MANAGEMENTPLAN

GHARANAWETLAND,JAMMU,J&K

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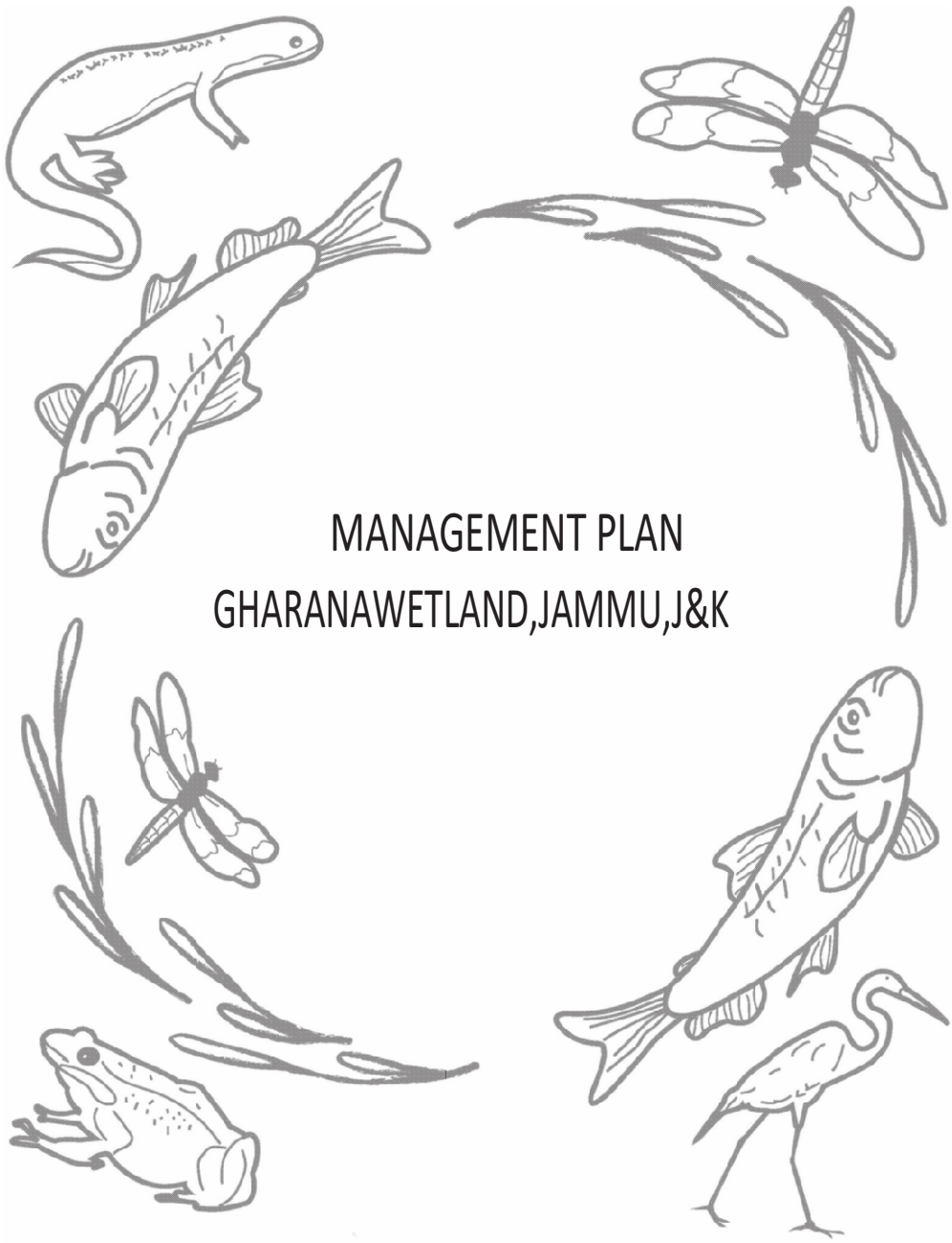

MANAGEMENT PLAN
GHARANAWETLAND,JAMMU,J&K

FOREWORD

TheGharanaWetlandConservationReservewasnotifiedbytheGovernment of Jammu & Kashmir vide Government order No: 20-FST of 1981 dated 04.02.1981.GharanaWetlandConservationReserveconstitutearemarkable habitat primarily for various species of migratory birds within the Central Asian Flyover (CAF).In addition to the migratory birds, this wetland also serves an important habitat for several species of resident birds and many other aquatic life forms.

For the first time, an attempt has been made to prepare a Management PlanforGharanaWetlandConservationReserve.DepartmentofWildlifeProtectio n has taken this initiative with the help of WWF-India. The Management Plan clearly lays out the strategies for addressing various threats to this wetland. This Management Plan shall serve as authentic document for scientific baselinedataforfuturemanagement.Theplanwillalsogoalongwayin securing habitat for iconic migratory water birds of the area.

IcongratulatetheWWF-IndiateaminJammu&Kashmirfortheirhardwork inpreparationofthismanagementplan.Ialsoputonrecordtheappreciation for efforts and guidance by Dr. Kumar M.K., IFS, Regional Wildlife Warden, Jammu for completion of this document.

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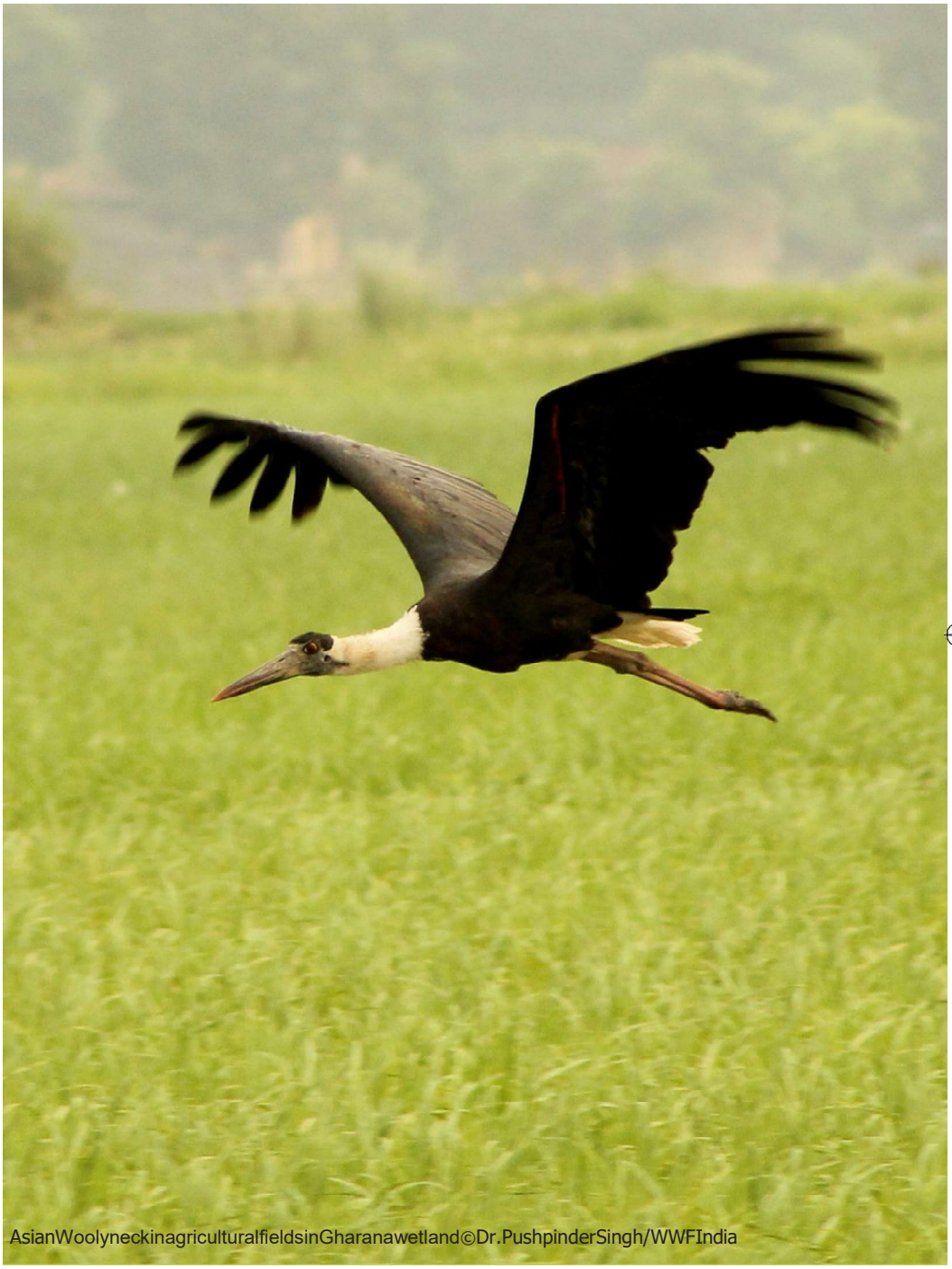
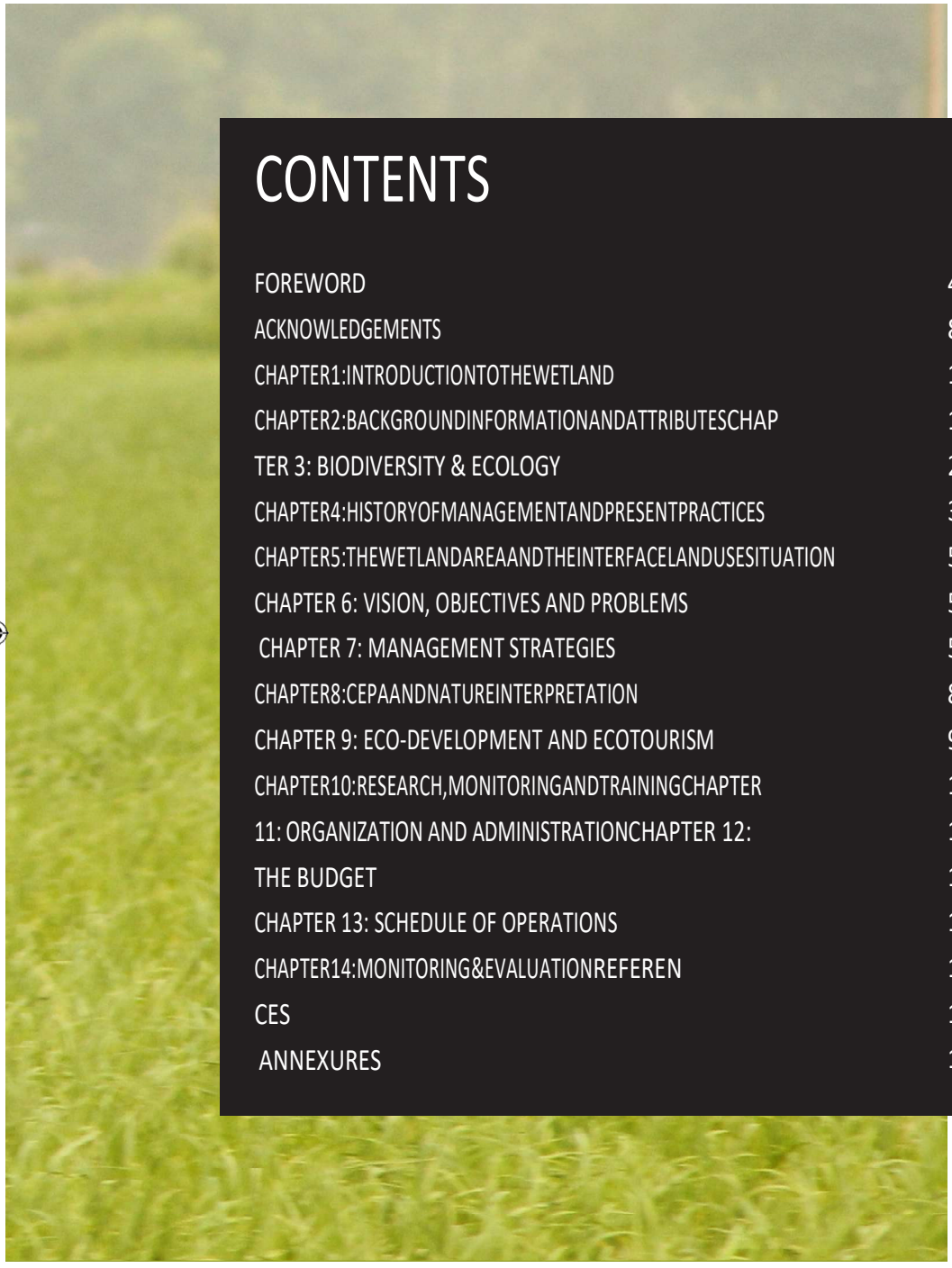


AsianWoolyneckinagriculturalfieldsinGharanawetland©Dr.PushpinderSingh/WWFIndia

6.|GharanaWetland,Jammu,J&K



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ACKNOWLEDGEMENTS

Managementplanningofaprotected area is a very complex task whichcan be accomplished only after contributions from one and all. The management planning of Gharana wetland, which is an ecologically sensitive wetland located right om the International border was not easy task and could only be accomplishedonlyafteragalaxyof experts, researchers and frontline staff came together to shoulderthis responsibility. Therefore, the authorsareextremelythankfultoall those who have contributed to the management planning of Gharana wetland.

First and foremost, the authors are grateful to former PCCFs and Chief Wildlife Wardens Sh. A.K Singh(IFS) and Sh. Suresh Chough for lendingtheirpatronagetotheproject and giving their valuable inputs from time to time. Authors are also appreciativeofMr.J.Frankoi(IFS), CCF Ecotourism, J&K, who alsolent his valuable time during the reviewmeetingsandalsocontributed through his prized suggestions. We arehighlygratefultoformerRegional Wildlife Wardens Sh. Asif M Sagar, Dr. Senthil Kumar and Sh. Tahir Shawl for the critical roles that they played during their respective tenures and helped this project and themanagementplanningexercisein multiple ways.

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Theauthorsalsorecognizeeffortsand contributions of the former Wildlife Wardens(Jammu)Sh.SayeedAhmed and Dr. Jatinder Singh (IFS) who always remained available for any help that was sought from them. SincerethanksarealsoduetoMs. Samina Charoo,

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CHAPTER1-INTRODUCTIONTOTHE GHARANA WETLAND

Name,Location& Extent

Gharanaisasmallwetlandlocatedat 32.5411282oN&74.6909402 oEand falls within the limits of two revenue villages, Gharana and Gharani. The Gharanavillagelendsitsnametothe wetland. Total area of the wetland as per the notification issued by the Department of Wildlife Forests, Govt. of J&K, is 80 ha (which turns out tobe1600kanals).Thewetlandhasvery limited open water in the middle and hasasurroundingexpanseofswamps which towards periphery merge with the agricultural fields owned by the residents of Gharana village.

Somepeoplesaythatthewetland has been there since the time immemorial and is being visited by migratory birds since a long time too. While some believe that the wetland was created by the villagers themselves for they needed mud to build and repair their mud houses. Every year peoplewouldremovethemudand this would deepen the wetland. Buteversincethevillagersstarted constructing concrete houses, thedepthofthewetlandhas decreased significantly.

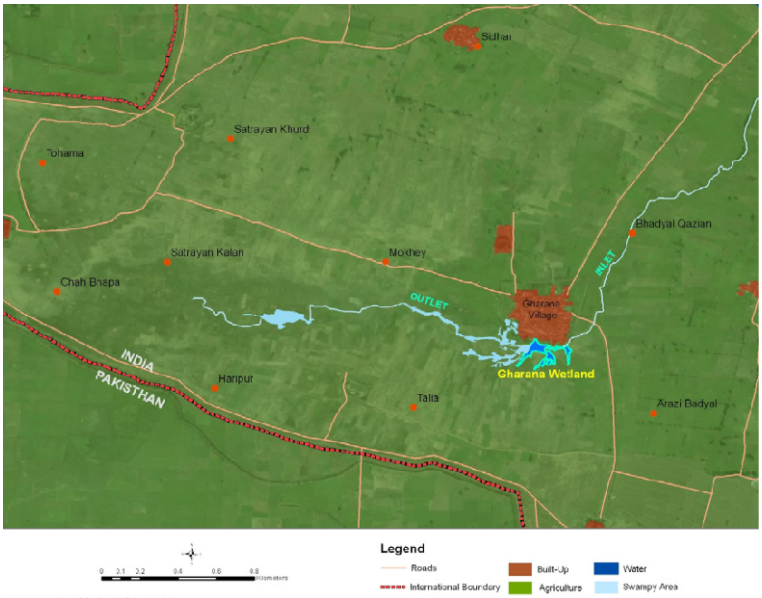


Fig1.1:MapofGharanaWetlandinit'spresentstates

TuftedDuckin Gharanawetland ©Dr.PushpinderSingh/WWFIndia

Approach and Access

Gharana is situated close to the Indo-Pakinternationalborderin tehsilRanbirSinghPuraofdistrict Jammu of Jammu and Kashmir. The wetland lies at a distance of around 35 km south of Jammucity and is about 10km from the town of Ranbir Singh Pura (R.S. Pura).Gharanaisapproachableby ametalledroad.TheInternational Borderliesataveryclose distance of500mfromthewetland.Toreach to the wetland, one has to divert from the NH44 to the Airport Road which further extends to the townof R.S. Pura. After reaching R.S. Pura town, one has to drive along the road leading to the Gharana village which passes through the agricultural fields known chiefly for cultivation of the Basmati Rice. The following route leads to the Gharanawetland:Jammu-Satwari-Miran Sahib-Kullian-R.S. Pura-Haripur-Gharana.

Definition of Wetlands

Definition by Mitsch and Gosselink, 1986: Wetlands are defined as lands transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surfaceorthelandiscoveredby shallow water.

The Ramsar Convention on Wetlands: Wetlands are the areasofmarsh,fen,peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish orsalt,includingareasofmarine water the depth of which at low tide does not exceed six meters. (article 1.1) The riparian and coastal zone adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands. (article 2.1)

Significance

GharanaGharanawetlandis significantforthefollowingreasons:

1. Gharana and the surrounding agricultural landscape together constitute an important habitat for speciesofwildfloraandfauna,both aquatic and terrestrial.

2. Gharana is situated along two importantflyways-theCentralAsian andEastAsian-AustralasianFlyways. It is an important wintering site for a variety of the migratory birds flying within these flyways. Thousands ofmigratorybirdsespeciallythe bar-headedgeesethrongthiswetland every winter.

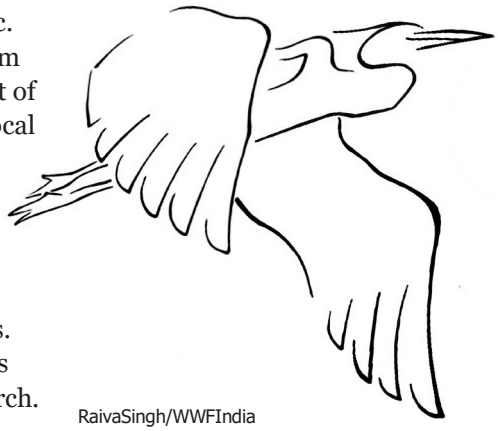
3. The wetland enjoys the status of an Important Bird Area (IBA) giving it an international recognition. Gharana is also a potential Ramsar Site. Gharana canalsoserveasanimportantcentrefor research and conservation education.

4. The wetland is famous among the tourists,bird-watchersandscholarsetc. Gharana wetland has huge ecotourism potentialandthereforehastheprospect of being a source of livelihood for the local community.

5. Like any other wetland, Gharana wetland also plays an important role inmaintainingtheecologicalbalance andprovidingotherecosystemservices. Theremaybenumerousotherfunctions served by it which need furtherresearch.

Birdmigration

Bird migration is a complexprocesswhereby birds undertake regular seasonal migration between geographically separated breeding and wintering ranges. The scale could vary from local levelshortdistancemigrationto long distance intercontinental migration. The whole exercise involved in the migration is meant for creating a balance between the available resources and to escape the harsh temperatures. The summer-timehabitatsareofteninhigher altitudes and latitudes whichare conducive for breeding and raising chicks while in winters when those places are too cold to survive, they are forced to migratetothelowlyingwarmer habitatswithsufficientfoodand shelter.



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CHAPTER2-BACKGROUNDINFORMATION ANDATTRIBUTES

Biogeography
Asperthebiogeographicclassification of India by Rodgers, Panwar and Mathur (2002), Gharana wetland anditssurroundingareasfallinthe 'Semi-Arid (4)' biogeographic zone and'Semi-Arid-PunjabPlains(4A)' biogeographic province of India.

Boundaries
AsperthenotificationissuedbytheDepartmentofForests,Govt of J&K, the Gharana wetland has following boundaries:
North: Gulabgarh village
South:Indo-PakInternationalBorder
East: Village Gharana
West:Indo-PakInternationalBorder

Altitudeandterrain
Gharanaissituatedintheplainswhich are to the south of Siwaliks of Jammu. The average altitude of these plains is around 275 m above mean sea level. The general terrain of the area is largelyflatandhomogeneousduetoits location in the plains contiguous with the Punjab Plains.

Geologyof the area
Gharana wetland is located in the plains to the south of Siwalik and therefore geologically is an area of recentage.Theseplainsarecovered by recent alluvium. The area is coveredbypost-Siwalik(geological recent past – ten thousand years ago)sedimentsshedbytheSiwalik Group of sedimentary strata.The group of strata of Middle Miocene to Pleistocene age is comprised ofsandstones,mudstones and pebble- and boulder conglomerates.Cannibalism of the Siwalik group of strata due to continuedupliftoftheHimalayan terrain since last 55 million years is the cause of shedding of these sediments to the Plains in front of the Himalayan foothill belt.The Gharana wetland is situated within this belt which is believed to have been created in the recent past.Thisisalsoevidencedbythe mudandclaysdomessurrounding the wetland on its eastern side. Lithologically these low lying domes are mainly composed ofsilt,sandandclaygradesediments which are similar to the wetland bank and wall sediments.There are no hard rock outcrops around the wetland.

On the other three sides the wetland is devoid of any such claydomesandthetopography is represented by the flat land comprising of top fertile soil

cover under which lies the clay andmudstonestrataofvariable composition, multicolored clay and occasional hard plastic clays with gravels. Deep underneath this top soil cover lies the Siwalik boulder conglomerate which has been encountered at varying depths in differentpartsoftheJammudistrict while boring for tube wells.

Catchment

Gharana wetland is surroundedbyarurallandscapedo minated by
agricultural fields. The agricultural fieldsaregrownwithpaddyandknown to produce the famed *Basmati* rice of Jammu.Besidespaddy,theothermain crop grown in the area is wheat. To theeastofthewetlandislocatedthe Gharanavillagewhichisdominated by concrete houses. The wetland receivesbulkofinflowfromsecurity ditchcontrolledbysecurityforces.The security ditch is fed by Ranbir Canal which itself receives water from Chenab River which has a large catchmentspanningoverJ&Kand Himachal Pradesh.

Climate

There is no authentic and reliable source of meteorological data located close to the Gharana wetland.Themostreliablesources of meteorological data is India MeteorologicalDepartment(IMD) and the nearest place that they collect and maintain data for is Jammu. The below given table depicts the climatological features of the area:

The climate of Jammu, like the rest of north-western India, features a humid subtropical climate, characterized by three well-definedseasonsviz,summer, winter and monsoon. The temperature in summer may rise to 46°C

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high°C (°F)	26 (79)	31 (88)	36 (97)	41 (106)	45 (113)	46 (115)	44 (111)	41 (106)	37 (99)	36 (97)	31 (88)	26 (79)	46 (115)
Average high°C(°F)	18.8 (65.8)	21.9 (71.4)	26.6 (79.9)	32.9 (91.2)	38.3 (100.9)	40.6 (105.1)	35.5 (95.9)	33.7 (92.7)	33.6 (92.5)	31.7 (89.1)	26.8 (80.2)	21.1 (70)	30.1 (86.2)
Averagelo w°C(°F)	7.4 (45.3)	9.6 (49.3)	13.6 (56.5)	19.0 (66.2)	24.4 (75.9)	26.8 (80.2)	24.5 (76.1)	24.0 (75.2)	23.0 (73.4)	18.4 (65.1)	12.6 (54.7)	8.5 (47.3)	17.7 (63.9)
Recordlow °C(°F)	−2 (28)	−3 (27)	3 (37)	6 (43)	7 (45)	13 (55)	13 (55)	8 (46)	12 (54)	4 (39)	2 (36)	−3 (27)	−3 (27)
Rainfall mm (in)	52.4 (2.063)	79.0 (3.11)	74.9 (2.949)	47.1 (1.854)	34.8 (1.37)	87.3 (3.437)	371.5 (14.626)	370.2 (14.575)	140.9 (5.547)	25.1 (0.988)	10.1 (0.398)	38.3 (1.508)	1,331.6 (52.425)

MeanmonthlyandannualtemperatureinJammu,Source:IMD

Swollenwetlandduringmonsoonseason©Dr.Pushpinder Singh/WWF

(115°F), and in the winter months occasionally falls below freezing. SummerstartinthemonthofApril with the month of June, generally, beingthehottestmonthoftheyear with average high temperatures of 40.6°C (105.1°F). Winter season start in November and continues till March with January being the coldest month. Temperature in January may average very low, reaching7°C(45°F).Monsoonsetsin the month of July and continues till September.

Average annual precipitation received by the area is about 42 inches (1,100 mm) with the bulk of therainfallinthemonsoonmonths, althoughthewinterscanalsobewet to rainfall caused by western disturbances. During the winter months,denseblanketoffogcovers the whole area and temperature even drops to 2°C (36 °F). The fog causes much inconvenience to the people living in the area.

In summer, particularly in the monthsofMayandJune,extremely intense sunlight can raise the temperature to 46°C (115 °F) leading to a hot local wind called *Loo* which sweeps the whole area hot and dry. Monsoon mainly reaches Jammu in the month of July and lashes the regionwith heavy downpours often accompanied by thunderstorms. The rainfall may total up to more than700mm(27in)inthewettest months.

Hydrologicalregime

Thesustainablewateravailability is an important determinant of the nature and health of a wetland. The hydrological balance of a wetland imparts the basic character to a wetland. Water is very crucial and the basic element for a wetland to prosper as an ecosystem. Maintaining a range of wetland hydrology types spanning both hydrologically variable and permanent wetlands is important for maintaining a range of habitat for water dependent biodiversity throughoutthelandscape(Roshier et al., 2002; Amano et al., 2008). Various chemical and physical properties of the wetlands such as nutrient availability, degree ofsubstrateanoxia,soilsalinity, sedimentpropertiesandpH are highly dependent on the hydrologic conditions of the wetlands. These modificationsofthephysiochemical environment, in turn, have a direct impact on the biotic response in the wetland (Gosselink & Turner 1978). When hydrologic conditions in wetlands change even slightly, thebiotamayrespondwithmassive changes in species composition and richness and in ecosystem productivity. Water, therefore, occupiesthepedestalinthewetland conservation.

Sourcesof water

The main source of inflow to the wetland is the security ditch which isactuallyacanalofwater running paralleltotheInternationalBorder with Pakistan. The security ditch is mainly supplied water from the RanbirCanalwhichoriginatesfrom Akhnoor and receives water from the River Chenab. The water from Ranbir canal is actually supplied for irrigation and in R.S. Pura its controllieswiththeSub-Divisional Magistrate (SDM), R.S. Pura who allows or stops the supply only after receiving applications from the panchayats of the beneficiary villagesaspertheirirrigationneeds.

There is a network of canals which carries water to different villages and to the security ditch from whichfurthersmallercanalssupply water to the villages in the forward areas beyond the security ditch. One similar but smaller channel supplies water to Gharana wetland. The overflow from the securityditch keeps the Gharana wetland flooded. When the Ranbir Canal is closed, the security ditch is flooded by pumping the ground water intoitandthesurpluswaterflowsoutt o the wetland. Gharana also receives rainwaterfromitscatchmentwhich largelycomprisesoftheagricultural fieldssurroundingthewetland.The domestic sewage inflow from the nearby Gharana village also enters the wetland and adds some volume to it. The water received by the wetlandfromtheditchaswellasthat from the catchment dominated by agricultural fields has high turbidity.

Depth

AspereldersintheGharanavillage tell that Gharana wetland used tobe significantly deeper than what it is today. But at present, the depthofGharana,onanaverage,does not exceed3feet.Itisashallowwetland which is getting even shallower due to continuous siltation. When the Gharana village had mud houses madefrommud,theactofremoving mudfromthebottomofthewetland for building houses or for plastering thewallswoulddeepenthewetland. But ever since (since about a decade) the locals built concrete houses,whateverdesiltingusedto be done, has completely stopped. The depth of the wetland has, therefore, decreased considerably over time.

Annualwaterlevelchanges

Gharana wetland encounters seasonal fluctuations in the water level. During the winter season, the wetland catchment receives lesser from the Ranbir Canalyetanoptimalwaterlevel is maintained. During the early summers(inthemonthsMarch & April) the Ranbir Canal is closedforde-siltationand repairs. During this period the canal runsdry,thewatersupplytothe wetland also stops temporarily. The wetland, during this lean phase depends on groundwater pumped by security forces in security ditch and rainfall in its catchment.Sincethesummersare very hot, the evapotranspiration from the surface of the wetland and aquatic vegetation leads to decline in the water level. During thisleanperiod,thewetlandoften gets reduced to a small pool of clear water. The area also gets significant amount of monsoonal rains. During monsoons, the wetland gets completely flooded and water breaches its boundary to enter the nearby agricultural fields.

Water Chemistry

Optimum water quality is as much important for an aquatic ecosystemasisthewaterquantity.Wate rquality plays a significant role in wetland
health and productivity. Water quality is affected by changes in nutrients, sedimentation,temperature,pH,heavy metals, non-metallic toxins, persistent organics and pesticides, and biological factors, among many other factors (Carr and Neary 2008). Standard statistical classification of surface freshwater quality for the maintenance of aquatic life by UNECE, 1994 has been presented in the table 2.2.

The water chemistry was studied for Gharana wetland asitreceivesdomesticsewage and agricultural inflows. For studying the water chemistry of Gharanawetland,watersamples were collected from six different sites within the wetland and analyzed with regard to their chemical characteristics (Table 2.1). Eleven parameters were studied which included pH, Sodium, Calcium, Magnesium, Potassium, Fluoride, Chloride, Nitrate, Sulfate, Phosphate and Carbonate.

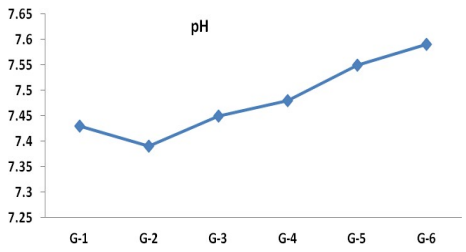
Gharanawetland©Dr.PushpinderSingh/WWFIndia

S.No	Sampling Sites	Sampling Location
1	G-1	Neartheentryofwaterfromthesecurityditch
2	G-2	Near the entry of village waste drain into the Gharana wetland
3	G-3	Eastern shore of the wetland
4	G-4	Westernshoreofthewetland Water
5	G-5	near the outlet
6	G-6	MiddleoftheWetland

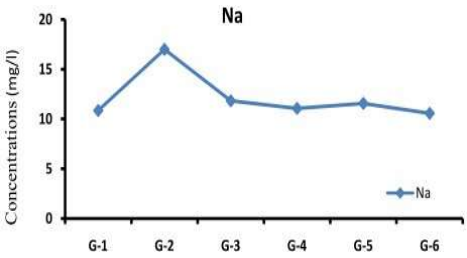
Table2.1LocationsofsamplingpointsinGharanaforwater sampling

Variables	Class I	Class II	Class III	Class IV	Class V
Oxygen regime					
DO (%)					
epilimnion (stratified waters)	90-110	70-90 or 110-120	50-70 or 120-130	30-50 or 130-150	<30 or >150
hypolimnion (stratified waters)	90-70	70-50	50-30	30-10	<10
unstratified waters	90-70	70-50 or 110-120	50-30 or 120-130	30-10 or 130-150	<10 or >150
DO(mg l^{-1})	>7	7-6	6-4	4-3	<3
COD-Mn (mg O_2 l^{-1})	<3	3-10	10-20	20-30	>30
COD-Cr (mg O_2 l^{-1})	-	-	-	-	-
Eutrophication					
Total P (µg l^{-1})[1]	<10 (<15)	10-25 (15-40)	25-50 (40-75)	50-125 (75-190)	>125 (>190)
Total N (µg l^{-1})[1]	<300	300-750	750-1,500	1,500-2,500	>2,500
Chlorophyll a (µg l^{-1})[1]	<2.5 (<4)	2.5-10 (4-15)	10-30 (15-45)	30-110 (45-165)	>110 (>165)
Acidification					
pH[2]	9.0-6.5	6.5-6.3	6.3-6.0	6.0-5.3	<5.3
Alkalinity (mg $CaCO_3$ l^{-1})	>200	200-100	100-20	20-10	<10
Metals					
Aluminium (µg l^{-1}; pH 6.5)	<1.6	1.6-3.2	3.2-5	5-75	>75
Arsenic (µg l^{-1})[3]	<10	10-100	100-190	190-360	>360
Cadmium (µg l^{-1})[4]	<0.07	0.07-0.53	0.53-1.1	1.1-3.9	>3.9
Chromium (µg l^{-1})[3]	<1	1-6	6-11	11-16	>16
Copper (µg l^{-1})[4]	<2	2-7	7-12	12-18	>18
Leader (µg l^{-1})[4]	<0.1	0.1-1.6	1.6-3.2	3.2-82	>82
Mercury (µg l^{-1})[4]	<0.003	0.003-0.007	0.007-0.012	0.012-2.4	>2.4
Nickel (µg l^{-1})[4]	<15	15-87	87-160	160-1,400	>1,400
Zinc (µg l^{-1})[4]	<45	45-77	77-110	110-120	>120
Chlorinated micropollutants and other hazardous substances					
Dieldrin (µg l^{-1})	na	na	<0.0019	0.0019-2.5	>2.5
DDT and metabolites (µg l^{-1})	na	na	<0.001	0.001-1.1	>1.1
Endrin (µg l^{-1})	na	na	<0.0023	0.0023-0.18	>0.18
Heptachlor (µg l^{-1})	na	na	<0.0038	0.0038-0.52	>0.52
Lindane (µg l^{-1})	na	na	<0.08	0.08-2.0	>2.0
Pentachlorophenol (µg l^{-1})	na	na	<13	13-20	>20
PCBs (µg l^{-1})	na	na	<0.014	0.014-2.0	>2.0
Free ammonia (NH_3)	na	na	-	-	-
Radioactivity					
Gross-alpha activity (mBq l^{-1})	<50	50-100	100-500	500-2,500	>2,500
Gross-beta activity (mBq l^{-1})	<200	200-500	500-1,000	1,000-2,500	>2,500

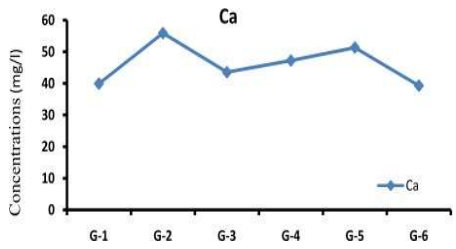
Table2.2:Surfacefreshwaterqualitystandardsforthemaintenanceofaquatic life



pH variability across Gharana wetland



Sodium distribution in water samples collectedfromGharana



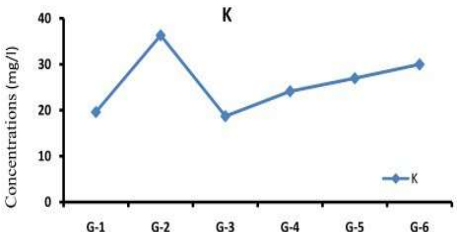
Calciumdistributioninwatersamples collected from Gharana wetland

Thevariouschemicalparameters which were studied are given as below:

1. pH: pH of water of Gharana wetlandrangedbetween7.39to7.59 at various sites which indicates the slightly alkaline nature of wetland. The pH value of the water expresses its tendency to donate or accept hydrogen ion on a scale of 0 (very acidic) to 14 (very basic). Natural waters generally range from pH 6.5 to pH 8.5.

