species
5.2	Vertebrate – Richness and abundance of Amphibian species	Indicates intactness of site specific native biotic community	Standard Amphibian survey	Decreasing trend in native species	Stable	Increasing trend in native species
5.3	Vertebrate – Richness and abundance of crocodile species	Indicates intactness of site specific native biotic community	Standard crocodile survey, questionnaire survey in adjacent village, purposive survey	Decreasing trend	Stable	Increasing trend
5.4	Vertebrate – Richness and abundance of turtle species	Indicates intactness of site specific native biotic community	Standard turtle survey, questionnaire survey in adjacent village, purposive survey	Decreasing trend in native species	Stable	Increasing trend in native species
5.5	Vertebrate – Richness and abundance of water bird species	Indicates intactness of site specific native biotic community	Standard water bird survey	Decreasing trend	Stable	Increasing trend
5.6	Vertebrate –	Breeding water bird	Breeding bird survey/	Decreasing trend	Stable	Increasing

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
	Breeding water Bird especially island nesting bird Status	abundance/nesting indicates health of the wetland	Monitoring colonial breeding bird and nest			trend
5.7	Vertebrates – Richness and abundance in aquatic mammals	Indicates intactness of site specific native biotic community	Standard otter or river dolphin survey	Decreasing trend	Stable	Increasing trend
5.8	Abundance of aquatic invasive fauna	Affect native biotic community	Standard survey for benthic communities and fish catch	Increasing trend of invasive faunal species in the wetland.	Decreasing trend of invasive fauna in the wetland.	No invasive species in the wetland.
5.9	Habitat potential	Overall habitat quality for the species of conservation significance	Standard habitat assessment for wildlife value of species of conservation significance.	Important habitat parameters required for species of conservation concern have degraded.	A few habitat parameters required for species of conservation concern have degraded.	Most of the key habitat parameters required for species of conservation concerns are met.
6.	**ANTHROPOGENIC DISTURBANCE**					
6.1	Human population density in the floodplain w.r.t the population density of entire river basin or wetland catchment	Presence of urban and/or rural settlement with high population density will always have increasing pressure on the biotic resources of the wetland and surrounding forested area and land. It is also	Field survey and secondary data.	>50%	10-50%	<10%

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
		an indicator of impact on lateral connectivity of the wetland				
6.2	Presence of solid biodegradable and non-biodegradable waste of anthropogenic origin in water and on shoreline	Directly impact wetland health in terms water quality and aesthetic value.	Field survey based on observer's perception.	Major portion of the wetland have scattered biodegradable and non-biodegradable litter.	Negligible litter in the wetland	Wetland free of scattered biodegradable or non-biodegradable litter.
6.3	Numbers of untreated sewage and industrial water active outlets/overflows/drains/storm water canal	Sewage and industrial effulents directly affects water quality and degrades wetland and river health.	Field surveys along the waterways. Secondary data from CPCB/SPCB/PCCs.	Substantial number of active treated and untreated wastewater outlets/overflows/ drains/ storm water canal draining into wetland.	Not more than 2 active treated outlets/storm water canal at the wetlands.	No wastewater treated or untreated discharge into the wetland.
6.4	Quality and quantity of sewage inflow	Sewage directly affect water quality and degrade wetland and river health.	Sampling and analysis as proposed in IS: 3025- Part I (1987). The standard limit is depicted in The Environment (Protection) Rules, 1986, Rule 3A and Schedule VI, General standards for discharge of environmental Pollutants Part A : Effluents,	Higher than the specified standards.	JUST fulfilling the specified standards.	No sewage coming into the wetland Or All effluents well below the specified limits

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
			discharge limit for Inland surface water			
6.5	Quality and quantity of industrial discharge	Industrial discharge directly affect water quality and degrade wetland and river health	Field survey and sample analysis using IS: 3025- Part I (1987). The effluent standards will be industry specific and "Standards for Emission or Discharge of Environmental Pollutants from various Industries" by CPCB should be strictly followed.	Higher than the specified standards.	JUST fulfilling the specified standards.	No industrial waste coming into the wetland Or All effluents well below the specified limits
6.6	Draining/Reclamation of wetland	Draining changes the plant composition and reduces the ability of wetlands to perform their hydrological functions.	Field surveys.	Presence of a well-established drainage infrastructure such as canal that considerably reduces the water holding capability of the wetland.	Presence of a drainage infrastructure such as canal that has a moderate effect on the wetland hydrology.	No drains or presence of drainage infrastructure such as canal that has little effect on the wetland hydrology.
6.7	Extent of fishing in the wetland	Overfishing may affect biodiversity and resource availability.	Perception of local fishermen. Fishing landing and market surveys.	Fishermen reported substantial decline in catch of native fish species during last 10 years. Decrease in fish	Fishermen reported decline in catch of native fish species during last 10 years.	Fishermen reported more or less stable fish catch during last 10 years

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
				catch (CPUE).		
6.8	Extent of other biomass extraction	Affects provisioning service value, causes disturbance	Field surveys. Household interviews. Perception of the observer.	Substantial biomass extraction from the wetland for sale as well as consumption. Removal of rare, endangered or threatened plant species.	Occasional biomass extraction from the wetland for consumption only. No removal of rare, endangered or threatened plant species.	Minimal/Negligible/sustainable (?) biomass extraction from wetland.
6.9	Extent of grazing in the wetland	Grazing causes high disturbance and changes plant species composition	Field survey to check number of livestock grazing in the wetland area. Availability of alternative grazing grounds and fodder sources.	Grazing animals have access throughout the wetland, established tracks throughout the wetland, dung widespread, major damage to vegetation	Grazing animals have access to around or less than 50% the wetland, some established tracks, dung uncommon , moderate damage to vegetation.	Grazing animals have partial access (less than 25%) to the wetland and little damage to the vegetation or no current signs of grazing.
6.10	Sand mining, Stone query	Affect natural shoreline feature, enhance siltation and alter habitat for nesting reptilians like turtles and crocodiles.	Field surveys. Perception of the observer.	Substantial sand or boulder mining on the bank and in water for commercial purpose by both	Sand and boulder mining on the bank and in water using traditional methods, primarily for local	No sand or boulder mining on the bank and in water.

