Draft Management Plan
2020-2030
Harike Wildlife Sanctuary

NALIN YADAV,IFS

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CHAPTER 1: INTRODUCTION

Wetlands are called as biological super markets and kidney of landscape because they provide wide-ranging ecosystem services which support human well-being in a number of ways. Various plant and animal species depend on wetlands during different parts of their life-cycle. In order to ensure that wetlands continue to provide their ecosystem services and support biodiversity, it is essential that a well-defined strategy and actions are identified for their conservation and wise use.

Wetlands are among the most productive habitats on earth providing shelter and nursery areas for important animals like fish as well as resident and migratory birds. There are various ecological function regulated by wetlands for rivers too. The global extent of wetlands is now estimated to have declined between 64-71% in the 20th century, and wetland losses and degradation continue worldwide. Adverse changes to wetlands, including coral reefs, are estimated to result in more than US$ 20 trillion in losses of ecosystem services annually and the global value of ecosystem services can decline by $51 trillion/yr.(Kubiszewski et al., 2017). Kubiszewski et al., 2017 also mentioned that adopting a set of policies similar to those required to achieve the UN Sustainable Development Goals, would greatly enhance ecosystem services, human wellbeing and sustainability.

There can be growth of USD $30 trillion/yr.In India, wetland ecosystems showing some diverse and unique habitats with respect to high level of plant and animal diversity. These wetland systems display numerous ecological goods and services and revealed the importance in terms of human welfare and natural resource management.

In other words, wetlands act as a transitional zone between land and water and also provide extreme protection against floods. In view of this, wetlands are

considered as threatened part of our natural ecosystem. In this regards, there is continuous declining in area and quality of wetlands showing serious consequences on wild life. In this regard, immediate steps are taken for restoring and sustaining the existing wetland area (Memon et al., 2018).

In India, Wetlands occupied 4.7% of the total geographical area of the country where in Punjab covered less than 1% of its geographical area. The conservation of wetland is crucial for sustainable development therefore there is need for strong wetland management strategies with practical solutions. A management plan reflects a common understanding between various stakeholders on the management purpose, significant threats and constraints limiting conservation and wise use, opportunities and specific actions for addressing these threats, and mainstreaming wetlands within the wider developmental planning.

The main emphasis has been given during preparation of the Management Plan for Harike sanctuary for ecosystem conservation and livelihood security of the communities' directly or indirectly dependent on the Harike wetland for sustenance.

The plan emphasizes on ecotourism as a potential tool to conserve Harike Wetland and its rich biodiversity while providing economic incentives to the local communities. The management plan emphasizes the commitment of Government of Punjab, Indian Government and also Ramsar Secretariat for conservation and sustainable management of the Harike wetland in support of sustainable development goals (SDGs).

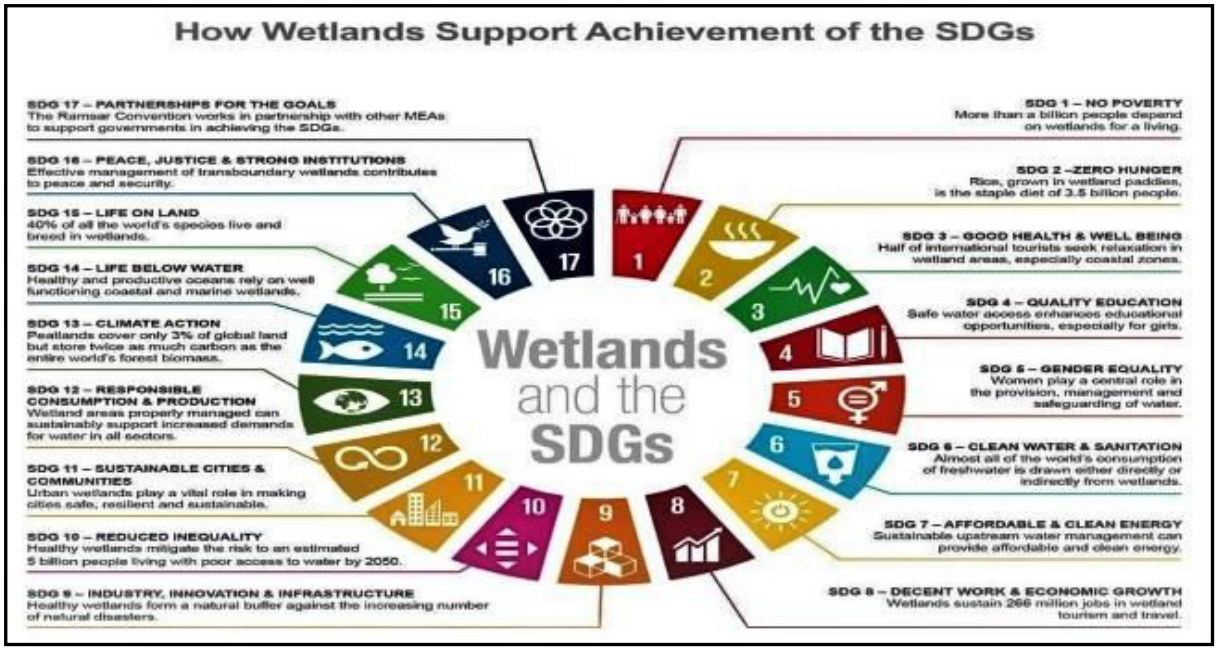


Fig: 1 Source: ramsar.org (sustainable development goals (SDGs)).

Wetland through optimum utilization of water in the reservoir, conservation and protection of the biodiversity. Wise use is the longest established example amongst intergovernmental processes, the implementation of which has become known as ecosystem approaches for conservation and sustainable development of natural resources, including wetlands. Wise use principle has been emphasized in the National Environment Policy (2006) and as the primary objective of the National Wetland Conservation Programme of the Ministry of Environment and Forests, Government of India.

The management framework presented in this plan represents the commitment of Government of Punjab, Government of India, and the Ramsar Convention on Wetlands to support conservation and wise use of resources in Harike Wildlife Sanctuary (here on words HWS).

CHAPTER 2: DESCRIPTION OF HARIKE WILDLIFE SANCTUARY

Harike Wildlife Sanctuary located in the state of Punjab, is a human-made reservoir at the confluence of Rivers Beas and Sutlej spreading over an area of approximately 86 sq. km. Harike reservoir came into existence in 1952 when barrage was put across the Beas and Sutlej rivers. It is a manmade wetland constructed to bring about water security to people of Punjab and nearby states. The area lies between 31º05'15"N and 31º14'15" North latitudes and 74º-55'30''and 75º-07'30'' East longitudes and falls in three districts of Punjab namely Ferozepur, Tarn Taran and Kapurthala.

The wildlife sanctuary is in triangular shape. Its southern boundary is formed with left marginal bund called L.M.B. (Left Marginal Bund), western with the barrage and metalled road and northern and eastern boundaries are formed with the confluence of Sutlej and Beas rivers. Ferozepur and Rajasthan feeders that emanates from the Harike Wildlife Sanctuary provides water to southern districts of Punjab and Rajasthan State.

The final notification of Harike Sanctuary was issued in 1999 under section 26-A, sub section of the Wildlife (Protection) Act, 1972. The sanctuary is managed by the Department of Forests and Wildlife Preservation, Punjab and protected under the Wildlife (Protection) Act, 1972 and amended Act, 2002. Harike Wildlife Sanctuary was designated as a Wetland of International Importance (Ramsar Site) in 1990 which tremendously increased the significance of this area.

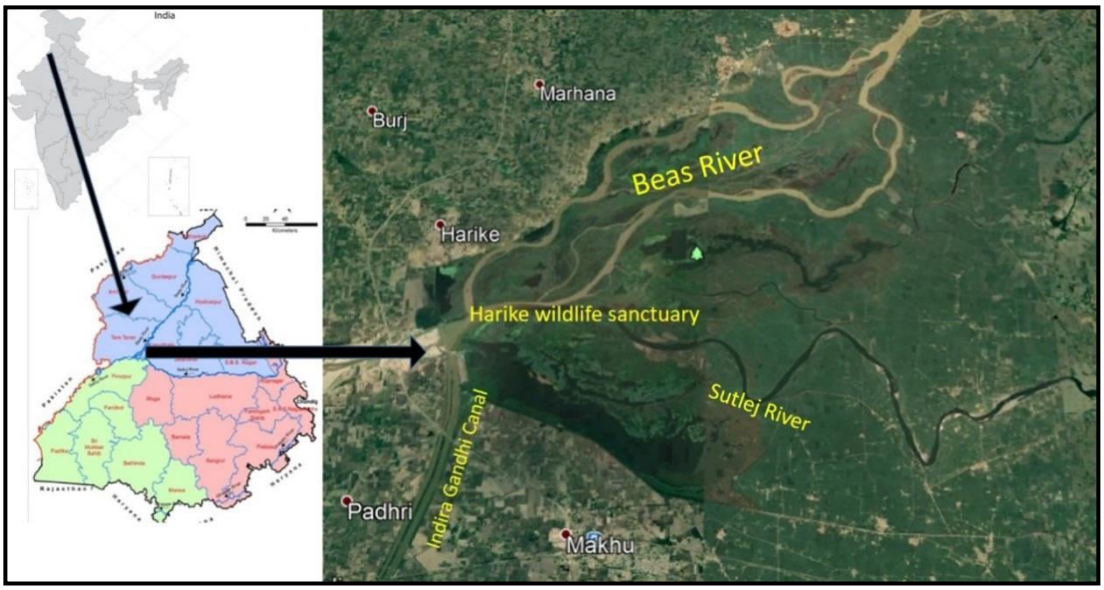


Fig 2: Location of Harike wildlife sanctuary with satellite image.

The terrestrial area

Even though Harike is a wetland area with a total area of 86 square km, significant area is dry land. Most of this dry land is located on the periphery as fertile floodplains, as flood protection embankments and in the form of many marshy islands of varying shapes and sizes.

The flood plains in the peripheral areas especially in the eastern part falling in the districts of Ferozepur and Kapurthala districts are very fertile and are mostly encroached and cultivated. The western side of the sanctuary falling in Amritsar district, especially in the villages of Kirian, Marar, Chamba and Kambo the soil is highly eroded and in the form of ravines. Efforts have been made with the coordinated efforts of the Department of Soil Conservation to check the erosion by constructing check dams and other mechanical structures.

However, these efforts need to be carried forward and given more impetus. There are big trees on western and southern boundaries where in northern and north-east boundaries is lack of trees. There is need ofbiological fencing with native vegetation to protect boundaries as well as biodiversity and this strategy will be useful to prohibit illegal encroachment in sanctuary.

The flood protection embankments are usually located at the boundary and performs the multiple tasks of not only protection bunds, but also as physical boundaries, approach roads, ideal habitat for species like the partridges, pheasants, lapwings etc. For example, the Left Marginal Bundh (LMB), which forms part of the southern boundary, also serves as an inspection/approach road, trekking route and bird watching area.

The LMB in particular is thickly wooded with the presence of old crops of shisham, kikar, jamun etc. There are also 14-15 year old plantations of arjun, willow, siris and subabul. However, most of the other bundhs are totally barren or are sparsely vegetated. These bundhs need to be planted up with suitable species to not only augment the habitat, but also to conserve the soil and water regime and to deter encroachments and cultivation by encroachers.

The islands are the ideal habitat of the birds and are characterized by almost total absence of trees, except some scattered and isolated ones, and the universal presence of tall grasses and reeds. These islands are also home to wild boars which can be seen basking in the afternoon sun and jackals, which are seen in early mornings or in the evenings.

The submerged area

In the total 86 square km area of the sanctuary, approximately half area consists of the wet area. However actual wet area is reduced on account of siltation and encroachment. Within the wet area, actual deep area is only 17-18 sq. km, rest is marshy area. Of the 17-18 sq. km deep water, open water is spread within 8-10 sq. km, rest is infested with water hyacinth. (PPCB, 1995)and water is lentic in several pockets and lotic in some portions. The water area is not contiguous as several islands and broken lands are found scattered within the wetland.

The wetland is surrounded by agricultural fields on all sides and largely by townships of Ferozepur and Kapurthala Districts. Effluents from these two

districts and increased agricultural activities find direct access to this lake. In addition, the wetland is influenced by domestic, agricultural and industrial waste of almost the whole Punjab brought in mainly by river Sutlej via Budda Nalla and Chittibein and to a lesser extent by river Beas and Kali-bein.

Legal position

Background:

The headworks built on the Sutlej River downstream of its confluence with Beas River and the reservoir created, which form the Harike lake and the enlarged wetland, is a purposeful project, which acts as the headworks for irrigation and drinking water supplies, through the Ferozepur, Rajasthan and Makhu feeder canals to supply to the command areas located in the states of Punjab and Rajasthan. The grand Indira Gandhi Canal in Rajasthan is fed from this source. The lake is triangular, with its apex in the west, bounded by a bund called the Dhussi Bund forming one side, a canal in the second and a major road on the third. The periphery of the lake is surrounded by agricultural land and the wetland is reported to be rich in ground water resources.

The land was initially acquired by the irrigation department for the purpose of barrage and the pond area. The ownershipof this land in the notified sanctuary had belonged to either revenue department or irrigation department.

All the land records and documentation pertaining to acquisition of land by the irrigation department from the affected villages were under their control and have never been transferred to the wildlife department. Even there have been communication from SDO Irrigation Harike to Revenue officials regarding removal of encroachment from their land.

Due to lack of availability of these records and lack of ownership with wildlife department, it has always become an impediment in demarcation of the sanctuary area and thus the actual area of the sanctuary at ground has not been clearly established.

However, with different notification the boundaries of the sanctuary were modified and the area was altered every time. However, there was no exercise on the ground to actually match this area from the one notified. Thus this lacuna has led to lack of proper demarcation in the area.

Wildlife Sanctuary Notifications

The area was first declared as a Sanctuary by Government of Punjab in 1976 vide gazette notification No. 4223- Ft-III-76/35745 dated 19th October, 1976 (Annexure 1), whereby an area of approximately 148 Km Sq. was declared as a Wildlife Sanctuary for a period of 10 years under section 18 (I) of Wildlife (Protection) Act, 1972 and prohibited the killing capturing, shooting and hunting of all kinds of wild birds and wild animals or carrying weapons in the area. The sanctuary was further notified in 1978 vide gazette notification of Punjab Government No. 4716-FT- III 78/ 4324 dated 15th March 1978, (Annexure 1).

In 1982, the sanctuary was again notified for a period of 10 years under section 18 (I) of Wildlife (Protection) Act, 1972 vide Gazette notification of Punjab Government No. 34 (4) FT –III- 82/11677 dated 26th August 1982, (Annexure 1). However, this time the “notified” area of the sanctuary has been reduced to 41. Sq. Km. approximately.

In 1992, the notification under section 18 (I) of the Wildlife (Protection) Act, 1972 was further extended for a further 10 years vide gazette notification No 34 (81) 92-1-T-IV/10818 Chandigarh Dated 8th Sept, 1992 Annexure 1). However, taking into consideration that the area downstream from the barrage is the only area where turtles are breeding and that the area near Left Marginal Bund and

Rajasthan Canal are used by waders, it was decided to include this useful habitat in the new notification.

Consequently, the "notified" area was again increased from 41sq km to 86 sq. km. Final notification of the area as a Sanctuary under section 26-A. of the Wildlife (Protection) Act, 1972 was made in 1999 vide notification No. 34/7/99-F.t-IV/16393 dated 18-11-1999 (Annexure 1). The area of sanctuary stands at 86 Sq. Km.

It may also be mentioned that recognizing the significance of the area as a wetland of international importance, Wetlands International, under the United Nations, declared the area as a Ramsar site in 1990, which is a rare and unique distinction.

Eco-sensitive zone

The zone of influence around Harike Sanctuary is 100m from sanctuary boundary which is also declared as the Eco-Sensitive zone by Notification No.SO.1568 E dated 12th May,2017. (Annexure 2)

The extent of the Eco-Sensitive Zone is an area of 100 meters all around the boundary of the Harike Wildlife Sanctuary comprising an area of 3.93 square kilometre approximately. The map of the Eco-Sensitive Zone and the boundary description of Harike Wildlife Sanctuary and its Eco-Sensitive Zone along with the latitudes and longitudes is annexed in notification. It also contains the list of villages whose area or parts thereof are falling within the Eco-Sensitive Zone along with the coordinates.

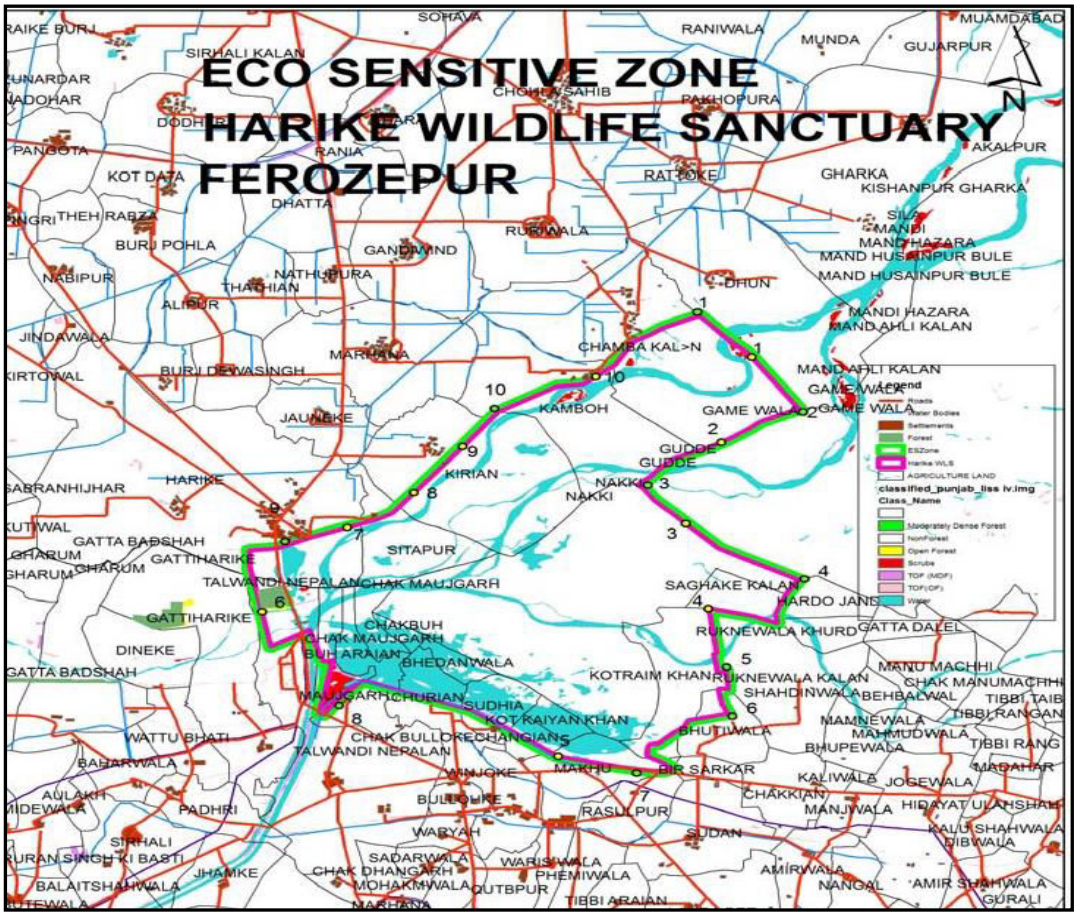


Fig: 3 Map of Eco-Sensitive Zone Boundary of Harike Wildlife Sanctuary, Punjab

Boundaries

The boundary of the sanctuary is not well defined in many areas. This is mainly because the area being marsh and inundated is hostile and not readily accessible. Moreover, the presence of encroachments and squatters has made it difficult to demarcate and delineate the boundary. The Sanctuary is bounded by the following natural boundaries:

NORTH: River Beas Bundh area terminated Village Kirian, Kambo Dhaiwala, Chamba kalan, Marar and Harike (district Amritsar), Marsh and River area (Government land) of Village Kirian, Kambo Dhaiwala, Chamba Kalan, Marar and Harike.

SOUTH: Left Bundh of Rajasthan canal (excluding Gurdwara Nanaksar, Harike Ishar Dham having an area of 104 Kanal 16 Marla) terminating at Bengaliwala Bridge and left bank of drain touching Village Mauzgarh (Ferozepur), Government land of Village Rasulpur and Bhottiwala in north of bund (district Ferozepur).

EAST: Government land of Village Jagjitpur, Khara, Mand Fatehpur, Nikki, Mand Kambo, Mand Kirian, Pipal, Singh-Ke-Kalan (district Kapurthala) and Kot Khaim Khan (district Ferozepur).

WEST: Harike-Makhu Road (Government land) of downstream Harike (district Amritsar), Government land of Village Talwandi Nepalan (district Ferozepur), Harike Head Works, River Sutlej downstream running water upto boundary touching Village Talwandi Nepalan.

Rights and concessions

There are no rights of any kind in these areas except the limited rights of water and way. After the final notification of the area as a Wild life Sanctuary in 1999 under section 26-A. of the Wildlife (Protection) Act, 1972, the ownership of the area vests with the Government and the management is in the hands of the

Department of Forests and Wild Life Preservation and no rights and concessions accrue as such.

Land use land cover

The Sanctuary is situated some 250 km from Chandigarh, the state capital. It is 58 km from Amritsar city and near to Tarntaran city, also the sanctuary is reachable from other areas like Jalandhar and Ludhiana via the town of Makhu, through a network of good roads. The nearest rail head is at Makhu and the nearest airport in Amritsar. It extends from 31° 8'33.73"N 74°56'8.76"E to 31°9'36.68"N 75° 1'33.26"E Latitude and from 31°12'2.58"N 75° 0'30.79"E to 31° 6'47.23"N 75° 0'2.82"E in longitude.

The zone of influence around HWS is 100m from sanctuary boundary which is also declared as the Eco-Sensitive zone by Notification No.SO.1568 E dated 12th May, 2017. The larger wetland area once stretched from village Goindwal Sahib along the river Beas and village Gidderpindi along the river Sutlej up to the village Kirtowal. However, the present form of the Sanctuary came into shape after the construction of the Harike Barrage. Harike reservoir came into existence when a barrage was constructed at the confluence of the Beas and Sutlej rivers near the town of Harike.

The present wetland area is more or less triangular in shape with the L.M.B. (Left Marginal Bund) forming one side, a road on the other and a canal on the third side. Hence, the type of wetland is a man-made reservoir comprising of waters from Beas and Sutlej rivers. The land use/land cover, settlements, drainage of Harike wetland ecosystem covering 295.5 sq. km. was mapped through on screen visual interpretation of multispectral IRS LISSIV and Carotsat 1 satellite data for the year 2010-11 by the Punjab Remote Sensing Centre, Ludhiana for the Harike wetland ecosystem which covers a large area. The Harike Sanctuary area of 86sqkm comes within this ecosystem.

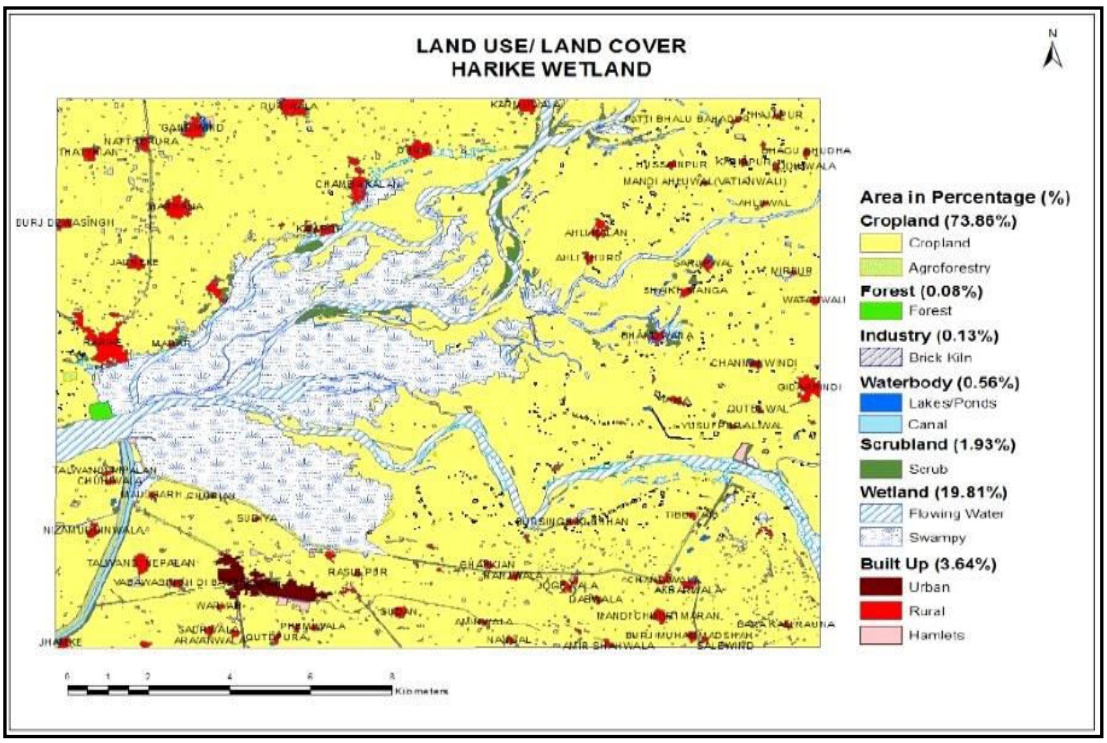


Fig 4: Land Use/Land Cover Harike Wetland (Source: PRSC,Ludhiana)

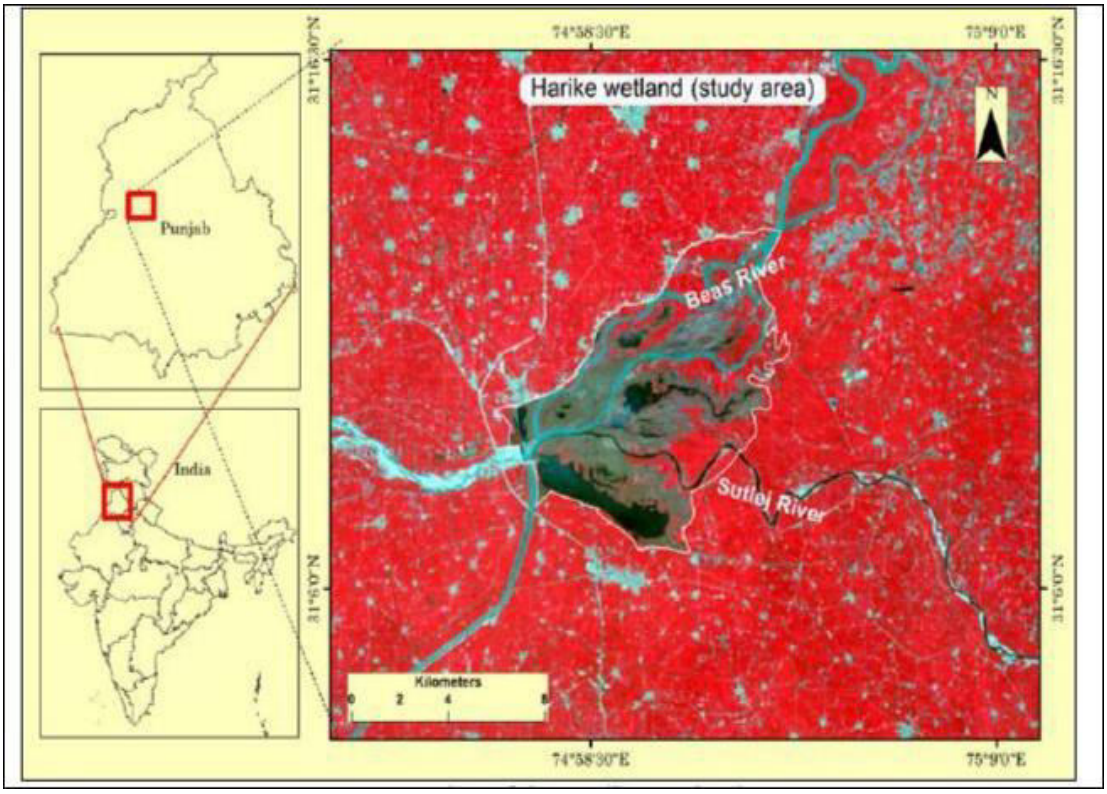


Fig 5: Harike wildlife sanctuary ***Source :***(Najar et al., 2017)

As per the scientific research paper Geospatial technology applied to spatiotemporal assessment of Harike Wetland, Punjab (2017) by Akanksha Bhardwaj, Gh Nabi Najar and Puneeta Pandey, the water area in the Harike Wetland is greater in the post-monsoon season than the monsoon and pre-monsoon seasons.The National Wetland Inventory and Assessment Report (SAC 2011), which mapped the wetland on the basis of pre-monsoon and post-monsoon data of 2007 as shown in the figure below.

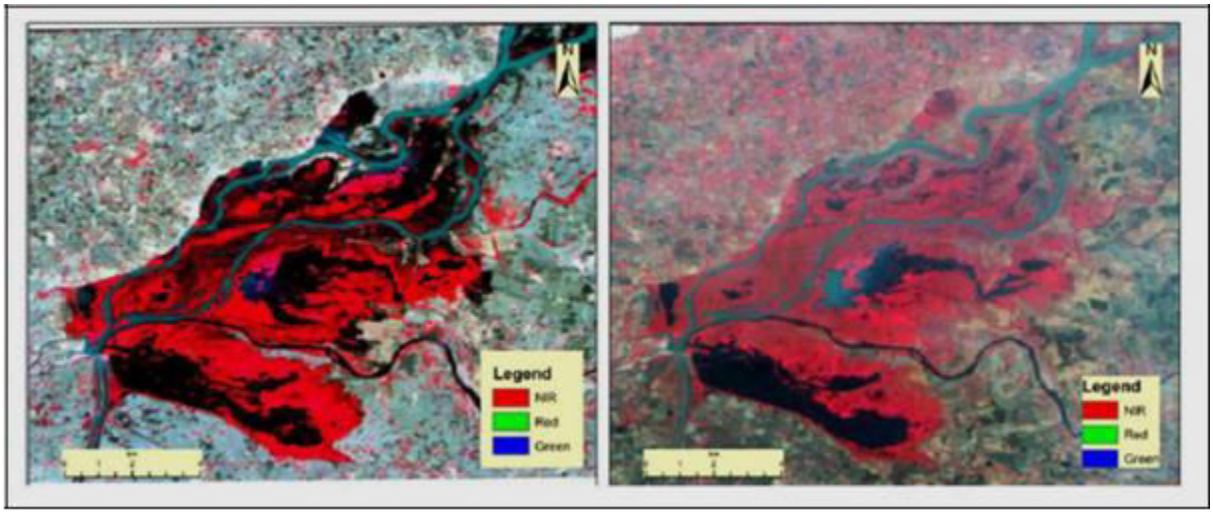


Fig 6: Pre and post monsoon map of the Wetland (Source: SAC 2011)

Harike Wildlife sanctuary is severely silted in the post monsoon season since it is heavily overloaded with the silt carried by the two rivers, Beas and Sutlej. Similarly, in a research paper "Estimation of Land Use/Land Cover Change of Harike by Gh Nabi Najar, Dr. Puneeta Pandey (2017) the following details are cited with respect to this wetland which gives an idea about the land cover change.

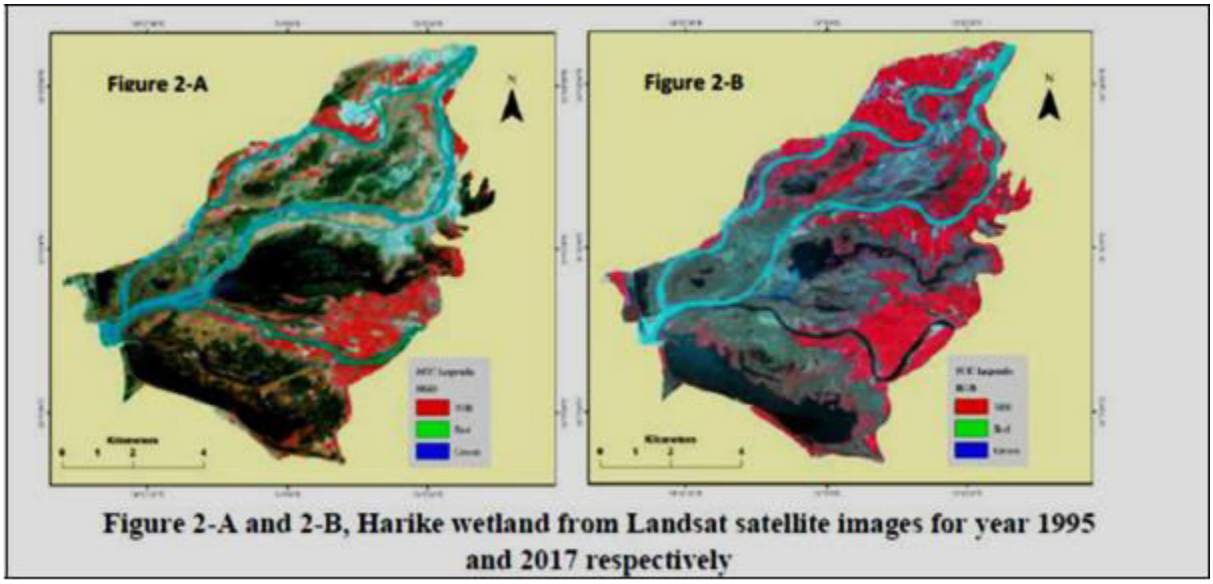


Fig 7: Land use and land cover change in Harike Wetland from the year 1995 to 2017.
Source: (Najar et al., 2017)

The paper also cites the wetland cover types used in image classification and interpretation with their definitions (Table 1)

Class	Definition
1. Water body	Areas of open water and small ponds including river Beas and Sutlej and the two Reservoirs (R1 and R2).
2. Wetland I	Dense vigorous vegetation including Eichhornia, some grasses and shrubs
3. Wetland II	Mainly composed of grasses (such as Typha and Arundo which are the two dominant vegetation types in the wetlands), and woodland vegetation.
4. Barren land	Residential areas, barren land, sandy lands along river Beas and Sutlej and bare soil
5. Agriculture land	Crop fields and fallow land.

In the year 1995 class water constituted 40.1 %(2975 ha) of the total area of Harike wetland which was subsequently reduced to 21.14% (1572 ha) in 2017.However, results shown that there was huge conversion towards the agricultural land from year 1995 (919 ha) to 2017 (2329 ha) accounting an increase of 153 percent. From 1995 to 2017 the barren land was reduced from 969 ha (13.04%) to 739 ha (9.94%) with decrease of 23.8%. Wetland vegetation type I and Wetland vegetation type II were changed from 1230 ha (16.55%) and

1342 ha (18.04%) from 1995 to 1511 ha (20.32%) and 1284 (17.27%) in 2017 respectively.

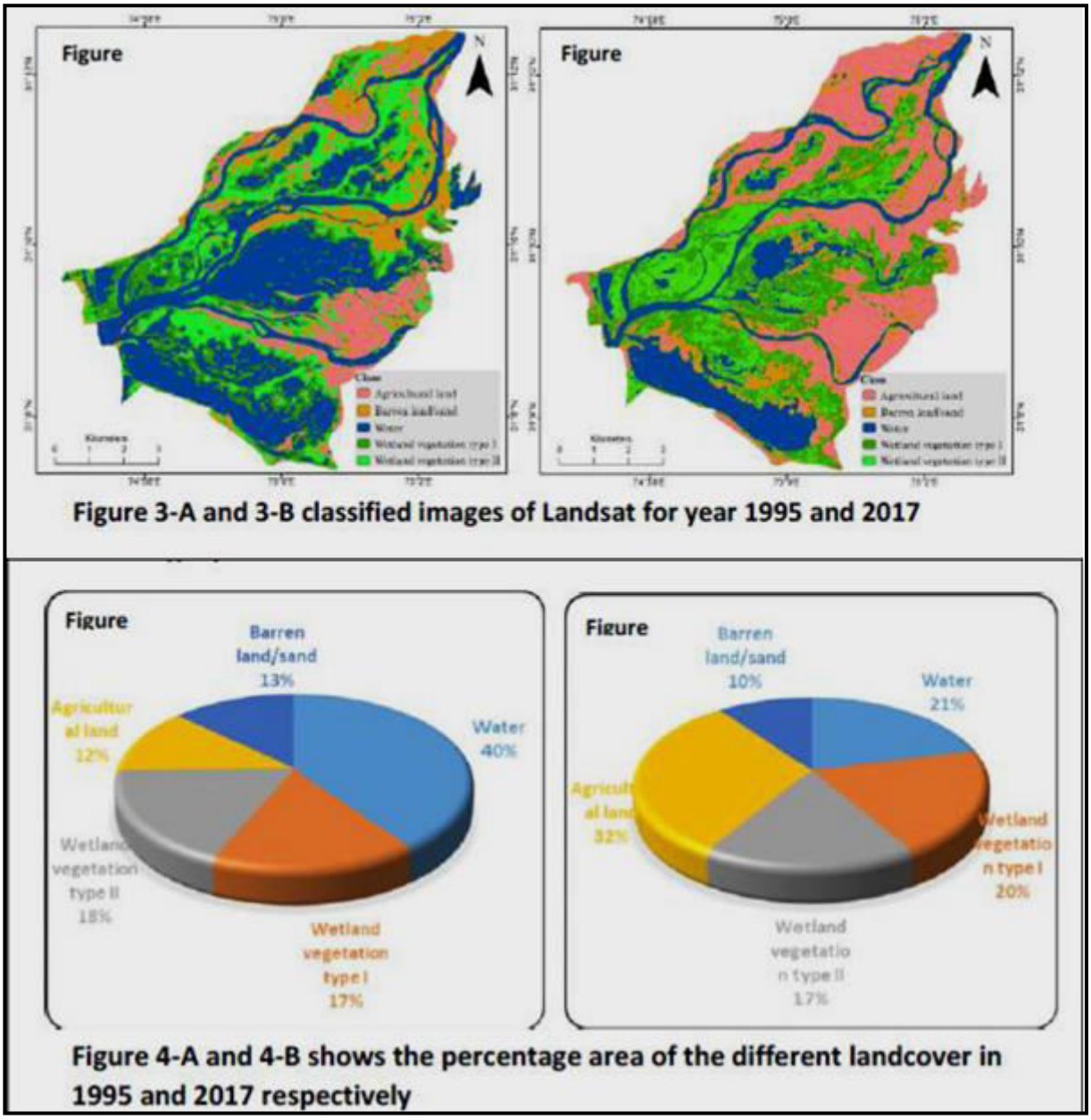


Fig 8: Land cover change in Harike Wetland from the year 1995 to 2017(Najar & Pandey, 2017)

Landover changes in percentage from year 1995 to 2017 has been summarised in the figure 6 which clearly indicates that in agricultural land there was highest increase (153%) whereas, water class indicates the highest decrease (-47.2%) in the land cover change. Land-use activities often affect the overall function of wetlands. The decrease in the water from 40% to 21% of the total area of the

wetland in 1995 and 2017 respectively is the indication of hydrology change of the wetland. Soil erosion and siltation are the other major issues responsible for the rapid land cover changes in the Harike wetland. The river Beas flows across the mountainous region of Himachal Pradesh carrying portion of sediment that ultimately finds its way to the wetland and there by replacing the water with swampy patches which further undergo succession. Further weed infestation such as *Eichhornia crassipes* (covers roughly 50% area of wetland), *Typha* species (dominant emergent marsh vegetation of Harike wetland) and *Nelumbo nucifera* worsen the situation. Uncontrolled discharge of waste water, industrial effluents carried by the water of river Sutlej and the surface run-off from the agricultural fields proliferate the aquatic weeds.

Distribution of Area

Terrestrial

The surrounding banks including the Bundhs, ravinous areas and the islands. It accounts for nearly 45 square km of the total area.

Water/Submerged

It includes the two main rivers draining into the area, the reservoir area and other seasonally submerged areas of varying depth. The total wet area contributes nearly 41 square km. The major area of sanctuary under agriculture land followed by rivers catchment and water body (Kumar, 2019).

Geology, rock and soil

On the north and east of the tract, the soil is fertile and is clayey in nature. It is drained off and subjected to erosion in low-lying areas. It is rich in organic manure and supports typical dry deciduous forest as well as cultivated in some areas by encroachers. The western side falling in Tarn Taran district has ravines and has serious problems of soil erosion.

Texture

The wetland area has sandy loam soil at the sites of inclusion of both the rivers. The texture becomes sandy (61.75-76.33%) at the confluence site, maybe due to the settling of sand, because of obstruction of the Barrage.

Characteristics

The soil in Harike is alkaline at all sites in all seasons with pH ranging between 7.25 to 8.04. The availability of organic carbon (0.40-0.55%), available nitrogen (9.4-26.4 mg/100gm), and available phosphorus (0.44-1.05 mg /100 g) within Harike makes it qualify for designation as **"**medium productive**"**. Specific conductance range of 208-245 mhos/cm along Sutlej bank site depict the area having large amount of dissolved solids in all seasons compared to Beas bank site, having conductance of 152- 211.67 mhos/cm. The values also depict that monsoons do not cause much dilution in influx of river Sutlej. The saturated soil along the wetland supports wetland birds as feeding ground. In moist soil butterflies also use them for mud paddling therefor the soil diversity supports variety of organism.

Drainage

Fig 9: Drainage Pattern of Harike Wetland (Source: Punjab remote Sensing Center.Ludhiana)

The depth of water varies from 0.3m to 1.8m. Though maximum recorded is 4.5m. There is proper water level maintenance provision. The water is drained by many small rivulets and nallahs besides two feeders i.e. Ferozepur and Rajasthan feeders that emanates from the Harike reservoir. The drainage is towards the south and south-west. The wetland is surrounded by agricultural fields on all sides and largely by townships of Tarn Taran and Kapurthala Districts. Effluents from these two districts and increased agricultural activities find direct access to this lake. In addition, the wetland is influenced by domestic, agricultural and industrial waste of almost the whole of Punjab brought in mainly by river Sutlej via Budda Nalla and Chittibein and to a lesser extent by river Beas and Kalibein. The Rajasthan and Ferozepur feeder canals, located at the southern part of the sanctuary, carry away approximately 29000 cubic feet per second of water to western Punjab and Rajasthan.

Climate

Temperature

The wetland experiences extreme heat during the months of April, May and June. The mean daily maximum temperature rises up to 43°C in June, and the mean daily minimum temperature can be as low as 0.60C in January. The winter extends from middle of November to middle of March. January is the coldest month with mean daily minimum temperature as low as 0.60C, occasionally dropping down below the freezing point of water.

Rain fall

The area normally experiences a dry climate all through the year, the monsoon showers constituting about 70 per cent of the annual rainfall. The average annual rainfall in the area during the last 15 years is about 700 mm. The

variation in rainfall during the year is appreciable. On an average there are 58 rainy days. Normally the months of July, August and September are wet months and remaining months of the year can be termed more or less dry months. Small portion of rainfall occurs during winter months of December to February. There are occasional showers during the summer months of April, May and June. The south-western monsoon begins in the first week of July and extends up to mid-September.

Frost

During winter, the frost is quite common. Wherever there is a long dry spell, the frost is quite severe. It causes considerable damage to young seedlings. Frost can be seen in the month of November to February every year. The visibility decreases by 10m sometime in late December and January.

Winds

During May and June hot and dry westerly winds locally called “LOO” are quite common. Dust storms also occur during these months. These are responsible for creating dry conditions. The strong winds followed by the rain during summer are responsible for uprooting of trees and breaking of big branches of large size old trees. During winter the cold spell carried by northerly winds is responsible for the retarded growth of plants.

CHAPTER 3: HYDROLOGICAL REGIME

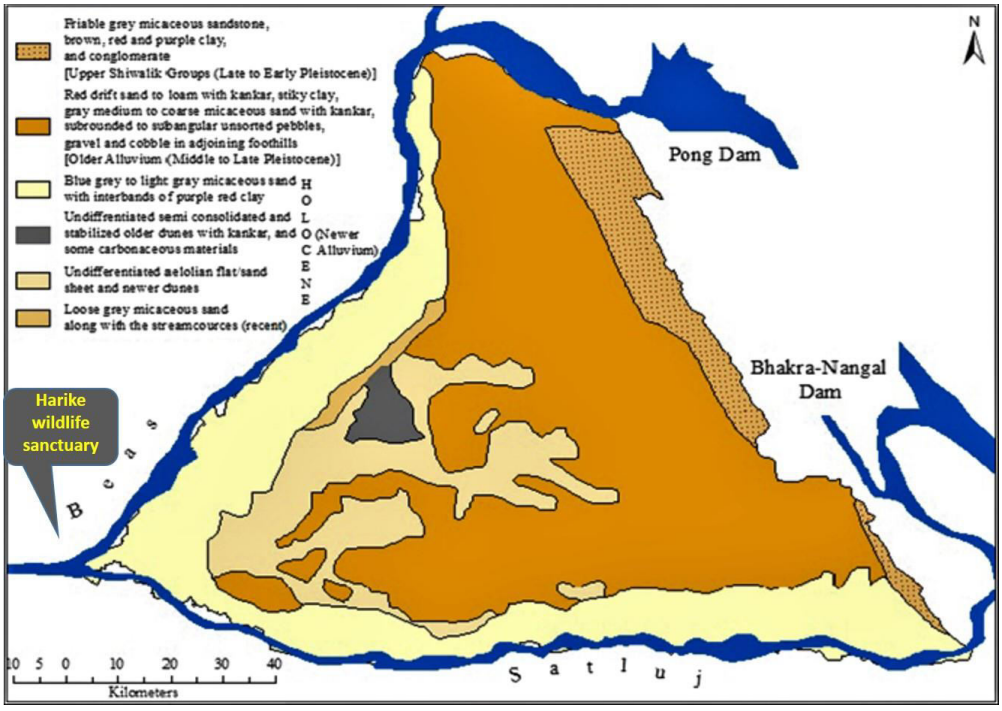


Fig 10: Hydrological Regime Source: (Gautam et al., 2020)

The Sutlej River is joined by the Beas River at Harike, where the Harike Barrage diverts water to the Rajasthan Canal and the Ferozepur. At Harike, inflows are also received from the Madhopur Beas link, which has a capacity of 280 m3/s and brings water from the River Ravi. Downstream of the barrage there is no dry season flow. The Rajasthan Canal has a capacity of 520 m3/s, and the Ferozepur Feeder a capacity of 315 m3/s. The water spread in Harike sanctuary post monsoon is greater because of the release of more water from the Pong and Bhakra Dams and the rainwater below the dams through feeding rivers. As a result of this the inundation and submersion of the villages close to the Harike sanctuary boundary is a huge problem in the monsoon season and also sedimentation due to huge quantity of silt brought downstream by the two rivers. The water holding capacity of the river has also decreased to problems like sedimentation and siltation along with encroachments in the sanctuary area. At Harike a bathymetric survey carried out in the year 2010 showed that Harike

Wetland has lost more than 83% of its water holding capacity over the past five decades as a consequence of rapid siltation.

Availability of water

As per the information provided by the Irrigation Department, the Harike Head works has sufficient water except summers (April-May), as such paucity of water is not a problem for the wetland. Availability of water in cusecs throughout the year is given below:

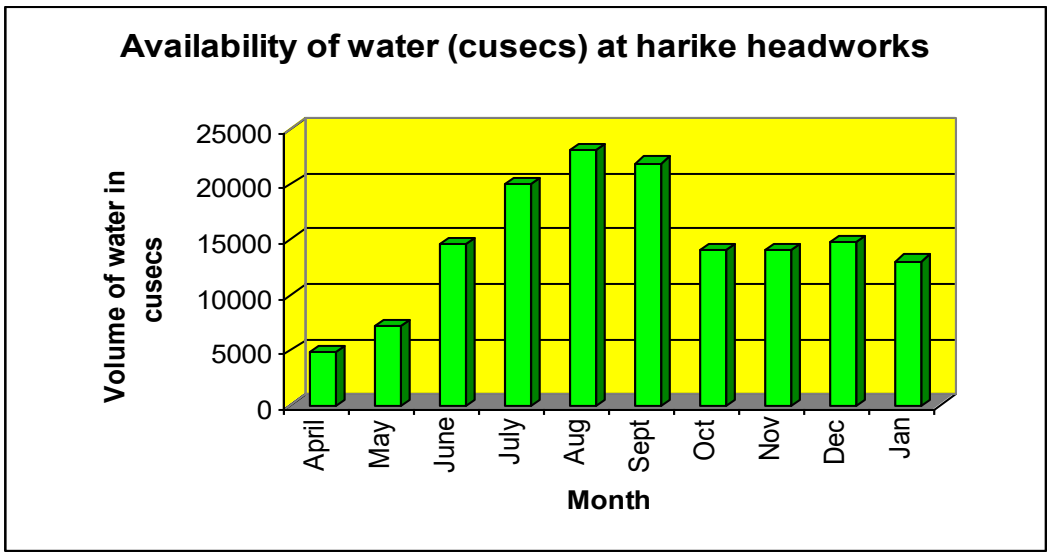


Fig 11: water discharge from Harike wetland from IGC Source: Punjab irrigation department

Water quality

As per the report "Status of water quality of Harike Wetland 2016-2017", prepared by Punjab Pollution Control Board,the water quality of Harike Lake conforms to Class-B with "pH between 6.5 and8.5,Dissolved Oxygen 5 mg/l or more, Total Coliform MPN/100ml 500 or less BOD 3 mg/l or less "as per the designated best use criteria of classification at Harike pattan which is largely due to the confluence of the river Beas, which is a relatively cleaner river with the river Sutlej. The river Sutlej is the most affected in terms of pollution which is from the Budha Nallah on the left bank and the East Bein on the right bank before it reaches Harike to form the lake with the river Beas, the meagre flow of

water in the river Sutlej also aggravates the problem as the dilution water is not available except during the rainy season and the quality of water is deteriorated in the whole stretch of river Sutlej till it reaches Harike. The parameters recorded at different sampling stations by PPCB in 2016-2017 is as given below:

The general criteria for water quality required for various beneficial use has been specified by the Central Pollution Control Board (1979). The Board has classified fresh/surface water into the following five "Designated Best Use" (DBU) classes:

A. Drinking water source without conventional treatment but after disinfection.
B. Original outdoor bathing.
C. Drinking water source with conventional treatment followed by disinfection.
D. Propagation of Wild life and fisheries.
E. Irrigation, industrial cooling and controlled water disposal.

Physical parameters

1. **pH**

   The pH at all the monitoring locations was found varied from 7.0 to 8.1 in the month of October, 2016 and 7.1to 8.0 during April, 2017.

2. **Turbidity**

   It is caused by the presence of suspended and colloidal matter such as clay, silt, organic and inorganic matter as well as aquatic organism. Turbidity was found to be 3to 89NTUinthe month of October, 2016 and varied between 4 to 48inApril, 2017.

3. **Conductivity**

   The conductivity of an aqueous solution express its ability to conduct or to carry an electric current which depends largely on the presence of ions and their total concentration, their mobility, their valency and relative concentration and of course on the temperature. At Harike Wetland the conductivity varied from 218 to 1636 micro S/cm

4. **Temperature:**

   Most of the processes going on in nature are influenced by temperature. Its immediate influence is on the dissolved oxygen content of the water and the metabolic activity of the organisms. Dissolution of oxygen in water at higher temperature decreases and its uptake by the micro-organisms for stabilizing the organic matter increases thereby leading to oxygen depletion affecting aquatic life. Water temperature of the wetland exhibits large fluctuations (table). The temperature is high during pre-monsoon: 29-300 C, moderate during post monsoon: 250C and very low during winter: 14-14.30C.n the month of October, 2016 and 192to 1694 microS/cm during April, 2017.

5. **Dissolved oxygen**

   Oxygen is required for all the organism to carry out metabolic activities and for production of energy for growth and reproduction. DO level was maximum in all the canals i.e. Ferozepur feeder canal, Rajasthan feeder canal & Bikaner canal. Varying between 2.4to 8.0mg/l in the month of October, 2016 and 2.8to 8.2mg/l during April, 2017.

Inorganic and non-metallic constituents

1. Chloride& Sulphate the Chloride contents in Natural water is due to dissolution of salts and discharge of sewage /drains and rain water in Rivers and Lakes. The concentration of chloride varied from 12to 134mg/l

in the month of October, 2016and 12 to 102 mg/l during April, 2017.Sulphate compounds originate from the oxidation of sulphite. The concentration of sulphate ions varied from 10to 126 mg/l in the month of October, 2016 and7 to 76mg/l during April, 2017.

2. Hardness

Calcium and magnesium exist in the form of oxides, hydroxides, carbonates and bicarbonates in the rocky stony beds which form the traversing ground for the rain waters and impart their character to the flowing water. Calciferous rocks impart natural hardness to water resources. Hardness of water is caused largely due to calcium and magnesium. Total Hardness was found between 90to 290mg/l in the month of October, 2016 and 40 to 226 mg/l during April, 2017.

Bio chemical oxygen demand & chemical oxygen demand

The organic matter present in surface water is broken down by natural process leads to depletion of oxygen. The amount of oxygen present in water helps to sustain aquatic life and it is important to know the BOD value remains below 5 mg/l during October, 2016 & April, 2017, whereas COD varied from 2 to 12 mg/l in the month of October 2016 & 2.5 to 384mg/l during April, 2017.

Heavy metals

Copper, Nickel, Arsenic, Mercury, Cadmium, Lead & Chrome were not detected at any sampling location. Iron was detected ranging from 0.06 to 0.38 mg/l. In the month of October 2016 & 0.12 to 0.17 mg/l during April, 2017 and Zinc was varied from 0.09 to 0.1 mg/l in October, 2016 and 0.09 mg/l to 0.28 mg/l during April, 2017. Nickel, Chrome, Cadmium & Lead

were not detected in sediment samples except Zinc which was detected ranging from 0.02 to 0.12 mg/gm in the month of October 2016 & upto 0.1 mg/gm during April, 2017.

Chemical characteristics

Table 2: Chemicals and its function and impact in water.