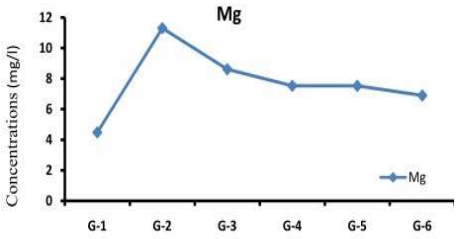
2. Sodium: Na+ concentrations ranging from 10.87 to 17.01 mg/l were observed in various parts of the wetland.HighestNa+concentrations were found near the point of influx of sewage from the village to the wetland,whereas,lowestvalueswere reported from the water inlet from thesecurityditch.Thisindicatesthat sewage water is the major source of Na+ to the water body. Na+ is considered toxic if the dose of Na+ ishighenough. Ifadequatewater is available,mostanimalscantolerate relatively large doses by increasing Na+ excretion.

3. Calcium: The value of Calcium ranged from 39.33 to 55.94 mg/l in thesamplestakenfromthewetland. Highest Ca2+ was observed nearthe inlet of drain from the village, whereas the lowest concentrations were noted from the centre of the lake. Weathering of carbonates is generallyconsideredtobethemajor source of Ca2+ in the water-bodies.



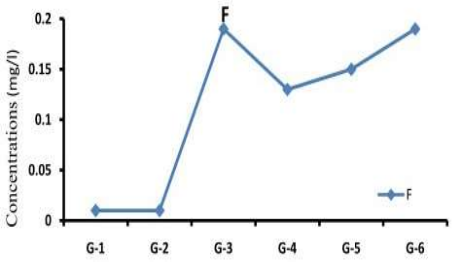
Potassiumdistributioninwatersamples collected from Gharana wetland

4. Potassium: Potassium concentration in the water samples ranged from 18.72 to 39.94 mg/l. Natural source of Potassium in water is the minerals like feldspar. Polluted waters are also an important source of the K+ to the water bodies. The runoff from the agriculturalfieldsisalsoasourceof potassium in the water.



Magnesiumdistributioninwatersamples collected from Gharana wetland

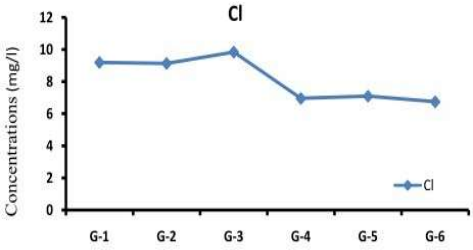
5. Magnesium: High values of magnesiumhavebeenreportedby astudycarriedbyNIHinGharana wetland (unpublished data). The values of Mg2+ ranged between 4.48and11.31mg/l.Highestvalues were reported from the inlet of sewage drain from the village whereas, the lowest values were reported at the entry point of water fromthesecurityditch.Weathering of carbonates is generally considered to be the major source of Mg2+ in the waterbodies.



Fluoridedistributioninwatersamples collected from Gharana wetland

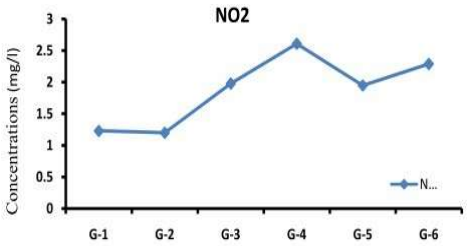
6. Fluoride: Fluoride concentration varied from 0.01 to0.19mg/linthewatersofthe Gharana wetland. Fluorides are the pollutants with immense significance as they have considerablepotentialforecological damage (Datta et al., 2014).
Fluorides accumulate steadily inthe environment as they do not breakdown easily. The highest values of Fluoride were found to be inthewatersamplestakenfromthe eastern shore of the wetland as well as middle of the wetland.

7. Chloride: Chloride in the Gharanawatersshowedavariation from 6.75 (centre) to 9.85 (drain inlet). Chlorides mostly enterwater bodies from several external sources such as rocks, agricultural runoff, industrial waste water, oil well waste, effluent from wastewatertreatmentplantsand salting road (Nollet, 2000).



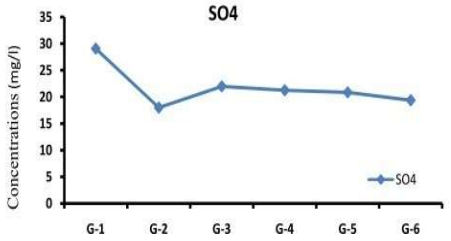
Chloridedistributioninwatersamples collected from Gharana wetland

8. Nitrate: Nitrate concentration varied between 1.23 to 2.62 mg/l in the Gharana waters. Lowest concentrationwasobservedinthe water entering from the security ditch,whereashighernitratevalues were observed at other samples collected from the wetland. Nitrate may contaminate water as a result of contact with natural minerals (e.g. niter), agricultural runoff (fertilizer, manure) or industrial processes. In Gharana, the most likely source of nitrate is the runoff from the agricultural fields in the wetland catchment.



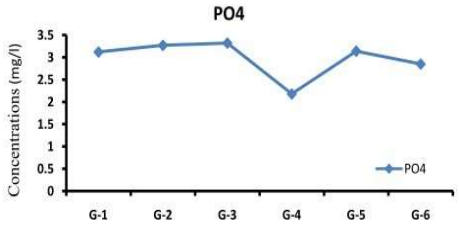
Nitratedistributioninwatersamples collected from Gharana wetland

9. Sulfate: The concentrations of sulfate in Gharana wetland ranged between 29.9 mg/l and 17.99 mg/l. Therearesevеralsourcesotherthan soil which bring sulfate in waterare, decaying of plant and animal matter, excessive use of fertilizer having the chemical product of ammonium sulfate. Sulfates are absorbed by the body only in very small quantities but at high concentration of magnesium and sodiumsulfateinwatermaycause



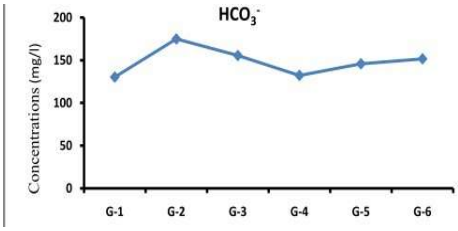
Sulfatedistributioninwatersamples collected from Gharana wetland

intestinaldiscomfort,diarrheaand consequently dehydration.



Phosphatedistributioninwatersamples collected from Gharana

10. Phosphate: Phosphate concentrations were observed to vary between 2.18 to 3.32 mg/l in theGharanawetland.Thechemical fertilizers are an important sourceofPhosphatesinthewater bodies and in case of Gharanathe Phosphates may be fed by theagriculturalrunofffromthe surroundingagriculturalfields.



Bicarbonatedistributioninwatersamples collected from Gharana wetland

11. Bicarbonate: From the results it can be concluded that thebicarbonateconcentrationin Gharanalakewaterranges between 130.33to175.06mg/l. Bicarbonate normally ranges from 25 to 400 mg/l.Thebicarbonateionsserve as the main buffer in freshwater systemsandprovidecarbondioxide for photosynthesis. The mainsourceofbicarbonateinfreshwa ter is minerals like limestone and dolomite.

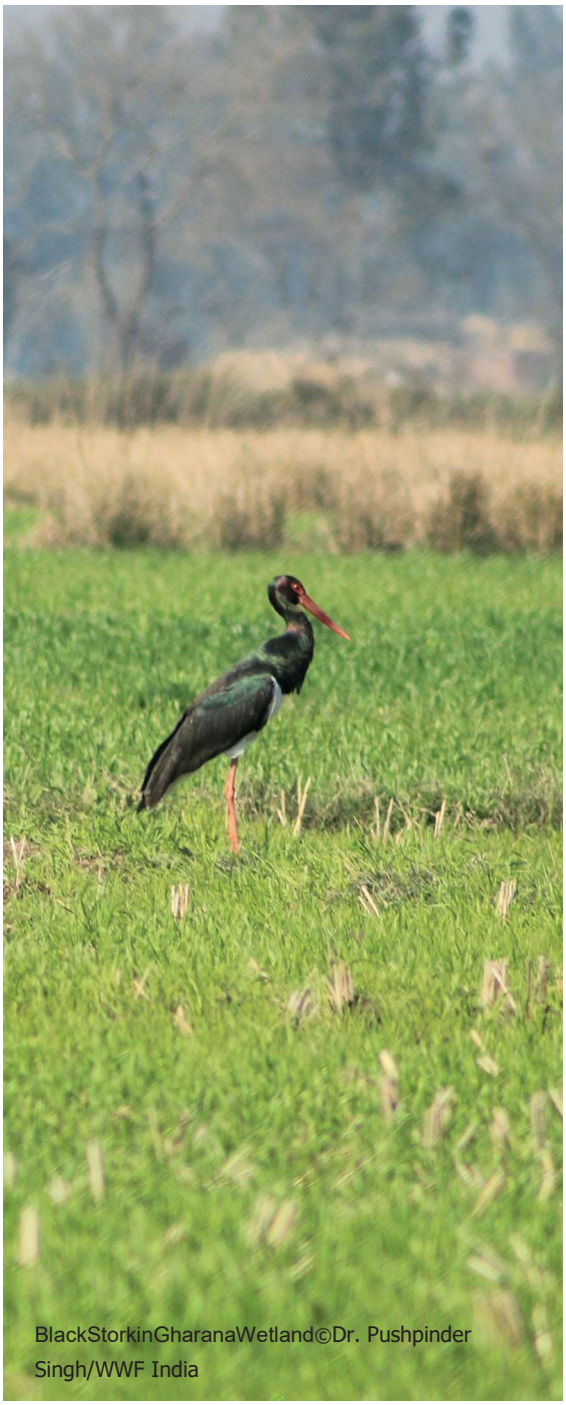
Gharanawetland©Dr.PushpinderSingh/WWFIndia

Effects of bird droppings on wetland ecology:
Although no study has been conducted in this regard, there possibly be some effect of bird droppingsonthewaterecology whichneedstobeinvestigatedby conducted a well-design study. The potential effects of birds' droppingsonthewetlandecology are:

i. The waterbirds that form large anddenseflocksatthebreeding/ roosting sites can potentially importenoughnutrientsthrough their droppings, to cause major shifts in trophic status of the waterbody.

ii. Bird droppings are rich source of nutrients like phosphorous (P) &nitrogen(N)andmaystimulate guanotrophication, a form of eutrophication caused by bird droppings.

iii. When bird droppings fall in a waterbody,theyenrichthewater with nutrients and often lead to algal blooms. The cyanobacteria blooms so formed produce cyanotoxins which release into thewaterafterthealgaediesand thus degrades the water quality. The most prominent impact of algalbloomsis'hypoxia'whichisa resultofextremeoxygendepletion which leads to unhospitable conditions for the aquatic animals and submerged plants.



BlackStorkinGharanaWetland©Dr. Pushpinder Singh/WWF India

CHAPTER3-BIODIVERSITY

Biodiversity: Wetlands are called as "biological supermarkets" and rightlysoastheyarehighonprimary productivity as well as biodiversity. The freshwater wetlands alone are known to support 20 per cent of the known range of biodiversity in India(Deepa&Ramachandra1999). Gharana wetland also stands out when it comes to the biodiversity of the wetlands in Jammu and has representation of species from a widerangeoftaxonomicalgroupsof floraandfauna.Whilesomeaspects related to biodiversity of Gharana have been studied thoroughly, there are numerous other aspects whichhavenotbeen researchedso well. The most thoroughly studied subject when it comes to Gharana is waterfowls and the most poorly studied aspect is invertebrates. As per the studies conducted here, by different researchers at different timeshavesuggestedthatGharana alongwithitssurroundingexpanse of agricultural landscape support numerous species of water-dependent species of birds. The remarkable diversity of avifauna of the area may be attributed to the reason that the area presents aheterogeneousmosaicofmicro-habitatswithinthelargerecosystem and that may be the reason for the diversity of feeding guilds that are represented here.

Gharana wetland is immensely important for supporting a large assemblage of migratory birds some ofwhicharegloballythreatenedand facingextinction locallyaswellasat the global level.

Terrestrialvegetation: The natural terrestrial vegetationis largely subtropical with the prevalence of *Acacia nilotica, Acacia modesta, Cassia fistula, Grewia optiva, Butea monosperma, Albizzia lebbek, Adhatoda vasica, Dalbergia sisso, Morus alba, Terminalia chebula* and *T. bellerica*etc.Some of the cultivated tree species planted close to the wetlands include*Eucalyptusspp.,Callistemon spp.* etc. Some species of shrubs found in the area include *Ziziphus mauritiana, Ipomoea carnea* and *Vitex negundo* etc. The terrestrial vegetation in and around the wetlandsprovidesfoodandshelterto many land birds which live close to the wetlands and are dependent on the wetlands.

Ecologicalroleofagricultural: fields: The agricultural fields, in general, play a critical role as wildlifehabitatasnumerousspecies of wild animals find refuge in the agricultural landscapes. The crop leftover after the harvest attracts many animals which migrate

for a shorter period or live there permanently.The heterogeneity offered by the presence of trees, grassy patches, water pools and channels enrich the agricultural habitat and allow for greater biodiversity. In case of Gharana wetland,theagriculturallandscape surrounding it adds great value to the biodiversity of the wetland. During *kharif* season when the paddy is cultivated, the whole landscape makes one large wetland and serves as a refuge for several species of summer visitors. As the winters arrive and fields are grown withwheatandtrifolium,thewinter migrants find attracted to them. Someofthenotablewintering species (such as Asian woolyneck, red-naped ibis, common crane, demoiselle crane, black stork etc.) are found predominantly in the agricultural fields rather than the wetland itself. Many of these birds find abundant food in the form of crop leftovers and at the same time, thecropleftoversalsoattractvarious invertebrates (especially insects) which themselves are food for many these birds. The crop fields not just provide a wide variety of foodbut also have vegetation patches which help them conceal themselves from the potential predators. The agriculturalfieldsconstituteahabitat whichiscompletein allrespects, and hold great ecological importance.

A flock of migratory birds in the agricultural fields near Gharana wetland ©Dr. Pushpinder Singh/ WWF India

Aquatic vegetation: The various species of aquatic plants found in Gharana wetland include Water Hyacinth *(Eichhornia crassipes)*, Alligator Weed *(Alternanthera philoxeroides)*, Mosquito Fern *(Azolla pinnata)*, Common Duckweed*(Lemnaminor)*,Greater Duckweed*(Spirodellapolyrrhiza)*, Water Morning Glory *(Ipomoea aquatica)*, Hydrilla *(Hydrilla verticillata)* and Cattail *(Typhalatifolia)*.

Though wetlands harbor a wide varietyofaquaticplants,butnotall plants are useful for the wetland. There are some species of aquatic plants which are not native and have invasive nature and can be considered as weeds. Weeds are generally vigorous and hardy and successfully compete with native species for space, light, nutrients and water. They deteriorate the health of a wetland by increasing the net surface area, increasingthe rate of evapotranspiration and enhancing the rate of succession which ultimately reduces its age.It is believed that any type of human disturbancein thewetland ecosystems greatly increases the risk of serious weed invasion. The WaterhyacinthandAlligator weed can be considered as weeds as they grow very fast and cover the entire wetland.Moreover,theyhardlyhave any food value for the aquatic birds. In Gharana, infestation of both the WaterhyacinthandtheAlligator weed are a serious of cause of concern for the conservation.

The Alligator weed *(Alternanthera philoxeroides)*isaperennialaquatic and semi-aquatic plant native to tropical and subtropical South America. It has been reported to be an invasive pest in at least 30 countries, scattered across tropical, subtropical and warm temperate areas. A problematic feature of alligatorweedisitsabilitytoproduce dense mats of interwoven stems extending many meters across a water surface, effectively forming a 'blanket' across the water. Such mats can be more than 1 m thick andsometimesbreakawayfromthe parent mat to become free-floating andself-sufficient(Grovesetal.1995; van Oosterhout 2007). On the other hand, water hyacinth *(Eichhornia crassipes)* is a free floating perennial aquatic plant, native to Amazonia, Brazil (Wright and Purcell 1995). It has spread throughout the tropical, subtropical and warm temperate regions of the world and caused environmental and cultural problems(WrightandPurcell1995, Centreetal. 2002). Water hyacinth forms dense impenetrable mats across water surfaces that greatly decrease biodiversity. It degrades water quality and limits access byhumans,machinery,animals and birds (Centre et al. 2002). Water hyacinth also has a large

evapotranspirationratelosingwater into the atmosphere at a rate that is up to six times faster than that fromtheopenwater(Pieterse1978). Both these weeds increase the rateof sedimentation in the wetland and fillthewetlandfasterthanexpected. Thishasbearingontheprosperityof ecosystem and the longevity of the wetland.

Lately, *Azolla pinnata* which is atypeofaquaticfernhasalsoemerged to be a weed. In the year 2012, there were seen Azolla blooms on theGharanawetlandwhichformed a dense and thick mat covering the whole wetland. This created a barrierbetweenthewetlandandthe atmosphere potentially leading to reduced mixing of air in the water and the penetration of light.

EcologicalSuccession: Ecological succession is a steady & gradual process of change in the species composition of a habitat as it shifts from one seral stage to another. Gharana wetland has also, over the years,seenhydrarchsuccessionfrom a relatively deeper waterbody to a shallower one. The wetland is much shallower towards the banks. There are abundant submersed aquatic plants in the deeper zones while the muddy shallow waters near the bankshavecattailsandotherrooted emergent species. The wetland has largematsofrooted-floatingspecies such as water hyacinth, alligator weed, azolla, spirodella and lemna. The alligator weed has formed an intensely dense network in the shallow zone towards the banks. These weeds trap sediments and reinforce the process of siltation in the wetland thereby furthering the ecological succession. These weeds also lead to comparatively greater evapotranspirationfromthewetland causing longer spells of dryness. This can, therefore, be summed up that the ecological succession has beenpushingthewetlandtowardsa terrestrial habitat and may not halt unless it is actively managed.

Fauna: Wetlands act as suitable habitats for various faunal species. Burger (1985) recognized wetlands as fragile ecosystems with diverse attributes including distinct avifauna. Gharana wetland is particularly important as it hosts large numbers of migratory birds everywinter.Gharanaisamongthe most important wintering grounds for migratorybirdsin theNorthern India,especiallyfortheBar-headed Goose.

Lesser-whistelingduckGharanawetland©Dr. PushpinderSinghWWF India

Birds: As has been mentioned that Gharana wetland is an important wintering habitat for migratorybirds, it is an important site among the network of wetlands which together constitute the East Asian-Australasian and Central Asian Flyways. Different studies on birds have been conducted by different researchers. Sohil and Sharma (2020)reported106speciesfromthe wetland and its surrounding area. Jamwal et.al (2017) revealed that in all 151 species of birds belonging to15 orders and 45 families are foundin Gharana wetland. Out of these 151 species of birds 74 species have been found to visit Gharana only during the winters. Around 54 species of birdswerefoundtoberesidenttothe area while 11 species are the summer visitors and the remaining 12 species of birds have found to be vagrant innature(Fig3.12).The majority of winter visitors to Gharana wetland have been observed to be linkedtotheordersCiconiiformes, AnseriformesandCharadiiformes. ProminentwintervisitorstoGharana wetland include, Bar-headed Goose *(Anser indicus)*, Ruddy Shelduck *(Tadorna ferruginea)*, Gadwall*(Anas strepera)*, Eurasian Wigeon *(Anas Penelope)*, Mallard *(Anas platyrhynchos)*, Northern Pintail *(Anas acuta)*, Northern Shoveller *(Anas clypeata)*, Red-crested Pochard *(Rhodonessa rufina)*, Common Pochard *(Aythya ferina)*and Tufted Duck *(Aythya fuligula)*.Long-tailed Duck *(Clangula hyemalis)* has also been documented tobesightedfromthewetlandaftera gap of 73 years (Jamwal et.al. 2017). These species of birds come from far off places like Russia, Siberia, South and East Asia, China and Caspian region.

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On the basis of abundance, ithasbeenfoundthatofthe totalof151species,33species are very common and can be spotted very easily while 56 species are termed common as they are not spotted as oftenasthosekeptinthevery commoncategory.Around62 speciesofbirdswerefoundto berarelocallyandcouldnotbe spotted easily (Fig 2.13).

Dependinguponthefeeding habits,eighttypesoffeeding guilds were identified in the Gharana wetland which include Herbivorous, Bark-feeder,Carnivores,Frugivores, Graminivore, Insectivores,

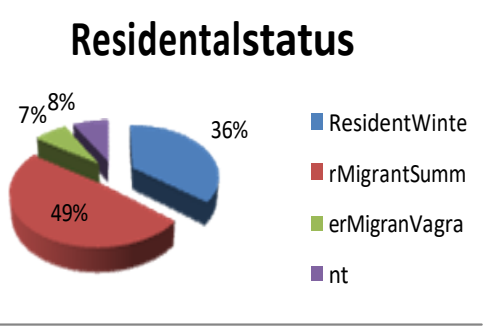


Fig3.12Graphdepictingresidentialstatusof BirdsinGharana

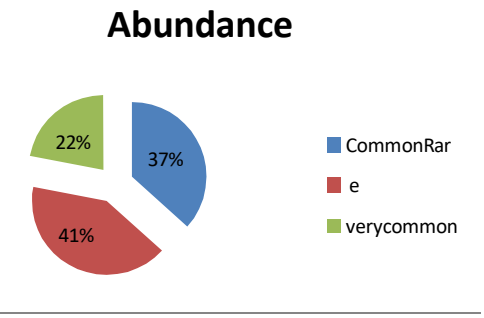


Fig3.13Graphdepictingabundanceof birdsinGharana

Table3.3:ThreatenedbirdsofGharana Wetland

Common Name	ZoologicalName	ICUNRedliststatus
Egyptian Vulture	*Neophronpercnopterus*	Endangered
SteppeEagle	*Aquila nipalensisAquila*	Endangered
GreaterSpottedEagle	*clanga*	Vulnerable
Common pochard	*Aythya ferina*	Vulnerable
River Tern	*Sternaaurantia*	VulnerableNear
Black-headed Ibis	*Threskiornismelanocephalus*	threatened
Black-neckedStork	*Ephippiorhynchus asiaticus*	Nearthreatened
Asian woollyneck	*Ciconia episcopus*	Nearthreatened
Black-tailedGodwit	*Limosa limosa*	Nearthreatened
Eurasian Curlew	*Numenius arquata*	Nearthreatened
Curlew Sandpiper	*Calidris ferruginea*	Nearthreatened
Ferruginous Duck	*Aythya nyroca*	Nearthreatened
Painted Stork	*Mycterialeucocephala*	Near threatened
PallidHarrier	*Circusmacrourus*	Near threatened

NectarivoreandOmnivore.Among the birds found, 19(13%) were herbivorous, 2 (1%) were bark-feeders,46(36%)werecarnivores, 6(4%)werefrugivores,7(5%) weregraminivore,40(26%)were insectivores,1(1%)werenectarivores and 30 (20%) were omnivores. A checklistofbirdsofGharanawetland has been attached as annexure I.

Other fauna: Gharana also harbours a healthy population of turtles, amphibians and fish. The Department of Wildlife Protection,in the past has introduced fish fingerlings for consumption by the birds.Theygenerallyintroducecarps like Rohu *(Labeo rohita)* and Mrigal *(Cirihuns mrigala)*. Important mammals found in the area include WildBoar,IndianPorcupine,Jackal, IndianHare,IndianGreyMongoose, Squirrel etc. Various species of snakes are also found in and around the wetland. Bengal monitor has also been reported from the area surrounding the wetland. Tara et al. 2011, reported around 14 species of aquatic bugs belonging to families Corixidae, Belostomatidae, Nepidae, Notonectidae, Hydrometridae, Pleidae, Mesovelidae, Vellidae and GerridaefromtheGharanaWetland. These aquatic insects are important members of aquatic ecosystems. They play an important role in nutrientcyclingoftheecosystemand also serve as reliable indicators of ecological characteristics of water. Theseinsectsarefrequentlyusedin biomonitoring studies because the responses of macroinvertebrates to organic and inorganic pollution havebeenextensivelydocumented (Thorne and Williams, 1997). Aquaticinsectsbelongingtoorder Hemiptera are important as fish food, bioindicators, predators and biocontrol agents. They are importantfoodformanyorganisms including fish, amphibians, waterfowlandotheranimals(Clark, 1992).

Wetland services and values: Wetlands provide many important useandnon-useservicestohumans. But the value of wetlands has been realized only recently. The most notable services provided by the wetlands include improving water quality, controlling flood, providing wildlife habitat and supporting recreational activities. Nowadays, there is growing concern about the importance of wetland ecosystems and wide variety of goods and services provided by them such as biodiversityorfreshwaterinhuman welfare(SchuytandBrander,2004).

Gharana wetland offers a host of ecosystem services. The investigationshaverevealedthe various use and non-use values providedbythiswetland.Usevalues are the values arising from the actual, planned or possible use of goods and services. They may be as given below:

Direct use values: Among the various Direct Use-values which areofferedbytheGharanawetland include:

1. **Micro-climatic regulation:** is another important value attributedtothesewetlandsespecially, Gharana wetland.Gharanamodifiesthemicro-climate of its surrounding area and provides slight relief to the locals against scorching heat in summers.

2. **Aesthetic/recreation value:** It for the aesthetic value of Gharana thatalotoftouristsvisitthiswetland during winters. The migratory birds wintering in Gharana are the main attractionfortouristsandtheyaddto the aesthetic value of Gharana.

3. **Irrigation/agricultural support:**Gharanawetlandbenefits the local population by providing water for irrigation. They pump water from the wetland to irrigate their fields during the lean phase. The overflow from the wetlands is one of the main sources of irrigation waterfortheresidentsofGharanaof village.

4. **Tourism:** Gharana wetland is fast gaining importance as a major eco-tourismdestination.Everyyear hundredsoftouristsvisitthiswetland to see the migratory birds. This wetland has lately attained the status of birders' paradise. Gharana holds the potential of providing tourism asa sustainable livelihoods options to the local communities.

Indirect use values: Indirect benefitsarederivedfromsupporting and protecting activities that have directly measurable values. Among the Indirect Use-values offered by the Gharana wetland include:

1. **Carbon sequestration/ storage:** Vegetation, both aquatic as well as terrestrial, removes the atmospheric carbon and fixes it by converting it into biomass. Though small,butwetlandssuchasGharana contribute significantly in carbon sequestration.

2. **Genetic resources:** Gharana wetlandactasstorehousesofgenetic resources. It plays a significant role inprotectionandmaintenanceofthe local gene pool.

3. **Groundwater recharge:** The groundwater pumps in the vicinity of the Gharana wetland have been found to yield greater volumes of water at shallower depths. This proves that the wetland plays a key role in ground water recharge. The hand-pumps in the neighborhoodof wetland keep running during the peaksummerswhenthefluxesfrom pumps away from the wetland go down.

4. **Nutrient regulation:** Wetlands trap the nutrients from the water and help them regulate by putting them back to their respective biogeochemical cycles. Gharana wetlandalsoplaysanimportantrole with regard to this.

5. Wildlife Habitat: Gharana wetland provides refuge to wide variety of wild flora and fauna. This wetland is particularly crucial for quite a few species of migratory avifaunawhichspendsignificantpart of their lives at this wetland (various species listed in annexure I).

ApartfromvariousUse-values,there isalsoaNon-usevalueattachedwith these wetlands, the Existence value. Themerethoughtoftheexistence of these wetlands, undoubtedly, provides satisfaction to the local dwellers the area.

ApairofTuftedDucksatGharanawetland
©Dr.PushpinderSingh/WWFIndia

Types of Wetland Services
BasedontheMillenniumEcosystem Assessment framework, ecosystem services from wetlands can be categorized into four broad categories. The categories are:

A. Provisioning services: These areessentiallytheproductsobtained from wetland ecosystems such as fresh water and fish for human consumption.

B. Regulatingservices: Theseare essentially the benefits to humans attributable to the regulation of ecosystem processes such as watertreatmentandlocalclimate regulation.

C. Supporting services: These servicesunderpintheproductionof allotherecosystemservicessuchas nutrient cycling, water cycling, and provisioning of habitat for wildlife.

D. Cultural services: These are typically non-material benefits received by people from direct and indirect interactions with wetlands suchasrecreation,aestheticvalues, spiritual benefits (e.g. indigenous connections with wetlands) and enhancements in knowledge.

CHAPTER4-HISTORYOFMANAGEMENT AND PRESENT PRACTICES

Site Status

Protected Area status: The GovernmentofJammuandKashmir, following its cabinet decision no. 35 dated 02.02.1981, issued an order bearing no. FST/GF—9/90 dated 04.02.1981 listing various National Parks, Sanctuaries and GameReservesofJ&Kstate.Under thesameorder,atotalof11wetland reserves,includingGharanawetland, were also notified. Following this the then district collector of Jammu, issued a public statement in 1982 bearing no. SO/2081-82 and dated 11.02.1982), declared the notified wetlandsaswetlandreservesbringing these wetlands under the ambit of theprovisionsoftheJammuand KashmirWildlifeProtectionAct, 1978, and granted a time period oftwomonthsforanybodytofile objections and rights, if any.

Backtheninthe1980sand1990s, game hunting was not illegal as it was allowed under the provisions of Jammu and Kashmir Wildlife ProtectionAct,1978andlikevarious other wetlands reserves of Jammu, Gharana also emerged as a major destination for game hunting. Huntingpermitswouldbeissuedand huntingenthusiastsfromJammuand surrounding areas would regularly visit these wetlands for game hunting. This trend could only be ended after Jammu and Kashmir Wildlife Protection Act, 1978 was amended in the year 2002 which madeitillegaltohuntexceptunder certain special circumstances. Following this, all the Game Reserves were re-designated asConservationReservesand this paved way for successful conservationoftheseveryimportant yet neglected wildlife habitats.

Wetland of National Importance Gharana has been identified as a wetland of national importance under National WetlandsConservationProgramme (NWCP). The criteria which have led to its getting identified as a wetland of national importance are mentioned as below:

Criterion 2: Gharana Wetland supportssomethreatenedecological communities (mentioned in the table 2.3).

Criterion5: Ifitregularlysupports 20,000 or more water birds.

Criterion6: Ifitregularlysupports 1%oftheindividualsinapopulation of one species or subspecies of water-birds

Important Bird Area (IBA): Gharana wetland is widely appreciated for the avian diversity that it possesses. Gharana wetland has also been given an international recognition by declaring it as an Important Bird Area (IBA) by BNHS and Birdlife International. Gharana has been identified as an IBA based onthecriterionA4iii(i.e.areaswhich support more than 20,000 birds annually) (Rahmani et al, 2012).

Potential Ramsar Site: Gharana Wetland together with other four wetlands (as a single wetland complex)hasimmensepotentialtobe declaredasaRamsarSite(Wetlandof International Importance). And they can be considered for the Ramsar Status under the following criteria foridentifyingtheWetlandsof International Importance:

Criterion 2: Gharana Wetland supports some threatened ecological communities(mentionedinthetable 2.3).

Criterion 5: Gharana and its adjoining wetlands can together be declaredasRamsarWetlandasthey all together, regularly support more than 20000 water birds.

Criterion 6: The estimated total global population of Bar-headed Goosehasbeenfoundtobe52,000-60,000 (Wetlands International, 2006). Gharana and its adjoining wetlands can also be considered for Ramsar Status under this criterion as theysupportatleast1%populationof Bar-headed Goose annually.

Legalstatusandlandtenure in surrounding areas: Gharana wetland, on its eastern side is bordered by the village of Gharanawhiletheagriculturalfields surround it from rest of the sides. The agricultural fields are under the occupation of the local residents of Gharana village. Some proportion of the 1600 kanals (200 acres or 0.80 km2) of notified land comes underthe category of 'Shamlat Deh' while someoftheremainingareaisclaimed by the locals to be their proprietary land.

RaivaSingh/WWFIndia

A report bearing no. SDMR/ Gharana/267/2009 and dated 30-7-2009thatemanatedfromtheofficeof the SDM RS Pura provided a breakup of the land tenure status of a total of area of 1600 kanals of land thatisdeemedtoconstitutethewetlan d. The information provided has been tabulated as below (Table 4.1):

In the initial years when the Gharana wetland was termed as a gamereserve,thelocalcommunities didnothaveanyobjection.Afterthe J&K Wildlife (Protection) Act, 1978 was amended in 2002, the wetland became conservation reserve and focus shifted from gaming to its conservation as a waterbird habitat. This led to disagreement betweenthelocalsandtheWildlife Department over the land tenure/ ownership which turned into a bitter conflict over the years. The main reason for the conflict is waterbirds (especially Bar-headed Goose) which the locals allege that destroy their rabi crops. A public interestlitigationwasfiled(PILNo. 35/2014) by the locals against the Department of Wildlife Protection intheHighCourtofJ&Kintheyear 2014 which saw the intervention of the court. The table 4.2 gives a timelineofthelegalinterventions/ directions by the Hon'ble High Court of J&K with regard to the case.

Table4.1:Revenuestatusofthelandin Gharana

S.No	Revenuestatusof theland	Area(inKanals&Marlas)	Khasranumbers
1	ShamlatDeh	213Kand14M	1211, 1212, 1362, 1393, 1411 (Gharana); 96(Gharani)
2	Private/Stateland	100 K(approximately)	
3	CatchmentLand	1286Kand6M	
	Total	1600 K	

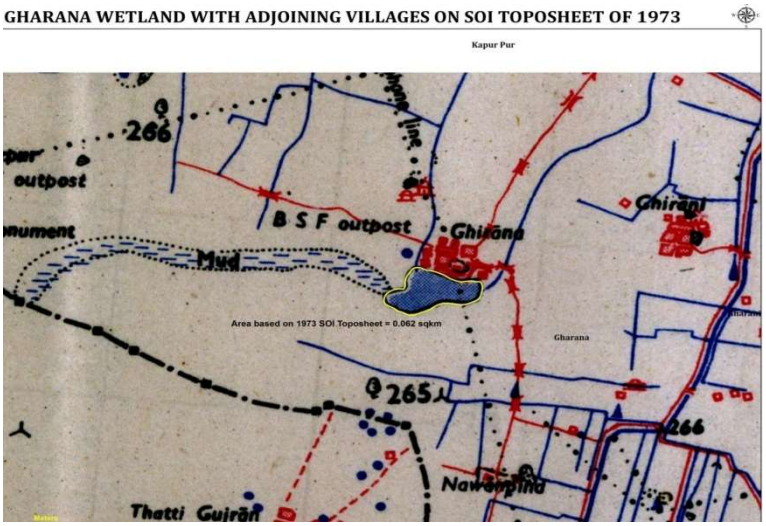


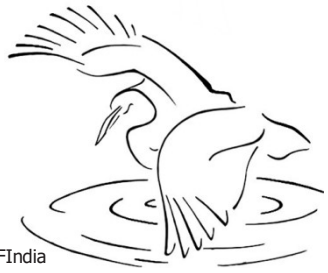
TABLE 4.2: A TIMELINE OF LEGAL INTERVENTIONS BY THE HIGH COURT OF JAMMU & KASHMIR

PILNo.35/2014titledRattanSinghVsStateandOrs.beforeHon'bleHighCourt J&K.
CourtCommissionconsistingofateamofLawyersvisitedtheGharanaWetlandon 20-05-2017 to assess the status of the Gharana Wetland Reserve. The Commission submitted the report to the Hon'ble Court.
WildlifeProtectionDepartmentwasdirectedtoundertakede-weedingofthewetland (Order dated 12-10-2017)
ThenHon'bleChiefJustice,J&KHighCourtvisitedthewetlandon01-12-2017
Govt.shallalsoconsiderthepossibilityofacquiringproprietorshiplandwhichwould be necessary for preserving the wetland of Gharana (Order dated 12-12-2017)
ThecounseloftheWildlifeDepartmentsubmittedthattheareawhichisimmediately required has been marked on the spot through poles after taking the GPS readings of each such pole. The exact points shall be marked out on a map based on the GPS readings based on this, we direct the revenue authority to identify the ownership occupationinrespectoftheareasomarkedout(Orderdated30-12-2017)
In compliance to the directions of the Hon'ble High Court (as per the order dated 30-12-2017),duringthehearinginthecase,theareawhichwasimmediatelyrequired was demarcated on the ground with the GPS & the PCC fence posts were erected on theperiphery.Thus,57postswereerectedcoveringanareaof408kanal14marla
Collector,LandAcquisitiondirectedtoconsidertheoptionofprovidingtheownersof the land, whose lands are to be acquired, alternate land in lieu of land notified under section 4 (1). A revised Integrated Development Plan to include Sewage Treatment Plant as essential (Order dated 05-03-2018)
Hon'bleCourtgrantedfourweeks'timetofilestatusreport(Orderdated31-08-2018)
Respondentstofilecompliancereporttoallpreviousdirectionsissuedbythecourt before next date of hearing- 12th Feb 2019 (Order dated 13-11-2018)
Revenueauthoritywasdirectedtoexplorethepossibilityofidentificationofalternate statelandandwildlifedepartmentisdirectedtotentativelyarrangeRs.11.00croreto Rs. 12.00 crore (order dated 14-05.2019)
The compliance report in respect of 14.05.2019 interim order the Revenue Authorities submitted that negotiations with the land owners have failed and the acquisition proceeding taken up under land acquisition act. The Forest Department (Wildlife Department) submitted that in compliance to court directions Rs, 11.70 CrorehasbeenarrangedandwillbedepositedintheaccountofthecollectorRSPura within a period of 2 weeks (order dated 23-07-2019)
Revenue department and forest department filed an affidavit. Petitioner was given anopportunitytofileresponsetotheseaffidavitsbeforenextdateofhearing(order dated 17-12-2019)
StatusreportontheencroachmentsofwetlandsoftheJammuandKashmirand action taken report on the wetlands (order dated 10-03-2020)

In compliance to the orders of the Hon'ble High Court, the followingactionsweretaken: Delineationof408Kanal14Marlaland, urgently required in the first instance for restoration of wetland, was done by the Wildlife Protection Department with support of Revenue and Police departments.The revenue status of acquired land is:

Private	Shamlat	State	Custodian	Total(K,M)
251.00	92.07	54.06	11.01	408.14

- For delineation 57 PCC fence posts were erected on ground. GPScoordinatesoflocationsof fence posts were recorded and submitted to the court.
- Indent was placed by the Wildlife Protection Department to the Collector,LandAcquisition(SDM RS Pura).
- ManagementPlanofGharana Conservation Reserve for five years has been prepared.
- AsdirectedbytheHon'bleCourt, Provision for Sewage Treatment Plant (STP) has been included in the Management Plan.
- As per directions of Hon'ble HighCourtandasrequisitioned by Revenue Department an amount of Rs. 11.70 crore (Rs. Eleven Crores Seventy lacsonly) has been transferred to the official account of SDM, RS Pura for Survey, Delineation, Demarcation, consolidation of protected area boundaries/re-locationfromcoreareabywayof acquisitionoflandforGharana Wetland.
- The final award for 408 Kanaland 14 Marlas was issued by the Collectorlandacquisitionvidehis office No: SDM/R/LA/Gharana-wetland/2021/1509-10 dated: 12.12.2020 for an amount of Rs. 14, 20, 59,011.
- Acquired land has been taken overbythedepartmentofwildlife protection on 02.12.2021 based on the SDM RS Pura office communication No: SDMR/ Misc/2021-22/942-49 dated: 27.11.2021 and Tehsildar Suchetgarh office letter No: TS/ PS/2021-22/550-58 dated: 29.11.2021 to take over the possession of the land on 2nd of December 2021.