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
				manual and mechanized tools. Intensity of mining.	subsistence.	
6.11	Boat wave or wake	Boat wave or wake caused by the movement of the boat through the water, the faster the speed, the larger and more damaging the effect of the wash on river banks and shorelines. Boat wave has potential to erode and undercut banks, causing severe damage to the riparian zone	Field observations.	Powered vessels frequent the waterway, and are found travelling above 'no wash' speeds. Erosion and undercutting of banks is severe in places within the study site.	Few small powered vessels are found on the waterway, travelling only at 'no wash' speeds of below 4 knots. Some erosion of the bank may be evident within the study site.	No powered vessels are permitted or found on the waterway. No erosion or undercutting of the bank is evident at any location in the study site.
6.12	Oil and grease from motorized boats for ferry and tourism	Leakage of oil and grease from motorized boats could lead to mortality of planktonic biota and suffocate fish and other aquatic life.	Sampling and analysis as proposed in IS: 3025- Part I (1987). The standard limit is depicted in The Environment (Protection) Rules, 1986, Rule 3A and Schedule VI, General standards for discharge of environmental Pollutants Part A : Effluents, discharge limit for Inland surface water	> 10 mg/L	Maximum 10 mg/L	Well below 10 mg/L

	Criteria and indicators	Explanation	Methods of assessment	Thresholds		
				Poor (Score: 1)	Fair (Score: 2)	Good (Score: 3)
6.13	Washing of clothes, vehicles near the wetland area.	Washing of clothes and vehicles near wetland areas using high sodium containing detergents causes pollution and nutrient enrichment of the wetland.	Field observations.	People washing cloths and vehicles using detergents regularly.	People washing cloths and vehicles using detergents occasionally.	No washing of cloths and vehicles in the wetland.
6.14	Any other activity that may degrade ecosystem (Landfills, defecation, cattle waddling, drying of cow-dung cake, overhead power line crossing wetland etc. that affects wetland integrity)	Water quality degradation, habitat modification.	Field surveys.	Substantial human pressure.	Fairly low human pressure.	No human pressure.

Annexure II

Checklist on Diversity of Birds in and around Bakhira Bird Sanctuary							
Terrestrial Birds							
SL. No.	**Common Name**	**Scientific Name**	**Order**	**Family**	**Statu**	**IUCN Status**	**Count**
1	Gray Francolin	*Francolinus pondicerianus* (Gmelin, 1789)	Galliformes	Phasianidae	R	LC	30
2	Red-Wattled Lapwing	*Vanellus indicus* (Boddaert,1783)	Charadriiformes	Charadriidae	R	LC	57
3	Yellow-Wattled Lapwing	*Vanellus malabaricus* (Boddaert, 1783)	Charadriiformes	Charadriidae	R	LC	1
4	Collared Pratincole	*Glareola pratincola* (Linnaeus, 1766)	Charadriiformes	Glareolidae	R	LC	8
5	Eurasian Collared Dove	*Streptopelia decaocto* (Frivaldszky, 1838)	Columbiformes	Columbidae	R	LC	19
6	Spotted Dove	*Spilopelia chinensis* (Scopoli, 1768)	Columbiformes	Columbidae	R	LC	14
7	Rock Pigeon	*Columba livia* (Gmelin,1789)	Columbiformes	Columbidae	R	LC	11
8	Yellow Footed Green Pigeon	*Treron phoenicoptera* (Latham, 1790)	Columbiformes	Columbidae	R	LC	5
9	Asian Koel	*Eudynamys scolopacea* (Linnaeus,1758)	Cuculiformes	Cuculidae	R	LC	7
10	Common Myna	*Acridotheres tristis* (Linnaeus,1766)	Passeriformes	Sturnidae	R	LC	62
11	Asian-Pied Starling	*Sturnus contra* (Linnaeus,1758)	Passeriformes	Sturnidae	R	LC	101
12	Brahminy Starling	*Sturnia pagodarum* (Gmelin, 1789)	Passeriformes	Sturnidae	R	LC	5
13	Chestnut Tailed Starling	*Sturnia malabarica*[(Gmelin, 1789)	Passeriformes	Sturnidae	R	LC	3
14	Citrine Wagtail	*Motacilla citreola* (Pallas, 1776)	Passeriformes	Motacillidae	R	LC	1
15	House Crow	*Corvus corax* (Vieillot,1817)	Passeriformes	Corvidae	R	LC	84
16	Large-Billed Crow	*Corvus macrorhynchos* (Wagler, 1827)	Passeriformes	Corvidae	R	LC	25
17	Plain Prinia	*Prinia inornata* (Sykes, 1832)	Passeriformes	Cisticolidae	R	LC	31
18	Zitting Cisticola	*Cisticola juncidis* (Rafinesque, 1810)	Passeriformes	Cisticolidae	R	LC	28
19	Ashy Prinia	*Prinia socialis* (Sykes, 1832)	Passeriformes	Cisticolidae	R	LC	3
20	Streaked Weaver	*Ploceus manyar* (Horsfield, 1821)	Passeriformes	Ploceidae	R	LC	49