Chemicals	Details
1. Chloride:	Chloride occurs naturally as rock salt. The concentration of chloride in Beas varies from 29-43 mg/l, that in Sutlej from 26-46 mg/l and at the reservoir, the concentration is 28-48 mg/l.
2. Sulphate	Sulphate compounds originate from the oxidation of sulphite. The concentration of sulphate ions varies from 20-26 mg/l in Sutlej, 19-28 mg /l in Beas and 14-25 mg/l in the reservoir. Highest values are observe in the month of June.
3. Hardness, Calcium, magnesium	In addition to anthropogenic sources, calcium, magnesium and sodium ions are generally present in natural water. Their presence in the surface water could be attributed to the dissolution of salt deposits or surface run-offs. Calcium and magnesium exists as the oxides, hydroxides, carbonates and bicarbonates in the rocky stony beds which form the traversing ground for the rain waters and impart their character to the flowing waters. Calciferous rocks impart natural hardness to water resources. Hardness of water is caused largely due

	to calcium and magnesium. The concentration of these ions are in the order of Ca>Mg>Na. **In the Sutlej**, the total harness concentration is between 114-132 mg/l, whereas calcium and magnesium contents varies from 22-28 mg/l and 1.0 mg/l-1.9 mg/l respectively. **In Beas,** total hardness keeps fluctuating between 90-96 mg/l. The Ca concentration varies from 20-33 mg/l while that of magnesium changes from 7-11 mg/l. **In the reservoir area**, the total hardness concentration varies from 90-181 mg/l, Ca from 23-28 mg/l and mg from 4.9-9.8 mg/l.
4. Sodium and Potassium	Sodium ions are generally present in natural waters and the concentration found in the wetland area could be attributed to the dissolution of deposit or by surface runoffs apart from anthropogenic sources. **In Sutlej**, the concentration of Na varies from 1.6-1.9 mg/l and that of K is around 1.0 mg/l **In Beas** the concentration of Na varies from 0.8-2.9 mg/l and that of K varies from 1.6-2.4 mg/l **At the reservoir**, the concentration of sodium and potassium varies from 0.1-1.6 mg/l and 0.8-1.0 mg/l respectively.
5. Alkalinity	Seasonal variations in alkalinity are noticed. Alkalinity of the Sutlej water varies from 92-104 mg/l, that of the Beas from 84- 108 mg/l and that

	in the reservoir area is 102-110 mg/l
6. Organic matterBiochemical Oxygen Demand (BOD) and chemical Oxygen Demand (COD)	The organic matter which enters the aquatic system is broken down under natural conditions to various end products by the naturally occurring micro-organisms and in this process, dissolved oxygen depletion takes place resulting in an ecological imbalance affecting the aquatic life and causing problems. Hence, it becomes pertinent to know the amount of organic matter present in the surface water. BOD represents the amount of oxygen that would be needed by the natural microorganisms for stabilizing a bio-degradable waste under aerobic conditions, whereas COD represents the amount of oxygen required for stabilizing waste when the waste is oxidized with a strong chemical oxidizing mixture. The BOD in Sutlej is nearly 2mg/l in September-Dec, and March, whereas in June it increases to about 4 mg/l. Similarly, COD values are around 5mg/l and 8 mg/l respectively in the same corresponding period, indicating that the water quality is worst in the month of June, when water levels are the lowest. BOD of Beas water is 1-2 mg/l and COD 2-4 mg/l Similarly, in the reservoir area, the BOD is around 2 mg/l and COD 3-6 mg/l. The presence of comparatively higher levels of BOD in the month of June i.e. around 4 mg/l and

	lower levels in the month of Sept, Dec and March, i.e., around 2 mg/l is due to higher rates of respiration and metabolism at higher temperatures, lesser solubility of oxygen at higher temperatures and faster production of photosynthetic oxygen.
7. Total Kedah's Nitrogen	TKN represents the organically bound nitrogen. In both the rivers, the concentration of TKN varies from a minimum of 2. mg/l – a maximum of 4.8 mg/l. The concentration of TKN in the reservoir is slightly less than in both the rivers the minimum concentration being 1.8 gm/l and the maximum being 4.1 mg/l.
8. Nutrients (Nitrites, Nitrates and Phosphates)	The nitrogen which enters our river system is mainly in the form of organic Nitrogen and ammonical nitrogen. With the passage of time, the organic nitrogen is gradually converted into ammonical nitrogen and later on if sufficient oxygen and nitrifying bacteria are present it gets transformed into nitrites and the nitrates. Phosphates and nitrates are the major nutrients for the biota. Phosphates are the energy rich molecules and act as energy currency for all the metabolic and cellular activities of the phytoplankton. Phosphate is also the limiting nutrient for the aerophytes. Both phosphorus and nitrogen are known to enhance productivity and if these are present in sufficient quantity, eutrophication results.

	On the Sutlej side of the lake, the concentration of nitrites is negligible (0.0-0.11). The nitrate concentration caries from 0.09-0.2 mg/l and that of phosphates ranged between 0.2-2.0 mg/l. On the Beas side, the nitrite concentration increases from 0.07-0.2 mg/l and that of nitrates varies from 0.12-0.21 mg/l while phosphates increase from 0.1-1.6 mg/l. At the reservoir area, the concentration of nitrite varies from 0-0.2 mg/l, that of nitrates from 0.08-0.4 mg/l while the concentration of phosphates fluctuates from 0.2-1.4 mg/l.
9. Pesticides in water and sediment	In Sutlej water, DDT is detected in the range of 3.0-6.1 mg/l and BHC from 0.5-0.9 mg/l whereas in the sediments DDT and BHC concentrations are 10.6-12.4 mg/g and 1.3-1.7 mg/g respectively. In Beas water, DDT concentration is 2.4-8.3 mg/l and BHC 0.5-0.8 mg/l. In sediments of the Beas, the concentrations of DDT are observed to be 4.6-10.2 mg/l while that of BHC is 0.9-1.2 mg/l. At the reservoir area, the DDT and BHC concentrations vary from 6.0-15 mg/l and 0.9-4.9 mg/l respectively. Sediment samples are found to contain 15.8-20.0 mg/g DDT and 1.0 – 1.5 mg/g BHC. This data indicates that river Sutlej is carrying more load of pesticides in comparison to river Beas and the pesticides have an accumulating

	effect owing to their non-biodegradability. Consequently, higher levels of pesticides like DDT and BHC have been detected in the sediments of Sutlej.
10.Heavy Metals	In water Copper, nickel, chromium and lead are not detected in the river water of Sutlej, Beas and the reservoir area. Zinc is being detected, however in small quantities. Its presence indicates the possible inputs from surface runoffs of residual fertilizers from the adjoining fields. In Sediments The concentration of zinc varies in sediments of Sutlej from 0.4-0.8 µg/g, it varies from 0.2-0.6 µg/g in Beas and from 0.9-1.0 µg/g in the reservoir area. The concentration of nickel varies from 0.01-0.06 µg/g, in sediments of both Beas and Sutlej. It varies from 0.07- 0.1 µg/g in the reservoir area. The concentration of chromium varies from 0.1-0.03 µg/g, in sediments of both Beas and Sutlej. It varies from 0.02- 0.04 µg/g in the reservoir area. The concentration of lead varies in sediments of Sutlej from 0.1-0.4 µg/g, it varies from 0.052-0.06 µg/g in Beas and from 0.2-0.5 µg/g in the reservoir area.

CHAPTER 4: BIODIVERSITY

The Flora

The flora of the sanctuary is dominated by the marshy conditions. However, the terrestrial flora as well as the water based flora like the planktons are equally important and play significant roles in the ecosystem. The vegetation species composition is important to maintain biodiversity therefore regular monitoring of vegetation in mandatory. The terrestrial animals and birds have specific habitat hence to regulate function of healthy ecosystem. Availability of floral diversity is key for sustainable habitats. Vegetation checklist is given in annexure.

Habitat and vegetation distribution

Table 3: Habitat diversity and vegetation composition

Habitat	Vegetation distribution
1. Terrestrial Area	*Dalbergia sissoo* (Shisham). *Vachellia nilotica*(Kikar/Babul), *Eucalyptus* hybrid, *Mangifera indica* (Mango), *Morus alba* (Toot), *Syzygium cumini* (Jamun), *Albizzia lebbeck* (Siris), *Acacia leucophloea* (Reru), *Azadirachta indica* (Neem). *Melia azadirachta* (Drek) and *Prosopis cineraria*(jand) However, there is also scattered presence of other species like *Ficus benghalensis* (borh), *Ficus religiosa* (Pipal), *Butea monosperma* (Dhak), *Pheonix sylvestris* (Khajur), *Populus deltoids* (poplar), *Ziziphus mauritiana* (Beri), *Bombax ceiba* (Simal) and*Cassia fistula*species.
2. Under growth:	It consists of *Zizyphus numullaria* (Mallah). *Artemisia scoparial* (Jhau), *Calotropis procera* (Akk), *Capparis*

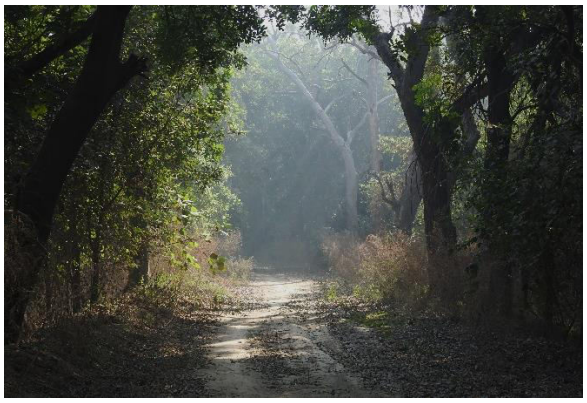
	sapiaria (Mins) *Cannabis sativa* (Bhang), *Capparis decidua*(Karir), *Carissa carandas* (Karonda), *Cassia tora* (Panwar), *Lantana camara* (punj phulli) and *Adhatoda vasica* (Basuti)
3. Ground Flora:	The vegetation is characteristic of normal forest strips of the adjoining areas as it comprises of considerably a large number of grasses, herbs and shrubs. Most of the strips, especially the water logged and low-lying areas adjoining the bundhs at the periphery, bear dense growth of Kana, Kahi. Thick growth of Kana/Kahi (*Sachrum* spp.), Panni (*Vetiveria zizanioides*), Dab (*Dismestachya bi-pinnate*), Bater (*Typha elephentina*). Khabbal (*Cynodon dactylon*) is found in moderately grazed areas. *Cenchrus* species (Amjan) grow in sandy places and *Desmostachya bipinnata* (Dab) flourishes under dry conditions. *Vetiveria zizanoides* (panni) is met within heavy soil which get flooded and *Typha elephentiana* (Buter) grown on water logged sites. Areas which have slight salinity carry *Aristida* species.
4. Marshy areas:	The marshy areas are the characteristics of the sanctuary. These are basically low lying areas which are inundated with water throughout or at least a part of the year. The characteristic vegetation is *Typha elephantine*, *Phragmites karka* and tall grasses, mainly *Saccharum spontaneaum* and *Saccharum benghalensis.* There are also *Cenchrus* species (Amjan) in sandy places and *Desmostachya bipinnata* (Dab) flourishes under dry conditions. *Vetiveria zizanoides, Arundo donax*,

	Eragrostis atrovirens, *Cyperus rotundus*, *Cyperus deformis* are the other major species in the marshy areas
5. Free floating	Water hyacinth (*Eichhornia crassipes*) and *Azolla* are the dominant free floating species
6. Rooted Floating	The rooted, floating species include lotus (*Nelumbo nucifera*), water lilies (*Nymphaea nouchali*, *Nymphaea stellata*), *Trapa bispinosa*
7. Submerged	The submerged species include *Hydrilla verticillata*, *Vallisneria, Hydrocharis* etc

Different Habitats in HWS

Deep Wetland

Woodland



Sandy area

Marshy area

Fig 12: Habitat diversity at Harike Wildlife Sanctuary

MICRO-ORGANISM IN WATER

Planktons

The standing crop density of plankton ranges from 267-300 µ/l along the Sutlej bank, high during pre-monsoon than in other seasons. The density along Beas bank is comparatively more 325-350 µl, and at the confluence sit, the density is midway between the two, 300-333 µ/l, (low during winter)(Moza & Mishra, 2008).

There is a marked variation in the composition of the planktons at the three sites. At the Sutlej river the population composition is around 69% phytoplankton and 31 % zooplankton. Phytoplankton is contributed almost equally by bacillariophyceae (26.13-29.15%), chlorophyceae (20.6-23.3%) and myxophyceae (17.75-21.6%). Zooplankton population was contributed by rotifers (8.3-11.11%), copepods (4.7-20.8%), and cladocerans (0-16.63%). Dominance of cladocerans during winter season confirms that during winter, polluted ingredients especially organic in nature increases in Sutlej, and consequently in Harike.

At the Beas side, the composition is 77% phytoplankton and 23% zooplanktons. Phytoplankton is contributed almost by bacillariophyceae (30.9-39.78%), chlorophyceae (20.52-30.9%) and myxophyceae (14.4-15.4%). Zooplankton population was contributed by rotifers (3.7-8.92%), copepods (9.7-15.4%), only. Comparatively low presence of blue-green algae and absence of cladocerans at this site in all seasons denote that the amount and nature of effluent brought in by Beas is comparatively less polluted than Sutlej(Moza & Mishra, 2008).

The composition of the planktons at the confluence is 81.4% phytoplankton and 18.6% zooplanktons. Phytoplankton is contributed almost by bacillariophyceae (27.15-29.20%), chlorophyceae (30-40%) and myxophyceae (16.36-23%). Zooplankton population was contributed by rotifers (10.80-16.30%), copepods (0-8.3%), only. The dominance of chlorophyceae, presence of considerable myxophyceae and rotifers exhibit that this site is eutrophic.

Periphyton

Overall, the density of periphytons is low during pre-monsoon (nil) and high during post-monsoon (350-367µcm2.).

At the Sutlej side the population composition like in the case of planktons is equally contributed by bacillariophyceae (30.26-37%), chlorophyceae (27.64-36.93%) and myxophyceae (32.22-37.2%). Presence of blue green algae almost equal to diatoms in open water system denotes the site polluted.

At the Beas side, the periphytons crop ranges between 150-433µcm2, low during pre-monsoon and high during post-monsoon. The population was formed of bacillariophyceae (33.3-48-2%), chlorophyceae (34.90-50%) and myxophyceae (16.6-21.90%). Obvious change in periphytons concentration and composition show that concentration of nutrient load brought by Beas varies significantly in different seasons compared to Sutlej. It being high during pre-monsoon than in other seasons.

The confluence site shows comparatively less changes in periphytons density (200-400µcm2) and composition of bacillariophyceae (49.6-53.3%), chlorophyceae (30.3-36.65%) and myxophyceae (10.0-19.4%) has almost similar contribution towards population in different seasons. Dominance of diatoms depicts this site less polluted than the other two sites.

The microphytic vegetation of Harike is mainly formed of:

- Diatoms : *Navicula, Nitzscia, Diatoma, Cymbella, Synedra*
- Green algae : *Spirogyra, Ulothrix, Crucigera*
- Blue green algae : *Spirulina, Microcystis, Phormidium*
- Rotifers : *Branchiomus, Ppolyarthra, Filinia*
- Cladocerans : *Daphnia*
- Copepods : *Cyclops*

The Fauna

Harike Wildlife Sanctuary is better known by the name of bird sanctuary as it attracts thousands of migratory birds besides this wetland also support many resident birds. Many resident birds species are breeding in sanctuary including some threatened species including Oriental darter (*Anhinga melanogaster*). The diverse habitat supports various kind of fauna including some critically endangered animals such as Indus river dolphin (*Platanista gangetica minor*) and Gharial*(Gavialis gangeticus*). The wood land provide hiding, foraging and reproduction round for mammals like Sambar deer (*Rusa unicolor*), Indian hog deer (*Axis porcinus),* Golden jackal (*Canis aureus*), Indian porcupine *(Hystrix indica)* and wild boar *(Sus scrofa).*The present existing knowledge of the occurrence and status of wildlife including fishes which are important from management point of view, is briefly discussed as below:

Birds

Harike wetland is a bird lover's and birdwatcher's paradise. This is because the wetland offers a variety of habitats to different bird species throughout the year. The islands inside the wetlands are prone to inundation during the monsoon season and then dry up. Subsequently they become covered with thick and sparse vegetation and provide ideal habitats to different bird species. In addition, they provide safe refuge for nest building and breeding.

The Bombay Natural History Society (BNHS) undertook a bird ringing study at Harike from Dec 25, 1980- 1985, during which a total of 167 bird species were

recorded of which 40 species were long distance migrants which pass through, or winter at Harike lake. The study also revealed that two bird flyways or migratory routes exists, one radiating westwards and the other towards the east. The migrants using the western passage use Harike as a stopover before moving to Bharatpur (Rajasthan), while the eastern passage ends at Point Calimere, Tamil Nadu.

The bird census in Harike wildlife sanctuary is organized by the Department Of Forest And Wildlife Preservation every year and is conducted with the help of field staff, technical experts from WWF and expert members from different organizations like BNHS, Chandigarh Bird Club, Amritsar Bird club, Avian Habitat and Wetland Conservation Society, Chandigarh, Ludhiana Bird club and Faridkot Bird club and Jagriti Samiti, Nangal and independent birders/naturalists from all over Punjab. The WWF team is involved in collaboration with wildlife staff in reconnaissance survey, orientation for the members, data collection, compilation and technical reporting. The census is carried out along with WWF staff with the approval given by the office of the Chief Wildlife Warden, Punjab.

91025 birds were recorded in last census in Jan 2020. Large flocks or Graylag goose (*Anser anser*), Bar headed goose (*Anser indicus*), Gadwall (*Mareca strepera*), Northern shoveler (*Spatula clypeata*), common teal (*Anas crecca*) and common coot (*Fulica atra*) arrive in the winters every year. Over a hundred greater flamingo were also spotted in the last year census.

The Forest and Wildlife Department has not carried out a detailed study with regards to census or population estimation, species distribution and pattern etc. however, by utilizing the available data carried out by various agencies and by ground verification on sample basis, the current species list for Harike is 391 avian species. This figure is arrived at by combining the data available from the first and second BNHS counts (Ali et al, 1982, Prakash et al, 1997, checklist

prepared by Ladhar et al, 1994, Ladhar et al, 2001, and Dhillon et al, 1996) as well as data from Kazmierczak et al, 1998 and Prasad, 2001 (Pers.com) and Harvey, 2002.

The overall avifaunal diversity is amazing with the 366 species accounting for of Punjab's entire avifaunal diversity (species). Of these 42.2 % are aquatic birds (Prakash et al, 1997). 9.4% are predominantly fish eating, 7.7% feed on deep water vegetation, aquatic invertebrates and insects and 8% comprises birds of prey including scavengers and rest are insectivorous and grainivorous. (Hussain S. A. 1979-84).

Harike is also home to several vulnerable and near threatened species. The vulnerable species include following :-

Table 4: Threatened species of birds

S.no	Birds	IUCN status
1	Ferruginous pochard (*Aythya nyroca*)	Near Threatened (Population decreasing)
2	Pallas's fish eagle (*Haliaeetus leucoryphus)*	Vulnerable (Population decreasing)
3	black-bellied tern (*Sterna acuticauda*)	Endangered (Population decreasing)
4	Greater spotted eagle (*Clanga clanga*)	Vulnerable (population decreasing)
5	Indian skimmer *(Rynchops albicollis*)	Vulnerable (population decreasing)
6	Oriental darter (*Anhinga melanogaster*)	Near threatened
7	Painted stork *(Mycteria leucocephala)*	Near threatened
8	Asian Openbill *(Anastomus oscitans)*	Near threatened
9	Whitebacked vulture*(Gyps bengalensis)*	Near threatened
10	Longbilled vulture*(Gyps indicus)*	Near threatened

Harike has a number of bird sightings and records more than 200 birds in year specially the Penduline Tit (Remiz pendulinus) were observed near the head works as well as in the plantation forest (Prakash et al, 1997) providing for the first record for these birds in Punjab. Similarly, the Rufous-vented Prinia (*Prinia burnesii*) was also recorded for the first time. The Syke's Nightjar

(*Caprimulgus mahrattensis*) were found to breed at Harike while the booted warbler (*Hippolais caligata*), the slenderbilled gull (*Larus genei*) and the Palebacked pigeon (*Columba eversmanii*) were also sighted. Other species that are national rarities include the white headed Duck (*Oxyura leucocephala*), European golden plover (*Pluvialis apricaria*), longbilled dowitcher (*Limnodromus scolopaceus*), Buff breasted sandpiper (*Tryngites subruficollis*), little gull (*Larus minutus*), Mew gull (*L.canus*), Black tern (*Chlidonias niger*), Chaffinch (*Fringilaa coelebs*), Eurasian linnet (*Carduelis cannabina*) and the corn bunting (*Miliaria calandra*).

Every year bird census is conducted in Harike wildlife sanctuary in the peak winter season in the month of January to estimate the count of migratory birds visiting the wetland. The details of bird census conducted at Harike Wildlife Sanctuary is as given below. The trend of the counts of birds visiting thesanctuary over the years show an ecosystem which is conducive for the winged visitors to use this habitat as breeding, wintering and staging ground.

Table 5: showing the bird count recorded during bird census from the year 2013 to 2021.

Year	Bird Count	No. of Species
2013	72488	76
2014	62065	71
2015	82100	73
2016	105890	83
2017	93488	86
2018	94771	93
2019	123128	83
2020	91025	94
2021	74869	88

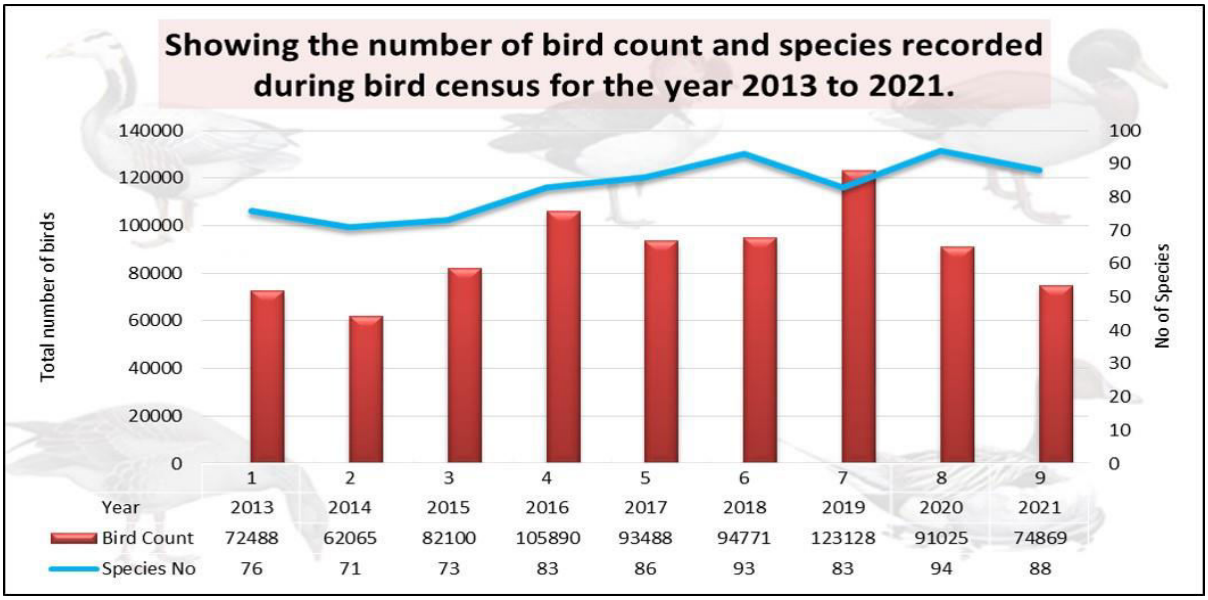


Fig 13: Bird's census from 2013 to 2021 in winter season

Minimum and maximum number of birds have been reported in 2014 and 2019 respectively.

In 2017 Black kite, Black-necked Grebe, Black-winged Kite, Common kestrel, Garganey, Great Bittern, Hen Harrier, Indian Black ibis, Little tern, Montagu's Harrier, Pallid Harrier were some new species reported from last year. In 2018 Ashy Prinia, Barn Swallow, Garganey, Jack Snipe, Jerdon's Babbler, Plain Martin, Striated heron, Yellow Bittern weresome new species reported. In year 2019 Eurasian Bittern, Jack Snipe, Slender Billed Gull, White-winged Tern, Yellow Bittern are New Species reported. In year 2020 Ashy Prinia, Black Bittern, Common Ringed Plover, Indian Stone Curlew, Jack Snipte, Jerdon's Babler, Osprey, Rufous-vented Prinia are New Species reported. In year 2021 Black Bittern, Horned Grebe, Isabelline Shirke, Steppe Eagle, Striated Heron, Wire-tailed swallow were new species reported which were not seen last year.

Mammals

Harike Wildlife Sanctuary harbours Indus River Dolphin (*Platanista gangetica minor*), Hog deer (*Axis porcinus*), Wild boar (*Sus scrofa*), Jungle cat (*Felis chaus*), Smooth Indian otter (*Lutra perspicillata*), Jackal (*Canis aureus*)

,common Mongoose (*Herpests edwardsi*), Indian crested porcupine (*Hystrix indica*) and Common Indian hare (*Lepus nigricolli*).The wild boars (*Sus scrofa*) come out to feed in late evening and early morning either in pairs or in herds. Their sense of smell is very acute whereas sense of sight and hearing is moderate. Four to six young ones are borne at a time. Mother is known to build a nest of heaped grass to hide their young ones. Being a riverine area Hog deer (*Axis porcinus*) is found in the area. They are mostly sighted in the islands having thick grass cover. Smooth Indian otter (*Lutra perspicillata*) has been listed in the IUCN Red List of Threatened Animals (1994). Otters inhabit burrows along the left marginal bundh and also on the islands. Jackals can be seen early in the morning or in late evenings at the left marginal bundh and sometimes at the "nose" of the reservoir.

Smooth coated otter
(Lutrogale perspicillata)

Wild Boar
(*Sus scrofa*)

Sambar Deer
(Rusa unicolor)

Fig 14: Some picture from a camera trap exercise done in Sept 2020.

The Indus River dolphin (*Platanista gangetica minor*), listed endangered by the IUCN red list, is a freshwater dolphin endemic to the Indus River system. The River Beas in Punjab is home to the only population of Indus River dolphins in India. The River Beas flows for 185Km through Punjab starting from 52 Head works, Talwara to Harike Headwork's. This 185Km stretch of the River Beas in Punjab was declared as a Conservation Reserve under the Wildlife Protection Act, 1972 on 29 August 2017.

Figure 15: Indus River Dolphin (*Platanista gangetica minor), sighted in Harike Sanctuary.*

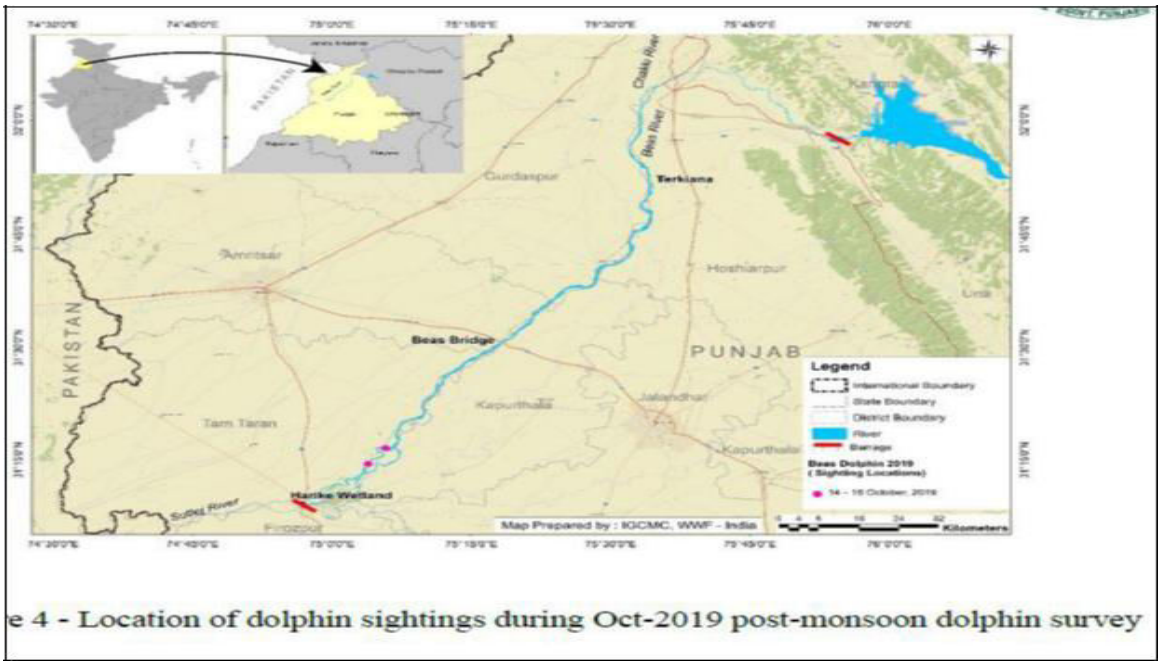
Later on 8th March 2019 in pursuance to the recommendations made by the Punjab State Board for Wildlife in its 2nd meeting held on 1.2.2019 under the Chairmanship of Hon'ble Chief Minister, Punjab, Indus River Dolphin (*Platanista gangetica minor*) was declared as "**StateAquatic Animal**" of State of Punjab. Notification is attached as Annexure-III

Indus River Dolphin Monitoring: Itis done by the department and WWF-India with the intent to conduct dolphin surveys twice in a year i.e. pre and post monsoon survey to estimate abundance of the dolphin, to detect changes in distribution and/or abundance, and identify key threats and devise a species long term conservation strategy.The field survey is conducted using two independent observation teams recording direct counts of dolphins from vessels travelling in

tandem along a *thalweg* (the line connecting the deepest points in the channel in cross-section) transect. There are two rigid inflatable boat used which are powered by 25hp outboard motors that travelled downstream, in tandem, separated by 1-1.5 km (approximately 10 mins) Significant secondary channels, split channels, or braids were surveyed by the rear boat, while the forward vessel continued along the main channel.

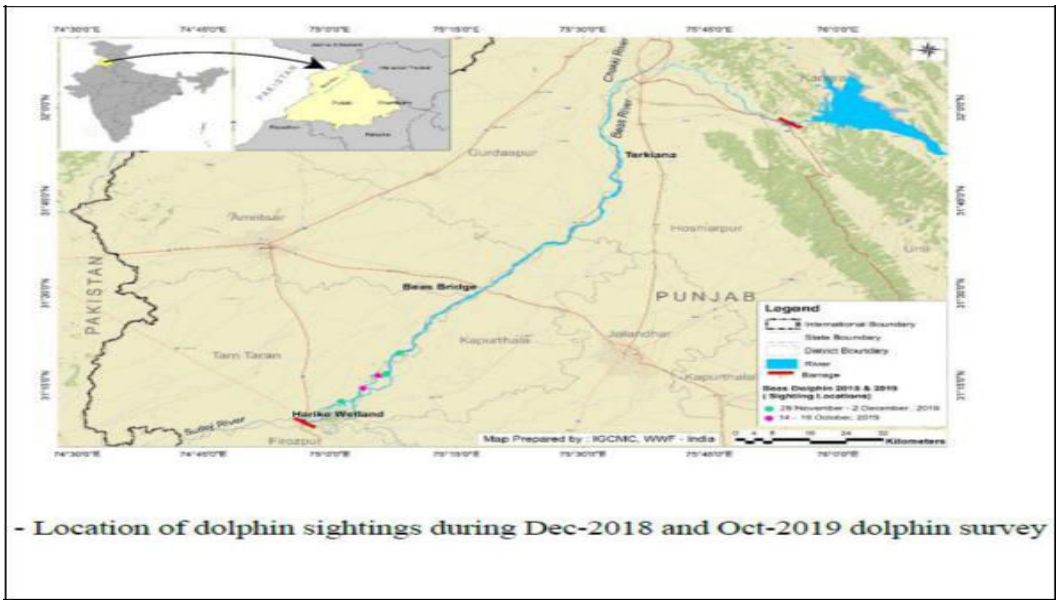
When a dolphin is sighted, the vessel continued moving downstream while observers focused on obtaining an accurate group size estimate. All sightings were confirmed by a second observer. Group sizesare evaluated with a best, high and low estimate of numbers to incorporate uncertainty. When dolphins are sighted, details are entered onto a sighting sheet, their distance is estimated, and nearby objects, such as the river banks, were measured with laser range-finders to improve the accuracy of distance estimates.Animals judged to be less than 1 m in length were designated as calves.

Location of Dolphin sightings during survey as shown in Figure.16 and Figure .17



e 4 - Location of dolphin sightings during Oct-2019 post-monsoon dolphin survey

Fig 16



- Location of dolphin sightings during Dec-2018 and Oct-2019 dolphin survey

Fig 17

Reptiles

Gharial (*Gavialis gangeticus*), listed critically endangered by the IUCN red list, were re-introduced to the Beas Conservation Reserve in 2017, more than thirty years after their disappearance from the river. Evaluation of field data collated from joint field surveys of Department of Forests and Wildlife Preservation, Punjab and WWF-India on Indus River Dolphin since 2015 shows that dolphins primarily occur in a 75km long stretch of the River Beas starting from Beas Dhera to Harike Headwork's. Possible abundance estimate of 5-11 individuals in the Beas River in 2018.

Punjab is among the few States of India which has successfully undertaken Gharial reintroduction along with riparian community in one of its pristine and mighty rivers – The Beas, thus making Harike one of habitats for Gharial in India.

It aimed to stabilise and establish breeding population of critically endangered Gharial in Beas Conservation Reserve and ensure their long-term survival. Under this project, Gharials were reintroduced in River Beas after three decades of their disappearance from the River Beas. **Reintroduction of Gharial** was conducted by the Department of Forest and Wildlife Preservation, Punjab

following a standard reintroduction protocol and with the technical assistance of the WWF-India. Forty-seven juvenile Gharial obtained from Gharial Breeding centre in Deori, Morena, and Madhya Pradesh were re-introduced in batches in the River Beas between December, 2017 and February, 2018.

The State Wildlife Board in its 1st meeting held on 27 April 2005 proposed reintroduction of Gharial in Punjab river system within the Harike Wildlife Sanctuary as an initial exercise. In the pursuance of decision taken in the meeting, the Department of Forests and Wildlife Preservation, Punjab submitted a proposal to the Ministry of Environment, Forests and Climate Change (MoEFCC), Govt. of India in 2005. After passing through different stages of scrutiny, MoEFCC., Govt. of India granted in principle approval permission to release Gharial in Harike Wildlife Sanctuary on 26 September 2014. The Department of Forests and Wildlife Preservation, Punjab was asked to communicate the proposed mode of release to the MoEFCC., Govt. of India. Between 22 October – 10 November, 2014 the Department of Forests and Wildlife Preservation, Punjab initiated an awareness exercise wherein workshops were held in 25 villages (Kirria, Kamboh di wala, Marar, Churian, Sudhian, Maujgarh, Changian, Purana Makhu, Kot Khaimkhan, Bhootiwala, Karmowala, Chamba, Dhun. Gagdewal, Jalabad, Bherowal, Govindwal, Dhunda, Mundapind, Ghadka, Gujarpura, Harike) around Harike Wildlife Sanctuary and River Beas. The local communities were informed about the proposed Gharial re-introduction and their opinions were sought.

On January 17, 2015 the Punjab State Wildlife Board Meeting chaired by the Hon'ble Chief Minister discussed the re-introduction of Gharial in the Harike Wildlife Sanctuary (HWLS). Following this WWF-India jointly with the Department of Forests and Wildlife Preservation (DFWPP) organized a workshop from March 10-12, 2015 to assess the technical feasibility of re-introduction of Gharial in the Beas system and Harike Wildlife Sanctuary.

During the workshop, field visits and open discussions were held among the subject experts and other stakeholders. Field visits were conducted covering 90 km stretch of River Beas and HWLS. Based on the field visit (rapid assessment) the team found that it is not feasible to release Gharial within the HWLS as it is a lentic ecosystem not suitable for the reintroduction of Gharial, which prefers flowing water. It was agreed that the Gharial may be released in Beas River which is less polluted than the Sutlej River.

As a preparation for Gharial re-introduction programme in Punjab, a joint team of WWF-India and Department of forests and Wildlife Preservation, Punjab personnel were sent to the Deori Gharial rearing centre during 24-26 October 2017 and 24-28 November 2017. During these visits the Madhya Pradesh Forest Department personnel gave training in assessing and segregation of release stock at the centre, recording of measurements for preparing of wooden transportation boxes, and; recording of pond measurements and water levels to simulate conditions.

In order to understand the habitat viability in terms of prey (*fish*) abundance, survey was conducted between 1-10 December 2017. Permanent fishing camps were identified and interviews were held with fishermen.

Following the IUCN protocol of species re-introduction, a stock of 25 captive reared Gharial were transported to Chatbir Zoo on 28 November 2017. These animals were kept off exhibit and on live fish feed. This stock was released in two batches respectively. The first batch comprised of 10 animals (3 males and 7 females) and was released in River Beas at village Gagdewal, Punjab on 25 December 2017. The second batch comprised of 15 animals (2 males and 13 females) and was released in River Beas at Wazir Bhullar, Punjab on 31 January 2018.

Following the IUCN protocol of species re-introduction, a stock of next 25 captive reared Gharial were transported to Chatbir Zoo on 11 March 2018.

These animals were kept off exhibit and on live fish feed. This stock was released in single batch. The batch comprised of 22 animals (4 males and 18 females) and was released in River Beas near village Wazir Bhullar, Punjab on 14 March 2018.

Fig 18: Gharial Reintroduction in Beas River, 2018

For the monitoring of gharial initially a joint field team of department along with WWF-India conducted monitoring from December 2017 to February 2018 and from March to April 2018. Motor boat surveys were conducted for 20 days, starting 10Km upstream from the release site and ended 20Km downstream. Distance measurements were guided by a GPS and google maps. Depth finder and flow meter were used for recording river characteristics. A constant boat speed of 5-6 Km/ hour was maintained while conducting the monitoring. Data were collected in the pre-designed datasheets.

Surveys of ghariyal is conducted twice in a year i.e. pre and post monsoon survey to estimate abundance of the species, to detect changes in distribution and/or abundance, and identify key threats and devise a species long term conservation strategy. Monitoring of gharial is done bythe team of wildlife department with the help of WWF India and local community. There geo locations are recorded as per there sightings in the river. The monitoring of gharials is a continuous process and its recorded at weekly basis.

Figure 19: Gharial Sighting in Mud Banks in Beas River

Lately two Gharials have been reported to be spotted in Ferozepur feeder canal near bangali wala pull down side 400 meter and down side 600 meter.

There have been 2 cases where a caracass of dead gharials were found in harike Headworks on dated 21-06-2019 and 12-09-2019 which then as per the protocol for Schedule-1 species there postmartums were conducted which recorded respiratory disorder as the cause of death. Thereafter they were cremated as per the protocol. Also, gharials have been rescued by the staff from the gate of baarage and after vet examination it was again released in the wild.

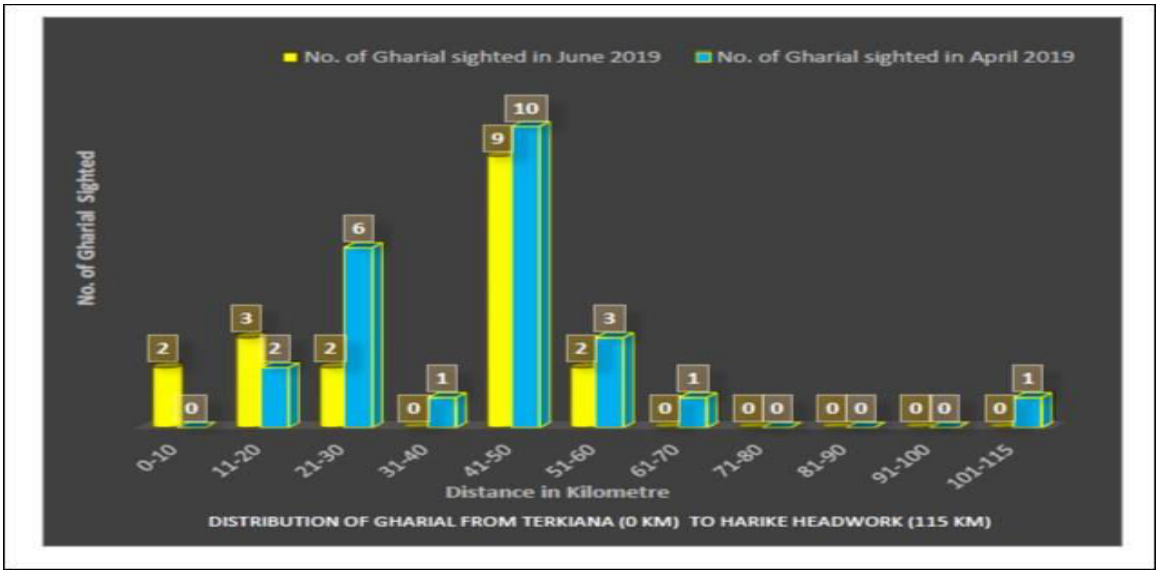


Figure 20:Gharial Distribution and Sighting details

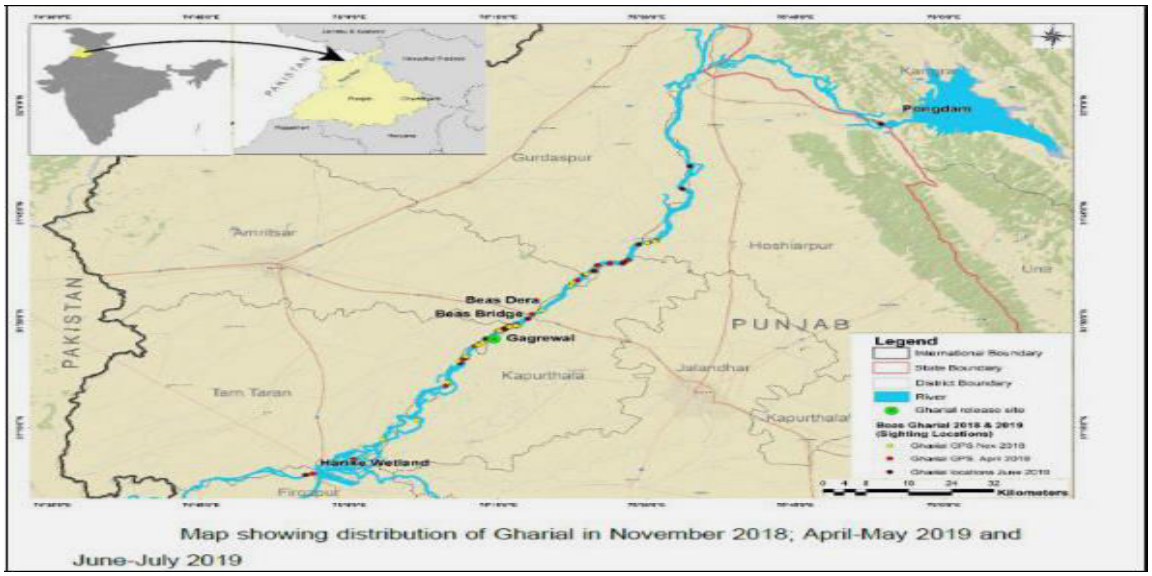


Fig 21: Map showing Gharial Distribution in Harike Sanctuary and Beas conservation reserve

Turtles

Indian roofed turtle (*Pangshura tecta*) and the indian flapshell turtle (Lissemys punctata andersoni) are the most commonfreshwater turtles. others include the brownroofed turtle (*Kachuga smithii*), indian softshell turtle (*Nilssonia gangetica*), brahminy river turtle (hardella thurji), indian narrow-headed softshell turtle (*Chitra indica*) and black pond turtle (Geoclemys hamiltonii)of these, *Pangshura tecta*, *Kachuga smithii*, *Nilssonia gangetica*, and Geoclemys hamiltonii) have been listed in schedule i of the indian wildlife (protection) act, 1972. geoclemys hamiltonii) has also been listed in category "v" (vulnerable, likely to move to endangered category) of the red data book of threatened animals. *Chitra indica* is endangered, *Pangshura tectum* is vulnerable, *Lissemys punctata* is vulnerable, *Kachuga smithii* is near threatened, *Nilssonia gangetica* is endangered, *Hardella thurji* is endangered.

The availability of three species, based on capture records is, highest with *Kachuga smithii*,than *Geoclemys hamiltonii* and *Chitra indica* 1%. *Nilssonia gangetica* and *Kachuga smithii* are seen throughout the year while *Lissemys punctata andersoni*, *Pangshura tecta*and *Geoclemys hamiltonii* are least

observed during the summer months.Three species of snakes are recorded. *Enhydris enhydris*, E. sieboldii, and Natrix (*Xenochropis*) piscator.

Amphibians

Four species of amphibians are found including 3 of frogs and one of toad. The frog species are: *Hoplobatachus tigerinus*, *Euphlyctis hexadactylus*, and*Euphlyctis cynophlyctus. Bufo stomaticus* is the soletoad species found in the area.

Fishes

Harike is a very rich wetland in terms of fish species diversity. Being at the confluence of two major rivers of Indus river system i.e. the Beas and Sutlej, it represents fish fauna of both the rivers and provides suitable environmental conditions for breeding, feeding and nesting. Though the wetland is subjected to varied pressures (anthropogenic and natural) it still is a rich aquatic ecosystems of the Punjab state.

As cited in the research paper "Distribution and abundance of fish populations in Harike wetland-A Ramsar site in India" there are 55 species of fishes were recorded from Harike wetland (Moza & Mishra, 2008) and these belong to 17 families and 35 genera. Maximum number of species (27) recorded were of family Cyprinidae followed by families Bagridae (7 species), *Siluridae, Schilbeidae, Channidae,Mastacembelidae* (3species each), *Gobiidae, Notopteridae,Sisoridae, Ambassidae and Belontiidae* (2 species each), *Clupeidae,Clariidae, Heteropneustidae, Synbranchidae, Belonidae and Nandidae* (1 species each).

Only two species Wallago attu and Cirrihinus mrigala were found at all seven sites. Two species, most abundantly found in the Harike wetland were Cirrihinus mrigala and Cyprinus carpio communis and these constitute 23% of the total fish catch. 20, 14, 60, 56, 12, 9, 8 fish species were recorded from

Beas, Sutlej, Lake, Riyasat, Confluence, Reservoir and Downstream respectively. IUCN designated (Molur and Walker, 1998), one Critically Endangered, four Endangered and thirteen vulnerable species of fish are being reported from Harike wetland. Earlier only 26 species of commercial importance were reported by Ladhar et al. (1994).

Species richness and species abundance were ascertained for all the sites. The two sites i.e. Reservoir and Downstream were not considered for analysis because of low species richness and species abundance. Reservoir is a site which is heavily choked with silt while in Downstream, water availability was very low during most of the study period. The dams and barrage hinder the movements of fishes thus their diversity decreases in downstream of the barrage (Katano et al., 2006). Species richness and species abundance were higher at two reaches i.e. Lake and Riyasat followed by Beas and Sutlej and lowest at the confluence.

The species richness and the estimated fish biomass of Harike envisaged from Harike-Pattan landing centre was 28.67 tonnes/month during 1999-2000 when the wetland was open to fishing. However, the biomass reduced to 10.40 t/month during 2000-01 and 12.95 t/m during 2001-02 when fishing was banned, thereby showing a decrease of 55-62% in fish catch. Taking Harike landing center catch as baseline data, the population is dominated by minor carp (32.91%), followed by common carp (22.78%). Indian Major Carps (12.80%) and large catfishes (11.91%) forms subsidiary contribution towards total population. The common species found include, *Notopterus chitala, Notopterus notopterus, Channa punctatus, Channastriatus, Catla catla, Labeo rohita, Wallago attu, Cirrhinus mrigala* etc.

Invertebrates

Following invertebrates are reported in Harike lake area:

Protozoans	:	*Chilomonas, Ceratium, Paramecium*
Rotifera	:	*Brachionus, Lacane, Monostyla, Rotifera, Philodena.*
Crustaceans	:	*Daphnia Cahydorus, mesocyclops, Planasia,Diaptonus.*
Arthropods	:	*Chironomus, Beetles, aquatic spiders, bugs, dragonflies, Damsel flies etc.*
Annelids	:	*Leeches*
Molluscs	:	*Lymnaea, Aniscus, Planorbis, Viviparus*

CHAPTER 5: ECOSYSTEM SERVICES

Wetlands play an important role in maintaining the ecosystem of an area. And even though no evaluation study has been done for Harike in particular, the general functions and values of Harike by virtue of being a wetland are being discussed. Many people use the terms functions and values interchangeably when discussing wetlands, even though functions and values are different. Functions are the physical, chemical, and biological processes occurring in and making up an ecosystem.

Processes include the movement of water through the wetland into streams or the ocean; the decay of organic matter; the release of nitrogen, sulphur, and carbon into the atmosphere; the removal of nutrients, sediment and organic matter from water moving into the wetland; and the growth and development of all the organisms that require wetlands for life.

Values are "an estimate, usually subjective, of worth, merit, quality, or importance". Wetland "values" may derive from outputs that can be consumed directly, such as food, recreation, or timber; indirect uses which arise from the functions occurring within the ecosystem, such as water quality, and flood control; possible future direct outputs or indirect uses such as biodiversity or conserved habitats; and from the knowledge that such habitats or species exist.

Regulatory and supporting ecosystem services

Scientists value the processes of wetlands individually, particularly the role of wetlands in the global cycles of carbon, nitrogen, and water. Many scientists consider the removal of carbon dioxide from the atmosphere into plant matter and its burial as peat (sequestration) the most valuable function of wetlands (Mitsch et al., 2015). Carbon sequestration is thought to be an important process

in reducing the greenhouse effect and the threat of global warming(Iverson et al., 2014).

The functions of the wetland can be discussed under the following heads:

Water balance

Wetlands play a critical role in regulating the movement of water within watersheds as well as in the global water cycle. Wetlands, by definition, are characterized by water saturation in the root zone, at, o r above the soil surface, for a certain amount of time during the year. This fluctuation of the water table (hydro period) above the soil surface is unique to each wetland type.

Wetlands store precipitation and surface water and then slowly release the water into associated surface water resources, ground water, and the atmosphere. Wetland types differ in this capacity based on a number of physical and biological characteristics, including: landscape position, soil saturation, the fiber content/degree of decomposition of the organic soils, vegetation density and type of vegetation.

Ground water recharge

Wetlands help maintain the level of the water table and exert control on the hydraulic head. This provides force for ground water recharge and discharge to other waters as well. The extent of ground water recharge by a wetland is dependent upon soil, vegetation, site, perimeter to volume ratio, and water table gradient. Ground water recharge occurs through mineral soils found primarily around the edges of.

The soil under most wetlands is relatively impermeable. A high perimeter to volume ratio, such as in small wetlands, means that the surface area through which water can infiltrate into the ground water is high. Ground water recharge is typical in small wetlands such as prairie potholes, which can contribute significantly to recharge of regional ground water resources. Researchers have discovered ground water recharge of up to 20% of wetland volume per season.

Climate control

Climate control is another hydrologic function of wetlands. Wetlands return over two-thirds of their annual water inputs to the atmosphere through evapotranspiration. Wetlands also act to moderate temperature extremes in adjacent uplands.

Oxidation-reduction

The fluctuating water levels (also known as hydrologic flux) that are characteristic of wetlands, control the oxidation-reduction (redox) conditions that occur. These redox conditions governed by hydro period play a key role in: nutrient cycling, availability, and export; pH; vegetation composition; sediment and organic matter accumulation; decomposition and export; and metal availability and export.

When wetland soil is dry, microbial and chemical processes occur using oxygen as the electron acceptor. When wetland soil is saturated with water, microbial respiration and biological and chemical reactions consume available oxygen. This shifts the soil from an aerobic to an anaerobic, or reduced, condition. As conditions become increasingly reduced, other electron acceptors than oxygen must be used for reactions. These acceptors are, in order of microbial preference, nitrate, ferric iron, manganese, sulphate, and organic compounds.

Wetland plants are adapted to changing redox conditions. Wetland plants often contain arenchymous tissue (spongy tissue with large pores) in their stems and roots that allows air to move quickly between the leaf surface and the roots. Oxygen released from wetland plant roots oxidizes the rhizosphere (root zone) and allows processes requiring oxygen, such as organic compound breakdown, decomposition, and de-nitrification, to occur.

Hydrologic flux and life support

Changes in frequency, duration, and timing of hydro-period may impact spawning, migration, species composition, and food chain support of the

wetland and associated downstream systems. Normal hydrologic flux allows exchange of nutrients, detritus, and passage of aquatic life between systems. Values of wetlands as a result of the functions of hydrologic flux and storage include: water quality, water supply, flood control, erosion control, wildlife support, recreation, culture, and commercial benefits.

Biogeochemical cycling and storage

Wetlands may be a sink for, or transform, nutrients, organic compounds, metals, and components of organic matter. Wetlands may also act as filters of sediments and organic matter. A wetland may be a permanent sink for these substances if the compounds become buried in the substrate or are released into the atmosphere; or a wetland may retain them only during the growing season or under flooded conditions. Wetland processes play a role in the global cycles of carbon, nitrogen, and sulphur by transforming them and releasing them into the atmosphere. The values of wetland functions related to biogeochemical cycling and storage include: water quality and erosion control.

Nitrogen

The biological and chemical process of nitrification/ denitrification in the nitrogen cycle transforms the majority of nitrogen entering wetlands, causing between 70% and 90% to be removed.

Phosphorus

Phosphorus can enter wetlands with suspended solids or as dissolved phosphorus. Significant quantities of phosphorus associated with sediments are deposited in wetlands. Phosphorus removal from water in wetlands occurs through use of phosphorus by plants and soil microbes; adsorption by aluminium and iron oxides and hydroxides; precipitation of aluminium, iron, and calcium phosphates; and burial of phosphorus adsorbed to sediments or organic matter . Wetland soils can, however, reach a state of phosphorus saturation, after which phosphorus may be released from the system.

Phosphorus export from wetlands is seasonal, occurring in late summer, early fall, and winter as organic matter decomposes and phosphorus is released into surface water. Dissolved phosphorus is processed by wetland soil microorganisms, plants, and geochemical mechanisms. (Walbridge and Struthers 1993) Microbial removal of phosphorus from wetland soil or water is rapid and highly efficient.

Carbon

Wetlands store carbon within peat and soil. Storing carbon is an important function within the carbon cycle, particularly given observations of increasing levels of carbon dioxide in the atmosphere and concerns about global warming. When wetlands are drained, the oxidizing conditions increase organic matter decomposition, thus increasing the release of carbon dioxide. When wetlands are preserved or restored, the wetlands act as a sink for carbon since organic matter decomposition is stable or slowed.

Sulphur

Wetlands are capable of reducing sulphate to sulphide. Sulphide is released to the atmosphere as hydrogen, methyl, and dimethyl sulphides or is bound in insoluble complexes with phosphate and metal ions in wetland sediments. Dimethyl sulphide released from wetlands may act as a seed for cloud formation. Sulphate may exist in soils or may enter wetlands through atmospheric deposition.

Suspended solids

Wetlands filter suspended solids from water that comes into contact with wetland vegetation. Stems and leaves provide friction for the flow of the water, thus allowing settling of suspended solids and removal of related pollutants from the water column. Wetlands may retain sediment in the peat or as substrate permanently.

Metals

Wetlands can remove metals from surface and ground water as a result of the presence of clays, humic materials (peats), aluminium, iron, and/or calcium. Metals entering wetlands bind to the negatively ionized surface of clay particles, precipitate as inorganic compounds (includes metal oxides, hydroxides, and carbonates controlled by system pH), complex with humic materials, and adsorb or occlude to precipitated hydrous oxides.

Iron hydroxides are particularly important in retaining metals in marshes. Wetlands remove more metals from slow flowing water since there is more time for chemical processes to occur before the water moves out of the wetland. Burial in the wetland substrate keeps bound metals immobilized.

Biological productivity

Wetlands are among the most productive ecosystems in the world. Immense varieties of species of microbes, plants, insects, amphibians, reptiles, birds, fish, and other wildlife depend in some way on wetlands. Wetlands with seasonal hydrologic pulsing are the most productive. Wetland plants play an integral role in the ecology of the watershed. Wetland plants provide breeding and nursery sites, resting areas for migratory species, and refuge from predators.

Decomposed plant matter (detritus) released into the water is important food for many invertebrates and fish both in the wetland and in associated aquatic systems. Physical and chemical characteristics such as climate, topography, geology, hydrology, and inputs of nutrients and sediments determine the rate of plant growth and reproduction (primary productivity) of wetlands.

A wetland with more vegetation will intercept more runoff and be more capable of reducing runoff velocity and removing pollutants from the water than a wetland with less vegetation. Wet land plants also reduce erosion as their roots hold the stream bank. Values associated with biological productivity of

wetlands include: water quality, flood control, erosion control, community structure and wildlife support, recreation, aesthetics, and commercial benefits.