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Dependenceonthewetlands: A stakeholders' survey was conducted in Gharana village for the identification of wetland services and the assessment oftheirdependenceontheseservices. The survey was conducted using semi-structured questionnaire survey format. As per the villagers' perception,followingserviceswere providedbytheGharanawetlandto the villagers:

•Water for Irrigation

•Bathingandwashingcattle

•Groundwater recharge

•Walkingaroundforpleasure

•Birdwatching

•Livestock Grazing

Water extraction for irrigation: The residents of Gharana who ownagriculturalfieldsaroundthe wetland often draw water from thewetlandtoirrigatetheirfields. Villagers have created a bund at the outlet to block the outlet ofthe wetland. The outlet is closed as and when water is required thereby flooding the fields in the surroundings. At times, water is also pumped from the wetland to the fields using electric pumps. The farmers believe this to be the primaryserviceofGharanawetland.

Water use for domestic purposes: Localsbelievethat wetland water is polluted and, therefore,cannotbeusedformostof the household purposes. But it can be used for some selected purposes including washing and bathing their cattle. Their cattle can also be seen sitting in the wetland for cooling off during extreme summers.

Groundwater recharge: It has been noticed that groundwater level close to the wetland is higher than away from it and this is evident from the depth of hand pumps. The hand pumpswhichareinthevicinityofthe wetland have been dug to a shallower depthascomparedtothoselocatedat a distance of more than 200 meters. This depicts that the water from wetlandrechargestheaquiferandthe villagersarealsoawareofthisservice of the wetland.

Livestock grazing: The village livestock can often be seen grazing on the grass and the weeds growing in and around the wetland. The Alligatorweedisgrazeduponbythe livestockandthevillagersbelievethat the cows which graze on the alligator weed yield greater quantity of milk. Grassonthefringesofthewetland, especially on the western side is frequented by the village livestock.

Bird watching: Though there has beenalotofcontroversywithregard to handling of the migratory birdsby villagers in Gharana but that controversy is largely limited to the Bar-headed Goose. They find the otherbirdsattractiveandcometothe

compoundoftheWildlifeDepartment hut to watch them.

Walking around for pleasure: Some of the villagers also believe that walkingaroundwetlandrelievesthem of stresses. They also believe that the cool breeze flowing from the wetland reduces the effects of summer heat and because of this they can be seen resting under the trees close to the wetland.

Fishing: Though, fishing is not allowed in Gharana, but the many peoplefishatitsmaininletandthe security ditch. They argue that the inlet and the security ditch are not apartofthewetlandandhencenot protected.Inmostofthecases,the fishermenareoutsidersandnotfrom the village. There have also been some instances where people were also seen fishing in the wetland and werestoppedbytheofficialsfromthe Wildlife Department.

Bathing: Generally, villagers do not prefer bathing in the wetland as they considerthewatertobepolluted.But some village children do bath in the wetland for pleasure.

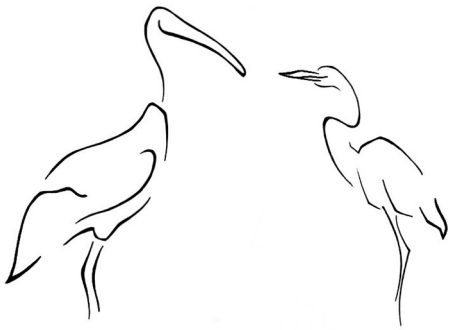
Statusofprotectionandthreats: Inspiteofthembeingsuchimportant ecosystems, the wetlands are being subjected to greater anthropogenic pressures, worldwide, which deteriorate their state of health or "ecological condition" (Brinson and Malvarez, 2002; Junk, 2002). It has been noted that the global area of wetlands has decreased at an ever increasing rate during the courseofthecentury(Matthews and Fung, 1987, cited in Adger and Luttrell,2000).Ofthetotalwetland area lost, 87 per cent accounts for the diversion to agricultural development, 8 per cent to urban development, and 5 per cent to other conversions (Barbier 1997). According to Mitchell & Gopal (1990), around 2400 species and subspecies of birds are supported by wetlands in India and the various threats of loss in their habitats have put in danger the diversity of these ecosystems. In India, as elsewhere, wetlands are facing tremendous anthropogenic pressures (Prasad et al., 2002), which can greatly influence the structure of bird community (Kler, 2002;Vermaetal.,2004;Reginald et al., 2007). The loss of 1km2 of wetlands in India will have much greater impacts than the loss of 1km2ofwetlandsinlowpopulation areas of abundant wetlands (Lee et.al., 1996). The National Environment Policy of India,2006 has also recognized that the WetlandsinIndiaareunderthreat from drainage and conversion for agricultureandhumansettlements, besides pollution. Lately it hasbeen realized that the wetlands are significant for the existence of life on earth. The Gharana wetland is under threat from the following:

Wetland Boundaries: Gharana wetlandwasbroughtwithintheambit of J&K Wildlife Protection Act, 1978, in the year 1982. After J&K became a union territory in 2019 and the J&K WPA, 1978 ceased to exist, the wetlandhascomeundertheambitof WPA, 1972. Till a few years ago, the wetland'sboundarieswerenotclearly demarcated but the Department,after an order by the Hon'ble High Court, has delineated the boundaries and demarcated them by erecting boundary pillars. To ensure thatthese boundaries are accepted by the villagers and other stakeholders, the Department is actively engaging with themandspreadingawarenessinthis regard.

Encroachment&otherformsof wetland reclamation: Gharana is under threat from encroachment by the locals. Except for northeastern side, the Gharana wetland is surrounded by agricultural fields which the locals are expanding towards the wetland. Every year they move further towards the wetland reclaiming a small portion ofit.Ontheeasternside,inGharana village, some of the houses built on the boundary of the wetland keep throwing garbage further ahead into thewetlandin pursuanceofforming a solid platform on which they plant fast-growingtreespecies.Thesurveys have revealed that a substantial part of the wetland has been lost to the encroachment by the locals. In fact, all the houses towards the west of the road passing through the Gharana wetlandhavebeenconstructedonthe reclaimed part of the wetland.

Habitat loss: A perfect habitatisbelievedtoofferabundant food, shelter and serenity. Birds and a
majority of other wildlife species are too shy to live in disturbed habitats. Rampant encroachment in Gharana and other wetlands has degradedthe quality of habitat for waterbirds. The expansion of agricultural fields towards the wetland has restricted the open water area to a small pool. Thesurroundingswampswithdense aquatic vegetation would offer the summer-visitors space for making nests to lay eggs. The vegetation cover in swamps are used by the birdstoconcealthemfrompredators. But over-grazing and agricultural expansionareharmingthishabitatin Gharana.

Poaching of water-birds and otheranimals:InGharanawetland, as mentioned earlier, poachers often indulge in illegally catching fish, turtles and at times birds also.



GharanaWetland,Jammu,J&K|.41

Bar-headedGeeseinGharanawetlandwithtractorinthebackground©Dr.PushpinderSingh/WWFIndia

Sewage, effluent and solid-waste: Water quality is a key determinant for the health of water body. Gharana wetland receives sewage inflows from the Gharana village and its catchment which is predominantly agricultural. The entry of runoff from agriculture fields brings with it higher concentrations of agricultural chemicalscausingtheirenrichment inwetlandsandthereforepollution. Fertilizers are one of the main source of pollutants as they are carried away from agriculturalareas by leaching, surface runoff and other processes. Aquatic ecosystems, especially, have been and are adversely affected by the agricultural chemicals (Kremser 2002). In the past 50 years, the use of pesticides in agriculture has significantly increased to 2.56 billion kg per year (Carlile et. al. 2006). The pesticides can contaminate waterand soils, pollute air, destroy natural vegetation,andaffectthefoodsupply of non-target organisms, such asfish, livestock, and wildlife including birds (Watson 2004). Not always do these chemicals enter the bodies of birds through water but the granular formations of pesticides applied to the agricultural fields are often ingested by the foraging wintering waterfowl. These granules of ingested pesticides are also a major cause of concern (USGS, 2007). The majority ofpesticidesincludingherbicidesand fungicidesareaminorthreattobirds; a few however may be acutely toxic to birds (Carlile et. al. 2006).

EncroachmentbylocalsinGharanawetland©Dr.PushpinderSingh/WWFIndia

Contaminationoreveneliminationof food sources, as well as disruption of theinternalhormonalregulation and intoxication are some of the negative impactsbypesticidesonbirds(Pretty 2005).

Another threat arises in the form of human and animal wastes. The open defecation is prevalent on the fringes oftheGharanawetlandandthecattle dung & cattle-shed wastes are also dumped at many places along its sides. This poses a prominent threat to the wetland ecosystem. These wastes are washed into the wetland by the rain concentrating various nutrients needed for the growth of aquatic weeds.

Wildlifehealth: Lackofawareness amongthelocalswithregardtoopen disposal of solid waste including cattle carcasses may have grossly negative affects on the health of the wildlife of Gharana wetland. It is a commonpracticeofdisposingoffthe dead animals in open and isolated places. This often attracts dogs and crows and this may spread zoonotic infections to the wildlife.

Weeds: Gharana wetland is threatened by the prevalence ofinvasiveexotics.Thespecies of weeds which are of greatest concern are *Eichhornia crassipes*(Water Hyacinth), *Alternanthera philoxeroides*(Alligatorweed)and *Azolla pinnata* (Mosquito fern). Theseweedsincreasethesurfacearea for evapotranspiration and therefore haveimpactonthehydrologyofthe wetland. Moreover, the presence of weeds also affects the aesthetic value of the wetland. The floating islands of Water hyacinth can be seenmovingaroundonthesurface of water under the influence of wind in Gharana. The Alligator weed forms a dense network over the surface of the wetland. These weedstrapthesedimentsandtheir annual growth cycle adds organic materialtothewetland.Boththese processes intensify the process of sedimentation of the wetland and reduce its volume. *Azolla* is comparativelynewtoGharanaand has appeared only recently. In 2012-2013itformeddenseandcontinuous mats covering the whole wetland. During this sudden *Azolla* bloom even the fish were also noticed to be dying. If this problem remains unabated, it can have long-lasting impactsonthewetlandecosystem.

Conflict with Migratory Birds: In Gharana wetland, the biggest bone of contention between thelocalfarmersandtheDepartmento f Wildlife Protection is the migratory birds especially the Bar-headed Geese. The Department, being the legal custodian of the wildlife of the state is bound to protect the wildlife including the migratory birds visiting the wetland while the localfarmerscomplainoftheheavy losses they have to suffer due to Bar-headedGoose.Farmersbelieve

Bar-headedGeeseflyingoveragriculturalfieldnearGharanawetland

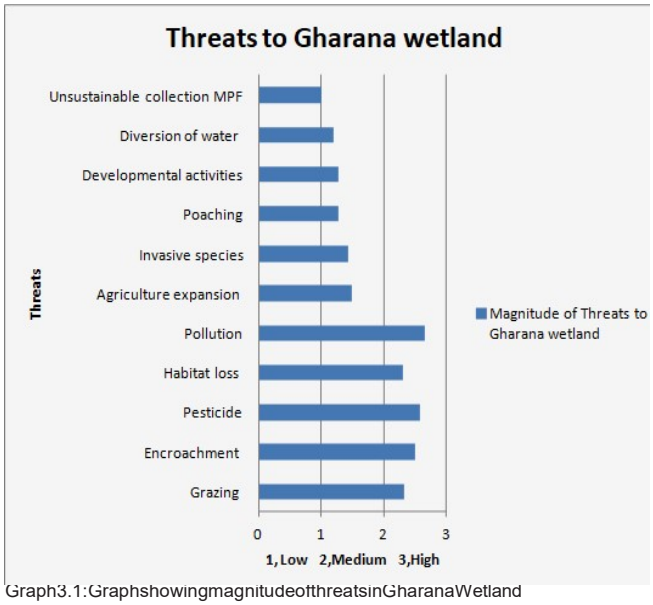
©Dr.PushpinderSingh/WWFIndia

thattheBar-headedGoosedamages their rabi crops chiefly wheat and *Trifolium*(foddercroplocallycalled as *Barseem*). During surveys it was noticedthatthefarmers'complaints are not completely baseless but they are often exaggerated too. Large flocks of Bar-headed goose enter the agriculture fields graze on the crops and in the process also trample the remaining crop thus,attimes,flatteningthewhole farms altogether. To ward off the migratory birds, locals at Gharana wetland have been using various methods and over the time these strategieshavealsochanged.Earlier they used to erect poles and put up on them the recording tape whose flickers would scare the birds away but now they burst crackers.

Feraldogs: Thesewetlands are closetotheInternationalBorder close to the International Border which is manned by the security forces, BSF and Indian Army. The leftover foodin thecampsofsecurity forcesisthrownoutandisallowedto be fed upon by the dogs. These feral dogs are a potential hazard for the wildlife of these wetland reserves. Thebreedingbirdsareparticularly vulnerable to these dogs.

Draining of water: The inlet and outlet of Gharana wetland arecontrolledbythevillagersof Gharanavillage.Theyopenorclose the inlet and outlet of wetland as per their needs not keeping in view the needs of water-birds. When they fear flooding of their fields by the wetland, they open the outlet and drain its water to bring down the water level. This can have a significant effect on the wetland ecosystemandbirdswhichinhabitit.

The below given graph depicts the threats to Gharana wetland and their magnitudeonascale of 1-3. When the value on this scale approaches 1, the threat is of lesser concern and vice versa.



Graph3.1:GraphshowingmagnitudeofthreatsinGharanaWetland

Tourism: The highly diverse assemblage of water birds that Gharana wetland is bestowed with has lent this place with the recognition of being among the mostfamoustouristdestinations of Jammu. Its tourism potential can be gauged from the number of tourists that this wetland receives during peak winters. Its proximity to the international border between India and Pakistan also enthuses many visitors. Despite its huge tourism potential, the wildlife tourism, interpretation and environmentaleducationarein infancy and not so developed. There is lack of infrastructural and other facilities related to tourism and have to be developedinduecourseoftime.

Scope: The proximity of Gharana wetland to the city of Jammu, the wintercapitalofJammu&Kashmir, brings it to the notice of the tourist traffic to Jammu. Jammu is visited byalargenumberreligiouspilgrims visiting Shri Mata Vaishno Devi Shrine in Katra and for the annual pilgrimage to the cave of Shri Baba Amarnath ji. Although slowly, Gharana is also being recognized by the taxi operators for its tourismpotential.Especially,duringthe winter season when the migratory birds arrive at the wetland, a large number of tourists, local as well as those from outside the state, visiting Jammu, throngthewetland.Ontheweekends, a lot of tourist rush can be observed. Wetland is also regularly visited by students,researchers,educationistsand birdingenthusiasts.Gharanalacksgood interpretational facilities and because

of this the nature-based tourism isfarbelowthepotentialthatthis wetland carries.Various schools alsobringtheirstudentstoGharana on various days of environmental importance like World Wetlands Day, World Migratory Bird Day and World Environment Day. It isalsocommonforpeoplelinked to the organizations working of environmental issues to visit the wetland. Gharana is well known among the local birdwatchers' groups owing to its amazing diversity of birds.

Interpretation programme: Gharana lacks a focused nature interpretation programme. At present the nature interpretation setup is restricted to a small room which has translides of some ofthebirdspeciesfittedwithspeaker system to play the recorded callsoftherespectivebirds. Apartfrom this few signage/boards have been erected showing some of the important birds of Gharana, its status as Important Bird Area (IBA) and the habitat range of the Bar-headed Goose.Some pamphlets havealsobeenprintedregardingthe avian diversity of Gharana wetland.

Basic facilities: There are no accommodation facilities available forthevisitorsatGharanawetland. Even the basic facility of toilets stands wanting. Despite a huge tourism potential that Gharana holds, there is neither any canteen noranyrest-house.Touristsvisiting the wetland often complain about the lack of basic facilities including toilets and clean drinking water.

Research, monitoring and training: Gharana is gradually turning into an active site for research, monitoring and training. The Jammu-based organizations, universities and research institutes havelatelystartedtobringitsfocus on the wetland and various issues related to it.

Research and monitoring: Unfortunately,Gharanawetlandhas been neglected by the researchersfor too long. Of late, Gharana has started attracting researchers from the research institutions from Jammu. The PG Departments of Biosciences and Environmental Sciences in the University of Jammu have conducted some researchonbiodiversityofGharana wetland.Theparticipantsattending refreshers courses in the PG Department of Environmental Sciences are often made to visit Gharana to experience the wetland ecosystem. The Department of Wildlife Protection has now been trying to engage some researchers in conducting studies related to the avifauna of the wetland. Bird ringingandbandingexerciseshave been conducted regularly in the recent years in collaboration with

Bombay Natural History Society, WWF-India and other prestigious institutions. Bird flu surveillance and related exercises for testing avianinfluenzabyinvolvingAnimal Husbandry Department, Sher-e-Kashmir University of Agricultural Science and Technology, Jammu have also been conducted fromtime to time. In the year 2012, a study was conducted with the aim to investigate the migration of bar-headed goose. The study was conducted in collaboration with the Wildlife Institute of India where Platform Transmitter Terminals were placed on two bar-headedgeese for investigating their local movement pattern and migratory route (Mahar et.al 2015). WWF-Indiaalsoconductedresearchonthe various aspects of Gharana wetland ecosystemforthepurposeofdrafting the management plan.

Training: There is no formal training provided to the field personalsatGharanawithregardto wetlandandwater-birdmonitoring. They lack skills which are important forregularmonitoringofthewetland ecosystems. They must be regularly trained and oriented with regard to water-bird identification, anti-poaching,catchmentmanagement, water sampling and wetland monitoring etc.

WildlifeConservationstrategies and their evaluation: In spite of these wetlands being declared as wetland reserves in 1982, the game hunting was prevalent as per the provisionsofJ&KWildlifeProtection Act, 1978 till the Act was amended in 2002. Since 2002, the hunting has been curbed and a continuous watch is kept by the wildlife staff posted Gharana. Conservation activitieshave been initiated which include publicextension&outreachactivities related to conservation, increased presence in the field, initiation of interpretationprogrammes,engaging non-governmental organizations, conducting active research and involving mass media in public outreach etc.

Bar-headed Geese in agricultural fieldnear Gharana wetland ©Dr.PushpinderSingh/WWFIndia

viewofGharanawetland©Dr.PushpinderSingh/WWFIndia

Administrative setup: The wetlands in Jammu have been kept under a separate range which has been named as Wetland Range controlled byaRangeOfficer.RangeOfficer
,
Wetlands, is based at Manda in Jammu.RangeOfficerisassisted by a forester (Block Officer) and his frontline staff in managing the wetland reserve. The overall control of the management ofwetlandrangelieswiththe Wildlife Warden, Jammu.

Road communication: Gharanawetlanddoeshavearoad communication but the condition of theroad isdeplorable. Gharana lies at a distance of 35 Km from Jammuandat30KmfromSatwari intersection on NH44. The state of road connecting Jammu with R. S. Pura is good but beyond R.S. Pura, it is in a very bad shape. Mobile communication network does not workverywellduetotheproximity of the wetland to the International Border.

CHAPTER5-THEWETLANDAREAAND THEINTERFACELANDUSESITUATION

Everywetlandhasazoneofinfluence and likewise Gharana too has a distinct but small zone of influence which comprises of the surrounding agricultural landscape and the security ditch.

The existing situation in the zoneofinfluence: Ashasalready been described, the catchment of Gharana wetland is largely homogeneousagriculturallandscape with some interspersed trees. In summer, paddy cultivation turns allthesurroundingareaintoahuge wetland while in winter season, wheat and *Trifolium* are grown in these fields. The surrounding agriculturalsetupbringsalotofsilt into the wetland, which ultimately settlesdownanddecreaseitsdepth. Theagriculturalfertilizersprobably augment weed proliferation in the wetland and along with the domesticwastearealsoacausefor eutrophication.

Villages around the wetlands: Though Gharani village is also located towards north of Gharana wetlandbutitisonlyGharanavillage which has significant influence on thewetlandwhichisbulgingintothe wetland from the eastern side. The Population of Gharana village has increasedoverthedecadesandthis has led to increased anthropogenic pressures on this wetland.

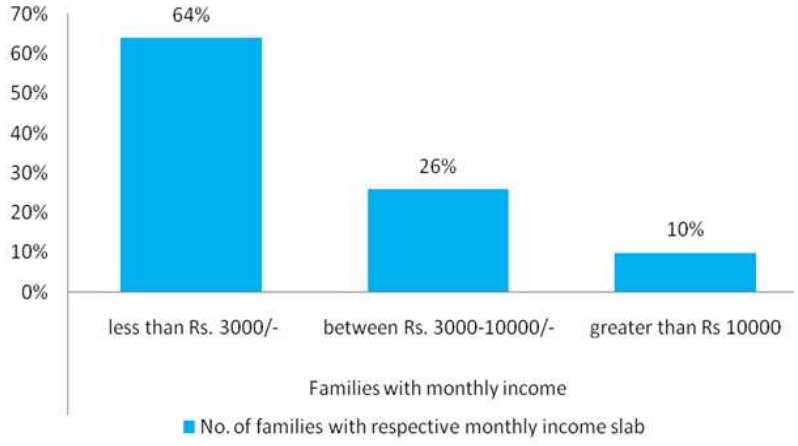
Ethnic identities, traditions, customs,relationshipsbetween distinct groups: The people in these villages have been living there right from the beginning. The area is dominated by *Dogra* culture which is a legacy left by the *Dogra*rulers of Jammu. In Gharana, *Jat*is the major ethnic group. Majority of the residents of the villages intheforwardareasofJammubelong to Hindu religion followed by the Muslims and Sikhs. Muslims are largely *Gujjars* who rear buffaloes and are involved in milk business. They are the major suppliers of milktotheJammucity.Thedialect spokenhereislargelysimilartothe rest of the *Dogri* speaking areas of Jammu region. The *Gujjars* speak *Gojri*whichisaltogetheradifferent language and hence differs from *Dogri* in its dialect. Despite the ethnic and cultural diversity that is prevalenthere,alltheethnicgroups bond very well with each other.

Relationship with the wetland: Gharanawetlandoccupies an

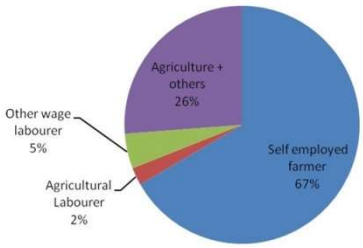
important place in the lives of the residentsofGharanavillage.Largely unaware but at times unwilling to share the details, they reap many benefits from the wetland. The dependence of the local people on the resources of Gharana wetland reserve has been discussed in detail in section 4.3.

Stateofthepeople'seconomy: The state of economy of the communities living close to the ecologically sensitive areas has a bearing on the state of the ecology ofthoseareas. Asper thecensusof India, 2011, 60% of the population of Gharana is unemployed. The data suggests that except for a few families, most of the peopleofthisvillagearepoor.Becau seof the prevalence of unemployment, they are largely dependent on the agricultureandalliedactivities.For the assessment of socio-economic status of Gharana village, semi-structured questionnaire interviews were conducted with the residents of Gharana. As per the data obtained through the survey, a majority of the households(i.e.64%)havetosurvive on a meager amount of less than Rs. 3,000 per month. Only 10% of thehouseholdsearnmorethanRs. 10,000 per month (Fig 5.1).

As per the survey, about 67% householdshavefarmingastheir onlybread-winnerwhile;around 26%householdshaveagriculture as the source of livelihood along with the other sources of livelihoods (includingGovernmentemployment, artisan/craftsman, business etc.). Around 2% of the households drive their income from labor on the agricultural fields (Fig 5.2). Because of agriculture being the main economic activity of the people, it is themainlivelihoodproviderfor95% of the residents of Gharana.



Graph 5.1:Averagemonthlyincomeof householdsofGharanavillage



Graph5.2:NumberofhouseholdsinGharanavillage andtheirlivelihoodsources

Vocations, landuse, use of wetland and wetland products: Though their land holdings aresmall, the people living in thevillages located in the vicinity of Gharana wetland practice intensive farming. The *Basmati* rice grown hereisbelievedtobeamongthebest. Some of the villagers also work as agriculturallabourers.Somefamilies also rear buffaloes and goats are also rearedbymanyfamilies.Someofthe familiesarealsoinvolvedin business based on milk and milk products.

Wetlandmanagementpractices and their implications for people: The Best Management Practices in Wetland Management always take into consideration the socio-economic setup of the local communities and consider them as apartoftheenvironmentandplan management strategies keeping on view their aspirations. As of know there is a lot of resentment among the local communities especiallyatGharanawetland.The awareness level of local communities with regard to wetland and their significanceisquitelow.Theyneedto besensitizedabouttheimportance of wetlands and also need to be involved in decision-making. Moreover,villagersalsodonotfind the wetlands to be any economic importance but they think that if these wetlands can be reclaimed, they can be turned into highly productive agricultural land. The encroachment has been rampantin pastbecause the boundaries of the wetlands till recently have highly been vague. The present management strategies of the WildlifeDepartmentaredesigned to engage with the villagers and gain their confidence.

Development programmes and conservation issues: Different departments are implementing their development schemes in Gharana. Rural Development Department is constructing a road, repairing lanes and also constructing sewers. Department of Wildlife Protectionhasalsosupportedthe diggingofatube-wellinGharana village to reduce dependence of villagers on the wetland. Wildlife Department has also constructed abuildingforitsofficeinGharana. Various departments have their developmental schemes going on in other villages. All these developmentalprogrammesmay not always be ecologically sound and may have implications for wetlands.

A summary of problemsfacedbypeoplethataffectthe managementofthewetlands: Theeconomicstateofpeoplelivingin the vicinity of these wetlands is poor. Some of the villagers are landless whileamajorityofthemaremarginal farmers. Their financial insecurity pushes them to lookout for new ways of income generation. The economic vulnerability of the poor, who have tomeetshorttermhouseholdneeds, leaves them with the choice of using theenvironmentalresourcesoftenin ways deemed not to be ecologically sound. Their dependence on the biological resources of Gharana wetland may not be very high, but this wetland is an important part of their lives. It has often been seenthatstrictimplementationof environmental laws for achieving conservation has led to alienation of localcommunitiesandthisshallbea challengeforthewildlifedepartment in this case too.

Cattle being washed in the Gharana wetland©Dr.PushpinderSingh/WWFIndia

CHAPTER6-MANAGEMENTVISION, OBJECTIVES AND PROBLEMS

Vision: This management plan envisions a well-protected and healthyGharanawetlandecosystem which is rich in biodiversity; is perfect habitat for the migratory birds; has a sustainable flow of ecosystem services; is a perfect example of stakeholders' participationintheconservation and is center for recreation and conservation education.

Objectives of the management plan: Wetlands are extremely dynamicandvibrantecosystemswith a lot of ecological activity. But they are often influenced by both natural and human factors. Managementmay be defined a framework of well-targeted activities carried out forachievingcertaindesirablegoals. The aim of wetland management is tomaintaintheirbiologicaldiversity and productivity, and to permit the wise use of their resources. The management actions have to bemuch focused with well-defined outcomes.Themanagementplanwill define clearly the site management objectiveswhichwillhelpsetrealistic goals so as to provide a sense of direction, focus and a guide for the actions needed. The outcomes set under the management plan will act asyardstickbywhichdesiredsuccess can be measured.

In case of Gharana wetland the followingobjectiveswillbeachieved through the management plan in order to achieve the vision stated above

I. Maintaining Ecological integrity of the wetland Reserve through stakeholder involvement and promoting eco-development practices: Thefirstandforemostobjectiveof this management plan shall be to maintain the ecological functions and biodiversity value of Gharana wetland reserve. This has to be done through conserving biotic communities of wild plants and animalswithinthenaturalandsemi-natural parts of this ecosystem. The approach of this objective has to be intensive and holistic so that all theattributesofthewetlandsunder consideration are simultaneously taken care of. This wetland has tobe taken care of keeping in view its values, especially, as habitat for the migratory avifauna. This objective mandates complete stoppage of all such human activities which threatentheecologicalintegrity

Acrucialroleinthisshallbeplayed by stakeholders. There is need to strengthen the mechanisms forinvolvementofstakeholders especially the local community livingin thevicinityofthewetland reserve. The involvement of local community can give them a sense of belongingness to the wetland and its resources. There is need to provide the stakeholders a proper platformsothattheirconcernscan be heard and mutually agreeable solutions can be arrived at through meaningful dialogue. The stakeholder involvement will helpinresolvingtheexistingorpotenti al conflictsbetweenthepeopleandthe various organizations which have anystakeorinterestinthiswetland, and helps create positive attitudes, thus establishing commitments towards future initiatives.

Inthemeantime,tostakeholder support can be harnessed by supporting them through Government sponsored eco-development projects. These projects would, on one hand, cutdownontheill-effectsofthe traditional developmental regime around these wetlands, while on theotherhand,itwillbenefitlocal communitiesbyraisingthestandard of their living. The employment opportunities generated during the implementation of these projects would provide them alternate sources of livelihood.

II. Promoting Ecotourism at Gharanawetland: Alloverthe world, wetlands are known to offersignificantopportunitiesfor tourismandrecreation,generating income for governments, for the tourism industry itself, and for the local communities as well (Destinationwetlands,2012).Inthis case, Gharana wetland possesses considerable tourism potential. One objective of this management plan will also be to support and promote ecologically responsible tourism by involving local community in response to the economic aspiration of the local community at Gharana wetland. The eco-friendly tourism practices at Gharana may provide an enthralling experience to tourists, in themeantime,transferringeconomic benefits to the local communities which may indirectly help in gatheringsupportforconservationto the wetland.

III. Conservation Education&NatureInterpret ation: This management plan also calls for developing the Gharana wetland reserve as a center for conservation educationandnatureinterpretation. Thefacilitiesmustbedeveloped for facilitating the conservation education at Gharana targeting students, tourists, local villagers and the staff of Wildlife Department. An interpretation center is proposed to besetupforawarenessofthevisitors about the wetland and its resources.

IV. Better communicationand decision making: The management plan will enable better communication within and between concerned organizations and stakeholders. Management planning processes provide an important means of involvement andcommunicationwiththesite's stakeholders.Managementplanwill also help the managers in taking quicker and better decisions. It will also aid communication with other agencies to aid collaboration and is a practical means of sharing information about wetland and thus helpingcomparisonswithothersites.

V. Research and Monitoring: The management plan also suggests to carryout long term research and monitoringofGharanawetland.The findings could be included in the management after thorough review ofthemanagementinitsnextphase. Partnerships must be developedwith various research institutionsfor conducting inter-disciplinary research on conservation aspects of the wetland.

VI. Compliance with existing policies: Themanagementplanwill alsohelpinhighlightingtheneedfor compliance with local, national and international policies. It will help in linking local level actions with wider (national and international) wetland policies; will contribute to bringing the wetlands under the ambit of the Ramsar Convention; and gather supportundernationallevelAction Plans and strategies.

VII. Arranging financial resources for management: Themanagementpla nwillalsohelp in obtaining financial resources requiredtomanagethewetlandsite as well as to identify opportunities for generating income to support managementprocesses.Thedetailed budget provided in the management plan will seek funding.Shortfalls in management capacity, such as staff, equipment or other resources, will be identified and budgeted for in the plantogenerateadequatefundingfor them.

Spoonbillin Gharana wetland
©Dr.PushpinderSingh/WWFIndia

Problems in achievingobjectives

A number of problems are likely to confront the implementing agencyi.e.DepartmentofWildlife Protection, Govt. of Jammu and Kashmir in implementing the management plan and achieving the objectives set under it. The problems which are likely to be faced are summarized as below:

Vague boundaries and associated problems: A management plan can only be implemented when there is clarity about the extent of the area being takenintoconsideration.Butinthis case, as has already been stated in the section 4.4.1, the boundaries of the wetland have been highly vague till the recent time. And because of this lack of clarity with regard to its extentthe wetland reserve has been subjected to rampant encroachment by the locals in past. But after recent directions from the Hon'ble High Court of J&K, the Department of Wildlife Protection has taken over thelandimmediatelyrequiredforth e wetland reserve.

Conflicting landuse in and around the wetland: Gharana wetlands is surrounded by the agricultural land which is subjected to intensive agriculture with large inputs of agrochemicals. These chemicals find direct entry into the wetlandandarepotentiallyharmful to the aquatic life and the food web involving it. It may be highly difficult to align the surrounding landuse to theprinciplesofconservationdesired as per the management plan

People's dependence especially for irrigation: The locals in Gharana are highly dependent onthe water from Gharana wetland to irrigate their fields especially during thedryperiod.Asnecessitatedunder the management plan, the locals will havetolosethecontrolon theinflow and outflow of the wetland and this may not be acceptable to many of them.

Conflict with migratory birds: The local villagers complain for the damage caused by the migratory birds to their winter crops especially the Bar-headed Goose. They devise different tactics to ward off these birds among them are bursting crackers and lining fields with flickering recording tapes. This managementplanabsolutelyopposes any such activity and seeks to secure the wetlands as habitats for the migratory birds. This may not be agreeable for the farmers.