21	Black-Breasted Weaver	*Ploceus benghalensis* (Linnaeus, 1758)	Passeriformes	Ploceidae	R	LC	119
22	Green- Bee Eater	*Merops orientalis* (Latham, 1801)	Coraciiformes	Meropidae	R	LC	13
23	Blue-Tailed Bee Eater	*Merops philippinus* (Linnaeus, 1766)	Coraciiformes	Meropidae	R	LC	31
24	Indian Bushlark	*Mirafra erythroptera* (Blyth, 1845)	Passeriformes	Alaudidae	R	LC	36
25	Bengal Bushlark	*Mirafra assamica* (Horsfield, 1840)	Passeriformes	Alaudidae	R	LC	6
26	Oriental Skylark	*Alauda gulgula* (Franklin, 1831)	Passeriformes	Alaudidae	R	LC	8
27	Sarus Crane	*Antigone Antigone* (Linnaeus, 1758)	Gruiformes	Gruidae	R	VU	28
28	Paddy Field Pipit	*Anthus rufulus* (Vieillot, 1818)	Passeriformes	Motacillidae	R	LC	42
29	Richards Pipit	*Anthus richardi* (Vieillot, 1818)	Passeriformes	Motacillidae	R	LC	3
30	Black Drongo	*Dicrurus macrocercus* (Vieillot, 1817)	Passeriformes	Dicruridae	R	LC	22
31	Common Hawk Cuckoo	*Hierococcyx varius* (Vahl, 1797)	Cuculiformes	Cuculidae	R	LC	1
32	White Breasted Kingfisher	*Halcyon smymensis* (Linnaeus,1758)	Coraciiformes	Alcedinidae	R	LC	8
33	Black Hooded Oriole	*Oriolus xanthornus* (Linnaeus, 1758)	Passeriformes	Oriolidae	R	LC	1
34	Indian Golden Oriole	*Oriolus kundoo* (Sykes,1832)	Passeriformes	Oriolidae	R	LC	1
35	Oriental Magpie Robin	*Copsychus saularis* (Linnaeus, 1758)	Passeriformes	Muscicapidae	R	LC	2
36	Black-Winged Kite	*Elanus caeruleus* (Desfontaines, 1789)	Accipitriformes	Accipitridae	R	LC	8
37	Rufous Treepie	*Dendrocitta vagabunda* (Latham, 1790)	Passeriformes	Corvidae	R	LC	2
38	Greater Coucal	*Centropus sinensis* (Stephens, 1815)	Cuculiformes	Cuculidae	R	LC	5
39	Large Gray Babbler	*Turdoides affinis* (Sykes,1832)	Passeriformes	Leiothrichidae	R	LC	15
40	Jungle Babbler	*Argya striata* (Dumont, 1823)	Passeriformes	Leiothrichidae	R	LC	52
41	Jungle Owlet	*Glaucidium radiatum* (Tickell, 1833)	Strigiformes	Strigidae	R	LC	1
42	Spotted Owlet	*Athene brama* (Temminck, 1821)	Strigiformes	Strigidae	R	LC	1
43	Red Avadavat	*Amandava amandava* (Linnaeus, 1758)	Passeriformes	Estrildidae	R	LC	57
44	Common Rosefinch	*Carpodacus erythrinus*) (Pallas, 1770)	Passeriformes	Fringillidae	R	LC	4

45	Plum-Headed Parakeet	*Psittacula cyanocephala* (Linnaeus, 1766)	Psittaciformes	Psittaculidae	R	LC	2
46	Indian Gray Hornbill	*Ocyceros birostris* (Scopoli, 1786)	Bucerotiformes	Bucerotidae	RM	LC	8
47	Fulvous-Breasted Woodpecker	*Dendrocopos macei* (Vieillot, 1818)	Piciformes	Picidae	R	LC	1
48	Red-Rumped Swallow	*Cecropis daurica* (Laxmann, 1769)	Passeriformes	Hirundinidae	R	LC	2
49	Lesser-Adjutant Stork	*Leptoptilos javanicus* (Horsfield, 1821)	Ciconiiformes	Ciconiidae	R	VU	2
50	Black-Headed Ibis	*Threskiornis melanocephalus* (Latham, 1790)	Pelecaniformes	Threskiornithidae	R	LC	14
51	Woolly-Necked Stork	*Ciconia episcopus* (Boddaert, 1783)	Ciconiiformes	Ciconiidae	R	VU	6
52	Steppe Eagle	*Aquila nipalensis* (Hodgson, 1833)	Accipitriformes	Accipitridae	R	EN	1
53	Pied Bushchat	*Saxicola caprata* (Linnaeus, 1766)	Passeriformes	Muscicapidae	R	LC	12
54	Striated Grassbird	*Megalurus palustris* (Horsfield, 1821)	Passeriformes	Locustellidae	R	LC	4
55	Eurasian Hoopoe	*Upupa epops* (Linnaeus, 1758)	Bucerotiformes	Upupidae	R	LC	6
56	Indian Roller	*Coracias benghalensis* (Linnaeus, 1758)	Coraciiformes	Coraciidae	R	LC	4
Aquatic Birds							
SL. No.	**Common Name**	**Scientific Name**	**Order**	**Family**	**Statu**	**IUCN Status**	**Count**
57	Asian Openbill Stork	*Anastomus oscitans* (Boddaert, 1783)	Ciconiiformes	Coraciidae	R	LC	20
58	Purple Swamphen	*Porphyrio porphyria* (Linnaeus, 1758)	Gruiformes	Rallidae	R	LC	4
59	Eurasian Coot	*Fulicaatra* (Linnaeus, 1758)	Gruiformes	Rallidae	M	LC	2
60	Common Sandpiper	*Actitishypoleucos* (Linnaeus, 1758)	Charadriiformes	Scolopacidae	R	LC	1
61	River Tern	*Sterna aurantia* (J.E. Gray, 1831)	Charadriiformes	Laridae	R	NT	5
62	Purple Heron	*Ardea purpurea* (Linnaeus, 1766)	Pelecaniformes	Ardeidae	R	LC	1
63	Lesser Whistling Duck	*Dendrocygna javanica* (Horsfield, 1821)	Anseriformes	Anatidae	R	LC	6
64	Indian Spot-Billed Duck	*Anas poecilorhyncha* (Forster, 1781)	Anseriformes	Anatidae	RM	LC	2
65	Little Grebe	*Tachybaptus ruficollis* (Pallas, 1764)	Podicipediformes	Podicipedidae	R	LC	15
66	Little Cormorant	*Phalacrocorax niger* (Vielloti , 1817)	Suliformes	Phalacrocoracidae	R	LC	24