Decomposition

A pH above 5.0 is necessary for bacterial growth and. Increased pH, accelerates decomposition, causing the release of carbon dioxide from wetlands and land subsidence. The nutrients and compounds released from decomposing organic matter may be exported from the wetland in soluble or particulate form, incorporated into the soil, or eventually transformed and released to the atmosphere.

Decomposed matter (detritus) forms the base of the aquatic and terrestrial food web. Decomposition requires oxygen and thus reduces the dissolved oxygen content of the water. High rates of decomposition, such as occur after algae has bloomed, can reduce water quality and impair aquatic life support.

Community structure and wildlife support

The inundated or saturated conditions occurring in wetlands limit plant species composition to those that can tolerate such conditions. Wetland shape and size affect the wildlife community and the wetland's function as suitable habitat. The shape of the wetland varies the perimeter to area ratio. The amount of perimeter versus area has importance for the success of interior and edge species. Shape is also important for the possibility of movement of animals within the habitat and between habitats.

Wetland size is particularly important for larger and wide ranging animals that utilize wetlands for food and refuge, since in many locations wetlands may be the only undeveloped and undisturbed areas remaining. Values associated with community structure and wildlife support in wetlands include: fish and wildlife support, recreation, aesthetics, and commercial benefits.

Water quality

Wetlands help maintain and improve the water quality of our nation's streams, rivers and lakes. Since wetlands are located between uplands and water resources, many can intercept runoff from the land before it reaches open water. As runoff and surface water pass through, wetlands remove or transform pollutants through physical, chemical, and biological processes. It has been estimated that a 2,500 acre wetland can saves $1 million in water pollution control costs annually.(Zedler & Kercher, 2005).

Flood protection

Wetlands help protect adjacent and downstream properties from potential flood damage. The value of flood control by wetlands increases with: (1) wetland area, (2) proximity of the wetland to flood waters, (3) location of the wetland (along a river, lake, or stream), (4) amount of flooding that would occur without the presence of the wetlands, and, (5) lack of other upstream storage areas such as ponds, lakes, and reservoirs. Wetlands within and upstream of urban areas are particularly valuable for flood protection.

The impervious surface in urban areas greatly increases the rate and volume of runoff, thereby increasing the risk of flood damage. Wetlands, on contrast, "hold" heavy rainfalls, preventing possible flooding downstream. By storing the water in the soil or retaining it in the surface waters of lakes, marshes, etc., wetlands reduce the need for expensive engineered structures.

Wetland vegetation also plays a role in slowing down the flow of flood water. The USEPA has determined that the cost of replacing the flood control function of 5,000 acres of wetland comes to $1.5 million (USEPA 1995).

Erosion control

By virtue of their place in the landscape, riparian wetlands and marshes located at the margin of lakes protect the stream banks against erosion. Wetland plants

hold the soil in place with their roots, absorb wave energy, and reduce the velocity of stream or river currents.

Reservoirs of biodiversity

Wetlands in general are home to a great diversity of species. Although freshwater ecosystems cover only 1% of the Earth's surface, they hold more than 40% of the world's species and 12% of all animal species. This is because diverse species of plants, insects, amphibians, reptiles, birds, fish, and mammals depend on wetlands for food, habitat, or temporary shelter.

Provisioning ecosystem services

Fuel wood

The dried leaves, shrubs, grasses and twigs of trees contributes to fuel for marginal section of village around sanctuary. In the eco sensitive zone and road side trees provide fuel wood for needy people.

Food

Wetland are most productive ecosystem therefore variety of food can be found. Fish is the major food provided by wetland including some aquatic plants too. The sanctuary have high potential for fish because of strategic location at confluence of Beas and Sutlej.

Medicinal plants

The people have/had been using medicinal plants for treatment of variety of disease. The traditional knowledge system are still functional and use of some medicinal plants are also know to common people. This knowledge can be used for conservation of plants as well as this can be used for economic benefit to local communities.

Water supply

Wetlands act as reservoirs for the watershed. Wetlands release the water they retain (from precipitation, surface water, and ground water) into associated surface water and ground water. Forested wetlands overlying permeable soil may release up to 100,000 gallons/acre/day into the ground water. Ground water can be adversely affected by activities that alter wetland hydrology.

Drainage of wetlands lowers the water table and reduces the hydraulic head providing the force for ground water discharge. If a recharge wetland is drained, the water resources into which ground water discharges will receive less inflow, potentially changing the hydrology of a watershed. It has been calculated that if 80 percent of a 5 acre wetland were drained, available ground water would be reduced by an estimated 45 percent.

Cultural ecosystem services

Wetlands have archaeological, historical, cultural, recreational, and scientific values. Societies have traditionally formed along bodies of water and artifacts found in wetlands provide information about these societies. The presence of many Gurudwaras in the vicinity of the Sanctuary gives testimony to the legend that on the advice of Sri Guru Nanak Dev Ji, the sacred Rabab was taken by Mardana from Bharoana.

Gurudwara Rabasar Sahib, Gurudwara Ishar dham etc. The Gurudwara Nanaksar Sahib is most visited place in the radius of 10km of sanctuary. Mostly people visit sanctuary after worship at Gurudwara sahib. The sanctuary holdspotential for nature education and experiential learning. The promotion of nature education will be great endeavour for wetland conservation.

Figure 22: Pictures of various activities done in Harike wildlife Sanctuary.

CHAPTER 6: Past System of Management

GENERAL HISTORY AND BACKGROUND:

Harike Wildlife Sanctuary is a famous bird sanctuary of Punjab State. It comprises of an area of approximately 86 sq. km. which falls in the man-made reservoir created by impounding water 7m below the confluence of Beas and Sutlej rivers 150 Km. North-West of Chandigarh. The head-works control the flow of these rivers water and throw back barraged into large lake called Harike Lake which touches three districts of Punjab State viz. Kapurthala, Amritsar and Ferozepur. This lake attracts a large number of migratory birds from other countries. The area of this lake was chosen for declaring it as a closed area as early as in 1978 due to its potential for attracting migratory birds. Later on, it was declared as a Wildlife Sanctuary in 1982 for a period of ten years. Looking towards its economic, aesthetic and recreational values, it was declared as a "Wetland of International Importance" and included in the International Wetland map.

It has an excellent natural environment in the form of air and water covering the vast area. It is an exotic place for peace loving people., water is clean and transparent. Typical dry deciduous forest along with many shrub species is found in this area. In spite of gradual environmental degradation, birds continue to migrate and hence wildlife survives. Efforts have been made to modify habitat by improving water features for increased bird migration. The need has been felt to find out the limiting factors so that management plan is drafted for a period of ten years covering with core and buffer area of sanctuary totalling approximately 86 sq. km.)

(Some important Gurudwara's like Baoli Sahib and Rababsar falls within the vicinity of Harike wetland. The religious places play an important role in conservation, as Gurudwara authorities do not allow any person to hunt the birds

in the area. The famous religious place situated in the Sanctuary area is "Issar Dham". The brief history of this religious place is that about 70-80 years ago, Baba Issar Singh's, of Nanaksar (Kaleran Wale's), body was immersed. Each year on 7th Oct and on 13th April a large number of devotees used to gather at Harike. At this place, devotees constructed a beautiful Gurudwara called Issar Dham Harike (Nanaksar).

The area has historical importance too. In Sikh history, famous fighter Gen. Sham Singh Attariwala who is closely related to Maharaja Ranjit Singh fought against British forces on 21-22 Dec 1845. The Sikh forces defeated British at Ferozepur, Sham Singh Attariwala sacrificed his life near Fatehgarh Sabaroan. A large number of public gathers each year on 21st December at this place to pay their tributes to Sikh General Martyr.

Past system of Management and their results:

Prior to the re-organization of states, the wildlife conservation was through implementation of provision of Indian Forest Act, 1927 and rules framed under wild Birds and Animal (Protection) Act, 1912. By the time Indian Forest Act, 1927 was implemented, shooting blocks were recognised and certain areas with rich–game were declared and hunting was allowed. Then Wildlife (Protection) Act, 1933 and 1959 came into enforce in the state after its promulgation in the Indian Board for Wildlife in 1952. It was implemented in Punjab State on 1-4-1975. Previously hunting was allowed in this area with prior permit. Three kinds of licenses viz. small game, big game and special game licenses were issued. This continued till 1976 after which area of this lake was closed for hunting after its recognition as one of the International Wetland. This continued till now when area of 86 Km. Sq. is declared as a wildlife sanctuary for a period of 10 years. Presently Harike Wildlife sanctuary is effectively managed under the control of Chief Wildlife Warden, Punjab under Wildlife (Protection) Act,

1972, Wildlife (Protection) Punjab rules 1975, Wildlife (protection) Amendment Act, 1991. There was no central assistance before 1988. The Wildlife staff was involved in checking wildlife offences relating to hunting of migratory birds. The Government of India started providing financial Assistance w.e.f. 1989 and several developmental works were undertaken. The construction of staff quarters, creation of ponds and mounds, fencing of area, removal of water hyacinth partly, rewards to informers to prevent illegal poaching are some of the works which were undertaken. The sanctuary is open, earlier approx. 20,000 Rft. area of sanctuary was fenced which with time has been damaged. The entire land is a Government land. There is no tribal community and residing in this area. Of course the surrounding villagers do let loose their livestock released them in the area for grazing and also trying to encroach upon the land.

Special works of improvement:

Removal of water hyacinth:

The presence and spread of water hyacinth, which covers almost half of the water areas is a major problem facing the sanctuary management. However, in past with the launching of the Operation Sahyog pilot project by the army, and subsequent continuing of the techniques used in the project by the departmental staff to remove water hyacinth has resulted in clearing large areas of this dangerous weed. However, paucity of funds made available to the sanctuary, and the absence of a comprehensive plan to tackle the problem has made the efforts more or less ineffective. This is because the rate of multiplication of the weed is such that by the time a certain portion is removed of the weed, the weed has multiplied again to more or less the same level during the intervening period. It is therefore imperative that a comprehensive plan is put into place and adequate resources ae made available for its implementation.

Silvicultural Improvement:

Plantation of suitable species in strategic areas as well as in the blank areas is an important aspect of habitat improvement and resource management. In previous years, many areas especially along the bundhs and areas removed from encroachments have been taken up for plantations. The survival percentage of the plantations is fairly good. Details of plantations are given in annexure attached.

Protection:

Protection of the area from encroachers, poachers, illicit felling, illegal fishing, production of illicit liquor are some of the most important components of management of the sanctuary. The staff has done good work in these areas. A number of poachers are caught and prosecuted, many tools and implements including vehicles, boats etc have been seized and confiscated, many cases under the Public Premises Act has been launched against the encroachers to evict them. Details are given in Annexure. However a lot needs to be done and the strategy is outlined in the chapter on proposals for future management.

Communications and Buildings:

Although no new buildings and vehicles were acquired/constructed during the last few years, renovations of existing check post have been ensured. A watchtower at Bhootiwala checkpost was constructed in financial year 2019-20 under PUNCAMPA scheme. Apart form this to boost ecoturism new infrastructure have been constructed by tourism department under Asian Development Bank Project .

This includes an interpretation center along with a discussion room at the R.M.B area of the sanctuary. This is to create awareness among the

visitorsabout the wetland and its ecosystem. A cafeteria along with washroom complex has been created for the visitors.

Figure 23: interpretation Center at Harike Wildlife Sanctuary

Figure 24 : cafeteria at Harike Wildlife Sanctuary

Under the project some guard posts, watch-towers, bird hideouts, jetties for boating at Nose point were also created. This infrastructure was handed over to the department in September 2020.Detailed List is given in Annexure VII attached.

CHAPTER 7: THE MANAGEMENT PLAN FRAMEWORK

Management Objectives

Goal:

To maintain and improve the hydrological regime of the site both qualitatively and quantitatively for sustaining the aquatic biodiversity of the wetland thereby maintaining wetland habitat for sustaining the various lifeforms that it supports and to build capacity and promote eco-tourism to position Harike as a model for wetland conservation through participation of all the stakeholders and by engaging local community.

General Objectives of Management:

Even before the declaration of the area as a Wild Life Sanctuary under the Wild Life (Protection) Act, 1972, the general area of the wetland used to play an important part in offering a unique habitat for birds and aquatic organisms. Subsequently, the unique features of the area began to attract national and international attention. The area was declared closed under the Wild Life (Protection) Act, 1972 as far back as 1976, leading to the final declaration as a Wild Life Sanctuary in 1999. It got identified as one of the wetlands for special conservation action and management by the national Committee on Wetlands, Mangroves and Coral Reefs of the Ministry of Environment and Forests, Government of India. The final icing on the cake came when it gained international fame in 1990 when the Ramsar Convention notified Harike as a Wetland of International Importance (Ramsar Site).

The goal is to maintain ecosystem components and eco-processes of Harike Sanctuary to enable delivery of ecosystem services, namely provision of water security, ground water recharge, a suitable habitat for congregation of

migratory birds, for the survival of population of Indus river Dolphin,Gharials,Smooth Coated Otter and supporting terrestrial and aquatic flora and fauna , flood buffering, , nutrient capture, ecotourism, recreation and aesthetics.

The management objectives are enlisted as given below:

- To regulate and improve the hydrological regime.
- To ensure soil and water quality.
- To ensure effective habitat management.
- To maintain and conserve the species diversity and population.
- To promote stakeholder engagement for proper management of the area.
- To promote awareness on conservation needs through effective communication strategies.
- To ensure capacity building of the stakeholders towards achieving common goals
- To promote institutional development.
- To ensure research and monitoring.

CONSTRAINTS IN ACHIEVING OBJECTIVES:

Resource Constraints

The sanctuary is inadequately staffed at the field level with no clearly sanctioned post at sanctuary level, the cadre strength is fixed at division level. Also, for the sanctioned strength there are vacancies which hampers the management of the sanctuary. The intensive management of the sanctuary makes it mandatory that adequate staff is provided for effective protection. There are 11 beatsin the sanctuary whereas only 5 guards are working in sanctuary. For improving the protection of the sanctuary, each of the ten

compartments can be considered as a beat and consequently there should be ten guards for the sanctuary.

There is only one vehicle for the Range Forest Officer as well as patrolling by field level staff. There is a need to provide two wheelers to the foresters for better patrolling. In addition, there is a need to have effective communication by providing mobile sets to the field level staff. The sanctuary needs intensive management considering the rich biodiversity it protects. However, the inadequacy of funds and the lack of adequate infrastructure, communication and institutional support are the major constraints which hamper the effective management of the Sanctuary.

Documentation / Monitoring

Although the Sanctuary has been in existence from 1994, the basic scientifically made inventory for the various natural resources is lacking. The census operations have been carried for birds. However, no census has been carried out with regard to other flora and fauna in the sanctuary. Periodic monitoring of other lesser-known species among amphibians, reptiles etc is also lacking as this would help in assessing the health of the ecosystem. Also no study has so far scientifically dealt with assessing the socio-economic status of the adjoining villages. Such documentation would go a long way in formulating an effective eco-development plan. Whatever limited studies that have occurred in the past have also not been documented adequately to serve as a database for future management initiatives.

Weed infestation:

One of the most serious problems facing the sanctuary is the problem of weed infestation. The predominant weed causing much of the problem is the water

hyacinth (*Eichhornia crassipes*). Eichhornia is native to Brazil and was "introduced" to India during the early 20th century - allegedly by a British Raj Memsahib who saw them in Africa and thought they'd be pretty in her new Indian garden.

Extensive growth of the weed has acquired dangerous dimensions and has become the most dominant plant in the ecosystem. And even though it plays some role in biological purification of wastewater as it is known to take up heavy metals and nutrients, and can be used for various purposes, the extensive growth has not only detracts the migratory avifauna but is also replacing the natural aquatic floral and faunal composition in the ecosystem.

The extensive growth can be attributed to eutrophication of the lake waters. Effluents from cities and villages in the catchment and fertilizer runoff that find their way into the lake result in high organic loading which aids rapid multiplication of the weed.

Encroachments

Another major problem sanctuary is facing is that of encroachment. The sanctuary is surrounded by prime agricultural areas on almost all sides. This has led to the tendency of the surrounding people to encroach upon the area. Originally, before the existence of the barrage, the most of the land under water at present was occupied by a number of villages. After the barrage was constructed, the submerged land and surrounding areas were brought under government control. However, the absence of a proper rehabilitation scheme for the displaced villages has led to some of the farmers contesting the decision of the government. Some encroachments date back to the days of terrorism when the terrorists used to hide in the thick undercover and the inundated and isolated

areas of the sanctuary. Besides, the hostile nature of the terrain which makes it difficult to access the area in all seasons and the lack of manpower of the sanctuary have added to the problem.

The encroached areas are used for agricultural purposes and thereby causing destruction to the natural habitat of the many species that inhabit and thrive in the area. Moreover, it also increases the human and biotic pressure on the area causing disruption in the ecological uniqueness of the area.

Lack of Stakeholder Participation

There is need for proper engagement of all stake holders for the management of the sanctuary. These stakeholders include various other department who needs to participate for conservation efforts. These includes primarily revenue department who is the keeper of all the revenue records and need to play apivotal role in encroachment removal along with police department.

Irrigation department which was the primary department which was involved in the acquisition of the land and have all the records from the time Harike barrage was conceptulised. However, no clear cut possession of land by the irrigation department and record updation has taken place regarding the land which was acquired from the villagers. This has eventually lead to weakening of court cases in the encroachment cases.

With increase in level of pollution in rivers primarily in Satluj has lead to deteriotion of habitat in the sanctuary along with its detrimental effect on its ecosystem. This called for strong action from Punjab Pollution Control Board to ensure that immediate steps are undertaken to stop the further deteriotion of the habitat.

Similary departmetnts like fisheries, cultural and tourism etc are also need to actively engaged in the management of the sanctuary.

The participation of these stakeholders will also ensure that this will help in controlling the factors which are outside the legal protection of sanctuary. But they impact the ecological stability of the protected area and are important for its management.

In the past there have been efforts to include community to participate actively in management of the sanctuary. For instances making of SHG to provide them livelihood to them, giving them livelihood opportunity.

However so far these stakeholders have not been successfully brought on the same plan and have been working in the silos.

Siltation

The accumulation of materials deposited by the feeding inlets like the rivers Sutlej and Beas and also of the erosion of the banks of the surrounding areas has led to siltation in the reservoir area in particular and in the sanctuary in general. When the lake came into existence in 1952, it had an area of 41 sq km and supported a rich flora and fauna. By 1993 the lake had shrunk to a mere 28 sq km, i.e 13 sq km within a span of 40 years. Assuming the siltation rate does not increase, this gives the lake a life span of 80 years. However, any increase in the erosion rate in the catchment will proportionately decrease the lifespan of the lake. The water storage capacity of te lake decreased from 67,900 acre feet in 1952 to 35,670 acre feet in 1980 and 14,740 acre feet in 1990. There has therefore been a 78.29 peercent reduction in the storage capacity in a span of just four decades. Islands covered with a growth of Ipomoea fistulosa, Typha elephantiana and Sachharum spontaneum have emerged within the lake. Thirteen such lakes are present and the average depth of the lake now varies from a few centimeters to two meters.

The causes of siltation can be attributed to the erosion in the catchment area which is basically devoid of permanent green cover as most of these areas are engaged in agriculture and consequently the soil is loose and unstable. Modern agricultural practices involve deep ploughing that increases runoff with precipitation.

Siltation not only affects the quality of water but the reduction in water depths has a direct bearing in the species composition of the ecosystem as well. Harike is well known for the number of "diver" species of birds found in the area. These species depend on the availability of optimum level of water for their feeds.

Pollution:

The lake is a receptacle for domestic, agricultural and industrial wastes generated within its catchment. Presently the two feeder rivers, Sutlej and Beas receives waste water from the catchment towns like Ludhiana, Rupnagar etc. Non-point sources of pollution such as agricultural runoffs are also major contributors. As the lake is surrounded by predominantly agricultural lands where the use of fertilizers and pesticides is high, the runoff during the rains from fields unprotected by bundhs or fencing grasses is a major contributing factor to the pollution load of the lake. Wheat and rice are the main crops grown in the catchment. Wheat, which has a growing period of just over six months, uses approximately 139 kg of nitrogen fertilizer per acre. Since it is sown after the rains, the loss of fertilizer due to runoffs is not so high as that in rice, which is planted with the start of the monsoon season, as it requires abundant water. Over 10 tons/acre of organic fertilizer is applied to rice fields along with 100-120 kg nitrogen fertilizer. Fertilizer runoff may be very high if immediate rain follows. The loss of fertilizer is often upto 100 percent. Even if rain does not

follow, the loss is at least 10-25 %. Considering the fact that the catchment is almost entirely cultivated, with less than 3 percent forest cover, the agricultural runoff is substantial. All this waste fertilizer ultimately finds its way into the lake through ground water movement and surface runoffs.

Twelve drains fall into the Sutlej and thirteen into the Beas. Of these, some are seasonal choes, some are drains from smaller settlements and villages while the rest are from major cities. A number of cities are located along the Sutlej and the Beas and their numerous tributaries which discharge large amounts of both domestic and industrial sewage into the rivers. Along the bans of the Sutlej are ten major cities which collectively dispose off about 300 mld (million liters per day) of domestic sewage directly into the river. Ludhiana alone releases about 150 mld of urban waste into the Sutlej through the Budda nallah. Major towns situated along the Beas are Talwara, Pathankot, Mukerian and Beas. The Beas receives effluents of these towns along with the non point runoff which includes fertilizers and organic wastes.

Almost all the organic sewage is discharged without treatment into the drains. Seven major industries discharge their wastes into the Sutlej and two into the Beas. Most of these receive only primary treatment.

Poaching/Fishing

Harike wetland used to be a major source of fishery to the state of Punjab till 1999 when it was notified (final notification under sec 26 of Wild Life (Protection) Act, 1972) as a sanctuary and the provisions of the Act are enforced in full swing thereby banning all activities including fishing inside the sanctuary area. The prohibition of fishing inside the sanctuary has resulted in a decrease of almost 54-56% in total fish catch. However, as the huge demand of fish still remains in the market, a lot of people venture into fishing illegally inside the

sanctuary. As Punjabis are traditionally not a fish eating community, local fishermen are few. The contractors bring in fishermen from outside, especially from Ballia (Bihar) and Gorakhpur (UP). Most of these fishermen which are engaged purely for commercial purposes reside on their open boats and makeshift hutments inside the wetland, camping at different sites each night thus making it difficult to track their movement and catch them.

The frequent movement of the boats disturbs the larger animals and avifauna and is a cause for their depleting population. The cutting down of nearby grasses and small trees for building temporary shelters has also adversely affects the habitat. The gill nets used by the fishermen cause mortality amongst ducks and turtles.

Even though relative less in occurrence, the problem of poaching, especially of the birds is also prevalent. The modus operandi in most cases is to use pesticide soaked grains to render the birds unconscious, which are then fished out of the water with nets.

Biotic Pressures:

The population of people in the surrounding villages has been gradually increasing during the last few decades. However, with limited resources, the demand on the agricultural lands surrounding the area and directly on to the wetland area has increased tremendously. This has led to many man-animal conflicts and also conflicts between the management and the villagers.

CHAPTER: 8 FUTURE MANAGEMENT STRATEGIES

Objectives for management

Even before the declaration of the area as a Wild Life Sanctuary under the Wild Life (Protection) Act, 1972, the general area of the wetland used to play an important part in offering a unique habitat for birds and aquatic organisms. Subsequently, the unique features of the area began to attract national and international attention. The area was declared closed under the Wild Life (Protection) Act, 1972 as far back as 1976, leading to the final declaration as a Wild Life Sanctuary in 1999.

It got identified as one of the wetlands for special conservation action and management by the national Committee on Wetlands, Mangroves and Coral Reefs of the Ministry of Environment and Forests, Government of India. The final icing in the cake came when it gained international fame in 1990 when the Ramsar Convention notified Harike as a Wetland of International Importance (Ramsar Site).

However, in the absence of a comprehensive management plan, the lack of co-ordination of various agencies involved in the management of the sanctuary, and continuing biotic interference, the sanctuary is facing several problems.

In light of the above facts, the crucialobjectives of management of this management plan shall be as under:

A. To create ideal habitats for the birds and wildlife by carrying out habitat improvement works and protection.
B. To improve the environment and to reduce the ill effects of pollution so that the ecological balance of the area is not disturbed
C. To increase the vegetative cover of the area by undertaking plantations of indigenous and site specific species.

D. To check and reduce soil erosion and consequent siltation in the wetland area by adopting suitable soil conservation measures
E. To create awareness among the public and involve the people in the management of the area
F. To enhance the aesthetic value of the area
G. To conserve the area on a sustainable basis.
H. To promote nature education programmes.
I. To organise and improve cultural ecosystem services at sanctuary.
J. To creation of modules for education and recreation.

Methods to be adopted

In order to fulfil the above objectives various treatments are necessary, the broad outlines of which are mentioned below:

i. Creation of baseline data. As the management of the sanctuary needs specific prescriptions to address specific issues, it is very important to have basic raw data as well as processed data so that the prescriptions can be made in a more accurate manner. This would include field works like surveys of topography, demography, socio-economic dynamics, census, population estimates, experiments, as well as interpretation and extrapolation of the data so gathered to draw inferences and arrive at certain conclusions. Existing literature as well as the expertise of scientists, NGOs etc. who have already worked on the area may also be utilized.
ii. Once the data is available, to prescribe appropriate prescriptions to address specific issues.
iii. Formation of sub plan so that similar problems are grouped, categorized in a scientific manner so that a common prescription can be given and that the available resource is optimally utilized.

iv. Focus would be on scientific management rather than mere protection of the area.

v. Involvement and participation of the people especially those living around the sanctuary in the management of the sanctuary.

vi. Give special impetus to the awareness and publicity campaign to highlight the importance, values as well as the problems of the sanctuary.

vii. Ensuring that all agencies involved in the management of the sanctuary cooperate with each other and work in tandem so that all the resource and expertise available is utilized.

Implementation of objectives

Harike is a unique place being graced with great natural resource and beauty. It plays an important role in the ecology and environment of the surrounding area. It also serves as a source of livelihood for many people living around the area. The sanctuary is also beset with many problems. Even though many efforts were made in the past involving several agencies, to address the problems and to also improve the condition of the sanctuary.

However, most of these efforts were not based on scientific, management prescriptions; the agencies involved are not well coordinated, sometimes leading to overlapping of efforts; and most importantly the efforts seem to be more like stop-gap arrangements as an when funds were made available, rather than framing a management policy and allocating adequate budgetary provisions. It is envisaged that the objectives laid out in this plan and the prescriptions made herein would go a long way in better management of the sanctuary.

In order to achieve the general objectives of this Management Plan and keeping in view the method of treatment to be adopted, the following subplans shall be constituted:

1. Habitat Improvement Subplan.
2. Conservation and Protection Subplan.
3. Soil and Moisture Conservation Subplan.
4. Eco-development Subplan.
5. Pollution Control Subplan
6. Monitoring Research & Documention Subplan

Abstract of the Subplans

An abstract of the different Subplan proposed and their salient features are outlined below:

Habitat improvement Subplan

The main purpose of this sub plan would be to prescribe appropriate measures by which the general conditions of the habitat can be improved. Area wise this sub plan will cover the whole of the sanctuary area.

Conservation andProtection Subplan

This sub plan deals with the protection of the sanctuary from poachers, encroachers, illegal fishing and other offences occurring in the sanctuary area. This sub plan will also extend to the whole of the Sanctuary.

Soil and moisture conservation Subplan

In this sub plan the problems of soil erosion, siltation etc is discussed in detail and measures to be adopted are prescribed. This sub plan is mainly restricted to the outer peripheral areas as the problem is very acute here. However, the interior areas facing similar problems will also be treated under this sub plan

Eco-development Subplan

This sub plan focuses on the role of the people living around the sanctuary and how best their help and cooperation can be sought and obtained for participatory

management. This sub plan will operate in areas lying in the immediate vicinity of the Sanctuary.

Pollution Control Subplan

This subplan deals with the issue of increasing pollution in upstream of Harike wildlife sanctuary which is having detrimental effect on its ecosystem. This plan will primarily include the upstream areas which are the source of the pollution and the internel area where efforts will be made to treat the affected areas.

Monitoring Research & Documention Subplan

This subplan delas with different protocols for monitoring of various parameters affecting the ecosystem in Harike Wildlife Sanctuary. It also highlights various fields which needs research for successful management of the sanctuary. And various aspects of documentation for proper data keeping of the records.

Period of the management plan

This Management Plan will be for a **10 years** i.e. from the year **2020-2021** to **2029-2030**. No midterm revision is anticipated during the plan period. However, the Management Plan will be reviewed in the year **2025-26.**

CHAPTER 9: HABITAT IMPROVEMENT SUBPLAN

GENERAL DESCRIPTION

Harike is one of the most important wetlands of India and also of the world. The wetland is known internationally for its contribution towards wildlife resources and particularly being a very important wintering place for migratory avifauna. The birds include many long distance migratory birds, some coming from as far as Siberia and the Arctic region. Some 350-400 species of birds have been reported by various researchers who have conducted studies from time to time. Rare species like scaup duck, white-headed stiff tailed duck, and bronze capped teal are also found in this area.

A study conducted by Hussain S. A. (1979-84) reveals that about 9.4% are predominantly fish eating, 7.7% feed on deep water vegetation, aquatic invertebrates and insects and 8% comprises birds of prey including scavengers and rest are insectivorous and grainivorous. Fishery resources of Harike as observed through estimated catch and depicted in Table 3 revealed that fish catch varied drastically during the 6 consecutive years. The catch was all time high, 286.7 t/yr during 1999-2000 with an average of 28.67 t/m, when the Sanctuary area too was used for fishing activity to some extent.

The catch decreased sharply thereafter, culminating in an average decrease of 57%. Simultaneous decrease in estimated total catch of whole Sutlej river too showed similar decreasing trend from528.8 t/year (1999-2000) to 279.2/264.5 t/yr, almost52.79% decrease during the same tenure, without any untoward calamity reported/observed between 1999 to 2002 in and around Harike (Moza & Mishra, 2008) as Besides, the sanctuary is home to other species of animals like the smooth Indian otter, hog deer, wild boar, turtles, jackals etc.

It is because of this rich biological wealth and the significant role it plays in the ecology of the area that the government of India had given it the status of Wetland

for Special Conservation Action and Management. The wetland has also been declared as a Wetland of International Importance under the Ramsar Convention. Taking into consideration the above discussed points, it is very important that the habitat in the area is maintained and improved so that the rich heritage is conserved and preserved.

Aquatic habitat

Special objects of management

The special objects of management of this sub plan are:

i. To improve the habitat of the many species of birds and animals residing and visiting the area.
ii. To identify important features and areas critical to the habitat and to take appropriate measure for their protection and improvement.
iii. To prescribe specific measures for habitat improvement.
iv. To best utilize the resources of the area in a sustainable manner.
v. To involve people in the process of habitat improvement.
vi. To educate and improve public awareness approach for conservation of wetland.
vii. E-flow monitoring
viii. Enhancing habitat connectivity

Methods of interventions in habitats

The general methods to be adopted in order to achieve the above said objectives include:

1. Removal of water hyacinth from wetland.
2. Plantation and Afforestation activities on islands and embankments.
3. Maintenance of water quality by biological interventions.
4. Regular monitoring and research on biological elements of wetland.
5. Control on domestic and industrial drainage in wetland.

Ecology of water hyacinth *(eichornia crassipes)*

Water hyacinth (*Eichornia crassipes*) is a member of the pickerelweed family (Pontederiaceae). It is also known by other names such as, *Eichhornia speciosa* Kunth; *Piaropus crassipes* (Mart.) *Britton; Piaropus mesomelas; Pontederia crassipes; Heteranthera formosa.* The plants vary in size from a few centimeters to over a meter in height. The glossy green, leathery leaf blades are up to 20 cm long and 5-15 cm wide and are attached to petioles that are often spongy-inflated. Numerous dark, branched, fibrous roots dangle in the water from the underside of the plant.

This plant flowers in mid-summer in more northern areas.The inflorescence is a loose terminal spike with showy light-blue to violet flowers (flowers occasionally white). Each flower has 6 bluish-purple petals joined at the base to form a short tube. One petal bears a yellow spot. The fruit is a three-celled capsule containing many minute, ribbed seeds.

Water hyacinth is not winter-hardy. Its minimum growth temperature is 12o C (54o F); its optimum growth temperature is 25-30o C (77-86o F); its maximum growth temperature is 33-35o C (92-95o F) (Abera Hailu Degaga, 2018).

Habitat

Water hyacinths grow over a wide variety of wetland types from lakes, streams, ponds, waterways, ditches, and backwater areas. Water hyacinths obtain their nutrients directly from the water and have been used in wastewater treatment facilities. They prefer and grow most prolifically in nutrient-enriched waters. New plant populations often form from rooted parent plants and wind movements and currents help contribute to their wide distribution. Linked plants form dense rafts in the water and mud.

The fibrous root system of water hyacinth provides nesting habitat for invertebrates and insects. Leaf blades and petioles are occasionally used by coots. However, whatever benefits this plant provides to wildlife are greatly overshadowed by the environmental invasiveness of this noxious species.

Distribution and origin

Eichhornia crassipes is native to Brazil. There are about seven species of Eichhornia native to South America; among them are E. azurea, E. diversifolius and E. paniculata. It was introduced in India in about 1896 as an ornamental pond plant. Since then it has been spreading in all parts of the country and invading all forms of stagnant and slow moving water creating major problems.

The weed reached the Harike area through the years by natural dispersal mechanisms, most important being the discharge of water from the two main rivers Sutlej and Beas, and its tributaries, which passes through the major portions of Punjab and bringing with it all kinds of effluents, pollutants and other submerged materials. It has been spreading in the lake because favourable conditions like eutrophication, high nutrient content and subsequent high productivity of the lake ecosystem are prevalent. This coupled with the high rate of reproduction of the weed and the lack of proper control mechanism and efforts has contributed to the extensive spread of the weed.

In the early part of 1980, it was recorded that the plant had covered around 15% of the water surface. According to an investigation carried out by Irrigation and Power Research Institute of Punjab, Amritsar, in the beginning of 1988, it had covered 75% of water surface. The Central Inland Fisheries Research Institute has reported in 2003 that 8-10 square km area of the deep water, open water area (which is nearly 18-20 square km of the total wet area; the total wet area being some 41 square km) is infested with water hyacinth.

Reproduction

Water hyacinth reproduces sexually by seeds and vegetative by budding and stolen production. Daughter plants sprout from the stolons and doubling times have been reported of 6-18 days. (Barrett, 1980)reported a seven fold increase in hyacinth spread in 50 days time. Pooling and noted that two hyacinth plants developed into 1200 offsprings in 120 days. The seeds can germinate in a few days or remain dormant for 15-20 years. They usually sink and remain dormant until periods of stress (droughts). Upon re-flooding, the seeds often germinate and renew the growth cycle.

Detrimental effects of water hyacinth

Water hyacinth is listed as one of the most productive plants on earth and is considered the world's worst aquatic plant. It forms dense mats that interfere with navigation, recreation, irrigation, and power generation. These mats competitively exclude native submersed and floating-leaved plants. Low oxygen conditions develop beneath water hyacinth mats and the dense floating mats impede water flow and create good breeding conditions for mosquitoes. The effects of water hyacinth can be listed as follows:

- *Eichhornia crassipes* mats clog waterways, making boating, fishing and almost all other water activities, impossible
- Water flow through water hyacinth mats is greatly diminished
- an acre of water hyacinth can weigh more than 200 tons; infestations can be many, many acres in size; mats may double their size in as little as 6-18 days (Warrington et al., 1976).
- Water hyacinth mats degrade water quality by blocking the air-water interface and greatly reducing oxygen levels in the water, eliminating underwater animals such as fish (Penfound & Earle, 1948).

- Water hyacinth greatly reduces biological diversity: mats eliminate native submersed plants by blocking sunlight, alter immersed plant communities by pushing away and crushing them, and also alter animal communities by blocking access to the water and/or eliminating plants the animals depend on for shelter and nesting (Madsen, 1997).

Beneficial effects

As fodder

Water hyacinth (*Eichhornia crassipes*) is being used for feeding of livestock particularly pigs on an extensive scale in many Countries including China, Thailand, Vietnam and other south-east Asian Countries. In China pig farmers boil chopped water hyacinth with vegetable waste, rice bran, Copra cake and salt to make a suitable feed. In Malaysia water hyacinth is cooked with rice bran and fish-meal and mixed with copra meal as feed for pig, duck and pond fish. Similar practices are used in countries like Indonesia, Philippines and Thailand.

Water hyacinth particularly dewatered by chopping and processing can be fed a component of feed directly to live stock, as a research conducted for conversion of water hyacinth into silage has shown. Its palatability and nutritive values can be increased by mixing it with other nutritious fodder grasses in addition to molasses etc.

Studies carried out at National Dairy Research Institute have shown that it is possible to feed water hyacinth to cattle in the form of silage, prepared in combination with paddy straw. Such silage was found to contain 5.64% of the digestible crude protein and 40.26% of total digestible nutrients and is comparable to many green fodders.

As manure

It was also mentioned in a number of papers that feeding trails have initiated at the Orissa University of Agriculture and Technology on feeding of water hyacinth as a component of ration for piglet. The results of the experiments at that centre have indicated that feeding water hyacinth to piglets can reduce dependence and economise on conventional protein concentrates usually fed to the animals. Similar trials are also being conducted at the Assam Veterinary College on feeding of piglets. A detailed note on Vermiculture technology.

As raw material for stuffs

Water hyacinth can be used for bag, mats and other stuffs. This could be used as economic development tool for local communities. This can help in control of weed as well as economic sustainability. There is need to development innovation and training programmes.

Control of water hyacinth

Depending on the location, spread, ecological viability and economic considerations, the general methods of control of water hyacinth include mechanical means, using mechanical harvester, conveyor belts, chopping machines etc, using certified herbicides like 2,4-D, diquat, and a combination of diquat and complexed copper have been in use worldwide, biological control using insects like weevil and fishes like species of grass carps.

Past Efforts in Harike

The problem of eradication of water hyacinth was first discussed in a meeting held on 20.1.1982 under the chairmanship of Agriculture and Irrigation Minister Punjab. This problem was again discussed in high-powered meeting held on

10.9.1983 under the chairmanship of Financial Commissioner Development, Punjab.

In past consultation with I.U.C.N., world wildlife Fund of India, Punjab Agriculture University, Ludhiana, Director & Warden of Fisheries Punjab, Irrigation and Power Research Institute, Amritsar and Council for Science & Technology Environment Punjab. Irrigation and Power Research Institute Amritsar is also working on the problem to study the habits, propagation & eradication of water hyacinth.

There are foreign firms manufacturing machines which is effective for the removal of weeds from the lake, the cost of machine to be around Rs. 1 crore with operational charges. Itis informed that these deweeding machines are operating successfully over Europe, France, Austria and United State of America. Due to paucity of funds, as of now this machine could not be purchased.

In past, Council for Science & Technology Punjab under the Development and management of Harike Wetland Ecosystem Project assigned the task of removal of water hyacinth to Irrigation Dept. Punjab. The Council for Science & Technology Punjab, has given funds to the Irrigation Department, Punjab for the eradication of water hyacinth manually.

Irrigation and Power Research Institute, Amritsar has been carrying out studies in the biological control of the weed by using weevils. IPRI has so far released some 1 lac weevils of Neochetina eichhorniae and Neochetina bruchi till date in the Harike wetland area as well as in the infested drains feeding Harike Ecosystem.

In December 1999, Chief Minister Punjab, requested the then GOC-in-C Western Command, **Lt Gen Vijay Oberoi**, PVSM, AVSM, VSM for assistance in restoration of Harike Wetland which was on the verge of an ecological disaster. The Army took on the task in right earnest. The Golden Arrow

Division of **the Vajra Corps of the Indian Army** embarked on '**Mission Harike**' on 10 July 2000.

What started as a pilot project to clear a limited area, culminated into a major project in the removal of water hyacinth from a large portion of the lake. Army adopted a multi-dimensional approach under its ongoing **OPERATION SAHYOG** and laid down specific objectives for itself.

After the final notification of the area as a Wildlife Sanctuary in 1999, under the Wild Life (Protection) Act, 1972, the responsibility of control and removal of water hyacinth has become the sole responsibility of the Forests and Wild Life Preservation Department. The department has been making concerted efforts towards this objective.

Removal of water hyacinth

Water hyacinth has a specific role to play in an ecosystem and total eradication of one particular weed may not be desirable. Weeds would continue to grow in water bodies subjected to eutrophication due to running of water from agricultural fields and surrounding areas. Water hyacinth could absorb several heavy metals and help in purification of water. In case the plant was completely eradicated it could result in the growth of some other undesirable weeds.

Dr. Robert Grub of Bombay Natural History Society recommended that controlled growth of hyacinth in a water body could be useful provided it was periodically removed and not allowed to die and set in water. The objective of this plan therefore is not to completely eradicate or remove water hyacinth from the ecosystem, but to contain the weed to an optimum level so as to play a constructive role in the ecosystem.

As already mentioned elsewhere in the Plan, of the physical, chemical and biological methods available, the use of chemical herbicide like 2,4-D is being ruled out because of the delicate nature of the ecosystem. The mechanical and biological methods will be adopted in future course of action.

The strategy would be to remove the weeds physically from certain specified locations like the LMB stretch as the machines to be used are heavy and cannot reach interior areas. Secondly, weevils will be released in strategic areas spread out in the sanctuary in a large scale and special attention will be given in the catchments /upstream area.

Mechanical methods

After the successful completion of Operation Sahyog by the army, through which ingenious mechanical methods and machines were devised and used by the army, and the subsequent transfer of material and technology to the Wild Life Department, the staff of the department has acquired considerable knowledge and experience in the mechanical control of the weed.

The weeds will be removed using a combination of manual power, booms, boats, conveyor belt machines, tractor and tractor trolleys. Each conveyor machine will act as a base unit being placed at a site where there is maximum density of the weed and it is fed by manual labour, and by boats and booms dragging the weeds from far off places to the base unit from where it can be removed by the conveyors. The weeds so removed from the water are then taken away to specified spots for final disposal.

The Sanctuary already has 6 conveyor machines of which are not in working condition now. Also, the sanctuary has a shortage of tractors and trolleys which needs to be acquired, and till such acquisition takes place, the machines may be hired from local sources. There is a need for a procurement of a weed removal machine. The removal process shall be done twice a year:

1. Phase one: Immediately after the migratory birds leave, i.e. March- April till the flowering starts i.e. June-July. Ideal would be April-May.

2. Phase two: Just before the arrival of migratory birds. Ideal would be October-Mid November.

The main idea is to remove the weed before it flowers and multiplies, and to cause least disturbance to the birds and their habitat just before or during the migration period.
An estimate for the financial cost and physical progress of work based on existing wage rates discussed later.

Biological methods

As briefly discussed earlier, water hyacinth can also be controlled by the use of insects like weevils and/or certain species of fish which feed on this weed. The use of fish in the sanctuary is ruled out due to lack of knowledge, situational requirements and viability. However, the use of weevils can be done to a more effective level. Generally, two types of weevils are used- *Neochetina eichhorniae* and *Neochetina bruchi*.

The weevils have been used very effectively throughout the world. In Harike also, the Amritsar based Irrigation and power Research Institute has carried out field trials and has till date released about 1 lac weevils in the Harike wetland area as well as in the infested drains feeding Harike Ecosystem.

Considering the fact that the department has almost negligible knowledge about the technology, few manpower and resources, and also the fact that institutes like IPRI, Amritsar have already initiated some work, it is advisable to utilize the already existing system and resources by co-coordinating with IPRI, Punjab Council for Science and Technology and other such institutes. However, efforts will be made to train the staff of the sanctuary to use this technology so that in the long run, the sanctuary can take up the work in-house. The first half of the plan period

Management Plan may be utilized to coordinate with other institutes to control the weeds biologically and also to train the staff in the methodology to be employed. The second half (last 5 years) may be devoted to establishing its own infrastructure and carrying out the operation, on its own, if need be.

The main underlying principle would be to:

- Identify areas where the weevils can be released.
- Calculate the number of weevils to be released per unit area taking into consideration the existing site conditions.
- Identify the best time of year to carry out the operation.
- Observe the effect of the weevils on other organisms especially those that are a vital part of the ecosystem.
- And based on the above principles/guidelines, to use the weevils to control the water hyacinth effectively.
- Preserve the biodiversity of the area.
- Create ideal habitats for birds to build their nest, breed, and brood.
- To check and control soil and moisture conservation.
- To reclaim barren and problematic areas.
- To check and control encroachments.

Utilization of water hyacinth and other bio resources

For improving and diversifying livelihood of local communities and increasing their stakes in wetland conservation and management, there have been efforts for preparing handicrafts from water hyacinth. Initiatives for promoting water hyacinth based handicraft products have been fruitful and are now being sold in the local market.

It is further recommended, promotion of the handicraft activity on a large scale with efforts for marketing tie ups with the noted handicraft selling enterprises. Business models for economic utilization of water hyacinth may also be reviewed and considered to increase incentives to individual farmers, as well as scope for improvement in product design to enhance marketability of the products.

To enhance and diversify livelihood of local people, self-help groups in Harike wetland area may be provided low cost machines for rope making from biomass and training. Further, initiatives may be made to train local people in preparing handicraft items from water hyacinth blended with locally available bio-resources for e.g. *Saccharum munja, Eulaliopsis binata (Bhabbar grass), Typha sp., Vetiveria zizanioides (khas)* etc to support and diversify livelihood of local communities. Moreover, efforts may be made for enhancing marketing of the products involving business management institutions.

Terrestrial habitat

Even though Harike is basically a bird sanctuary with predominantly aquatic birds constituting the population, the presence of trees, forests and woodland is very important in the wetland ecosystem. The existing crop is mostly limited to the peripheral bundhs. There are some trees in the many islands except some isolated and scattered trees. Most flat areas in the eastern side falling in Ferozepur and Kapurthala districts are encroached for agriculture. The encroached area must be reclaimed by plantation of trees, the tree species with rapid growth should be selected for plantation.

Tree species selection for plantation

Native tree species must be selected for restoration and plantation in HWS. In the bundhs, encroached areas and the peripheral plains the species composition that may be planted are:

Tree	Shrubs	Grasses
1. Acacia nilotica	*Carissa carandas*	*Chrysopogon zizanioide*
2. Albizia lebbeck	*Punica granatum*	*Bothriochloa pertusa*
3. Albizia procera	*Eriobotrya japonica*	*Dichanthium annulatum*
4. Azadirachta indica	*Prunus species*	*Panicum virgatum*
5. Toona ciliate	*Grewia tenax*	*Cynodon dactylon*

6. Mangifera indica		*Cenchrus ciliaris*
7. Melia azadirach		
8. Morus alba		
9. Poplar deltoides		
10. Salix spp		
11. Syzygium cumini		
12. Terminalia arjuna		
13. Mitragyna parvifolia		
14. Trewia nudiflora		
15. Phoenix sylvestris		
16. Dalbergia sissoo		
17. Ficus species		

Table 6: Vegetation list for plantation atembankment.

In the ravines, the tree species with native shrub and grasses to be planted include:

Tree species	**Tree species**
1. Tecomella undulata	*8. Salvadora oleiodes*
2. Acacia nilotica	*9. Capparis decidua*
3. Senegalia catechu	*10. Pongamia pinnata*
4. Acacia tortilis	*11. Prosopis spp*
5. Cassia siamea	*12. Sapindus mukorossi*
6. Salvadora persica	*13. Zizyphus nummularia*
7. Dendrocalamus strictus	

Table 7: vegetation list planted at ravine area.

The tree species to be planted in the plains and the encroached area are:

1. Acacia nilotica	*7. Madhuca indica*
2. Albizia spp	*8.Mangifera indica*
3. Butea monosperma	*9. Melia azadirach*
4. Dalbergia sissoo	*10. Salix spp*
5. Emblica officianalis	*11. Syzygium cumini*
6. Ficus spp	*12. Terminalia arjuna*

Table 8: vegetation list to be planted at encroached area

In the islands which are marshy in nature, the tree species to be planted are:

1. Dendrocalamus strictus	*4. Syzygium cumini*
2. Ficus spp	*5. Terminalia arjuna*
3. Salix spp	*6. Trewia nudiflora*

Table 9: Vegetation list to be planted at Island

Planting techniques

The following general guidelines would be kept in mind while undertaking plantations:

1. No felling is prescribed (except in the case of unavoidable circumstances for which written permission is to be taken from the Chief wild Life warden) and so all the areas to be taken up are blank areas and not felled areas.
2. Areas will be measured and marked on the ground with the help of pegs and cleared of jungle growth. (alignment, jungle clearance)
3. The earthwork should be completed by the end of February to allow the soil-weathering. Minimum disturbance shall be caused to the soil and vegetation.
4. Wherever possible, the irrigated plantations will be raised and arrangements for assured irrigation will be made in advance. At least two irrigations during the months of summer dry season and once during the dry winter months are essential.
5. Planting shall start with the onset of pre-monsoon and completed by the end of July or the first week of August.
6. Good healthy plants raised in polythene bags or root trainers should be used for plantation.
7. The spacing will vary as per site conditions. However, in general the following may be adopted.
8. In the bundhs, plain areas and encroached areas: 3m x 3m. This may be modified to 3m x 2m according to site conditions and type of species.
9. In the islands having marshy conditions: 5m x 5m and this will be done in scattered pockets and not continuously. The main idea is to stock up the islands which are filled with only reeds and tall grasses

with some tree species scattered around, without disturbing the uniqueness of the marshy conditions.

10. In the ravines: 3m x 4m in staggered fashion and with contour trenches.
11. The failures should be beaten up during the same planting season. The planting stock used for beating up should consist of healthy and vigorous plants.
12. Frost hardy species like neem, Kikar, if not planted under shade, shall be covered during the winter months to protect from the damages of frost.
13. In low-lying areas, planting can be done after the flood waters have receded or by planting on mounds and ridges constructed for the purpose.
14. The young plantations shall be tended by carrying out weeding and hoeing till the second year of planting. During the first season, three weeding and hoeing should be done in the months of August, October-November and February/March.
15. Pruning should be carried out during the winter season especially during December-January in case of shisham, mulberry, kikar etc. Care should be taken to ensure that pruning is done only on the best stems, which are to be retained as the final crop. In case of larger stem, after cutting the branches, the cut portion should be treated with some pesticides to avoid infection from the exposed parts.
16. Soil preservation measures should preferably be completed one year in advance in the areas taken up for plantation.
17. In terms of species, preference will be given to local, indigenous, hardy and frost resistant varieties, subject to site conditions.

18. In a particular compartment, preferably one species will be planted with 10% mixture of other species in order to maintain biodiversity.
19. All natural regeneration of the species shall be retained and adopted.

Planting program

The regular monitoring of tree cover area for maintaining significant density of tree in habitat. There must be regular plantation programmes to cover reclaimed encroached area. The invasion of weed should also be controlled in all habitats including tree species also. There are some species like *Prosopis juliflora* and *lucenia leucocephala*whichis threat to forest cover in long run. Plantation of vegetation species composition have been given according to habitat.

It is to be noted that:

a. Current area under encroachment must be reclaimed by restoration with forest and wetland communities. So the yearly targets may be decided depending upon the removal of encroachments.
b. Area removed from encroachments should be taken up for plantations on top priority basis so that further encroachments in the area are avoided.
c. Also, areas which are at boundary and are prone to encroachment should also be planted so that they are not further encroached and act as natural fencing.
d. Also, plantations can be done on islands which will help him in consolidation of loose soil, also trees will help in increasing heronry and nesting sites for birds.

Creation of nursery

To meet the seedling requirement of the proposed planting programme, nurseries need to be set up at appropriate places. One major modern nursery is proposed to be set up in the Harike office complex. This would not only serve the planting

requirements but would also cater to the needs of the local requirements of the surrounding villages. The nursery should have all the modern facilities like root trainers, mist chamber, shade house, sprinkler system etc. As far as possible chemical fertilizers and pesticides are not to be used, in their place, organic composts and vermicompost and bio pesticides may be used.

The collection of seed and saplings from sanctuary from habitats in different season.

Species for saplings	**(Seed, rhizome, cutting)**	**Months of collection**	**Habitat**
Syzygium cumini	*Seeds, saplings*	August- October	*Tree cover*
Terminalia arjuna	*Seeds, saplings*	July to January	*Tree cover*
Melia azadirach	*seeds*	October	*Tree cover*
Albizia procera	*Seeds*	October – November	*Tree cover*
Albizia lebbeck	*Seeds, saplings*	August- October	*Tree cover*
Acacia nilotica	*Seeds*	December – January	*Tree cover*
Zizyphus nummularia	*Seeds*	January to march	*Tree cover, ravine*
Dalbergia sissoo	*Seeds*	December – January	*Tree cover*
Ficus spp	*Seeds, saplings*	August – September	*Tree cover*
Senegalia catechu	*Seeds*	November	*Tree cover, ravine*
Grewia tenax	*Seeds*	October	*Tree cover*
Capparis decidua	*Seeds, saplings*	October – December	*Tree cover, ravine*
Salix spp	*Cuttings*	June –September	*River islands, tree cover*
Chrysopogon zizanioide	*Rhizome*	September – October	*Along river and wetland*
Cassia fistula	*Seeds*	September- November	*Tree cover*

Table 10: list of vegetation species for collection of saplings from sanctuary for plantation.

Besides the above mentioned measures which are treated in detail, the following measures also needs to be implemented:

- Creation of shallow ponds and mounds: As different species need shallow as well as deep waters for their biological activities these features need to be created. Mounds also need to be created in certain areas, especially in some of the islands.
- Dead, dry and fallen trees should not be removed as these are ideal habitats for the birds, insects and other organisms.
- Snags, dens nests and other such structures used by the animals and birds should not be disturbed.
- Termite hills, honeycombs etc should not be destroyed or removed.Snags should be maintained at the islands fore animals like the wild boar and Indian otter inhabits.

E-flow monitoring

E-flows studies need to be conducted for the River Beas and River Sutlej for enhancing the hydrological regime and for ensuring water balance qualitatively and quantitatively. There is need to establish hydrological and meteorological monitoring stations in the key locations in Harike Wildlife Sanctuary to map the variations in hydrological regimes. This work will be led by the Department of Forests and Wildlife Preservation, Punjab and achieved in collaboration with experts from State E-flow working group, Punjab Pollution control board and Department of Water resources.

Enhancing habitat connectivity

Harike wildlife sanctuary act as a habitat connector for the Sutlej and Beas River. Parts of the Harike Wildlife Sanctuary and small streams joining the River Beas and River Sutlej are clogged due to heavy silt deposition and reduced water flow over years. There is need of human interventions like enhanced water flows, the desilting exercise at

particular locations and creation of small wetlands along the River Beas and the River Sutlej to connect watershed of the Rivers Sutlej and River Beas and enhance the water holding capacity of the Harike Wildlife Sanctuary. This work will be led by the Department of Forests and Wildlife Preservation, Punjab and achieved in collaboration with subject experts and organizations, State E-flow working group, Irrigation Department, Punjab and Department of Water resources

CHAPTER 10: CONSERVATION&PROTECTIONSUB PLAN

The protection of the sanctuary from various threats like encroachments, poaching illegal fishing, grazing and other activities harming the sanctuary and its resources is very important so that the habitat is protected, illegal activities are curved the natural heritage is preserved. This sub planis formed for the main purpose on focusing on the issues related to the protection of the sanctuary from such threats. It will cover the whole of the sanctuary.

Special objects of management

The special objectives of the sub planare:

1. Identification of the threat perceptions faced by the sanctuary,their causes and possible remedies.
2. Take suitable measures for the protection of the sanctuary from such threat perceptions.
3. To involve the people in the protection and management of the sanctuary.