Lack of awareness: The lack of awareness about the wetlands and need for their conservation among the local communities can be a real setback to the implementation of thismanagementplan.Amajorityof locals at Gharana wetland find the birds to be of no use and, rather,

AgriculturalexpansiononthefringesofGharanawetland©Dr.PushpinderSingh/WWF India

consider them as nuisance. It will take a lot of effort to change their mindset regarding the significance of birds and biodiversity. In spite of the Gharana wetland holding immense tourism potential, the local villagers have hardly been the beneficiaries of itandlackawarenessabouteconomic value of wetlands. It is important that the locals are sensitized about the wetland and the livelihood opportunities it can provide so that the locals can also be involved in implementationofthemanagement plan.

Administrativeproblems: The administrativecontroloverthe wetlandareahas,tillrecentpast, been weak due to the ambiguity related to wetland boundaries.
Further, the security ditch which is also an important site for birds, is not under the control of the Wildlife Department and is controlledbysecurityforces.The general inflow into the security ditch,whichistheprimesourceof water for the Gharana wetland, is controlled by the Sub-Divisional Magistrate (SDM). This complex administrative situation has been making it difficult to implement conservation and management activitieswithoutkeepingallthese agencies in loop.

CHAPTER7-MANAGEMENTSTRATEGIES

ManagementStrategies
Amanagementstrategyisaset of procedures dealing with the management of a particular issue. Different management strategies have been laid down in the sections to follow. Strategies related to ecotourism and eco-development havebeendiscussedseparatelyinthe forthcoming chapters.

Wetland delineation and boundary demarcation: Any area dedicated to the protection of biological diversity, and of natural and associated cultural resources, and is managed through legal or othereffectivemeansistermedasa Protected Area, as per the Wildlife ProtectionAct1972.Alltheprotected areas involve geographically-focused operation of special policies and targeted actions. Establishment of a protected area of any kind requires the proper delineation ofitsclearlydefinedboundaries.These boundaries can either be defined by physicalfeaturesorbymanagement actions. The Conservation Reserves in India are synonymous to the 'IUCN Category V Protected Areas'. The IUCN specifically puts it down that the drawing of appropriate boundariesforCategoryVprotected areas is critical to their success. Wellmarkedboundariesfacilitate effective planning and management ofprotectedareas.GharanaWetland Conservation Reserves does nothave clearly demarcated boundaries and there is need for clearly marked boundaries. But the boundary-drawing exercise for protected areas(especiallyaCategoryVarea) poses special challenges and two important points must be kept in mind while working on wetland delineation:

1. Such protected areas require particular attention to be paid to the social aspects thus making this exercise more than just a simple matterofmappingandinterpreting natural phenomena. As the local community has relatively high stakes and is often a source of knowledge also, it therefore is proposed to be directly involved in drawing up boundaries.

2. Boundary must not be thought ofasasharpbarrierbetweenareas of different quality as in most situations it may be based on an easily identifiable feature within a zone of transition.

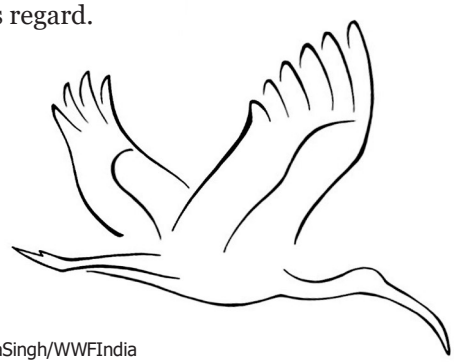
Boundary dispute, in the case of Gharana wetland is an old oneand has been lingering on for a longtime.Anareaof1600*Kanals*(0. 80 sq. km)

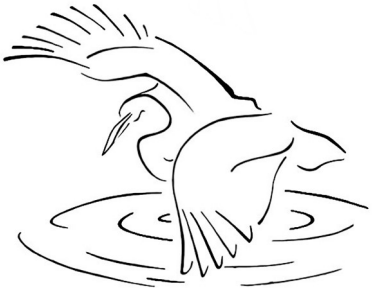
hasbeennotifiedbutitwasnotbeen demarcated clearly on the groundtill recently, when the boundaries were demarcated after an order in thisregardbytheHighCourtofJ&K. While clearly marked boundaries are necessary to ensure the integrity of the protected areas, it is important that they are also permeable as the protected areas should never be treated as islands. Jurisdictional delineations proposed here will identify the legal boundaries of the wetland over which the Wildlife Department will have regulatory jurisdiction under the Wildlife Protection Act, 1972.

Rehabilitation/Compensationto locals whose legally owned landsareacquired: Itisperceived that while delineating the legal boundaries of the wetlands, need may be felt for acquiring some of the privately owned land. It that case, it is highly recommended that all landrelatedcasesmustbedealtwith efficiently and expeditiously. The compensation must be provided as per the legal provisions laid down in this regard.

Hydrology and Water source management: The health of wetland ecosystems depends on itshydrologicalregimewhichalso determines the ecological character of a wetland. Any change in the hydrological regime of a wetland cancauseirreversibledamagetoits ecosystem. Some of the important attributes of wetland hydrology whichhaveabearingonthestateof wetland include inflow & outflow, water quality, nutrient loading and siltation.

Inflow, outflow & water securityofthewetland: Incase of Gharana, inflow and outflow are controlled arbitrarily by the localfarmersaspertheirirrigation needs. During the season of paddy cultivation, they open the inlet completely to allow extra amounts of water to the wetland while close the outlet simultaneously. This floods some of the fields in the close vicinity while those at some distance are irrigated by pumping water from the wetland using the electric pumps.





RaivaSingh/WWFIndia

Electricpumpcarriedbyfarmersforabstractionofwaterfrom Gharanawetland©Dr.PushpinderSingh/WWFIndia

GharanaWetland,Jammu,J&K|.61

those at some distance are irrigated by pumping water from the wetland usingtheelectricpumps.Also,during the periods of lean flows, often the dryingfieldsareirrigatedbypumping water from the wetland. Such interferences with wetland hydrology arehighlyundesirable.Itistherefore recommended that the dependence of farmers on the wetland for irrigation may be reduced by providing alternate sources of water for irrigation. This can be achievedby constructing an alternate channel for irrigation water. This channel is proposedtobestartedfromthecanal which carries overflow of surplus water from the inlet of Gharana wetland and should run parallel to the wetland along the road leading to the BSF camp. This alternate watersourceforirrigationwilllessen their dependence for irrigation on wetland. There is also need for propermaintenanceofgroundwater pumping station which has been setup for the purpose of irrigation. As the main source of water for the wetland is the Security ditch and itisneededthatthesecurityforcesare taken on-board and the proposed managementinitiativesarediscussed with them also. The security forces must be convinced for sharing water to maintain the minimum desirable levels of water in Gharana.

Pollution control: The water quality plays as much important roleasplaysthewaterquantityin maintaining a healthy wetland. It is important that the pollution sources are identified and tackled with in efficientwayssothatoptimumwater quality can be maintained in the wetland. In this chapter, the solid and liquid wastes are dealt with in the different sections.

Solid Waste Management (SWM): Improper disposal ofsolid waste is a matter of concernatGharanawetland.Asthem odern day consumerism is no more need-based;ithasrathertakenanutterly exploitative shape, there is also need for starting a mass awareness campaign to aware the general public to make choices which are healthy and environmentally responsible.The mass media can playanimportantroleinsensitizing common masses about their role in successful management of the solid wastes. Among the most dangerous wastesofmoderndayarethesingle- use plastics. There is a complete ban on the use of polythene bags in Jammu, yet they are used like ever before. There is also need to spread awareness among people about the ill-effects of polythene and makethe polythene ban a reality. The solidwastesmustbecollectedatthe site designated for the same at the Gharanabus-stop.Thewasteshaveto be segregated and stored in separate bins meant for biodegradable and non-biodegradable respectively. The biodegradable wastes are proposed

tobefurthersentforcompostingand proper disposal thereafter. The non-biodegradable wastes must either be recycled and those which are not recyclablecouldbetransportedtothe nearest municipal committee i.e. R.S Pura for their proper disposal.

OpenDefecation: Opendefecation is proposed to be completely banned in the vicinity of the wetland. Apart from being an unhealthy habit of personal hygiene, open defecation also leads to pollution of community land and water resources. In Gharana, the human excreta lying in open gets washed into the wetland when it rains adding nutrients to the wetland. It is suggested that all the households must be advised to build toilets and the poorer ones oughttobeprovidedaidforbuilding them. Under the new format of CentralRuralSanitationProgramme (CRSP)arevisedanddemanddriven approach titled as "Total Sanitation Campaign (TSC)" has been started under which sanitary facilities are provided to the rural communities. As this campaign also lays greater emphasisonInformation,Education & Communication and Human Resource Development, the communities can also be sensitized abouttheimportanceofmaintaining good hygiene.

Technologicaloptionsavailable for SWM in Gharana:

i) BiodegradableSolid Waste:

Composting: Any organic waste including vegetable waste, garden waste, agricultural waste, cattle dung, and so on, can be composted. However, meat scraps and bones, and very oily waste have to be avoidedastheseattractrodentsand insects and can lead to odors. It is not necessary to have a structure as composting can be successfully carriedoutinanycornerofahouse yard or field. However, a structure such as a compost pit can retainthe heat which helps to speed up the composting process and also improves aesthetics.

Vermi-composting:A Asagainst ordinary composting, which uses natural processes to break down organicmaterial,vermi-composting uses various species of worms to break down the organic material, producing nutrient rich compost. Vermi-composting can be carried outinavermi-tankoravermi-bed. Somelocalearthwormspeciessuch as*Octolasiontyrtaeum,Amynthus diffringens* and *Metaphire houlleti*etc. can be tested and used for thispurposes.TheAfricanspecies of earthworms such as *Eisenia fetida* and *Eudrilus eugenae*which are conventionally used for vermicompostingprocessinIndia mayalsobeused.Boththesespecies are very efficient vermicomposting species and have wide range of temperature tolerance and high reproductive potential.

Gasification(Biogas): When biodegradable organic solid waste is subjected to anaerobic decomposition, a gaseous mixture of Methane (CH_4) and Carbon-dioxide(CO_2)knownas Biogascouldbeproducedunder favorableconditions.Community/ individual biogas plant will helpin achieving the targets related to waste management and, in themeantime,willalsohelpin reducingdependenceonthedung-basedhouseholdfuelswhichcause higher levels of indoor pollution. The Khadi and Village Industries Commission (KVIC) is a pioneerindesigningbiogasplantsin India and provides technical help in setting them up.

ii) Non-biodegradableSolid Waste

Recyclablewastes: Wastesuch as plastic, glass, metal, and so on can be sold to scrap collectors. The scrap collectors further send themtotheplaceswheretheycan bebroughtbacktotheproduction line, therebyrecycling&reducing wastes and in the meantime generating some employment.

Non-recyclablewastes: Such wasteswhichcannotberecycled must be disposed of in a proper way to a landfill or a dumping site identified by the municipal committee of RS Pura town.

Participatory Approach in SWM

iii) Promotion of a variety of technologiesthatareuser-friendly and affordable;

iv) Promotionofeffectivewaste management principles;

v) Segregationatsourceofsolid waste(biodegradableandnon-biodegradable)andliquidwaste(gray water and black water);

vi) Household based treatmentandmanagement,asafirs toption, and community-based collection, treatment and disposal systems,as the second option, based on the principlethatwastehastobetreated as close to the source as possible;

vii) Involvementofcommunity-based groups (for example, youth clubs, self-help groups (SHGs), mahila mandals) in waste management operations;

viii) Involvingrecyclers(forexample, kabadiwalas) as partners;

ix) Emphasisonadoptionof recycling/reuse options;

x) Developinganeffectivefinancial model to address capital and operational costs; and

xi) Creatingincentivesformotivation and sustainability.

Box7.1:Solid Waste
Whatissolidwaste? Any waste other than human excreta, urine and wastewater is called solid waste.Solidwastecanbeclassifiedintotwotypes:biodegradableandnon-biodegradable (Fig 7.1). • Biodegradablewasteisthatwhichcanbedecomposedbybiological processes, for example, vegetable peel, food, farm waste, and so on. Organicwasteisbiodegradableandcanberecycled;and • Non-biodegradablewastecannotbebrokendownbybiologicalprocesses, forexample,plastics,glass,metal,andsoon.Non-biodegradablewastecan be further classified into two types: recyclable and non-recyclable – Recyclablewasteisthatwastewhichhaseconomicvaluethatcanbe recovered, for example, metal, plastics, glass, PET bottle, and so on – Non-recyclablewasteisthatwastewhichdoesnothaveeconomicvalueof recovery, for example, tetra packs, thermocol, and so on.

Garbage disposalon thefringes ofGharana wetland ©Dr.PushpinderSingh/WWFIndia

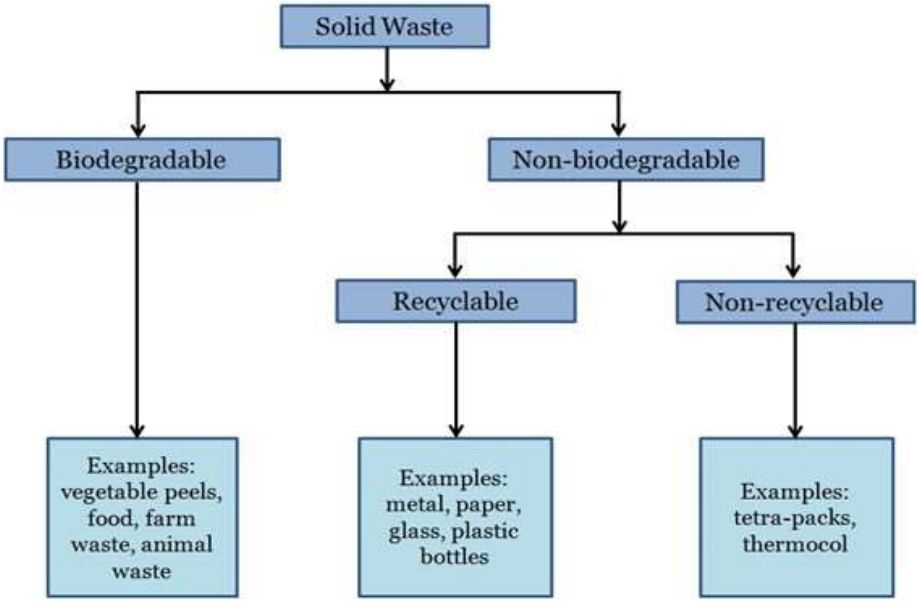


Fig7.1:Typesofsolidwaste

Pollution from Point-Source: ForGharana,themajorpointsource of pollution is domestic sewage carried by the common sewerage system. The domestic sewageleaving the individual houses is carried by a poorly constructed seweragesystemtothewetland.The main sewer carrying this sewage dumps it into the wetland near the Wildlife Department hut. The sewage has implications for the wetland ecosystem and can lead to irreversible consequences. There is need to setup mechanism for proper disposal of sewage. The following methodscanbeappliedfortreatment of sewage:

i) AtHouseholdLevel:Soakage pits can be viable methods of domestic sewage disposal at the household level. A Soakage pit is a dug out pit filled with stones or preferablyoverburntbricks.The largenumbersofstonesorbricks increasethesurfaceareaoverwhich biological and chemical action takes place. The water seeps into the ground and reduces danger of pollutingthegroundwatersources. This is the cheapest technology for management of wastewater at household level. It prevents greywaterstagnationandvector breading.

ii) At Community Level: The optionsavailableatthecommunity levelincludea).CommunityLeach

Pitandb).CommunitySewage Treatment Plant.

a). Community Leech Pit: Itis a large pit which is dug to keep stagnatingthespilledwastewater. Thespilledwatercanbeabsorbed in the soil over time. It is among the cheapest and simplest ways of dealing with the wastewaterwhich would otherwise enter the community water sources and pollutethemandalsopreventvector breeding.Theseepageofwastewater from the pit leading to groundwater pollution is a disadvantage of Leech pits.

b). Community Sewage Treatment Plant:A small scale communitysewagetreatmentplant can also be setup for treatment of the domestic sewage. The influent, which is highly polluted andcarries large amounts of nutrients, pollutants and organic matter, is passedthrough,atleast,fivestages of treatment depending on the level ofpollution.Theeffluentisrelatively cleaner water which can be used for agricultural purposes. The process also generates sludge which, after treatment,canbeusedasmanure.A basic schematic design of a Sewage Treatment Plant has been shown in fig 7.2. A detailed plan for setting up of the Sewage Treatment Plant at Gharana wetland has been included as annexure VI.

Thesuccessofcommunitylevelwater treatment system cannot be achieved in the absence of a well-plannedseweragesystem. Community sewerage system leads the wastewater to a desired location whereeitheraCommunityLeechPit is dug or a Sewage Treatment Plant issetup.Theeffluentfromtreatment plant could be used for irrigation of the agricultural fields or it canbe let into the wetland or if desired canalsobedisposed-offbeyondthe boundaries of the wetland into the channelwhichcarriesoutflowfrom the wetland.

c). Natural processes based wastewater treatment system: Sewagetreatmentplantsareagreat option where there is no dearth of power and financial resources. In case of Gharana, which is located very close to the Indo-Pak International border, which often witnesses cross-border firing, the STP could get damaged and given thatitisacostandpowerintensive system,itsmaintenancemaybecome very difficult and eventually the system may fail. In order to avoid this, a natural processes based wastewater treatment system may be developed for Gharana wetland. Such systems involve treatment of wastewaterthroughthenatural,self-treatmentprocessesaidedbyaquatic vegetation,soilandgravel.Thebasic principle of this method for sewage treatment is the flow of wastewater through the filtration system, where

vegetationtrapsthepollutants.Such systems help treat the wastewater with even low concentrations of organic matter that the activated sludge processes in conventional STPsoftenstruggleswith.Theyhave the capability to efficiently remove theorganicmatter,suspendedsolids andphosphorus.Butmostofall,itis acomparativelysimplersystemwith lowercostandpowerdemands.Such a system may prove to be the best alternative for treatment of the domestic sewage that is producedbytheGharanavillage.Thei rdesign must only be chalked out with the help of domain experts. And their constructionandcommissioningmay be undertaken under the supervision and guidance of the experts. A detailed account of different natural processes based wastewater treatmentsystemshasbeenprovided as annexure VII.

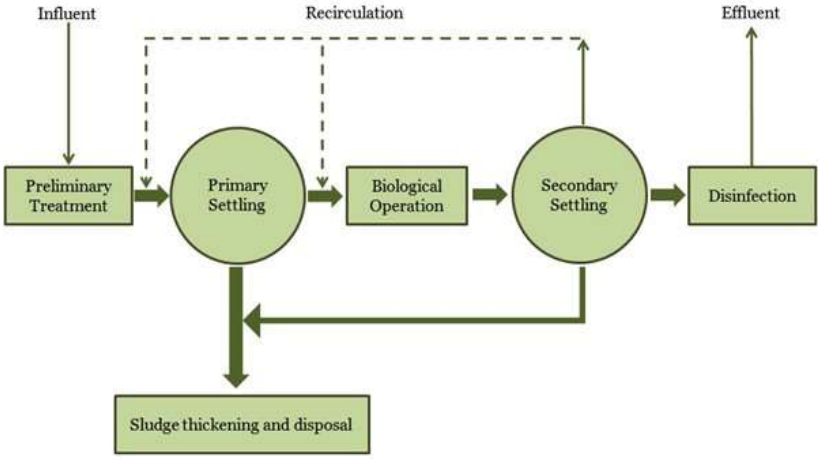


Fig 7.2 Schematic diagram of a basic Sewage Treatment Plant

Pollution from Non-point Sources: The main non-point source of pollution for Gharana wetland is the agricultural runoff fromthesurroundingagricultural fields.

i) Reducing dependence on agriculturalchemicals: Thereis need of minimizing the application rates for chemical pesticides, herbicides, and fertilizers in the agriculturalfieldsintheimmediate catchments of all the wetlands. Timing chemical applications operationsaccordingtoweather forecasts or seasonal weather patterns would certainly help in reducing the pollution.

An effective pest control program mightrequiretheuseofpesticidesas

asmallcomponentofanintegrated pest management program. Practices such as crop rotation, proper site selection, proper fertilization, and good cultivation techniques promote a healthy crop and reduce pest infestation, thereby reducing the need for pesticide use. An integrated pest management program protects the environment, reduces pesticide and fertilizer inputs,andenhanceseconomicgain. Farmers must be educated through well targeted awareness campaign about ill-effects of these agricultural chemicals and principles of organic farming must be promoted. All the required assistance with regard to organic farming including methods of producing organic manures and their provision at subsidized rates mustbeprovidedbytheDepartment of Wildlife Protection.

ii) Sediment and Silt Control:
Due to continuous siltation of Gharana wetland, there has been significantreductioninitsdepthand subsequently its volume. Siltation is a potent threat to the aquatic ecosystems which can have adverse impacts on both flora and fauna, especiallythenativefishstock.Too muchsedimentcancloudthewater, reducing the amount of sunlight that reaches aquatic plants. It can also clog the gills of fish or smother fish larvae. Sediments cause the introduction of weeds and dry-landplantspeciesintothewetlands. Sediments increase the concentrationofnutrients&metals in water-bodies as pollutants like fertilizers, pesticides, and heavy metals are often attached to the soil particles and this can causealgalbloomsanddepleted oxygen, which is deadly to most aquatic life. It is suggested that effectivecontrolofnonpointsource pollutioninagriculturehastofocus on controlling soil detachment and overland flow, with considerations for solutional transport and chemical drift.For pollutants that tend to bind to sediment, control of erosion and sediment transport off site can reduce not only impacts from increased sediment loading, but impactsfrom other pollutants as well duetotheinteractionsofpesticidesan d nutrients with sediment. Despiteall the ill-effects of sedimentation, mechanical desilting operations cannot be advised for the removal of existing silt deposits as mechanical dredging can cause significant environmental damage to the wetland and its associated wildlife. Dredging operations are required to be conducted in some parts of the wetland where it has to be deepened for species of diving waterbirds but it is recommended to be done by manual labor. Such areas which require dredging for deepeninghavebeenhighlightedin the layout provided in figure 9.1 in the chapter 9.

It is further suggested that interventions be made for silt and sedimentstobecontrolledatsource. Mulching is a temporary practice of soilstabilizationanderosioncontrol inwhichmaterialssuchascutgrass, wood chips, wood fibers, or straware placed on the soil surface to temporarilystabilizedisturbedareas until a seeded crop or vegetation is established.Thebenefitsofmulching stemfromreducingthedirectimpact of rain, maintaining maximum soil infiltration, and decreasing the quantity, velocity, and transport capacity of runoff water. Silt-traps can be setup in the inlet channels for trappingthesediments.Sandbagcheck dams are found to be most suitable option for sediment control in the inlet(Fig7.3).Thetrapismonitored regularly and silt and sediments accumulated behind the trapareremovedperiodicallysoth at open spaces in the trap are not completely clogged. A grass-lining must be created in the inlet channels as a long time measure. The more permanent solutionstillliesininitiativesby farmers which can reduce erosion and sedimentation by applying managementpracticesthatcontrol the volume and flow rate of runoff water, keep the soil in place, and reduce soil transport. When water isslowedorstilled,sediments(and associated pollutants) can settle out of the water column, thereby inhibiting their entrance into the wetlands. Contour tillage, buffer strips,diversions,andterracesarea few other methods to slow and trap silt and sediments.

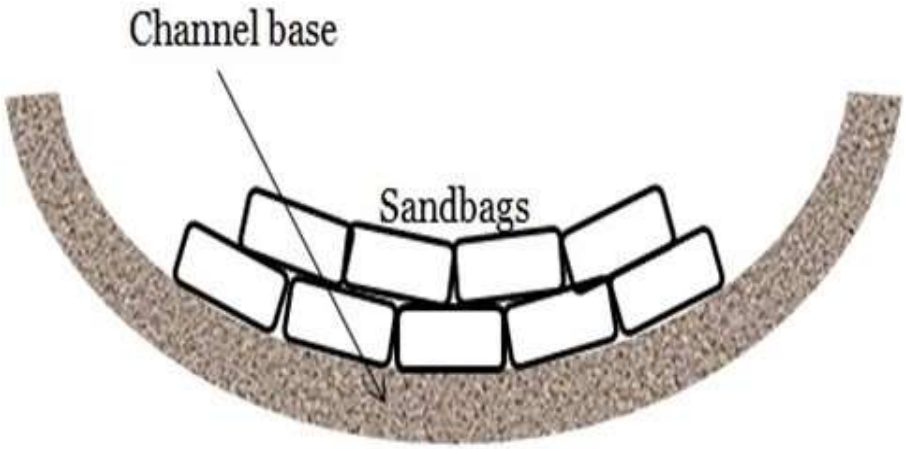


Fig 7.3: Sandbag based Sediment Trap

iii) Livestock-related controls:
The livestock is proposed to be not allowedtoenterthewetlandasthey deteriorate the quality of water. They also shake and disturb the bottomsedimentsthustemporarily increasing the turbidity of water. Therehastobeprovidedanalternate sitetothevillagersfortheirlivestock. An attempt in this regard has been made by providing a tube-well/ wallowing pond but the awareness must be raised regarding this.

Monitoring Water regime:
Itisadvisedthatregularhydrological monitoringofthewetlandistakenup under the guidance of some expert agency. The following parameters need to be monitored continuously for successful management of the wetland:

1) Waterlevel:Astaffgaugeneeds to be installed on the edge of the wetland, near the Wildlife Departmenthutanddailyreadingof water needs to be taken.

2) Depth: Biannual bathymetric surveys need to be conducted to find out any changes in the depth of the wetland. This would helpin ascertaining that whether the sediment control measures have workedeffectivelyforthewetland andwouldalsohelpin estimating correspondingchangesinvolumeof wetland (if any).

3) Weather monitoring: An automatic weather station also needs to be installed near the wetland to collect the data on the local weather. There needs to be maintained a detailed inventoryofthemeteorologicaldata of the area.

4) Water quality monitoring:
Physico-chemical monitoring has also been recognized as being avital component of an integrated assessmentprogrammethatutilises biological measures for assessing the condition of waterways. The monitoring of standard physico-chemical parameters can be of use in several ways. Firstly, it providesa record of the physico-chemical characteristics of the water-body, which when continued over an extended period, provides a record ofthevariationinthecharacteristics over time. Secondly, many physico-chemical parameters have theability to alter the toxicity of particular pollutants. The majority of standard physico-chemical waterqualityparametersissimple, inexpensive and quick to measure, andhavetobeusedtocomplement any eco-toxicological or biological monitoringstudy.Standardformat as annexed is to be followed on periodic basis for monitoring.

Habitatmanagement
Gharanawetlandformsanexcellent habitat for various wildlife species especially migratory water-birds. Gharanaandthe surrounding

landscape supports around 151 differentspeciesofbirdsincluding those of migratory water-birds which use them as wintering grounds.Butasthesewetlandsare under pressure from the human activities, the water-birds also facethethreatoflosingtheirmost preferred habitats in Jammu

Key areas in and aroundthewetlands

Though entire wetland is important but there are few areas which are favoritespotsforsomeofthewater-bird species. These areas/zones occupy an important place resting andfeedingplacesforsomeselected waterfowl species. These key areas are seen to be having greater numbers of birds as compared tothe rest of the wetland. Such areas must be given greater attention within the protected area setup. It is required that greater amount of efforts must be directed towards surveillanceandmonitoringofthese areas.

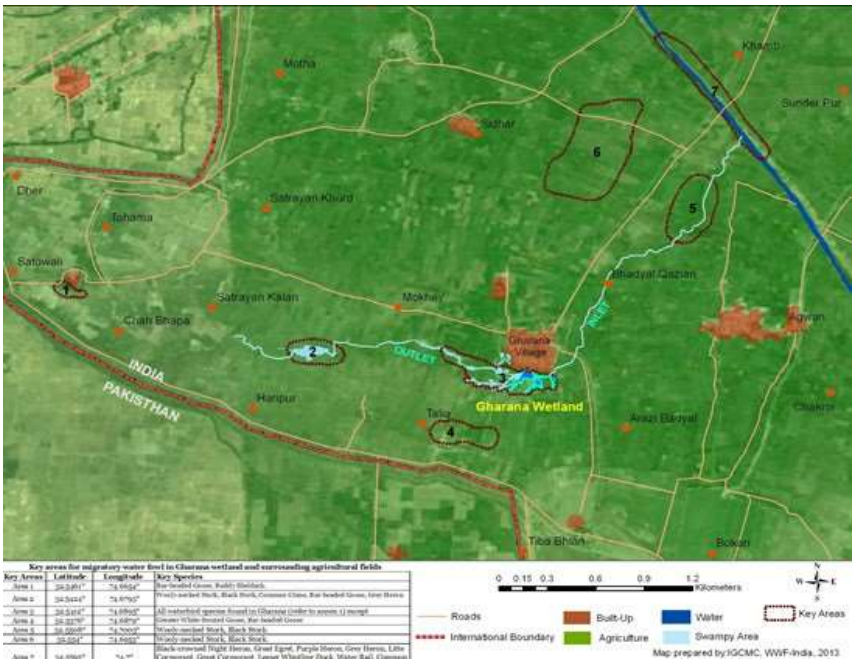
In Gharana, the wetland alone is not the only preferred site for the migratorybirds.Thesurrounding areas are as much preferred habitat as the wetland. Further, it is believed that boundaries of a protectedareamustbeconsidered permeableandtheprotectedareas must never be treated as islands within the surrounding area. It isratheressentialtostrengthen the links which protected areashave with their surroundings. In Gharana,therehavebeenidentified sixkeyareasotherthanthewetland itself which are important to the migratory waterfowl. These other key areas are outside of the actual designated wetland and lie in the agricultural fields and the security ditch. The map 7.1 below shows all the seven key areas in and around Gharana wetland. These have been discussed below:

i) GharanaWetland(Area3):

Gharanawetlanditself with open water in the centre and the surrounding swamps is the richest of all the areas. All birds listed inthe checklist of birds of Gharana (Annexure1)exceptCommonCrane find the main wetland as key site. Especially, the divers, dabblersandwadersareconcentrate dinthe main wetland. Those villagers who own agricultural land across the wetland often wade through the wetlandtoreachtheirfields.While doingthistheyhavetopassthrough the areas of very high water-bird activity. Because the birds are very shybeings,theyeasilygetdisturbed and have to fly away. It is therefore recommended that the locals must be unconditionally prohibited from passing through the wetland.

ii) Security ditch (Area 7):

The location on security ditch at32.5595°and74.7°,nearthe



Map 7.1 Key areasfor migratory birds inGharana wetland

Gharana wetland is one of the favorite spots for the migratory birds. Clear and deep water oftheditchaccompaniedwiththick weed growth and the surrounding terrestrial vegetation serves the needs of birds very well. The birds which are found here include Black-crownedNightHeron,Great Egret, Purple Heron, Grey Heron, LittleCormorant,GreatCormorant, Lesser Whistling Duck, Water Rail, Common Moorhen and Eurasian Coot.

iii) Agricultural fields (areas1, 2, 4, 5 and 6): Winter flooded croplands, both harvested andnot,canprovideimportanthabit at for wintering waterfowl, and agriculture is the most prevalent landuse around Gharana wetland. The agricultural fields grown with wheat and Trifolium are especially important to waterfowl. The research indicates that waterfowl feedinginricefieldsalsoreducesthe weeds in the next production cycleof rice. But the waterfowl species, especially the Bar-headed Goose, grazing wheat and Trifolium is the major cause of conflict between Department of Wildlife Protection and the local communities. Wooly-necked Stork and Black Stork are also found roaming and feeding in the agricultural fields and are not believed to harm the crops.

There are around 6 key areas located in and around the wetland (in the surroundingagriculturalfields)andtheseareashavebeentabulatedasbelow:

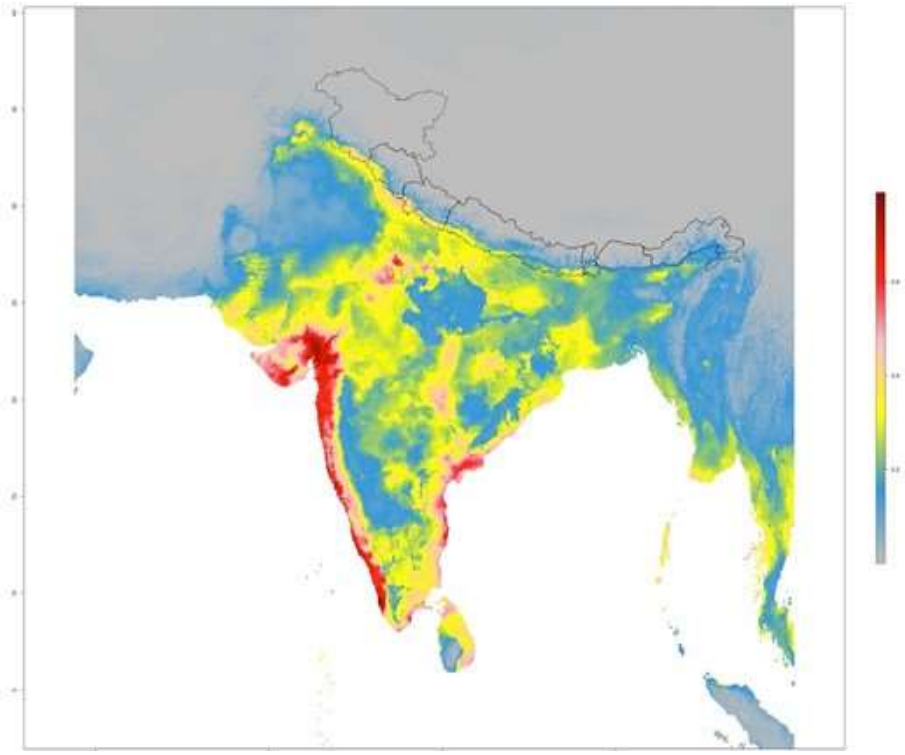
Table6.1:FiveKeyhabitatareasformigratorybirdsintheagriculturalfields surrounding Gharana

KeyAreas	Latitude	Longitude	KeySpecies
Area1	32.5461°	74.6654°	Bar-headed Goose, Ruddy Shelduck, GreylagGoose,GreaterWhite-fronted Goose
Area2	32.5424°	74.6793°	Asianwoollyneck,BlackStork,Common Crane, Bar-headed Goose, Grey Heron, Greylag Goose, Greater White-fronted Goose
Area4	32.5376°	74.6879°	GreaterWhite-frontedGoose,Bar- headed Goose, Greylag Goose
Area5	32.5508°	74.7003°	Asian woollyneck, Black Stork
Area6	32.554°	74.6953°	Asian woollyneck, Black Stork

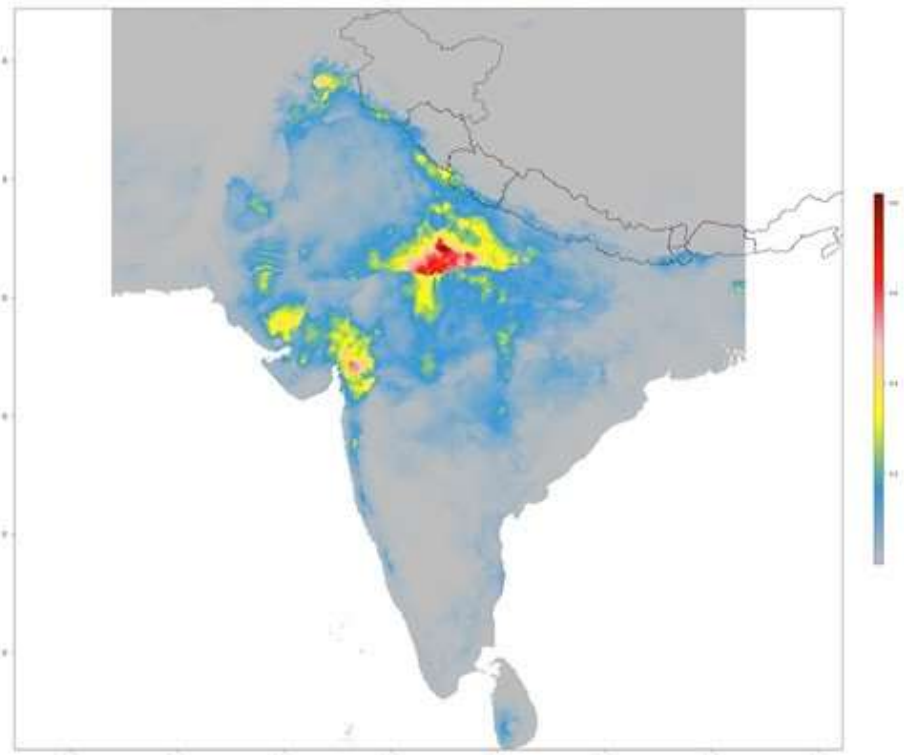
Revivalofnativeaquaticfauna: Efforts must be made to revive various species of native fauna ofthe Gharana wetland especially fish and turtles. Gharana wetland is visited by many waterfowl species which are piscivorous, and this is gauged by the closely studyingthe dominant feeding guilds prevalent in the wetland and its surroundings. Sohil and Sharma (2020) reported that carnivorous feeding guild was the most dominantoneandsimilarlyJamwal et.al. (2017) reported 36% of birds as carnivorous. The Department of Wildlife of Protection has in past madeefforts to enrich the wetland by introducing fingerlings of Rohu and Mrigal. However, nowthere isneedforrevivenativefishfauna of the area. The species of fish belonging to the genera *Channa*and *Puntius*. must be introduced inthewetlandonanexperimental basisandundercloseobservation. Othernativefishspecieswhichmay be deemed necessary may also be introduced under supervision of experts.