67	Little Egret	*Egretta gazetta* (Linnaeus,1766)	Pelecaniformes	Ardeidae	R	LC	10
68	Cattle Egret	*Bubulcus ibis* (Linnaeus,1766)	Pelecaniformes	Ardeidae	R	LC	82
69	Intermediate Egret	*Egretta intermedia* (Wagler,1827)	Pelecaniformes	Ardeidae	R	LC	4
70	Indian Pond Heron	*Egretta garzetta* (Linnaeus, 1766)	Pelecaniformes	Ardeidae	R	LC	11
71	Black Bittern	*Ixobrychus flavicollis* (Latham, 1790)	Pelecaniformes	Ardeidae	R	LC	1
72	Bronze-Winged Jacana	*Metopidius indicus(Latham,1790* (Latham, 1790*)*	Charadriiformes	Jacanidae	R	LC	3

Annexure III

Classification, local name and IUCN status of ichthyofauna of Bakhira Lake

Family	Species name	Local Name	IUCN Status
Cyprinidae	*Cirrhinus mrigala* (Hamilton, 1822)	Nain	LC
	Cirrhinus reba (Hamilton, 1822)	Rewa bata	LC
	Labeo gonius (Hamilton, 1822)	Kursi	LC
	Labeo rohita (Hamilton, 1822)	Rohu	LC
	Labeo angra (Hamilton, 1822)	Raia	LC
	Puntius sophore (Hamilton, 1822)	Sidhari	LC
	Puntius chola (Hamilton, 1822)	Sidhari	LC
Siluridae	*Wallago attu* (Bloch & Schneider, 1801)	Padhani	NT
	Mystus vittatus (Bloch, 1794)	Tangra	LC
	Ompok sp.	Langana	
Ailiidae	*Ailia coila* (Hamilton, 1822)	Patasi	NT
Heteropneustidae	*Heteropneustes fossilis* (Bloch, 1794)	Singi	LC
Belonidae	*Xenentodon cancila* (Hamilton, 1822)	Kauwa	LC
Channidae	*Channa marulius* (Hamilton, 1822)	Souri	LC
	Channa punctatus (Bloch, 1793)	Girohi	LC
	Channa striatus (Bloch, 1793)	Souri	LC
Ambassidae	*Chanda baculis* (Hamilton, 1822)	Baam	LC
	Chanda ranga (Hamilton, 1822)	Chanari	LC
Nandidae	*Nandus nandus* (Hamilton, 1822)	Dhebari	LC
Osphronemidae	*Trichogaster fasciata* (Bloch & J. G. Schneider, 1801)	Khosti	LC
Mastacembelidae	*Macrognathus aculeatus* (Bloch, 1786)	Bam	LC
Notopteridae	*Notopterus notopterus* (Pallas, 1769)	Foli	LC

Annexure IV

The List of Aquatic Plants of Bakhira Tal

S.No.	Common Name	Botanical Name
Family : TYPHACEAE		
1	Patera Cultail	*Typha latifolia*
2	Patera	*Typha angustifolia*
Family : SPARGANIACEAE		
3	Ban Reed	*Sparganium fluctans*
Family : POTAMOGETONACEAE		
4-	Pond weed (Pota mogetan)	*Potamageton natans*
5-	Pond weed	*Potamageton nodusus*
6-	Pond weed	*Potmageton pectinatus*
7-	Pond weed	*Potamageton amplifolins*
8-	Pond weed	*Potamageton crispus*
9-	Pond weed	*Potamageton filiformis varborealis*
10-	Pond weed	*Potamageton caplillaceas*
11-	Horned Pond Weed	*Zalihichellia palustris*
Family : NAJADACEAE		
12-	Bushy Pond Weed	*Najas flexilisis*
13-	Bushy Pond Weed	*Najas minor*
14-	Bushy Pond Weed	*Najas graminea*
Family : ALISMACEAE		
15-	Limnophyton	*Limnophyton obtusifolium*
16-	Arrow head duck Potato	*Sagittiaria caneata*
17-	Arrow head duck Potato	*Sagittiaria gigayanensis*
18-	Arrow head duck Potato	*Sagittiaria brevirostra*
19-	Arrow head duck Potato	*Sagittiaria rigida*
20-	Arrow head duck Potato	*Sagittiaria graminea*
21-	Arrow head duck Potato	*Sagittiaria cristata*
22-	Water Plantain	*Alisma plantagoaquatica*
23-	Water Plantain	*Alisma gramineum*
Family : HYDROCHARITACEAE		
24-	Wild Celery	*Vallisneria Americana*
25-	Tape Grass	*Vallisneria spiralis*
26-	Frogbit	*Limnobium spongia*
27-	Hydrilla	*Hydrilla verticillata*
Family : POACEAE		
28-	Bahma Grass	*Cynodon dactylon*
29-	Geega Grass	*Dichanthium annulatum*
30-	Reed Grass	*Phragmitis maximus*
31-	Reed Grass	*Phragmitis karka*
32-	Wild Rice	*Zizania aquatic*
33-	Wild Rice	*Oryza rufipogon*
34-	Kans	*Saccharum spontaneum*
35-	Love Grass	*Eragrastic hypnoides*
36-	Fox Tail	*Alopecurus aequalis*
37-	Sloughi Grass	*Beckmannia syzigachne*
Family : CYPERACEAE		
38-	Motha	*Cyperus alopecuroides*
39-	Mothi	*Cyperus bulbosus*
40-	Mothi	*Cyperus iria*
41-	Mothi	*Cyperus compressus*