Methods of treatment to be adopted

The methods to be adopted in order to achieve the objectives:

1. Survey, mapping and demarcation of the area under treatment.
2. Identification of problem area, habitual offenders, etc., their causes and prescribing suitable remedies to tackle them.
3. Fencing of sensitive areas.
4. Prosecution of offenders.
5. Establishment of a legal cell.
6. Augmentation of existing resources like infrastructure, buildings, communication etc.
7. Coordinate with police and other agencies for better protection.

8. Create awareness among the people so that they are deterred from committing offences and help the authorities in the management of the sanctuary.

Survey, mapping and demarcation

It goes without saying the presence of survey sheets and maps are vital tools for the management and protection of the sanctuary. However, because of the remote nature of the area, difficult accessibility and difficult terrain the survey and demarcation of the limits of the area has been a difficult proposition. Many surveys were conducted by various agencies at different times but almost all of these surveys were meant for ascertaining certain ground conditions like spread of water, vegetation, extent of pollution etc. and not for demarcation or fixing the limits of the sanctuary as such.

The lack of proper survey and mapping due to the factors mentioned has led to disputes between the sanctuary staff and the people inhabiting the adjoining villages regarding the boundary and limits of the sanctuary and more often than not, it leads to encroachments and litigations.

SURVEY:

In light of the above, it is very imperative that a proper and detailed survey is conducted for the main purpose of demarcation and fixing the boundary and limits of the Wild Life Sanctuary. This has become more important after the final declaration of the area as a Wild Life Sanctuary and the application of the provisions of the Wild Life (Protection) Act, 1972.

For the survey, the main strategy would be:

- ✓ The earlier works carried out by the irrigation department, the army and other agencies would be referred.

- ✓ As the staff of the sanctuary has negligible knowledge and skills regarding survey works, the services of staff from the revenue department, retired patwari / kanungos, and experts may be requisitioned.
- ✓ The staff of the sanctuary would also be trained so that they gradually take over the work in future so that any component of the management of the sanctuary does not suffer because of dependence on other agencies. Moreover, their services would be all the more important in the settlement of disputes and the several ongoing litigations.
- ✓ The department should also ensure that the post of at least one patwari is created and filled up on a permanent basis
- ✓ The use of modern technologies like GPS and GIS and satellite data like remote sensing data may be employed.

MAPPING:

Once the surveywork is completed, maps would be generated. The maps should have the following features:

- ✓ **Physical map**: showing the actual boundary and limits of the Wild Life Sanctuary. It should also contain other features like the extent of water, land mass, uplands, swamp/marsh areas, existing rivers, tributaries, islands, bundhs, roads, and other such physical features on the ground.
- ✓ **Infrastructure map**: showing existing roads, firelines, tracts, buildings, checkposts, barriers, watch-towers, bird hide-outs, boat jetty/landing spots, wireless towers/base sets, boundary pillars etc.
- ✓ **Vegetative map**: showing the vegetation of the area, their location, types, blank areas etc.
- ✓ The maps should be prepared using modern technology like the GIS software. The good offices of the Town Planning Officers and other agencies that have expertise in the field may be utilized. The maps should

be prepared on the same scale so that integrating and interpreting different maps of the same area is not troublesome.

Fencing

Even though the terrain is hostile and not easily accessible, there are still some areas where people from adjoining villages encroach upon. There are also certain areas from where cattle and other animals enter into the sanctuary area, graze and destroy the habitat. Some routes are used by poachers and illegal fishers to gain entry into the area. There are also certain isolated cases where animals from the sanctuary, especially the wild boar, have gone into the surrounding villages and cause damage and fear among the residents. Such vulnerable areas need to be properly identified and fenced.

The general guidelines to be followed are:

- Identification of vulnerable areas and categorizing them into areas prone to
  - ✓ Encroachments
  - ✓ Grazing
  - ✓ Poaching
  - ✓ Animal attack
- The identified areas should be fenced by either barbed wire or by chain-link fencing.
- For barbed wire fencing, it is advisable to use RCC pillars whereas for chain linked fencing, angle-iron fence post are ideal.
- In areas where grazing and animal attack takes place, barbed wire fencing can be utilized. The fence post should be a minimum of 5 feet above the ground, three strands and cross of the barbed wire between each pair of pillar should be used.
- For areas prone to encroachments and poaching, chain-linked fencing is preferable. The fence should be a minimum of 6 feet. If barbed wire

fencing is to be used in such areas then the pillars should be at least 7 feet above the ground, 5 strands of barbed wire and a cross between two pillars should be used.

- ❖ The existing fencing should be regularly monitored and repair and maintenance should be carried out wherever necessary.
- ❖ In cases of severely affected areas, a ditch-cum-bund running parallel with the fencing may also be constructed. And in areas of occasional problems only the ditch-cum-bund may be used instead of the fencing.
- ❖ The concept of social fencing whereby the help and cooperation of the surrounding villages is sought and obtained by interacting with them directly or through the village panchayat, village forests committees (VFCs) etc. should be explored and employed wherever feasible.

Prosecution of offenders

As the boundary is porous and there are many incidents of illegal activities in the sanctuary, it is important that besides taking preventive measures like demarcation and fencing, the staff also keep constant vigil and take appropriate legal action against the offenders. There are many cases filed in differnet courts for illegal encroachment.

Patrolling

One of the important aspects of protecting the sanctuary is to keep strict vigil by regularly patrolling the area and also by conducting surprise checks, raids and traps. The patrolling is to be done both on land and on water. The patrolling on water is to be done using motorized boats as well as manual boats. The patrolling on the land is to be done by jeep and motorcycles. The general instructions for patrolling are:

- ➢ Special unit, within the staff (existing and upgraded, as and when it happens) would be raised for the sole purpose of patrolling the area.

- There will be two such Patrol Units, one for the land and one for the water.
- Each patrol Unit will consist of a Block officer, two guards and two labourers. During night patrol 2 policemen would also form part of the party.
- The patrol party would have mobile communication systems either in the form of gps handset or mobile phones.
- All members of the field staff would have to serve in the patrol units for at least twice a week.
- A comprehensive time chart would be prepared containing details of the persons, time and date of patrolling to be done.
- This patrol would be over and above those carried out by the Wild Life Guards who have to control and manage the areas under their jurisdiction.

Removal of encroachments

Encroachment is a major problem facing the management. Besides being an illegal activity, it destroys the habitat, increases, biotic interference in the surrounding area, destroys the ecological balance by the excessive use of fertilizers, insecticides, ground water, burning of straw etc.

The land was initially acquired by the irrigation department for the purpose of barrage and the pond area. The ownership of this land in the notified sanctuary belonged to either revenue department or irrigation department.

All the land records and documentation pertaining to acquisition of land by the irrigation deparment from the affected villages were under their control and have never been transferred to the wildlife department. Even there have been communication from SDO Irrigation harike to Revenue officials regarding removal of enchroachmnet from their land.

Due to lack of availability of these records and lack of ownership with wildlife department, it has always become an impediment in demarcation of the sanctuary area and thus the removal of encroachments. Most of these encroachments are there from the time sanctuary is notified, and are in fact remnants of the terrorism days. Most of the encroachers have, through litigation and also through dubious means, managed to change the revenue records in their favour. The staff of the sanctuary has taken many actions against the encroachers. Details are given in annexure. However, a lot remains to be done and accomplish.

The following actions may be taken for the removal of encroachments:

- A joint stakeholder approach with officers from revenue,irrigation,police and wildlife department for verification of the land records and clarification of the ownership of the land.
- Demarcation of all the areas encroached.
- Physical marking on the ground of the demarcated areas by erecting bundhs, fence post, boundary pillars etc., as already elaborated earlier, so that the area demarcated is not altered till it is finally evicted.
- Take stringent action against persons altering the demarcated areas by destroying or shifting the pillars etc.
- Identification of areas where the encroachers have managed to change the revenue records in their favour, and encroachers who have not yet changed the revenue records.
- Once the above identification is made, to initiate process for eviction under the Public Premises Act against the encroachers who have changed the revenue records in their favour. Legal action may also be taken for the destruction of habitat under provisions of Wild life (Protection) Act, 1972. Provisions of the Indian Penal Code may also be invoked wherever applicable. The latest amendment of the Wild Life (Protection) Act, 1972, in 2004 has given full powers to the Wild Life authorities for the eviction of

encroachers similar to the provisions given in the Public Premises Act. The government needs to frame appropriate rules regarding the matter so that the provisions of the act can be fully implemented and the wild life officers can dispose of encroachment cases without depending on the revenue authorities.

- For the encroachers who have not changed the revenue records in their favour, they may be prosecuted under provisions of the Wild Life (Protection) Act, 1972, for encroaching, habitat destruction and other activities prohibited under the said Act. Here again, provision of IPC may also be invoked for taking legal action.
- Establish good working relations with the revenue department, police and the district administration so that coordination with the departments helps in removing the encroachers. This may be achieved by having regular meetings with the DC or the SDM on a monthly basis to discuss the problem and progress. Similar meetings may also be held with the Police authorities from time to time.
- The support of the general public, especially of the concerned village is also necessary. For this awareness camps and meetings may be held in the villages and the encroachers may be black listed in their own village by the panchayat.
- The local elected representatives like the sarpanch, MLA and MP needs also to be taken into confidence and informed from time to time about the activities and the damage caused by the encroachers and to seek their support so that unnecessary interference from them is avoided when action is taken against the encroachers.
- Once an area is removed from encroachment, the area should be immediately fenced and planted up with suitable species so that further encroachments do not take place.

DEMARCATION:

After completion of the survey and mapping, demarcation of disputed areas should take place by digital means. As demarcation involves legal issues as well, the help and coordination of other agencies like the district administration, the police, the revenue department etc should be taken. Wherever possible the village panchayat and elders of the concerned village should be taken into confidence so that any avoidable confrontation does not arise. A committee of retired revenue officers can be formed for this purpose.

Once the area is demarcated, boundary pillars should be fixed at strategic points. In the past there have been cases where the boundary pillars were either destroyed or shifted by encroachers for vested interests. In order to avoid such cases the following measures are to be carried out:

- The boundary pillars should be large and sturdy enough so that it cannot be uprooted or shifted easily. At least 1/3 of the total length of the pillar should be below the ground and fixed with concrete.
- Each boundary pillar should be numbered and recorded.
- The forward and backward bearings would be recorded for each boundary pillar
- If GPS is used, the coordinates (latitude and longitude) of the boundary should also be recorded.
- A minimum of 10 trees should be planted around each boundary pillars so that their location in the field is further simplified and enhanced.

Prevention and prosecution of other offences

The sanctuary encounters many offences occurring in the sanctuary, including grazing, poaching, illegal fishing, habitat destruction, illicit felling, illicit manufacturing of local brew, etc. It is very important that these offences are kept in check and strict action is taken against the offenders.

Fishing: The most common offence is that of fishing in the protected area. Fish productivity is the main index in determining the ecosystem values. Harike is a highly productive area and till the final notification of the area as a Wild Life Sanctuary in 1999, fishing inside the sanctuary area was allowed and the government earned revenue to the tune of crores of rupees from the sale of fishes.

The Department used to give contracts to contractors and the contractors in turn hire local labour for catching the fish and sell it in almost all parts of the state. However after the declaration of the area as a sanctuary in 1999, no such activities are allowed inside the sanctuary area.

All fishing and related areas are now reduced to the downstream of the two major draining canals of Rajasthan and Ferozepur Feeders. As a result, the quantum of catch has drastically reduced and the economic conditions of the big contractors as well as that of the local population depending on the activity have also reduced consequently.

The fishermen have a larger catch and variety besides the relative ease with which they can fish, inside the sanctuary as the area is highly productive, not disturbed and has greater expanse. This is one of the most important reasons why the people still prefer to fish inside the area, even if it means being caught and prosecuted for doing so. In order to prevent and control fishing activity, the following actions are recommended:

- ✓ Patrol sensitive areas especially at night and early dawn
- ✓ Change the personnel patrolling and manning the check post to avoid possible connivance of the lower staff

- ✓ Identify habitual offenders, most of who are from the surrounding villages, their modus operandi including the tools and vehicles used by them and keeping a strict watch on them.
- ✓ Identify the persons dealing with fish in the local market at Harike and carry out surprise raids from time to time to ascertain that the fish coming there are from legal sources and not from the sanctuary.
- ✓ Once an offender is caught, immediate legal action is to be taken as per provisions of the Wild Life (Protection) Act, 1972. The provisions of IPC like sections 378 (Theft). 441 (Criminal Trespass), 503 (Criminal Intimidation) etc. should also be invoked wherever applicable. All tools, implements, carts, vehicles etc. used in the commission of the offence should be seized and confiscated as per provisions of the Wild Life (Protection) Act, 1972.
- ✓ Creation of awareness among the surrounding people and seeking their help and cooperation in prevention and prosecution of the offenders.
- ✓ Encourage the people dependent on fishing, especially the small time fishermen to cultivate fish in their own ponds. For this the help and expertise of the Fisheries Department, NGOs etc. can be utilized.

Habitat destruction: Another common offence is the destruction of habitat mainly by the removal of Trapa and lotus. As already discussed, the flower of the lotus is used for religious purposes, the seeds (locally called gol dodey) and the stem (locally called Bhaey) is used for edible purposes. The actions recommended for illegal fishing may also be adopted for curbing this offence.

Grazing: The problem of grazing is common in many areas around the sanctuary. In some cases, the cattle even reaches the interiors by wading/swimming through the shallow areas of the streams. Besides the measures already listed above for the control, the following measures may be taken:

- ✓ Seizure of the cattle and confiscation as per provisions of the Wild Life (Protection) Act, 1972, and the cattle Trespass Act.
- ✓ Preparation of a cattle pound to keep the cattle during the pendency of litigation. And to dispose them off by sending to pounds owned by the government or other agencies as per rules applicable.
- ✓ The local population may be encouraged to stall feed their cattle. Certain identified persons/families may be given grasses and other fodder species which are removed from the sanctuary for management purposes as outlined in the chapter on JFM.
- ✓ Certain areas in the surrounding villages which are lying waste and fallow may be identified with the help of the local people themselves so that grazing areas may be developed by planting suitable grasses and shrubs.

Illicit felling: Although not a major problem, there are cases of illicit felling and lopping of trees in the periphery of the sanctuary. These are mainly for fuel wood and fodder purposes. The following measures may be adopted, over and above the measures already outlined before:

Identification of areas in the surrounding villages for plantation of trees having fuel wood and fodder qualities. These areas may be office complexes, school grounds, panchayat lands, link roads, gurudwaras etc.

Create public awareness to encourage people to protect and manage the plantations so raised and to cause minimum damage to the habitat.

Legal cell

There are a lot of litigations going on against the offenders. Most of these cases are long drawn-out cases going on for several years and involving legal intricacies. While the offenders hire the best lawyers available, most of the cases of the sanctuary are handled by the staff of the sanctuary that have little or negligible legal knowledge.

Due to lack of manpower and lack of expertise of the manpower available, the cases are not represented properly and quite often the cases are decided against the government. Besides, some of the staff is engaged routinely in court cases that too in different courts that they are not able to carry out their other duties effectively in the sanctuary.

It is therefore recommended that a legal cell may be set up to look after the prosecution and other legal works of the sanctuary. The legal cell shall be constituted with a qualified lawyer who may either be a government one or a private lawyer hired on contract basis, a clerk, and two field staffs.

The legal cell besides looking after the court cases will also advise the sanctuary management in future course of action against offenders and possible offenders especially the encroachers who have political clout and influence, so that un-necessary litigation is avoided.

Protection and Conservation of threatened species

Threatened mammals

The rare freshwater dolphins (*Platanista gangetica minor*) are found in the 75 km stretch of the Beas River, which includes the 3 km stretch of the Harike Wildlife Sanctuary. The stretch of River Beas from Beas to Harike Wildlife Sanctuary needs urgent protection measures to reduce the risk of further decline in the dolphin population and focus conservation actions. Dolphin census is

proposed as part of the annual wildlife census being conducted by Department of Forest & Wildlife Preservation.

Fishing in Harike wetland area needs to be regulated in terms of fishing practices and gear to eliminate/reduce incidental entanglement of dolphins in fishing gear. IEC(Information Education Communication) activities targeting fishers in Harike wetland area is recommended. Suitable incentives may be provided to fishers for release of entangled dolphin. Some fishers of the area could be identified and trained for dolphin status survey.

Sighting of dolphin can be reported by the fisherman to the office of DFO (Wildlife), Ferozepur. A mechanism can be developed whereby record of sighting of dolphin can be displayed, preferably near existing Interpretation Centre. These fishermen could be engaged in annual wildlife census as well. Community based ecotourism could be fostered in due course. It is also recommended to delineate and mark boundary of Harike Wetland for better management of wetland.

Ecological studies of Hog deer (*Axis porcinus*) and Smooth Indian otter (*Lutrogale perspicillata)* is proposed. As part of this activity, management plan recommends study of habits including breeding pattern, behaviour and habitat mapping of threatened wildlife species, protection, preservation and improvement of habitats, census and collection, collation and analysis of statistical data regarding species to be conserved, etc.

Management plan recommends research on reproduction biology of threatened species to support reintroduction programmes, if need be. Changes in abundance and diversity of threatened species in wetlands over time may be monitored through annual census focusing on threatened species.

Management plan also recommends undertaking feasibility of introducing captive breeding programme for threatened species when it is ascertained that species survival in wild is severely threatened on account of impaired natural

breeding, or for any other reasons. Focus on threatened species is recommended in annual wildlife census.

Conservation method for Indus river dolphin

The Indus River dolphin (*Platanista gangetica minor*) is one of the world's most threatened cetaceans. It is endemic to the Indus River System. The main threats to the Indus Dolphin are illegal fishing, water pollution and stranding in irrigation canals. There is also a potential risk of inbreeding due to the confined population in the Indus Dolphin Reserve(Waqas et al., 2012).

The main reason for the initial decline of the Indus river dolphin population was the construction of numerous dams and barrages that began in the 1930s. This construction split the population into small groups, degraded their habitat and impeded migration. Now the major threats include accidental capture in fishing nets, plus they are hunted for their meat, oil and for use in traditional medicines.

Prey base enhancement and replenishment

Presence of fishes in an aquatic habitat is a good indicator of the health and status of that ecosystem. Harike Wildlife Sanctuary and the Beas Conservation Reserve has recently gone through an ecologically stressful condition tones of molasses were spilled in the river causing mass mortality of the fishes. Natural rejuvenation of freshwater fish diversity will take years and the ongoing destruction of habitat on account of various natural and anthropogenic factors like the polluted water and declining water table is affecting water quality, biodiversity and fish growth. It is proposed to enhance the prey base in the Harike Wildlife Sanctuary, the fish needs to be reintroduced/restocked both in the form of seedlings and adults from different source populations. Monitoring needs to be conducted after reintroduction to evaluate the fish composition and density. It is also proposed to create ranches and rearing of native carnivores' fishes in the Harike Wildlife Sanctuary. This will be carried out by a trained

team of the Department of Forests and Wildlife Preservation Punjab with the support from the Fisheries Department of Punjab, National Fisheries Board and experts from the national and international organizations and institutes like institutes IUCN, Wildlife Institute of India World Wide Fund for Nature & Zoological Survey of India.

Effective methods for conservation for dolphin

1. Robust control on illegal fishing.
2. Pollution control in its habitat.
3. Monitoring weed and vegetation expansion in the habitat.
4. Siltation levels and depth of water bodies should be monitored.
5. Regular monitoring of dolphin.
6. Keeping record of breeding population of dolphin.
7. Public awareness and education activities for local communities.
8. Research developments on dolphin and sympatric species.

Threatened birds

Study of migration, mortality, territoriality and other behaviour of the birds to understand both local, regional and trans-border movements, particularly threatened birds is proposed. Changes in abundance and diversity of water bird species in wetlands over time should be monitored through annual census focusing on threatened birds. The nesting distribution and mortality of birds should be studied.

Annual census focusing on threatened bird species should be carried out. BNHS has expertise in conducting in Bird ringing in wetlands which can be leveraged for training of personnel from Forests and Wildlife Preservation Department, volunteers, etc. Bird ringing by expert trappers using annual rings with encrypted codes should be undertaken. The forest department can communicate

to Wildlife institute of India, Dehradun for wildlife research such as breeding biology of species and tagging and tracking birds.

Methodologies for census of wildlife population and ecological monitoring

Aquatic birds can play an important role in wetland management in that they are extremely sensitive to hydrological fluctuations. Such sensitivity can be used to set management goals for the wetlands. The strong association of heronry birds with aquatic ecosystems makes these birds excellent barometers of environmental health.

It is, therefore, crucial that a systematic effort be made to maintain and monitor populations and understand the factors that affect population fluctuations. Information on the effects of water management on avian population parameters is urgently needed for most wetlands types. Understanding the relationships of wetland birds to management strategies will allow managers to take the needs of aquatic birds into consideration.

Water fowl census has following objectives: (i) To obtain information on an annual basis, of water bird populations, during the non-breeding period of most species, as a basis for evaluation of sites and monitoring of populations, (ii) to monitor on an annual basis, the status and conditions of wetland, and (iii) to encourage a greater popular interest in water birds, and thereby promote their conservation.

In view of these objectives, it is recommended that methodologies followed by Asian Waterfowl Census, being coordinated by Wetlands International and BNHS is implemented in Harike Wetland area. Further, methodologies are proposed based on similar experiences in wetlands in India. A programme for ecological monitoring of the Keoladeo National Park (KNP) and its environs has been designed and is being implemented. Methods used in KNP are:

1. **Road transect method**

Road transect method has been very useful for counting raptors ranging in wider areas. This method was employed to determine raptor species distribution and their relative abundance in Keoladeo National Park. Roads and trails in the park provided convenient access to the study area were used as transects for survey carried out monthly in clear weather by a two-member team about an hour after sunrise from a moving vehicle (with speed 20 km/hr) stopped at specified points to count flying and perched birds. This allowed large areas of the park to be searched efficiently for raptors. A pair of good binoculars and spotting scope was used to aid identification of distant birds.

2. Direct count method

Nesting population of heronry species was estimated using complete direct count of the colony sites in August 2005. The count was carried out about an hour after sunrise in a clear weather by a team of three persons (including two forest staff members). The boat was also used in areas inaccessible by foot during counting.

Data was collected on colony size and composition. The numbers of active nests (with birds either incubating or making nest) per tree were counted for different heronry species. Information was also recorded on the nest habitat use; nesting tree species, height, dbh and canopy size.

In KNP, Rajasthan and Okhla Barrage Bird Sanctuary, Delhi, Total count method was used. Waterfowl was counted fortnightly at fixed times (half an hour after sunrise to 1100 and 1500 h to half an hour prior to sunset) from vantage points, walking along untarred roads and dykes. In Okhla barrage bird sanctuary, waterfowl was counted at sporadic intervals and times of the day in blocks accessible from tarred road.

For population census and monitoring of terrestrial birds (Forests and woodlands), following methods have been used:

1. Encounter rate and call index (Nanda Devi National, Park, Uttaranchal) were used wherein birds were counted as and when encountered.
2. Transect (Anamalai Hills, Western Ghats, Tamil Nadu) was used where in Fixed width transects approx. 100 m was used.

Counts were done at constant time of day and due consideration made for varying weather conditions. However, when inclement weather conditions preceded a morning census, work was done in the evening.

Variable width line transects (Dampa Tiger Reserve), Mizoram was used wherein birds were counted at constant time of the day (0.5–3 h after sunrise), while walking at a slow, uniform pace to complete each transect in 50 min. Detections were placed in perpendicular distance classes away from the transect. In Silent Valley, Kerala, counts were made constant time of the day (30 min after sunrise in all months) and weather.

Further, it is recommended that field methods for monitoring land birds by Bibby et al., 2000. Field Methods for Bird Surveys. Bombay Natural History Society, Mumbai and Counting birds in India: Methodologies and trends, Wildlife population monitoring: some practical considerations etc, may be referred too.

Based on the experience of ecological monitoring and experiences at KNP, the population monitoring should be carried out for a decade at least to understand the ecology, ecosystem functioning and monitor changes in Harike wetland area, The parameters may include availability of water, release of water, fish fry.

As part of ecological monitoring, carrying capacity and ecological requirement of seeds of plants and fish should be studied. Species specific data on behavioral ecology of birds should be collected for parameters like habitat, food, nesting sites and breeding period. Bird ringing should be undertaken in Harike Wetland area for population monitoring of birds, in particular migratory birds.

Management plan proposes Ecological studies of 3 Critically Endangered species and 1 endangered species. As part of Species Recovery Programme, MoEFCC has initiated Project Vulture in Haryana, Punjab and Gujarat. Rs 18.40 lakhs was provided to Government of Punjab for Project Vulture. Management plan recommends research on reproduction biology of endangered species to support reintroduction programmes, if need be. Changes in abundance and diversity of water bird species in wetlands over time may be monitored through annual census focusing on threatened birds.

For conservation of Red headed vulture, management plan recommends developing vulture breeding programme in consultation and coordination with Forests and Wildlife Preservation. Bombay Natural History Society has demonstrated capacity of vulture conservation and captive breeding in India. BNHS is executing three Vulture Conservation Breeding Centers (VCBCs) at Pinjore in Haryana, Rajabhat Khawa in West Bengal and Rani in Assam.

As part of this activity, management plan recommends study of habits and habitats of threatened wildlife species, protection, preservation and improvement of habitats, census and collection, collation and analysis of statistical data regarding species to be conserved, etc. This would also entail study of breeding and nesting behavior, mapping the distribution of bird nests, nest counts, mortality of adults and chicks. Further, bird ringing, transect methods for survey and census in the period in which threatened species are recorded to occur in wetland area is recommended. For detailed Bird census and survey techniques publication such as Gregory et al., 2004 may be referred and customized to suit wetland specific habitat.

Management recommends research on reproduction biology of threatened species to support reintroduction programmes, if need be. Further, Guidelines on Preparation of Action Plan for Conservation of Terrestrial Species (species

recovery plan) prepared by Wildlife Institute of India, 2009 may be referred too. Alliance for Zero Extinction (AZE) is a global alliance, which identifies threatened species (CR and EN), based on the global IUCN Red Listing, occurring in a single location, as the highest priority in initiating on-the- ground conservation action. There are 19 species recognized by the AZE in India. The Zoo Outreach Organization and the Indian Alliance for Zero Extinction (In AZE) have identified a further 40 species and sites based on the assessments of freshwater fish and aquatic plants.

It is recommended to seek synergies with such global and national initiatives for conservation of aquatic biodiversity in wetlands. Necessary training of personnel to strengthen captive breeding projects for critically endangered/endangered species of wild animals is recommended.

It recommends to follow Ramsar handbook no. 13 "Inventory, assessment, and monitoring": An integrated framework for wetland inventory, assessment and monitoring, Fourth Edition, 2010.Ecological studies of nineteen threatened bird species are proposed. Focus on threatened species is recommended in annual wildlife census.

Threatened reptiles

Pangshura tecta, Kachuga smithii, Nilssonia gangetica (Aspideretes gangeticus) and Geoclemys hamiltonii) reported in Harike wetland area has been listed in Schedule I of the Indian Wildlife (Protection) Act, 1972. Nilssonia gangetica and Geoclemys hamiltonii have also been listed in Category "V" (Vulnerable) in the IUCN Red list of Threatened species. Pangshura tecta is listed under Least Concern category.

A suitable proposal for conservation and management of threatened turtles in Harike wetland (including upstream/downstream areas) can be developed by Department of Forests and Wildlife Preservation in consultation with PSCST.

Funding opportunities can be explored with agencies such as Turtle Survival Alliance, USA.

MoEFFC has initiated Management Effectiveness Evaluation (MEE) of Protected Areas. Bir Motibagh Wildlife Sanctuary was included for undertaking MEE during 2012-13 & 2013-14. Management plan recommends conducting Management Effectiveness Evaluation (MEE) of Harike Wildlife Sanctuary to understand the effectiveness of conservation and management measures and take remedial and corrective measures for implementation of future conservation and management measures in Harike Wildlife Sanctuary.

Conservation of Indian gharial (Gavialis gangeticus)

Indian Gharial, Gavialis gangeticus is the only surviving member of an ancient family of crocodiles, found to swarm the Ganges and its tributaries from Chambal in Rajasthan to Mahanadi in Orissa and Brahmaputra and Barak valley of Assam. Formerly, the species was distributed across the rivers of Pakistan, Burma, North India, Nepal and Bhutan. Now its population has shrunk up to 96% throughout its past range; 5,000-10,000 in the 1940s to less than 200 by 1976.

In 2006, the mature gharial population is less than 200 in India and 35 adults in Nepal. The species is extinct in Pakistan, Bangladesh and Bhutan. Only two records for the species were recorded from Myanmar in 1927 and presumed extinct now. The drastic decline in the gharial population over the last decades can be attributed to over-hunting for skins and trophies, egg collection for consumption and killing for indigenous medicine.

Now, only three widely separated breeding subpopulations are left in India and one in Nepal. While hunting is no longer considered to be a significant threat, anthropogenic activities cause an extreme limitation to gharial range due to

irreversible loss of riverine habitat. Because of the rapid population decline, the gharial is listed by IUCN, as critically endangered.

Reintroduction of Gharial was conducted by the Department of Forest and Wildlife Preservation, Punjab following a standard reintroduction protocol and with the technical assistance of the WWF-India. Forty-seven juvenile Gharial obtained from Gharial Breeding centre in Deori, Morena, and Madhya Pradesh were re-introduced in batches in the River Beas between December, 2017 and February, 2018.

The Harike wildlife sanctuary is the only habitat in the world where Indus river dolphin and Indian Gharial are suriving together. Hence the Harike wildlife sanctuary needs to conserve.

Effective methods for conservation for Indian Gharial

There should be i) controlled fishing in the river, ii) use of nylon gill net, stone and sand mining in the river should be prohibited, iii) proper management and care of nests at captivity iv) regular surveys and monitoring of gharial in the wild areas and v) reintroduction programme to save the remaining gharials (Saikia, 2013).

Some other measures:

1. Pollution control in habitat.
2. Monitoring weed and vegetation expansion in the habitat.
3. Preserving of sandy islands with efficient protection.
4. Regular monitoring and surveying of Indian Gharial.
5. Keeping record of breeding population of Indian Gharial.
6. Public awareness and education activities for local communities.
7. Research developments on Indian Gharial and sympatric species.
8. Prey base enhancement and replenishment by assisting natural growth of fish population.
9. E-flow Monitoring of the flow of upstream of Harike to ensure suitable flow for their survival.

CHAPTER 11: SOIL AND MOISTURE CONSERVATION SUB PLAN

GENERAL DESCRIPTION

The problem of soil erosion although not acute is definitely a cause of concern. This is because the erosion of soil in the immediate catchment has not only damaged the soil and leads to the gradual siltation of the lake area, it has also eaten into the economy of the surrounding villages because of the loss of soil and consequent effect on agriculture.

The problem is most severe on the western side of the sanctuary, especially in the villages of Kirian, Kambo dhaiwala, Chamba kalan, Marar etc falling in Amritsar district. Here the area is elevated, some areas having heights of some 100-150m above the surface of water, and in certain areas the drop has a slope of almost 90 degrees. Through the years, the soil has been reduced to gullies and ravines, all the gullies draining into the lake. There is negligible vegetation in the area, with no trees or grasses in most areas. Consequently, the area has been rendered useless for agricultural purposes. The main causes for the condition can be attributed to:

i. Semi-arid climate with sparse annual rainfall
ii. The coarse textured, sandy loam nature of the soil
iii. Overgrazing of the land
iv. Deforestation of meagre vegetation existing on these lands
v. Cultivation of marginal lands for agriculture
vi. Faulty water management

Certain areas on the eastern side have also problems of erosion. However, the problem is not as severe on this side as the area is low lying and flat. The main causes of soil erosion in this area being the high rate of flow of current cutting into the banks and barren nature of the soil.

The islands and the interior areas are more or less not affected by erosion as all these islands are marshy in nature and have reeds, tall grasses, shrubs and herbs which binds the soil.

Special objects of management

The special objectives of this sub planare:

- Identification of areas prone to erosion, their causes and impact on the sanctuary.
- To prescribe and take suitable remedial measures to deal with the problem.
- To involve the people in the protection and management of the sanctuary.

Methods of treatment to be adopted

Identification of problem areas and data collection of such sites

- Closure of such areas to biotic interference.
- Managing the growth of gullies and ravines.
- Reclamation of the gullies/ravines for various land uses.
- Conservation measures in surrounding agricultural areas.

Closure to biotic interference

One of the most important causes for the formation of gullies and ravines is biotic interference. It is therefore very important that the first step for controlling such soil erosion is to close the area to biotic interference like grazing, illicit felling of sparse shrubs and tree vegetation etc. This would not only improve the quality of grasses but also the quantitative improvement in yield.

Managing the growth of gullies and ravines

Although the closure of affected area is an effective measure, the absorption of maximum rainfall and allowing runoff in guided fashion through safe disposal structures in a gully is equally important. This can be achieved by:

Contour, graded and peripheral bundh

Contour bunding consists of constructing narrow bases trapezoidal bunds on contour to impound runoff water behind them so that all the stored water so absorbed gradually into the soil profile for crop use. The bundhs can be either open ended or hooked up at the ends. Since the area is low on rainfall and the soil permeable, the bundhs with hooked up ends are recommended.

Graded bunding is recommended for some of the areas where the soil is hard and impermeable. In this method the water is made to flow in a graded channel constructed on the upstream side of the bundh at non erosive velocities and is led to safe outlets or grasses waterways.Similarly bundhs can be constructed at the periphery of the treated area to contain the water within and increase the absorption time for the soil.

Stabilization of bundhs

Bundhs need stabilization through grasses or otherwise. After 4-5 rainy seasons, cross sections of bundhs becomes very less and they become useless owing to frequent breaching. For this, planting of grasses species which can provide good ground cover and also have elaborate root system is recommended. The species of grasses which may be used for the purpose include: *Dichanthium annulatum, Cenchrus ciliaris, Pennisetum purpureum, Andropogon ischaemum, Cynodon dactylon* etc.

Gully plugging

Gully plugs help in protection of the gully beds by reducing speed of run off water, redistributing it, increasing percolation, increasing siltation and improving moisture regime for establishment of vegetation.

Gully plugs of various materials, e.g., brushwood, live hedges, earth, sand bags, brick masonry and boulders may be used depending on the width, length, and bed slope of the gully and anticipated runoff. However, live hedges and earthen plugs are recommended in the area. This is because, even though all forms of gully plugs are effective, earth is the cheapest and most readily available material and it is therefore, easier and economical to construct the earthen gully plugs; boulders are not available readily and are expensive; brushwood is often available but there is likely to be shortage of wooden posts. Moreover, brushwood gully plugs are often prone to white ants and termite attacks and they disintegrate in a couple of year's time. For the same considerations of short life and high cost, the sand bag gully plugs are not recommended.

In narrow gullies whose width do not exceed 3m, live hedges, such as Euphorbia sp., may be planted at the gully beds in 3 rows spaced 9 cm apart and the stems at 9cm centers in each row alternatively staggered.

For gullies where no runoff is expected from the top, earthen gully plugs of 1.1 m^2 cross section with a grassed ramp of 22.5 cm below the top level and spaced at 45-60m horizontal interval are suitable; for gullies in excess runoff from the top is expected, an earthen gully plug of 2.2 m^2 cross section with a pipe outlet may be used.

For large catchments (more than 1.6 ha) composite checkdams of earth and brick masonry (spillway portion) is necessary. Vegetative checkdams may also be use for the control of small gullies. The species that may be used for such purposes are *Arundo donax, Jatropha curcas, Agave Americana, Ipomea carnea, Vitex negundo* and *Euphorbia* spp.

Reclamation of the gullies/ravines for various land uses

Owing to the acute shortage of land, it is very important that the treated gullies and ravines are reclaimed for cultivation (in the surrounding areas outside the sanctuary), and for habitat improvement measures (in areas falling within the sanctuary).

Methods of reclamation

Terracing of side slopes

In this method side slopes of medium gullies are terraced wherever a uniform slope length is available. A back slope is provided and a ridge bundh is provided at the edge of each terrace. The terrace face, graded outlets, ridge bunds are stabilized by sodding of suitable grasses like *Dichanthium* and *Cenchrus*, as discussed before. The terrace so available may now be used for cultivation or other purposes.

Afforestation

The best land use of ravine lands is to retire them to permanent vegetation of grasses and trees. This type of land use is most effective to arrest and rehabilitate deep and narrow ravines.

Even though closure of the area to biotic interference has indicated that in the early stage of closure, grass species predominate, but as succession progressed, grass species declines and are gradually replaced by shrubs and tree species. Thus in the long run, a ravine ecosystem will support a tree vegetation of scrub forest type. However, it has also to be kept in mind that simple closure by itself may not recloth the eroded lands due to adverse and harsh edaphic and climatic conditions prevailing in the area.

The species to be planted in these areas include: *Acacia nilotica*, *Cordia myxa, Prosopis cineraria, Azadirachta indica, Zizyphus nummularis, Dendrocalamus strictus,* etc.

The planting technique to be used includes construction of contour trenches, staggered contour trenches, staggered contour pits etc. The spacing recommended is 3m x 4m with 3m between rows and 4m between plants and the plants planted in staggered pits connected by alternate contour trenches.

In plantation of tree species in ravines, the major problem is the initial establishment of the seedlings owing to severe moisture stress, especially during the post-monsoon period. To overcome this, the following methods of mulching may be employed:

a. weeding and hoeing
b. spreading of grasses and weeds around the seedlings (1m dia)
c. creating clods round the plant (1m dia)
d. Two timings of mulching i.e., in August and October.

Management of grasses

Another important aspect in the reclamation of ravines is the management of grasses. There is no better way of protecting the bundhs of newly reclaimed areas than to cover them with suitable vegetation. Grasses and legumes have a dual role to play because they not only give the safest, cheapest and earliest protection to the soil but also provide the much needed fodder and green manure.

Better agricultural practices in surrounding villages

The agricultural lands in the surrounding villages offers the maximum soil and water losses as it is cultivated very frequently for the growth of various types of crops and very often remain exposed to rain which causes accelerated erosion. It is therefore very important that the people are made aware, trained and made to follow certain agronomic practices so that while obtaining sustained economic yields soil fertility is maintained by protecting the soil and conserving water.The measures which can be adopted are:

Selection of crops for maximum cover

It is generally believed that legumes provide better cover and better protection to land against soil erosion then clean cultivated or row crops. As such, for providing quick canopy, especially in early stages which is more critical from erosion point of view, cowpea, sunhemp, moong and groundnut is recommended.

Crop rotation

Crop rotation involves incorporation of legumes with cereals in a sequence to take advantage of different feeding zones, both for nutrients and water, and to offset disadvantages of mono-cropping in controlling insects, pests and diseases etc.

Intercropping / mixed cropping

This is an age old practice wherein different crops (erosion resisting and erosion permitting) are cultivated simultaneously either by means of inter-cropping or by strip cropping. The main advantage of this measure are good crop cover, feeding of crops from different soil layers and under rain fed conditions an assurance to farmer against total failure.

Proposed action plan interventions for soil and water conservation

It requires long term comprehensive management plan. New and innovative activities have been identified. The thrust of management plan is to sustain the good practices which have been demonstrated in the past. The proposed management plan is based on baseline data, field visits, identification of issues, impacts and ongoing activities & budget, monitoring and evaluation in Harike

wetland area. This assessment is the basis of design of the management plan. In addition, Zone of Impact has been identified and delineated.

Soil and Water Conservation

Priority micro-watersheds and area to be identified and treated for soil and water conservation. The area requiring soil and water conservation measures in different micro-watersheds should be interpreted using high resolution satellite images available on Google Earth and ground verification. Due to change in river course and the soil conservation measures taken up earlier, the total area to be treated has been reduced..

Proposed soil and water conservation works

The following types of soil and water conservation works are proposed:

- Field bunding along with grass on bunds
- Land levelling
- Masonry drop structures with 1-20 metre crest length
- Stream bank protection with field bunds and vegetative measures
- Stream bank protection with stone masonry retention wall
- Afforestation/Planting trees and bushes
- Construction and maintenance of spurs and retention wall
- Maintenance/de-silting of existing drop structures
- Good agricultural practices on cultivated lands
- Installation of Soil Observatory Post and Hydrological Stations for flow measurements

The vegetative barriers along with earthen and masonry structures help in sustainable and cost effective soil and water conservation measures. The vegetative measures are planned in gully heads with mild slope to stop gully from being expanded further with closely planting rose of grasses and bushes.Different mechanical measures like control bunds, field bunds and land

levelling are planned for the treatment of agriculture land adjoining drainage lines. Levelling of fields is normally done by the farmers themselves.

In non-arable lands, the biological measures like afforestation of degraded forest lands, developments of common waste lands and pastures with suitable grasses, horticulture plantation, private cultural waste lands are planned to reduce by loss and increase water infiltration. Drainage line treatments reduce runoff and sediment flow is done by different measures like Vegetative Barriers, Earthen Check Dam and Brick Masonry Check Dams.

CHAPTER 12: ECO-DEVELOPMENT SUB PLAN

GENERAL DESCRIPTION

In today's world of globalization and increased empowerment of the people it would be absurd to keep away people's involvement in the very things which were meant to benefit them. Success stories of Joint Forest Management (JFM) has been emerging from many areas across the country and also from around the world. In such stories people's involvement in the protection and management of natural resources has help tremendously and many areas of conflict have been resolved and many new so called "local" but innovative ideas have emerged. Moreover, the concept of "policing" is rather outdated and it is high time that we shift to "management." Besides, Eco-development and nature education have emerged as an important strategy for biodiversity conservation.

The term eco-development has been defined and used variously in different parts of the country. Basically, it envisages conservation of biodiversity by addressing both the inputs of the local people on the protected area and the protected area on the local people. It provides incentive for conservation and also support from local people.

It is with this observation that the need of giving a separate sub planwas felt so that the issue is addressed head on and the benefits of JFM and peoples involvement are reaped.

Special objects of management

- To involve people participation in certain areas of management of the sanctuary.
- To win the confidence of the people surrounding the area so that the general interest of the sanctuary is safeguarded and inimical attitude of the people is removed.

- To empower the people towards self-help activities so that their dependence on the sanctuary is reduced.
- To create certain assets which would be beneficial for the general public of the surrounding area.
- To develop capacity building in the surrounding villages to plan and implement sustainable modes of development which are not detrimental to the ecosystem also.
- To promote land practices compatible with the objective of biodiversity conservation in the surrounding villages.
- To create awareness and a sense of responsibility among the people.

Methods of treatment to be adopted

- Conduct Socio-economic survey.
- Identify people/family/villages directly dependent on the sanctuary.
- Sources of livelihood and income generating capacity.
- Micro planning using PRA and other techniques.
- Asset creation and employment generation.
- Formation of Harike Eco Development Committee for involvement of people in development process.

Socio-economic survey

In order to involve people in the management of the sanctuary it is very important that the confidence of the people towards the sanctuary and its staff is built up and enhanced. This can be done by carrying out some "people friendly" schemes in the surrounding. These schemes can only be formulated and implemented when basic data regarding the village, its people, population dynamics, literacy, land use pattern, livestock, dependence on forests and forest products etc. are available.

At the present moment there is very little data available. It is therefore necessary to carry out a socio economic survey to gather all these relevant information. While conducting the survey, the involvement of the people is a must so that the data reflects the actual ground realities and the real problems, strengths, hopes and aspirations of the people.

For this techniques like participatory rural appraisal (PRA) may be employed. The services of reputed NGOs, voluntary organizations operating in the area etc. may be used for the purpose.

Identification of Problem and thrust areas.

From the basic data obtained through the socio economic survey, identification of thrust areas, village wise, will be carried out. This includes:

- People/families dependent on forests and the sanctuary area
- Areas available for plantation and other such activities
- Problems unique to the village and how it can be addressed
- Contributions that the people can do.
- Expectations of the people from the sanctuary and the staff.

Income generation and asset creation activities

Once the problem areas and thrust areas are identified, certain concrete steps should be taken to address the issue. This may include:

Taking up plantations of fuel wood and fodder species so that the people's dependence on the forests and the sanctuary for these products is reduced.

Employment generation by employing labour from among the locals for plantations and other activities where manual labour is required. Some of theprotection work can also be given to the local youth as they know the terrain well and they are familiar with the tricks used by offenders.

Some of the educated, unemployed youth may be engaged on daily wage or contract basis to act as guides for tourists and visitors visiting the area.

Creation of community assets like:

- Solar energy based systems like solar lamps for street lighting, solar cookers etc.
- Bio-gas plants using cow dung.
- Nursery for raising seedlings for plantation as well as for commercial activities by the villagers.
- Compost and vermi-compost plants.
- Utilization of water hyacinth for beneficial uses. This may include.
- Bio-gas plant.
- Composting and vermi-composting.
- Paper making.
- Mats and furniture making.
- Skill enhancement activities.
- Sewing and embroider.
- Bee-keeping.

Fisheries:

In Punjab, despite unorganised fish marketing and absence of fish cooperatives, there is no fish marketing problem. The area outside 500 metres the Harike Wildlife Sanctuary is in the prohibited zone. The wetland serves as breeding place for fish. However, contract for fishing in the area outside the sanctuary area is being given. There is a good potential of developing fisheries in a cooperative mode.

Eco-friendly and sustainable development of village ponds for income generation activities and for easing out the foreseen threat of water scarcity can be undertaken in villages. These ponds ifexisting properly renovated /re-modelled on scientific lines can be put to multifarious usage. After leasing out the renovated pond to the village person, they will be getting livelihood

opportunity in the village itself. Secondary and tertiary benefits will have accrued to all residents and the State in terms of pond as source of harvesting rain water, recharging of underground water as source of assured crop irrigation, clean environment management and helping to improve the State economy accordingly.

After the rehabilitation of the village ponds i.e. after the execution of renovation/remodelling works on scientific lines, the water use efficiency of village ponds can be enhanced through their multifarious usage as under: -

1. Arresting decline of underground water table as renovation of village ponds will be helpful in recharging of the underground water table.
2. For livelihood generation through fish farming / Ornamental fish production
3. For table fish production for food and nutritional security
4. For agricultural crop irrigation
5. As recipient of used water from household kitchen/bathrooms for keeping the environment neat and clean / providing additional health benefits.

National Biodiversity Action Plan 2008 (addendum 2014) envisages integration of wetland conservation, including conservation of village ponds and tanks, into sectoral development plans for poverty alleviation and livelihood improvement, and link efforts for conservation and sustainable use of wetlands with the ongoing rural infrastructure development and employment generation programmes and promotion of traditional techniques and practices for conserving village ponds.

Thus it is proposed that development of fisheries in cooperative mode. Eco-friendly and sustainable development of village ponds for income generation activities in Harike wetland area is proposed.

Cultivation of Trapa and lotus

The fruits of trapa are a local delicacy and is harvested and sold in the local as well as surrounding markets of Amritsar and Ferozepur. Lotus is cultivated for its stem (locally known as bhaey), and its seeds (locally known as gol dodey) which are edible. As these two activities are unique to this area, economics needs to be worked out and awareness spread so that more and more people can carry out this activity for income augmentation.

This is not an exhaustive list, rather a suggestive list, which may be improved upon as and when new and innovative ideas arise especially from the micro-planning and PRA exercises.

Utilization of water hyacinth and other bio resources

For improving and diversifying livelihood of local communities and increasing their stakes in wetland conservation and management, there have been efforts for preparing handicrafts from water hyacinth. Initiatives for promoting water hyacinth based handicraft products have been fruitful and are now being sold in the local market. It can also be used for making compost and manure which can be utilized by people locally, with proper marketing and support it can also be sold in nearby areas.

Compost and vermicomposting, using both traditional organic materials as well as using water hyacinth. This is all the more important not only from the point of view of income generation but also from the point of organic farming, whereby the farming and agricultural activities around the sanctuary can gradually shift to the environment friendly method of using organic fertilizers like compost and vermicompost instead of chemical fertilizers which are increasingly polluting the area.

Formation of Harike Eco Development Committee

An Eco Development Committee can be formed at Harike which can help in involvingpeople in process of management and planning. As there are many villages which are part of HWS there can be JFMC of each village whereas JFMC may be formed and governed as per the guidelines issued by Punjab Government vide notification no. Notification No. 46/242/99-Ft.III/18759 Dated 18.11.2003.

Thereafter EDC will have composition with the following structure:

- Chairman EDC 1 elected member from JFMC Heads. (on rotation basis).
- Members 7 members elected from JFMCs(on rotation basis).
- Member 1 representative from local NGOs/NGI
- Member Secretary 1 Local Forester/ Forest Guard

Village EDC will also facilitate the establishment of Self Help Groups and Nature Clubs among the communities and their functioning. Other functions like protection, management of eco-tourism infrastructure etc. can also be assigned to EDC after its training and capacity building.

Benefit sharing:

The amended Wildlife (Protection) Act, 1972, has made provision for benefit sharing from materials removed from the sanctuary. Under these provisions grasses like *sarkanda* which are removed from the sanctuary for habitat improvement practices like clearance for fire-lines, jungle clearance for plantation etc.can be given to the neighbouring villages. This will be done in a controlled and regulated manner so as to fulfil the bona fide requirements of the local populations while ensuring that the condition of the wetland is not compromised.

CHAPTER 13 : POLLUTION CONTROL SUBPLAN

GENERAL DESCRIPTION

The untreated industrial effluents from district Hoshiarpur, Gurdaspur, Kapurthala are directly discharged in River Beas and untreated industrial effluents from district Jalandhar, Rupnagar, SBS Nagar Ludhiana, Phillaur are directly discharged in River Sutlej. Both the rivers carry this pollution load to Harike and further in other districts of Punjab and Rajasthan State.

In addition to this, the domestic sewage from villages and towns located on banks of Sutlej and Beas River and the pesticides used by local farmers for their fields directly enter the Harike Wildlife Sanctuary. The water quality in the wildlife sanctuary gets adversely impacted and harshly impacts the aquatic fauna and flora .

The quality of water of Harike wetland is under immense pressure owing to over exploitation and due to various sources of pollution, with a result that its rich flora and fauna is under threat. Water quality, being an important factor in the conservation of wetland, it is necessary to know the existing water quality, as well as to keep a constant watch on it for further improvement.

The special objectives of this sub plan are:

- Identification of source of pollution their causes and impact on the sanctuary.
- To prescribe and take suitable remedial measures to deal with the problem.
- To involve the stakeholders in the protection and management of the sanctuary.

Methods of treatment to be adopted

There is a need to conduct monitoring of Harike wetland to study the effect on water and sediment quality due to discharge of Wetland Harike domestic/industrial wastewater/surface run offs. This has to be augmented to identify the problem areas and data collection of such sites by PPCB at regular interval. For effective monitoring following sites should be earmarked for regular monitoring of the water samples.

1) U/s Goindwal sahib	6) Satluj 100m U/s BNU	11) D/s Harike Lake
2) D/s Goindwal Sahib	7) Satluj 100m D/s BNU	12) Harike lake
3) Point source east bein	8) Point Source Buddha Nallah	13) Ferozepur feeder Canal
4) Satluj U/s East bein	9) Beas at Harike	14) Rajasthan Feeder Canal
5) Satluj D/s East bein	10) Satluj at harike	15) Bikaner Canal

Table 11: Sites for sample collection

Physical, chemical and biological analysis of the samples

For evaluation of the water quality physical and chemical parameters are usually monitored by the agencies.

Since the chemical analysis alone cannot provide a true picture of the water quality of the river, biological evaluation of the water is also necessary to confirm its suitability for some of the uses. Hence sample should be analysed for benthic organisms, Benthic macro-invertebrates.

Physical Parameters	Chemical Parameters	Biological parameters
pH Conductivity Dissolved oxygen level Hardness Bio chemical oxygendemand & Chemical Oxygen Demand Visible effluent discharge	Inorganic and Non Metallic Constituents Chloride & Sulphate Turbidity (NTU) Hardness (mg/l) Fluoride (mg/l) Chloride (mg/l) Sulphate (mg/l) Total Alkalinity (mg/l) P-Alkalinity (mg/l) Phosphate (mg/l) Sodium (mg/l) Potassium (mg/l	Chlorophyll-a Phytoplankton Zooplankton Fecal coliform Bacteria Benthos Macrophytes Microbial Monitoring of water and sediment Saprobity Index Diversity Index

Table 12: Parameters for Analysis of water sample

For monitoring of these parameters monthly data can be collected by engaging PPCB and any other reputed agency working in this field.

Conservation measures in surrounding agricultural areas.

To reduce the effect of pollution due to run off from the agricultural fields of the surrounding areas of the nearby districts training programmes for farmers can be organized. The idea is to implement integrated programmes on organic farming and integrated pest management to reduce non-point source of pollution in prioritized villages in the Harike Catchment area.

This will help in improving the water quality in the of the harike wildlife sanctuary in long term and also have health benefits to community at large. For implementation of this programme Agriculture department along with different institutes/universities/ngo can be involved.

Since the aim is the restoration and maintenance of the lake quality by eliminating or reducing polluted discharges to the extent possible and practicable therefore the following recommendations are made:

- To keep vigil on the level of pollution, regular monitoring of the point sources of pollution i.e. Budha Nallah and East Bein needs to be checked and the discharges of sources of pollution falling into the Budha Nallah and the East Bein need to be controlled and their quality needs to be kept under checked.
- In-situ low cost treatment systems need to be installed in all the out falls falling into Budha Nallah and East Bein.
- Deforestation in the catchment area should be strictly prohibited to minimize surface runoffs.
- Afforestation in the catchment area of wetland should be enhanced to avoid soil erosion.
- Source of pollution from agricultural & other activities must be identified & plugged.
- Water level at Harike reservoir should be maintained to save biotic life

CHAPTER 14: MONITORING RESEARCH& DOCUMENTION SUBPLAN

MONITORING AND EVALUATION

The effects and results of the prescriptions given in the plan and their implementation, like habitat improvement measures, plantations, and other treatments will be monitored and evaluated yearly preferably by a separate unit set up for the purpose. The corrective measures will be taken, if need be, on the basis of the results of the study. Responsibility and accountability of the staff and officials will be adhered to as laid down in the departmental rules.

RESEARCH AND DEVELOPMENT

The management and of the sanctuary depends largely on the data available – data on the problems and threat perceptions, their causes, possible solutions; data on the role of the wetland in the ecology of the area- its evaluation, values, interrelationship between various biotic & abiotic factors etc. Without having these data, appropriate remedies cannot be prescribed.

Not many studies have been carried out on the ecology of the wetland, its resource base, interactions with the adjoining upland areas, its diminishing aquatic zone and the impact on processes in the ecosystem. Though a number of publications have appeared, they cover specific aspects of the system and an integrated system approach is lacking. Studies carried out by different agencies and researchers so far include research on avian, fish and turtle populations, water quality assessments and weed control.

It is therefore recommended that an integrated approach is adopted where research work treats the sanctuary as an ecological unit and the various factors involved in it.

Some of the possible areas of study are:

1. The potential of Harike wetland ecosystem in terms of energy flow and trophic structure.
2. Identification of the biological diversity existing in the area, right from the microbes to mammals, their inventory and establish the role of the organisms in the ecosystem.
3. The population estimates of avifauna, especially the waterfowls. Limiting factors affecting the waterfowl count, their causes etc.
4. Minimum vegetation area required for providing protection and breeding of waterfowl.
5. Study relating to vulnerable species of birds, the smooth Indian otter and the fishing cat.
6. The physiology and dynamics of bird migration to this area with respect to ecological and other conditions.
7. For water management, geological characteristics, ground water discharge, ground water recharge should be determined.
8. Land use management in the entire catchment area.
9. The role of Eco-development and their impact on the people.
10. Preparations of GIS maps for the sanctuary and adjoining landscape.
11. Details assessment of ecosystem services of the sanctuary and the adjoining landscape.