Further, in order to assess the suitabilityoftheGharanawetland as a potential habitat for revivalof two turtle species *(Lissemys punctata* and *Nilssonia gangetica)*amodellingexercisewasco nducted. The study revealed that multiple parameters influenced the potential distribution of *Lissemys punctata*and *Nilssonia gangetica* across itscurrentdistribution range.

According to our findings, Annual Mean Temperature (Bio 1), PrecipitationofWettestMonth(Bio 13), and Precipitation Seasonality were the most important variables for *Lissemys punctata* distribution andfor*Nilssoniagangetica*Wettest Month Precipitation (Bio 13), Mean DiurnalRange(Bio2),Precipitation Seasonality (Bio 15), and Mean Temperature of the Warmest Quarter (Bio 10) are critical parameters that define its potential distribution. When we examined potential distribution across therangefortheIndianspecies *Lissemyspunctata*and*Nilssonia gangetica*(Maps6&7).Ourmodels revealedthatinthecaseof*Lissemys punctata*, Gharana has less suitable climatic habitat than potential habitatwhencomparedwithGujrat, Maharashtra, Goa, Karnataka, Kerala, and some parts of Andhra Pradesh and Orissa where the species has its best habitat. Similar is the case with *Nilssonia gangetica*aswell.Itisthereforerecommended that wetland can be considered for revival of both the turtle species ona purely experimental basis. The detailed report of the modelling studyhasbeenattachedasannexure VII in the report.



Map7.2.Present-dayoccurrenceprobabilityof*Lissemyspunctata*



Map7.3.Present-dayoccurrenceprobabilityof*Nilssoniagangetica*

Weed management: The presence of invasive aquatic weeds poses a huge challenge to the wetland managers. Gharana wetlandalsofacesthreatfromthe vigorousgrowthofaquaticweeds. The major weeds of concern in GharanawetlandareAlligatorweed *(Alternanthera philoxeroides)*, Water Hyacinth (*Eichhornia crassipes)* and Mosquito Fern *(Azolla pinnata).*

GeneralMethodsofWeed Control: There are three mainmethodsofweedcontrol i.e. mechanical, chemical and biological. In case of Gharana wetland, it is suggested that only mechanicalmethodsbeused,laid down as below:

Weed removal using manual&mechanicalmethods: Manual and mechanical techniques such aspulling,cutting,andotherwise damaging plants, may be used tocontrolsomeinvasiveplants, particularly if the population is relatively small.These techniques can be extremely specific,minimizingdamageto

desirable plants and animals,but they are generally labor and timeintensive.Treatmentsmust typicallybeadministeredseveral times to prevent the weed from re-establishing, and in the process, laborersandmachinesmayseverely trample vegetation and disturb soil,providingprimeconditionsfor re-invasion by the same or other invasive species (Tu et.al 2011).

Controlling major Weedsin Gharana:

Alligator Weed: Alligator weed *(Alternanthera philoxeroides)* of the family Amaranthaceae is an invasiveweedoriginallyfromSouth America(Vogtetal.1979)andisnow widespread throughout the world (Buckingham 1996). In J&K, it has also been reported from the Wular Lake in Kashmir (Masoodi, and Khan, 2012). In Gharana wetland, Alligator weed forms highly dense network which covers almost whole of the wetland. It is removed every year by manual methods. After manually uprooting the network, it is dumped inside the wetlandin the form of heaps far away fromthewetland.Therearethree principal methods recommended for controlling Alligator weed; mechanical, chemical and biological. The mechanical or manual control involveslocaleradicationoftheweed at a few locations where infestations are small. This method is not very effective in case of large infestations. The chemical methods are not recommended for the chemicals may have implications for the ecosystem. The biological control using the flea beetle *Agasicles hygrophila* has been quite successfulinaquaticecosystemsof warm temperate regions (Centre forWeedManagement2003).This method can be tested for Gharana wetland and if successful, may be adopted in long term.

Water Hyacinth: Water hyacinth *(Eichhornia crassipes)* is a free floating perennial aquatic plant, native to Amazonia, Brazil (Wright and Purcell 1995). It has spread throughoutthetropical,subtropical and warm temperate regions of the world and caused environmental and cultural problems (Wright and Purcell 1995, Centre et al. 2002). It forms dense impenetrable mats across water surfaces that greatly decrease biodiversity. It degrades water quality and limits access by humans, machinery, animals and birds (Centre et al. 2002). Water hyacinth also has a large evapo-transpiration rate losing water into the atmosphere at up to six times that lost by open water (Pieterse 1978). So far, only the mechanical controlmeasureshavebeenusedfor water hyacinth control in Gharana wetland. They are the safest and least expensive way to control water hyacinth and is therefore recommendedtobecontinuedfor

itscontrolin future.

Azolla: Mosquito Fern/Red Azolla *(Azolla pinnata)* is a species of fern known by several common names, including feathered mosquito-fern and water velvet. It is native tomuch of Africa, Asia from China to Japan, India and the Philippines, andpartsofAustralia.Itgrowsfrom 1 cm to 2.5 cm wide and is a bright green colour. Its colour changes to deep red when it is exposed to the sun, thus the name Red Azolla. Azollagrowsinwaterwaysindense patches, which can look like a green or red carpet. In Gharana it has emerged only recently and as mentionedearlier,in2012itformed thick & dense mats. Such thick, complete coverings of Azolla can cause de-oxygenation of the water. This can affect organisms such as fish and other aquatic plants, and the decay of the latter can lead to astrongodour.InGharana,itwas controlled by manually removing it using a net. There have also beenconductedstudiestoexplore biological controls for this weedinsomecountriesandthey,sof ar, have appeared feasible. A weevil, *Stenopelmus rufinasus*, has been tested successfully as a biological control agent for *Azolla pinnata*. This weevil is found in the United States(Richerson&Grigarick1967). It controls Azolla filiculoides and *Azollacaroliniana*,thenativeAzolla species occurring in the U.S. as its host plants (Lumpkin 1993). This weevil can be tested for biological control of *Azolla pinnata* in the Indian conditions and if found successful,canbeusedinfuturein Gharana too.

Training for revenue generation from weeds: At times, while managing the aquatic weeds, opportunities also emerge for livelihood alternatives and generationofrevenue.Forinstance, the problem of water hyacinth infestation in Harike Lake Punjab and other water-bodies in the surrounding villages had become a huge problem for wildlife and wetland managers. But some craftsmendevelopedthetechniques of making crafts from the dried shoots of the water hyacinth. This technique has become livelihood earner for some of the village craftsmen.Thisartishasalsobeing displayed at some of the events of national level. The craftsmen from Punjab can be invited in Gharana to train the local villagers here, so thatpeopleherecanalsobetrained in making crafts from weeds which have infested Gharana wetland.

Integratedweedmanagement: Herbicides have to be consideredas a temporary control method. Depending upon the herbicide selection and the weed species, durationofcontrolcanrangefrom a few weeks to several months.

Long-term weed control can be achieved by using a combination of recommended aquatic de-weeding methods. For example, use of the properherbicidesfollowedbygrass carpstockingwilleffectivelycontrol and prevent the reoccurrence of most submersed weed problems. ForasmallwetlandlikeGharana, manual and biological means of weed control are best suited and subsequently integrated weedmanagementstrategycan be evolved using other suitable methods.

5AdaptiveWeedManagement

A weed management program has to be accomplished using an adaptive management approach. ThevariousstepsintheAdaptive Weed Management Cycle are as follows (Fig 7.4):

1. Establishmanagementgoalsand objectives for the wetland site

2. Determinewhichplantspeciesor populations, if any, block or have potentialtoblockattainmentofthe management goals and objectives;

3. Determinewhichmethodsare availabletocontroltheweed(s);

4. Develop and implement a managementplandesignedtomove conditions toward management goals and objectives;

5. Monitor and assess the impacts of management actions in terms of their effectiveness in moving conditionstowardthesegoalsand objectives; and

6. Reevaluate,modify,andstartthe cycle again.

It must be noted that the control activities do not begin until the first threestepshavebeentaken.Aweed control program is best viewed

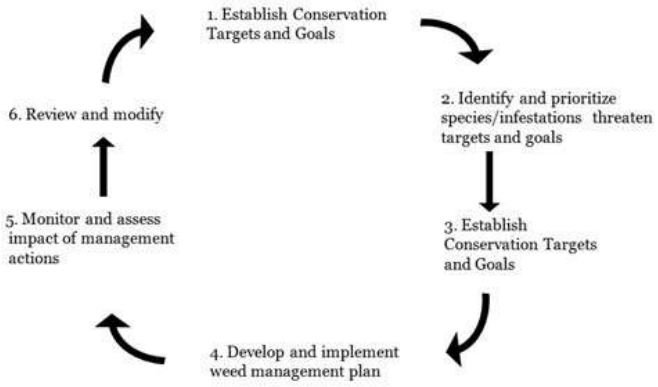


Fig 7.4: Adaptive Weed Management
Source: Weed Control Methods Handbook: Tools & Techniques for Use in

as part of an overall restoration program, therefore the focus is onwhatonewantstoreplacethe weedwith,ratherthanjustsimply eliminating the weed. One need to keep in mind that the ultimate purpose of the work is to preserve nativespecies,communities,and/or functioning ecosystems.

Wildlifehealthmonitoring: The frequency and magnitudeof disease incidents amongst water-birds (from emerging or re-emerging disease agents) have increased to the extent that they demand serious attention. Some waterbirddiseasesalsohavehuman and domestic animal implications and vice versa. These diseases not only affect waterbirds, but have impacts on the economic, health and cultural values of humans. Thereisalsoneedofsettingupofa comprehensive system for wildlife health monitoring. The underlying factors for emergence of diseases are related to increases in human populations, human consumption patterns, and the redistribution of species and/or further aggregation of gregarious species inamannerthatfacilitatesdisease transmission. Improvements in diseasesurveillance,diagnosisand prevention are critically needed to address and manage disease outbreaks among waterbirds. Though Wildlife Department has conductedsomestudiesregarding conducted some studies regarding this in collaboration with Sher-e-Kashmir University Agricultural Science and Technology (Jammu) and Jammu University, there is need to establish a system under whichcollaborations/partnerships can be developed with the expert organizations and such activities can be made a regular feature.

Participatory decision making: Participatorymanagement isdescribedbytheRamsar Convention on Wetlands as a learningprocessthathelpsimprove joint capacities for study and action among all those involvedin the conservation of wetlands. Wetland management planning thatisinclusivehasamuchbetter chance of success. The long-term success of any management plan is dependentontheunderstandingof, andsupportfor, managementgoals among the stakeholders.

The Ramsar Convention aims to motivate people 'to appreciate the values of wetlands so that they become advocates for wetland conservation andwiseuseandmay act to become involved in relevant policy formulation, planning and management' (Resolution VIII.31; WetlandCEPA.RamsarHandbook No. 4, 3rd edition, 2007).

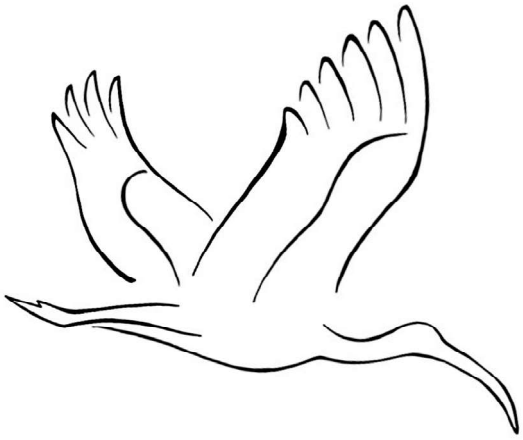
GeogheganandRenard(2002)have suggested four key messages on communityinvolvementinplanning andmanagementofprotectedareas:

•Effective management requires the integration of the full diversity of stakeholders and takes into account thedifferingwaystheyareimpacted byandimpactuponprotectedareas;

•The long-term success of participatorymanagementdepends onthesuitabilityoftheinstitutional arrangements;

•Given the limited resources available for protected area management,transparentprocesses of negotiation are required to determine how much participation is possible and what objectives are given priority; and

•Participatory management ofprotectedareasmustyield appreciablebenefitsforlocal communities.



Stakeholdersandtheir roles in conservation of Gharana wetland:

Themajorstakeholdersandtheir roles at Gharana wetland are:

i) Local communities: The local communities are largely agrarian and have farming as the major source of livelihood. The local communities live in the vicinity of thesewetlandsandareresponsible for changes taking place in and around the wetlands.

ii) Panchayati Raj Institutions (PRI): They are legally recognized representatives of the local communities.Theyareauthorized to voice the concerns of local communities and can also play an importantroleininvolvingpeople in decision making.

iii) Department of Wildlife Protection, Government of J&K: Being the legal guardian of the wildlife of the state, the Wildlife Department, under the Wildlife Protection Act, 1972 has sole legal jurisdiction over the wetlands and henceauthoritytotakedecisionsfor management of the wetlands.

iv) Department of Revenue, Government of J&K: The Revenue Department is responsible for keeping and maintaining the land records.Inthiscase,thedelineation of these wetlands has to be carried out with the involvement of the Revenue Department.

v) Security Forces: Since allthese wetlands are close to the International Border between India and Pakistan, there is a huge presence of Indian Army andBorderSecurityForce(BSF). Besides, the security ditch which is a major source of inflow to Gharanawetlandisalsounderthe control of Security forces.

vi) Irrigation Department: The Gharanawetlandreceiveswater from the irrigation canals and hence this department is also a stakeholder.

vii) Rural Development Department:RuralDevelopment Department implements the schemes/projectsrelatedtorural development such as Swach BharatAbhiyanintheruralareas lying close to the wetland.

viii) Tourism Department: The Gharana wetland is emerging as an important tourist spot. The Tourism Department can help promoting this wetlandasanecotourismdestination and facilitate bringing this wetland on the tourism map of the state.

ix) Local policy makers and politicians: They can help in resolving the ongoing conflict betweenthebirdsandthefarmers.

x) Tour operators: They are the people who facilitate planning local tours of Jammu and while doingthis they can promote the Gharana wetlandasabirdingandecotourism destination.

xi) Researchers and students: By conducting research, they can strengthen the baseline data for all these wetlands which would help in sharpeningthemanagementprocess.

Socio-economicsurveybeingconductedinGharanavillage©Dr.PushpinderSingh/WWFIndia

CHAPTER8-CEPAANDNATURE INTERPRETATION

Communication, Education andPublicAwareness(CEPA)
Communication, education and public awareness (CEPA) was formally recognized as a high priority, cross-cutting area of work for the Ramsar Convention on Wetlands of International Importanceatthe29thmeetingof theStandingCommitteeinFebruary 2003. Resolution X.8 with regard to CEPA adopted during 10th Meeting of the Conference of the Parties in 2008 in Korea consolidated the Convention's position regarding conduct and delivery of CEPA.

Theguidingprincipleswhichgive strength to the Ramsar CEPA Programme are:

a) The CEPA Programme offers toolstohelppeopleunderstandthe values of wetlands so that they are motivated to become advocates for wetland conservation and wise use and may act to become involved in relevantpolicyformulation,planning and management.

b) The CEPA Programme fosters productionofeffectiveCEPAtools and expertise to engage major stakeholders'participationinwise use of wetlands and to convey appropriatemessagesinorderto promote the wise use principle throughout society.

c) The Ramsar Convention believes that CEPA are proposed to form a central part of implementing the Convention by each Contracting Party. Investment in CEPA will increase the number of informed advocates, actors and networks involvedinwetlandissuesandbuild an informed decision-making and public constituency.

The key CEPA strategies identified by Ramsar Convention's CEPA Oversight Panel which can help in achievementofobjectivessetunder CEPAprogrammearementionedas below:

1. Awarenessmessages:Using a series of simple messages is an effective CEPA strategy. Such messages can be in form of famous sayings, quotes, slogans or poemsetc. and have to be written on the wallsorondisplayboardsontheway fromentrance/receptionboothtothe wetland.

2. Usinglocal communication

tools: Using the local mediafacilities,whetherthisbenewspapers, newsletters, local radio or TV channels, can be effective in reaching a broad range of stakeholders. Local mediaisalreadyveryactiveinJammu and arguably has an important role toplayifGharanawetlandistobe conserved.

3. Information products: Brochures, fact sheets and postersareexamplesofinformationproducts that can be developed. It is very importantthatcontentiskeptsimple and suitable for the target audience. The information products should be bilingual (in English and Hindi).

4. Meetings, fora & consultations: Smaller or larger gatheringswithspecificallytargeted stakeholders can be very effective – especially when a higher level of involvement is intended, or when implications of the measures will be highforaspecificstakeholders'group.

5. Visitoraccess: Allowingpeopleto visitthewetlandcanprovidepersonal experiences that build understanding and support very effectively. Encouraging and providing support for visitors is an excellent way to develop tourism potential that can contributetotheresourcesneededfor managing the site.

6. Interpreting the site for visitors: Interpretingthesitefor visitors through signage, visitor facilities and dedicated guides will enhance their experience. Local communities often represent a rich repositoryofknowledgebuiltupover time and this can form the basis of locally-based interpretation for a wetland. Many sites and dedicated centresmake effective use of both guides and volunteers in working with visitors.

7. Special events, community awareness days: Special events on suitable days such as the Convention's annual campaign, World Wetlands Day (2 February), canbeusefulinbuildingawareness and involvement over time. Other important events like World Migratory Bird Day, Big Bird Day, Turtle day, World Environment Day and Wildlife Week should be an annual feature. Organizing these events at Gharana will give an opportunity to the stakeholders to discussitwithinthemselvesandwith others the issues related to Gharana wetland.

8. Community education initiatives and programmes: Where resources and expertise are available, education and awareness programmesarevaluableadditionto themanagementofasite.Awareness programmescanbebroadorspecific to a particular audience, such as schools or local community centres. The members of local community atGharanacanalsobetakenforan exposurevisittosomeotherwetland outside the state

WWFteamtryingtoeducatelocalchildernaboutmigratorybirds© Dr.PushpinderSingh /WWF India

GharanaWetland,Jammu,J&K|.85

being managed with community involvement to demonstrate them the role of community in wetland conservation.Thiswillpromptthem to think likewise which may help in breaking their rigid anti-wetland stance toward Gharana wetland.

9. Dedicated facilities: Many wetlands around the world benefit fromdedicatedfacilitieswhichassist andenhancevisitoraccess.Facilities can range from observation decks to bird hides to dedicated visitor's centres. While these facilities may vary in scope, dedicated facilities provide a strong focus for wetland-related activities and can contribute greatlytoparticipatorymanagement.

10. Participatory approaches to managementplanning: Whilethe wetland manager bears the ultimate responsibilityfortheimplementation of the management plan, building partnerships to develop the plan will help ensure support for its implementation.Involvingrelevant stakeholders in the management planning process, particularly localcommunitiesandindigenous peoples, will be beneficial in a number of ways.

- A participatory approach to identifying values will build commitment towards managing forthosevaluesinthelongterm.
- Relevantstakeholderscan holdimportantknowledge about the site. Incorporating knowledge from thosedirectlyrelatedtothewetl and facilitates valuable exchange of knowledge, combining traditional or historical knowledge with scientific knowledge.
- Involving stakeholders in the planning process will, in the longterm,assistindeveloping asharedvisionforthewetland and in crafting measures for achieving desired outcomes.

Resourcematerial/ publications:
Publicationsplayanimportant role as they provide the information to the visitors in aneasilyunderstandableform. Followingpublicationsforthearea are proposed:

- WetlandBrochure
- ChecklistofBirds
- Posters
- OutreachMaterial

Publicationscanbepricedandthe money generated can be fed back through village eco-development committee. The revenue can be used for replenishing the stock of publications and also maintaining theconservationeducation centre.

WetlandBrochure
Thebrochurewouldconsistofallthe information that would be required by a visitor for planning the visit and alsowhatonecanexpecttoseeinthe area. The brochure would also have a list of *do's* and *don'ts* i.e what is allowedandwhatisprohibitedwhile visiting the wetland. It would also give information on the timings and the best time and season for visiting the wetland.

Checklist of Birds of Gharana
Gharana wetland has large number of resident and migratory birds whichhavebeenrecorded.Presence of raptors such as marsh harrierand hen harrier in good numbers indicate the health of the wetland region. The area is a well-known birding site among bird lovers and students. In order to assistthe students a checklist of birds has been prepared. This checklist must regularly be updated with the help of birdwatchers and new records mentioned. The checklist canbeproducedbothinhindiand englishsothatthestudentsfromthe neighboring schools and colleges also benefit.

Posters on Gharana
Aseriesof3pictorialpostersis recommended namely:

•BiodiversityofGharanaWetland (flora and fauna except birds)

•SpecialposteronBirdsofGharana

•EcosystemServicesfromGharana Wetland

These posters can be sold as souvenirsforthevisitorsandcan alsobeusedasoutreachmaterial for the local villagers and school children. The posters can be producedintwolanguagesi.e.Hindi and English.

Outreach Material
Sincelocalvillagersandchildrenare also potential visitors to the area, therefore it is important to reachout to them through publications and other means. The materials can be activity booklets like draw and color, sheets or cards. The material produced has to be in Hindi and in easy to understand language. The activity booklets can be used by school children and on successful completion of the activity they can be given a Certificate which would motivate the children tolearn more about their surrounds. These materials can be used during special events day such as World EnvironmentDay5thJune,Wildlife Week 2-8th October and Wetland Day 2nd February.

Audiovisuals
Films are an important medium of mass communication and are ofgreaterimportanceintherural settings where very few people areliterate.A20minutes'filmon Gharanawetland,itsimportance, threatsandtheirmitigationcanbe

producedwithstrongvisualcontent. ThecommentarycanbeinHindi foruseinthevillagesbutEnglish commentarycanbesuperscriptedfor use in the Conservation Education Centre. Short clippings and teasers must be spread through the social media accounts and website of Wildlife Department.

NatureInterpretationCenter-Window to the Wetland Nature Interpretation Centers (NICs) are the corner-stone of Communication, Education and Public Awareness (CEPA) programme of Ramsar Convention. Resolution X.8 with regard to communication, education, participationandawareness(CEPA) adopted during 10th Meeting of the Conference of the Parties held on 28 October-4 November 2008 at Changwon, Republic of Korea, recognized the wetland education centers(beingreferredtoasnature interpretation center here) and related facilities as key places of learningandtrainingaboutwetlands and wetland-related CEPA.

The plan being presented here deals with nature interpretation and wetland conservation education for the visitors at Manda Deer Park/ Jambu Zoo. The main goal will be a safe,visuallycoherent,appropriately sequenced and enjoyable experience with a focus on Conservation education, exhibits and self-guided activities.Signageandexhibits,shall welcome, orient and educate people visiting the interpretation centerand Gharana wetland. Through the signage, exhibits and brochures peoplewillbebetter informedabout how to make most of their visits to natural areas while leaving the minimum of their footprint. Most of theanticipatedqueriesanddoubtsof the visitors will be cleared after they consult the exhibits.

For designing and implementation oftheconceptualplanthefollowing information will be required:

•Identifyingthepotentialtarget audience for the program

•Identifyingthethemes

•CollatingimportantinformationAllocatingBudget

Socio-economic surveybeingconductedinGharanavillage ©Dr.PushpinderSingh/WWFIndia

Nature Interpretation Centre: Concept, Design and Function

A well-directed programme on nature interpretation and wetland conservation education center would contribute towards an effectivecampaignforconservation of Gharana wetland and nature in general. The Nature Interpretation Centre (NIC) is proposed to be located at the Jambu Zoo.The NIC would serve the visitors to the Jambuzoo.whichislikelytoattract high numbers of visitors which generally include school children, wildlife enthusiasts, bird watchers, researchers and casual visitors.

Theexteriordesignandplacement ofNICshouldwelcomethevisitors andsetthetonefor theexperience inside. Placement should make it visually obvious but not obtrusivetothevisitors.Thebuildinge xterior should visually complement the natural surroundings. Upon entering the NIC, visitors would be greeted at the reception desk. Reception area should have the location map of main wildlife areas of Jammu fixed on the wall which would give the visitors a glimpse of the numbers, spreads and overview ofwildlifeareasinJammu.Leaving the reception area, the visitors wouldenterthelargerexhibitroom through the right entrance, where exhibits are on display. The text in the panels would be minimum and would be bilingual i.e. English and Hindi. A detailed layout of the NIC hasbeenshownbelowinthefig8.1.

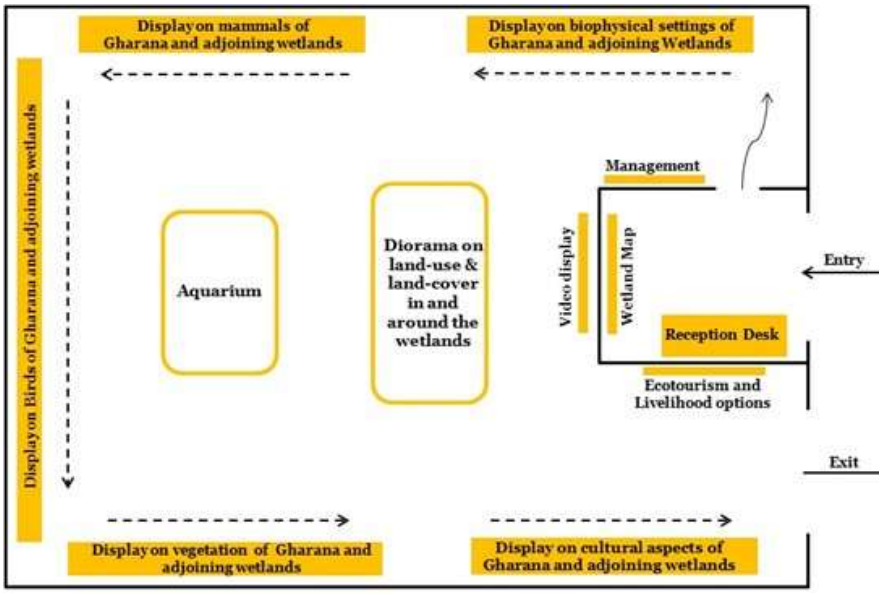


Fig8.1:LayoutofGharanaNatureInterpretationCentre

Panel 1: BiophysicalsettingsofGharanawetland The panel would tell about the biophysicalcharactersofGharana wetland ecosystem including ground and surface water, soil, geomorphology,geologyandclimate etc.

Panel2:MammalianFauna
Thisdisplaywillprovideinformation on the various species of mammals found around the Gharana wetland. It would also depict their habitat requirements and threats to their survival.

Panel3:Avifauna
This panel will provide detailed information on the birds' species foundinGharanawetland.Thepanel will contain figures and statistics on the bird assemblage of this wetland includingtheirhabitatrequirements, residential status, feeding habits and their significance for humans. There will also be a table containing informationregardingthethreatened avifauna of Gharana wetland.

Panel4:Vegetation
This panel will contain information on the aquatic vegetation found in Gharana wetland. Beside this, there will be information regarding the terrestrial species of flora found in all the wetlands. The panel will also provide details on different weed species and give some insights into theecologicalconsequencesofweed infestations in the wetland.

Panel 5: Cultural significance
This panel will provide information on the cultural significance of Gharana wetland. The visitors will get an understanding of how arelocal communities directly linked to thiswetland.Thepanelwillhighlight the direct dependence of people on Gharana.

Panel 6: Ecotourism andLivelihoodoptions
Thispanelwillcontaininformation regarding the basic principles of Ecotourism and the role it plays in being a sustainable source of livelihood for locals. The panel will highlight the need for promotion of ecotourisminGharanawetland.This panel will also provide information on other livelihood options provided by the wetlands to the local communities.

Panel7:Interactive Video Display
ThisdisplaywillactuallybeanLCD panel which would have the option ofplayingthecallsofselectedbirds along with displaying the actual photos of birds. There would alsobe option of screening films on the wetlandsandotherrelatedissuesfor the audience on this LCD panel.

Panel8:Management
This panel would describe the issues related to the management of Gharana wetland and also describetheinitiativestakenbythe Department of Wildlife Protection.

This panel will also provide informationonthelegalconservation status of Gharana wetland under the Wildlife Protection Act, 1972. Apart from this, there should be put-down the names of various other organizations working for conservationofthesewetlands.The panel should also highlight the role thatpeoplecanplayinconservation of the wetland.

ExhibitI:Adioramaon land-use & land-cover of Gharana wetland

Thisexhibitwillbeadiorama of the Gharana wetland and its surroundinglandscape.Thediorama will help in getting a bird's eye-view of the wetland. The exhibit will help in understanding the land-useandland-coverpatternsinand around the wetland and the possible pressuresanychangesinthemmight put on the wetland.

Better visitor guidance and orientationatthe wetland

Ithasoftenbeennoticedthatvisitors at the Gharana wetland are not very wellinformedaboutthesitesoftheir importance. Many of them, at times, drift into the agricultural fields and this irritates the locals and alienates them towards the visitors. Tourists have also been seen wandering around the wetland which disturbs thebirdsandonecanseethemflying off to other parts of the wetland or into the surrounding fields. There isneedforestablishingasystemto direct the tourists to the places of their importance.

Visitor signs

A system guided by the signs and symbols needs to be set to givedirectionstothevisitorsto make them reach the sites of their importance. The number of signs should be kept to minimum. The signs should welcome the visitors, directthemandcontrolthemfrom straying from the path.

Entrance/Reception/ Orientation Booth

The welcome sign will direct the visitors to a booth which will housea detailed map of the wetland the points of visitor importance. The booth will be placed in such a way thatallthevisitorsshallhavetopass through it. The personal manning theboothwillthenawarethevisitors about the various do's and don'tsand then direct them to path leading to the point of bird watching in the Bird-watching zone. In the bird-watchingzone,anotherpersonalwill takechargeandeducatesthevisitors about the wetland and facilitates bird-watching.Thepersonalspresent in the bird-watching zone will also provide the visitors with various optical instruments needed for bird-watching. They will brief visitors about the various species and help them in their identification while giving brief information regarding

migrationandtheirsummer habitats.

Visitor Statistics
The personal manning the booth will alsomaintainthetouriststatistics.He will count the number of tourists and numbers of groups and record them in the register provided to him. This will help in assessment of numbers of visitors to the wetland and therefore successful management of tourism at the wetland.

Pathway Directional Signs In order to regulate the flow of visitor's pathway directional signs should be placed at regular intervals so that the visitors are awarewhichwaytogo.Thesigns shouldleadthemtoallthemajor facilities that are available forthe visitors such as parking area, toilets, drinking water, birding point/watch-tower, canteen and the exit.

Gharanawetland©Dr.PushpinderSingh/WWFIndia

CHAPTER9-ECO-DEVELOPMENTAND ECOTOURISM

Eco-development: Eco-development is an approach to development through rationaluseofnaturalresourcesby means of appropriate technology and system of production which take into account and provide for the conservation of nature (Source: GREMES / UNUN). It referstodevelopmentatregional and locallevels,consistentwiththe potentialsoftheareainvolved,with attention given to the adequate and rational use of natural resources,technologicalstylesand organizational forms that respect the natural ecosystems and local social and cultural patterns.

In India, the rise of conflict between wildlife managers and localcommunitiesinmidof1970s, ledtotheemergenceandgrowthof thethinkingoneco-developmental approach.

The resultant ideology led toaninnovativeandameliorative developmentalapproachwhich goesbeyondmereprotection.These measures also took into account theissueofpeople'sdependencies overtheprotectedareas.The1983 National Wildlife Action Plan formallyrecognizedandmandated eco-development as a PA-people supportive programme.

Rationale: Eco-development programme will try to address the conflict between environmental conservation and development in Gharana. It will lay out a holistic approach to deal with the interests ofthewetland,thelocalcommunity in Gharana village and the other stakeholders.

Objectives:

1. To align the developmental system in and around the Gharana wetlandreserveinaccordancewith local conservation needs.

2. Involving local stakeholders inthe conservation and management ofGharanaWetlandReserveandto generate long term support for this reserve.

3. To generate additional sources andopportunitiesoflivelihoodfor the people living in the Gharana village.

4. Toreducetheconflict,ifany, between the wildlife and the humanslivingaroundGharana

wetlandreserve.

5. To ensure people's participation in conservation of wetlands and developing Gharana wetland as a modelin'communityparticipation and nature education'.

Strategies:Theeco-development strategies being discussed in the following paragraphs shall be devised to achieve the objectives listed above:

Strategyforinvolvingpeople in wetland conservation

The people need to be realized that the wetland is an important componentoftheirlivesandthat its conservation has to be given thehighestpriority.Theyneedto accept the migratory waterfowl, especiallyBar-headedGoose,asan integral part of the wetland.

Thefollowingstepswillbetaken for implementing this strategy:

i) Organizingasmallconservation group of locals from Gharana villageengagedthroughdailyand weeklymeetingsanddiscussions. There has to be presence of government officials in this conservation group.

ii) Discussing problems related to wildlifeandwetlandconservation and also the problems faced by local community. This will make the communities feel connected with the wetland and will also improvetheirrelationshipwiththe Wildlife Department.

iii) Starting small incomegeneration programmes and routing them through the local conservation groups. There is a needtostartasocietyforlivelihood assistance with a seed fund to lend money for emergency purposes to villagers at interest rates lesser than those offered by the banks. Providing funding to the villagers for setting up small businesses will alsohelpinbuildingpublicsupport for the Wildlife Department. These activities will help inpoverty amelioration leading to strengthening of socio-economic frameworkofthelocalcommunity.

iv) Exposure visits of local communities and staff of the wildlifedepartmenttothewetlands which are known for being models of community-based wetland conservation.

v) Raising awareness levels and imparting training to the local conservationgroupsregardingthe following:

a) Personalitydevelopmentand leadership qualities.

b) Basics of environmental conservationandmanagementof natural resources.

c) Laws,rulesandlegalprovisions with regard to environment in India and Jammu and Kashmir State.

d) Governmentschemesmeantfor development and upliftment of rural communities.

e) Healthrelatedissues.

Strategy for employment and income generation
Followingstepsareproposedfor generation of alternate options of employment and income generation:

i) Training a selected group of village youth as 'Nature Guides' in Gharanawhowouldbeguidingthe tourists/visitors during their visit to Gharana wetland. They will be trainedinpersonalitydevelopment and customer handling.

ii) Training in dairy products, mushroom cultivation, farm compostingandvermicomposting etc. would help in livelihood generation.

iii) Possibilityoffinancialassistance should be explored form J&K Grameen Bank under self-employment schemes.

iv) Opportunities should be explored with Khadi and Village Industries Commission Ltd. for financialassistancetosetupsmall scale village industries which don'thaveanyecologicalfootprint.

v) Imparting training for bee-keeping to a small and select group oflocalstoandsettingupofasmall retail outlet for selling honey to the tourists/visitors is also seen as an alternate livelihood option.

vi) Someofthelocalsshouldalso be involved in horticulture. The seedlingswillbeprovidedbythe StateForestDepartmentandthe trainedpersonalsfromHorticulture Department should be engaged for helping in raising the plantation in the areas identified for the same.

vii) Interested locals should be assisted for showcasing traditional meansoftransport*(Tonga)*aswell ase-rickshawandhorse-ridingetc. as tourist attraction.