42-	Mothi	*Cyperus deformis*
43-	Motha	*Cyperus rotundus*
44-	Motha	*Cyperus scarious*
45-	Spikerush	*Eleocharis actutangula*
46-	Pola	*Eleocharis dulcis*
47-	Poli	*Eleocharis plustris*
48-	Poli	*Eleocharis obtuse*
49-	Balruse	*Scirpus articulates*
Family : ARACEAE		
50-	Arrowarum	*Peltandra virginica*
Family : LEMNACEAE		
51-	Big duck Weed	*Spirodela polirhiza*
52	Duck Weed	*Lemna minor*
53	Water Meal	*Wolffia globosa*
Family : NYMPHAEACEAE		
54	Water Lily	*Nymphaea nouchali*
55	Water Lily	*Nymphaea pubeschens*
56	Sacred Lotus	*Nelumbo nucifera*
Family : SALVINIACEAE		
57	Water Velvet	*Azolla pinnata*
Family : TRAPACEAE		
58	Water chestnut	*Trapa natans*
59	Water chestnut	*Trapa racemosus*
Family : GENTIANCEAE		
60	Floating heart (Water Queen)	*Nymphoides coradatum*
61-	Water Queen	*Nymphoides indicum*
62-	Water Queen	*Nymphoides aquaticum*
63-	Water Queen	*Nymphoides cristata*

Annexure V

Certain other prominent Aquatic Fauna

S.No.	Common Name	Zoological Name
Class : ANNELIDA		
1	Jonk	*Hirudinaria sp.*
2	Kenchua	*Phertima sp.*
Class : ARTHROPODA		
3	Kekada	*Cancer sp.*
4	Jheenga	*Macrobranchium lamarrie*
5	Scorpio	*Nepa robustus*
Class : MOLUSCA		
6	Ghongha	*Pila sp.*
Class : AMPHIBA		
7	Frog	*Rana timnocharii*
8	Indian Frog	*Rana tigrina*
9	Toad	*Alytes*
Class : REPTILEA		
10	Kachhuwa	*Kachuga kachuga*
11	Paniha Snake	*Natrix piscator*
12	Blind Snake	*Typhlops*
13	Karait	*Bhungarus*

Annexure VI

DETAILED PROJECT REPORT OF BAKHIRA BIRD SANCTUARY

(To be submitted to MoEF&CC, Government of India)

S.No.	Item	Details
1.0	**Background**	Bakhira bird sanctuary, established in 1980, is the largest natural floodplain wetland in the Sant Kabir Nagar district. The sanctuary forms the largest natural floodplain wetland of India, spanning an area of 28.9421 km^2. It was declared a bird sanctuary in 1990 by the Govt. order 822/14-3-60/1989, dated 14/5/1990. The sanctuary is named after the small township 'Bakhira', located adjacent to the lake. It forms an important wintering and staging ground for a number of migratory waterfowls and proffers a critical resource of breeding grounds for resident birds. Additionally, the sanctuary is also important for indigenous fish fauna and provides multifaceted ecosystem services to the local communities.
1.1	If included in the state priority	Yes
1.2	Justification for selection on priority	The Bakhira wetland is the largest natural floodplain wetland of India which provides a wintering and staging grounds for a number of migratory waterfowls and is thus a critical habitat resource for migratory bird species. The wetland harbours a variety of water birds like Cranes, Asian openbill stork, River terns, Cormorants and Waterfowls. The area is also important for variety of indigenous fish fauna like *Channa, Labeo, Wallago* and provides multifaceted ecosystem services to the local communities. The winter visiting birds specially enhance the biodiversity of the area and thus creating promising opportunities for ecotourism and bird watching. Further, the lake is directly or indirectly supports the livelihoods of people who live around 50 km radius of this lake.
1.3	Lake Water Use & Primary purpose for rejuvenation	The local communities around the sanctuary are dependent on this wetland for fishing, irrigation, bathing, cattle grazing and resource collection. The inlet of the lake is blocked by a small barrage increasing the risk of siltation and proliferation of invasive weeds. Additionally, the lake is being drained by two canals further reducing the water levels thus warranting rejuvenation.

1.4	Location	The sanctuary is located in Sant Kabir Nagar district. It consists of Bakhira Tal extending over gram samaj land and agricultural land and reserve forest of Khalilabad Compartment No.5. The sanctuary extends from 26.30'N to 27.30'N latitude and 82.17'E to 83.30'E longitude.		
1.5	Stakeholders involved	Local farmers, fishermen communities, irrigation department, revenue department, forest department, tourism department		
1.6	Outcome of the public hearing on site	The major concern raised by public is that the land rights of farmers in and around the sanctuary needs to be settled		
2.0	**Physical profile of the lake**	Annexure - III		
2.1	Catchments area :	About 1000 sq.km		
2.2	Water spread area (ha):	Max. 2,878.99 ha and Min. 1,582.35 ha		
2.3	The depth of the lake:	Maximum 7 m (monsoons), minimum 1-2 m (summers)		
2.4	Storage capacity:			
3.0	**Lake Water Quality Analysis:**	Lake Water Quality		
3.1	Agency engaged for water quality monitoring: Wildlife Institute of India, Dehradun,	Physico-chemical parameters	Summer season	Winter season
		pH	7.96±0.3	7.3±0.6
		TSS (mg/l)	26.0±0.3	22.0±0.3
		BOD (mg/l)	12.4±2.4	8.5±2.4
		COD	8.5±2.4	23.9±4.06
		Nitrogen (mg/l)	5.04±0.09	9.52±0.09
		Phosphorous (mg/l)	0.003±0.01	0.39±0.01
	Biological profile:	Fish: 22 species belonging to 15 genera, 11 families and 7 orders Annexure - IV		
3.2	Sediment Analysis. Phosphorous (Phosphate-P) Total Heavy	Phosphate in surface water is normally derived from the leaching of minerals from the rocks or soil, decomposing organic matter and drainage from agricultural areas. Phosphate content of the water of Bakhira lake ranged from <0.003±0.01 (January) to 0.39±0.01 mg/l (May).		