It is also to be noted that many agencies, both at individual and institutional levels are carrying out researches on various aspects of the sanctuary. These efforts need to be coordinated so that a cohesive unit is achieve and to ensure that time, money, energy and valuable resources are not wasted by replicating.

Maintenance of records

A detailed record of each management activity like habitat improvement works, plantations etc. shall be maintained in order to have a solid database for scientific

monitoring, evaluation and future planning. The controlling officers should check all these records and documents in their field tours.

The records to be maintained include:

Annual plan of operations.

The Divisional Forest Officer should prepare Annual Plan of Operations(APO) in advance and works executed according to the approved plan. The plan would be in conjunction with the prescriptions laid down in the Management Plan.

1. Weed Control Journal.

Weed control measures including removal of water hyacinth is one of the major activities of management. A detailed record of the operations, duration, labour employed, expenditure incurred, quantum of weed removed, utilization of machinery etc. should be maintained on a monthly basis. An abstract of the physical and financial progress should also be prepared for each month.

The Journal should be signed by the concerned guard and countersigned by the Wild Life Inspector every month. The inspection notes by the officers should be filled in the journals. The Divisional Forest Officer should inspect the entries at the time of annual office inspection.

2. Plantation Journals

For each plantation, a separate journal shall be maintained in prescribed form, wherein a complete record of the plantation *vim* year of plantation, area under plantation, number of plants, species planted, details of expenditure incurred month wise, compartment-wise/strip-wise/locality-wise, etc. should be given.

It will also, later on, include the maintenance cost for subsequent three years. At the end of each year observations regarding success of the

plantation, growth figures etc. shall be recorded in the journals. Instructions of the Principal Chief Conservator of Forests, Punjab, regarding checking of plantations issued from time to time, should also be followed.

3. Nursery Registers.

For each nursery, a separate register shall be maintained. It shall have monthly detail of operations and expenditure incurred, plants raised, plants used departmentally, plants supplied to the public during the month etc. Detail of plants supplied free of cost to other Government, departments, public institutions etc. shall also be recorded in the register. Plants destroyed as a result of natural calamities or otherwise shall be got written off from the competent authority. A copy of the nursery register showing details of species wise nursery stock should be sent to the Divisional Office monthly.

4. Divisional Note-Book.

The Divisional Forest Officer should maintain a note-book in which the following information should be recorded:

- Population estimate of the birds during the year
- Sighting of rare, endangered birds and the area of their sighting
- Flowering and seeding of important tree species.
- Climate-rainfall and temperature experienced during the year and its effect on the wild life and forest crop.
- Pests and diseases noticed on the wild life and forest crop; the treatment and result thereof.
- Problems regarding labour.
- Any other matter important from the management point of view

5. Fire Control Forms

The record of forest fires should be maintained in the prescribed Performa. The details of area burnt with sketch, cause of fire, date of fire, damage, date of time of control, damage and the appropriate financial loss will be recorded. The information should be correct and up-to-date.

6. Deviation Statement.

No deviation should be done without the prior approval of the competent authority. To exercise control over progress of various operations at the end of each financial year, the prescription of the Management Plan will be compared with the progress of works done on the ground. Any excess or shortfall will be recorded, giving reasons for deviation and sanction of the competent authority be given.

7. Beat Books

Each guard should maintain a Beat-Book that has been prepared and issued by the Divisional Office. The Beat Book shall contain the following information:

- Map of the area in his beat.
- Details about the area, boundaries, H.B. Nos. etc.
- Duties of Beat Forest Guard.
- Abstract copy of the relevant sections of the Indian Forest Act, 1927, Wild life Protection Act, 1972, Forest (Conservation) Act, 1980 and Vernacular translations thereof.
- List of buildings, roads, paths, fire lines etc. in his beat.
- List of court cases pertaining to his area
- List of encroachments
- List of trees prevalent in his area
- List of major birds and animals found in his area
- List of habitual offenders who commit crimes/offences in his area.

Monitoring

As far asmonitoring is concerned in the sanctuary there is need to monitor the land use/ different habitats; quality of water and soil; the status of forest vegetation and major wildlife species at regular intervals. This monitoring should be extended to the adjoining landscape; of course the frequency of monitoring in the landscape could be longer.

Features of Monitoring Program

The main target of the monitoring program will be the ecological values of the reserve, associated habitats and major wildlife species. However, the monitoring has to be extended to the other socio-economic parameters of the program, level of conflict and support of local people and other stakeholders for conservation. It is proposed to have permanent protocols for the monitoring of the habitat and key faunal and avian species.

Biodiversity monitoring

Information on population trends of a different species is essential for understanding thelong-term conservation status of that species/community. Hence, a long-term monitoringof major wildlife species, birds, aquatic vegetation, and fishes is prescribed. Professionalinstitutions/NGOs can be engaged for this purpose and the work can be coordinated bylocal NGOs, or State Forest Department. Harike Wildlife Sanctuary is known for its ecosystem services and avian fauna, which may be considered as the bio-indicators to assess the health of ecosystem. Therefore, long term monitoring of these parameters is important.

Avifaunal monitoring

There are a large number of terrestrial and aquatic bird species in the area.

Therefore, it is proposed to continue the bird census which is conducted once in

a year using standard protocols for the entire landscape. To capture the seasonality of the birds, the survey could also be attempted twice in a year. And also there is a need to do a census of terrestrial birds including the resident birds of Harike.

Habitat monitoring

Habitat monitoring is essential to understand the efficacy of this plan. Any changes in the habitat are expected to affect the associated wildlife. Therefore, monitoringof wildlife habitat is inevitable. Permanent monitoring plots need to be established tomonitor the changes in the vegetation structure both in the watershed conservation andresource use zone. Land use and land cover mapping and monitoring may also be carriedout using remote sensing and GIS tools in very five year intervals. Agencies working in the field can be engaged for the above activities.

Wildlife health monitoring

Every year a joint monitoring team along with the Veterinary Departments, should conducta systematic health monitoring of the wild animals inside the reserve and livestock in theadjoining area. This is important to keep a check on the spread of any disease fromlivestock to wildlife or vice versa.

Apart from these species specific monitoring and surveying needs to be done. Monitoring of gharial and Indus river dolphins twice a year during post and pre-monsoonseason is proposed. It had been discussed earlier in details.

Institutes like WII and NGO should be involved in such activity for technical inputs and monitoring.

Environmental monitoring

Forest contributes to maintenance of water and air quality. Hence, it becomes important to monitor both water and air quality to check if the ecosystem is

functioning well or not. Therefore, water and air quality of may be monitored once ina year continuously using prescribed protocol with the help the State Pollution ControlBoard.

Tourism monitoring

Tourism monitoring should become a regular feature of the monitoring programmes atSanctuary. The records of the tourist coming tosanctuary has to be meticulously maintained and stored in a computerized database. Tourist feedback surveys also need to be takenperiodically to know about visitor satisfaction levels and also to seek suggestions fromthem.

Monitoring Parameters, Frequency and Responsibility

Monitoring Parameters, Frequency and Responsibility		
Wetland Monitoring Parameters	Frequency	Responsibility
Physio-chemical and Biologicalparameters **Weather** Approximate depth of mainstream/depth of water table Color and intensity Odor Visible effluent discharge **Core Parameters** Temperature (Air/Water) 0C pH Conductivity µS/cm DO (mg/l) BOD (mg/l) Nitrate-N (mg/l) Ammonia-N (mg/l) Total Coliform MPN/100ml Fecal Coliform MPN/100ml Bio Monitoring Probity Index Diversity Index **General Parameters** COD (mg/l) TKN (mg/l)	Monthly	Punjab Pollution Control Board/Reputed Research Institutes

Total Dissolved (mg/l) Total Fixed Solids (mg/l) Total Suspended (mg/l) Turbidity (NTU) Hardness (mg/l) Fluoride (mg/l) Chloride (mg/l) Soleplate (mg/l) Total Alkalinity (mg/l) P-Alkalinity (mg/l) Phosphate (mg/l) Sodium (mg/l) Potassium (mg/l) Calcium (mg/l) Magnesium (mg/l) **Trace Metals** Arsenic (mg/l) Nickel (mg/l) Copper (mg/l) Mercury (mg/l) Chromium (mg/l) Cadmium (mg/l) Zinc (mg/l) Lead (mg/l) Iron (mg/l) Pesticides Alpha HCH (µg/l) Beta HCH (µg/l) Gama HCH (µg/l) 4,4' DDT (µg/l) 4,4' DDE (µg/l) 4,4' DDD (µg/l) Alpha Endosulphan (µg/l) Beta Endosulphan (µg/l) Dieldrin (µg/l) Aldrin (µg/l) Endrin(µg/l) Endrin Aldehyde(µg/l) Methyl Parathion (µg/l)		
BIOLOGICAL PARAMETERS Chlorophyll-a Phytoplankton Zooplankton Fecal coliform Bacteria Benthos	Monthly Monitoring	Punjab Pollution Control Board/Reputed Research Institutes or centre

Macrophytes Microbial Monitoring of water and sediment		

Research studies for conservation and sustainable management 1. Estimation of blue carbon in Harike 2. Nutrient profiling of fishes 3. Core profiling studies, sedimentation rate andbiological characterization 4. Microbial community analysis using metagenomicsfrom sediment andwater 5. Research and monitoring on Flora and Fauna.	Yearly/seasonal	Reputed Research Centres and Institutions
Habitat Management **Plantation, habitat Interventions and Weed Management, Enforcement of Wildlife Protection Act, Encroachment**	Yearly/Daily/Seasonal	Department of Forests and Wildlife Preservation
Water Management and Water balance Monitoring, desilting and reservoir management	Daily/Seasonal /Yearly	Department of Water resources/Irrigation/Canals
Capacity Building and Training	Monthly	Reputed Training Institutes or Department of Forests and Wildlife Preservation ,Non-profitOrganizations,Volunteers, Field Experts
Land Records and Demarcation	Need based	Revenue Department and Department of Forest and Wildlife Preservation, Punjab

Regular Faunal Survey and Monitoring (Gharial survey/Monitoring, Dolphinsurvey, Bird Census etc.)	Seasonal	Department of Forests and Wildlife Preservation, Punjab with technical assistance from reputed Institutes/ Field Experts
Awareness Programmes	Need based	Department of Forests and Wildlife Preservation, Punjab in collaboration with reputed N.G.Os or Institutes
Fisheries related monitoring and evaluation	Seasonal/Annually	Department of Fisheries
Survey and Mapping	Need based	Punjab Remote sensing centre, Ludhiana/ survey of India, Forest survey of India.
Organic Farming Practices in the Boundary villages	Monthly/seasonal	Department of Agriculture

Table 13- Monitoring Parameters, Frequency and Responsibility

Punjab State Wetlands Authority

The ministry of Environment ,Forests & Climate Change, Government of India, New Delhi vide its Notification no G.S.R 120(E) dated 26.9.2017 has notified Wetlands (Conservation & Management) Rules,2017. Subsequent, to this Punjab Government vide notification no.34/2/2018-FT-5/1192195/1 Dated 21-3-2018 notified the State Wetland Authority

i)	Hon'ble Chief Minister, Punjab (Minister in-charge, Wildlife Preservation Department)	Chairperson
ii)	Addl. Chief Secretary, Department of Forests and Wildlife Preservation	Vice Chairperson
iii)	Secretary in - charge of the Department of	Member ex – officio

	Environment	
iv)	Secretary in - charge of the Department of Forests	Member ex – officio
v)	Secretary in - charge of the Department of Urban Development	Member ex – officio
vi)	Secretary in - charge of the Department of Rural Development	Member ex – officio
vii)	Secretary in - charge of the Department of Water Resources	Member ex – officio
viii)	Secretary in - charge of the Department of Fisheries	Member ex – officio
ix)	Secretary in - charge of the Department of Irrigation and Flood Control	Member ex – officio
x)	Secretary in - charge of the Department of Tourism	Member ex – officio
xi)	Secretary in - charge of the Department of Revenue	Member ex – officio
xii)	Director, State Remote Sensing Centre	Member ex – officio
xiii)	Chief Wildlife Warden, Punjab	Member ex – officio
xiv)	Member Secretary, State Biodiversity Board	Member ex – officio
xv)	Member Secretary, State Pollution Control Board	Member ex – officio
xvi)	Additional Principal Chief Conservator of Forests of the Regional Office of Ministry of Environment, Forest and Climate Change, Chandigarh	Member ex – officio
xvii)	Additional Secretary, Department of Forests and Member Wildlife Preservation	Member Secretary
	Experts	
xviii)(i)	Director, Wildlife Institute of India, Dehradun or his expert representative	Expert in Wildlife and Wetland
(ii)	Director, WWF - India Rivers, Wetlands and Water Policy	Expert in Hydrology
(iii)	Director & Warden, Fisheries Department, Punjab	Expert in Fisheries
(iv)	Chief Architect, Punjab	Expert in Landscape
(v)	Head, Department of Economics, Punjabi University, Patiala	Expert in Socio Economics
	Co-opt Members	
xix)(i)	Sh. Jatinder Sharma, IFS, Principal Chief Conservator of Forests HOFF), Punjab	Head of Forest Department

(ii)	Dr. Satnam Singh Ladhar, Additional Director (Environment), Punjab State Council for Science & Technology	Expert in Wetlands
(iii)	Mrs. Gitanjali Kanwar, Senior Project Officer, WWF - India, Harike.	Expert in River Conservation and Education

The State Wetlands Authority shall exercise the following powers and perform the following functions, namely:

(a) Prepare a list of all wetlands of the State or Union Territory within three months from the date of publication of these rules;

(b) Prepare a list of wetlands to be notified, within six months from the date of publication of these rules taking into cognizance any existing list of wetlands prepared/ notified under other relevant State Acts.

(c) Recommend identified wetlands based on their Brief Documents, for regulation under these rules.

(d) Prepare a comprehensive digital inventory of all wetlands within a period of one year from the date of publication of these rules and upload the same on a dedicated web portal to be developed by the Central Government for the said purpose, the inventory to be updated every ten years.

(e) Develop a comprehensive list of activities to be regulated and permitted within the notified wetlands and their zone of influence;

(f) Recommend additions. If any, to the list of prohibited activities for specific wetlands,

(g) Define strategies for conservation and wise use of wetlands within their jurisdiction, wise use being a principle for managing these ecosystems which incorporates sustainable uses (such as capture fisheries at subsistence level or harvest of aquatic plants) as being compatible with conservation, if ecosystem functions (such as

water storage groundwater recharge, flood buffering) and values (such as recreation and cultural) are maintained or enhanced.

(h) Review integrated management plan for each of the notified wetlands (including trans - boundary wetlands in coordination with Central Government), and within these plans consider continuation and support to traditional uses of wetlands which are harmonized with ecological character;

(i) In cases wherein lands within boundary of notified wetlands or wetlands complex have private tenancy rights recommend mechanisms for maintenance of ecological character through promotional activities,

(j) Identify mechanisms for convergence of implementation of the management plan with the existing State/ Union Territory level development plans and programmes.

(k) Ensure enforcement of these rules and other relevant Acts, rules and regulations and on half - yearly basis (June and December of each calendar year) inform the concerned State Government or Union Territory Administration or Central Government on the status of such notified wetlands through a reporting mechanism;

(l) Coordinate implementation of integrated management plans based on wise use principle through various line departments and other concerned agencies.

(m) Function as nodal authority for all wetland specific authorities within the State or Union Territory Administration;

(n) Issue necessary directions for conservation and sustainable management of wetlands to the respective implementing agencies.

(o) Undertake measures for enhancing awareness within stakeholders and local communities on values and functions of wetlands; and;

(p) Advise on any other matter suo-moto, or as referred by the State Government.

(III) The Authority shall, within ninety days of publication of these rules, shall constitute,-

a) A technical committee to review brief documents, management plans and advise on any technical matter referred by the Wetland Authority, and ;

b) A grievance committee consisting of four members to provide a mechanism for hearing and forwarding the grievances raised by public to the Authority.

(iv) Chief Wildlife Warden, Punjab shall be Chief Administrator of the State Wetlands Authority and his office will also be a Secretariat to the Authority.

(v) All Divisional Forest Officers (Wildlife and Territorial) under whose jurisdiction notified wetlands falls will be responsible for the implementation of Wetlands (Conservation & Management) Rules, 2017 and implementation of ongoing National Plan for conservation of aquatic ecosystem of MoEF & CC, Government of India.

(vi) The Committees referred to in sub - rule 5 (6) of Wetlands Rules 2017 shall meet at least once in every quarter to perform their functions,

(v) The Authority shall meet at least thrice in a year.

(vi) The term of non - official members of the Authority shall be for a period of two years.

A technical committee /Grievance committee was constituted under Punjab state Wetland Authority as per the Para III of the notificationwillreview brief documents, management plans and advise on any technical matter referred by the Wetland Authority and to provide a mechanism

for hearing and forwarding the grievances raised by public to the Authority. The members of the committee are as follows:

As per para V of the notification All Divisional Forest Officers (Wildlife and Territorial) under whose jurisdiction notified wetlands falls will be responsible for the implementation of Wetlands (Conservation & Management) Rules, 2017 and implementation of ongoing National Plan for conservation of aquatic ecosystem of MoEF & CC, Government of India. The Harike wildlife sanctuary falls under the jurisdiction of Divisional Forest Officer(Wildlife),Ferozepur who is in-charge of enforcement of wildlife protection act,1972 .The sanctuary encompasses area belonging to three districts Ferozepur,Kapurthala and Tarantula.

Also, recently dated 19/03/2021 vide Notification No. DFWLP-40/1/2021-Ft-5/ Chandigarh **Harike Wetland and Eco-Tourism Development Authority** has been notified. The mandate of this authority is intersectoral coordination in promoting conservation efforts & ecotourism at Harike. It includes representatives from different departments like tourism, waterresources,PPCB etc. The complete list with Notification is attached as Annexure No IV.

CHAPTER 15: ECOTOURISM

Concept of Eco-Tourism

The concept of ecotourism has evolved over the past decade due to an increased awareness of the world's dwindling biological diversity, and as a reaction against mass tourism. The major underlying assumption of successful ecotourism is that visitors can provide the necessary economic incentives to achieve local conservation and development.

That is, ecotourism is able to generate revenue, which can be used to protect and conserve the existing biodiversity and natural environment that draws visitors to a particular site. Ecotourism's objectives, therefore, include visitor education, non-alteration of ecosystems and local economic benefits.

Ecotourism is basically a very specific type of nature based tourism, in which small groups of people are taken to experience various aspects of nature, and participate in wildlife viewing, nature trekking, education tours, and so on. Special care is taken to prevent negative impacts of the ecosystem, and tourist education in matters related to the environment is given high priority. The distinguishing feature of ecotourism is that it emphasizes the ecological fragility, carrying capacity and

Tourism Interpretation centre

Bird Hides

biodiversity conservation of the region, while acting as a liaison between communities and tourism industry.

Harike, due to its unique biodiversity and enchanting beauty has a great potential for ecotourism. The Government of Punjab, felt the need to develop ecotourism in Harike as far back as 2000 when the then Principal Secretary chaired a meeting to discuss the issue. Subsequently experts from Wetlands International were engaged to formulate an action plan for implementation.

As ecotourism needs the involvement of other agencies like the Department of Tourism, huge financial outlay, massive advertising and marketing, which goes beyond the physical limits of the sanctuary and beyond the jurisdiction of this Management plan, and also keeping into view the legal issues of working in a notified Wild Life Sanctuary.

It is also proposed to develop ecotourism guidelines for Harike Wildlife sanctuary. The guidelines would specify do's and don'ts for various stakeholders in accordance with Wetlands (Conservation and Management) Rules, 2010. Such a guideline can also be used for other wetlands, factoring in area of the wetland and site specific conditions.

OBJECTIVES

The main objective of ecotourism in Harike wildlife sanctuary is to ensure ecologically responsible tourism, through adequate livelihood support and empowerment of local communities.

Main objectives of ecotourism will be as follows:

1. To generate alternate livelihood opportunities for local community and help them torationalize the existing land use in sanctuary.
2. To promote conservation awareness amongst the visitors and local people throughconservation education and interpretation.
3. To establish a sustainable ecosystem between the sanctuary, visitors and the hostcommunities.

STAKEHOLDERS IN ECOTOURISM

The diversity of visitor experiences that sanctuary can offer, the ecotourism activities in this area will need support of different stakeholders. Although, the lead rolewill be played by the local communities and the various government departments.For instance, irrigationdepartment, which has control over the reservoir will also need to be taken on board indifferent ecotourism activities. Eventually, with growth of the area, it will be in interest ofthe sanctuary to partner with other outside groups such as tour operators, hoteliers, education institutions in and around the area, research organizations, etc.

TARGET GROUPS FOR ECOTOURISM

The major target groups among the visitors will be:

1. General public, who visit for leisure and recreation.
2. Nature Enthusiasts, including international visitors, who are interested in different ecological and socio-economic attributes of the sanctuary.
3. Bird Watchers, with specific focus on the avian fauna of the area.
4. Students, who may visit as part of their school/institute's nature education programmes.
5. Youth and other enthusiasts, who are interested in trekking the area.
6. Senior citizens and young children, who wish to have treks that are more comfortable.

Ecotourism Activities

Following activities are proposed for ecotourism in the plan period:

1. Existing trails at L.M.B. need to be further developed as good bird watching and animal sighting trails, with minimum intrusion or disturbance to the habitat.

2. Along the trail routes, locations for watch towers, hides and observation points (Bare minimum number) need to be identified and installed. At present, there are already watchtowers and bird hides located on strategic points of L.M.B. trail. These structures should be compatible with the natural surrounds of the area.
3. Educated local youth from nearby villages and wildlife department staff should be trained in ecotourism. The local youth should act as nature guides for running the ecotourism programme in sanctuary. These guides will have a dualresponsibility of visitor management and protection of sanctuary while taking visitors ontrails.
4. Boating jetty at Harike has already been developed at Nose point. It also has a ticketing counter. Apart from this boating sites can be explored at R.M.B. pond area and Churrian view point. Since churrian view point has the maximum footfall in the sanctuary.
5. An interpretation centre already developed at Harike can be further equipped with important themes of the area i.e. Geological history and significance of Indus riverine system along with its tributaries, its cultural and religious values, wetland ecosystem, biodiversity of sanctuary and our role in conservation of this landscape etc.
6. Interpretation centre also has a special room for participants attending an educational activity. It can be further equipped with projector and screen arrangements for video and audio inputs to the visitors.
7. A cafeteria for eateries and refreshments near the interpretation centre is already in place. This can further showcase local cuisines with the participation of local communities. A mini- canteen at L.M.B. trail for visitors can be made with ensuring that no single use plastic is used and with proper waste disposal system.

8. Extension and education material such as signage, wayside exhibits, banners, postersand brochures, films highlighting the sanctuary be developed to engage visitors with rich biodiversity of the sanctuary.

INTERPRETATION CENTRE

The interpretation centre at R.M.B. will help disseminate information, generate awareness and enhance visitor experience. As already mentioned, the interpretation centre will provide written and audio-visual information on the Indus riverine system, the array of ecological, social and cultural values of the large landscape as well as weave a story around the development of Harike as a wildlife sanctuary.

Primary themes of interpretation should include:

- **Key River Systems and Wetlands in Punjab**
- **Significance of being a Ramsar site.**
- **Beas Conservation Reserve**
- **Significance of Wetlands**
- **Ecosystem Services Biodiversity of Harike**
- **Avian (Resident, Migratory, Water Fowl)**
- **Aquatic Species**
- **Terrestrial species Conservation Initiatives**
- **Wetland conservation**
- **Species specific intervention**
- **Community engagement Individual actions**
- **Various interventions by the department.**

ECO-TOURISM INFRASTRUCTURE

In Harike, under ADB funded project started in Nov 2016 by tourism department a project was commenced with a total expenditure of about 9.22 crore, under which

infrastructure was created which included interpretation centre, watch towers, bird hides, jetty etc.

However, there is still a need for accommodation facilities in Harike town. Apart from Canal rest house there is no other government rest house in the area. Also since it's a small village there is a lack of good private hotels. Nearest hotels are located in district headquarters of Ferozepur, Tarnataran, Amritsar etc.

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Resting Spot (Bird Hide)</td>
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Toilets- (Entry and Exist Point)</td>
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Guard Post ,Jetty ,Car Parking at L.M.B</td>
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Viewing Deck</td>
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Observation Deck View (Nose Point)

Pedalling Boats

Battery Operated Carts

Boating Jetty and Ramp

Fig 25: Picture of work done by Tourism Department in Harike wildlife Sanctuary.

Thus it is proposed that for boosting ecotourism in the area it is must to have accommodation facilities for visitors especially avid birdwatcher who comes from outside Punjab.

These accommodation facilities might include tented accommodation like Swiss tents which can be temporarily erected at Nose point or at LMB. There can be also some tree houses to accommodate people at night and to give them unique experience of living in forest.

For larger groups Eco huts along with necessary infrastructures like kitchens, dormitory parking etc. need to be developed. This can be constructed at Range office complex where whole complex can be setup. Also, a convention centre of Eco Development Committee can be made by renovation of the existing infrastructure at Harike Range office complex. This may include a meeting room for general discussions, training persons, library to accommodates books on biodiversity of Harike wildlife sanctuary, wetlands and other topics related to environment. This may also include rest rooms for resource persons coming for training, committee members etc. There is also a need for Inspection bungalow at Harike by renovation and refurbishment of old building alongside Range office complex at Harike town for overall administration of tourism through various authorities. It will serve the purpose of periodic inspections and proper monitoring by the implementing agency, funding agencies and other government bodies related to Tourism.

For boosting ecotourism boating infrastructure can be also enhanced by making jetties at Nose point and at R.M.B. These can be used by both staff for patrolling and visitors.

Boating by motor boat to Sangam point on chargeable basis can be started where it can be operated by engaging local people. Similar peddle boating at various points like nose point, RMB, churrian can be explored.

Though toilet complexes have been created at Entry and exit point but still there is a need to make toilets along the trail for the visitors. Other than this watchtowers, gazebos, bird hides etc. along the trail and also at some islands can be created to help the bird watching activity. For the mobility of the visitors there can be optionsof cycles at rent, electric cycles, electric vehicles, rickshaws, e-rickshaw on the track.

Few more cycling routes can also be developed for the visitors, there can be track developed from interpretation centre towards RMB. This can have gazebos, tree houses along the trails.

Network of facilities

A network of in-situ and ex-situ facilities is required for ecotourism development in the Harike wetland area. Specific facilities to be developed for the area include:

- Nature trails in the left marginal bund and right marginal bund and also in the peripheral areas of the sanctuary and in few islands will be developed.
- Bicycling routes for bird watching in the periphery of the lake.
- Board walks and bird hides leading to bird hides/towers strategically located in the periphery of the sanctuary,bunds as well as on the islands in the lake.
- Adequate security arrangements with fencing wherever required, with watch &ward kiosks.
- Safety equipment including lifeboats, life jackets, life buoys.
- Other equipment's required for bird watching will be provided on chargeable basis etc.
- Solar lighting at strategic points.
- Camping sites at trail area and islands
- Construction of log huts in islands for serious bird watchers to stay and do bird watching in regulated zones.

Ex situ facilities such as stops for refreshments shall be arranged through private enterprise at strategic midway points on highways leading to Harike.

ORGANIZATIONAL SET UP

Special skills and adequately trained staff and manpower are required to design, organize and run a set up for eco-tourism needs. This kind of service

industry requires a combination of skills in dealing with hospitality, transportation, facility, maintenance, excellent public relation (both with the tourists and local people as well as good knowledge of local people) as well as good knowledge of local flora, fauna & customs, Well-experienced professionals in the field will be the Managers of the project.

A firm policy of recruiting, training and appointing suitable candidates from the communities will be followed. Similarly, the local communities will be given adequate opportunities to benefit from the venture. Local man/woman power, local food produce, local handicrafts and local cultural skills such as dances, drama, folk art, folk songs etc., will be encouraged. Financial and other benefits to local communities will be encouraged.

Mode of operations and functioning of the infrastructure:-

The sanctuary comprises of the following villages surrounding its periphery:

Sr. No.	District	Name of Village	No. of Villages
1	Ferozepur	Booh-Arian, Talwandi Nipalan, Sudian, Churian, Mojgarh, Kot-kaim-khan, Sanghe-ke-kalan, Bhedan wala, Makhu, Rasulpur.	10
2	Kapurthala	Jagjitpura, Khara, Deva Singh wala, Mand-Kirrian, Mand-Fatehpur, Mand-kambo, Pipal, Nakki, Patii- waras, Kishanpura, Sitapur, Gatta-poh-Vindian, Nihalpura, Sanghe-ke-khurd.	14
3	Tarntaran	Kirrian, Kambo-Dhae wala, Chamba kalan, Harike, Marrar.	5

Villages youths,women who are unskilled, semi-skilled and skilled can be first identified using the participatory appraisal approach and then based on the need identified they may be trained in various facets of eco-tourism. **Eco development Committees** shall be formed for various eco-tourism activities.The establishment of the EDC and election its Executive Committee must be undertaken in accordance with the provisions of the new Joint Forest Management Resolution

The whole process involves:

- *Making contact / breaking the ice with the village community*
- *Reaching out to each village separately*
- *Village meeting to assess relative 'forest dependency' and 'wellness'*
- *Collecting socio-economic information from households*
- *Forming the EDC and electing the Executive Committee*
- *Preparing the micro-plan document with the EDC Executive Committee*
- *Entry point and common interest activities*
- *Enhancing capacity of EDC Executive Committee members*

Memorandum of understanding between forest & environment department and edc for running eco-tourismfacilities like cottages,dormitories,parking facilities,souvenir shops,tour guides,boat men,watch and ward and interpretation centremay be framed as per relevant rules and guidelines.

- A Memorandum of Understanding defines the relationship between the FD and EDC whereby ownership and/or management of a facility and performing eco-tourism related activities is entrusted to the EDC in return for providing certain facilities and services to agreed standards and principles of ecotourism.

- It may be complemented by anagreement in which services are outlined (quantified) in more detail and reviewed annually.
- Both parties are partners sharing a common interest: to protect the natural resource base upon which ecosystem services and, therefore, local livelihoods depend.
- The responsibilities of each partner are defined, the role of the FD being advisory and facilitative, while that of the Executive Committee of the EDC is to oversee the management of the Eco lodge by a societyor cooperative of EDC members and to take executive decisions.
- Gross income generated from the eco lodge and ancillary facilities and services, or net income after deduction of running costs (e.g. food, fuel, cleaning materials etc.), may be allocated according to the following guidelines:
    - 20% tourist accommodation maintenance, development and staff training fund;
    - 20% protected area welfare/developmentfund to be administered by DFO Wildlife;
    - 10% EDC fund for redistribution among EDC members for development of other income-generating activities; and
    - 50% for wages of employees who are carrying out various eco development activities.
    - The accounts should be professionally audited.
    - Provisions should include certain reciprocal conservation management commitments on the part of the EDC, which might include recording/monitoring wildlife encountered while guiding nature walks, reporting incidences of poaching and fire, and protecting an area adjacent to the facility from encroachment and fire.

MARKETING

Marketing eco-tourism both for local communities and overseas visitors is a specialist job. This will be done as per professional advice which will include detailed marketing strategy.Government should put up ads in print and other media to invite people from all around forthe programme

NATURE EDUCATION PROGRAMME

Harike wildlife sanctuary will have regular nature education programme. Nature camps, bird walks etc. could be organized for school children free of cost. Similarly, these programmes could be designed and organized for colleges and target groups as paid programme. Since it is located at juncture of many districts as Ferozepur,Kapurthla,Tarntaran , Amritsar and Jalandhar it has a huge potential of nature education.

NATURE CAMPS

With the motto of "Catch them Young ", this place has a huge potential for providing children with environmental education that helps them become the educatedthink tanks of tomorrow. Therefore, it is essential to create awareness among the masses to conserve the environment.

These camps are one of the apt tools for this purpose and

has been successful in various parts of the country. Such camps could be one

of the important activities of the reserve for disseminating awareness about natureconservation and also for building a local constituency for the conservation of this area.

BIRD WALKS/NATURE WALKS

Migratory birds being the major attraction among the visitors require planned walks with bird guides who can help them in identifying and appreciating the rich flora and fauna of the sanctuary. These bird walks and nature walks can be

organized at fixed time schedules starting from 6am in the morning for approximate duration of 2 hours.

To engage people brochurescontaining the information about the birds,trees,animals etc. should be provided to the group.

There should be a panel of locally available resource persons who can add value to the

Programme. They can further help in training the local youth who can act as tour guides for the visitors.

Infrastructure requirements:

1. Accommodation facilities
2. Conference hall/Meeting space for lectures and interactive sessions
3. Audio-visual equipment
4. Reference materials
5. Binoculars
6. Spotting-scopes
7. Handheld lenses
8. Laptop
9. CDs of wildlife films / Educational documentaries
10. Transport facilities
11. Brochures, pamphlets
12. White board/Marker pens
13. Printer/Copier/Scanner
14. Power Back up

PUBLICITY AND AWARENESS

Even though the sanctuary has gained national and internal recognition, there is still very little awareness among the people, especially those living around the sanctuary. It is very important that the unique features of the Sanctuary, its

enchanting beauty, its aesthetic, environmental and economic values as well as the threats faced by it are highlighted and widely publicized, so that awareness is created. This can be achieved by:

- Promoting ecotourism through various social media platforms with professional help.
- Utilizing the services of local cable TV especially in the surrounding districts of Amritsar, Kapurthala and Ferozepur as well as Doordarshan Kendra, Jallandhar, Chandigarhfor dissemination of information and awareness.
- Publication of information brochures, pamphlets booklets containing all types of information, including pictures of birds and the area
- Setting up of signboards containing vital information at the International airport at Amritsar, the Railway station and Bus stands in the immediate vicinity of the area as well as in major cities and towns around the state.
- Large scale celebration involving public participation on occasions like World Wetlands Day, World Environment Day, World Science day etc.
- Utilizing the facilities available at the Interpretation centre which has a library and audio-visual materials for educating the local people as well as students and groups visiting the sanctuary from time to time.
- Gradually a website should also be developed with the help of professionals.

CHAPTER:16 DEVELOPMENT AND RENOVATION OF INFRASTRUCTURE

One of the important features of protection which often is overlooked is the acquisition/upgradation of the infrastructure needed for protection works. Some of the important ones are highlighted below:

Vehicles

The Sanctuary has a Swaraj Mazda truck, a motorcycle, motorboats and a tractor. The motorcycle is used by the Staff; the truck by the other staff for patrolling and transport of materials. The tractor is also used for transportation of materials as well as in other activities. It is therefore proposed that the following vehicles are needed and should be acquired and placed at the disposal of the sanctuary staff on priority basis if not available:

- OneSUV: To be used by the DFO.
- One Mahindra utility vehicle: for use in patrolling and transport of materials.
- One Truck: The old one needs to be condemned and disposed of as per rules.
- 3 motorcycles: to be used by block officers. The old one needs to be condemned and disposed of as per rules.
- One tractor-trolley: The old one needs to be condemned and disposed of as per rules.
- One ambulance for rescuing injured animals and birds from sanctuary are and nearby areas.
- Motorboats for patrolling and also for tourist purpose under eco-tourism project. There are 2 motorboats which were bought in 2019-20 and are in good condition. However, there is need for FRP boats as they are fast, reliable and more durable for management and protection purposes Water Hyacinth removal machine for regular removal of water hyacinth.
- Drone for monitoring the vast area and to control illegal activities efficiently.

Buildings

For better management of the area it is important that the staff are present at their headquarter and for that residential provisions need to be looked after. The complex in the headquarters at Harike has inadequate facilities for the staff, and there are no residential provisions for the staff.

Besides, some other buildings are required in other areas. The following buildings are recommended:

- ACF residence & Office at Harike
- Ranger residence at Harike.
- Block officer and Guard quarters: one at Makhu check post and one at Kirian and Headquarter complex.
- Block officer offices at Lakkadwala Check post ,
- Inspection hut at island in the middle of the lake and range office complex.
- Garage at Harike for the vehicles.
- Store-room: one each at Harike, Nose and Makhu check post
- Up gradation and repair of the existing Interpretation Centre at Churrian.
- A guest house at Harike office complex is needed as currently there is no staying place for officers on tour to sanctuary and also for visitors.
- Old interpretation centre at range office complex can be upgraded to Eco development Committee Room with Hall for meetings and trainings session.
- Rescue centre for birds and animals at Harike range office complex for safe keeping and treatment of injured animal for birds.
- Being a bird sanctuary there is always a possibility of injured birds so aviary with such birds can be constructed. This can also be visited by interested visitors.

Check posts and barriers

There are already 6 check posts spread at strategic points around the sanctuary. However, 3 more are proposed in Kot kaiyam khan, Papal and Kambo dhaiwala. These 3 areas are prone to encroachment and a lot of human activities also take place in the surrounding area.

Besides 2 more barriers also need to be set up to monitor movement of people and vehicle on the approach roads which are commonly used by the villagers as well as by the sanctuary staff. One is proposed on the road leading up to Village Kot kaya khan from Kapurthala side. The other is proposed at the road from Kirian.

Watch-towers

Watch towers are also an important feature for the management of the sanctuary including poaching, grazing, fire etc. it also serves as vantage points for bird watching. There arewatchtowers are constructed by tourism department under ADB project. However,more are proposed for more effective control ex. atPapal, Kambo. There are islands where watch towers can be constructed for better monitoring and vigilance.

Firearms

The offenders operating inside the sanctuary area often use arms and other dangerous weapons while carrying out their activities. There are many cases when chases were abandoned when the miscreants opened fire, or when captured, the crooks took out weapons threaten the staff and then ran away. There are also cases when personnel of the field staff got injured when fired upon by the crooks. It is therefore mooted that an armed wing of the staff be established which includes one Block officer and 4 guards.

Appropriate firearms may be issued to the personnel of the armed wing so that the protection of the sanctuary can be done in a more effective manner and it also

deters adventurism from the crooks. For this the staff should be properly trained and all the requirements as laid down in the Arms Act should be fulfilled. As the decision for such a measure is to be taken at the government level and may take time, the services of the police team placed at the disposal of the DFO should be properly utilized till such a decision is taken.

Also, armed guards from organization like PESCO can also be hired for better protection against armed miscreants.

Roads

All the existing approach roads should be made all weather, motorable roads. Most of the road in the interior areas is not well maintained and it becomes difficult for patrolling and other purposes in rainy season. Almost all the islands do not have inspection paths because of which there is little to no management in the islands where there is dense vegetation of reefs and marshes. Most of the cases of manufacturing of illicit liquor are done in such areas. It is therefore proposed to construct inspection paths in these islands so that they may be monitored and managed effectively.

CHAPTER: 17 HUMAN RESOURCES AT SANCTUARY

Another main component in protection and management of the sanctuary is the manpower available. Presently cadre is sanctioned at division level and as such no cadre sanction has been made at sanctuary level. The situation prevailing at the present moment is not adequate and the following structure and strength is recommended:

The cadre of staff working in the Wildlife Division Ferozepur and the new proposed structure fordivision including staff requirement at ranges is as shown under:

S. No.	Name of the Post	Sanction	Working	New Proposed Posts	Total post
1	D.F.O. Wildlife	1	1	0	1
2	A.C.F	0	0	2	2
3	Superintendent	1	1	0	1
4	Sr. Assistant	1	1	1	2
5	Jr.Assistant/Clerk	3	2	2	5
6	Forest Ranger	3	0	1	4
7	Deputy Forest Ranger	1	1	1	2
8	Range clerk	0	0	2	2
9	Forester	5	5	3	8
10	Legal officer	0	0	1	1
11	Forest Guards	13	14	7	20
12	Peon	2	1	6	8
13	Chowkidar	0	0	2	2
14	Driver	1	1	4	5
15	Boatman	0	0	4	4
16	Research officer	0	0	1	1
17	Research Assistant	0	0	1	1
18	Veterinary officer	0	0	2	2

19	Computer Data operator	0	0	3	3
20	Librarian	0	0	2	2
21	Cinema/audio-visual operator for Interpretation centre	0	0	2	2
22	Guide	0	0	4	4
23	Multipurpose Worker	6	0	4	10
	Total	37	27	55	92

Table14: Cadre strength of the Division

Proposed structure and responsibilities

Structure: - For better management following staff strength is prescribed for HarikeWLS.

- A Divisional Forest Officer (WL) at the Division level to supervise the division in Ferozepur.
- ACF to supervise and help DFO being stationed at Harike.
- A permanent post of Range Officer at division to subordinate the DFO and carry out the work in Ferozepur. He will be the inchargefor vigilancee and flying squad.
- A permanent post of Range Forest Officer who will be the in charge of the HWL and will carry out execution of works.
- 4 Foresters will help the RFO in the execution of works, protection, court cases.
- 10 Forest guards will be appointed as incharge of beats after the division of beats for better management and protection. One forest guard will look after the nature interpretation center and related activities and two forest guards per check post should be made available as per the field requirements. Others in patrolling squad.

- Staff to manage the rescue centres that are to be constructed in the future to manage the rescued animals.
- Daily Wages/ Watchers will be employed as per requirement.
- One computer technician at division level is required to maintain all records, GIS data etc.
- One Social facilitator will be appointed for the establishing relations with local people framing eco-development activities and arranging meeting with wildlife functionaries.
- One Veterinary officer will be appointed to deal with postmortem, rescues operations, animal health etc. and one trained medical assistant to assist the doctor.

Staff Amenities.

The Harike WLS does not have adequate infrastructure for staff. The availability of housing and other facility will enable the staff to perform their duties more efficiently.

A) Amenities, Infrastructure, Uniform, Weapon and communication

- Each staff should be provided a house/ rental accommodation near to the WLS area.
- Transport facilities up to Forest Guard should be provided for effective execution of work and patrollingbike to Forest Guard/ Foresters and bicycle to watcher/Daily wager must be given.
- A four-wheel vehicle like pickup trucks or rescue vehicles should be made available at wildlifesanctuary to meet any emergency/ rescue or would serve as an ambulance etc.
- Checkpostswill be renovated and new check posts will be constructed in strategic locations as prescribed earlier.

- Facilities like safe drinking water, furniture, electricity must be provided for the field staff should be made available.
- Uniforms along with fieldequipment viz binoculars, measuring tape, compass, range finder etc., field books, tranquilizers and warm clothing in winters must be provided.
- Each staff will be provided PDA (Personal Digital Assistant) for field duties.
- All the staff must be given the uniform, arms and training to use arms. Necessary amendments in the relevant Acts may be sought through competent authorities.

(B) Incentive and Rewards

- A special pay must be given to all the field staff for encouraging the staff. The provisions of government of India for special pay must be explored and implemented.
- Rewards/ incentive or commendation certificate should be given to the staff for meritorious work done to motivate the staff. The DFO (WL) may give citation/certificate to the meritorious staff.
- The provisions for incentives and awards at central government level should be explored and applied as per procedure for officials and non-officials.
- A corpus fund can be created for the welfare of WLS by the WLS authorities or the families of staff working in Sanctuary. This corpus fund may be used as welfare fund or to run the Souvenir shop.

CHAPTER: 18 FINANCIAL FORECASTS

GENERAL CONSIDERATIONS

The following is the financial forecast of the management plan. The calculations are based on current rates. The Management Plan is basically based on conservation measures and no revenue generation activities are prescribed. This is because there is no felling prescribed for the trees, no removal of grasses, except for the improvement of habitat, construction of inspection paths or fire lines, no auction of fruits etc. takes place in the sanctuary area. Besides, as a thumb rule the offences are not compounded but are rather prosecuted in courts of law, so the revenue from fines and forfeitures is also absent. So this Financial Forecast reflects only the Expenditure component.

Expenditure:

The estimated expenditure to be incurred for the management activities during the 10-year plan period is as follows.

Proposed Budget Activities of the Management Plan for Harike Wildlife Sanctuary (2020-21 to 2029-30)

ABSTRACT OF TEN YEAR BUDGET PROPOSAL FOR HARIKE SANCTUARY (2020-21 TO 2029-30)													
Sr. No 1	**Components**	**Amount (INR in lakhs)**										**Total Budget for 10 Years**	**Remarks**
		Year1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year9**	**Year 10**		
1	Habitat improvement sub plan	301.94	108.34	108.34	108.34	108.34	108.34	108.34	108.34	108.34	108.34	1277.00	Detail of the proposed budget component wise in following pages.
2	Protection Sub Plan	108.80	72.50	54.35	48.30	48.30	48.30	48.30	48.30	48.30	48.30	573.75	
3	Soil and Moisture Conservation sub Plan	36.90	36.90	36.30	36.30	36.30	36.30	36.30	36.30	36.30	36.30	364.20	
4	JFM and Eco-development sub plan	41.14	41.14	41.14	41.14	41.14	41.14	41.14	41.14	41.14	41.14	411.40	
5	Publicity and Awareness Activities	66.55	54.45	44.77	32.67	32.67	32.67	32.67	32.67	32.67	32.67	394.46	
6	Research activities	20.57	20.57	20.57	20.57	20.57	20.57	20.57	20.57	20.57	20.57	205.70	
7	Eco-Tourism	338.80	130.68	83.49	104.06	61.71	61.71	61.71	61.71	61.71	61.71	1027.29	
	Sub Total	914.70	464.58	388.96	391.38	349.03	349.03	349.03	349.03	349.03	349.03	4253.80	
	Grand Total 4253.80 Lakh												

Note: Salaries and other office related expenditure are excluded and above financial forecast can vary while planning for operations every year based on the field conditions and requirements during management.

Table 15: Financial Forecast for next 10 years.

TEN YEAR BUDGET PROPOSAL FOR HARIKE SANCTUARY (2020-2030)													
Activity No	**Description of Activity**	**Unit Rate**	**Target**	**Amount (INR in Lakhs)**										**Total Budget for 10 yrs**
				Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	
Component # 1 Habitat improvement sub plan														
Activity 1.1	Removal of invasive species like water hyacinth. Procurement of Machinery with running and maintanece cost	L/s		161.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	485.00
Activity 1.2	Plantation of Indigenous Fruit and Fodder trees Afforestation related activities	1.46584/ Ha	5 Ha per year	7.32	7.32	7.32	7.32	7.32	7.32	7.32	7.32	7.32	7.32	73.20
Activity 1.3	Island Improvement Works	L/s		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 1.4	River conservation throgh planting trees, shrubs for healthy and stable river banks and better fish and wilife habitate and to provide a buffer zone between river and land use.	L/s		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Acitivity 1.5	Development of grasslands for birds as a suitable habitat.	61106/Ha	2 ha per year	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	12.20
Activity 1.6	Species Reintroduction Programmes and Breeding programmes	L/s	L/s	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Activity 1.7	Purchase of Fire Fighting Equipments and fire tender vehciles and operation cost	L/s	L/s	40.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	85.00
Activity 1.8	Revitalisation and cleaning of BCR and haike WLS by removing plastic, polythene and other waste including weeds by engaging beas rakshak (People from local riparian communities)			5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 1.9	Prey base enrichment for Gharials and other aquatic wildlife rivers-Release of fishh seedingh (3")	Rs.3 per fish seed	500000/ seed every year	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	150.00
	Escalation cost (10%)			24.95	8.95	8.95	8.95	8.95	8.95	8.95	8.95	8.95	8.95	105.50
	Admin and Operation Cost (10%)			27.45	9.85	9.85	9.85	9.85	9.85	9.85	9.85	9.85	9.85	116.10
	Sub total (A)			**301.94**	**108.34**	**108.34**	**108.34**	**108.34**	**108.34**	**108.34**	**108.34**	**108.34**	**108.34**	**1277.00**
Component # 2 Protection Sub Plan														
Activity 2.1	Bird Census and Monitoring ,rescue	L/s	L/s	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	20.00
Activity 2.2	Wildlife health monitoring,rescue operation	L/s	L/s	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	20.00
Activity 2.3	Indus River Dolphin Surve and , monitoring	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 2.4	Gharial Monitoring Survey and montoring	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Acitivity 2.5	Research and Monitoring of biodiversity like inventorization, Studies on ecological processes, Studies on ecological characters, Studies on Biodiveristy, Bird ringing or Banding, Prey Base assessment, studies on climate change impacts on Wetland	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 2.6	Boundary delineation, demarcation, fencing and stabilisation of boundary including Digitization and Geo tagging and installation of boundary pillar and maintenance	L/s	L/s	10.00	10.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	65.00

Activity 2.7	Construction of Rescue, rehabilitation and treatment centre including operation cost	L/s	L/s	50.00	20.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	110.00
Activity 2.8	Engaagement of Labour for Watch and Ward during Fire Season for 3 months (20*26*3 Mandays) and in Winter Season for 3 Months for Protection (20*26*3 Mandays)	350 per day	3120 Mandays/Year	10.92	10.92	10.92	10.92	10.92	10.92	10.92	10.92	10.92	10.92	109.20
	Escalation cost (10%)			8.99	5.99	4.49	3.99	3.99	3.99	3.99	3.99	3.99	3.99	47.40
	Admin and Operation Cost (10%)			9.89	6.59	4.94	4.39	4.39	4.39	4.39	4.39	4.39	4.39	52.15
	Sub total (A)			**108.80**	**72.50**	**54.35**	**48.30**	**48.30**	**48.30**	**48.30**	**48.30**	**48.30**	**48.30**	**573.75**
Component # 3 Soil and Moisture Conservation sub Plan														
Activity 3.1	Development of a plan for rejuvenating polluted areas like river sutlej through expert session and framing detailed action plan	L/s	L/s	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Activity 3.2	Water quality, sediment testing and preparation of wetland health report cards and Estimation of the extent of nutrients from agriculture in the surrounding areas that drains inisde the sanctuary.	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 3.3	Soil erosion control and conservation measures like Vegetative hedge,Brushwood Check Dam,Grass Planting , Crate Wire, Structures, Preparation of Bridal Path for trails, Dry stone check dam and other structures and methods for oisl conservation	L/s	L/s	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	250.00
	Escalation cost (10%)			3.05	3.05	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	30.10
	Admin and Operation Cost (10%)			3.35	3.350	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	33.10
	Sub total (A)			**36.90**	**36.90**	**36.30**	**36.30**	**36.30**	**36.30**	**36.30**	**36.30**	**36.30**	**36.30**	**364.20**
Component #4 JFM/Eco-devlopement sub plan														
Activity 4.1	organization Camps for farmers to teach them new agriculture	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 4.2	Honorarium for Research Person and externel agencies to be engaged.	L/s	L/s	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	20.00
Activity 4.13	Distribution of literature and Package	L/s	L/s	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	20.00
Activity 4.4	Training for handicraft making and compost	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 4.5	Fisheries Devlopment in Villages in sanctuary	200000/ Per ponds	5 ponds every year	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Activity 4.6	Entry Point activities undertaken in forest fringe villages for execution of programmes to be undertaken from the State Funds	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 4.7	Capacity building and training for EDC/JFMC members	L/s		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
	Escalation cost (10%)			3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	34.00
	Admin and Operation Cost (10%)			3.74	3.74	3.74	3.74	3.74	3.74	3.74	3.74	3.74	3.74	37.40
	Sub total (A)			**41.14**	**41.14**	**41.14**	**41.14**	**41.14**	**41.14**	**41.14**	**41.14**	**41.14**	**41.14**	**411.40**
Component # 5 Publicity and Awareness Activities														
Activity 5.1	Public awareness ,engagement programmes and conservation oriented activities	L/s	L/s	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Activity 5.2	Preparation of Documentaries,Audio Visuals, Films,Pamphlets,field books, guides and Brochures, souvenirs, Publications, Mobile Apps, website	L/s	L/s	20.00	10.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	75.00
Activity 5.3	Nature Camps,Wetland day, Environment Day,Bird Festival and other awareness celebrations and workshops	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00

Activity 5.4	Advertisement Boards and Signages, Soveniers	L/s	L/s	5.00	5.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	26.00
Activity 5.5	Purchase of Computers,Audio Visual aids and development of IT infrasturcture for communitaction and outreach	L/s	L/s	15.00	15.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	75.00
	Escalation cost (10%)			5.50	4.50	3.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	32.60
	Admin and Operation Cost (10%)			6.05	4.95	4.07	2.97	2.97	2.97	2.97	2.97	2.97	2.97	35.86
	Sub total (F)			**66.55**	**54.45**	**44.77**	**32.67**	**32.67**	**32.67**	**32.67**	**32.67**	**32.67**	**32.67**	**394.46**
Component # 6 Research activities														
Activity 6.1	Bird Research regarding migration patttern, ringing excersice, Banding breeding and other research etc	L/s	L/s	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	20.00
Activity 6.2	Indus River Dolphin, Gharial and other wildlife Survey Research regarding reintroduction,inbreeding etc	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 6.3	Study about ecology of the wetland, its resource base, interactions with the adjoining upland areas, its diminishing aquatic zone and the impact on processes in the ecosystem by external agency	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 6.4	Research and Monitoring of biodiversity like inventorization, Studies on Biodiveristy , Prey base assessment, studies on climate change impacts on Wetland	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
	Escalation cost (10%)			1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	17.00
	Admin and Operation Cost (10%)			1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	18.70
	Sub total (A)			**20.57**	**20.57**	**20.57**	**20.57**	**20.57**	**20.57**	**20.57**	**20.57**	**20.57**	**20.57**	**205.70**
Component # 7 Ecotourism														
Activity 7.1	Upgradation,Renovation and Refurshibment of existing Interpretation Centers in harike and Churrian	L/s	L/s	50.00	10.00	10.00	7.00	5.00	5.00	5.00	5.00	5.00	5.00	107.00
	Establishing audio visual facilities, furniture dioramas, digital and interactive facilities in existing Tourism Infrastructure in Harike	L/s	L/s	20.00	10.00	10.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	80.00
Activity 7.2	Purchase of Tents to develop Camping sites	L/s	L/s	5.00	0.00	5.00	0.00	5.00	5.00	5.00	5.00	5.00	5.00	40.00
Activity 7.3	Training of nature guides / boatmen,bird watchers,battery vehicle operators	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
Activity 7.4	Constriuction and Establishment of Cottages/Eco Lodges/ Dormitories/ dining, kitchen, toilet and accomodation for tourists and maintained	L/s	L/s	100.00	20.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	165.00
Activity 7.5	Construction of Bird Hides and maintenance	L/s	L/s	6.00	6.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	28.00
Activity 7.6	Construction of Watch Towers and maintenance	L/s	L/s	20.00	20.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	80.00
Activity 7.7	Creation and improvement of nature trails,bridal path story walk with public amenities	L/s	L/s	37.00	0.00	0.00	33.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00
Activity 7.8	Purchase of binoculars, spotting scopes, telescope and portable chairs and other equipments to promote bird watching andUniforms for staff who are managing eco tourism in Harike	L/s	L/s	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00

Activity 7.9	Solar lightings in eco trails, accomodation areas and log huts in islands	L/s	L/s	10.00	10.00	5.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	39.00
Activity 7.10	Drinking water supply,Waste Disposal, sanitation facilities for tourists	L/s	L/s	10.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	60.00
Activity 7.11	Bicycles and E-Rickshaws for tourists	L/s	L/s	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	20.00
Activity 7.12	Signages and boards for awareness generation in tourism zone	L/s	L/s	10.00	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	60.00
	Escalation cost (10%)			28.00	10.80	6.90	8.60	5.10	5.10	5.10	5.10	5.10	5.10	84.90
	Admin and Operation Cost (10%)			30.80	11.88	7.59	9.46	5.61	5.61	5.61	5.61	5.61	5.61	93.39
	Sub total (G)			**338.80**	**130.68**	**83.49**	**104.06**	**61.71**	**61.71**	**61.71**	**61.71**	**61.71**	**61.71**	**1027.29**
	Total			**914.70**	**464.58**	**388.96**	**391.38**	**349.03**	**349.03**	**349.03**	**349.03**	**349.03**	**349.03**	**4253.80**
GRAND TOTAL (10 years)		**Total 4253.80 lakh**												

Note:Salaries and other office related expenditure are excluded and above financial forecast can vary while planning for operations every year based on the field conditions and requirements during management.