Strategy for improving infrastructure: The approach road to Gharana Wetland is very narrow.Theroadhaslongstretches dominated by loose gravel which tends to be rough and skiddy. Many tourists/visitors complain aboutthedeplorabilityoftheroad. Thoughtheissueofroadisbeyond the purview of this plan, but if this wetland is to be developed as a good tourist spot, it is a must that the condition of this road is also improved.

Strategy for agriculture and irrigation:Aseparatechannel

forirrigationhastobeconstructed so that the farmers who havefields close to the wetland do not have to pump-out water from the wetland to irrigate their fields. The control of inlet and outlet ofthewetlandmustliewiththe Wildlife Department and not the local farmers which, at present, are controlled by the farmers. For thesakeofsavingtheircropsfrom being overwatered or at those times when they do not need to water their crops at all, they close the inlet and open the outlet and therefore let the wetland run dry. These unwanted periods of water shortageputthewetlandecosystem under extreme hydrological stress. This necessitates complete separation of wetland and irrigation system. The proposed irrigation channel must run alongsidetheroadrunningparallel to the International Border.

TractorploughingfieldsadjacenttoGharanawetland

©Dr.PushpinderSingh/WWFIndia

Bar-headed Geese in agricultural fieldnear Gharana wetland ©Dr.PushpinderSingh/WWFIndia

Village-levelspecificstrategies

TheEco-developmentprogrammes are generally implemented in theEco-developmentzone,that is unanimously decided by the agencies involved and the limit of this zone may extend up to a distance from the boundary of the protected area as may deemed fit. Gharana village will have an eco-development committee/society which, after registration, will look after and coordinate the eco-developmentactivitiesonbehalfof the village

Monitoring and Evaluation

Impacts of eco-development activities on the improvement of thewetlandecosystemandwildlife that inhabits it will be periodically monitored and evaluated. The monitoring and evaluation committee will be headed by the Regional Wildlife Warden and assisted by the Wildlife Warden Jammu.TheCommitteewillalso contain the members of local community. The final evaluation report will be submitted to the Chief Wildlife Warden, J&K.

Tourism

Tourism is the major economic activity in the natural areas. It helpsthecommunitiesdepending on them by shifting their direct economic dependence on the natural resources of these ecologically sensitive areas by providing alternate sources of livelihood. But very often, the practices related to tourism are exploitive and abusive towards the fragile ecology of the areas, leading to ill impacts. Promoting sustainable tourism activities in wildlife areas helps in the conservationofwildlifeareasand

isinfactoftenoneoftherationales for the protection of natural areas. There is need to follow values of sustainable tourism by making optimal use of environmental resources that constitute a key element in tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity.Itmustbeensuredthatt hetourists donotdisrespectthesocio-cultural authenticity of host communities. Tourism should conserve cultural heritage & traditional values, and contribute to inter-cultural understandingandtolerance. The tourism should ensure viable, long-term economic operations, providingsocio-economicbenefits to all stakeholders that are fairly distributed, including stable employment and income-earning opportunities and social services to hostcommunities,andcontributing to poverty alleviation.

Ecotourism

The International Ecotourism Society(TIES)definesecotourism as:

"Responsible travel to natural areas that conserves the environmentandimprovesthe welfare of local people."

TheWorldConservationUnionhad given the definition of ecotourism as:

"Environmentally responsibletravel and visitation to natural areas, in order to enjoy and appreciate nature (and any accompanying cultural features, bothpastandpresent)thatpromote conservation, have a low visitor impact and provide for beneficially active socio-economic involvement of local people."

Ecotourism should by definition have a positive impact on both natural areas and the local community.Ecotourismisasector of sustainable tourism. It is based on nature travel and includes all the principles of sustainability. Ecotourism is about uniting conservation,communities,and sustainable travel.

Themainprinciplesofecotourism are:

i. Minimizeimpact.

ii. Buildenvironmentalandcultural awareness and respect.

iii. Providepositiveexperiencesfor both visitors and hosts.

iv. Providedirectfinancialbenefits for conservation.

v. Providefinancialbenefitsand empowerment for local people.

vi. Raisesensitivitytohostcountries' political, environmental, and social climate.

Objectives

Followingarethemainobjectives of Ecotourism plan proposed for Gharana wetland:

1. To support the conservation of naturalareas,habitats,andwildlife, and minimize damage to them.

2. To optimize the use of scarce andnon-renewableresourcesin development and operation of tourismfacilitiesandservicesandto minimizethepollution ofair, water, andlandandgeneration ofwasteby tourism enterprises and visitors.

3. To optimize contribution of tourismtoeconomicprosperityof the local community of Gharana wetland, including proportion of visitor spending that is retained locally.

4. To strengthen the number and quality of local jobs created and supported by tourism at Gharana, including level of pay, conditions of serviceandavailabilitytoallwithout discrimination by gender, race, disability or in other ways.

5. To seek a widespread and fair distributionofeconomicandsocial benefits from tourism throughout therecipientcommunity,including improving opportunities, income and services available to the poor.

6. Toprovideasafe,satisfyingand fulfillingexperiencetothevisitors whovisitGharana.

7. To engage and empower localcommunitiesinplanning and decision making aboutthe management and future developmentoftourismatGharana wetland, in consultation with other stakeholders.

8. To maintain and strengthen the qualityoflifeinsettlementscloseto Gharana wetland, including social structures and access to resources, amenities and life support systems, avoiding any form of social degradation or exploitation.

9. To respect and enhance historic heritage, authentic culture, traditions,anddistinctivenessofthe local communities.

Strategies

Strategies suggested below are crucial for promotion of responsible tourismandinthemeantimeraising awareness among the stakeholders regardingimportanceofresponsible tourism practices.

Zoning

Zoningisastandardmethodused to organize visitors/tourists, and hence it is critical in achieving the appropriate combination of concentration and dispersal. For tourism, zoning involves decisions about what type of recreational opportunity will be provided and where.Zoningcanalsobetemporal,

thatisanareasetasidefordifferent uses at different times seasonally.

Keeping in view the limited spatial extentofGharana,thereisverylittle scopeofmakingprovisionsforother recreational activities except bird-watching.

BirdWatchingZone: Gharana wetland may be small in extent butithasremarkableassemblage of avifaunal species, especially in winters. This attracts thousands of tourists who, in the eagerness of reaching closest to birds, often disturb them and force them fly away.Thisprobablyhappensdue to lack of a designated zone for bird watching. This necessitates designation of a distinct 'Bird-WatchingZone'.Asalmostallthe speciesfoundherecanbespotted inthemainwetlandareanearthe inspection hut, this zone can be designatedas'Bird-WatchingZone' and tourists should be prohibited to approach the wetland from any other place except settlement side, in and around the inspection hut and around the new parking area. In addition, a well-camouflaged watch-tower needs to be installed amid the trees at this place which will help in camouflage. Moreover, the tower should be painted with colors which easily mix in the background. Watchtowers play an important role in bird-watching as they provide vantage points to the bird-watchers and researchers for watching and counting the birds. But in Gharana, the watch-tower installationalsoposesanimportant security threat. This watch-tower can easily be misinterpreted by the Pakistani security forces to be for defense purposes and may also be targeted. To counter this, tower must bear a board on its top on which is very clearly written the name of the Wildlife Department and the purpose of this tower. This will help in reducing the threat up to some extent.

Birdwatchers atGharana wetland©Dr.PushpinderSingh/WWFIndia

Community involvement
Going by the definition of Ecotourism,theultimatebeneficiary of the ecotourism should ideally be the local communities. It should, therefore, provide direct financial gains to locals and empower the communities, but in doing so, it should not harm the environment. The community can reap the direct benefits of tourism only whenitgetsinvolvedactivelyin conservation and ecotourism. IncaseofGharanawetland,the local community is largely an agrarian one. The locals have little awareness about the benefits of ecotourism.Itisimportantthatthe people of Gharana are acquainted with benefits of ecotourism and involved in the activities related to responsible tourism.

Helping the local community with establishing businesses for tourismwillbeimportantaspect of managing visitation at Gharana wetland.ThelocalsatGharanacan be involved in ecotourism in the following ways:

Interpretation and tourist guiding: For communicating effectively about the Gharana and more broadly about wetlands, trained and knowledgeable guides will be required. Leading and managingtouristgroupsinwetland sites requires a combination oftouristhandlingskills and conservation knowledge. When groups are well-led, they will help to protect the places they visit, and the riskthattheymaycauseanydamage is considerably reduced. The way groups are led and managed canalso make a vital contribution to wetland awareness just by creating memorable and enriching experiences for visitors. To achieve this, Wildlife Department staff and local communities need training andsupportonhowtomanageand interact with tourist groups. They will also need information and understanding about the site and its special features, and knowledge about appropriate tourist behavior to help visitors get the most out of their visits and to minimize disturbance and damage. Tourist guides and wildlife staff will be trained through regular training programmes and workshops. They willalsobetakenforexposuretrips to some of the thriving ecotourism destinations.

Home-stays: Home-stays are a unique concept where a room in your house is rented to a visitor who lives with the family in a homelike setting. The visitor gets to know about the local culture apartfromgettingaccommodation at a comparatively cheaper rate. Thelocalsgetthedirectbenefitin the form of money charged from the visitor as rent. This gives the stakeholders the direct benefit

of helping in conservation. Homestayshavebeenagreatsuccess story in the neighboring UT of ladakh where they are successfully operated by local communities near some of the protected areas. A similarinitiativecanbetakenincase of Gharana on pilot basis, which if successful,canbereplicatedkeeping in view the requirement. There is no lodging facility at Gharana village and it is not likely to come up due to the proximity to International Border.Thehome-stayscanprovide a good option for overnight stay by outsiders, if someone wants to experience a stay at the wetland especiallyduringtheseasonwhen migratory birds visit.

Involvementof*Tonga-wallahs*: *Tonga* ride has become a rarityin Jammu with only a few places offering it and Gharana is one of them. A *Tonga* ride is always a delight and is also cheaper than theconventionaloptionsoftravel but most of all it represents the ecologicallysensitivetraveloptions. It also lets the economic gains to flowdirectlytothelocalcommunity which will indirectly build support for the wetland conservation. The *Tonga-wallahs* of Gharana and the surrounding villages will be contacted and offered to be involved in this regard. If they show their consent to get involved in transporting the visitors to Gharana wetland, a system will be designed under which an area will bedesignatedasTongastandmost likely at a site close to the Nature InterpretationCentre.Thesystem will be designed under which an area will be designated as *Tonga*stand most likely at a site close to the new parking area. The system will be designed with theinvolvementalltherelevant stakeholders.

Visitor Facilities

Gharana Wetland Conservation Reserve lacks basic visitor facilities which are a pre-requisite for successfullymanagingatouristsite. It is very important that the basic visitor facilities including toilets, washrooms, shelter, and garbage collectionsystemareprovidedatall such places which receive tourists. In addition, providing suitable facilities can help to reduce the adverse impacts of such nuisances as littering. For designing a toilet complex for visitors, *Sulabh International* will be contacted. They are leaders in designing andmaintenanceofpublictoilet complexesandrelatedactivities. Garbage bins will be installed in the visitor area and the wastes collected will be disposed-off with the other wastes generated in the village. A system will also be developed for safedisposalofthesolidwasteswith the help from *Sulabh International*. Someadditionalvisitorfacilitieslike small restaurants and a souvenir shop, similar to the one at Manda Zoo, can also be set up which will generate revenues additional to the

entrancefeesthatwillbecharged. They will be built and operated by the Department of Wildlife Protection through locals on an outsourced basis.. A supporting infrastructureoflocalbusinesses will also be encouraged that can provide goods and services to visitors.

Access: Betteraccessisveryvital for tourism. In case of Gharana Wetland, the current state of the approach road is a setback tothetourism.Keepinginview the proposed eco-development strategies, a conceptual layout has beendevelopedforGharanawetland which has been presented in the figures 9.1 and 9.2.

Eco-labeling:Certification& Labeling as quality promise

In many European countries, managers of protected areas, includingwetlands,areencouraged to maintain high standards in theirmanagementofsustainable tourism and interactions with the tourism sector through eco-labeling.Eco-labelingprovidesfor formulation of guidelines which define the standards of services to be maintained for sustainable tourismatthetouristsites.Under eco-labelingschemes,theservices provided to the tourists are monitoredandtestedperiodically for their quality and the service providers are given certificates of

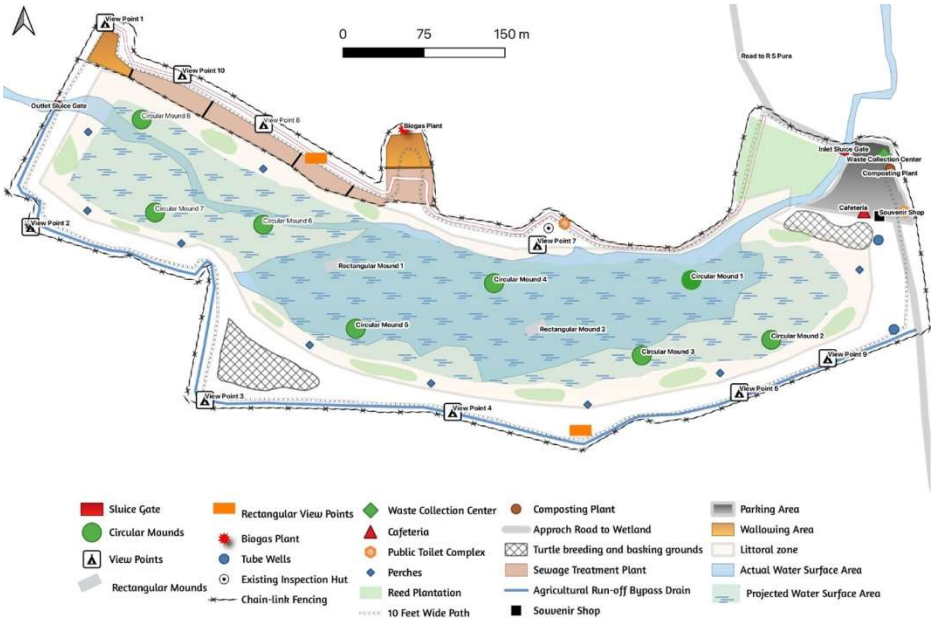


Fig.9.1:Layoutdepictingproposedactivitiesat Gharanawetland

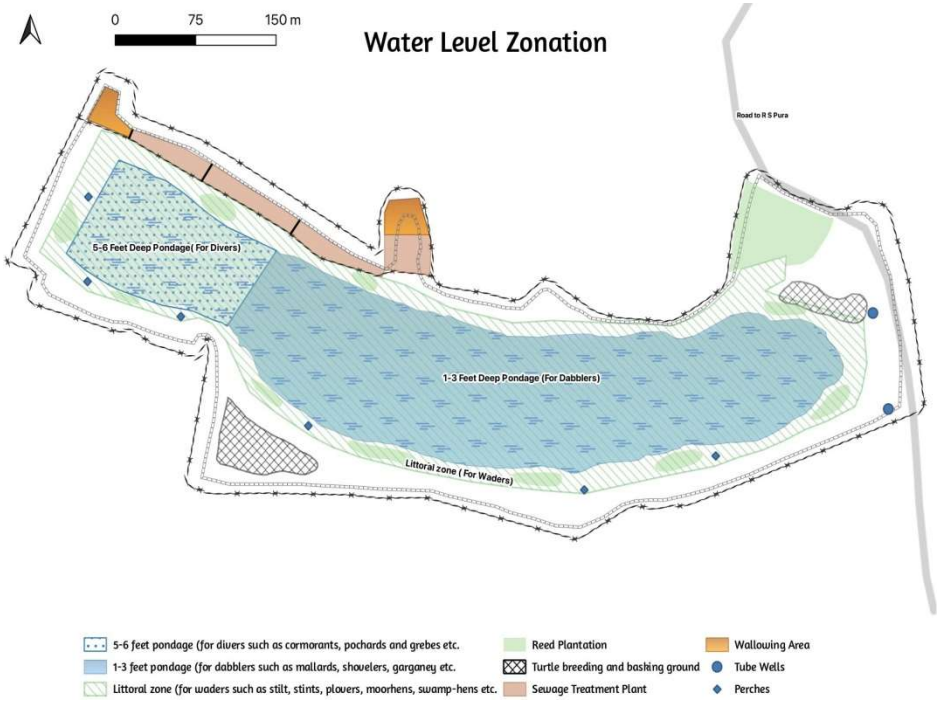


Fig.9.2:ProposedwaterlevelzonationatGharanaWetland

quality. They may alsobe rated on a grading scale which would help in improving the quality and delivery of services. NGOsordomainexperts who have experience of workingondevelopmentof eco-certificationguidelines must be involved for eco-labeling of services offered at Gharana wetland. Eco-certification guidelines willhelpin ensuringbetter qualityofservicesprovided totouristsvisitingGharana wetland.

DogchasingtheBar-headedGeeseinGharana wetland
©Dr. Pushpinder Singh/WWF India

CHAPTER10-
RESEARCH,MONITORING&TRAINING

Research and monitoring

In case of Gharana wetland, notmuchofresearchhasbeen conducted.TheDepartmentof Wildlife Protection in collaboration with the Wildlife Institute of India (WII), World Wide Fund for Nature India (WWF India), University of Jammu and Bombay Natural History Society(BNHS)haveconductedsome studies related to migratory birds and wildlife. Some isolated studies have also been carried out by local universitiesonsomeotheraspectsof the wetland.

For management strategies to be successful, it is important that theybereviewedperiodicallyand bechangedaspertheneeds.This is called adaptive management.
An essential part of adaptive management is monitoring the state ofthewetland.Itisproposedthatthe Wildlife Department, with the help of other agencies, should regularly monitor water and soil quality; aquaticvegetation;monthly,seasonal and annual waterfowl abundance in all the wetlands under consideration. Waterfowl count must not be missed during the period of Asian Waterfowl Count (AWC).

data which can be helpful for better conservation and management of thesewetlands.Butthereislimitless scope for research in the fields of natural and social sciences in all these Wetland Reserves. There is ample of opportunity to workon these wetlands as they are like naturallaboratorieswhichcontain deep waters, marshy areas and agricultural fields, with diverse flora andfaunasubjectedtoanthropogenic pressures. Some researchers from University of Jammu and some other institutions have started conducting research on the issues related to Gharana wetland.

It is suggested that Wildlife Department should invite students for internships who, under the guidance of Research Officer and Wildlife Warden, Jammu, would conduct research on different aspects of these wetland. This would, on one hand, help in generation of useful data regarding those aspects of the wetlandsandwhileontheotherhand it would also draw the attention ofthe research community towards thesewetlands.Somepotentialareas of research which could be taken uponpriorityinthereserveareas follows:

i) Quantifying the crop damage attributed to the conflict between Bar-headed Goose and the local farmers of Gharana and surrounding villages.

ii) The pollution caused by the non-point sources of pollution (largely agricultural fields) in Gharana and other wetlands.

iii) The breeding ecology of Pheasant-tailed Jacana in Gharana wetland.

iv) Preparation of a detailed checklist of macro-benthic invertebrates of Gharana wetland.

v) Impacts of pollution on the various avifaunal species of Gharana wetland.

vi) Ecotourism potential of Gharana wetland and tourism carrying capacity of the area.

vii) Role of Gharana wetland in conservation of Rare, Threatened and Endangered birds.

viii) Ideal landscape and habitat composition for Gharana Wetland ecosystem.

Monitoring programme

Since Gharana wetland is considered one of the important waterfowl habitats, the main focus of the monitoring program should remain avifauna. As the quality of habitat is an important determinant of the diversity of avifauna, habitat monitoring is also very important. Monitoring protocols must be developed for monitoring of wetland fauna and their habitat. Help can be taken from the research institutions, organizations or individuals who have the required experience and expertise.

Biodiversity monitoring

The main focus of the biodiversity monitoring program will be monitoring of avifauna of Gharana wetland. In addition to this, state of quality of habitat should also be monitored.

On-site water quality testing in Gharana wetland ©Dr.PushpinderSingh/WWFIndia

Avifaunalmonitoring

The avifaunal monitoring should focus on the periodical monitoring of bird fauna of wetland and the surrounding areas including agricultural fields. This will include both water-birds and terrestrial-birds. The counting of birds should bedoneondailybasiswhichshould becompiledtogeneratemonthlydata about the birds. This data would help in the generating patterns and trends of species diversity and abundanceon monthly, seasonal and annual basis. A special register dedicated to maintaining daily data recorded in these wetlands should be issued tothe field staff. This register should be checked by the wildlife warden and the research officer regularly. While recording field data, utmost level
of care must be taken in ensuring that the data is recorded as per the pre-decidedmethodology/protocols. The field staff must also be trained and guided from time to time about the correct methodology of bird monitoring. Recently the staff has started to follow proper methods of counting and recording birds.

Asian Waterfowl Counts:

Apartfromtheregularmonitoring exercise, monitoring of wintering water-birdsofGharanawetlandhas to be conducted especially during the Asian waterfowl count (AWC). The count has to be done as a total count by using 2-3 vantage pointsintheperipheryofthewetland. The wetland. The counts are generally conductedinmid-Januaryandoften the week-end is selected for the easeofthevolunteers.TheWildlife Warden, Jammu will organize the AWC count every year andinvite local birdwatchers to help in conducting the count. The event would also be an opportunity to interactwithlocalbirdwatchersand other conservationists. The event shouldbeamajoractivityeveryyear. A blank AWC datasheet has been attachedasannexure(AnnexureVI).

Habitatmonitoring

Plotsmaybelaidoutfromtime totimetoregularlymonitorthe vegetationstructureofthewetland and its immediate vicinity. This would help in detecting any shiftin the floral composition of the area especially to keep a check on invasive species and weeds. A detailed monitoring protocol has tobedevelopedforthe areasbeing treatedforweed-controlandhabitat restoration activities. Since it is a small wetland, monitoring the habitat may not be a fruitful exercise throughtheinterpretationofsatellite imageries.

Environmental monitoring

Waterandsoilquality: Water qualitymonitoringwouldbecarried out every year. Results of the waterqualityassessmentexercise conducted at Gharana during the managementplanningexercisehave

been provided in Chapter 2. The water samples must be taken from the same locations as were used to collect the water samples before. The samplescollectedshouldbeanalyzed forapre-decidedsetofparametersin a standard water quality testing lab. Likewise,water,soilandsiltfromthe wetland should also be monitored for its quality and presence of various pollutants. A sediment core from some undisturbed site would be very helpful in finding out the sedimentation rate in the wetland.A detailed monitoring protocol needstobedevelopedforwaterand soil testing which would guide on parameterstobetested,locationsof sampling, seasons of sampling etc.

Bathymetry

A bathymetry exercise is necessary to find out the bottom profile and mostimportantlyinidentifyingthe areas of wetland which are heavily silted. This will help in taking decision regarding silt control and in most serious cases take correctivedesiltationoperations. It is recommended that a similar bathymetric exercise may be carried outeveryalternateyearsoastoknow about the siltation profile of the wetland.Sincethewetlandisnotvery deep the bathymetric surveys can beconductedbythefieldstaffwith help of a staff-gauge (a large size, extendable graduated scale) using a boat. The data regarding depth mustbecollectedatdifferentpoints along the length and breadth of the wetlandandshouldberecordedona paper along with the GPS locations. This data should later be overlaidon the map of the wetland to get a clearpictureofthesame.Aseriesof biannual bathymetric maps of this wetlandwouldlateronprovetobean important resource for the managers of this wetland.

Wildlife health monitoring

The field staff is proposed to be trained to collect preliminary datafromthebirdsfounddead. The Wildlife Institute of India at Dehradun has developed the protocols for the same and also has experts who can give training to the staff.WildlifeProtectionDepartment also keeps on organizing exercises to detect the possibilities of bird-flu in the migratory birds but this exerciseneedstobetakenupwitha more systematic way.The poultry farms in the nearby areas must be checked regularly for any disease outbreak. And those birds which continuously visit the surroundings of these poultry farms (including Crows and Cattle Egrets) must also be monitored continuously. There is need to brief local people about the importance of disease surveillance procedures and advise them to report about any apparently sick or dead bird found in and around the wetland.Standardprotocolsmustbe followed while handling such birds. Department of Veterinary Sciences

at Sher-e-Kashmir University of AgriculturalSciencesshouldalsobe involvedindiseasesurveillanceand monitoring.

Catchment monitoring

Catchments of the wetland hasbeenunderpressurefromtherisin g human population. It is being put under ever increasing pressure for cateringtotheneedsofthegrowing population. Most importantly, the pressureonagriculturallandtofeed this surging population has forced the farmers to bring as much landas possible under farming. This has increased the problem of siltation in the wetlands. The construction of humansettlementsinthecatchments has changed the landuse further more. These activities have also have bearingonthehydrologicalaspectsof these wetlands. The catchment of the wetland also need to be monitoredfor the land-use and land-cover changes.Thiscanbedonebyanalysis andinterpretationoftheGISimagery involving the Department of Remote Sensing of the State.

Meteorologicaldatacollection

Currently there is no proper infrastructure and instruments facilities are available at Gharana Wetland Conservation Reserve. It therefore is necessary to establishasmallAutomaticWeather Station (AWS) in collaboration with the Pollution Control Committee to regularly collect data on weather conditions.TheBlockOfficershould be assigned the duty of collectingthe data regularly on a prescribed format and reporting the same to Wildlife Warden and the Research OfficerthroughRangeForestOfficer on monthly basis. The database should be maintained in a proper manner which would help in taking up appropriate wetland management strategiesin future. TheBlock Officer shouldalsoberesponsibleforlooking after the instrument and maintaining it in good shape.

Socialmonitoring

The socio-economic conditions of the local communities and theirdependenceonthewetland reserve also need to be monitored periodically. This would help in assessment of the local social pressures, if any, on the wetland reserves. Another important aspectofsocialmonitoringwillbepress ures from tourists and tourism. Tourism monitoring should be an important andregularfeatureofthemonitoring programmes at Gharana wetland. The records of the tourist coming to Gharana wetland have to be maintainedcarefullyandhonestly. The data collected in this regard should be transferred on monthly basis to the Research Officer who shouldanalyzethedataandmaintain thesameinacomputerizeddatabase. From time to time, tourist feedback surveys also need to be conducted toinquireaboutvisitor satisfaction

Bar-headedGeese inagricultural fieldnear Gharanawetland
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andtoseeksuggestionsfromthem regarding improving the services provided.

Periodic monitoring reports

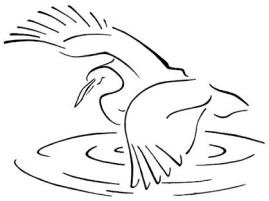
Monitoring reports should be submitted to the management authorities after every monitoring period. Sincere efforts should be madetobringdownthelagbetween the monitoring exercise and the submission of report so that proper managementdecisionscanbetaken intime.Moreover,throughthetime lag, the data tends to be redundant and this should be taken care of.

Establishinga'CentreforBird Ringing and Rehabilitation'

It is recommended that a 'CentreforBirdRingingandRehabilit ation' should be established at Gharana wetland. The centre will coordinate and facilitate the bird ringing,
banding, collaring as well as satellite telemetry studies for studying the migration patterns of the migratory waterfowl of the wetland. Birdringing has been done at Gharana wetland from time to time with the involvement of BNHS, WWF andWII but following the setting up of thisproposedcentre,thisactivitywill becomeanannualfeature.Thecentre would also help in the rehabilitation of the sick and injured birds found in and around the wetland. Many times there are found injured birds whichdieforwantofpropercareand treatment. The rehabilitation centre willmakethearrangementsforcare and treatment of any injured or sickbirdfoundinthevicinityofthe wetland.

Declaration as a Ramsar Site

Gharana wetland along with the otherfourwetlandsqualifiestobe a Ramsar site. The three criteria underwhichtheycanbeincludedin the list of internationally important wetlands have already been mentioned in the chapter 3. In this regard, Wildlife Warden, Jammu needs to initiate the process. He/ she should complete the Ramsar Information Sheet (RIS) and send it along with the application on a prescribedformatfordesignationof Gharana and its adjoining wetlands as Ramsar Site to Chief Wildlife Warden, J&K. Chief Wildlife Warden will in turn forward the application to the Wetland Division of the Ministry of Environment andForests(MoEF).Theformat of the Ramsar InformationSheet(RIS)hasbeen attachedas Annexure V. After the Gharana wetland is declared as a Ramsar
site, it will enjoy an international recognition which would help in securing funding for research and conservationfromnationalaswell as international donors.



GharanaWetland,Jammu,J&K|.111

Training/capacity building of wildlife Staff

Regulartrainingandcapacity building is essential for achieving optimum management of the protected areas. It is very important thatthefieldstaffatGharanawetland develops a thorough understandingof the wetland ecosystem and its conservation and management techniques. By getting to know about the modern wetland conservation & management techniques, practices they would be able to regularly monitor and record the various indicators of wetland condition and report them in a professional way. As improving the knowledge of staff helps them to carryout their duty with an increased understandingand awareness, this also boosts their dedication and confidence in their work. Better capacity and awareness also helps them in dealing with various stakeholder groups with greater confidence. Improved skills and knowledge will improve their productivity and quality of output which would finally raise the stature oftheDepartment.Capacitybuilding in this regard can best be achieved through trainings designed for this purpose.Trainingsshouldbecarried out in an organized and structured manner, in order to achieve maximum results. Primarily, there should be system for the field staff to be sent for the regular refresher andorientationprogrammes.Those who show more interest should be sent for advance level trainings to specialized training institutes. Various professional organizations shouldbeinvolvedindevelopingand conducting training programmes. Officersofthedepartmentshould also be involved in training programmes.

Orientation programmes: From time to time during the visit of senior officer should take some time to take classes of a couple of days of the junior level staff and brief various types of work in the field which are necessary. It should beadirectinteractionwiththestaff members which can solve number of problems of the junior level staff onthespot.Thistypeoforientation training programme should include observation techniques, recording, nature interpretationanddevelopmentofco mmunication skill. This has to be established as a tradition and the senior managers must take it the lead with regard to this.

Field technique training programmes: Training should cover the technical aspects of the population estimation, application of law and regulation, techniquesof observing animals and making records, and techniques in forensic science in case of wildlife. The field staffshouldalsobetrainedinusing the basic field equipment like GPS, Rangefinder,Compass,Binoculars,

Fieldscopes, Digital and DSLR cameras etc. they should also be trained in interpreting maps and conductingphyto-sociologicalstudies and collecting samples etc.

Advance-level training programmes: Advance-levelshort term training courses for junior-level as well as for senior level officers are equally important for the betterment of management of any protected area. Currently many Wildlife Guards, Foresters, andRangersdonothaveanyformal traininginthewildlifemanagement. There should be a provision of utilizing the opportunities of Diploma and Certificate courses in WildlifeManagementforthestaffof appropriate level. The management should contact Wildlife Institute of Indiaforsuchtrainingprogrammes. Ifpossiblewetlandmanagersshould also be sent to other countrieswhere wetlands are being managed in a better way to study the various aspects of wetland management. Everyopportunityshouldbeavailed to elevate management skills and performance of the field staff.

Someareaswheretrainingwill benefitthestaffareasfollows:

a) Knowledge and identification of bird species found in the wetlands, habitsofspecies,biologyandecology of important species

b) Wetlandecology,interdependence ofplantandanimalspecies

c) Monitoringmethods,population estimation methods

d) Anti-poaching skills and documentationofoffencecases

e) Use of instruments such as compass,binoculars,digitalcamera, GPS

f) Computer literacy

Training for Locals and Tour Guides: Training programmes should also be organized for the local people, particularly local youth who can work in future as a nature guide andtouroperatorswiththeintention to build their capacity. Important aspectstobecoveredinsuchtraining programmes are:

a) Wildlife(Protection)Act,1972

b) Skillsofdealingwithtourists

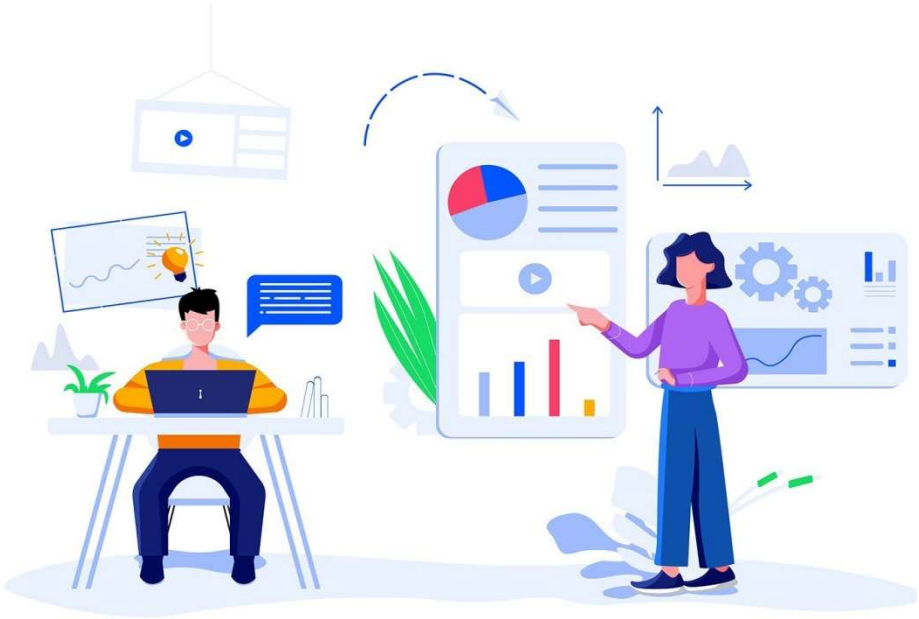
c)Interpretational skills

d) Skillsonidentificationofbird species

e) Basicwetlandecology

Establishing a learning centre As has already been discussed in Chapter 7, Gharana wetland should bedevelopedasacentreforwetland study. In addition to the Nature Interpretation Centre discussed intheChapter 7,amodern library

must be setup which would contain important books and literature pertaining to wetlands. This learning centre will prove to be an important resourceforthestudents,researchers and general masses. In addition, it should also have proper internet connectivity and should also have subscribedtotheimportante-groups on birds, conservation and wetlands etc. This would keep the Gharana management updated about the latest developments in these fields. Aquarterlyorbiannuallynewsletter could also be published focusing on wetland issues in Jammu which would draw attention of all the relevantstakeholderstowardsthese important ecosystems.



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CHAPTER 11- ADMINISTRATIVE SETUP AND EQUIPMENTS

Structureandresponsibilities

Administrative setup: As has alreadybeendiscussedintheChapter 3, the wetlands in Jammu are kept under a separate range, "wetland range",controlleddirectlybyaRange Officer. Range Officer, Wetlands, is based at the Headquarters in Manda, Jammu.RangeOfficerisassistedbya forester (Block Officer) and frontline staff in managing the all the five Wetland Reserves. The Block Office is based at Gharana Wetland. The overallcontrolofthemanagementof wetland range lies with the Wildlife Warden, Jammu. The Wildlife Warden, Jammu works under the supervision of Regional Wildlife Warden, Jammu.

Keeping in view the significance of Gharana wetland and prospects ofit turning into an important centre fornatureinterpretation& learning andamodelofwetlandconservation in the J&K state, it is recommended that greater attention be given towards its overall management and promotion. It necessitatesthat an officer of the level of an Assistant Conservator of Forests (ACF) be given the responsibility ofmanagingtheproposedsetupof Nature Interpretation Centre (NIC) and Centre for Bird Ringing and Rehabilitation. The ACF would be abletobuildanetworkwithschools and other educational institutions for various conservation education activities. When the proposed

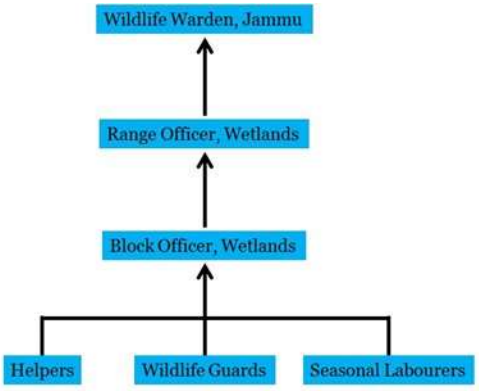

Fig 10.1: Present administrative Setup in Gharana and adjoining wetlands

setup takes the final shape, the insufficiency with regard to the number of junior level staff may alsobefelt.Itisrecommendedthat more junior level staff, i.e. wildlife guards/helpers, be recruited (on permanent or temporary basis, as may be deemed fit). As the local community at Gharana has always complained of being neglected by the Govt., especially the Wildlife Protection Department, and this beingtheoneofthecausesfortheir resentment,theirrepresentationin the management may also help in diminishingthatfeelingofalienation towards Government. Further, as a field vehicle and a boat are being recommended to be purchased, it is also recommended that a driver and aboatmanmayalsobeappointedfor the same.