	metal content Total Pesticide content	
4.0	**Lake Catchment Details:**	
4.1	Present population	As per 2011 censes, about 128,530 people were residing in and around Bakhira wetland surrounding area
4.2	Projected population (10 yrs & 30 yrs):	The district population growth rate (%) is 20.81%. The population recorded in 2011 was 128,530. If the population growth rate remains at 20.81%, it is predicted that; after 10 years and 30 years from the previous census, the population will reach 1,34,706 and 1,54,747 individuals respectively.
4.3	Rate of Water Supply (LPCD)	
5.0	Environmental concerns/Sources of Pollution (Point &non-point sources including industrial, if any):	Bakhira bird sanctuary is altered by various anthropogenic disturbances and rapid urbanization. The major environmental concerns are: ➢ Weed infestation ➢ Sedimentation and silt load from water surface & surface run off from the catchment ➢ Lack of man-power and field staff, which leads to encroachments and other illegal activities around the wetland. ➢ Indiscriminate fishing ➢ Cattle grazing ➢ Pollution (agriculture wastes and sewage)
6.0	**Conservation and Management Plan**	The vision of the plan is "The long term conservation of sanctuary for posterity and the maintenance of the ecological process and functions supported by it for the benefit of the nation and the humanity". This is a plan to conserve the unique and rich avian fauna and other aquatic life present in Bakhira wetland for posterity and to manage the sanctuary accordingly. The wetland has higher potential for attraction of migratory water birds, so the vision of this wetland emerges from the set of values identified.
6.1	I&D works	The wetland is located along the floodplain of Rapti river. During monsoon excess water from Rapti river enters through irrigation canal and reaches the wetland.
6.1.1	Existing scenario	Bakhira bird sanctuary was declared in 1980 and came into existence on 14th May 1990 vide gazette notification no. 822/14-3-60/1989 dated 14.04.90 issued by Govt. of U.P. under section 18 of Wild life Act 1972 due to reasonable ecological, floral, faunal, natural and geological values to preserve and develop its ecology and home for resident and migratory water birds. Prior to declaration of the sanctuary the area was being

		managed by the villagers. In the existing scenario, however most fishing activities are prohibited and thus the livelihood opportunities for the local communities have dwindled. The settlement process is on but still unresolved. The major problems are: settlement of land rights, illegal fishing and poaching, weed infestation, siltation, lack of stringent sanctuary boundaries, man-power and infrastructure.
(a)	Quantum of sewage entering the lake	No major inflows of sewage apart from those flowing from the nearby villages
(b)	Sewerage system	Does not exist
6.1.2	Proposed measures	Considering the present scenario, the following measures are proposed for effective management of Bakhira wetland: ➢ Sufficient man-power and field staff ➢ Enhanced tourism facilities like watch towers, sighting facilities, dedicated interpretation center, road access from nearby town ➢ Promotion of eco-development programmes ➢ Periodical removal of weeds
(a)	Projected design discharge and the basis for assessment	Not applicable
(b)	Proposed sewerage system	Not applicable
	Lake Catchment	Not applicable
	Entire town	Not applicable
(c)	Sewers	Not applicable
(d)	Sewage pumping station	Not applicable
6.2	Sewage treatment	Minor sewage treatment plant at village level is required
6.2.1	Proposed STP capacity and the technology	Small scale at village level
6.2.2	If the sewage is proposed to be treated in any existing ETP or any other STP proposed to be funded under	Not applicable

	NRCP or any other scheme (JNNURM/UIDSSMT)	
6.2.3	Final disposal	Not applicable
6.3	In-situ cleaning	Not applicable
6.3.1	De-weeding	Periodic removal of weeds in Bakhira wetland is required to improve the ecosystem health of the wetland. Thus, eradication of weed is proposed by two mechanical de-weeding machines with two motor boats for this purpose.
6.3.2	De-silting (wet/dry) Area to be de-silted (If the calculation is based on mapping of lake profile through bathymetry using standard methodology)	De-silting is periodically required in the inlet/ irrigation canals to maintain the water flow. In addition, de-silting is also required for the weed chocked peripheral areas of the wetland. Thus, one mechanical de-silting machine with a boat is proposed.
6.3.4	Ozonizers/ floating fountain/ bioremediation	10 floating fountains are proposed for water aeration in the lake.
6.3.5	Any other measures proposed	
6.4	**Storm water management**	
6.4.1	Rainfall intensity	The intensity of rainfall is low, which has caused the water column to drop. The rainy season starts with the onset of monsoon during the last week of June and extends up to September. Winter rains occur in the month of January and February.
6.4.2	Lake water balance	The water from nearby villages flows down into the lake through gulleys/ nallas. The excessive water in the rainy season is being drained into Rapti river through a gate situated at Chorma Nala by irrigation department established in 1980.
6.4.3	Screen barrier/ silt trap	Screen barrier at vulnerable areas around the lake near the villages is required. Silt traps required to prevent the sediments from agriculture lands reaching to lake.
6.4.4	Disposal of storm water	Not applicable
6.5	**Solid waste management**	
6.5.1	If any resource recovery is also	Not applicable