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Punjab Pollution Control Board Report Harike Wetland 2016-17
Mangement Plan of Harike Wildlife Sanctuary (2006-07-2016-17)
Gharial post release monitoring in river beas, punjab by WWF & Department of Forest and Wildlife preservation

ANNEXURE-I

Notifications

1999 Notification

GOVERNMENT OF PUNJAB
DEPARTMENT OF FORESTS AND WILDLIFE PRESERVATION

Notification

The 18th November, 1999.

No. 34/7/99-Ft-IV/16393 : Whereas *vide* Government of Punjab Forest Department Notification No. 34(21)92-Ft-IV/10818 dated the 8th September, 1992, Harike pond area has been declared as Wildlife Sanctuary for all kinds of wild birds and wild animals for a period of next ten years and killing, capturing, shooting and hunting of all kinds of wild Birds and wild Animals or carrying of fire arms in this area, has been strictly prohibited, under sub- section(1) of section 18 of the Wildlife(Protection) Act, 1972(Act No. 53 of 1972).

And whereas the area described in the specification below has been considered by the State Government to be of adequate ecological, faunal, floral, geomorphological, natural and zoological significance for the purpose of protecting, propagating and developing wildlife and its environment.

Now, therefore, in exercise of the powers conferred by sub-section (1) of section 26-A of the aforesaid Act, and all other powers enabling him in this behalf, the Governor of Punjab is pleased to specify the limits of the area as described in the specifications below which shall be comprised within the Sanctuary and declare that the said area shall be Sanctuary from the date of publication of this notification in the Official Gazette:

SPECIFICATIONS

Name of the District	Locality.	Boundaries.
1.	2.	3.
Amritsar, Ferozepur and Kapurthala	Harike Head Works upstream Pond area and downstream Government area.	**North :-** River Beas bundh area terminated Village Kirian, Kambo Dhaewala, Chamba Kalan, Marar and Harike (district Amritsar), Marsh and River area (Government land) of Village Kirian, Kambo Dhaewala, Chamba Kalan, Marar and Harike.

1.	2.	3.
Amritsar, Ferozpur And Kapurthala	Harike Head Works upstream pond area and downstrean Governmet area-*concld.*	**South :** Left bund of Rajasthan Canal (excluding Gurudwara Nanaksar Harike Ishar Dham

having an area of 104 Kanal 16 Marla) terminating at Bengaliwala bridge and left bank of drain touching Village Mauzgarh (Ferozepur) upto left marginal bund terminating and having curve at Village Bhottiwala (Ferozepur) Government land of Village Rasulpur and Bhottiwala in North of bund(Distt. Ferozepur).

East: Government land of Village Jagjitpur, Khara, Mand Fatehpur, Nikki, Mand Kambo, Mand Kirian, Pipal, Singh-ke-kalan (Distt. Kapurthala) and Kot Khaim Khan (Distt. Ferozepur).

West: Harike- Makhu Road (Government land) of downstream Harike (Distt. Amritsar), Government land of Village Talwandi Nepal an (Distt. Ferozepur) Harike Head Works River Sutlej downstream running water upto boundary touching Village Talwandi Nepal an.

(Total area 86 Sq. Km.)

J.S. KESAR,

Financial Commissioner & Secretary to Govt. Pub.,

Department of Forests & Wildlife Preservation.

1992 Notification:

PUNJAB GOVERNMENT
FOREST DEPRTMENT

NOTIFICATION

No. 34(21)92-Ft-IV/10818 Chandigarh dated 8.9.1992.

In exercise of the powers conferred under section 18 (1) of the Wildlife (Protection) Act, 1972(Act No. 53 of 1972). The governor of Punjab is pleased to declare that one month after date of this notification, the Harike pond area will be a Wildlife Sanctuary for all kinds of Birds and wild Animals for a period of next ten years and killing, capturing, shooting and hunting of all kinds of wild Birds and wild Animals or carrying of fire arms in this area, shall be strictly prohibited.

Name of the Districts.	Locality.	Boundaries.
Amritsar, terminated Ferozepur & Kapurthala.	Harike Head works Works upstream pond and and downstream Government area. village Kalan.	**North:** River Beas bundh area Village Kirian, Kambo Dhaewala and Chamba Kalan, (Distt. Amritsar) Marsh area and River (Government land) of Kirian, Kambo Dhaewala, Chamba **South** : Left bund of Rajasthan Canal terminating at Bengaliwala bridge and left bank of drain touching Village Mauzgarh (Ferozepur) upto left marginal bund terminating and having curve at Village Bhottiwala (Ferozepur) area of Village Rasulpur and Bhottiwala in North of bund (Distt. Ferozepur). **East**: Village Jagjitpur, Khara, Mand Fatehpur, Nikki, Mand Kambo, Pipal, Singh-ke-kalan (Distt. Kapurthala) **West**: Harike- Makhu Road(Government land) of down stream Harike (Distt. Amritsar), Government land of Village Talwandi Nepalan (Distt. Ferozepur) Harike Head Works River Sutlej downstream running water upto boundary touching Village Talwindi Nepalan.

Total area 86 Sq. Km. approximately

C. L. BAINS
Secretary to Government Punjab, Forests
And Wildlife Preservation Department.

No. 34(21)92-Ft-IV/10819 Chandigarh, dated the 8.9.1992.

A copy, with a spare copy of the Notification, is forwarded to the Controller of Printing and Stationary, Punjab, Chandigarh, for publication the above Notification may please be supplied to this Department in due course of time.

Under Secretary to Government Punjab,
Forests Department.

No. 34(21)92-Ft-IV-10820 Chandigarh, dated the 8.9.1992.

A copy with a copy of the Notification is Forwarded for information to the:

1. Principal Chief Conservator of Forests, Punjab, Chandigarh. With reference to this letter No. 475, dated 14.5.92.
2. Commissioner, Jalandhar and Ferozepur Division.
3. Deputy Commissioner, Amritsar, Ferozepur and Kapurthala.

Under-secretary to Government Punjab,
Forests Department.

1982 Notification:

GOVERNMENT OF PUNJAB
WILD LIFE PRESERVATON DEPARTMENT

Notification

No. 34(4)FT3-82/11677. – The 26th August, 1982

In supersession of Punjab Government Notification No. 4716-Ft-III-78/4324, dated 15th March, 1978 and in exercise of the powers conferred under section 18(1) of Wildlife (Protection) Act, 1972 (Act No. 53 of 1972), the Governor of Punjab is pleased to declare that one month after the date of publication of this Notification, the Harike Pond area will be a Wild Life Sanctuary, for all kinds of Wild Birds and Wild Animals for a period of 10 years. Killing, capturing and hunting of all kinds of Wild Animals and Wild Birds or carrying of fire-arms in this area shall be strictly prohibited:

District	**Locality**	**Boundaries**
Amritsar, Ferozepur & Kapurthala	Harike Head Works extending Pond Area	**North:** River Beas Bundh. **South:** Left Marginal Bundh, terminating at village Rasulpur. **West:** Marginal left Bundh terminating Point touching village Rasulpur & Boundary line of Makhu area (Ferozepur District), Jagjitpur, Khara, Mand Fatehpur, Nikki, Singhe-ke-Kalan, Pipal, Mand Kamboh villages (Kapurthala District), Village Kiryan (Amritsar District) terminating at Beas River Bundh. **East:** Harike-Makhu road passing on Headworks
	Total area is 41 Sq.Km. approximately	

P. H. VAISHNAV
Secretary to Government, Punjab
Forest Department, Chandigarh.

1978 Notification

PUNJAB GOVERNMENT
FOREST DEPARTMENT

Notification

Chandigarh Dated the 15.3.78

No. 4716-Ft-III-78/4324.

In superession of Punjab Govt. Notification No. 4223-Ft-III-76/35745 dated the 19th October, 1976 and subsequent corrigendum No. 4223-Ft-III-76/37860 dated the 10th November, 1976 and in exercise of the powers conferred under section 37(i) of the Wildlife (Protection) Act, 1972, the Governor of Punjab is pleased to declare that one month after the publication of this notification, the area of Harike Headworks, upstream and downstream as scheduled below shall be a closed area for all kinds of wild animals and birds for a period of 10 years, and killing, capturing, shooting and hunting of all kinds of wild birds and wild animals or carrying weapons in the area shall be strictly prohibited:

District	**Locality**	**Boundaries**
Ferozepur Amritsar Kapurthala Jullundur	On both sides of Harike Head works Downstream extending About 2 K.M. and an average about 12 K.M. upstream	**North:** Northern boundaries of revenue estates of Chamba Kalan (Hadbast No. 351) Kamboh (Hadbast No. 335) and Kirian (Hadbast No. 356) of Tarn Taran Tehsil and revenue estates of Harike (Hadbast No. 187) and Buh (Hadbast No. 188) of Patti Tehsil, District Amritsar. **South:** Jullundur-Ferozepur Railway Line. **East:** Straight Line from Rly. bridge over river Sutlej to village Chamba Kalan (Hadbast No. 351) of Tehsil Tarn Taran. **West:** Straight line joining crossing of Railway bridge on Ferozepur Feeder with village Buh (Hadbast No. 188) of Patti Tehsil.
Total area 148 Sq. K.M. approximately		

K.S. BAINS
Secretary to Government, Punjab,
Forest Department.

No. 4716-Ft-III-78/4325, Dated 15-3-78

A copy is forwarded to:

1. Chief Conservator of Forests, Punjab, with reference to his memo No. 2700 dated 23-11-1977 for information

Sd/-
Deputy Secretary to Govt. Punjab
Development Department.

1976 Notification

PUNJAB GOVERNMENT
FOREST DEPARTMENT

Notification

Dated Chandigarh the 19-10-76

No. 4223-Ft-III-76/35745.

In exercise of the powers conferred under section 18(1) of the Wildlife (Protection) Act, 1972, the Governor of Punjab is pleased to declare that one month after the publication of this notification, the area of Harike Headworks upstream and downstream as scheduled below shall be a sanctuary for all kinds of wild animals and birds for a period of 10 years, and killing, capturing, shooting and hunting of all kinds of wild birds and wild animals or carrying weapons in the area shall be strictly prohibited:

District	**Locality**	**Boundaries**
Ferozepur, Amritsar, Kapurthala Jullundur	On both sides of Harike Headworks Downstream extending about 2 K.M. and an average about 12 K.M. upstream.	**North:** Northern boundaries of revenue estates of Chamba Kalan (Hadbast No. 351), Kamboh (Hadbast No. 355) and Kirian (Hadbast No. 356) of Tarn Taran Tehsil and revenue estates of Harike (Hadbast No. 187) and Buh (Hadbast No. 188) of Patti Tehsil District Amritsar. **South**: Jullundur-Ferozepur Railway Line. **East:** Straight line from Railway bridge over river Sutlej to vill. Chamba Kalan (Hadbast No. 351) of Tehsil Tarn Taran. West: Straight line joining crossing of Railway bridge on Ferozepur Feeder with village Buh (Hadbast No. 188) of Patti Tehsil.

Total area 148 Sq. Km. approximately.

K.S. BAINS
Secretary to Government, Punjab,
Forest Department.

No. 4223-Ft-III-76/25746, Chandigarh, dated the 19-10-76

A copy is forwarded to:

***

3. Chief Conservator of Forests, Punjab, with reference to his memo No. CM.XX.2/1819 dated 15-9-1976 etc. information.

Sd/-
Under Secretary Development.

ANNEXURE-II

2017 Notification

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
Eco Sensitive Zone Notification

Dated New Delhi, the 12-05- 2017

In exercise of the powers conferred by sub-section (1), clause (v) and clause (xiv) of sub-section (2) and sub-section (3) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) read with sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986, the Central Government hereby notifies an area to an extent upto100 metres all around the boundary of the Harike Wildlife Sanctuary in the State of Punjab as the Harike Wildlife Sanctuary. Eco-sensitive Zone is an area of 100 meters all around the boundary of the Harike Wildlife Sanctuary comprising an area of 3.93 square kilometre. Detail provisions of notification are as under:

1. Extent and boundaries of Eco-sensitive Zone.—(1) The extent of the Eco-sensitive Zone is an area of 100meters all around the boundary of the Harike Wildlife Sanctuary comprising an area of 3.93 square kilometre approximately.

(2) The map of the Eco-sensitive Zone is given fig 3. The boundary description of Harike Wildlife Sanctuary and its Eco-sensitive Zone along with the latitudes and longitudes is appended as Annexure.

(3) The list of villages whose area or parts thereof are falling within the Eco-sensitive Zone along with the coordinatesare given as Annexure.

2. Zonal Master Plan for the Eco-sensitive Zone.—(1) The State Government shall, for the purpose of the Eco sensitive Zone prepare, a Zonal Master Plan, within a period of two years from the date of publication of final notification in the Official Gazette, in consultation with local people and adhering to the stipulations given in this notification.

(2) The Zonal Master Plan shall be approved by the Competent Authority in the State Government.

3. The Zonal Master Plan for the Eco-sensitive Zone shall be prepared by the State Government in such manner as is specified in this notification and also in consonance with the relevant Central and State laws and the guidelines issued by the Central Government, if any.

(4) The Zonal Master Plan shall be prepared in consultation with all concerned State Departments, namely:-

(i) Environment
(ii) Forest
(iii) Urban Development;
(iv) Tourism
(v) Municipal
(vi) Revenue
(vii) Agriculture
(viii) Punjab State PollutionControl Board, for integrating environmental and ecological considerations into it.

(5) The Zonal Master Plan shall not impose any restriction on the approved existing land use, infrastructure and
activities, unless so specified in this notification and the Zonal Master Plan shall factor in improvement of all infrastructure and activities to be more efficient and eco-friendly.

(6) The Zonal Master plan shall provide for restoration of denuded areas, conservation of existing water bodies, management of catchment areas, watershed management, groundwater management, soil and moisture conservation, needs of local community and such other aspects of the ecology and environment that need attention.
(7) The Zonal Master Plan shall demarcate all the existing worshipping places, village and urban settlements, types and kinds of forests, agricultural areas, fertile lands, green area, such as, parks and like places, horticultural areas, orchards, lakes and other water bodies.
(8) The Zonal Master Plan shall regulate development in theEco-sensitive Zone so as to ensure Eco-friendly development and livelihood security of local communities.
Measures to be taken by State Government.-The State Government shall take the following measures for giving effect to the provisions of this notification, namely:-
(1) Land use.—
(a) Forests, horticulture areas, agricultural areas, parks and open spaces earmarked for recreational purposes in the Eco-sensitive Zone shall not be used or converted into areas for major commercial or major residential complex or industrial activities. Provided that the conversion of agricultural and other lands, for the purpose other than that specified within theEco-sensitive Zone may be permitted on the recommendation of the Monitoring Committee, and with the prior approval of the competent authority under the Relevant State Laws and other rules and regulations of Central/State Government as applicable and vide provisions of this Notification, to meet the residential needs of the local residents such as-:
(i) Widening and strengthening of existing roads and construction of new roads;
(ii) Construction and renovation of infrastructure and civic amenities;
(iii) Small scale industries not causing pollution;
(iv) Cottage industries including village industries; convenience stores and local amenities supporting eco-tourism including home stay.
Provided further that no use of tribal land shall be permitted for commercial and industrial development activities without the prior approval of the competent authority under the Relevant State Laws and other rules and regulations of State Government and without compliance of the provisions of article 244 of the Constitution or the law for the time being in force, including the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (2 of 2007): Provided also that any error appearing in the land records within the Eco-sensitive Zone shall be corrected by the State Government, after obtaining the views of Monitoring Committee, once in each case and the correction of said error shall be intimated to the Central Government in the Ministry of Environment, Forest and Climate Change: Provided also that the above correction of error shall not include change of land use in any case except as Provided under this sub-paragraph.
(b) Efforts shall be made to reforest the unused or unproductive agricultural areas with afforestation and habitat restoration activities.
(2) Natural Springs.-The catchment areas of all natural springs shall be identified and plans for their conservation and rejuvenation shall be incorporated in the Zonal Master Plan and the guidelines shall be drawn up by the State Government in such a manner as to prohibit development activities at or near these areas which are detrimental to such areas.
(3) Tourism/Eco-tourism.—(a) all new eco-tourism activities or expansion of existing tourism activities within the Eco-sensitive Zone shall be as per the Tourism Master Plan for the Eco-sensitive Zone.
(b)The Eco-Tourism Master Plan shall be prepared by Department of Tourism in consultation with State Departments of Environment and Forests.
(c) The Tourism Master Plan shall form a component of the Zonal Master Plan.
(d) The activities of Eco-tourism shall be regulated as under, namely:-

(i) No new construction of hotels and resorts shall be allowed within 1 km from the boundary of the Wildlife Sanctuary or upto the extent of the Eco-sensitive Zone whichever is nearer. However, beyond the distance of 1 km. from the boundary of the Wildlife Sanctuary till the extent of the Eco-sensitive Zone, the establishment of new hotels and resorts shall be allowed only in pre-defined and designated areas for Eco-tourism facilities as per Tourism Master Plan.
(ii) All new tourism activities or expansion of existing tourism activities within the Eco-sensitive Zone shall be in accordance with the guidelines issued by the Central Government in the Ministry of Environment, Forest and Climate Change and the eco-tourism guidelines issued by the National Tiger Conservation Authority (as amended from time to time) with emphasis on eco-tourism.
(iii) Until the Zonal Master Plan is approved, development for tourism and expansion of existing tourism activities shall be permitted by the concerned regulatory authorities based on the actual site specific scrutiny and recommendation of theMonitoring Committee and no new hotel /resort or commercial establishment construction is permitted within Eco-sensitive Zone area.
(4) Natural Heritage.—All sites of valuable natural heritage in the Eco-sensitive Zone, such as the gene pool reserve areas, rock formations, waterfalls, springs, gorges, groves, caves, points, walks, rides, cliffs, etc. shall be identified and a heritage conservation plan shall be drawn up for their preservation and conservation as a part of the Zonal Master Plan.
(5) Man-made heritage sites.—Buildings, structures, artefacts, areas and precincts of historical, architectural, aesthetic, and cultural significance shall be identified in the Eco-sensitive Zone and heritage conservation plan for their conservation shall be prepared as part Zonal Master Plan.
(6) Noise pollution.—Prevention and Control of noise pollution in the Eco-sensitive Zone shall be complied with in accordance the with Noise Pollution (Regulation And Control) Rules, 2000 under the Environment (Protection) Act, 1986.
(7) Air pollution.—Prevention and control of air pollution in the Eco-sensitive Zone shall be complied with in accordance with the provisions of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981).
(8) Discharge of effluents.—Discharge of treated effluent in Eco-sensitive Zone shall be in accordance with the provisions of the General Standards for Discharge of Environmental Pollutants covered under the Environmental (Protection) Act, 1986 and rules made thereunder or standards stipulated by State Government.
(9) Solid wastes. - Disposal and Management of solid wastes shall be as under:-
(i) The solid waste disposal and management in the Eco-sensitive Zone shall be carried out in accordance with the Solid Waste Management Rules, 2016 and published by the Government of India in the Ministry of Environment, Forest and Climate Change vide notification number S.O. 1357 (E), dated the 8th April, 2016,
(ii) The inorganic material may be disposed in an environmental acceptable manner at site identified outside the Eco- sensitive Zone.
(iii) No burning or incineration of solid wastes and establishment of landfills shall be permitted in the Eco-sensitive Zone.
(10) Bio-medical waste.—Bio medical waste management shall be as under:
(i) The bio-medical waste disposal in the Eco-sensitive Zone shall be carried out in accordance with the Bio-Medical Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change vide Notification number GSR 343 (E), dated the 28th March, 2016.

(ii) No common treatment facility or incineration shall be permitted within the Eco Sensitive Zone.

(11) Vehicular traffic: The vehicular movement of traffic shall be regulated in a habitat friendly manner and specific provisions in this regard shall be incorporated in the Zonal Master Plan and till such time as the Zonal Master plan is prepared and approved by the Competent Authority in the State Government, the Monitoring Committee shall monitor compliance of vehicular movement under the relevant Acts and the rules and regulations made thereunder.

(12) Vehicular Pollution.—Prevention and control of Vehicular Pollution shall be complied with in accordance with applicable laws and efforts to be made for use of cleaner fuel for example CNG, LPG, etc.

(13) Plastic Waste Management: The Plastic Waste Management in the Eco-sensitive Zone shall be carried out as per the provisions of the Plastic Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change vide notification number G.S.R. 340(E), dated the 18th March, 2016,

(14) Construction and Demolition Waste Management: The Construction and Demolition Waste Management in the Eco-sensitive Zone shall be carried out as per the provisions of the Construction and Demolition Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change vide notification number G.S.R. 317(E), dated the 29th March, 2016.

(15) E-waste- The E- Waste Management in the Eco-sensitive Zone shall be carried out as per the provisions of the E- Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change.

(16) Industrial Units.— (i) On or after the publication of this notification in the Official Gazette, no new polluting industries shall be allowed to be set up within the Eco-sensitive Zone.

(ii) Only non-polluting industries shall be allowed within Eco-sensitive Zone as per classification of Industries in the Guidelines issued by the Central Pollution Control Board in February 2016, unless so specified in this notification and in addition, non-polluting cottage industries shall be promoted.

(17) Protection of Hill Slopes: The protection of hill slopes shall be as under- (a) The Zonal Master Plan shall indicate areas on hill slopes where no construction shall be permitted. (b) No construction on existing steep hill slopes or slopes with a high degree of erosion shall be permitted

18) Strategy/plan under Ramras convention to be followed for protection of species for Harike wetland.

(19) The Central Government and the State Government shall specify other measures, if it considers necessary, in giving effect to the provisions of this notification.

4. Prohibited, Regulated and Promoted Activities.-

All activities in the Eco -sensitive Zone shall be governed by the provisions of the Environment (Protection)Act, 1986 (29 of 1986) and the rules made there under including the Coastal Regulation Zone Notification,2011 and theEnvironmental Impact Assessment Notification, 2006 and other applicable laws including the Forest (Conservation) Act,1980 (69 of 1980), the Indian Forest Act, 1927 (16 of 1927), the Wildlife (Protection) Act 1972 (53 of 1972), and amendments made thereto and be regulated in the manner specified in the Table 1 below, namely:-

Sl. No.	Activities	Remarks
A	**Prohibited**	

	Activities:	
1.	Commercial Mining.	All new and existing (minor and major minerals), stone quarrying and crushing units are prohibited with immediate effect exceptformeetingthe domestic needs of bona fide local residents including digging of earth for construction or repair of houses and for manufacture of country tiles or bricks for housing and for other activities. (b) The mining operations shall be carried out in accordance with the order of the Hon'ble Supreme Court dated 04 August, 2006 in the matter of T.N. God VarmanTirumala Vs. UOI in W.P.(C) No.202 of 1995 and dated 21 April, 2014 in the matter of Goa Foundation Vs. UOI in W.P.(C) No.435 of2012.
2.	Setting of industries causing pollution (Water, Air, Soil, Noise, etc.).	No new industries and expansion of existing polluting industries in the Eco- sensitive zone shall be permitted. Only non-polluting industries shall be allowed within Eco-Sensitive Zone as per classification of Industries in the Guidelines issued by the Central Pollution Control Board in February 2016, unless so specified in this notification. In addition, non-polluting cottage industries shall be promoted.
3.	Establishment of major hydroelectric project.	Prohibited (except as otherwise provided) as per applicable laws.
4.	Use or production or processing of any hazardous substances.	Prohibited (except as otherwise provided) as per applicable laws.
5.	Discharge of untreated effluents in natural water bodies or land area.	Prohibited (except as otherwise provided) as per applicablelaws.
6.	Establishment of solid waste disposal site and common incineration facility for solid and bio medical waste.	No new solid waste disposal site and waste treatment/processing facility of solid waste is permitted within Eco sensitive zone. Further installation of common or individual incineration facility for treatment of any form of solid waste generated from industrial process and health establishment/ hospitals etc. is Prohibited
7.	Establishment of large-scale commercial livestock and poultry farms by firms, corporate, companies.	Prohibited (except as otherwise provided) as per applicable laws except for meeting local needs.
8.	Setting of new saw mills.	No new or expansion of existing saw mills shall be permitted within the Eco- sensitive Zone.

9.	Setting up of brick kilns.	Prohibited (except as otherwise provided) as per applicablelaws.
B.	**Regulated Activities:**	
10.	Commercial establishment of hotels and resorts.	No new commercial hotels and resorts shall be permitted within one kilometer of the boundary of the Protected Area or upto the extent of Eco-sensitive zone, whichever is nearer, except for small temporary structures for Eco- tourism activities. Provided that, beyond one kilometer from the boundary of the protected Area or upto the extent of Eco-sensitive zone whichever is nearer, all new tourist activities or expansion of existing activities shall be in conformity with the Tourism Master Plan and guidelines as applicable.
11.	Construction activities.	No new commercial construction of any kind shall be permitted within one Kilometer from the boundary of the Protected Area or upto extent of the Eco-Sensitive Zone whichever is nearer: Provided that, local people shall be permitted to undertake construction in their land for their use including the activities listed in sub-paragraph (1) of paragraph 6 as per building byelaws to meet the residential needs of the local residents such as: - widening and strengthening of existing roads and construction of new roads; construction and renovation of infrastructure and civic amenities; Cottage industries including village industries; convenience stores & local amenities supporting eco-tourism including home stays;andpromoted activities listed in this Notification.
12.	Small scale nonpolluting industries.	Non polluting industries termed as White Category as per classification of industries issued by the Central Pollution Control Board in February 2016 and non-hazardous, small-scale and service industry, agriculture,floriculture, horticulture or agro-basedindustry producing products from indigenous materials from the Eco- sensitive Zone shall be permitted bythe competentAuthority.

13.	Felling of Trees.	(a)There shall be no felling of trees on the forest or Government or revenue or private lands without prior permission of the competent authority in the State Government. (b) The felling of trees shall be regulated in accordance with the provisions of the concerned

		Central or State Act and the rules made thereunder.
14.	Collection of Forest produce or Non-Timber Forest Produce (NTFP).	Regulated under applicable laws.
15.	Infrastructure including civic amenities	Shall be done withmitigation measures, as per applicable laws, rules andregulationandavailableguidelines.
16.	Under taking other activities related to tourism like over flying the Eco-sensitive Zone area by hot air balloon, helicopter, drones, Microlites, etc.	Regulated under applicable law
17.	Erection of electrical and telecommunication towers related infrastructure.	Promote underground cabling.
18.	Fencing of existing premises of hotels and lodges.	Regulated under applicable laws.
19.	Discharge of treated waste water/effluents in natural water bodies or land area.	The discharge of treated waste water/effluents shall be avoided to enter into the water bodies. Efforts to be made for recycle and reuse of treated waste water. Otherwise the discharge of treated waste water/effluent shall be regulated as per applicablelaws.
20.	Commercial extraction of surface and ground water.	Regulated under applicable law.
21.	Open Well, Bore Well etc. for agriculture or other usage.	Regulated and the activity should be strictly monitored by the appropriate authority.
22.	Commercial Sign boards and hoardings.	Regulated under applicable laws.
23.	Air, Noise and vehicular pollution.	Regulated under applicable laws.
24.	Introduction of Exotic species.	Regulated under applicable laws.
25.	Eco-tourism.	Regulated under applicable laws
26.	Security Forces Camp.	Regulated under applicable laws.

27.	New wood based industry.	No establishment of new wood based industry shall be permitted within the limits of Eco-Sensitive Zone: Provided that new wood based industry may be set up in the Eco- sensitive using 100% imported wood stock.
28.	Eco-friendly cottages for temporary occupation of tourists such as tents, wooden houses, etc. for Eco-friendly tourism activities.	Regulated under applicable laws.
29.	Solid Waste Management.	Regulated under applicable laws.
	C. Promoted Activities:	
30.	Rain water harvesting.	Shall be actively promoted.
31.	Organic farming.	Shall be actively promoted.
32.	Adoption of green technology for all activities.	Shall be actively promoted.
33.	Cottage industries including village artisans, etc.	Shall be actively promoted.
34.	Use of renewable energy and fuels.	Bio gas, solar light etc. to be actively promoted.
35.	Agro-Forestry.	Shall be actively promoted.
36.	Use of eco-friendly transport.	Shall be actively promoted.
37.	Skill Development.	Shall be actively promoted.
38.	Restoration of Degraded Land/Forests/Habitat.	Shall be actively promoted.
39.	Environmental Awareness.	Shall be actively promoted.

Table 1: Various activities mentioned under notification of Eco-sensitive zone

ANNEXURE-III

Government of Punjab

Department of Forests and Wildlife Preservation

(Forest Branch)

NOTIFICATION

No. 34/10/2019-Ft5/1171 Chandigarh, the dated 08/03/2019

Subject: Declaration of Indus River Dolphin (*Platanistagangetica minor*) as State Aquatic Animal of Punjab.

In pursuance to the recommendations made by the Punjab State Board for Wildlife in its 2nd meeting held on 1.2.2019 under the Chairmanship of Hon'ble Chief Minister, Punjab, Indus River Dolphin (*Platanistagangetica minor*) is hereby declared as " **State Aquatic Animal**" of State of Punjab.

This issues with the approval of Chief Minister, Punjab.

Sd/-

Dr. RoshanSunkaria

Additional Chief Secretary

Chandigarh and Financial Commissioner, Govt. of Punjab

Dated 08-03-2019 Department of Forests and Wildlife Preservation

Endst. No.34/10/2019-Ft5/1172 Chandigarh, dated 08/03/2019

A copy is forwarded to the following for information and necessary action:

1. Principal Secretary/ Chief Minister Punjab
2. Private Secretary/ Forest Minister, Punjab
3. Chief Secretary, Punjab
4. All Additional Chief Secretary/ Principal Secretary/ Secretary to Government of Punjab/ Commissioner of Divisions.
5. All Head of Departments, Punjab
6. Director General of Police Punjab
7. Principal Chief Conservator of Forests (HoFF), Punjab.
8. Principal Chief Conservator of Forests (Wildlife),Punjab.
9. Chief Wildlife Warden, All States/ UTs.
10. All Members of Punjab State Board for Wildlife
11. All Members of Punjab State Wetlands Authority.
12. All Chief Conservator of Forests/ Conservator of Forests,Punjab
13. All Deputy Commissioners and Senior Superintendents ofPolice of Punjab State.
14. A copy with a spare copy of the notification is forwarded tothe Controller, Printing &Stationery, Punjab for publication the same in Government gazette.

Additional Secretary, Govt. of Punjab

Department of Forests and Wildlife Preservation,

ANNEXURE-IV

File No.W/DFWP-CWLWOT-10/1/2021-CCF(W)-DFWP-CWLW 1/159131 /2021

Government of Punjab
Department of Forests & Wildlife Preservation
(Forest Branch)
NOTIFICATION

No. DFWLP-40/l/2021-Ft-5/ Chandigarh, dated 19/03/2021

Whereas Harike has high potential for conservation of flora & fauna and promoting ecotourism;

Whereas in the State budget for the year 2020-21 an announcement for creation of Harike Wetland and Eco-Tourism Development Authority was made;

Whereas there is a need of intersectoral coordination in promoting conservation efforts & ecotourism at Harike;

Now to promote such intersectoral coordination, Harike Wetland and Eco-Tourism Development Authority is hereby constituted with followingcomposition: -

Sr.No	Designation	
1.	Conservator of Forests (Wildlife), Parks & Protected Area Cirde, Punjab	Chairperson
2.	Representative of Secretary, Department of Tourism & Cultural Affairs, Punjab	Member
3.	Representative of Secretary, Department of Animal Husbandry, Fisheries & Dairy Development, Punjab	Member
4.	Representative of Conservator of Forests (Territorial) Ferozepur Circle/Bist Circle	Members
5.	Representative of Deputy Commissioners, Tarntaran/ Kapurthala/ Ferozepur	Members
6.	Representative of Chief Engineer, Department of Water Resources, Punjab	Member
7.	Environmental Engineer, Punjab Pollution Control Board (PPCB), Punjab (having jurisdiction over Harike area)	Member
8.	Representative of Chief Engineer, Bhakra Beas Management Board (BBMB), Punjab	Member

9.	Divisional Forest Officer (wildlife), Ferozerpur	Member Secretary

Note: 1. The Authority may co-opt any experts or NGOs in the field of wildlife as and when required.
2. Representative of the Secretary should not be below the level of Addl. Secretary/ Joint Secretary and Representative of Engineers at the level ofSuperintendent Engineer.

Dated the: 18.03.2021

Ravneet Kaur, IAS
Additional Chief Secretary to Govt, of Punjab
Department of Forests & Wildlife Preservation.

No. DFWLP-40/l/2021-Ft-5/ Chandigarh, dated 19/03/2021

A copy is forwarded to the following for information and necessary action:-

1. Additional Chief Secretary, Department of Tourism & Cultural Affairs,Punjab
2. Additional Chief Secretary, Department of Animal Husbandry, Fisheries &Dairy Development, Punjab.
3. Principal Chief Conservator of Forests (HoFF), Punjab, Forest Complex,Sector - 68, S.A.S Nagar (Mohali).
4. Chief Wildlife Warden, Punjab.
5. Chief Engineer, Bhakra Beas Management Board (BBMB), Punjab.
6. Chief Engineer, Department of Water Resources, Punjab.
7. Deputy Commissioner, Tarn Taran/ Kapurthala/ Ferozepur.
8. Conservator of Forests (Territorial) Ferozepur Circle/Bist Circle.
9. Environmental Engineer, Punjab Pollution Control Board (PPCB),Amritsar, Punjab.
10. Nodal Officer, (Gazette Notification) office of Principal Chief Conservatorof Forests (HoFF), Punjab, Forest Complex, Sector - 68, S.A.S Nagar(Mohali) with a request to forward the same to the Controller, Printing &Stationary, Punjab, Chandigarh for printing the Gazette Notification inthe ordinary Gazette and supplying 100 copies of the Printednotification to this Department.

Under Secretary
19/03/2021

ANNEXURE-V

BOUNDARY DESCRIPTION OF HARIKE WILDLIFE SANCTUARY AND ITS ECO-SENSITIVE ZONE WITH GPS CO-ORDINATES

Sl. No.	G.P.S Coordinates of Wildlife Sanctuary	
1.	7501’11.464’’ E	31012’38.538’’N
2.	7502’23.912’’ E	31011’21.99’’ N
3.	7500’42.249’’ E	31010’25.157’’ N
4.	7502’25.773’’ E	3109’13.974’’ N
5.	7501’35.587’’ E	3108’7.122’’ N
6.	7501’37.375’’ E	3107’29.994’’ N
7.	7500’34.031’’ E	3106’46.1514’’ N
8.	74057’14.822’’ E	3107’38.569’’ N
9.	74056’39.182’’ E	3109’44.377’’ N
10.	74058’59.485’’ E	31011’25.659’’ N
G.P.S Coordinates of Eco-Sensitive Zone		
1.	7501’52.835’’ E	310 12’1.452’’ N
2.	7501’34.696’’ E	31011’2.261’’ N
3.	7501’4.657’’ E	310 9’57.285’’ N
4.	7501’22.24’’ E	310 8’51.855’’ N
5.	74059’39.782’’ E	310 7’1.927’’ N
6.	74056’24.163’’ E	310 8’47.361’’ N
7.	74057’24.162’’ E	310 9’53.702’’ N
8.	74058’5.56’’ E	310 10’21.754’’ N
9.	74058’38.68’’ E	310 10’58.258’’ N
10.	7400’6.688’’ E	310 11’49.004’’ N

ANNEXURE-VI

List of villages falling in the eco-sensitive zone of harike wildlife sanctuary with gps co-ordinates

Sl. No.	Name of Village	Latitude			Longitude		
		Degree	Minute	Second	Degree	Minute	Second
District Ferozepur							
1.	Ruknewala Kalan	31	07	45.98	75	02	36.97
2.	Bhootiwala	31	07	09.44	75	01	44.00
3.	Kot Qaim Khan	31	08	07.19	75	01	22.99
4.	Rasulpur	31	05	41.64	75	00	41.04
5.	Purana Makhu	31	06	26.87	74	58	34.78
6.	Changian	31	07	10.46	74	59	43.34
7.	Sudhia	31	07	32.72	74	59	16.85
8.	Churrian	31	07	48.04	74	58	34.58
9.	Maujgarh	31	08	23.83	74	57	15.39
10.	Talwandi Nepalan	31	06	19.52	74	57	44.53
District Kapurthala							
1.	Mand Singhpura	31	10	52.45	75	01	17.90
2.	Gudde	31	10	30.53	71	01	44.51
3.	Jand	31	09	04.05	75	03	03.28
District Tarn Taran							
1.	Harike	31	10	08.39	74	56	33.94
2.	Marrar	31	10	00.06	74	57	31.81
3.	Kirrian	31	10	36.50	74	58	24.84
4.	Kambodhai Wala	31	11	31.79	74	58	55.72
5.	Chamba Kalan	31	12	30.46	75	00	33.24
6.	Dhundhaiwala (Dhun)	31	13	04.62	75	01	28.59

ANNEXURE-VII

Checklist

Micro-organism

Phylum Protozoa	Identified species	Phylum Protozoa	Identified species
1	*Arcella sp.*	12	*Mesodinium sp.*
2	*Astramoeba radiosa*	13	*Nuclerearia simplex*
3	*Centropyxis sp.*	14	*Paramaecium sp.*
4	*Ceratium sp.*	15	*Pelomyxa sp.*
5	*Chilomonas sp.*	16	*Quadrulella sp*
6	*Cothurnia sp.*	17	*Rugipes sp.*
7	*Difflugia sp.*	18	*Stokesia vernalis*
8	*Dinamoeba sp.*	19	*Thecamoeba verrucosa*
9	*Endosphaera*	20	*Trinema sp.*
10	*Euglypha sp.*	21	*Volvox sp.*
11	*Halteria sp.*		

Rotifera			
1	*Albertia sp.*	27	*F. terminalis*
2	*Anurecopsis sp.*	28	*Gastropus hyptopus*
3	*Asplanchna priodonta*	29	*Hexarthra mira*
4	*Ascomorphella sp.*	30	*Horringia sp.*
5	*Brachionus angularis*	31	*Hydratina senta*
6	*Brachionus bidentata*	32	*Kellicotia sp.*
7	*Brachionus calyciflorus*	33	*Keratella quadreta*
8	*Brachionus forficula*	34	*Keratella serrulata*
9	*Brachionus havanensis*	35	*Keratella tropica*
10	*Brachionus plicatilis*	36	*K. cochlearis*
11	*Brachionus quadridentata*	37	*K. valga*
12	*Brachionus rubens*	38	*Lecane leontina*
13	*Calisformes sp.*	39	*Lecane luna*
14	*Cephalodella gibba*	40	*L. depressa*
15	*Colurella adriatica*	41	*L. ohioensis*
16	*Colurus sp.*	42	*Lepadella ovalis*
17	*Drilophaga sp.*	43	*Monostylla bulla*
18	*Diplois daviesiae*	44	M. *closterocerca*
19	*Dorria dalecarlica*	45	*M. lunaris*
20	*D. daviesiae*	46	*Mytilina sp.*
21	*Encentrum fellis*	47	*Notholca accuminata*
22	*Epiphanes clavulata*	48	Notometta *sp.*
23	*Epiphanes* macruera	49	*Notops sp.*
24	*Euchlanis dilatata*	50	*Philodina sp.*
25	*Filinia longiseta*	51	*Platyias patulus*
26	*F. brachiata*	52	*Platyias polycanthus*

Phylum	Identified species	Phylum	Identified species
53	*Pleosoma lenticulare*	58	*Proales fallaciosa*
54	*Pleosoma triacanthum*	59	*Rotifera sp.*
55	*Pleurotrocha petromyzon*	60	*Testudinella sp.*
56	*Polyarthra vulgaris*	61	*Trichocera multricrinis*
57	*Pompholyx sulcata*		

Crustacea			
Copepoda	*Cyclops sp.*	Cladocera	*Polyphemus pediculus*
Copepoda	*Diaptomas sp.*	Cladocera	*Simocephalus sp.*
Copepoda	*Mesocyclops sp.*	Ostracoda	*Canthocamptus staphilinus*
Copepoda	*Nauplius sp.*	Ostracoda	*Chlamydotheca sp.*
Cladocera	*Alona sp.*	Ostracoda	*Cyclocypris sp.*
Cladocera	*Bosmina longirostris*	Ostracoda	*Cypris sp.*
Cladocera	*Ceriodaphnia sp.*	Ostracoda	*Entocythera sp.*
Cladocera	*Chydorus sp.*	Ostracoda	*Ergasilus sp.*
Cladocera	*Daphnia sp.*	Ostracoda	*Potamocypris sp.*
Cladocera	*Eurycercus lamellatus*	Ostracoda	*Stenocypris sp.*
Cladocera	*Holopedium gibberrum*	Decapoda	*Caridina nilotica*
Cladocera	*Leptodera kindtii*	Anostraca	*Chirocephalus diaphanus*
Cladocera	*Macrothrix rosea*	Anostraca	*Paleomenetes sp.*
Cladocera	*Moinodaphnia sp.*		

Insects

Group	*Species*	Group	*Species*
Coleoptera	*Aquatic beetles*	Diptera	*Anopheles sp*
Coleoptera	*Dytiscus sp.*	Diptera	*Cranefly*
Coleoptera	*Hydrophilid beetles*	Diptera	*Culex sp.*
Odonata	*Aeshna sp. naid*	Diptera	*Deronectes sp.*
Odonata	*Anax sp.*	Diptera	*Dicroneta sp.*
Odonata	*Damselflies*	Diptera	*Forcipoymae*
Odonata	*Dragonflies*	Diptera	*Pentaneura*
Odonata	*Hagenius*	Diptera	*Phantom* midge
Diptera	*Chironomus sp.*	Diptera	*Simulium sp.*
Diptera	*Dixa* midge	Diptera	*Tanypus sp.*
Diptera	*Chaoborus sp.*		

Ephemeroptera	***Ephemerdla sp.***
Ephemeroptera	*Ephemeropteran*

Group	*Species*	Group	*Species*
	sp. (unidentified)		
Hemiptera	Aquatic *bugs*	**Trichoptera**	*Caddis flies*
Hemiptera	*Hydrometra*	Trichoptera	*Ceraclea sp.*
Hemiptera	*Notonecta sp.*	Trichoptera	*Leptocerus sp.*
Hemiptera	*Plea leechi*	Trichoptera	*Phryganea sp.*
Neuroptera	*Neuropteran sp. (unidentified)*	Trichoptera	*Trichopteran sp. (unidentified)*
		Hymenoptera	*Polynema natans*

Nematoda		**Annelida**	
1	*Aphlenchoides sp.*	1	*Aelosoma hemprichi*
2	*Dory/aimus sp.*	2	*Chaetogaster sp.*
3	*Rhabdolaimus* minor	**3**	*Glossiphonia sp.*
		4	*Holobdella sp.*
		5	*Lumbriculus sp.*
		6	*Nais sp.*
		7	*Placobdella sp.*
		8	*Stylaria lacustris*
		9	*Tubifex tubifex*

Mollusca			
1	*Alasmidonta sp.*	10	*Indoplanorbis exustus*
2	*Aniscus sp.*	11	*L. auricularia*
3	*Anodonta sp.*	12	*L. columella*
4	*Anodontoides sp.*	13	*L. glabra*
5	*Bellamia bengalensis*	14	*L. haldemani*
6	*Eupera sp.*	15	*L. lateola*
7	*Goniobasis sp.*	16	*L. palustris*
8	*Gyraulus sp.*	17	*L. perger*
9	*Hydrobia sp.*	18	*L. stagnalis*

Group	*Species*	Group	*Species*
19	*L. trunculata*	31	*Pleurocera* acuta
20	*Larecaulis alte*	32	*Polymesoda sp.*
21	*Legumia latissima*	33	*Pomacea sp.*
22	*Lymneae accuminata*	34	*Promenetes sp.*
23	*Lyrodes sp*	35	*Sabulina octona*
24	*Musculium sp.*	36	*Sphaerium sp.*
25	*Neoplanorbis sp.*	37	Terebia *granifera*
26	*Neritina sp.*	38	*Tritigonia sp.*
27	*P. camplanatus*	39	*Unio sp.*
28	*P.* corneus	40	*Valvata tricarinata*
29	*Pisidium dubium*	41	*Viviparus bengalensis*
30	*Planorbis albus*		

Vertebrate fauna of Harike wetland

Amphibia

Phylum	Identified Species	Phylum	Identified Species
1	*Bufo stomaticus*	3	*Euphlyctis hexadactylus*
2	*Euphlyctis cynophlyctis*	4	*Hoplobatrachus tigerinus*

Reptiles

Group	Scientific Name	Group	Scientific Name
Turtles		*Snakes*	
1	*Aspideretes gangeticus*	1	*Enhydris enhydris*
2	*Chitra indica*	2	*E.sieboldii*
3	*Geoclemys hamiltonii*	3	*Xenochrophis piscator*
4	*Hardella thurjii*	Gharial	
5	*Kachuga smithii*	1.	*Gavialis gangeticus*
6	*Lissemys punctata*		
7	*Pangshura tectum*		

Pisces

Sl.no	Scientific Name	Sl.no	Scientific Name
1.	*Ambassls nama or Chanda nama*	37.	*Labeo rohita*
2.	*Ambassis ranga or Chanda ranga*	38.	*Macrognathus cavasius*
3.	*Amblypharyngodon mola*	39.	*Macrognathus aral*
4.	*Bagarius bagarius*	40.	*Mastacembelus* armatus
5.	*Bagarius yarelii*	41.	*Mystus aor*
6.	*Botia birdi*	42.	*Mystus bleekeri*
7.	*Catla catla*	43.	*Mystus cavasius*
8.	*Carrasius carrasius*	44.	*Mystus micropthalamus*
9.	*Carrasius auratus*	45.	*Mystus seenghala*
10.	*Channa marulius*	46.	*Mystus vittatus*
11.	*Channa punctatus*	47.	*Notopterus chitala*
12.	*Channa striatus*	48.	*Notopterus notopterus*
13.	*Cirrhinus cirrhosus*	49.	*Ompok bimaculatus*
14.	*Cirrhinus mrigala*	50.	*Ompok malabricus*
15.	*Cirrhinus reba*	51.	*Ompok pabda*
16.	*Clarias batracus*	52.	*Osteobrama cotio*
17.	*Clupisoma garua*	53.	*Ophiocephalus sp*
18.	*Colisa fasciatus*	54.	*Oxygaster sp.*
19.	*Colisa lalius*	55.	*Parluciosoma daniconius*
20.	*Ctenopharyngodon idellus*	56.	*Puntius chilinoides*
21.	*Cyprinus carpio*	57.	*Puntius chola*
22.	*Esomus danricus*	58.	*Puntius chrysopterus*
23.	*Eutropiichthys murius*	59.	*Puntius filamentosus*
24.	*Eutropiichthys vacha*	60.	*Puntius sarana*
25.	*Garra gotyla gotyla*	61.	*Puntius sophore*
26.	*Glossogobius giuris*	62.	*Puntius tetrarupagus*
27	*Glyptothorax punjabensis*	63.	*Puntius ticto*
28.	*Gudusia chapra (Clupea chapra)*	64.	*Rita rita*
29.	*Gambusia affinis*	65.	*Salmostoma bacaila (Chela bacaila)*
30.	*Heteropneustes fossilis*	66.	*Salmostoma horai*
31.	*Hypophthalmichthys molitrix*	67.	*Schizothorax richardsonii*
32.	*Labeoangra*	68.	*Strongylura luira*
33.	*Labeo bata*	69.	*Tor puttitora*
34.	*Labeo calbasu*	70.	*Trichogaster fasciatus (Colis*a f*asciatus)*
35.	*Labeo caeruleus*	71.	*Wallago attu*
36.	*Labeo gonius*	72.	*Xenentodon cancila*

Mammals

Sl.no	Scientific Name	Common Name	Sl.no	Scientific Name	Common Name
1	*Antilope cervicapra*	Blackbuck	8	*Herpestes edwardsi*	Common mongoose
2	*Axis porcinus*	Hog deer	9	*Lutra lutra*	Common Otter
3	*Boselaphus tragocamelus*	Nilgai	10	*Lutrogale perspicillata*	Smooth Indian otter
4	*Canis aureus*	Jackal	11	*Sus scrofa*	Wild boar
5	*Canis lupus*	Indian wolf	12	*Vulpes bengalensis*	Indian fox
6	*Felis chaus*	Jungle cat	13	*Platanista gagetica minor*	Indus river dolphin
7	*Gazella gazella*	Chinkara			

List of birds reported from harike

List of Birds

S. No.	Common Name	Zoological Name	Family
1	Adjutant Stork	*Leptoptilos dubius*	CICONIIDAE: Storks
2	Alpine Swift	*Apus melba melba*	APODIDAE: Swifts
3	Amaller or Median Egret	*Egretta intermedia intermedia*	ARDEIDAE: Egrets
4	Ashy Drongo	*Dicrurus leucophaeus*	DICRURIDAE: Drongos
5	Ashycrowned Finch Lark	*Eremoptenx grisea*	ALAUDIDAE: Larks
6	Asian Paradise Flycatcher	*Terpsiphone paradisi*	MUSCICAPIDAE: Flycatchers
7	Asiatic Sparrow-Hawk	*Accipiter nisus nisosimilis*	ACCIPITRIDAE: Hawks
8	Avocet	*Recurvirostra avocetta*	RECURVIROSTRIDAE: Stilts
9	Bank Myna	*Acridotheres ginginianus*	STURNIDAE: Mynas
10	Barheaded Goose	*Anser indicus*	ANATIDAE: Ducks, Geese
11	Bengal Green Pigeon	*Columba livia livia*	COLUMBIDAE: Pigeons
12	Black Bittern	*Dupetor flavicollis*	ARDEIDAE: Bittern
13	Black Crowned Finch-Lark	*Eremoptenx nigriceps affinis*	ALAUDIDAE: Larks
14	Black Headed Munia	*Lonchura malacca*	PLOCEIDAE: Sparrows and Weaverbirds
15	Black Headed or Brahminy Myna	*Sturnus pagodarum*	STURNIDAE: Mynas
16	Black Necked Grebe	*Podiceps nigricollis*	PODICIPEDIDAE: Grebes
17	Black Necked Stork	*Ephippiorhynchus asiaticus*	CICONIIDAE: Storks

18	Black or King Vulture	*Sarcogyps calvus*	ACCIPITRIDAE: Vultures
19	Black Stork	*Ciconia nigra*	CICONIIDAE: Storks
20	Black Tailed Godwit	*Limosa limosa*	CHARADRIIDAE: Plover, Sandpipers, Snipe
21	Black Tern	*Chlidonias niger*	LARIDAE: Gulls, Terns
22	Black Throated Thrush	*Turdus ruficollis atrogularis*	MUSCICAPIDAE: Flycatchers
23	Blackbacked Yellowheaded Wagtail	*Motacilla citreola calcarata*	MOTACILLIDAE: Wagtails
24	Blackbellied Tern	*Sterna acuticauda*	LARIDAE: Gulls, Terns
25	Blackeared or Large Indian Kite	*Milvus migrans lineatus*	ACCIPITRIDAE: Hawks, Vultures
26	Blackheaded Bunting	*Emberiza melanocephala*	EMBERIZIDAE: Buntings
27	Blackheaded Gull	*Larus ridibundus ridibundus*	LARIDAE: Gulls, Terns
28	Blackthroated Weaver Bird	*Ploceus benghalensis*	PLOCEIDAE: Weaverbirds
29	Blackwinged Kite	*Elanus caeruleus vociferus*	ACCIPITRIDAE: Hawks, Vultures
30	Blue Cheeked Bee-eater	*Merops persicus*	MEROPIDE: Bee-eaters
31	Blue Throated Barbet	*Megalaima asiatica asiatica*	CAPITONIDAE: Barbets
32	Blue Winged Teal or Garganey	*Anas querquedula*	ANATIDAE: Ducks, Geese
33	Blueheaded Rock Thrush	*Monticola fulicate cambaiensis*	MUSCICAPIDAE: Flycatchers
34	Blueheaded Yellow Wagtail	*Motacilla flava beema*	MOTACILLIDAE: Wagtails
35	Bluetailed Bee-eater	*Merops philippinus philippinus*	MEROPIDE: Bee-eaters
36	Blyth's Reed Warbler	*Acrocephalus dumetorum*	MUSCICAPIDAE: Flycatchers
37	Bonelli's Eagle	*Hieraaetus fasciatus*	ACCIPITRIDAE: Hawks, Vultures
38	Booted Eagle	*Hieraaetus pennatus*	ACCIPITRIDAE: Hawks, Vultures
39	Booted Warbler	*Hippolais caligata*	MUSCICAPIDAE: Flycatchers
40	Brahminy Kite	*Haliastur indus indus*	ACCIPITRIDAE: Hawks, Vultures
41	Brahminy or Ruddy Shelduck	*Tadorna ferrugenia*	ANATIDAE: Ducks, Geese
42	Bristled Grassbird	*Chaetornis striatus*	MUSCICAPIDAE: Flycatchers
43	Broad Billed Sandpiper	*Limicola falcinellus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
44	Brook's Leaf Warbler	*Phylloscopus subviridis*	MUSCICAPIDAE: Flycatchers
45	Brown Chief Chaff	*Phylloscopus collybites tristis*	MUSCICAPIDAE: Flycatchers
46	Brown Crake	*Amaurornis akool akool*	RALLIDAE: Rails, Coots