Conservation Reserve Management Committee
AsnecessitatedbytheWildlife Protection Act, 1972, Management Committee may be constituted and notified by the State Government. TheManagementCommitteeshould meet regularly and give advice to Chief Wildlife Warden on the matters concerning conservation, maintenance and management of theGharanaWetlandConservation Reserve. As per the statutory requirements, committee should comprise of the representatives of the Forest Department, Wildlife Department, one representative of each village Panchayat in whose jurisdiction the wetland reserve is located,threerepresentativesofnon-governmental organization active in the area and representatives of otherrelateddepartments(probably, Agriculture and Animal Husbandry Departments) not exceeding two. A representative of the Wildlife ProtectionDepartmentshouldbeits member secretary.

Biodiversity Conservation Committee: The Biodiversity Conservation Committee which has also been talked about in the previouschaptersshouldcomprise of 20 members with 40 % female representation.Thereshallbenobar to the membership of the committee on the basis of religion, caste or gender. The committee shall have following composition:

i) RangeOfficer,WetlandsRange

ii) Block Officer, Wetlands Block

iii)Nambardarofthenearestvillage

iv)Sarpanch of the nearest village

v) 16membersoflocalcommunities, chosen unanimously by all the villagers, with females not less than 40% of the total membership of 20

The committee shall:
a) ensurethecooperationoflocal communities in implementation of the Management Plan for the

ConservationandManagementof Gharana wetland.

b) facilitatetheresolutionofdisputes betweenWildlifeDepartmentandthe local communities

c) engagethemselvesandthefellow members of local community in awareness activities related to wetlands and their conservation

d)represent the interests of the localcommunitiesbeforethepolicy makers

e) involvethemselvesandfellow members of local community in activities listed under eco-developmentprogrammmedesigned for their area

f)help in implementation and promotion of eco-tourism plan for theirrespectivewetlandconservation reserves

FieldandOfficeEquipment:

i) Telephone facility: As the Gharana wetland is very close toInternationalBorder,mobile connectivity is very limited and rare, probably due to security concerns.SincetheFieldOffice atGharanaalsolackstelephone facility,itbecomeverytoughto communicate and coordinate with theWildlifeHeadquartersatManda. It is, therefore, recommended that provisions for landline telephone connectivitybemadefortheofficeat Gharana wetland.

ii) Medical facilities: Though Governmentmedicalfacilitiesexist at the town of R.S. Pura as well as Jammu city, there is a need to maintain a complete first aid kit at Gharanaoffice.Thiswouldnotjust be useful for the wildlife staff but also for the locals and the tourist visiting the wetland. Apart from the conventional set of emergency medicinesitmustalsocontainanti snake-bite kit. A small first aid kit shouldbekeptwiththereceptionof Nature Interpretation Centre.

iii) Field Vehicles: It is often seen that the field surveys are either delayedorcancelledjustforwantof the field vehicles. Therefore, three field vehicles, one 4-wheeler and two 2-wheelers may be provided to thefieldstaffforconductingsurveys and anti-poaching raids in the field. The 4-wheeler should be equipped with 4-wheel drive facility. The responsibilityofmaintenanceoffield vehicle shall be of the Block Officer

iv) Inflatable Boat: An inflatable raft/boat along with the desired equipmentshouldbeprovidedtothe Block Office at Gharana. The boat is required for conducting surveys andcollectingsamplesinGharana wetland.

v) Survey Equipment: The field staffatGharanashouldbeprovided

withthebasicsurveyequipment. Following equipment required for field surveys must be provided to the field staff:

a) GPS

b) Rangefinder

c) Compass

d) Binoculars

e) Fieldscopewithtripod

f) Digital(point&shoot)Camera

Field survey equipment should remain in the custody of the Block Officer, Gharana. He should issue theequipmenttothestaffmembers forfieldsurveys,whohavetoreturn it back to the Block Officer after the completion of surveys.

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CHAPTER12-THEBUDGET

Thebudgetandmicro-plan

Formulation of budget proposal has been done on the basis of approximateeconomiccostofactivitiesinmarket.Themicro-planalong with budget for the management of Gharana wetland reserve has been drafted for a period of five years. The detailed activity-wise budget plan and has been given as below:

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Budget Plan

S.No	Strategies	Activities	Budget (Lakh INR)	Targets									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
1	Boundaries demarcation and settlement	Settlement with locals by way of providing cash compensation through acquisition/purchase of their land making core area of Gharana Conservation Reserve (354 kanals & 8 marlas @ Rs. 4 lakh per kanal)	1500	Aquiring of 408 Kanal & 14 marlas	1170		330						
		Boundary demarcation involving local stakeholders and Revenue Department of 408 kanals & 14 Marlas of land in Gharana presently notified following the order of the Hon'ble High Court of J&K	5	408 Kanal & 14 marlas	5								
		Earthen embankment and bunding of 408 kanals & 14 Marlas of the wetland (8ft X 1.6ft) along with mud drain all along the boundary	111	5000 rft	50	Operation and Maintenance	50	Operation and Maintenance	3	Operation and Maintenance	3	Operation and Maintenance	5
		Chain link fencing in Ghanara all along its border along with a concrete drain along the village	352	9000 rft	300		50	Operation and Maintenance	1			Operation and Maintenance	1

		Boundary demarcation of rest of the land in Gharana (i.e. 1100 kanals)	20							550 Kanals	10	550 Kanals	10
2	Water management	Two motorized groundwater pumps to be installed as an alternate source of water as an SOS measure, especially for the lean phase	62	2 pumps	50	Operation and Maintenance	3	Operation and Maintenance	3	Operation and Maintenance	3	Operation and Maintenance	3
		Two Sluice gates to be installed for maintain optimum water levels in Gharana wetland	32	2 gates	30			Operation and Maintenance	0.5			Operation and Maintenance	1.5
3	Sewage treatment and management	Soil based treatment system	195	Setup the treatment system	100	Complete setup	50	Operation and Maintenance	15	Operation and Maintenance	15	Operation and Maintenance	15
4	Solid Waste Management	A system for collection and transportation of non-biodegradable solid waste to be set up at Gharana village	40	Purchase of trolleys and engagement of helpers	10	Operation and Maintenance	10	Operation and Maintenance	10	Operation and Maintenance	5	Operation and Maintenance	5
		Two public toilet blocks to be constructed with technical help from Sulabh International	27.5			Setting up of the toilet complex	20	Operation and Maintenance	2.5	Operation and Maintenance	2.5	Operation and Maintenance	2.5
5	Biogas Plant	Following consent of the stakeholders, a suitable site for setting up of a community-level biogas plant to be identified. The Khadi and Village Industries Commission (KVIC) to be roped in for	21			Setting up of the biogas plant	15	Operation and Maintenance	3	Operation and Maintenance	1.5	Operation and Maintenance	1.5

		technical help for setting up of the plant											
6	Composting	Semimechanized composting plant should be set up to convert the organic wastes to compost. The compost produced should be supplied to the local farmers.	5.6			Setting up of the composting plant	5	Operation and Maintenance	0.2	Operation and Maintenance	0.2	Operation and Maintenance	0.2
		Diesel Generator set (25KW) for emergency power for the mechanized composting plant	26			Equipment cost	20	Operation and Maintenance	2	Operation and Maintenance	2	Operation and Maintenance	2
7	Habitat Improvement	De-siltation and sediment trapping operations (including creation and maintenance of silt traps)	15	As per actual work	9	As per actual work	1.5	As per actual work	1.5	As per actual work	1.5	As per actual work	1.5
		Selective dredging operations to deepen some selected areas of the wetland	12.5	As per actual work	10	As per actual work	1	As per actual work	0.5	As per actual work	0.5	As per actual work	0.5
		Weed control and management using appropriate bio-mechanical controls methods and proper disposal	15	As per actual work	3	As per actual work	3	As per actual work	3	As per actual work	3	As per actual work	3
		Sparse plantation of trees (for nesting) and reed plantation on the wetland boundary	2.5		0.5		0.5		0.5		0.5		0.5
		Creating bird perches	2		2								

		Broadcasting of sprouted wheat seeds/sowing of Trifolium	5		1		1		1		1		1
		Improvement of littoral zone	10		2		2		2		2		2
		Species reintroduction	20		10		10						
8	Communication, Education and Public Awareness (CEPA)	Exposure visits for the representatives of Gharana and Gharani villages	30	To Bharatapur Bird Sanctuary	10			To Harike Wetland Reserve	10			To Okhla Bird Sanctuary	10
		Resource materials, including signage, fact sheets, posters, pamphlets/handouts, audio-visuals on Gharana for various stakeholders to be produced	12	Designing, printing, publishing & dissemination	3	Designing, printing, publishing & dissemination	3	Designing, printing, publishing & dissemination	2	Designing, printing, publishing & dissemination	2	Designing, printing, publishing & dissemination	2
		Education and awareness workshops for various stakeholders	9	Awareness programmes	2	Awareness programmes	2	Awareness programmes	2	Awareness programmes	2	Awareness programmes	1
		Exposure trips to be organized for media personals and tour operator agencies for publicity of Gharana	7.5	One annual exposure trip for media personals	1.5	One annual exposure trip for media personals	1.5	One annual exposure trip for media personals	1.5	One annual exposure trip for media personals	1.5	One annual exposure trip for media personals	1.5
		Setting up of a Nature Interpretation Centre (NIC)	60			Construction and set-up	30	Operation and Maintenance	20			Operation and Maintenance	10
		Local women at Gharana to be trained in weed-based handicraft production on the lines of Harike Wetland in Punjab	10	Primary training	3	Primary training	3	Refresher training	2	Refresher training	1	Refresher training	1

9	Eco-development, ecotourism and poverty alleviation	Selected local youth at Gharana wetland to be trained as nature guides	8	Primary training	2	Primary trainirg	2	Primary training	2	Refresher training	1	Refresher training	1
		A monitoring system to be developed to monitor tourists visiting the Gharana wetland	4	Resources required for this	0.5	Resources required for this	0.5	Resources required for this	1	Resources required for this	1	Resources required for this	1
		Road linking Gharana wetland to the R.S. Pura town to be repaired/improved for better connectivity (to be funded by PWD/R&B) as oer the tourism potential	27	Initial repairing of the road	25					Maintenance	2		
		Construction of tile lanes in the in Gharana village	55			Initial construction of 60% of lanes	30	Construction of remaining 40% of lanes	20	Maintenance	3	Maintenance	2
		Souvenir Shop & cafeteria to be setup at Gharana village	23			Initial investment in setting up of 1 souvenir shop & 1 cafeteria	15	Subsequent annual investments & maintenance	3	Subsequent annual investments & maintenance	3	Subsequent annual investments & maintenance	2
		A parking space to be constructed	35	Construction of parking space	15	Construction of parking space	15			Maintenance	3	Maintenance	2
		10 view-points to be constructed for tourists to have a better view of the wetland	33	Construction of 5 view points	15	Construction of 5 view points	15			Maintenance	2	Maintenance	1
		Maintenance of canal from security ditch to wetland	7	Initial construction/ maintenance works	3	Maintenance	1	Maintenance	1	Maintenance	1	Maintenance	1
		Two electric carts to be purchased	19			Purchasing of the carts	15	Maintenance	0.5	Maintenance	1.5	Maintenance	2
		Purchase of visitor facilities like benches,	18	Purchasing	7		7	Maintenance	2	Maintenance	1	Maintenance	1

		chairs, tables, lawn umbrellas											
		Community wallowing pond	5		3		0.5		0.5		0.5		0.5
		Seed-money for registration of the society/entrepreneurship incubation centre	10		5		5						
10	Research and Monitoring	A detailed and updated inventory of the biological diversity of Gharana wetland and its surrounding area to be developed	14.5	Seasonal surveys	7	Seasonal surveys	3	Seasonal surveys	1.5	Seasonal surveys	1.5	Seasonal surveys	1.5
		Regular avifaunal census to estimate population trends of avifaunal assemblage of these wetlands	2.5	Seasonal surveys	0.5	Seasonal surveys	0.5	Seasonal surveys	0.5	Seasonal surveys	0.5	Seasonal surveys	0.5
		A long-term study to be conducted on bird migration using Platform Transmitter Terminal (PTT) and bird ringing	75			Initial purchase of PPTs for the study	25	Purchase of more PPTs & expenditure on study	25	Expenditure on study	20	Expenditure on study	5
		Bird rescue & rehabilitation center	35		5		10		10		10		
		Office and field equipment, listed as below, to be purchased for the field station at Gharana wetland: a) GPS: 5 no. (@ Rs. 20,000/piece) b) Rangefinder: 3 no. (@ Rs. 30,000/piece)		Priority-wise purchase of capital assets/		Priority-wise purchase of capital assets/		Priority-wise purchase of capital assets/		Priority-wise purchase of capital assets/		Priority-wise purchase of capital assets/	

11	Capital assets	c) Compass: 3 no. (@ Rs. 10,000/piece) d) Binoculars: 5 no. (@ Rs. 15,000/piece) e) Field-scope with tripods: 5 no. (@ Rs. 80,000/piece) f) Digital Camera: 2 no. (@ Rs. 20,000/piece) g) Boat: 3 no. (@ Rs. 5,00,000/boat) h) Rescue Van (Tata Mobile): 1 no. (@ Rs. 12,00,000/vehicle) i) Motorbikes: 2 no. (@ Rs. 80,000/- per bike) j) Telecommunication sets: 10 no. (@ Rs. 6,000/- per set) k) Night vision: 5 no. (@ Rs. 1,00,000/piece) l) Drone: 1 no. (@ Rs. 5,00,000/- per piece) m) Portable water & Soil-testing kit: 2 no. (@ Rs. 5,00,000/piece) n) Automatic Weather Station: 1 no. (@ Rs. 8,00,000/piece)	137	equipment	30	equipment	30	equipment	30	equipment	30	Equipment and maintenance	17
12	Miscellaneous/ Contingency/ unforeseen/ overhead expenses	For expenditure related to unforeseen and overhead expenditures	35	Miscellaneous expenditure	15	Miscellaneous expenditure	5	Miscellaneous expenditure	5	Miscellaneous expenditure	5	Miscellaneous expenditure	5
		Total Budget	**3150.6**		**1905**		**791**		**188.2**		**143.2**		**123.2**

CHAPTER13-SCHEDULEOFOPERATIONS

Annual schedule of operations
Themanagementplan,whichspans over a period of five years, shouldbe divided into smaller annualplansforthesakeofclarityande ase of implementation. Each annual plan should clearly lay down the annual schedule of operations. The annual plans should be drafted by the Wildlife Warden, Jammu under guidance of Regional Wildlife Warden. An officer of the level of Assistant Conservator of Forest and the Range Officer, Wetlands should be assisting the Wildlife Warden in the process of drafting of Annual Plans. Each annual plan, in its final form, should then be presented before the Conservation Reserve Management Committee/authority. The Committee after giving its recommendations on the annual plan, will forward it to be presented beforeChiefWildlifeWardenofJ&K for his final approval. After Chief Wildlife Warden gives his approval to the annual plan, it can be sent for implementation as per the schedule laid down. A detailed schedule of operations for 5 years has also been laid out in the log-frame attached as Annexure IV.

Recordofdeviationsand implemented targets

Itisrecommendedthatallactivities/ works listed in the annual plan must be carried out as per the previously decided and approved schedule. But there may be some unavoidable circumstanceswhichmayhinderthe schedule of operations. In that case, the schedule of operations may be modified for the required changes at the earliest and be sent to the ConservationReserveManagement Committee which shall forward to the Chief Wildlife Warden for his approval.

Aproperrecordshallbemaintained of the implemented targets and deviations. The record should be maintained by the Range Officer, Gharana which he should submit to the Wildlife Warden, Jammu who after scrutinizing the record shall forward it to the Regional Wildlife Warden. If some activity/work meant to be remains incomplete in the designated annual plan period, the work must be included in the successive annual schedule of operations.

Employmentpotential
The activities/works related to implementation of management planwillalsoleadtogenerationof employment opportunities for the people and local communities are

the most likely beneficiaries of it. It is also very important to know as to howmanyman-daysofemployment was created in a financial year through different works. A good record of the same should be maintainedbytheofficeoftheRange Officer, Gharana. The record should be inspected thoroughly by the ACF andtheWildlifeWarden(Jammu)as a part of office inspection.

PaddycultivationinthecatchmentofGharanawetland/WWFIndia

CHAPTER14-MONITORING&EVALUATION

Projectmonitoring

Themanagementplanforan ecosystem or an area is part ofadynamicandcontinuing managementplanningprocess.The plan should be kept under review and adjusted to take into account the monitoring process, changing priorities, and emerging issues. Management planning must be regardedasacontinuous,long-term process. Planning should begin by producing a minimal plan that meets, as far as resources allow, the requirements of the site andoftheorganizationresponsiblef or
managing the site. It is important to recognize that a management plan will grow as information becomes available. Though a management plan defines objectives at a specific point in time, but good planning requirescontinuousmonitoringand evaluationtoassessitseffectiveness. Regular review gives feedback onthe effectiveness of management actionsandthusenablesfine-tuning of the plan, or, if necessary, more fundamentalrevision(Hockingset.al, 2006).

Needandschedulefor monitoring

Themainpurposeofmonitoringis

1. To keep the project implementationatdesirablepace.

2. To fine-tune the management strategies after learning from the ongoingimplementationexercise.

3. Toenableandsupportanadaptive approach to management.

4. Tohelpineffectiveresource allocation.

5. Topromoteaccountabilityand transparency.

Monitoring agency & schedule of monitoring

Monitoring of management plan implementation should ideally be done by some agency which is not involved in the implementation of the project. The agency selected for project monitoring should not haveanystakesintheproject.The monitoring must be done on an annual basis after the culmination of every annual plan (annual schedule of operations). The implementing agencyshouldprovideallthe records maintained by its officials pertaining to project implementation and the

monitoring agency should examine these records to find to if there has beenanylapseintheimplementation of the project. Any discrepancy noted during the monitoring must be recorded and should be brought to the notice of the Chief Wildlife Warden, J&K. The monitoring agencyshouldsubmitareporttothe ChiefWildlifeWardenregarding the progressoftheprojectonthebasisof records provided to it.

Evaluateandadapt

Adaptive management: First andforemost,theevaluationshould be seen as a normal part of the process of management. Adaptive management is based on a circular rather than a linear management process, which allows information concerningthepasttofeedbackinto andimprovethewaymanagement is conducted in future (Holling, 1978; Salafsky et.al, 2001). Evaluation helps management to adapt and improvethroughalearningprocess.

As depicted in the figure on the previous page, there will be annual reviewsofthemanagementplan.As has been laid down in the previous chapter, i.e. Chapter 13, that the management plan for Gharana wetland will be implemented by splitting into smaller annual plans. After the completion of everyannualplan,anexternalagency will monitor and review the progress of implementation of the plan. During these reviews, new and revisedideas and strategies will also be recommended to be incorporated into the plan. This would make the management planning a dynamic process leading to an ever-evolving management plan.

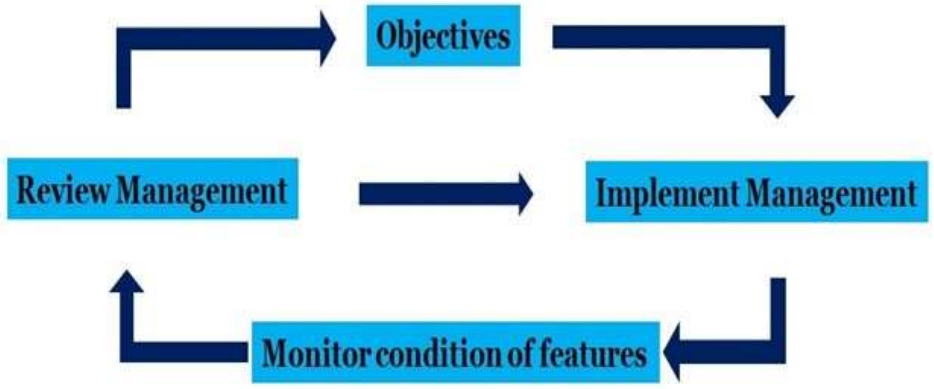

Fig 14.1: The Adaptive Management Cycle

Source:Managingwetlands.RamsarHandbookNo.16,3rdedition,2007.

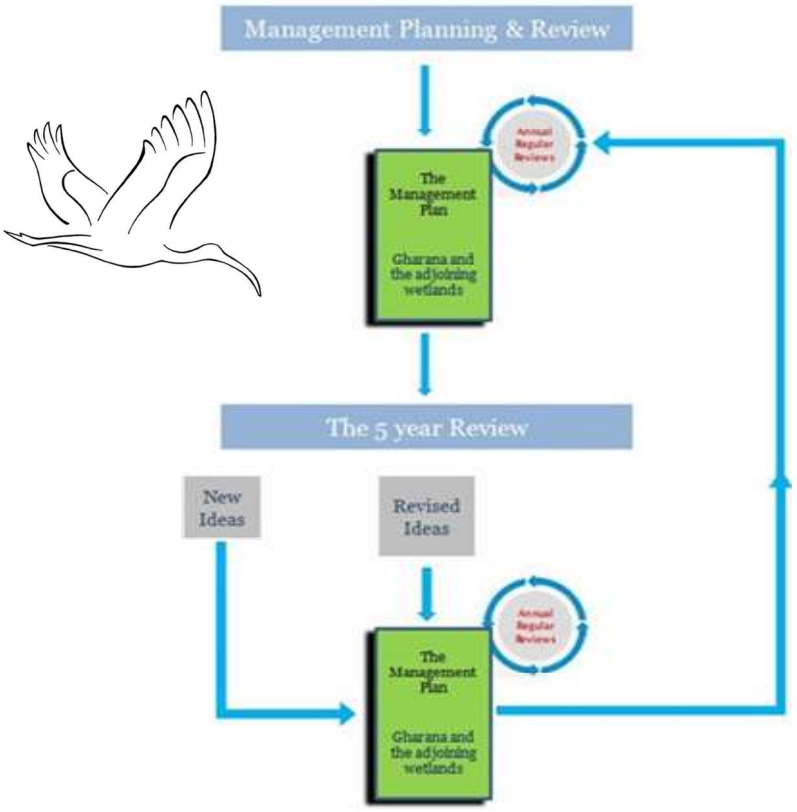

Fig14.2:ManagementPlanningforGharanawetlandandits review

IllegalfishinginGharanawetland/WWFIndia

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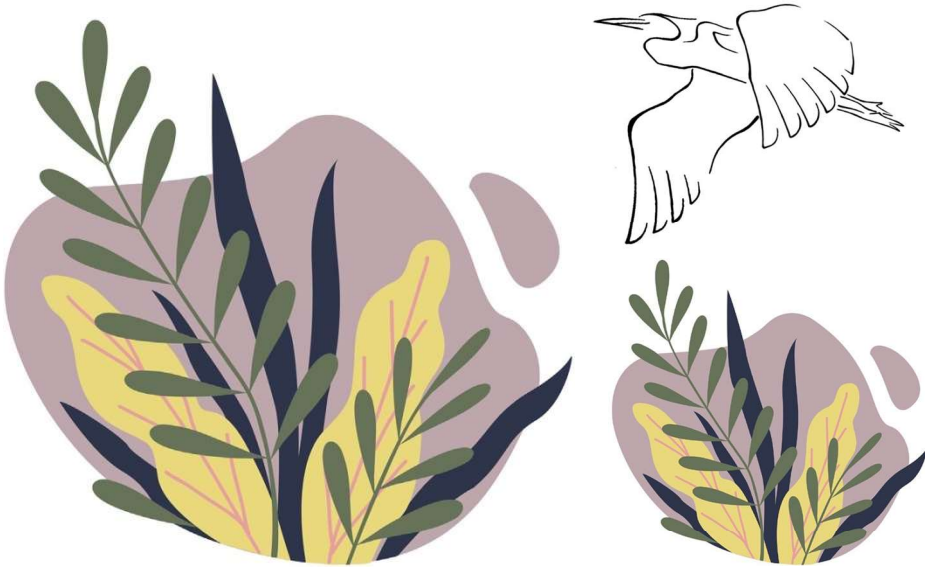

ANNEXURES

AnnexureI:ChecklistofbirdsofGharanaWetland:

SNo.	Order	Family	Common name	Scientific name	IUCN Redlist Status
1.	Podicipediformes	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	Least concern
2.	Pelecaniformes	Phalacrocoracidae	Great Cormorant	*Phalacrocorax carbo*	Least concern
3.			Little Cormorant	*Phalacrocorax niger*	Least concern
4.	Ciconiiformes	Ardidae	Yellow Bittern	*Ixobrychus sinensis*	Least concern
5.			Black-crowned Night Heron	*Nycticorax nycticorax*	Least concern
6.			Indian Pond Heron	*Ardeola grayii*	Least concern
7.			Cattle Egret	*Bubulcus ibis*	Least concern
8.			Little Egret	*Egretta garzetta*	Least concern
9.			Intermediate Egret	*Ardea intermedia*	Least concern
10.			Great Egret	*Ardea alba*	Least concern
11.			Purple Heron	*Ardea purpurea*	Least concern
12.			Grey Heron	*Ardea cinerea*	Least concern
13.		Ciconiidae	Painted Stork	*Mycteria leucocephala*	Near Threatened
14.			Black Stork	*Ciconia nigra*	Least concern
15.			Asian woollyneck	*Ciconia episcopus*	Near Threatened
16.			Black-necked Stork	*Ephippiorhynchus asiaticus*	Near Threatened
17.		Threskiornithidae	Black-headed Ibis	*Threskiomis melanocephalus*	Near Threatened
18.			Red-naped Ibis	*Pseudibis papillosa*	Least concern
19.			Glossy ibis	*Plegadis falcinellus*	Least concern
20.			Eurasian Spoonbill	*Platalea leucorodia*	Least concern
21.	Anseriformes	Anatidae	Lesser Whistling Duck (Lesser Tree Duck)	*Dendrocygna javanica*	Least concern
22.			Greylag Goose	*Anser anser*	Least concern

23.			Greater White-fronted Goose	*Anser albifrons*	Least concern
24.			Cotton Pygmy Goose	*Nettapus coromandelianus*	Least concern
25.			Bar-headed Goose	*Anser indicus*	Least concern
26.			Ruddy Shelduck	*Tadorna ferruginea*	Least concern
27.			African Comb Duck	*Sarkidiornis melanotos*	Least concern
28.			Eurasian Wigeon	*Anas penelope*	Least concern
29.			Gadwall	*Anas strepera*	Least concern
30.			Eurasian Teal	*Anas crecca*	Least concern
31.			Mallard	*Anas platyrhynchos*	Least concern
32.			Indian Spot-billed Duck	*Anas poecilorhyncha*	Least concern
33.			Northern Pintail	*Anas acuta*	Least concern
34.			Garganey	*Anas querquedula*	Least concern
35.			Northern Shoveler	*Anas clypeata*	Least concern
36.			Red-crested Pochard	*Netta rufina*	Least concern
37.			Common Pochard	*Aythya ferina*	Vulnerable
38.			Ferruginous Duck	*Aythya nyroca*	Near Threatened
39.			Tufted Duck	*Aythya fuligula*	Least concern
40.	Falconiformes	Accipitridae:	Black-winged Kite	*Elanus caeruleus*	Least concern
41.			Black Kite	*Milvus migrans*	Least concern
42.			Steppe Eagle	*Aquila nipalensis*	Endangered
43.			Greater Spotted Eagle	*Aquila clanga*	Vulnerable
44.			Eurasian Marsh-Harrier	*Circus aeruginosus*	Least concern
45.			Eurasian Sparrowhawk	*Accipiter nisus*	Least concern
46.			Himalyan buzzard	*Buteo buteo*	Least concern
47.			Long-legged Buzzard	*Buteo rufinus*	Least concern
48.			Besra	*Accipiter virgatus*	Least concern
49.			Northern Goshawk	*Accipiter gentilis*	Least concern

50.			Booted Eagle	*Hieraaetus pennatus*	Least concern
51.			Egyptian Vulture	*Neophron percnopterus*	Endangered
52.			Shikra	*Accipiter badius*	Least concern
53.			Hen Harrier	*Circus cyaneus*	Least concern
54.			Western Marsh-Harrier	*Circus aeruginosus*	Least concern
55.			Pallid Harrier	*Circus macrourus*	Near Threatened
56.			Short-toed snake Eagle	*Circaetus gallicus*	Least concern
57.		Falconidae	Eurasian Hobby	*Falco subbuteo*	Least concern
58.	Galliformes	Phasianidae	Gray Francolin	*Francolinus pondicerianus*	Least concern
59.	Gruiformes	Rallidae	Western Water Rail	*Rallus aquaticus*	Least concern
60.			White-breasted Waterhen	*Amaurornis phoenicurus*	Least concern
61.			Common Moorhen	*Gallinula chloropus*	Least concern
62.			Purple Swamphen	*Porphyrio porphyrio*	Least concern
63.			Common Coot	*Fulica atra*	Least concern
64.	Charadriiformes	Jacanidae	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	Least concern
65.		Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	Least concern
66.			Little Ringed Plover	*Charadrius dubius*	Least concern
67.			White-tailed Lapwing	*Vanellus leucurus*	Least concern
68.		Scolopacidae	Common Greenshank	*Tringa nebularia*	Least concern
69.			Common Snipe	*Gallinago gallinago*	Least concern
70.			Common Redshank	*Tringa totanus*	Least concern
71.			Common Sandpiper	*Actitis hypoleucos*	Least concern
72.			Green Sandpiper	*Tringa ochropus*	Least concern
73.			Curlew Sandpiper	*Calidris ferruginea*	Near Threatened
74.			Little Stint	*Calidris minuta*	Least concern
75.			Ruff	*Calidris pugnax*	Least concern

75.			Ruff	*Calidris pugnax*	Least concern
76.			Eurasian Curlew	*Numenius arquata*	Near Threatened
77.			Black-tailed Godwit	*Limosa limosa*	Near Threatened
78.		Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	Least concern
79.		Glareolidae	Oriental Pratincole	*Glareola maldivarum*	Least concern
80.			Little Pratincole	*Glareola lactea*	Least concern
81.		Laridae	River Tern	*Sterna aurantia*	Vulnerable
82.			Common Tern	*Sterna hirundo*	Least concern
83.			White-winged Black Tern	*Childonias leucopterus*	Least concern
84.	Columbiformes	Columbidae	Eurasian Collared-Dove	*Streptopelia decaocto*	Least concern
85.			Eastern Spotted Dove	*Spilopelia chinensis*	Least concern
86.			Rock Pigeon	*Columba livia*	Least concern
87.	Psittaciformes	Psittacidae	Rose-ringed Parakeet	*Psittacula krameri*	Least concern
88.			Plum-headed Parakeet	*Psittacula cyanocephala*	Least concern
89.	Cuculiformes	Cuculidae	Greater Coucal	*Centropus sinensis*	Least concern
90.			Asian Koel	*Eudynamys scolopaceus*	Least concern
91.			Pied Cuckoo	*Clamator jacobinus*	Least concern
92.			Common Cuckoo	*Cuculus canorus*	Least concern
93.	Strigiformes	Strigidae	Spotted Owlet	*Athene brama*	Least concern
94.	Coraciiformes	Alcedinidae	White throated Kingfisher	*Halcyon smyrnensis*	Least concern
95.			Common Kingfisher	*Alcedo atthis*	Least concern
96.			Crested Kingfisher	*Megaceryle lugubris*	Least concern
97.		Meropidae	Green Bee-eater	*Merops orientalis*	Least concern
98.			Blue-tailed Bee-eater	*Merops philippinus*	Least concern
99.		Coraciidae	Indian Roller	*Coracias benghalensis*	Least concern
100.		Upupidae	Eurasian Hoopoe	*Upupa epops*	Least concern

101.		Bucerotidae	Indian Grey Hornbill	*Ocyceros birostris*	Least concern
102.	Piciformes	Picidae	Black-rumped Flameback	*Dinopium benghalense*	Least concern
103.			Yellow-crowned Woodpecker Dendrocopos mahrattensis	*Dendrocopos mahrattensis*	Least concern
104.		Capitonidae	Coppersmith Barbet	*Megalaima haemacephala*	Least concern
105.	Passeriformes	Alaudidae	Crested Lark	*Galerida cristata*	Least concern
106.		Hirundinidae	Wire-tailed Swallow	*Hirundo smithii*	Least concern
107.			Barn Swallow	*Hirundo rustica*	Least concern
108.			African Plain Martin	*Riparia paludicola*	Least concern
109.		Motacillidae	Grey Wagtail	*Motacilla cinerea*	Least concern
110.			Meadow Pipit	*Anthus pratensis*	Least concern
111.			Tree Pipit	*Anthus trivialis*	Least concern
112.			Rosy Pipit	*Anthus roseatus*	Least concern
113.			White Wagtail	*Motacilla alba*	Least concern
114.			Citrine Wagtail	*Motacilla citreola*	Least concern
115.			White-browed Wagtail	*Motacilla maderaspatensis*	Least concern
116.		Campephagidae	Small Minivet	*Pericrocotus cinnamomeus*	Least concern
117.		Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*	Least concern
118.		Laniidae	Bay-backed Shrike	*Lanius vittatus*	Least concern
119.			Long-tailed Shrike	*Lanius schach*	Least concern
120.		Muscicapidae	Pied Bushchat	*Saxicola caprata*	Least concern
121.			Variable Wheatear	*Oenanthe picata*	Least concern
122.			Isabelline Wheatear	*Oenanthe isabellina*	Least concern
123.			Black Redstart	*Phoenicurus ochruros*	Least concern
124.			Oriental Magpie-Robin	*Copsychus saularis*	Least concern
125.			Grey Bushchat	*Saxicola ferreus*	Least concern

126.			Indian Robin	*Saxicoloides fulicatus*	Least concern
127.			Bluethroat	*Luscinia svecica*	Least concern
128.			White-tailed Stonechat	*Saxicola leucurus*	Least concern
129.		Paridae	Great Tit	*Parus major*	Least concern
130.		Nectariniidae	Purple Sunbird	*Cinnyris asiatica*	Least concern
131.		Zosteropidae	Indian White-eye	*Zosterops palpebrosus*	Least concern
132.		Estrildidae	Scaly-breasted munia	*Lonchura punctulata*	Least concern
133.		Passeridae	House Sparrow	*Passer domesticus*	Least concern
134.			Sind Sparrow	*Passer pyrrhonotus*	Least concern
135.		Ploceidae	Baya Weaver	*Ploceus philippinus*	Least concern
136.			Black-breasted Weaver	*Ploceus benghalensis*	Least concern
137.		Sturnidae	Brahminy Starling	*Sturnia pagodarum*	Least concern
138.			Common Starling	*Sturnus vulgaris*	Least concern
139.			Bank Myna	*Acridotheres ginginianus*	Least concern
140.			Asian Pied Starling	*Gracupica contra*	Least concern
141.			Common Myna	*Acridotheres tristis*	Least concern
142.		Oriolidae	Eurasian Golden Oriole	*Oriolus oriolu*	Least concern
143.		Dicruridae	Black Drongo	*Dicrurus macrocercus*	Least concern
144.			Ashy Drongo	*Dicrurus leucophaeus*	Least concern
145.		Corvidae	House Crow	*Corvus splendens*	Least concern
146.			Rufous Treepie	*Dendrocitta vagabunda*	Least concern
147.			Large-billed Crow	*Corvus macrorhynchos*	Least concern
148.		Cisticolidae	Ashy Prinia	*Prinia socialis*	Least concern
149.			Striated Prinia	*Prinia crinigera*	Least concern
150.			Common Tailorbird	*Orthotomus sutorius*	Least concern
151.			Plain Prinia	*Prinia inornata*	Least concern

151.			Plain Prinia	*Prinia inornata*	Least concern
152.			Common Chiffchaff	*Phylloscopus collybita*	Least concern
153.			Zitting Cisticola	*Cisticola juncidis*	Least concern

Winter visitor

Summer visitor

Resident

RaivaSingh/WWFIndia

142.|GharanaWetland,Jammu,J&K

AnnexureII:ApprovalofmanagementplanforGharanawetlandby Chief Wildlife Warden, J&K

Boulevard Road, Near Lalit Grand Palace, Srinagar – 190001 Tel/Fax No: 0194-2501069 (May - October).
Manda - Hills (Near Ashoka Hotel) Jammu – 180005, Tele/Fax: 0191-2572570 (November - April)
Website: www.jkwildlife.com
Email: jkwildlife78@gmail.com
jkwildlife72@gmail.com

सत्यमेव जयते

GOVERNMENT OF JAMMU & KASHMIR
OFFICE OF THE CHIEF WILDLIFE WARDEN

Subject: Approval of Management Plan for Gharana Wetland Conservation Reserve.