	prepared	
6.6	**Catchment area treatment**	
6.6.1	Afforestation	A 100 m green belt is proposed at the lake perimeter to prevent erosion. Further, organic farming must be promoted around the lake.
6.6.2	check dams etc.	Not required
6.7	**Non-core components**	
6.7.1	Chain link fencing	Required to check the cattle entry into the critical habitat of lake (critical bird habitats)
6.7.2	Bathing ghats	The villagers residing in villages around the sanctuary have been using this lake for bathing during low water level period, especially in summer. In order to facilitate the traditional water use by the local people in a sustainable manner: 4 Bathing Ghats are proposed to be built at different locations
6.7.3	Island development	To facilitate roosting, nesting and breeding for resident birds, islands must be created. The islands will be elliptical in shape with a minimum perimeter of 305m and a shortest width of 50m. At the periphery and center, suitable native wetland plant species will be planted. Two islands are proposed in the Bakhira wetland
6.7.4	Fountain	In order to maintain the circulation of dissolved oxygen throughout the water column, 10 floating fountains are proposed. The same has been mentioned in section 6.3.4.
6.7.5	Development of fisheries	It is proposed to restock the commercially important native fishes such as *Channa* spp., *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala* etc. in the lake to enhance the livelihoods of local communities. This can be carried out by both Fisheries and Forest departments jointly. Only the native species must be permitted in this restocking programme.
6.7.6	Plantation	A 100 m green belt around the lake is recommended. Tree species that are native to the region should be planted including *Acacia spp*. Few trees may be planted in the islands for the roosting and nesting of birds.
6.7.7	Lighting, parks, benches/ seat	Simple lighting system should be installed in the 4 proposed bathing ghats and Interpretation Centre area. Sitting benches should be made around 4 proposed watch tower areas and other strategic locations.
6.7.8	Others	
7.0	**Water Quality Monitoring:**	
7.1	Agency to be engaged and the schedule for water quality monitoring during and after	Department of Zoology, St. Andrew's College, Gorakhpur Two portable multi-parameter water and soil quality instruments are proposed for regular monitoring of water quality parameters in the wetland.

	the project implementation .	
8.0	**Environmental Awareness and Public Participation:**	1. Development of sanctuary as an important tourist destination and recreation spot. 2. Sensitization of local people and tourists about the wetland and its flora and fauna. 3. Educate the local people and tourists regarding wild animals and their importance in the ecosystem. 4. Organization of nature trails for students and tourists for awareness through ecosystem and wildlife excursion. Nature walks can be organized between October to June where bird watching and animal sighting can be specifically promoted. 5. Organization of awareness and orientation workshops for officials of different departments and other stakeholders working in sanctuary. These can be followed by film shows on birds and other wildlife in the Interpretation center. 6. Organization of competition in schools and colleges regarding the values of sanctuary, its ecology, birds and other wildlife will be held on specific national days pertaining to them for raising interest and awareness about wildlife in young students.
9.0	**Operation and Maintenance Plan:**	
9.1	Why required/ essential, total estimated cost annually	Estimated budget Rs. 3447 laks (Rs. 34.47 crore)
9.2	Ways & means to mobilize the revenue	Through eco-tourism, eco-developmental activities and sustained fisheries
10.0	**Commitments:** (Enclosures to be attached for each of the following)	
10.1	To bear 30% of the project cost	
10.2	For implementation of the project and also for O&M	
10.3	To generate revenue through dedicated	

	streams to meet O&M costs (resolution)	
10.4	Duly filled IFD Performa giving O&M details	
10.5	SOR followed – Certificate for excess cost to be borne by the State Govt.	
10.6	Land availability for STP and other proposed works	Not applicable
10.7	Encroachment removal/rehabilitation plan/ Commitment of local body or DC	*Encroachment:* Since the settlement, proceeding is still under progress hence private land included in the sanctuary has not been brought under control of the Forest department. Once the settlement process is complete this problem will be solved. *Rehabilitation:* Eco-tourism should be considered for generating alternative employment opportunities for the local communities. This would reduce the pressure on the wetland. Sustainable fishing practices with integrated organic farming, cultivation of wetland flora can be encouraged. The forest department and stakeholders can promote eco-developmental activities by involving local communities.
10.8	Lake ownership	The lake is a property of Govt. property and was declared a bird sanctuary in 1990 by the Govt. order 822/14-3-60/1989, dated 14/5/1990
10.9	Any other	Management of the wetland in a comprehensive holistic manner is solicited by involving local communities, stakeholders and forest department.

Cost Estimates
(To be submitted to MoEF&CC along with DPR)

S. No.	Items	Quantitative Estimates (Rs in Lakh)	Rate	Cost (Rs in Lakh)	Remarks
I	**Establishment of Management Unit (Strategies)**				
a.	Periodic meetings of Management Plan Implementation and Review Committee	0.5 x 5	0.5/year	2.5	
b.	Demarcation of Boundaries	5 x 1	5/year	5	
c.	Patrolling boats (2)	25 x 2	25/boat	50	
d.	Inflatable boats (2)	25 x 2	25/boat	50	
e.	Boat for tourists (two 8 seaters)	25 x 2	25/boat	50	
f.	Four wheelers (2) for ACF and two RFOs and Research Biologist	10 x 2	10/vehicle	20	
g.	Construction of floating Jetty (1) for tourists and staff boats	25 x 1	25/jetty	25	
h.	Construction of approach road to the Sanctuary from the Main road	(200 x 1) + (10 x 4)	200 for first year + 10/annum for years II to V	240	
II	**Wildlife Tourism, Interpretation and Conservation Education**				
a.	Strengthening the wetland biodiversity interpretation centre at Bakhira	(20 x 1) + (1 x 4)	20 for first year + 1/annum for years II to V	24	
b.	Development of two watch towers for patrolling and tourism	10 x 2	10/tower	20	
c.	Establishment and management of nature trails and boat routes	(25 x 1) + (5 x 4)	25 for first year + 5/annum for years II to V	45	
d.	Establishment of Nature camps and other logistic facilities for Tourists/visitors at Bakhira	(500 x 1) + (50 x 4)	500 for first year + 50/annum for years II to V	700	
e.	Establishment of Nature camps for school and college students with accommodation facilities for minimum 20 students	(20 x 1) + (2 x 4)	20 for first year + 2/annum for years II to V	28	
f.	Preparation and printing of awareness materials (Sanctuary Brochure, Checklist of Birds, Checklist of key fauna, Plant identification guide, Posters	1 x 5	1/year	5	
g.	Organising Outreach Programs	2 x 5	2/year	10	
h.	Establishment of Environmental clubs in schools and colleges	0.5 x 5	0.5/year	2.5	
i.	Establishment and maintenance of Audio-Visual Facilities	(5 x 1) + (0.25 x 4)	5 for first year + 0.25/annum for years II to V	6	
j.	Establishment of Bathing ghats for villagers and visitors	50 x 1	50/year	50	
k.	Establishment of fountains	(50 x 1) + (1 x 4)	50 for first year + 1/annum for years II to V	54	
l.	Lighting, park benches and seats	(50 x 1) + (0.5 x 4)	50 for first year + 0.5/annum for	52	