47	Brown Fish Owl	*Bubo zeylonensis leschenault*	STRIGIDAE: Owls
48	Brown Rock Chat	*Cercomela fusca*	MUSCICAPIDAE: Flycatchers
49	Brown Shrike	*Lanius cristatus cristatus*	LANIIDAE: Shrikes or Butcherbirds
50	Brownbacked Indian Robin	*Saxicoloides fulicate cambaiensis*	MUSCICAPIDAE: Flycatchers
51	Brownheaded Gull	*Larus brunnicephalus*	LARIDAE: Gulls, Terns
52	Buff-Breasted Sandpiper	*Tryngites subruficollis*	CHARADRIIDAE: Plover, Sandpipers, Snipe
53	Caspian Tern	*Sterna caspia*	LARIDAE: Gulls, Terns
54	Cattle Egret	*Bulbulcus ibis coromandus*	ARDEIDAE: Egrets
55	Central Asian Starling	*Sturnus vulgaris porphyronotus*	STURNIDAE: Mynas
56	Cettis Bush Warbler	*Cettia cetti*	MUSCICAPIDAE: Flycatchers
57	Chaf Finch	*Fringilla coelebs*	FRINGILLIDAE: Finches
58	Chestnut Bittern	*Ixobrychus cinnamomeus*	ARDEIDAE: Bittern
59	Collard Pratincole	*Glareola pratincola*	BURHINIDAE: Stone curlew
60	Common Babbler	*Turdoides cauldatus caudatus*	MUSCICAPIDAE: Babblers
61	Common Crow Pheasant or Coucal	*Centropus sinensis sinensis*	CUCULIDAE: Cuckoos
62	Common Hawk Cuckoo	*Cuculus various various*	CUCULIDAE: Cuckoos
63	Common or Fantail Snipe	*Gallinago gallinago gallinago*	CHARADRIIDAE: Plover, Sandpipers, Snipe
64	Common Pochard	*Aythya ferina*	ANATIDAE: Ducks, Geese
65	Common Ringed Plover	*Charadrius hiaticula*	CHARADRIIDAE: Plover, Sandpipers, Snipe
66	Common Sandpiper	*Tringa hypoleucos*	CHARADRIIDAE: Plover, Sandpipers, Snipe
67	Common Shelduck	*Todorna tadorna*	ANATIDAE: Ducks, Geese
68	Common Teal	*Anas crecca crecca*	ANATIDAE: Ducks, Geese
69	Common Tern	*Sterna hirundo hirundo*	LARIDAE: Gulls, Terns
70	Coot	*Fulica atra atra*	RALLIDAE: Rails, Coots
71	Corn Bunting	*Miliaria calandra*	EMBERIZIDAE: Buntings
72	Cotton Teal or Quacky Duck	*Nettapus coromandelianus coromandelianus*	ANATIDAE: Ducks, Geese
73	Crested Bunting	*Melophus lathami*	EMBERIZIDAE: Buntings
74	Crested Honey Buzzard	*Pernis ptilorhyncus ruficollis*	ACCIPITRIDAE: Hawks, Vultures
75	Crested Serpent Eagle	*Spilornischeela cheela*	ACCIPITRIDAE: Hawks, Vultures
76	Crimson Breasted Barbet or Coppersmith	*Megalaima haemacephata indica*	CAPITONIDAE: Barbets
77	Curlew Sandpiper	*Calidris testacea*	CHARADRIIDAE: Plover, Sandpipers, Snipe
78	Dabchick or Little Grebe	*Podiceps ruficollis capensis*	PODICIPEDIDAE: Grebes
79	Darter or Snake Bird	*Arhinga rufa melanogaster*	PHALACROCORACIDAE: Darter

80	Desert Warbler	*Sylvia nana*	MUSCICAPIDAE: Flycatchers
81	Desert Wheat Eater	*Oenanthe deserti*	MUSCICAPIDAE: Flycatchers
82	Dunlin	*Calidris alpina alpina*	CHARADRIIDAE: Plover, Sandpipers, Snipe
83	Dusky Crag Martin	*Hirundo concolor concolor*	HIRUNDINIDAE: Martins
84	Dusky Horned Owl	*Bubo coromandus coromandus*	STRIGIDAE: Owls
85	Eastern Curlew	*Numenius arquata orientalis*	CHARADRIIDAE: Plover, Sandpipers, Snipe
86	Eastern Baillon's Crake	*Porzana pusilla pusilla*	RALLIDAE: Rails, Coots
87	Eastern Black Naped Oriole	*Oriolus chinensis diffusus*	ORIOLIDAE: Orioles
88	Eastern Common Crane	*Grus grus lifordi*	GRIUDAE: Cranes
89	Eastern Grey Heron	*Ardea cineria rectirostris*	ARDEIDAE: Herons
90	Eastern Greylag Goose	*Anser anser rubrirostris*	ANATIDAE: Ducks, Geese
91	Eastern Large Egret	*Ardea alba modesta*	ARDEIDAE: Egrets
92	Eastern Little Bustard	*Otis tetrax orientalis*	ORIDIDAE: Bustards
93	Eastern Orphean Warbler	*Sylvia hortensis jerdoni*	MUSCICAPIDAE: Flycatchers
94	Eastern Purple Heron	*Ardea purpurea manilensis*	ARDEIDAE: Herons
95	Eurasian Eagle Owl	*Bubo bubo*	STRIGIDAE: Owls
96	Eurasian Linnet	*Carduelis cannabina*	FRINGILLIDAE: Finches
97	European Golden Plover	*Pluvialis aspricaria*	CHARADRIIDAE: Plover, Sandpipers, Snipe
98	European Hoopoe	*Upupa epops epops*	UPUPIIDAE: Hoopoes
99	European Kestrel	*Falco tinnunculus tinnunculus*	FALCONIDAE: Falcons
100	European Roller	*Coracious garrulus*	CORACIIDAE: Roller
101	European Tree Pipit	*Anthus trivalis trivalis*	MOTACILLIDAE: Pipits
102	European Wryneck	*Jynx torquilla torquilla*	PICIDAE: Woodpeckers
103	Falcated or Bronze Capped Teal	*Anas falcata*	ANATIDAE: Ducks, Geese
104	Finsch's or Common Indian Starling	*Sturnus vulgaris poltaratskyi*	STURNIDAE: Mynas
105	Forest Eagle Owl	*Bubo bubo bengalensis*	STRIGIDAE: Owls
106	Forest Owlet	*Athene blewitti*	STRIGIDAE: Owls
107	Gadwall	*Anas stepera stepera*	ANATIDAE: Ducks, Geese
108	Glossy Ibis	*Plegadis falcinellus falcinellus*	THRESKIORNITHIDAE: Ibises
109	Great Black Backed Gull	*Larus ichthyaetus*	LARIDAE: Gulls, Terns
110	Great Created Grebe	*Podiceps cristatus cristatus*	PODICIPEDIDAE: Grebes
111	Great Stone Plover or Great Thick Knee	*Esacus magnirostris recurvirostris*	BURHINIDAE: Stone curlew
112	Greater Spotted Eagle	*Aquila clanga*	ACCIPITRIDAE: Hawks, Vultures
113	Green Sand Piper	*Tringa ochropus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
114	Green Shank	*Tringa nebularia*	CHARADRIIDAE: Plover,

			Sandpipers, Snipe
115	Grey Headed Canary Flycatcher	*Culicicapa ceylonensis*	MUSCICAPIDAE: Flycatchers
116	Grey Hornbill	*Tockus birostris*	BUCEROTIDAE: Hornbills
117	Grey Quail	*Coturnix coturnix coturnix*	PHASIANIDAE: Quails
118	Grey Wagtail	*Motacilla caspica caspica*	MOTACILLIDAE: Wagtails
119	Greyheaded Yellow Wagtail	*Motacilla flava thunbergi*	MOTACILLIDAE: Wagtails
120	Greywinged Blackbird	*Turdus boulboul*	MUSCICAPIDAE: Flycatchers
121	Gullbilled Tern	*Gelochelidon nilotica nilotica*	LARIDAE: Gulls, Terns
122	Hen Harrier	*Circus cyaneus*	ACCIPITRIDAE: Hawks, Vultures
124	Himalayan Slaty Headed Parakeet	*Psittacula himalayana*	PSITTACIDAE: Parakeets
125	Himalyan Golden Eagle	*Aquila chrysaetos daphanea*	ACCIPITRIDAE: Hawks, Vultures
126	Hobby	*Falco subbuteo subbuteo*	FALCONIDAE: Falcons
127	Hodgsons's Pied Wagtail	*Motacilla alba alboides*	MOTACILLIDAE: Wagtails
128	Hume's Lesser White Throat	*Sylvia curruca althaea*	MUSCICAPIDAE: Flycatchers
129	Hume's Short Toed Lark	*Calandreila acutirostris*	ALAUDIDAE: Larks
130	Imperial Eagle	*Aquila haliaca haliaca*	ACCIPITRIDAE: Hawks, Vultures
131	Indian Barn Owl	*Tyto alba stertens*	STRIGIDAE: Owls
132	Indian Baya or Weaver Bird	*Ploceus philipinus philipinus*	PLOCEIDAE: Weaverbirds
133	Indian Baybacked Shrike	*Lanius vittatus vittatus*	LANIIDAE: Shrikes or Butcherbirds
134	Indian Black Ibis	*Pseudibis papillosa papillosa*	THRESKIORNITHIDAE: Ibises
135	Indian Black Partridges	*Francolinus francolinus asiae*	PHASIANIDAE: Partridges
136	Indian Blackwinged Stilt	*Himantopus himantopus himantopus*	RECURVIROSTRIDAE: Stilts
137	Indian Blue Rock Pigeon	*Columba livia intermedia*	COLUMBIDAE: Pigeons
138	Indian Cliff Swallow	*Hirundi fluvicola*	HIRUNDINIDAE: Martins
139	Indian Cormorant	*Phalacrocorax fuscicollis*	PHALACROCORACIDAE:Cormrants
140	Indian Crested Lark	*Galerida Cristata chendoola*	ALAUDIDAE: Larks
141	Indian Golden Oriole	*oriolus oriolus kundoo*	ORIOLIDAE: Orioles
142	Indian Great Horned Owl or Eagle Owl	*Bubo bubo bengalensis*	STRIGIDAE: Owls
143	Indian Great Reed Warbler	*Acrocephalus stentoreus brunnescens*	MUSCICAPIDAE: Flycatchers
144	Indian Grey Shrike	*Lanius excubitor*	LANIIDAE: Shrikes or Butcherbirds
145	Indian Griffon Vulture	*Gyps fulvus fulvescens*	ACCIPITRIDAE: Vultures
146	Indian House Crow	*Corvus splendens splendens*	CORVIDAE: Crows

147	Indian House Sparrow	*Passer domesticus indicus*	PLOCEIDAE: Sparrows
148	Indian House Swift	*Apus affinis affinis*	APODIDAE: Swifts
149	Indian Jungle Crow	*Corvus macrorhynchos culminatus*	CORVIDAE: Crows
150	Indian Jungle Nightjar	*Caprimulgus indicus indicus*	CAPRIMULGIDAE: Nightjar
151	Indian Koel	*Eudynamys scolopacea*	CUCULIDAE: Cuckoos
152	Indian Litte Brown Dove or Senegal Dove	*Streptopelia senegalensis*	COLUMBIDAE: Doves
153	Indian Little Nightjar	*Caprimulgus asiaticus asiaticus*	CAPRIMULGIDAE: Nightjar
154	Indian Little Ringed Plover	*Charadrius dubius jerdoni*	CHARADRIIDAE: Plover, Sandpipers, Snipe
155	Indian Longbilled Vulture	*Gyps indicus indicus*	ACCIPITRIDAE: Vultures
156	Indian Longtailed Nightjar	*Caprimulgus macrurus albonotatus*	CAPRIMULGIDAE: Nightjar
157	Indian Magpie Robin	*Copsychus saularis saularis*	MUSCICAPIDAE: Flycatchers
158	Indian Moorhen	*Gallinula choloropus indica*	RALLIDAE: Rails, Coots
159	Indian Myna or Common Myna	*Acridotheres tristis tristis*	STURNIDAE: Mynas
160	Indian Paddy Field Pipit	*Anthus novaeseelandiae rufulus*	MOTACILLIDAE: Pipits
161	Indian Palm Swift	*Cypsiurus parvus batasiensis*	APODIDAE: Swifts
162	Indian Pea Fowl	*Pavo cristatus*	PHASIANIDAE:Pheasants,Partridges,Quail
163	Indian Pied Kingfisher	*Ceryle rudis leucomelanura*	ALCEDINIDAE: Kingfisher
164	Indian Pied Myna	*Sturnus contra contra*	STURNIDAE: Mynas
165	Indian Pitta	*Pitta brachyura brachyura*	PITTIDAE: Pittas
166	Indian Plaintive Cuckoo	*Cacomantis passerinus*	CUCULIDAE: Cuckoos
167	Indian Pond Heron or Paddy Bird	*Ardeola graii graii*	ARDEIDAE: Herons
168	Indian Purple Moorhen	*Porphyrio porphyrio poliocephalus*	RALLIDAE: Rails, Coots
169	Indian Purple Sunbird	*Nectarinia asiatica asiatica*	NECTARINIIDAE: Sunbirds
170	Indian Red Turtle-Dove	*Streptopelia tranquebanca tranquebanca*	COLUMBIDAE: Doves
171	Indian Ring Dove	*Streptopelia decaocto decaocto*	COLUMBIDAE: Doves
172	Indian River Tern	*Sterna aurantia*	LARIDAE: Gulls, Terns
173	Indian Rosefinch	*Carapodacus erythrinus roseatus*	FRINGILLIDAE: Finches
174	Indian Rufoustailed Finch Lark	*Ammomaenes phoenicurus phoenicurus*	ALAUDIDAE: Larks
175	Indian Shikra	*Accipiter badius dussumieri*	ACCIPITRIDAE: Hawks, Vultures
176	Indian Skimmer ro Scissorbill	*Runchops albicollis*	LARIDAE: Gulls, Terns
177	Indian Small Blue Kingfisher	*Alcedo atthis bengalensis*	ALCEDINIDAE: Kingfisher
178	Indian Small Green Bee-	*Merops orientalis orientalis*	MEROPIDE: Bee-eaters

	eater		
179	Indian Spotted Dove	*Streptopelia chinensis suratensis*	COLUMBIDAE: Doves
180	Indian Spotted Munia	*Lonchura punctulata punctulata*	PLOCEIDAE: Sparrows and Weaverbirds
181	Indian Stone Curlew	*Burhinus oedicnemus indicus*	BURHINIDAE: Stone curlew
182	Indian Streaked Weaver Bird	*Ploceus manyar flaviceps*	PLOCEIDAE: Weaverbirds
183	Indian Striated of Redrumped Swallow	*Hirundo daurica eruthropygia*	HIRUNDINIDAE: Martins
184	Indian Tailor Bird	*Orthotomus sutorius guzuratus*	MUSCICAPIDAE: Flycatchers
185	Indian Thickbilled Flowerpecker	*Dicaeum agile agile*	DICAEIDAE: Flowerpecker
186	Indian Whiskered Tern	*Chlidonias hybridus indicus*	LARIDAE: Gulls, Terns
187	Indian White Backed Vulture	*Gyps bengalensis*	ACCIPITRIDAE: Vultures
188	Indian White Breasted Water Hen	*Amaurornis phoenicurus phoenicurus*	RALLIDAE: Rails, Coots
189	Indian White Eye	*Zosteropsisa palpebrosa palpebrosa*	ZOSTEROPIDAE: White Eye
190	Indian White Wagtail	*Motacilla alba dukhunensis*	MOTACILLIDAE: Wagtails
191	Indian Witetyailed Swallow	*Hirundosmithii filifera*	HIRUNDINIDAE: Martins
192	Indus Sand Lark	*Calandreila raytal adamsi*	ALAUDIDAE: Larks
193	Intermediate Egret	*Mesophoyx intermedia*	ARDEIDAE: Egrets
194	Jack Snipe	*Lymnocryptes minimus*	ROSTRATULIIDAE: Panted Snipe
195	Kashmir Black Redstart	*Phoenicurus ochruros phoenicuroides*	MUSCICAPIDAE: Flycatchers
196	Kashmir Grey Tit	*Oarus Major caschmirensis*	PARIDAE: Tits or Titmice
197	Kentish Plover	*Charadrius alexandrinus alexandrinus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
198	Laggar Falcon	*Falco biarmicus jugger*	FALCONIDAE: Falcons
199	Large Cormorant	*Phalacrocorax carbo sinensis*	PHALACROCORACIDAE:Cormrants
200	Large Grey Babbler	*Turdoides malcolmi*	MUSCICAPIDAE: Babblers
201	Large Indian Parakeet	*Psittacula eupatris nipalensis*	PSITTACIDAE: Parakeets
202	Largepied Wagtail	*Motacilla maderaspatensis*	MOTACILLIDAE: Wagtails
203	Lesser Adjutant	*Leptotilus javanicus*	CICONIIDAE: Storks
204	Lesser Black Backed Gull	*Larus fuscus fuscus*	LARIDAE: Gulls, Terns
205	Lesser Sand Plover	*Charadrius mongolus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
206	Lesser Spotted Eagle	*Aquila pomarina hastata*	ACCIPITRIDAE: Hawks, Vultures
207	Lesser Whistling Teal or Tree Duck	*Dendrocygna javanica*	ANATIDAE: Ducks, Geese

208	Little Cormorant	*Phalacrocorax niger*	PHALACROCORACIDAE:Cormrants
209	Little Egret	*Egretta garzetta garzetta*	ARDEIDAE: Egrets
210	Little Gull	*Larus minutus*	LARIDAE: Gulls, Terns
211	Little Stint	*Calidris minuta*	CHARADRIIDAE: Plover, Sandpipers, Snipe
212	Long Toed Stint	*Calidris subminuta*	CHARADRIIDAE: Plover, Sandpipers, Snipe
213	Longbilled Pipit	*Anthus similis*	MOTACILLIDAE: Pipits
214	Longlegged Buzzard	*Buteo rufinus rufinus*	ACCIPITRIDAE: Hawks, Vultures
215	Mallard	*Anas plathyrhynchos*	ANATIDAE: Ducks, Geese
216	Marsh Harrier	*Circus aeruginosus aeruginosus*	ACCIPITRIDAE: Hawks, Vultures
217	Marsh Sandpiper or Little Green Shank	*Tringa stagnatilis*	CHARADRIIDAE: Plover, Sandpipers, Snipe
218	Masked Wagtail	*Motacilla alba personata*	MOTACILLIDAE: Wagtails
219	Mew Gull	*Larus canus*	LARIDAE: Gulls, Terns
220	Montagu's Harrier	*Circus pygragus*	ACCIPITRIDAE: Hawks, Vultures
221	Moustached Warbler	*Acrocephalus melanopogon*	MUSCICAPIDAE: Flycatchers
222	Nakta or Comb Duck	*Sarkidiornis melanotos melanotos*	ANATIDAE: Ducks, Geese
223	Night Heron	*Nycticorex nycticorex nycticorex*	ARDEIDAE: Herons
224	North Asiatic Merlin	*Falco columbarius insignis*	FALCONIDAE: Falcons
225	North Indian Black Drongo or King Crow	*Dicrurus adsimillis albirictus*	DICRURIDAE: Drongos
226	North Indian Grey Partridges	*Francolinus pondicerianus interpositus*	PHASIANIDAE: Partridges
227	North Indian Scarlet Minivet	*Pericrocotus flammeus speciosus*	CAMPEPHAGIDAGE: Minivets
228	North Western Plain Wren-Warbler	*Prinia subflava terricolor*	MUSCICAPIDAE: Flycatchers
229	Northern Ashy Wren-Warbler	*Prinia Socialis Stewarti*	MUSCICAPIDAE: Flycatchers
230	Northern Blossomheaded Parakeet	*Psittacula cyanocephala bengalensis*	PSITTACIDAE: Parakeets
231	Northern Blue Throat	*Erithacus svecicus svecicus*	MUSCICAPIDAE: Flycatchers
232	Northern Brown Crowned Pygmy Wood Pecker	*Picoides nanus nanus*	PICIDAE: Woodpeckers
233	Northern Golden Backed Wood Peacker	*Dinopium benghalense benghalense*	PICIDAE: Woodpeckers
234	Northern Green Barbet	*Meganalima zeylanica caniceps*	CAPITONIDAE: Barbets
235	Northern Jungle Myna	*Acridotheres fuscus fuscus*	STURNIDAE: Mynas

236	Northern Mottled Wood Owl	*Strix ocellata grisescens*	STRIGIDAE: Owls
237	Northern Pied Bushchat	*Saxicola caprata bicolor*	MUSCICAPIDAE: Flycatchers
238	Northern Reseringed Parakeet	*Psittacula krameri borealis*	PSITTACIDAE: Parakeets
239	Northern Roller or Blue Jay	*Caracias benghalensis bengalensis*	CORACIIDAE: Roller
240	Northern Small Minivet	*Pericrocotus cinnamomeus peregrinus*	CAMPEPHAGIDAGE: Minivets
241	Northern Spotted Owl	*Athene brama indica*	STRIGIDAE: Owls
242	Northern Whitebrowned Fantail Flycatcher	*Rhipidura aureola aureola*	MUSCICAPIDAE: Flycatchers
243	Northren Gold Fronted Chloropsis or Leaf Bir	*Chloropsis aurifrons aurifrons*	IRENIDAE: Leaf brids
244	Northwestern Iora	*Aegithina tiphia septentrionalis*	IRENIDAE: Loras
245	Oriental Pratincole	*Glareola maltivarum*	BURHINIDAE: Stone curlew
246	Osprey	*Pandion haliaetus haliaetus*	ACCIPITRIDAE: Hawks, Vultures
247	Oystercatcher or Sea-Pie	*Haematopus ostralegus ostralegus*	HAEMATOPODIDAE: Oystercatcher
248	Pacific Golden Plover	*Pluvialis fulva*	CHARADRIIDAE: Plover, Sandpipers, Snipe
249	Painted Snipe	*Rostratula benghalensis benghalensis*	ROSTRATULIIDAE: Panted Snipe
250	Pale Harrier	*Circus macrourus*	ACCIPITRIDAE: Hawks, Vultures
251	Pariah Kite	*Milvus migrans govinda*	ACCIPITRIDAE: Hawks, Vultures
252	Peewit Lapwing or Green Plover	*Vanellus venellus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
253	Peninsular Chestnut Bellied Nuthatch	*Sitta castanea castanea*	SITTIDAE: Nuthatches
254	Persian Rock Pipit	*Anthus similis decaptus*	MOTACILLIDAE: Pipits
255	Pheasant Tailed Jacana	*Hydrophasianus chirurgus*	JACANIDAE: Pheasant
256	Pied Chat	*Oenanthe picata*	MUSCICAPIDAE: Flycatchers
257	Pied Crested Cuckoo	*Clamator jacobinus serratus*	CUCULIDAE: Cuckoos
258	Pied Harrier	*Circus melanoleucos*	ACCIPITRIDAE: Hawks, Vultures
259	Pintail	*Anas acuta*	ANATIDAE: Ducks, Geese
260	Plumbeous Redstart	*Rhyacornis fuliginosus fuliginosus*	MUSCICAPIDAE: Flycatchers
261	Punjab Collared Scops Owls	*Otus bakkamoena plumipes*	STRIGIDAE: Owls
262	Punjab Jungle Bush Quail	*Perdicula asiatica punjaubi*	PHASIANIDAE: Quails
263	Punjab Raven	*Corvus corax subcorax*	CORVIDAE: Crows
264	Punjab Redvented Bulbul	*Pycnonotus cafer intermedius*	PYCNONOTIDAE: Bulbuls

265	Rajasthan Redwhiskered Bulbul	*Pycnonotus jocosus abuensis*	PYCNONOTIDAE: Bulbuls
266	Red Breasted Flycatcher	*Ficedula parva*	MUSCICAPIDAE: Flycatchers
267	Red Munia or Avadavat	*Estrilda amandava amandava*	PLOCEIDAE: Sparrows and Weaverbirds
268	Red Throated Pipit	*Anthus cervinus*	MOTACILLIDAE: Pipits
269	Red Throated Thrush	*Turdus ruficollis ruficollis*	MUSCICAPIDAE: Flycatchers
270	Redcrested Pochard	*Netta rufina*	ANATIDAE: Ducks, Geese
271	Redheaded Bunting	*Emberiza bruniceps*	EMBERIZIDAE: Buntings
272	Redheaded Merlin	*Falco chicquera chicquera*	FALCONIDAE: Falcons
273	Redwattled Lapwing	*Vanellus indicus indicus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
274	Redwinged Bush Lark	*Mirafra etythroptera*	ALAUDIDAE: Larks
275	Richard's Pipit	*Anthus richardi*	MOTACILLIDAE: Pipits
276	Ring Tailed or Pallas Fishing Eagle	*Haliaeetus leucoryphus*	ACCIPITRIDAE: Hawks, Vultures
277	River Chat or White Capped Red Start	*Chaimarrornis leucocephalus*	MUSCICAPIDAE: Flycatchers
278	Rofous Vented Prina	*Prinia burnesii*	MUSCICAPIDAE: Flycatchers
279	Rosy Starling or Rosy Pastor	*Sturnus roseus*	STURNIDAE: Mynas
280	Ruddy Crake	*Porzana fusca fusca*	RALLIDAE: Rails, Coots
281	Ruff & Reeve	*Philomachus pugnax*	CHARADRIIDAE: Plover, Sandpipers, Snipe
282	Rufous Tailed Shrike	*Lanius isabellinus*	LANIIDAE: Shrikes or Butcherbirds
283	Rufous Winged Bushlark	*Mirafra assimica*	ALAUDIDAE: Larks
284	Rufousbacked Shrike	*Lanius schach erythronotus*	LANIIDAE: Shrikes or Butcherbirds
285	Rufous-Fronted Prinia	*Prinia buchanani*	MUSCICAPIDAE: Flycatchers
286	Rurkestan Small Skylark	*Alauda Gulgula inconspicua*	ALAUDIDAE: Larks
287	Sandwitch Tern	*Strena sandviridis*	LARIDAE: Gulls, Terns
288	Scaly Thrush	*Zoothera dauma*	MUSCICAPIDAE: Flycatchers
289	Scaup Duck	*Aythya marila marila*	ANATIDAE: Ducks, Geese
290	Seberian Collared Sand Martin	*Riparia aparia diluta*	HIRUNDINIDAE: Martins
291	Shoveller	*Anas clypeata*	ANATIDAE: Ducks, Geese
292	Siberian Honey Buzzard	*Pernis ptilorhyncus orientalis*	ACCIPITRIDAE: Hawks, Vultures
293	Siberian Tree Pipit	*Anthus hodgsoni yunnanensis*	MOTACILLIDAE: Pipits
294	Sind Golden Backed Wood Pecker	*Dinopium benghalense dilutum*	PICIDAE: Woodpeckers
295	Sind Jungle Babbler	*Turdoides striatus sindianus*	MUSCICAPIDAE: Babblers

296	Sind Redwinged Bush Lark	*Mirafra etythroptera sindiana*	ALAUDIDAE: Larks
297	Sind Wood Shrike	*Tephrodornis pondicerianus pallidus*	CAMPEPHAGIDAE: Shrikes
298	Sind Yellow-Bellied Wren Warbler	*Prinia flaviventris sindiana*	MUSCICAPIDAE: Flycatchers
299	Sindh Jungle Sparrow	*Passer pyrrhonotus*	PLOCEIDAE: Sparrows
300	Singing Bush Lark	*Miragra Javiniaca cantillans*	ALAUDIDAE: Larks
301	Slaty Headed Babbler	*Pomatorhinus schisticeps horsfieldii*	MUSCICAPIDAE: Babblers
302	Slaty-Blue Flycatcher	*Ficedula tricolor*	MUSCICAPIDAE: Flycatchers
303	Slender Billed Gull	*Larus genei*	LARIDAE: Gulls, Terns
304	Small Indian Pranticole or Swallow Plover	*Glareola lactea*	GLAREOLIDAE: Pratincoles
305	Smew	*Mergus albellus*	ANATIDAE: Ducks, Geese
306	Spanish Sparrow	*Passer hispaniolensis transcaspicus*	PLOCEIDAE: Sparrows
307	Spoonbill	*Platalea leucorodia major*	THRESKIORNITHIDAE: Spoonbill
308	Spotbill Duck	*Anas poecilorhyncha poecilorhyncha*	ANATIDAE: Ducks, Geese
309	Spotted Crake	*Porzana porzana*	RALLIDAE: Rails, Coots
310	Spotted or Dusky Red Shank	*Tringa erythropus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
311	Steppe Eagle	*Aquila nipalensis*	ACCIPITRIDAE: Hawks, Vultures
312	Striated Grassbird	*Megalurus palustris*	MUSCICAPIDAE: Flycatchers
313	Striated Marsh Warbler	*Megalurus palustris toklao*	MUSCICAPIDAE: Flycatchers
314	Striolated Bunting	*Emberiza striolata striolata*	EMBERIZIDAE: Buntings
315	Sulphar Bellied Warbler	*Phylloscopus griseolus*	MUSCICAPIDAE: Flycatchers
316	Sykes's Nightjar	*Caprimulgus mahrattensis*	CAPRIMULGIDAE: Nightjar
317	Tawny Eagle	*Aquila rapax vindhiana*	ACCIPITRIDAE: Hawks, Vultures
318	Tawny Pipit	*Anthus campestris campestris*	MOTACILLIDAE: Pipits
319	Temminck's Stint	*Calidris temminckii*	CHARADRIIDAE: Plover, Sandpipers, Snipe
320	Terek Sandpiper	*Xenus cinereus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
321	Tibetan Black Bird	*Turdus merula maximus*	MUSCICAPIDAE: Flycatchers
322	Tufted Duck	*Aythya fuligula*	ANATIDAE: Ducks, Geese
323	Turkestan Blackhead Wagtail	*Motacilla flava melanogrisea*	MOTACILLIDAE: Wagtails
324	Ultramarine Flycatcher	*Ficedula superciliaris*	MUSCICAPIDAE:

			Flycatchers
325	Upland Pipit	*Anthus sylvanus*	MOTACILLIDAE: Pipits
326	Vinaceousbreasted Pipit or Rosy Pipit	*Anthus roseatus*	MOTACILLIDAE: Pipits
327	Wall Creeper	*Tichodroma muraria nepalensis*	SITTIDAE: Creeper
328	West Himalayan Longtailed Minivet	*Pericrocotus ethologus favillaceus*	CAMPEPHAGIDAGE: Minivets
329	West Himalayan Rusty Chheked Scimitar Babbler	*Pomatorhinus erythrogenys erythrogenys*	MUSCICAPIDAE: Babblers
330	West Himalayan Tree Creeper	*Certhia himalayana limes*	SITTIDAE: Creeper
331	West Siberian Collared Bushchat or Stone Chat	*Saxicola torquata maura*	MUSCICAPIDAE: Flycatchers
332	Western Crowned Warbler	*Phylloscopus occipitalis*	MUSCICAPIDAE: Flycatchers
333	Western Sirkeer Cuckoo	*Taccucula leschenaultii sirkee*	CUCULIDAE: Cuckoos
334	Western Spotted Babbler	*Pellorneum ruficeps punctatum*	MUSCICAPIDAE: Babblers
335	Western Striated Babbler	*Turdoides earlei earlei*	MUSCICAPIDAE: Babblers
336	Western Swallow	*Hirundo rustica rustica*	HIRUNDINIDAE: Martins
337	Western Tree Pie	*Dendrocitta vagabunda pallida*	CORVIDAE: Crows
338	Western Turtle- Dove	*Streptopelia orientalis meena*	COLUMBIDAE: Doves
339	Western Yellow Eyed Babbler	*Chrysomma Sinense hypoleucum*	MUSCICAPIDAE: Babblers
340	Westren Grey Headed Flycatcher	*Seicercus xznthoschistos albosuperciliaris*	MUSCICAPIDAE: Flycatchers
341	Wheat Ear	*Oenanthe oenanthe*	MUSCICAPIDAE: Flycatchers
342	White Breasted Kingfisher	*Halcyon smyrnensis smyrnensis*	ALCEDINIDAE: Kingfisher
343	White Capped Bunting	*Emberiza stewarti*	EMBERIZIDAE: Buntings
344	White Cheeked Bulbul	*Pycnonotus leucogenys leucogenys*	PYCNONOTIDAE: Bulbuls
345	White Crowned Penduline Tit	*Remiz coronatus*	PARIDAE: Tits or Titmice
346	White Faced Wagtail	*Motacilla alba leucopsis*	MOTACILLIDAE: Wagtails
347	White Headed Stiff Tailed Duck	*Oxyura leucocephaia*	ANATIDAE: Ducks, Geese
348	White Ibis	*Threskiornis aethiopica melancephala*	THRESKIORNITHIDAE: Ibises
349	White Necked Stork	*Ciconia episcopus epicopus*	CICONIIDAE: Storks
350	White Stork	*Ciconia ciconia ciconia*	CICONIIDAE: Storks
351	White Tailed Lapwing	*Vanellus leucurus*	CHARADRIIDAE: Plover, Sandpipers, Snipe
352	White Tailed Stone Chat	*Saxicola leucura*	MUSCICAPIDAE: Flycatchers
353	White Throated Munia	*Lonchura melabarica malabarica*	PLOCEIDAE: Sparrows and Weaverbirds

354	White Winged Black Tern	*Chlidonias leucopterus*	LARIDAE: Gulls, Terns
355	Whitebellied Minivet	*Pericrocotus erythropygius erythropygius*	CAMPEPHAGIDAGE: Minivets
356	White-Eyed Buzzard Eagle	*Butastur teesa*	ACCIPITRIDAE: Hawks, Vultures
357	White-Eyed Pochard or Ferruginus Duck	*Aythya nyroca*	ANATIDAE: Ducks, Geese
358	Wigeon	*Anas penelope*	ANATIDAE: Ducks, Geese
359	Wood or Spotted Sandpiper	*Tringa glareola*	CHARADRIIDAE: Plover, Sandpipers, Snipe
350	Xinjang Ground Jay	*Podoces biddulphi*	CORACIIDAE: Roller
361	Yellow Bittern	*Ixobrychus sinensis*	ARDEIDAE: Bittern
362	Yellow Eye Pigeon	*Columba eversmanni*	COLUMBIDAE: Pigeons
363	Yellow Fronted Pied or Mahratta Wood Pecker	*Picoides mahrattensis mahrattensis*	PICIDAE: Woodpeckers
364	Yellow Legged Herring	*Larus cachinnans*	LARIDAE: Gulls, Terns
365	Yellow Throated Sparrow	*Petronia xanthocollis xanthocollis*	PLOCEIDAE: Sparrows
366	Yellow Wattled Lapwing	*Vanellus malabaricus*	CHARADRIIDAE: Plover, Sandpipers, Snipe

List of vulnerable species found in harike:

S. No.	Common Name	Scientific Name
1	Ferruginous Duck	*Aythya nyroca*
2	Palla's Fish Eagle	*Haliaetus leucoryphus*
3	Greater Spotted Eagle	*Aquila clanga*
4	Imperial Eagle	*Aquila heliaca*
5	Black bellied Tern	*Sterna acuticauda*
6	Indian Skimmer	*Rynchops albicollis*
7	Pale backed pigeon	*Columba eversmanii*
8	Rufous vented prinia	*Prinia burnesii*
9	Syke's Nightjar	*Caprimulgus mahrattensis sykes*

Detail of bird censuscoducted in wildlife range harike

Year	Bird Count	Year	Bird Count
2013	72488 (Migratory birds Census)	2018	94771
2014	62065	2019	123128
2015	82100	2020	91025
2016	105890	2021	74869
2017	93488		

Flora of Harike wetland

Aquatic vegetation

i. **Aquatic macrophytes**

Cyanophyceae		*Baccillariophyceae*	
1	*Anabaena sp.*	1	*Amphora sp.*
2	*Nostoc sp.*	2	*Bascillaria sp.*
3	*Oscillatoria sp.*	3	*Cymbella sp.*
4	*Spirulina sp.*	4	*Denticula sp.*
Chlorophyceae		5	*Fragilaria sp.*
1	*Characium sp.*	6	*Gomphonema sp.*
2	*Cladophora*	7	*Melosira sp.*
3	*Pediastrum sp.*	8	*Navicula sp.*
4	*Phosphidium sp.*	9	*Nitzschia sp.*
5	*Spirogyra*	10	*Pinnularia sp.*
6	*Tetradon sp.*	11	*Pleurosigma sp.*
7	*Ulothrix sp.*	12	*Synedra sp.*

Euglenophyceae	
1	*Euglena sp.*
2	*Volvox sp.*

ii.Aquatic Macrophytes			
1	*Alisma sp.*	22	*Paspalum paspaloides*
2	*Azolla sp.*	23	*P. pectinatis*
3	*Ceratophyllum sp*	24	*Phragmites karka*
4	*Chara sp*	25	*Pistia sp.*
5	*Cynodon dactylon*	26	*Polygonum lanigerum*
6	*Cyperus pangori*	27	*Polygonum recumbens*
7	*Demostachya bipinnata*	28	*potamogeton crispus*
8	*Eichhornia crassipes*	29	*Saccharum benghalense*
9	*Eleocharis sp.*	30	*Saccharum spontaneum*
10	*Hydrilla verticillata*	31	*Sagittaria sagittifolia*
11	*lpomea aquatica*	32	*Salvinia natans*
12	*Ipomoea carnea*	33	*Scirpus sp*
13	*Ipomoea crassicaulis*	34	*Setaria verticillata*
14	*Ipomoea fistulosa*	35	*Spirodella sp.*
15	*Juncus sp.*	36	*Tamarix dioca*
16	*Lemna perpusilla*	37	*Typha angustata*
17	*Malvastrum coromandelinum*	38	*Typha elephantina*
18	*Myriophyllum spicatum*	39	*Vallisnaria spiralis*
19	*Najas minor*	40	*Vitivera sp.*
20	*Nelumbo nucifera*	41	*Wolffia sp.*
21	*Nymphaea sp.*		

TREES:

Sl.no	Scientific name	Common Name	Family
1	*Acacia catechu*	Khair	Leguminosae
2	*Aegle mermelos*	Bel	Rutaceae
3	*Albizia lebbeck*	Kala Siris	Leguminosae
4	*Albizia procera*	Chitta siris	Leguminosae
5	*Azadirachta indica*	Neem	Meliaceae
6	*Bauhinia variegata*	Kachnar	Leguminosae
7	*Bombax ceiba*	Simbal	Bombacaceae
8	*Callistemon lanceolatus*	Bottle brush	Myrtaceae
9	*Cassia fistula*	Amaltas	Leguminosae
10	*Cassia siamea*	Cassia	Leguminosae
11	*Dalbergia sisoo*	Shisham	Leguminosae
12	*Delonix regia*	Gulmohar	Leguminosae
13	*Eucalyptus spp*	Safeda	Myrtaceae
14	*Ficus bengalensis*	Bohr	Urticaceae
15	*Ficus religiosa*	Pipal	Urticaceae
16	*Leucaena leucocephala*	Subabul	Leguminosae
17	*Mangifera indica*	Amb	Anacardiaceae
18	*Melia azadirachta*	Drek, Bakain	Meliaceae
19	*Morus alba*	Toot	Urticaceae
20	*Phoenix sylvestris*	Khajoor	Palmae
21	*Polulus deltoides*	Poplar	Salicaceae
22	*Pongamia pinnata*	Sukchain	
23	*Prosopis cineraria*	Jand, khejri	Leguminosae
24	*Prosopis juliflora*	Mesquite	Leguminosae
25	*Salix alba*	Willow	Salicaceae
26	*Syzigium cumini*	Jamun	Myrtaceae
27	*Tectona grandis*	Sagwan/teak	Verbenaceae
28	*Terminalia arjuna*	Arjun	Combretaceae
29	*Terminalia bellerica*	Bahera	Combretaceae
30	*Toona ciliata*	Toon	Meliaceae
31	*Zizyphus mauritiana*	Ber	Rhamnaceae

SHRUBS:

Sl.no	Scientific name	Common Name	Family
1	*Achyranthus aspera*	Puthkanda	Amaranthaceae
2	*Adhatoda vasica*	Basuti	Acanthaceae
3	*Calotropis procerea*	Ak	Asclepediaceae
4	*Cannabis sativa*	Bhang	Urticaceae
5	*Capparis aphylla*	Karir	Capparidaceae
6	*Capparis sepiaria*	Hins	Capparidaceae
7	*Carissa caranda*	Karaunda	Apocynaceae
8	*Chenopodium album*	Bathu	Chenopodiaceae

9	*Clerodendrium nultiflorum*	Clerodendron	Verbenaceae
10	*Diospyros fordiflora*	Tondu	Verbenaceae
11	*Flocourtia indica*	Kangu	Bixaceae
12	*Ipomoea fistulosa*	Ipomoea	Convolvulaceae
13	*Lantana camara*	Panchphuli, Lantana	Verbenaceae
14	*Murraya koengii*	Gandhela	Rutaceae
15	*Nerium odorium*	Kaner	Apocynaceae
16	*Tamarix dioica*	Lal Jhau,Farash	Tamaricaceae
17	*Tinospora malabarica*	Giloe	Menispermaceae
18	*Xanthium strumarium*	Jindoo	Compositae
19	*Ziziphus numularis*	Mallah	Rhamnaceae

HERBS

Sl.no	Scientific name	Common Name	Family
1	*Ageratum conyzoides*	Goat weed	Compositae
2	*Amaranthus viridis*	Wild weed	Amaranthaceae
3	*Arundinaria falcata*	Nara	Poaceae
4	*Cenchrus ciliaris*	Anjan	Poaceae
5	*Convolvulus arvensis*	Morning glory	Convolvulaceae
6	*Cynodon dactylon*	Khabbal	Poaceae
7	*Cyperus rotundus*	Nut grass	Cyperaceae
8	*Dendrocalamus strictus*	Bamboo	Poaceae
9	*Desmastachya bipinnata*	Dib	Poaceae
10	*Dichanthium annulatum*	Palwan	Poaceae
11	*Erianthus munja*	Munji	Poaceae
12	*Euloliopsis piñata*	Bhabbar	Poaceae
13	*Heteropogon contortis*	Sariala	Poaceae
14	*Parthenium hysterophorus*	Congress grass	Compositae
15	*Phragmites maxima*	Nari	Poaceae
16	*Saccharum spontaneum*	Kahi	Poaceae
17	*Themeda ananthera*	Lunji	Poaceae
18	*Typha elephantiana*	Bater	Poaceae
19	*Vetireria zizanoides*	Vetivera	Poaceae

Major industries polluting the sanctuary

Major industries discharging effluents into the river sutlej

S. No.	Name of Industry	S. No.	Name of Industry
1	National Fertilizer Ltd. Nayan Nangal	5	M/s Swaraj Mazda, Asron
2	P.N.F.C., Naya Nangal	6	M/s United Pulp and Paper Mills, Asron
3	Punjab Alkalies, Naya Nangal	7	M/s Zenith Paper Mills, Bannah
4	Ropar Thermal Plant, Ropar	8	Entire industry in Ludhiana through Budha Nullah

Major industries discharging effluents into the river beas

S. No.	Name of Industry
1	Mukerian Paper Mills, Mukerian
2	Goindwal Induatrial Complex, Goindwal

Major towns polluting the sanctuary

Towns discharging sewage into the river Sutlej

S.No.	Town	Population	Waste-water (mld)	Through Tributary/ river
1	Ludhiana	1050000	148.00	Budha Nullah/Sutlej
2	Jalandhar	550000	68.00	East Bein/Sutlej
3	Moga	129000	14.00	Moga Dr. Sutlej
4	Hoshiarpur	112000	12.00	East Bein/Sutlej
5	Kapurthala	80000	9.00	West Bein/Sutlej
6	Anandpur Sahib	12400	1.10	Sutlej
7	Ferozepur	76000	8.00	Sutlej
8	Nangal Township	13000	1.20	Sutlej
9	Naya Nangal	148000	2.20	Sutlej
10	Phagwara	107000	12.00	East Bein/Sutlej
11	Phillaur	22800	2.10	Sutlej
12	Ropar	36500	3.30	Sutlej
13	Nawan-shahr	29796	1.47	East Bein/Sutlej
14	Sultanpur Lodhi	13580	1.43	West Bein/Sutlej

Towns discharging sewage into the river Beas

S. No.	Town	Waste-water Generation (mld)
1	Pathankot	18.73
2	Mukerian	0.06
3	Talwara	2.10
4	Tanda	2.08
5	Dasuya	2.28
6	Beas	2.51
7	Harike	1.50

Villages within 10 kms of the sanctuary

Sr. No.	Name of Village	Total Population			Number of cattle		
		Male	Female	Children	Cow	Buffalo	Goat
	FEROZEPUR						
1	Dibwala	132	143	32	50	80	20

2	Ruknewala	192	195	54	45	145	30
3	Rasulpur	823	691	185	70	225	70
4	Jhamke	297	275	78	50	150	40
5	Chakkian	543	507	147	50	250	30
6	Boola	398	324	84	20	75	25
7	Bahar Wali	143	114	28	25	100	20
8	Famiwala	325	295	140	70	225	50
9	Amiwala	250	215	52	40	115	30
10	Amir Shahwala	351	329	100	40	120	30
11	Joge wala	1072	1007	274	80	330	50
12	Changian	62	52	8	15	65	-
13	Churian	128	107	22	30	125	10
14	Padhri	445	383	95	35	165	20
15	Tibbi Araian	187	174	38	45	190	20
16	Jage Wala	128	116	28	20	95	-
17	Gatti Harike	144	98	23	50	190	50
18	Mauj Garh	171	150	26	20	75	20
19	Silewind	258	276	75	40	110	50
20	Sarafali Khan	244	224	58	30	80	25
21	Qutabpura	277	238	80	40	200	40
22	Khialiwala	11	15	0	10	120	20
23	Sudhian	99	85	28	10	70	20
24	Talwandi Nepala	1460	1285	369	100	250	150
25	Makhu Colony	125	115	60	15	60	25
	KAPURTHALA						
26	Barowana	357	315	105	20	150	20
27	Sekh Manga	425	377	107	50	200	50
28	Sarupwal	342	313	67	12	150	10
29	Mir Pur	27	21	4	12	40	-
30	Sherpur	305	292	52	25	170	40
31	Sehwala Indresa	432	415	91	22	203	30
32	Ali Khan	919	779	267	28	298	35
33	Ali Khurd	226	186	53	18	73	10
34	Husainpur Bulle	170	156	45	10	95	10
35	Kabirpur	479	461	125	40	212	20
36	Watanwali	460	496	96	-	67	-
37	BhagoBuda	271	209	48	10	63	-
38	Hazara	24	18	5	18	60	-
39	Tibbi	42	36	8	12	70	-
40	Mand Inderpur	78	81	26	15	40	-
41	Ramgarh Dulali	18	18	7	4	25	-
42	Tikian	252	244	62	7	90	15
43	Gamu Chugla	20	15	13	-	35	-
44	Chanah windi	360	339	63	25	243	20
45	Wattanwali Khurd	125	1 20	62	12	79	10
46	Wattanwali Kalan	460	496	96	20	192	10
47	Green	92	83	52	8	70	15

48	Shahwala Niki	32	28	9	5	33	-
49	Mand Anrisa	11	12	6	3	10	-
50	Suchetgarh	241	248	35	20	80	8
51	Gamawal	31	28	12	15	45	-
52	Mandiwala	11	8	4	-	14	-
53	Jamey Wal	25	22	11	10	20	-
	TARN-TARAN						
54	Harike	4666	3996	1136	500	2550	200
55	Alipur	636	544	153	90	260	50
56	Kot Data	629	538	134	70	270	50
57	Kirian	770	708	198	60	230	20
58	Kambo	377	353	80	100	380	15
59	Karmuwala	600	550	1350	120	480	60
60	Kirtowal	2069	1846	459	260	700	65
61	Gandiwind	2391	2153	555	190	730	35
62	Chamba Kalan	1551	1447	373	220	530	50
63	Jauneke	655	619	186	40	120	40
64	Jinda wala	173	168	39	30	85	15
65	Thathian Khurd	612	587	141	45	150	22
66	Thata	887	840	230	180	760	60
67	Dhun	1192	1042	285	180	700	25
68	Tung	601	522	153	55	220	40
69	Dargahi Wala	250	225	525	45	200	28
70	Dhattal	328	289	61	35	195	18
71	Nathupur	749	693	198	100	450	75
72	Kuttiwala	296	260	63	70	300	24
73	Burj Deva Singh	451	388	71	80	270	35
74	Burj Pulah	550	450	135	90	300	28
75	Booh	1586	1478	380	180	800	50
76	Marhana	1854	1627	401	240	850	115
77	Marrar	108	83	13	20	70	5
78	Ruriwala	1433	1286	303	90	430	35
79	Ratta guda	1115	965	234	170	750	45
80	Chohla Sahib	6097	5464	1334	470	3000	200
81	Khara	1252	1105	266	170	600	75
82	Nabipur	556	473	120	55	300	36

List of check post in harike wildlife sanctuary

S. No.	Name of Check Post	Location
1	Head Works	Near Harike Head Works
2	Kirian	Village Kirian
3	Makhu	On R.D. 22 LMB
4	Bhootiwala	On Dhussi Bundh Near vill. Bhootwal
5	Bharowana	Village. Bharowana
6	Bengali wala	Near Bengaliwala Bridge

List of equipments

No.	Name of Equipment	Number	Remarks
1	**2**	**3**	**4**
1	Conveyor belt	6	For removing water hyacinth(Not working)
2	Motor boat	2	For patrolling(Working)
3	Motor Boat Engine	7	For patrolling (Not Working)
3	Binoculars	4	For bird watching (Working)
4	TV VCR	1	For publicity(Not Working)
5	Projector	1	For showing films on wildlife (Working)
6	Booms & Rankers	6	Collection of water hyacinth(Not Working)

List of vehicle

Sr. No	Vehicle Name	Vehicle No.	Engine Type	Status
1.	Mahindra Camper	PB05-Y-5186	Diesel	Working
2.	Swaraj Mazda	CH01 B-1013	Diesel	Not in Working Condition
3.	Swaraj Tractor 855	PJD-6128	Diesel	-do-
4.	Tata Mobile-207	CH-01-0462	Diesel	-do-
5.	Bullet Motorcycle	PJD-7414	Petrol	-do-
6.	Trolley	-	-	-do-

Details of watchtowers

S. No.	Location	Name of nearest F.R.H./Chauki/ Range/ Headquarters /Road	Height	Kind of Construction	Condition	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**
1	Head works	Harike Head Works	20'	Steel	Good	Used for bird watching, fire detection etc
2	Left Marginal Bandh	Near Gurudwara	20'	Steel	Good	-do-
3	Left Marginal Bandh	Vill. Churian	20'	Steel	Good	-do-
4	Makhu Checkpost	Makhu beat	20'	Steel	Good	-do-
5	Bhootiwala	Makhu Beat	30'	Iron	Good	-do-
6	Churian	Makhu Beat	30'	Iron	Good	Eco-Tourism

Details of wireless stations

No.	Location	Fixed	Mobile	Walkie Talkie	Total	Remarks
1	Office Complex Harike	1	1	4	6	Not in Working Condition
2	Bharoana	1	-	2	3	Not in Working Condition

Details of manned and unmanned barriers

Range	No.	Location	Remarks
1	**2**	**3**	**4**
Ferozepur	5	Harike	Manned
		interptation center	Manned
		Makhu	Manned
		Bhootiwal	Manned
		bangali wala pull	unmanned
Kapurthala	1	Bharoana	Manned

Details of encroahment

Sr. No.	District	Area (in ha.)	Remarks
1.	Tarn Taran	59.69Hac	Being proceeded against under Wildlife (Protection) Act, 1972
2.	Ferozepur	37.71Hac	-Do-
3.	Kapurthala	209 Hac	-Do-

Detail of eco-tourism development project in harike wetland

Sr.No	Component
A.	**RMB (Right Marginal Bandh)**
1.	Interpretation Center
2.	Special Space
3.	Cafeteria
4.	Kitchen
5.	Toilet (Male,Female,Handicap)
6.	Drinking Area
7.	Landscape Area
B.	**Nose Point**
1.	Car Parking
2.	Ticket Counter
3.	Boating Jetty
4.	Landscape Area
5.	Observation Deck (with watch tower)
C	**LMB (Left Marginal Bandh)**
1.	Toilet A(Male,Female& Handicap) Entry Point)
a.	Car Parking
2.	Toilet B (male,female &Handicap) Exit Point)
b.	Car parking
3.	FD Post (Entry)
a	E-rickshaw parking
4.	FD Post (Exit)
5.	Watch Tower 3 Nos.
6.	Resting Spot 5 Nos.
7.	Jetty Point near FD Post Entry point
8.	Viewing Deck
9.	Paver Road:- Gurudwara Sahib to FD Post(Entry)
10	Board Walk Excluded from the scope
D	**Modes of Transporation**
1	Battery operated vehicles 4 Nos.
2	Pedal Boats 2 seater 24 Nos.
3.	Pedal Boats 4 seater 24 Nos.

Detail of crime data in wildlife range harike

Year	Sr.No	Crime Data	Tools Used	No.of Accused	Species Common Name	DR.No	Section of WPA 1972
2009-10	1	21-01-2010	-	5	Fish	03	9,27,28,29,39
2009-10	2.	15-03-2010	-	2	Fish	348002	9,27,28,29,39,63,64
2009-10	3.	15-03-2010	-	2	Fish	04	9,27,28,29,39
2009-10	4.	25-03-2010	-	1	Turtle	345603	9,27,28,29,39,50,51
2010-11	1.	14-09-2010	Net, Motorcycle No. PB47-C-9580	1	Fish	348003	27,28,29,39
2010-11	2.	26-09-2010	-	3	Turtle	345604	27,28,29,39,51
2010-11	3.	07-11-2010	-	3	Fish	05	27,28,29,39,63,64
2010-11	4.	25-11-2010	-	-	Fish	345207	27,28,29,39,50,51,63,64
2010-11	5.	10-12-2010	-	1	Fish	09	27,28,29,39,50,51
2010-11	6.	04-12-2010	-	2	Fish	06	27,28,29,39,50,5,1,63,64
2010-11	7.	20-12-2010	-	1	Murgabi	345209	27,28,29,39,50,51,55
2010-11	8.	21-12-2010	Boat,Net	3	Fish	347203	27,28,29,39,50,51
2010-11	8.	30-12-2010	-	1	Fish	10	27,28,29,39,50,51
2010-11	9.	11-01-2011	Boat,Net,Peddle	1	Fish	08	9,27,28,29,39,63,64
2010-11	10.	14-01-2011	Dead Murgabi	1	Murgabi	345210	27,28,29,39,50,51
2010-11	11.	16-01-2011	Boat,Peddle,Dead Fish	2	Fish	348005	27,28,29,39,50,63,64
2011-12	1.	29-07-2011	Boat,Net	2	Fish	345212	27,28,29,39,50,51
2011-12	2.	30-07-2011	Boat,Peddle	2	Fish	345213	2728,29,39,50,51
2011-12	3.	21-09-2011	Boat,Net,Peddle	2	Fish	348006	27,28,29,39,50,51
2011-12	4.	12-10-2011	Boat,Net,Peddle	1	Fish	11	27,28,29,39,50,51,63,64
2011-12	5.	07-11-2011	Boat,Net,Peddle	1	Fish	348007	27,28,29,39,50,51
2011-12	6.	04-12-2011	Boat,Net,Peddle	3	Fish	10	27,28,29,39,50,51
2011-12	7.	04-12-2011	Boat,Net,Peddle	1	Fish	11	27,28,29,39,50,51,63,64

2011-12	8.	11-12-2011	-	1	Murgabi	345214	9,27,28,29,50,51,63,64
2011-12	9.	13-02-2012	Dead Murgabi	2	Murgabi	345215	9,27,28,29,50,51
2011-12	10.	05-03-2012	Boat,Net,peddle	3	Fish	14	27,28,29,39,50,51,63,64
2012-13	1.	15-05-2012	Boat,Net,Peddle	2	Fish	15	27,28,29,39,50,51
2012-13	2.	17-05-2012	Boat,Net,Peddle	2	Fish	347207	27,28,29,39,50,51
2012-13	3.	13-08-2012	Blero PB05E9875,Net,Peddle	1	Fish	347208	27,28,29,39,50,51
2012-13	4.	14-08-2012	Boat,Net,Peddle,Dead Fish	2	Fish	345012	27,28,29,39,50,51
2012-13	5.	25-09-2012	Boat,Peddle	1	Fish	347209	27,28,29,39,50,51
2012-13	6.	26-10-2012	-	2	Fish	345014	27,28,29,39,50,51
2012-13	7.	10-11-2012	Dead Murgabi	2	Murgabi	17	9,27,28,29,39,51
2012-13	8.	27-11-2012	Dead Murgabi	1	Murgabi	19	9,27,28,29,39,50,51
2012-13	9.	04-12-2012	Boat,Net,Peddle	4	Fish	13	27,28,39,50,51
2012-13	10.	26-12-2012	Boat,Net,Peddle	1	Fish	13	27,28,29,39,51
2012-13	11.	10-02-2013	Boat,Net,Peddle	5	Fish	348008	27,28,29,39,51
2012-13	12.	11-02-2013	Boat,Net,Peddle	2	Fish	348008	27,28,29,39,51
2013-14	1.	04-05-2013	Net	4	Fish	345216	27,28,29,39,51
2013-14	2.	16-10-2013	Boat,Net,Peddle	1	Fish	345018	27,28,29,39,51
2013-14	3.	19-10-2013	Boat,Net,Peddle	3	Fish	345019	9,27,28,29,51
2013-14	4.	25-10-2013	-	2	Wild Boar	345020	9,27,28,29,51
2013-14	5.	17-12-2013	Motorcycle	5	Cat,Murgabi	345219	9,27,28,29,39,51
2013-14	6.	04-01-2014	Boat,Net	2	Fish	345021	27,28,29,39,51
2013-14	7.	08-02-2014	-	1	Fish	345220	27,28,29,51
2014-15	1.	17-06-2014	Net	3	Fish	345614	27,28,29,39,51
2014-15	2.	23-07-2014	Boat,Net,Peddle	2	Fish	21	27,28,29,39,51
2014-15	3.	31-07-2014	Boat,Net,Motorcycle AEE9CQ 2986	1	Fish	22	27,28,29,39,51
2014-15	4.	13-08-2014	Boat,Net,Dead Fish	1	Fish	15	27,28,29,39,51
2014-15	5.	09-09-2014	Tractor,Troli,Wire	4	Wild Boar	345022	9,27,28,29,31,39,51
2014-15	6.	23-09-2014	Net	1	Fish	16	27,28,29,39,51

2014-15	7.	20-12-2014	Boat,Peddle,Net	3	Fish	18	27,28,29,39,50,51
2015-16	1.	16-06-2015	Net	2	Fish	348012	
2015-16	2.	30-08-2015	Boat,Peddle,Net	2	Fish	348013	9,27,28,29,39,51
2015-16	3.	14-09-2015	Boat,Peddle,Net	2	Fish	348014	9,27,28,29,39,51
2015-16	4.	29-09-2015	Motorcycle,Dead Wild Boar	3	Wild Boar	345025	9,27,28,29,39,50,51
2015-16	5.	29-09-2015	Motorcycle , Dead Wild Boar	3	Wild Boar	345025	9,27,28,50,51
2015-16	6.	09-03-2016	Dead Murgabi	3	Murgabi	345225	9,27,28,29,39,51
2016-17	1.	14-09-2016	Boat,Net	7	Fish	345226	27,28,29,39,51
2017-18	1.	04-02-2018	Boat,Peddle,Net	2	Fish	345028	27,28,29,39,51
2017-18	2.	20-02-2018	Boat,Peddle,Net	2	Fish	23	27,28,29,39,51
2018-19	1.	18-05-2018	-	Chadda Sugar Mill	Many Dead Fish	345405	29,32,51,58
2018-19	2.	09-12-2018	Dead Murgabi	3	Murgabi	345030	2,27,28,29,39,50,51
2018-19	3.	25-02-2019	Motorcycle No. PB05AD0694, Inverter, Bettra	3	-	345230	2,27,28,29,39,50,51
2019-20	1.	28-02-2019	Iron Weapon,Motorcycle	2	Nilgai	25	9,27,28,29,39,50,51
2019-20	2.	13-09-2019	Dead Fish	2	Fish	345407	-
2019-20	3.	17-11-2019	Dead Wild Boar	2	Wild Boar	345408	2,9,27,31,39,50,51

Arms & ammunition holders under10 km of HWS

Name and address of Arms& Ammunition holders which comes under10 Km around the Harike Sanctuary area

Sr. No	Village	Name	Father's name	Arms No.	Type of arm	Tehsil
1	**Dibwala**	Karnail Singh	Khushal Singh	30PS	DBBL	Zira
2	"	Raghbir Singh	Kashmir Singh	299/93	DBBL	Zira
3	"	Gurmit Singh	Gurbaksh Singh	6178/DM	DBBL	Zira
4	"	Saroop Singh	Piara Singh	453/99	SBBL	Zira
5	"	Mohinder Singh	Pishora Singh	309/93	DBBL	Zira
6	"	Gurdev Singh	Joginder Singh	1079/2000	SBBL	Zira
7	"	Baldev Singh	Baaj Singh	548/99	DBBL	Zira
8	"	Gurmit Singh	Kashmir Singh	297/93	DBBL	Zira
9	,,	Gurwinder Singh	Manjeet Singh	-	-	Zira
10	,,	Mandeep Singh	Balwant Singh	-	-	Zira
11	,,	Dharam Singh	Mukhtar Singh	-	-	Zira
12	**Ruknewala Kalan**	Banta Singh	Saba Singh	941/2000	DBBL	Zira
13	"	Harcharan Singh	Hardit Singh	381/85	DBBL	Zira
14	"	Joginder Singh	Bahal Singh	911/2000	SBBL	Zira
15		**Kashmir Singh**	Sama Singh	**-**	**-**	Zira
16	Variah	Gurmanbir Singh	Mehal Singh	**-**	**-**	Zira
17	**Ranga Dibi**	**Surjit Singh**	Mukhtiar Singh	**-**	**-**	Zira
18	**,,**	**Parkash Singh**	Mehinder Singh	**-**	**-**	Zira
19	**Rasoolpur**	Balwant Singh	Nishan Singh	1072/2000	DBBL	Zira
20	"	Jaswant Singh	Nishan Singh	369/96	DBBL	Zira
21	"	Jagir Singh	Dogar Singh	2278/99	SBBL	Zira
22	"	Kikar Singh	Chanan Singh	183/86	DBBL	Zira
23	"	Baldev Singh	Arjun Singh	340/96	315 Bore	Zira
24	"	Natha Singh	Jarnail Singh	268/99	12 Bore	Zira
25	"	Dogar Singh	Mangal Singh	72/80	SBBL	Zira
26	"	Baldev Singh	Pritam Singh	303	12 Bore	Zira
27	"	Jarnail Singh	Pritam Singh	423/96	12 Bore	Zira
28	"	Amrik Singh	Niranjan Singh	963/99	12 Bora	Zira
29	"	Bagicha Singh	Fateh Singh	962/99	DBBL	Zira
30	"	Kuldip Singh	Mukhtiar Singh	950/99	DBBL	Zira
31	"	Gurmit Singh	Malwant Singh	126/81	DBBL	Zira
32	,,	Lakha Singh	Bhajan Singh	-	-	Zira
33	,,	Gagandeep Singh	Gurdev Singh	-	-	Zira
34	**Jhamke**	Puran Singh	Mangal Singh	42/97	38 Bore	Zira

35	"	Puran Singh	Mangal Singh	241/95	12 Bore	Zira
36	"	Harjit Singh	Gurdial Singh	186/90	DBBL	Zira
37	"	Girdial Singh	Mangal Singh	481/95	DBBL	Zira
39	"	Swaran Singh	Bahadur Singh	5222/75	SBBL	Zira
40	,,	**Raghbir Singh**	Charanjit Singh	-	-	Zira
41	,,	**Sukhvir Singh**	Mann Singh	-	-	Zira
42	,,	**Sukhdev Singh**	Parwan Singh	-	-	Zira
43	,,	**Malkit Singh**	Karnail Singh	-	-	Zira
44	"	Jagtar Singh	Puran Singh	183/90	DBBL	Zira
45	"	Piara Singh	Ram Singh	184/90	DBBL	Zira
46	"	Amarjit Singh	Gurdial Singh	497/99	DBBL	Zira
47	**Jhamke 28**	Bhag Singh	Makhan Singh	061/PS	DBBL	Zira
48	"	Nachatar Singh	Bhag Singh	353/99	315 Bore	Zira
49	"	Lal Singh	Kartar Singh	427/99	315 Bore	Zira
50	"	Gurcharan Singh	Kartar Singh	185/90	DBBL	Zira
51	"	Jarnail Singh	Lachman Singh	324/99	DBBL	Zira
52	"	Meja Singh	Kaila Singh	259/SP	SBBL	Zira
53	"	Satnam Singh	Varan Singh	199/98	DBBL	Zira
54	"	Rajpal Singh	Kartar Singh	426/99	SBBL	Zira
55	"	Harpal Singh	Puran Singh	920/2000	SBBL	Zira
56	"	Balbir Singh	Udham Singh	1635/99	12 Bore	Zira
57	**Chakian**	Tarlok Singh	Tehal Singh	186/AP	315 Bore	Zira
58	"	Avtar Singh	Bahal Singh	255/SDM	SBBL	Zira
59	"	Rajpal Singh	Avtar Singh	204/86	32 Bore	Zira
60	"	Kartar Singh	Narain Singh	47/77	DBBL	Zira
61	"	Mohinder	Bahal Singh	1029/2K	DBBL	Zira
62	"	Gurdip Singh	Bahal Singh	1037/2K	DBBL	Zira
63	"	Vir Singh	Gurbaksh Singh	999/99	SBBL	Zira
64	"	Baldev Singh	Tehal Singh	895/99	DBBL	Zira
65	"	Jagir Singh	Hazara Singh	862/99	DBBL	Zira
66	"	Mukhtiar Singh	Ujjagar Singh	134/82	DBBL	Zira
67	"	Darabara Singh	Ujjagar Singh	400/97	DBBL	Zira
68	"	Milkha Singh	Tehal Singh	551/PS	DBBL	Zira
69	"	Milkha Singh	Tehal Singh	307/PS	38 Bore	Zira
70	**Chak Marhana**	**Bagicha Singh**	Mohinder Singh	-	-	Zira
71	**„**	**Nachhatar Singh**	Gurdev Singh	-	-	Zira
72	**„**	**Hira Singh**	Balkar Singh	-	-	Zira
73	**Buloke**	Harjit Singh	Ajaib Singh	1393/2000	12 Bore	Zira
74	"	Gurbir Singh	Karaj Singh	1697	DBBL	Zira
75	"	Baaj Singh	Ajaib Singh	1794/2000	DBBL	Zira
76	"	Baldev Singh	Bahal Singh	416/96	DBBL	Zira

77	"	Sukhwinder Singh	Tehal Singh	1208/2001	DBBL	Zira
78	"	Amarjit Kaur	W/o Sukhwinder Singh	1334/2001	DBBL	Zira
79	"	Arjan Singh	Nek Singh	355/97	DBBL	Zira
80	"	Surjit Singh	Nek Singh	355/93	DBBL	Zira
81	"	Vinod Kumar	Vasdev	907/2001	DBBL	Zira
82	"	Lakhbir Singh	Karnail Singh	993/99	DBBL	Zira
83	"	Sohan Singh	Mastan Singh	1114/99	DBBL	Zira
84	**Baharwali**	Dara Singh	Gurmej Singh	577/99	DBBL	Zira
85	"	Balwinder Singh	Gurmit Singh	585/99	DBBL	Zira
86	"	Mehar Singh	Tara Singh	578/99	DBBL	Zira
87	"	Shamsher Singh	Gurmej Singh	2693/82	DBBL	Zira
88	"	Jaswant Singh	Angrej Singh	1543/99	DBBL	Zira
89	"	Sukhwinder Singh	Ajaib Singh	1562/99	DBBL	Zira
90	"	Karnail Singh	Angrej Singh	542/95	DBBL	Zira
91	"	Ajaib Singh	Bhag Singh	338/99	DBBL	Zira
92	"	Tarsem Singh	Satnam Singh	580/99	DBBL	Zira
93	"	Balkar Singh	Sumer Singh	1316/99	DBBL	Zira
94	"	Jagjit Singh	Bachitar Singh	1317/99	DBBL	Zira
95	"	Malwinder Singh	Dalip Singh	974/99	SBBL	Zira
96	"	Gurmej Singh	Banta Singh	113/86	DBBL	Zira
97	"	Gurmej Singh	Banta Singh	113/86	38 Bore	Zira
98	"	Gurpartap Singh	Bhag Singh	164/85	32 Bore	Zira
99	"	Balwinder Singh	Kulwant Singh	211/95	SBBL	Zira
100	**Phemiwala**	Mukhtiar Singh	Najit Singh	281/97	DBBL	Zira
101	"	Buta Singh	Ranjit Singh	280/97	DBBL	Zira
102	"	Baljit Singh	Gurcharan Singh	282/97	DBBL	Zira
103	"	Avtar Singh	Gurcharan Singh	279/97	DBBL	Zira
104	"	Desa Singh	Sawan Singh	315/93	DBBL	Zira
105	"	Balwinder Singh	Bahal Singh	336/97	DBBL	Zira
106	"	Bachitar Singh	Harjit Singh	1017/99	DBBL	Zira
107	"	Sukhjit Singh	Fauja Singh	2097/2000	DBBL	Zira
108	"	Sardool Singh	Arlal Singh	726/98	DBBL	Zira
109	"	Baaj Singh	Mohinder Singh	225/85	DBBL	Zira
110	,,	Lovepreet Singh	Balwinder Singh	-	-	Zira
111	**Bharwali**	Manjinder Singh	**Salwinder Singh**	-	-	Zira
112	**Ammiwala**	Gurmukh Singh	Bahal Singh	597/98	12 BoreSBBL	Zira
113	"	Kirpal Singh	Moola Singh	261/93	SBBL	Zira
114	"	Harbans Singh	Bahal Singh	1240/98	DBBL	Zira
115	"	Lachman Singh	Joginder Singh	910/2000	DBBL	Zira
116	"	Veer Singh	Dalip Singh	265/Sep	SBBL	Zira

117	"	Kabal Singh	Ranga Singh	893/99	DBBL	Zira
118	"	Arjun Singh	Janga Singh	335/SDM	SBBL	Zira
119	"	Lakhman Singh	Banta Singh	1027/2000	DBBL	Zira
120	"	Sukhdev Singh	Angrej Singh	335/99	DBBL	Zira
121	"	Mohal Singh	Kehar Singh	695/99	DBBL	Zira
122	"	Malkit Singh	Arjun Singh	336/94	315 Bore	Zira
123	"	Gurwinder Singh	Joga Singh	235/95	DBBL	Zira
124	"	Karnail Singh	Harnam Singh	351/99	DBBL	Zira
125	"	Nishan Singh	Harbans Singh	755/98	DBBL	Zira
126	"	Darbara Singh	Nasir Singh	975/2000	SBBL	Zira
127	"	Harbhajan Singh	Amar Singh	1015/99	DBBL	Zira
128	"	Chanan Singh	Anoakh Singh	1238/98	DBBL	Zira
129	"	Subeg Singh	Gurcharan Singh	117/80	315 Bore	Zira
130	"	Gurmej Singh	Jagir Singh	74/79	DBBL	Zira
131	"	Kuldip Singh	Arjun Singh	240/97	DBBL	Zira
132	,,	Yadhwinder Singh	Raghvir Singh	-	-	Zira
133	,,	Gurpreet Singh	Avtar Singh	-	-	Zira
133	,,	Amrik Singh	Sucha Singh	-	-	Zira
134	,,	Gurpreet Singh	Harbhajan Singh	-	-	Zira
135	**Amirshah Wala**	Kikar Singh	Gurbaksh Singh	438/95	DBBL	Zira
136	"	Kirpal Singh	Bishan Singh	1095/99	SBL	Zira
137	"	Jaswant Singh	Sardool Singh	256/97	DBBL	Zira
138	"	Surinder Singh	Bikkar Singh	866/99	DBBL	Zira
139	"	Raj Singh	Bikkar Singh	865/99	DBBL	Zira
140	"	Mukhtiar Singh	Gurdial Singh	2033/98	DBBL	Zira
141	"	Mehal Singh	Santa Singh	418/96	DBBL	Zira
142	"	Kalga Singh	Santa Singh	870/99	DBBL	Zira
143	,,	Harjinder Singh	Biker Singh	-	-	Zira
144	**Joge Wala**	Jagwant Singh	Darshan Singh	285	DBBL	Zira
145	"	Joga Singh	Hardip Singh	952/2K	SBBL	Zira
146	"	Gurtej Singh	Karam Singh	397/97	DBBL	Zira
147	"	Bohar Singh	Gurmej Singh	644/97	DBBL	Zira
148	"	Sukhdev Singh	Veer Singh	1030/99	DBBL	Zira
149	"	Karnail Singh	Gurbakhsh Singh	987/99	DBBL	Zira
150	"	Mejor Singh	Malook Singh	1023/99	DBBL	Zira
151	"	Pipal Singh	Mandar Singh	951/2K	DBBL	Zira
152	"	Mohan Singh	Miha Singh	37/77	DBBL	Zira
153	"	Kulwant Singh	Surain Singh	609/99	DBBL	Zira
154	"	Variam Singh	Rashpal Singh	987/2K	DBBL	Zira
155	"	Bohar Singh	Angrej Singh	470/79	DBBL	Zira
156	"	Gulab Singh	Balkar Singh	477/99	DBBL	Zira

157	"	Malkit Singh	Amar Singh	955/97	DBBL	Zira
158	"	Lakhwinder Singh	Rashpal Singh	982/2K	315 Bore	Zira
159	"	Amar Singh	Malang Singh	866/99	DBBL	Zira
160	"	Balkar Singh	Piara Singh	2085/98	DBBL	Zira
161	"	Sukhwinder Singh	Sadhu Singh	220/89	DBBL	Zira
162	"	Sukhwinder Singh	Sadhu Singh	275/	DBBL	Zira
163	"	Sukhwinder Singh	Sadhu Singh	220/89	32 Bore	Zira
164	"	Rajpal Singh	Malook Singh	338/98	DBBL	Zira
165	"	Bhajan Singh	Hardev Singh	221/99	DBBL	Zira
166	,,	Jaspal Singh	Harbans Singh	-	-	Zira
167	,,	Sukhwinder Singh	Sukha Singh	-	-	Zira
168	**Jaggian**	Sukhdev Singh	Mohinder Singh	220/94	DBBL	Zira
169	**Churian**	Sawinder Singh	Malook Singh	562/99	SBBL	Zira
170	**Sudan**	**Nirmal Singh**	Shamsher Singh	-	-	Zira
171	**Sirhali**	**Kuldeep Singh**	Sohan Singh	-	-	Zira
172	**„**	**Dilawar Singh**	Bahal Singh	-	-	Zira
173	**„**	**Kashmir Singh**	Mukhtyar Singh	-	-	Zira
174	**„**	**Baldev Singh**	Ajiab Singh	-	-	Zira
175	"	Jagir Singh	Sanjan Singh	1516/99	DBBL	Zira
176	"	Kuldip Singh	Gurdial Singh	1307/99	DBBL	Zira
177	"	Gurdev Singh	Malook Singh	1711/	DBBL	Zira
178	"	Atma Singh	Buta Singh	2421/94	SBBL	Zira
179	**Padhri**	Darshan Singh	Tara Singh	452	DBBL	Zira
180	"	Piara Singh	Najar Singh	1398/98	DBBL	Zira
181	"	Swarn Singh	Mohan Singh	334/SDM	SBBL	Zira
182	"	Baaj Singh	Dogar Singh	561/97	SBBL	Zira
183	"	Hardip Singh	Dogar Singh	324/97	DBBL	Zira
184	"	Gurdial Singh	Sohan Singh	451/77	SBBL	Zira
185	"	Karnail Singh	Pala Singh	1311/99	DBBL	Zira
186	"	Amarjit Singh	Santa Singh	571/99	DBBL	Zira
187	"	Malkit Singh	Sucha Singh	582/98	SBBL	Zira
188	**„**	Harjinder Singh	Kabal Singh	-	-	Zira
189	**Tibbi arian**	Karnail Singh	Dham Singh	254/93	DBBL	Zira
190	"	Bhupinder Singh	Kirpal Singh	522/97	DBBL	Zira
191	"	Surjan Singh	Piara Singh	1375/98	DBBL	Zira
192	"	Avtar Singh	Chanan Singh	202/92	DBBL	Zira
193	"	Mehal Singh	Buta Singh	5081/97	DBBL	Zira
194	"	Harbans Singh	Puran Singh	321/94	SBBL	Zira
195	"	Jaswant Singh	Kirpal Singh	575/97	DBBL	Zira
196	"	Baldev Singh	Puran Singh	333/94	DBBL	Zira
197	"	Gian Singh	Puran Singh	331/99	315 Bore	Zira
198	**Jagewal**	Sukhwinder Singh	Kartar Singh	600/98	DBBL	Zira

199	"	Kulbir Singh	Arjun Singh	567/96	SBBL	Zira
200	"	Darshan Singh	Tara Singh	535/96	DBBL	Zira
201	"	Lal Singh	Gurnam Singh	1436/98	DBBL	Zira
202	"	Bakhsish Singh	Tara Singh	601/98	DBBL	Zira
203	"	Dalip Singh	Arjan Singh	187/87	DBBL	Zira
204	"	Joga Singh	Arjun Singh		DBBL	Zira
205	"	Bagga Singh	Arjun Singh	518/	DBBL	Zira
206	"	Kuljit Singh	Baghel Singh	1763/98	DBBL	Zira
207	"	Partap Singh	Balbir Singh	922/2000	DBBL	Zira
208	"	Gurwinder Singh	Balkar Singh	909/2000	DBBL	Zira
209	**Gatti Harike**	Gurjit Singh	Ghula Singh	1554/99	SBBL	Zira
210	"	Gurnam Singh	Darbara Singh	1497/99	SBBL	Zira
211	"	Chanan Singh	Jetha Singh	1546/99	SBBL	Zira
212	**„**	**Tarsem Singh**	**Bhag Singh**	**-**	**-**	Zira
213	**Moujgarh**	Parshotam Singh	Sadhu Singh	175/95	DBBL	Zira
214	"	Roor Singh	Vassan Singh	266/94	SBBL	Zira
215	"	Piara Singh	Mohan Singh	418/65	SBBL	Zira
216	"	Kulwant Singh	Vassan Singh	1565/99	SBBL	Zira
217	"	Balwinder Singh	Ghasita Singh	419/PS	DBBL	Zira
218	"	Surjan Singh	Sohan Singh	402	DBBL	Zira
219	"	Darshan Singh	Aaba Singh	1534/99	SBBL	Zira
220	"	Gurdev Singh	Ajaib Singh	354/96	12 Bore	Zira
221	,,	Jasbir Singh	Bakshis Singh	-	-	Zira
222	,,	Karaj Singh	Balbir Singh	-	-	Zira
223	,,	Bakhsis Singh	Tarlok Singh	-	-	Zira
224	**Milewind**	Boor Singh	Kishan Singh	1114/2000	DBBL	Zira
225	"	Sham Singh	Mukhtiar Singh	913/2000	DBBL	Zira
226	"	Sohan Singh	Thakur Singh	921/2000	DBBL	Zira
227	"	Jarmal Singh	Sukhchain Singh	1148/2001	DBBL	Zira
228	"	Joginder Singh	Ajit Singh	1631/99	SBBL	Zira
229	"	Balwinder Singh	Jagtar Singh	1633/99	DBBL	Zira
230	Makhu	Jaswant Singh	Bagicha Singh	-	-	Zira
231	,,	Bikram Singh	Rehsam Singh	-	-	Zira
232	,,	Avtar Singh	Sukhdev Singh	-	-	Zira
233	,,	Gurav Madaan	Surinder Madaan	-	-	Zira
234	,,	Baljit Singh	Sardul Singh	-	-	Zira
235	,,	Mehtab Singh	Rehsam Singh	-	-	Zira
236	,,	Davinderjit Kaur	D/o Lakhvir Singh W/o Gurjant Singh	-	-	Zira
237	,,	Palwinder Singh Dhillon	Sukhwinder Singh	-	-	Zira

238	,,	Vishal Monga	Vrinder Kumar Monga	-	-	Zira
239	,,	Inderjit Singh	Harbhajan Singh	-	-	Zira
240	,,	Jonathan	Surinder Masih	-	-	Zira
241	,,	Rohit Chodari	Rmesh Kumar	-	-	Zira
242	,,	Deepak Kumar	Vijay Kumar	-	-	Zira
243	,,	Hem Chand	Hans Raj	-	-	Zira
244	,,	Surav Chopra	Pardeep Chopra	-	-	Zira
245	,,	Balkar Singh	Hardeep Singh	-	-	Zira
246	,,	Sarabjit Singh	Hardeep Singh	-	-	Zira
247	,,	Amandeep Singh	Balwinder Singh	-	-	Zira
248	,,	Pritpal Singh	Balwinder Singh	-	-	Zira
249	**Sarf ali khan**	Sucha Singh	Gurdial Singh	927/99	SBBL	Zira
250	"	Gurnam Singh	Arbel Singh	1024/2K	SBBL	Zira
251	"	Jaswant Singh	Jagir Singh	2264/99	SBBL	Zira
252	"	Malwinder Singh	Mohan Singh	942/99	DBBL	Zira
251	"	Lahora Singh	Bhola Singh	8281	SBBL	Zira
253	"	Balbir Singh	Fauja Singh	534/96	SBBL	Zira
254	"	Raghbir Singh	Fauja Singh	508/96	SBBL	Zira
255	"	Jit Singh	Tara Singh	509/96	SBBL	Zira
256	,,	**Nishan Singh**	Harbhajan Singh	**-**	**-**	Zira
257	**Kutubpura**	Gurdarshan Singh	Banta Singh	735/98	SBBL	Zira
258	"	Jarnail Singh	Banta Singh	420/96	SBBL	Zira
259	"	Tehal Singh	Shingara Singh	510/SP	SBBL	Zira
260	"	Darbara Singh	Mehal Singh	986/99	SBBL	Zira
261	"	Sukhdev Singh	Mehal Singh	1026/99	SBBL	Zira
262	"	Ajit Singh	Vajir Singh	423/PS	SBBL	Zira
263	"	Balwinder Singh	Ajit Singh	1059/99	DBBL	Zira
264	"	Karnail Singh	Hakam Singh	1038/2000	DBBL	Zira
265	"	Gurpal Singh	Kehar Singh	512/PS	DBBL	Zira
266	"	Pramjit Singh	Dial Singh	728/98	DBBL	Zira
267	"	Malook Singh	Banta Singh	1474/99	DBBL	Zira
268	**Khiali**	Gurmit Singh	Harbans Singh	951/99	SBBL	Zira
269	"	Kashmir Singh	Tehal Singh	468/96	DBBL	Zira
270	**Dineke**	Rashpal Singh	Gurcharan Singh	**-**	**-**	Zira
271	Talwandi Nepala	Gurjant Singh	Jaswant Singh	-	-	Zira
270	,,	Amandeep Singh	Tehal Singh	-	-	Zira
272	,,	Sukhjit Singh	Jagjeer Singh	-	-	Zira
273	Guddu Wala	**Gurjant Singh**	GurdipSingh	_		Zira
274	Gatta Badshah	Nirmal Singh	Karam Singh	-	-	Zira

275	„	Khushwant Singh	Sukhdev Singh	-	-	Zira
276	„	Navdeep Singh	Balwinder Singh	-	-	Zira
277	„	Balwinder Singh	Jagga Singh	--	-	Zira
278	„	Angrej Singh	Tarlok Singh	-	-	Zira
279	„	Santokh Singh	Joga Singh	-	-	Zira
280	„	Bagga Singh	Mukhtiar Singh	-	-	Zira
281	Wato Bhati	Gurwinder Singh	Amrik Singh	-	-	Zira
282	,,	Sucha Singh	Meja Singh	-	-	Zira
283	,,	Sukhdev Singh	Kalga Singh	-	-	Zira
284	**Ratta Gudda**	Sarwan Singh	Visava Singh		SBBL	Sultanpur
285	"	Karam Singh	Surjan Singh		SBBL	Sultanpur
286	"	Pargat Singh	Major Singh		DBBL	Sultanpur
287	"	Sawinder Singh	Jagir Singh		DBBL	Sultanpur
288	"	Sunda Singh	Nagar Singh		DBBL	Sultanpur
289	"	Darshan Singh	Kartar Singh		DBBL	Sultanpur
290	"	Hardial Singh	Gurdip Singh		DBBL	Sultanpur
291	"	Gurmukh Singh	Gajjan Singh		DBBL	Sultanpur
292	"	Sukhwinder Singh	Aroor Singh		DBBL	Sultanpur
293	"	Jhiman Singh	Uttam Singh		DBBL	Sultanpur
294	"	Kashmir Singh	Chanan Singh		DBBL	Sultanpur
295	**Harike**	Bhajan Singh	Mangal Singh		SBBL	Patti
296	"	Mangal Singh	Ram Singh		315 Bore	Patti
297	"	Om Prakash	Ganga Bishan		DBBL	Patti
298	"	Amar Nath	Mohan Lal		DBBL	Patti
299	"	Harbhajan Singh	Dhanna Singh		DBBL	Patti
300	"	Sukhdev Singh	Surjit Singh		DBBL	Patti
301	"	Vijay Kumar	Ashok Kumar		DBBL	Patti
302	"	Jaspal Singh	Diwan Chand		DBBL	Patti
303	"	Sundar Singh	Roor Singh		DBBL	Patti
304	"	Satnam Singh	Gurbaksh Singh		DBBL	Patti
305	"	Vasdev	--		DBBL	Patti
306	"	Joginder Singh	Sundar Singh		DBBL	Patti
307	"	Jaswant Singh	Dharam Singh		DBBL	Patti
308	"	Gurcharan Singh	Shingara Singh		DBBL	Patti
309	"	Ravinder Kumar			DBBL	Patti
310	**Marar**	Shingara Singh	Piara Singh		SBBL	Patti
311	"	Amrik Singh	Joginder Singh		DBBL	Patti
312	"	Bohar Singh	Joginder Singh		315 Bore	Patti
313	**Kirian**	Balwant Singh	Surjan Singh		DBBL	Tarntaran
314	"	Surjit Singh	Sadha Singh		SBBL	
315	**Tung**	Harband Singh	Tarlok Singh		DBBL	Tarntaran

316	"	Resham Singh	Avtar Singh		DBBL	
317	"	Lakhwinder Singh	Milara Singh		DBBL	
318	"	Karam Singh	Gurcharan Singh		315 Bore	
319	"	Jarnail Singh	Ajaib Singh		315 Bore	
320	"	Jarnail Singh	Ajaib Singh		DBBL	
321	Dadehar sahib	Sohan Singh	Darshan Singh		DBBL	
322	"	Fajer Singh	Darshan Singh		DBBL	
323	"	Davinder Singh	Gurmej Singh		DBBL	
324	"	Mandip Singh	Makhan Singh		DBBL	
325	"	Sardool Singh	Kishan Singh		DBBL	
326	"	Makhan Singh	Ghula Singh		DBBL	
327	"	Gurcharan Singh	Dalip Singh		SBBL	
328	"	Natha Singh	Raj Singh		DBBL	
329	"	Raghbir Singh	Makhan Singh		SBBL	
330	"	Lakha Singh	Major Singh		DBBL	
331	"	Harcharan Singh	Hari Singh		DBBL	
332	"	Joginder Singh	Hari Singh		SBBL	
333	"	Kartar Singh	Ujjagar Singh		SBBL	
334	**Dhattal**	Balwant Singh	Buta Singh		DBBL	
335	"	Karnail Singh	Naranjan Singh		SBBL	
336	**Dhun Dhae Wala**	Najjar Singh	Sadhu Singh		DBBL	
337	"	Pargat Singh	Sohan Singh		DBBL	
338	"	Satnam Singh	Gurdial Singh		DBBL	
339	**Nakohar**	Gurnam Singh	Tarlok Singh		DBBL	
340	"	Manjinder Singh	Balwinder Singh			
341	"	Sarbjit Singh	Balwinder Singh		315 Bore	
342	"	Manjit Singh	Kartar Singh		Nil	
343	"	Kulwant Singh	Karnail Singh		DBBL	
344	"	Charan Singh	Darshan Singh		DBBL	
345	**Nabipur**	Balwinder Singh	Shingara Singh		DBBL	
346	"	Baldev Singh	Sulakhan Singh		315 Bore	
347	"	Atma Singh	Milkha Singh		DBBL	
348	**Sarhana**	Bakshish Singh	Bukan Singh		DBBL	
349	"	Harbans Singh	Harnam Singh		SBBL	
350	**Pangot**	Darshan Singh	Shingara Singh		DBBL	
351	"	Gurbachan Singh	Jassa Singh		315 Bore	
352	"	Gurbachan Singh	Gurbaksh Singh		DBBL	
353	"	Sukhwinder Singh	Gurnam Singh		DBBL	
354	"	Sarwan Singh	Gurbachan Singh		DBBL	
355	"	Gurjit Singh	Gurpal Singh		315 Bore	

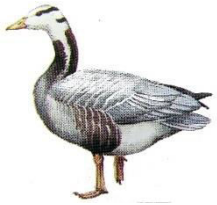
356	"	Nishan Singh	Partap Singh		315 Bore	
357	"	Kuldip Singh	Partap Singh		32 Bore Rev.	
358	"	Partap Singh	Jind Singh		DBBL	
359	"	Sukhchain Singh	Mangal Singh		DBBL	
360	"	Ranjit Singh	Sardool Singh		DBBL	
361	"	Surjit Singh	Gurdip Singh		DBBL	
362	"	Harjit Singh	Gurdip Singh		DBBL	
363	"	Harbans Singh	Ganda Singh		DBBL	
364	**Paringari**	Ghulla Singh	Hakam Singh		SBBL	
365	"	Sukhwinder Singh	Banta Singh		DBBL	
366	"	Ghulla Singh	Hakam Singh		DBBL	
367	"	Bakshish Singh	Shingara Singh		DBBL	
368	"	Ajaib Singh	Harnam Singh		DBBL	
369	**Burj Deva Singh**	Dara Singh	Kuldip Singh		DBBL	
370	"	Gurmail Singh	Banta Singh		DBBL	
371	"	Gurdev Singh	Karam Singh		DBBL	
372	**Burj Puhla**	Mohinder Singh	Harbans Singh		DBBL	
373	"	Baldev Singh	Ajit Singh		DBBL	
374	"	Surjit Singh	Najjar Singh		DBBL	
375	**Rooriwala**	Sukhdev Singh	Hari Singh		DBBL	
376	"	Sarbjit Singh	Partap Singh		315 Bore	
377	"	Balbir Singh	Sucha Singh		DBBL	
378	"	Karam Singh	Sardara Singh		SBBL	
379	"	Diwan Singh	Milkha Singh		DBBL	
380	"	Jarnail Singh	Milkha Singh		DBBL	
381	"	Tejinder Singh	Partap Singh		DBBL	
382	"	Gursharan Singh	Gurbaksh Singh		DBBL	
383	"	Arjun Singh	Hira Singh		DBBL	
384	"	Gurmej Singh	Bachittar Singh		DBBL	
385	"	Karnail Singh	Meja Singh		DBBL	
386	"	Gurbejh Singh	Sarwan Singh		DBBL	
387	**Alipur**	Kulwant Singh	Mota Singh	20233/92	DBBL	
388	"	Santa Singh	Fooman Singh	37852/96	DBBL	
389	"	Karaj Singh	Chaichal Singh		DBBL	
390	"	Jaswant Singh	Bahal Singh		DBBL	
391	"	Sukhdev Singh	Santa Singh		DBBL	
392	"	Surjit Singh	Sudagar Singh		12 Bore	
393	"	Charan Singh	Harnam Singh		DBBL	
394	"	Balbir Singh	Mohinder Singh		DBBL	
395	"	Amarjit Singh	Mohinder Singh		DBBL	

396	"	Mohinder Singh	Kishan Singh		DBBL	
397	"	Sawinder Singh	Arjun Singh		DBBL	
398	"	Gurpartap Singh	Mohinder Singh		315 Bore	
399	**Kot Data**	Kashmir Singh	Harnam Singh		SBBL	
400	"	Shingara Singh	Banta Singh		DBBL	
401	**Kambo Dhae Wala**	Bakhshish Singh	Mohinder Singh		SBBL	
402	"	Balbir Singh	Gurbaksh Singh		DBBL	
403	"	Kashmir Singh	Ujjagar Singh		DBBL	
404	"	Jagir Singh	Diwan Singh		DBBL	
405	"	Dalbir Singh	Milkha Singh		DBBL	
406	"	Swarn Singh	Jarnail Singh		DBBL	
407	"	Jasbir Singh	Bhajan Singh		DBBL	
408	**Karmuwal**	Bakhtavar Singh	Major Singh		DBBL	
409	"	Jagtar Singh	Najjar Singh		DBBL	
410	"	Jaswant Singh	Najjar Singh		DBBL	
411	**Kirtowal khurd**	Gurdev Singh	Najjar Singh		SBBL	
412	"	Gurbachan Singh	Nirmal Singh	F1/9320	12 Bore	
413	**Kirtowal Kalan**	Satnam Singh	Avtar Singh		DBBL	
414	"	Charan Singh	Teja Singh		DBBL	
415	"	Nirmal Singh	Puran Singh		DBBL	
416	"	Kultar Singh	Mehal Singh		DBBL	
417	"	Major Singh	Sooba Singh		DBBL	
418	**Gandi Wind**	Jodha Singh	Bali Singh		SBBL	
419	"	Swarn Singh	Dalip Singh		DBBL	
420	"	Guljar Singh	Bhola Singh		DBBL	
421	"	Jagir Singh	Chanan Singh		SBBL	
422	"	Karnail Singh	Naranjan Singh		SBBL	
423	**Chamba Kalan**	Manjit Singh	Gurnam Singh		DBBL	
424	"	Satpal Singh	Mohan Singh		DBBL	
425	"	Gajjan Singh	Gurcharan Singh		DBBL	
426	"	Balwinder Singh	Jagminder Singh		315 Bore	
427	"	Sawinder Singh	Bhagwan Singh		DBBL	
428	"	Jasmail Singh	Kundan Singh		DBBL	
429	"	Sukhwinder Singh	Sehjas Singh		DBBL	
430	**Jinda Wala**	Sewa Singh	Makhan Singh		DBBL	
431	"	Balwinder Singh	Surjit Singh		SBBL	
432	"	Nirmal Singh	Dhara Singh		SBBL	
433	"	Surjit Singh	Dhara Singh		SBBL	

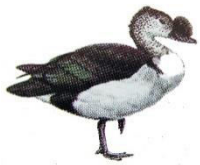
434	"	Amar Singh	Darshan Singh	15140		
435	"	Sadhu Singh	Makhan Singh		DBBL	
436	**Thathia Khurd**	Malkiat Singh	Pargat Singh		DBBL	
437	**Thatha**	Balbir Singh	Sardool Singh	430	32 Bore	
438	"	Baldev Singh	Jagir Singh		12 Bore	
439	"	Ranjit Singh	Phaman Singh		DBBL	
440	"	Harbans Singh	-		DBBL	
441	"	Amar Singh	Sampuran Singh		DBBL	
442	"	Manjit Singh	Harbans Singh		DBBL	
443	**Giddar Pindi**	Kesar Singh	Bhag Singh	8351	SBBL	
444	"	Vasakha Singh	Bhag Singh	9994	SBBL	
445	"	Lakhwinder Singh	Bhan Singh	40903	DBBL	
446	"	Manit Singh	Bhan Singh		315 Bore	
447	"	Harbans Singh	Kartar Singh	9966	DBBL	
448	"	Nirmal Singh	Charan Singh	9960	DBBL	

ANNEXURE-VIII

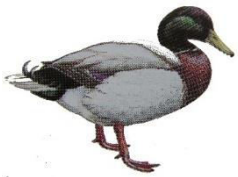
Illustrated pictures of some of the birds found in harike



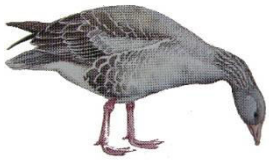
Barheaded goose



Comb duck

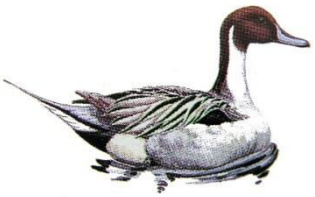


Mallard



Greylag goose

Garganey



Pintail

Ruddy Shelduck

Dabchick

Spotbilled duck

Falcated teal

Shoveller

Red crested Pochard

Common teal

Lesser whistling teal

Cotton teal

Common Pochard

Wigeon

Black headed gull

Indian skimmer

Indian skimmer

Black bellied tern

Black tailed godwit

Spur winged plover

Common redshank

Indian moorhen

Purple moorhen

Water cock

White breasted waterhen

Spoon bill

Black partridge

Painted snipe

Greater black headed gull

Spur winged plover

Stone curlew

Swamp partridge

Hoopoe

Hoopoe

Hoopoe

Pied myna

Lesser golden backed woodpecker

Common Kingfisher

Franklins wren warbler

Striated babbler

Common babbler

Small green bee-eater

Tailor bird

Asley wren warbler

Red vented bulbul

Red whiskered bulbul

Bluethroat

Indian roller

Indian roller

Purple sunbird

Grey tit

Dusky horned owl

Ashy crowned fish lark

Mammal pictures

Jackal
(*Canis aureus)*

Indian Fox
(Vulpes bengalensis)

Smooth coated otter
(Lutrogale perspicillata)

Indus River Dolphin
(*Platanista gangetica minor*)

Wild Boar
(*Sus scrofa*)

Gharial
(*Gavialis gangeticus*)

Sambar Deer
(Rusa unicolor)

Indian Porcupine
(Hystrix indica)

ANNEXURE-VIII

Public awarenessand education activities

Photogrpahs of world wetland day

Photos for annual bird census

Photogrpahs of wildlife week

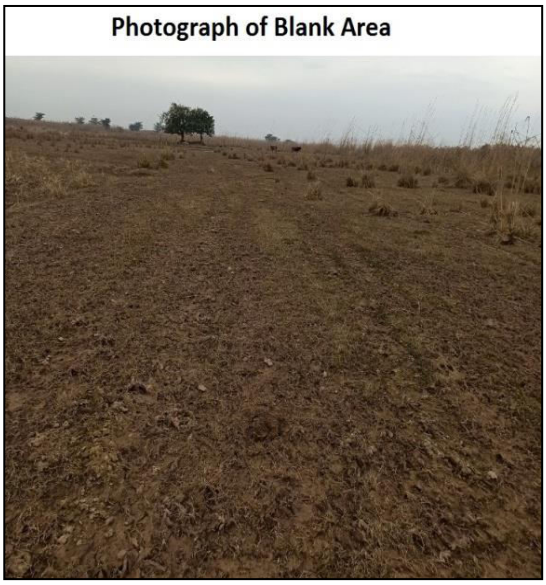
Photos for world environment day

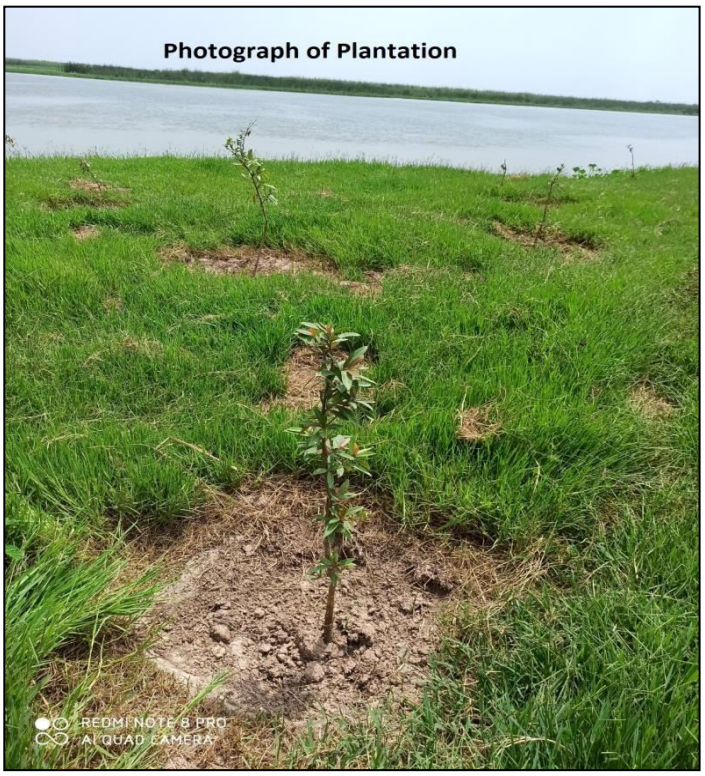
Photos for awareness camp

ANNEXURE-IX

Photos for plantation in sanctuary area.

05 Hec. Plantataion in Deva Singh wala Beat during the year 2019-20



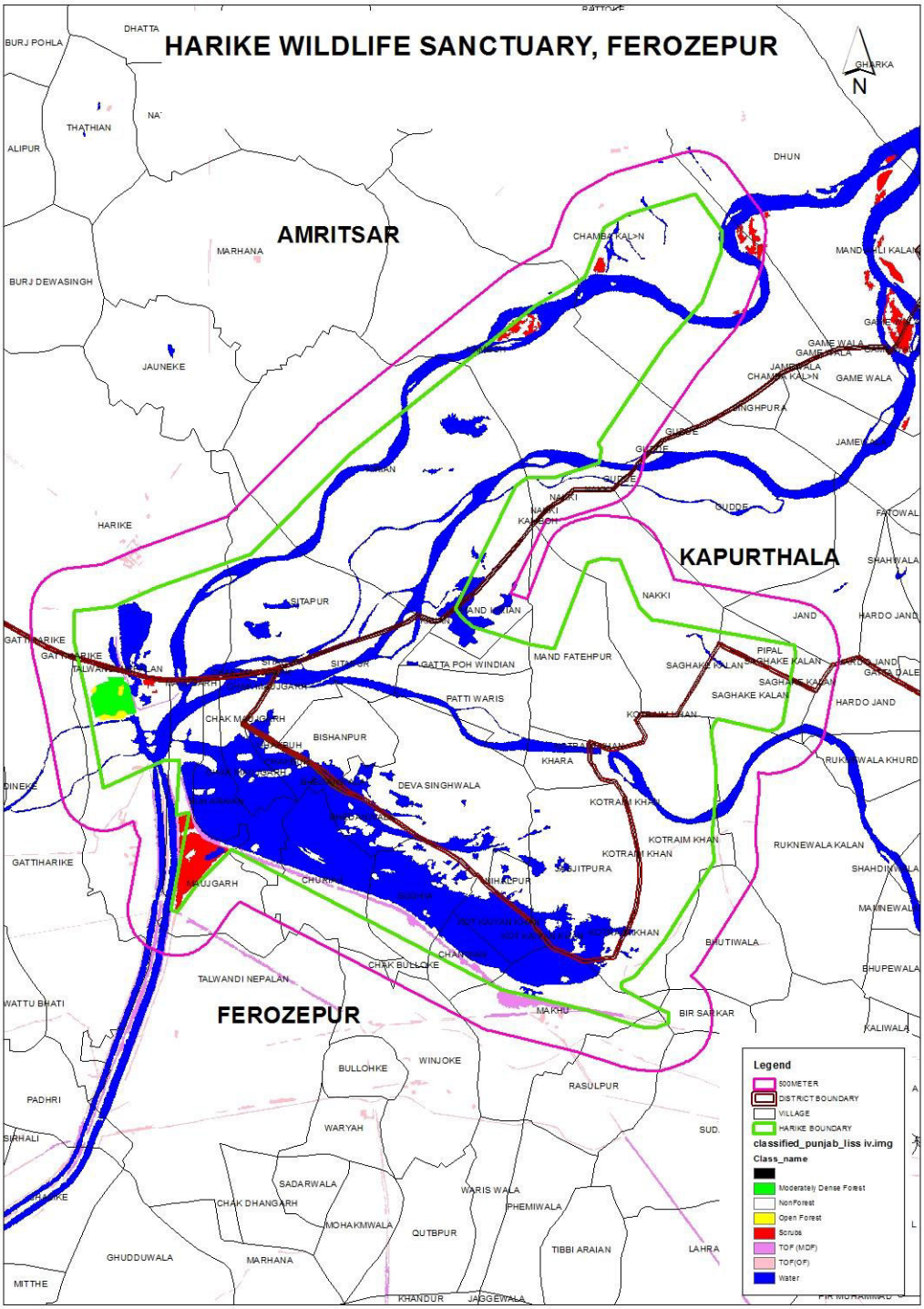


ANNEXURE-X

Photos of removal of Water hyacinth

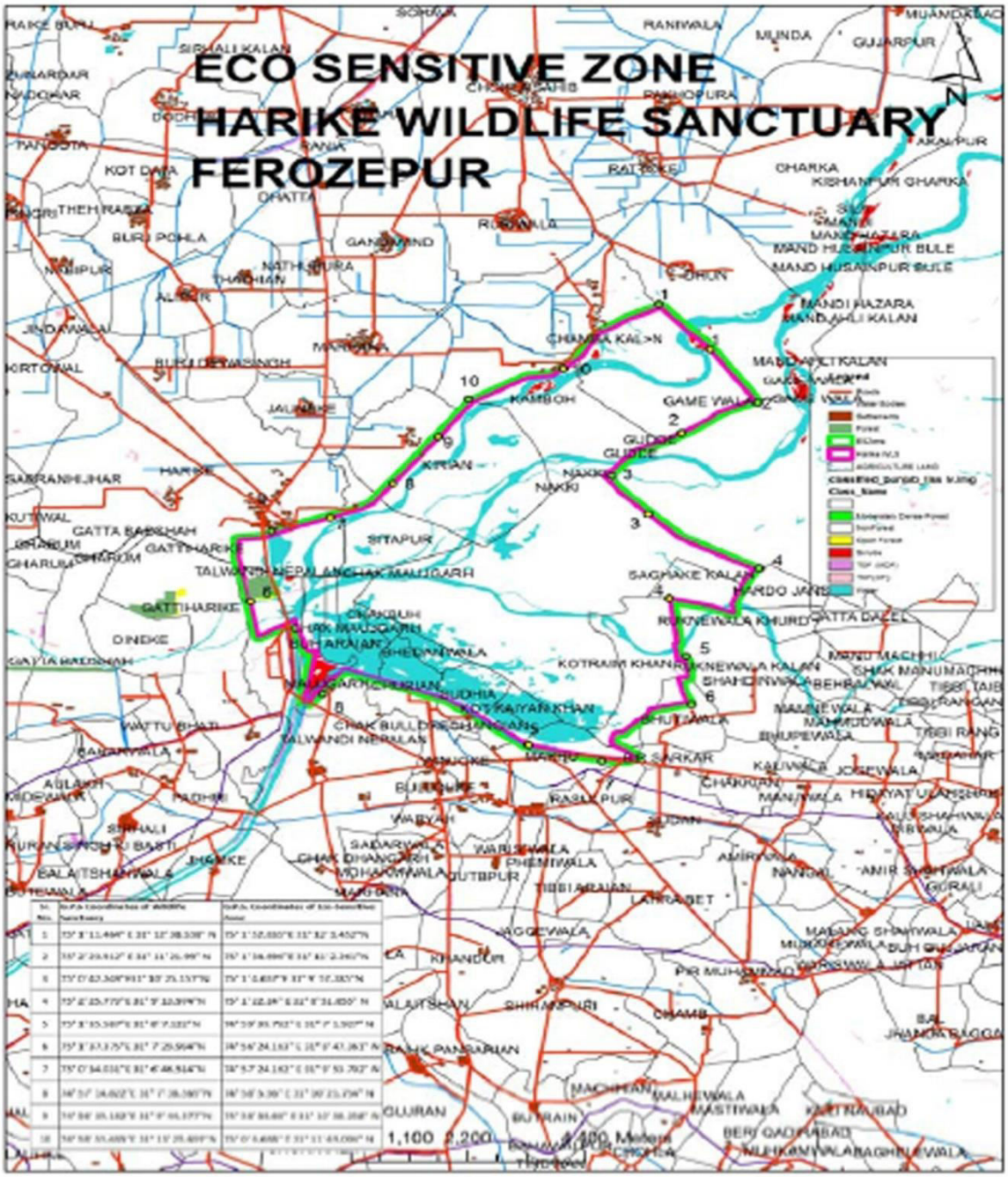
ANNEXURE-XI

Satelite map of Harike

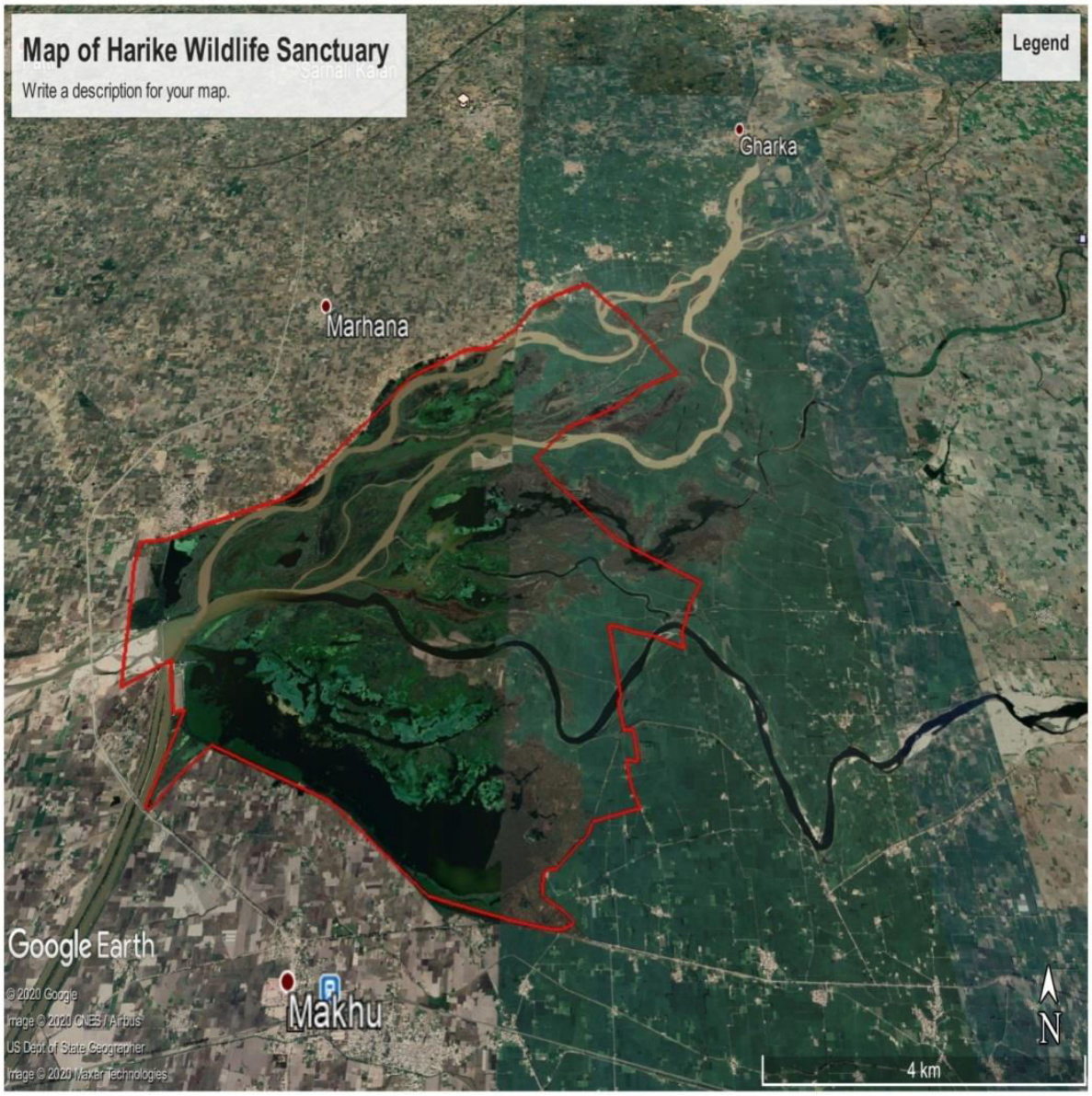


Eco-Sensitive Zone Boundary of Harike Wildlife Sanctuary

Map of Eco-sensitive Zone Boundary of Harike Wildlife Sanctuary, Punjab



Boundary of Harike on Google Earth.



Location Map of Harike