			years II to V		
III	**Pollution and Habitat Management (Cost to be estimated by Forest Department in consultation with SPCB & Fisheries department)**				
a.	Establish small scale sewage water treatment plants in villages around the Sanctuary	(50x1)+(2x4)	50 for first year + 2/annum for years II to V	58	
b.	Efficiently implement guidelines laid down by MoEFCC for the development of new industries/projects and for the existing industries, projects, treatment and dumping grounds in and around the area.	1 x 5	1/year	5	
c.	Monitoring of the pollution levels should be according the guidelines laid down by the Uttar Pradesh pollution control board	(1 x 1) + (0.5 x 4)	1 for first year + 0.5/annum for years II to V	3	
e.	Solid waste management	5 x 3	5/year	15	
f.	De-siltation of wetlands at selected points for birds	10 x 3	10/year	30	
g.	Develop the Sanctuary area is plastic free zone	1 x 2	1/year	2	
i.	De-weeding of invasive plants	5x3	5/year	15	
j.	Establish a 100 m Green belt (with planation of native tree species) along banks to protect and maintain near-stream vegetation that attenuates the release of sediment into stream channels	(50 x 1) + (5 x 4)	50 for first year + 5/annum for years II to V	70	
l.	Reclaim and restore satellite wetlands around BBS (within 50 km radius) through proper restoration techniques	10 x 2	10/year	20	
j.	Continuous monitor these wetlands, their properties and ecology in every season	(2) + (1x3) + (2)	2 for first year + 1/annum for years II to IV + 2 for fifth year	7	
k.	Stock enhancement of commercial fishes, crab and prawns may be carried out in these wetlands without disturbing the birds and other biodiversity of the region	5 x 3	5/year	15	
l.	Promote Bird watching and nature walk programs in these satellite wetlands	(10 x 1) + (1 x 4)	10 for first year + 1/annum for years II to V	14	
IV	**Long Term Conservation of Birds**				
a.	Regularly monitor the populations of birds	2 x 3	2/year	6	
b.	All the villages along the boundary of BBS should be brought under the Eco-Development Programme	50 x 5	50/year	250	
c.	Development of network of 'Green Cops/ Friends of Bakhira Sanctuary' comprising school and college students	2 x 5	2/year	10	

d.	Study the ecology and behaviour of certain migratory and breeding birds of BBS	(25 x 1) + (5 x 4)	25 for first year + 5/annum for years II to V	45	
e.	Habitat management for water birds of both migratory and resident	50 x 5	50/year	250	
V	**Sustainable Fisheries Management Plan (Cost to be calculated by Forest Dept with Fisheries Dept)**				
a.	Periodic Consultative dialogues and meetings with primary stakeholders (fishers) and State Fisheries Department	0.5 x 2	0.5/year	1	
b.	Mapping and demarcation of fishing zone inside the BBS through participatory and discussions with local communities	5 x 1	5/year	5	
c.	Promote sustainable fisheries through awareness programs	0.5 x 3	0.5/year	1.5	
d.	Ranching of suitable candidate species needed for stock enhancement inside BBS and their spill over would be fished	(5 x 1) + (2 x 1)	5/year (first year) + 2/year (fifth year)	7	
f.	Involvement of fishing communities in ecotourism activities				
g.	Awareness programs should be organized for minimizing catch of juveniles using slightly increased mesh size	0.5 x 5	0.5/year	2.5	
VI	**Disaster Management**				
a.	Shaping or strengthening of bund at vulnerable floods points of the Lake to protect property and life of villagers	100 x 2	100/year	200	
VII	**Climate Change Adaptation Plan**				
a.	Conservation of Eco-Sensitive Zone of BBS	1 x 5	1/year	5	
b.	Involving local communities in the management and minimize pressure on resources of BBS	1 x 5	1/year	5	
c.	Communicating and educating	1 x 5	1/year	5	
VII I	**Research, Monitoring and Training**				
a.	Establishing a Research and Monitoring Centre (RMC) at BBS	10 x 1	10/year	10	
b.	Avifaunal monitoring	2 x 5	2/year	10	
c.	Fish diversity monitoring	2 x 5	2/year	10	
d.	Habitat Monitoring	2 x 5	2/year	10	
e.	Socio-economic monitoring	2 x 5	2/year	10	
f.	Water and sediment quality monitoring	2 x 5	2/year	10	

g.	Preparation of Periodic monitoring reports	0.5 x 2	0.5/year	1	
h.	Appointment of Research Biologist and supporting staff	5+5.5+6+6.5+7	5 for first year with annual increment of 0.5/ year	30	
i.	Capacity building for in-house research and monitoring	1 x 5	1/year	5	
j.	Community involvement in research and monitoring	5 x 5	5/year	25	
IX	**Sustainable Eco-Development Plan for Community Involved Livelihood Generations**				
a.	Awareness and extension	5 x 5	5/year	25	
b.	Spearhead Teams Activities	10 x 5	10/year	50	
c.	Capacity building	5 x 5	5/year	25	
d.	**1.** Development of 'Village Conservation and Development Plans' (or Micro Planning)	50 x 1	50/year	50	
e.	The eco development programme at village level will have to be steered through Eco development committees and micro plans.	100 x 5	100/year	500	
f.	Chain link fencing (at selected areas to protect critical wildlife habitat from cattles)	50 x 1	50/year	50	
X	**Organisation and Administration (Cost to be estimated by Forest Department)**				
a.	Vehicular/boat infrastructure development:	(100 x 1) + (10/year)	100 for first year + 10/annum for years II to V	140	
			Grand Total	3447	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