Whereas; the Draft Management Plan of Gharana Wetland Conservation Reserve has been prepared for the first time by this Department in collaboration with the WWF-India.

Whereas; the draft said management Plan has undergone various reviews at different levels and suggestions and objections made by the participants were incorporated.

Whereas; the committee constituted vide this office order No: 13 of 2020 dated 08.01.2020 held its meetings on 28-01-2020 and 07.08.2020 to discuss the Draft Management Plan for Gharana Wetland Conservation Reserve.

Whereas; the above said committee recommended for approval of Management Plan of Gharana Wetland Conservation Reserve for a period 2021-2026,in the meeting held on 07-08-2020 subject to the incorporation of suggested points in the meeting.

Whereas; the Regional Wildlife Warden, Jammu vide his No: RWLWJ/2022/5733-34 dated 02.03.2022 has submitted that the suggested points in the final meeting of committee have been incorporated in Management Plan of Gharana Wetland Conservation Reserve and recommended for its approval.

Therefore, under the authority vested under Sections 36 A (2) of Wildlife Protection Act, 1972 the undersigned accords approval to the Management Plan for Gharana Wetland Conservation Reserve for the period 2021-26, subject to the condition that all activities as per the prescriptions in the Management Plan shall be undertaken within provision of Wildlife Protection Act, 1972 and orders of the Hon'ble Supreme Court/ High Court of J&K issued from time to time.

(Suresh Kr. Gupta) IFS
Pr. Chief Conservator of Forests/
Chief Wildlife Warden
Jammu & Kashmir

No: WLP/Res/2021-22/ 398-401 dated: 05 -03-2022.

Copy to the:
01. Commissioner/ Secretary to Government, Forest Ecology & Environment Department, Civil Secretariat, J&K, Jammu for kind information.
02. Regional Wildlife Warden, Jammu.
03. Wildlife Warden, Jammu Division.
04. Pvt. Secretary to Pr. Chief Conservator of Forests &HoFF, J&K for kind information of PCCF/HoFF.

AnnexureIII:Slideshowingsomeimportantaquaticplantsfound in Gharana Wetland:

Alternanthera philoxeroides

Hydrilla verticillata

Eichhorniacrassipes

Azollapinnata

Spirodellapolyrrhiza

Lemnaminor

AnnexureIV:RamsarInformation Sheet

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

Notes for compilers:

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.

2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 14, 3rd edition). A 4th edition of the Handbook is in preparation and will be available in 2009.

3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

1. Name and address of the compiler of this form:

2. Date this sheet was completed/updated:

3. Country:

For Office Use Only

DD MM YY

Designated Date | Site Reference Number

4. Name of the Ramsar site:
The precise name of the designated site in one of the three official languages (English, French or Spanish) of the Convention. Alternative names, including in local language(s), should be given in parentheses after the precise name.

5. Designation of new Ramsar site or update of existing site:

This RIS is for (tick one box only):
a) Designation of a new Ramsar site ❑; or
b) Updated information on an existing Ramsar site ❑

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area

The Ramsar site boundary and site area are unchanged:

or
If the site boundary has changed:
i) the boundary has been delineated more accurately ❑; or
ii) the boundary has been extended ❑; or
iii) the boundary has been restricted** ❑

and/or

If the site area has changed:
i) the area has been measured more accurately ❑; or
ii) the area has been extended ❑; or
iii) the area has been reduced** ❑

** **Important note**: If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

7. Map of site:
Refer to Annex III of the *Explanatory Note and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:
i) **a hard copy** (required for inclusion of site in the Ramsar List): ❑;

ii) **an electronic format** (e.g. a JPEG or ArcView image) ❑;

iii) **a GIS file providing geo-referenced site boundary vectors and attribute tables** ❑.

b) Describe briefly the type of boundary delineation applied:
e.g. the boundary is the same as an existing protected area (nature reserve, national park, etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

8. Geographical coordinates (latitude/longitude, in degrees and minutes):
Provide the coordinates of the approximate centre of the site and/or the limits of the site. If the site is composed of more than one separate area, provide coordinates for each of these areas.

9. General location:
Include in which part of the country and which large administrative region(s) the site lies and the location of the nearest large town.

10. Elevation: (in metres: average and/or maximum & minimum)

11. Area: (in hectares)

12. General overview of the site:
Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

13. Ramsar Criteria:
Tick the box under each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11). All Criteria which apply should be ticked.

1	2	3	4	5	6	7	8	9
❑	❑	❑	❑	❑	❑	❑	❑	❑

14. Justification for the application of each Criterion listed in 13 above:
Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):
Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

b) biogeographic regionalisation scheme (include reference citation):

16. Physical features of the site:
Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

17. Physical features of the catchment area:
Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).

18. Hydrological values:
Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

19. Wetland Types

a) presence:
Circle or underline the applicable codes for the wetland types of the Ramsar "Classification System for Wetland Type" present in the Ramsar site. Descriptions of each wetland type code are provided in Annex I of the *Explanatory Notes & Guidelines*.

Marine/coastal: A · B · C · D · E · F · G · H · I · J · K · Zk(a)

Inland: L · M · N · O · P · Q · R · Sp · Ss · Tp · Ts · U · Va
Vt · W · Xf · Xp · Y · Zg · Zk(b)

Human-made: 1 · 2 · 3 · 4 · 5 · 6 · 7 · 8 · 9 · Zk(c)

b) dominance:
List the wetland types identified in a) above in order of their dominance (by area) in the Ramsar site, starting with the wetland type with the largest area.

20. General ecological features:
Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

21. Noteworthy flora:
Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14, Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically

important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

22. Noteworthy fauna:
Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14. Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

23. Social and cultural values:

a) Describe if the site has any general social and/or cultural values e.g., fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values:

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning?

If Yes, tick the box and describe this importance under one or more of the following categories:

i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:

ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:

iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:

iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

24. Land tenure/ownership:
a) within the Ramsar site:

b) in the surrounding area:

25. Current land (including water) use:
a) within the Ramsar site:

b) in the surroundings/catchment:

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:
a) within the Ramsar site:

b) in the surrounding area:

27. Conservation measures taken:
a) List national and/or international category and legal status of protected areas, including boundary relationships with the Ramsar site:
In particular, if the site is partly or wholly a World Heritage Site and/or a UNESCO Biosphere Reserve, please give the names of the site under these designations.

b) If appropriate, list the IUCN (1994) protected areas category/ies which apply to the site (tick the box or boxes as appropriate):

Ia ❑ ; Ib ❑; II ❑; III ❑; IV ❑; V ❑; VI ❑

c) Does an officially approved management plan exist; and is it being implemented?:

d) Describe any other current management practices:

28. Conservation measures proposed but not yet implemented:
e.g. management plan in preparation; official proposal as a legally protected area, etc.

29. Current scientific research and facilities:
e.g., details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:
e.g. visitors' centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

31. Current recreation and tourism:
State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

32. Jurisdiction:
Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept of Agriculture/Dept. of Environment, etc.

33. Management authority:
Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

34. Bibliographical references:
Scientific/technical references only. If biogeographic regionalisation scheme applied (see 15 above), list full reference citation for the scheme.

Please return to: **Ramsar Convention Secretariat, Rue Mauverney 28, CH-1196 Gland, Switzerland**
Telephone: **+41 22 999 0170** Fax: **+41 22 999 0169** e-mail: **ramsar@ramsar.org**
Available for download from http://www.ramsar.org/ris/key_ris_index.htm.

AnnexureV:DataSheetsforAsianWaterfowl Count

Asian Waterbird Census (South Asia)

WETLANDS INTERNATIONAL

Please return to your National Co-ordinator or Wetland International, 3A 39, Kelana Centre Point, Jalan SS7/19, Petaling Jaya 47301 MALAYSIA **(before March)**

Country:

Name of Site:

Date:

Province/State/Prefecture:

Nearest Large Town:

Site Code (only for official use):

Type: A - Aerial, F - On foot, B - By boat, M - Mixed

Coverage: V-25%, W-25-50%, X-50-75%, Y-75-99%, Z-100%

Has the site been counted before?

Yes ☐ No ☐

Waterfowl Counts

_____ *GREBES*

_____ Little Grebe *Tachybaptus ruficollis*

_____ Red-necked Grebe *Podiceps grisegena*

_____ Great Crested Grebe *P. cristatus*

_____ Black-necked Grebe *P. nigricollis*

_____ Unidentified grebes

_____ *PELICANS*

_____ Great White Pelican *Pelecanus onocrotalus*

_____ Spot-billed Pelican *P. philippensis*

_____ Dalmatian Pelican *P. crispus*

_____ Unidentified pelicans

_____ *CORMORANTS & DARTERS*

_____ Great Cormorant *Phalacrocorax carbo*

_____ Indian Shag *P. fusciollis*

_____ Little Cormorant *P. niger*

_____ Unidentified cormorants

_____ Oriental Darter *Anhinga melanogaster*

_____ *HERONS & EGRETS*

_____ Great Bittern *Botaurus stellaris*

_____ Yellow Bittern *Ixobrychus sinensis*

_____ Cinnamon Bittern *I. cinnamomeus*

_____ Black Bittern *I. flavicollis*

_____ Malayan Night Heron *Gorsachius melanolophus*

_____ Black-crowned Night Heron *Nycticorax nycticorax*

_____ Indian Pond Heron *Ardeola grayii*

_____ Cattle Egret *Bubulcus ibis*

_____ Striated (Little Green) Heron *Butorides striatus*

_____ Western Reef Egret *Egretta gularis*

_____ Little Egret *E. garzetta*

_____ Intermediate Egret *E. intermedia*

_____ Great Egret *E. alba*

_____ Purple Heron *Ardea purpurea*

_____ Grey Heron *A. cinerea*

_____ Goliath Heron *A. goliath*

_____ White-bellied Heron *A. imperialis (insignis)*

_____ Unidentified herons and egrets

_____ *STORKS*

_____ Painted Stork *Mycteria leucocephala*

_____ Asian Openbill *Anastomus oscitans*

_____ Black Stork *Ciconia nigra*

_____ Wooly-necked (White-necked) Stork *C. episcopus*

_____ White Stork *C. ciconia*

_____ Black-necked Stork *Ephippiorhynchus asiaticus*

_____ Lesser Adjutant *Leptoptilos javanicus*

_____ Greater Adjutant *L. dubius*

_____ Unidentified storks

_____ *IBISES & SPOONBILLS*

_____ Black-headed (White) Ibis *Threskiornis melanocephalus*

_____ Black Ibis *Pseudibis papillosa*

_____ Glossy Ibis *Plegadis falcinellus*

_____ White Spoonbill *Platalea leucorodia*

_____ *FLAMINGOS*

_____ Greater Flamingo *Phoenicopterus roseus*

_____ Lesser Flamingo *Phoeniconaias minor*

_____ Unidentified flamingos

_____ *GEESE & DUCKS*

_____ Fulvous (Large) Whistling Duck *Dendrocygna bicolor*

_____ Lesser Whistling Duck (Lesser Tree Duck) *D. javanica*

_____ Greylag Goose *Anser anser*

_____ Bar-headed Goose *A. indicus*

_____ Unidentified geese

_____ Ruddy Shelduck *Tadorna ferruginea*

_____ Common Shelduck *T. tadorna*

_____ White-winged Wood Duck *Cairina scutulata*

_____ Comb Duck *Sarkidiornis melanotos*

_____ Indian Cotton Teal *Nettapus coromandelianus*

_____ Eurasian Wigeon *Anas penelope*

_____ Falcated Teal *A. falcata*

_____ Gadwall *A. strepera*

_____ Common (Green-winged) Teal *A. crecca*

_____ Mallard *A. platyrhynchos*

_____ Spot-billed Duck *A. poecilorhyncha*

_____ Northern Pintail *A. acuta*

_____ Garganey *A. querquedula*

_____ Northern Shoveler *A. clypeata*

_____ Marbled Teal *Marmaronetta angustirostris*

_____ Red-crested Pochard *Netta rufina*

_____ Common Pochard *Aythya ferina*

_____ Baer's Pochard *A. baeri*

_____ Ferruginous Duck *A. nyroca*

_____ Tufted Duck *A. fuligula*

_____ Common Goldeneye *Bucephala clangula*

_____ Goosander *Mergus merganser*

_____ White-headed Duck *Oxyura leucocephala*

_____ Unidentified ducks

_____ *CRANES*

_____ Common Crane *Grus grus*

_____ Black-necked Crane *G. nigricollis*

_____ Sarus Crane *G. antigone*

_____ Siberian Crane *G. leucogeranus*

_____ Demoiselle Crane *Anthropoides virgo*

_____ Unidentified cranes

_____ *RAILS, GALLINULES & COOTS*

_____ Water Rail *Rallus aquaticus*

_____ Slaty-breasted Rail *R. striatus*

_____ Slaty-legged Crake *Rallina eurizonoides*

_____ Baillon's Crake *Porzana pusilla*

_____ Ruddy Crake *P. fusca*

_____ Brown Crake *Amaurornis akool*
_____ White-breasted Waterhen *A phoenicurus*
_____ Watercock *Gallicrex cinerea*
_____ Moorhen *Gallinula chloropus*
_____ Purple Swamphen *Porphyrio porphyrio*
_____ Common Coot *Fulica atra*

FINFOOT & JACANAS

_____ Masked Finfoot *Heliopais personata*
_____ Pheasant-tailed Jacana *Hydrophasianus chirurgus*
_____ Bronze-winged Jacana *Metopidius indicus*

SHOREBIRDS - WADERS

_____ Painted Snipe *Rostratula benghalensis*
_____ Crab Plover *Dromas ardeola*
_____ Oystercatcher *Haematopus ostralegus*
_____ Ibisbill *Ibidorhyncha struthersii*
_____ Black-winged Stilt *Himantopus himantopus*
_____ Avocet *Recurvirostra avosetta*
_____ Great Stone Plover *Esacus recurvirostris*
_____ Oriental Pratincole *Glareola maldivarum*
_____ Little Pratincole *G. lactea*
_____ Northern Lapwing *Vanellus vanellus*
_____ River Lapwing *V. duvaucelii*
_____ Yellow-wattled Lapwing *V. malabaricus*
_____ Sociable Plover *V. gregarius*
_____ White-tailed Plover *V. leucurus*
_____ Grey-headed Lapwing *V. cinereus*
_____ Red-wattled Lapwing *V. indicus*
_____ Pacific Golden Plover *Pluvialis fulva*
_____ Grey Plover *P. squatarola*
_____ Long-billed Plover *Charadrius placidus*
_____ Little Ringed Plover *Charadrius dubius*
_____ Kentish Plover *C. alexandrinus*
_____ Mongolian Plover *C. mongolus*
_____ Greater Sand Plover *C. leschenaultii*
_____ Black-tailed Godwit *Limosa limosa*
_____ Bar-tailed Godwit *L. lapponica*
_____ Whimbrel Numenius *phaeopus*
_____ Eurasioan Curlew *N. arguata*
_____ Spotted Redshank *Tringa erythropus*
_____ Redshank *T. totanus*
_____ Marsh Sandpiper *T. stagnatilis*
_____ Greenshank *T. nebularia*
_____ Nordmann's Greenshank *T. guttifer*
_____ Green Sandpiper *T. ochropus*
_____ Wood Sandpiper *T. glareola*
_____ Terek Sandpiper *Xenus cinereus*
_____ Common Sandpiper *Actitis hypoleucos*
_____ Ruddy Trunstone *Arenaria interpres*
_____ Red-necked Phalarope *Phalaropus lobatus*
_____ Eurasian Woodcock *Scolopax rusticola*
_____ Solitary Snipe *Gallinago solitaria*
_____ Printail Snipe *G. stenura*
_____ Swinhoe's Snipe *G. megala*
_____ Common Snipe *G. gallinago*
_____ Jack Snipe *Lymnocryptes minimus*
_____ Asiatic Dowitcher *Limnodromus semipalmatus*
_____ Great Knot *Calidris tenuirostris*
_____ Sanderling *C. alba*
_____ Little Stint *C. minuta*
_____ Temminck's Stint *C. Temminckii*
_____ Long-toed Stint *C. Subminuta*
_____ Dunlin *C. alpina*
_____ Curlew Sandpiper *C. ferruginea*
_____ Spoon-billed Sandpiper *Eurynorhynchus pygmeus*
_____ Broad-billed Sandpiper *Limicola falcinellus*
_____ Ruff *Philomachus pugnax*
_____ Unidentified shorebirds

GULLS, TERNS & SKIMMERS

_____ Sooty Gull *Larus hemprichii*
_____ Heuglin's Gull *Larus heuglini*
_____ Yellow-legged Gull *Larus cachinnans*
_____ Brown-headed Gull *L. brunnicephalus*
_____ Black-headed Gull *L. ridibundus*
_____ Slender-billed Gull *L. genei*
_____ Unidentified gulls
_____ Whiskered Tern *Childonias hybridus*
_____ White-winged Black Tern *C. leucopterus*
_____ Gull-billed Tern *Gelochelidon nilotica*
_____ Caspian Tern *Hydroprogne caspia*
_____ Indian River Tern *Sterna aurantia*
_____ Common Tern *S hirundo*
_____ Black-bellied Tern *S. melanogaster*
_____ Little Tern *S. albifrons*
_____ Saunders' Little Tern *S. saundersii*
_____ Great crested Tern *S. bergii*
_____ Leeser Crested Tern *S. bengalensis*
_____ Sandwich Tern *S. sandvicensis*
_____ Unidentified terns
_____ Indian Skimmer *Rynchops albicollis*

ADDITIONAL SPECIES

_____
_____
_____
_____
_____
_____

USEFUL SITE INFORMATION: (please circle the relevant figures)

CONDITION OF WETLAND: 1. Wet (water present), 2 Totally dry, 3. Totally frozen

PROTECTION: 1. By Government, 2. By Tradition, 3. Private ownership, 4. Unprotected, 0. Unknown

THREATS AND USES: 0 Unknown, 1 None, 2 Sedimentation, 3 Excessive overgrowth of vegetation, 4 Cutting/clearance of vegetation, 5 Eutrophication, 6 Agriculture along drying margins, 7 Excessive cattle grazing, Pollution by: 8 domestic sewage, 9 solid waste, A Industrial waste, B oil, C pesticides, D fertilizers, E Mining, F Hunting/trapping/poaching of birds, G Little fishing, H Large scale fishing, I Partial reclamation, J Complete reclamation, K Dam/barrage construction, L Tourism/recreation

TIME OF COUNT: START : am/pm FINISH : am/pm

PARTICIPANT(S) NAME (S) AND ADDRESS(ES):

_____ Brown Crake *Amaurornis akool*
_____ White-breasted Waterhen *A phoenicurus*
_____ Watercock *Gallicrex cinerea*
_____ Moorhen *Gallinula chloropus*
_____ Purple Swamphen *Porphyrio porphyrio*
_____ Common Coot *Fulica atra*

FINFOOT & JACANAS

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_____ Ruddy Trunstone *Arenaria interpres*
_____ Red-necked Phalarope *Phalaropus lobatus*
_____ Eurasian Woodcock *Scolopax rusticola*
_____ Solitary Snipe *Gallinago solitaria*
_____ Printail Snipe *G. stenura*
_____ Swinhoe's Snipe *G. megala*
_____ Common Snipe *G. gallinago*
_____ Jack Snipe *Lymnocryptes minimus*
_____ Asiatic Dowitcher *Limnodromus semipalmatus*
_____ Great Knot *Calidris tenuirostris*
_____ Sanderling *C. alba*
_____ Little Stint *C. minuta*
_____ Temminck's Stint *C. Temminckii*
_____ Long-toed Stint *C. Subminuta*
_____ Dunlin *C. alpina*
_____ Curlew Sandpiper *C. ferruginea*
_____ Spoon-billed Sandpiper *Eurynorhynchus pygmeus*
_____ Broad-billed Sandpiper *Limicola falcinellus*
_____ Ruff *Philomachus pugnax*
_____ Unidentified shorebirds

GULLS, TERNS & SKIMMERS

_____ Sooty Gull *Larus hemprichii*
_____ Heuglin's Gull *Larus heuglini*
_____ Yellow-legged Gull *Larus cachinnans*
_____ Brown-headed Gull *L. brunnicephalus*
_____ Black-headed Gull *L. ridibundus*
_____ Slender-billed Gull *L. genei*
_____ Unidentified gulls
_____ Whiskered Tern *Chlidonias hybridus*
_____ White-winged Black Tern *C. leucopterus*
_____ Gull-billed Tern *Gelochelidon nilotica*
_____ Caspian Tern *Hydroprogne caspia*
_____ Indian River Tern *Sterna aurantia*
_____ Common Tern *S hirundo*
_____ Black-bellied Tern *S. melanogaster*
_____ Little Tern *S. albifrons*
_____ Saunders' Little Tern *S. saundersii*
_____ Great crested Tern *S. bergii*
_____ Leeser Crested Tern *S. bengalensis*
_____ Sandwich Tern *S. sandvicensis*
_____ Unidentified terns
_____ Indian Skimmer *Rynchops albicollis*

ADDITIONAL SPECIES

_____
_____
_____
_____
_____
_____

USEFUL SITE INFORMATION: (please circle the relevant figures)

CONDITION OF WETLAND: 1. Wet (water present), 2 Totally dry, 3. Totally frozen

PROTECTION: 1. By Government, 2. By Tradition, 3. Private ownership, 4. Unprotected, 0. Unknown

THREATS AND USES: 0 Unknown, 1 None, 2 Sedimentation, 3 Excessive overgrowth of vegetation, 4 Cutting/clearance of vegetation, 5 Eutrophication, 6 Agriculture along drying margins, 7 Excessive cattle grazing, Pollution by: 8 domestic sewage, 9 solid waste, A Industrial waste, B oil, C pesticides, D fertilizers, E Mining, F Hunting/trapping/poaching of birds, G Little fishing, H Large scale fishing, I Partial reclamation, J Complete reclamation, K Dam/barrage construction, L Tourism/recreation

TIME OF COUNT: START : am/pm FINISH : am/pm

PARTICIPANT(S) NAME (S) AND ADDRESS(ES):

AnnexureVI:ConceptNote onNaturalTechnologiesfor Wastewater Treatment at GharanaWetlands,Jammu, Jammu & Kashmir

Background

Gharana wetland, an ecologically and strategically important wetland, is located very close tothe international border between India and Pakistan. It is located rightnexttothevillageofGharana in the Ranbir Singh Pura Town (R S Pura) at a distance of 35 km from Jammu district headquarters. Gharana wetland is very rich in wildlife, especially avifauna. Astudy has reported 151 species of birds from the wetland and the surroundingagriculturallandscape. The wetland is known as bird-watchers' paradise, for harbouring an array of migratory birds which arrive here in winters and leave in the beginning of summers. It actsas a wintering habitat for water- bird species like bar-headed goose, commoncrane,greylaggoose,lesser &greater whitefrontedgoose, black stork, woolly-necked stork andblack ibis etc. Its avian diversity has helped the wetland gain the statusof an 'Important Bird Area (IBA)' conferred jointly by the Bombay Natural History Society and the BirdlifeInternational.Apartfromits avian diversity, the wetland also has a good population of turtles, snakes, fish, frogs and different species of insects.Thewetlandisseenbysome researchers as a potential Ramsar Site. Although a small wetland with awaterexpanseofonly0.80sq.km, this ecologically significant wetland has been declared as a conservation reserve by the Government of Jammu & Kashmir and is looked after by the Department of Wildlife Protection of the state of J&K.

IncaseofGharana,whichisasmall wetland, a very small change in its water quality may have significant bearing on its ecosystem. The untreated /raw sewage from the houses and cattle-sheds enters directly into the Gharana wetland. This untreated sewage has particularly high concentrations of phosphates and nitrates apart from various metals and organics. These nutrients enrich the wetland water and sediments and lead to eutrophication. The eutrophication leads to increase the wetland productivity causing proliferationof wetland plants, especially water hyacinth and alligator weed. The aquatic weeds like water hyacinth and alligator weeds are infamousfor their high speed of proliferation andultimatelycoveringthewetland with their floating mats. These dense networks of weeds become unmanageable after a certainperiodoffewyearsandveryhar dto remove. Gharana wetland has also beencompletelytaken-overbythese invasive species of weeds. Another

invasive species which is new to Gharana is Azolla, an aquatic fern which, if it not managed properly, as ability to completely takeoverthe wetland. Azolla has a symbiotic relationshipwithAnabaenaazollae, which fixes atmospheric nitrogen and gives the plant access to sufficient amounts of this limiting factor. In presence of enough nitrogen and phosphates from sewage,Azollaspreadslikeanything. In past, Gharana has witnessed Azolla blooms which virtually choked the wetland by spreading on its surface. During Azolla bloom, it was also seen that Bar-headed Geese refrained from landing directly inthe wetland. The nutrients from sewagetendtobio-accumulateinthe various types of macrophytes which when consumed by the birds lead to their bio-magnification. This may have long-term implications for the various species and ultimately the ecosystem. First impression plate (Photographic impression) is givenat Figure 1.0

Concept of Natural Treatment

The natural technologies of wastewater treatment use natural, commonlyoccurringself-treatment processesthattakeplaceinthesoil, water and wetland environment. The vegetation is directly involved inthetreatmentprocess,especially by the formation of favourable conditions for the development of microorganisms involved inthetreatmentprocess,and simultaneous utilization of released plant nutrients for the biomass production. “Natural TechnologiesofWastewaterTreatmen t”isfocused ontheverytopicalissueoftheuseof natural technologies of wastewater treatment, including, among others, constructed treatment wetland, soil filters, waste stabilization ponds,Polishingponds,aquatic plants systems, irrigation by pre-treated wastewater. These

naturaltechnologiesofwastewater treatment belong to the group of environmentally friendly ways of treatment and management of particular types of wastewaters. However, they encompass management of waste containing especially organic load present. Natural technologies of wastewater treatmentareespeciallyrepresented by:

Soilfilters(SF);

Constructedtreatmentwetlands (CTW);

Wastestabilizationponds(WSP)

Hydroponic System;

Bioremediation;

Polishing Ponds;

Oxidation Ponds;

Hybrid and combined systems of decentralizedandnaturaltreatment systems;

In principle, it is of advantage to have several inlet points in orderto distribute the pollution load more equally and to create a larger area for sedimentation. On the other hand, it might be advisabletoprovideaslightlyseparat edinlet zoneinordertoavoidbulkyfloating matters littering the total pond surface. The inlet points should be farthest away from the outlet. The outlet should be below water surface in order to retain floating solids, including algae. Gravel beds functioning as roughing filter are advisablebetweenpondsinrowand before the final outlet. Erosion of banks by waves could be a problem with larger ponds. Therefore, slope should be 1 (vertical) to 3 (horizontal)andpreferablycovered with rocks or large sized gravel. Banks and dams could be planted withmacrophytes,suchascattailor Phragmites. Dams between ponds should be paved and wide enoughto facilitate maintenance. Smaller volumes of wastewater, such as from schools, hospitals, residential housesshouldbetter bepre-treated in Imhoff tanks, baffled reactors or at least sedimentation pits, before reaching the aerobic stabilization pond. Properly operated Imhoff tanks that keep water fresh and without smell are preferable. A septictankwouldbebetterifregular de-sludging of the Imhoff tanks cannot be guaranteed. The effluent will be “stinky” anyhow. If pre-treatment in ponds does not take place, the pond must be provided with a deeper sedimentation zone near the inlet. However, bad odouris to be expected. It might be wiserto construct a small sedimentation pond on which a sealing scum layer will develop. Flow principle ofaerobicpondisgiveninFig.2a) andb)andthecompletetreatment

chainof(HybridandCombinedDEWATS)technologyalongwithNATURAL TREATMENT would be best example is given in Fig. 3.

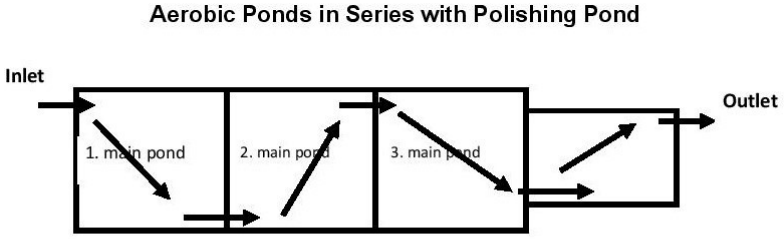


Fig.2 a): Flow pattern of aerobic-facultative ponds in series

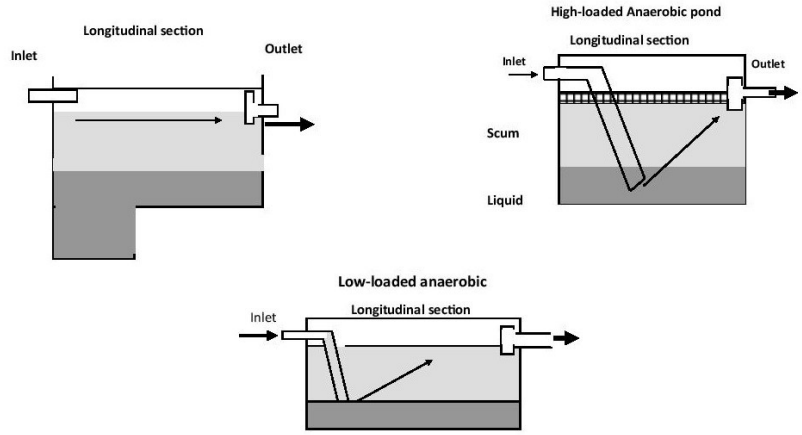


Fig. 2 b): Principles of anaerobic ponds. Sedimentation ponds have a HRT of about 1 day, low loaded ponds are supposed to be odourless because of almost neutral pH, high loaded ponds form a sealing scum layer on top

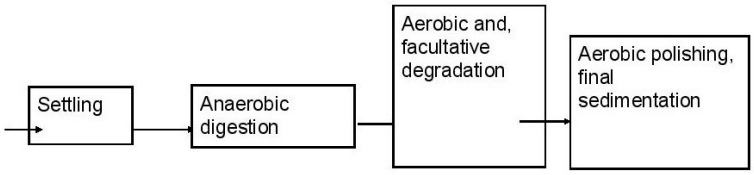


Fig 3: The complete treatment chain of DEWATS-Natural Treatment technologies

A centralized treatment system impliesthetechnologiesrequired highly qualified operational staff which is closely supervised by an experienced management. The centralized system also involves in high cost in conveyance of domestic sewage through long distanceseveragecommandarea ofthecitylimitandalsorequired electricity to run this treatment system with high maintenance whereas decentralized treatment system(DEWATS)commandslow maintenance. DEWATS implies that technologies which cannot be “switched on and off” as one likes, is integral to the DEWATS concept. DEWATS are intendedtoperformfunctionevery daywith the efficiency envisaged. Systems, which are highly efficient but require a great deal of regular caretofunctionatanacceptablelevel,do not suit the concept of decentralized wastewater treatment. To avoid any misunderstanding: the technologies which are regarded here as non- DEWATS (Centralized) are by no meansinferiortreatmentsystems.A totallycentralizedsystemwouldrest in the lowest plant construction cost pertreatmentvolumeofwastewater. On the other hand, connecting individual sources to the treatment unit may result in up to five times the cost for the required sewerage. Managementcostsarecomparatively low because one highly qualified manager cares for a large volume ofwastewater;respectivelyalarge number of users, maintenance costs are quite high, instead, becausesophisticatedmechanized equipmentrequiredpermanentcare. The technologies which do not fit in with DEWATS and precisely fit in Centralized system are:

- Therotatingdiscreactor
- Thetricklingfilter
- Theactivatedsludgeprocesses
- HighloadASPfollowedby BiofiltrationandChemical coagulation f/b High rate Biofiltration
- Thefluidizedbedreactor
- Thesequencingbatchreactor
- UpflowAnaerobicSludge Blanket

The technologies which fit in Decentralizedtreatmentsystem (DEWATS) are:

- Septictank
- Imhofftank
- Anaerobicfilter
- Baffledsepticktank
- Horizontalgravelfilter
- Anaerobicponds

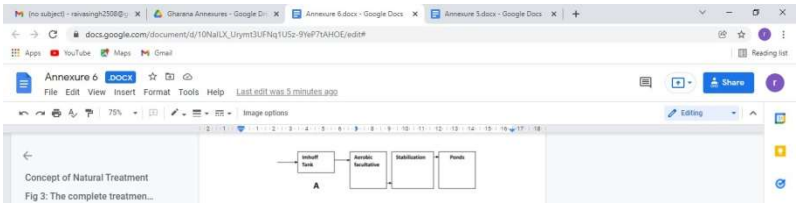
- Aerobicponds

Those systems which work with compressed air-either for aeration orfloatation–orrequirechemicals for treatment are also excluded from DEWATS. The UASB is also not suitable, despite its simple technology. High-rate trickling filters may be suitable when the distribution system functions permanently. Similarly, vertical planted filter beds may be suitable ifalternatechargingoffilterbedsis incorporated into the "production process" of wastewater itself. The choice of treatment system will dependonthemanagementcapacity atsite. For instance, even horizontal ground filters can fall if grain size or surface area is insufficient and in situation where little to no care istobewiththeinvestment.Butof course, it might be difficult for the planning engineer to tell the client thatheconsidershimbeingcareless. Despite their reliability impressive treatment performance, such well-known and proven systems as UASB,tricklingfilter,rotatingdiscs, etc. are not considered as being DEWATS as these systems require carefulandskilledattendance.Most of the treatment process which are used in large-scale treatment plants despite their proven efficiency do not meet the DEWATS criteria andtherefore,cannotbeincluded. The activated sludge process, the fluidized bed reactor, aerated or chemical flocculation and all kinds of controlled recirculation of wastewater are part of this category. Regularorcontinuousre-circulation is partly acceptable under the condition that the pumps are used cannot be switched off easily, i.e. separately from transportation pumps. However, inferior quality need not to be when there is sufficient space for the plant. There are certain measures at hand to discharge effluent of acceptable quality:

- Provisionofsufficientspaceat the source of pollution
- Pre-treatmentatsourceandpost treatment where sufficient land is available
- Pre-treatmentatsourceandpost treatment in co-operation with others.
- Acceptinganeffluentwithhigher pollution load.
- Restricting wastewater producingactivitiesatthis particular site.
- Connectiontocentraltreatment plant via sewage line.

Permanent dilution of wastewater ortheinstallationofamechanized and highly efficient treatment plant remain theoretical options, becauseexperienceshowsthatsuch

processesarechronicallyafflictedby irregular operation. There are three basic treatment systems which may fall in the category of constructed wetlands. These are i) the overland treatment system; ii) the vertical flow filter, and iii) the horizontal flow filter. For overland treatment the water is distributed on carefully contoured land by sprinklers. The system requires permanent attendanceandmaintenance.For that reason, it does not belong to DEWATS. For vertical filter treatment the wastewater is distributedwiththehelpofadosing device on two or three filter beds which are charged alternately. Charging intervals must be strictly followed which makes the vertical filter less suitable for DEWATS. Thus, here we discussed only horizontal filter under constructed wetland. The horizontal filter is simple by principle and requires almost no maintenance, however undertheconditionthatithasbeen well designed and constructed. Design and construction require a solidunderstandingofthetreatment process and good knowledge of the filter medium that is to be used. Constructedwetlands,especially sand and gravel filters are byno means a simple technology, although they may look like part of nature. Before deciding onfiltertreatments,oneshould always consider the alternative of constructing wastewater ponds instead.Nonetheless,filtertreatment as the great advantage of keeping the wastewater below ground. The horizontal and the vertical filter are two systems that are principally different. The horizontal filter is permanently soaked with water and operates partly aerobic (free oxygen present, partly anoxic (no freeoxygen but nitrate – NO_3- present) and party anaerobic (no free oxygen and no nitrate present). The vertical filter is charged in intervals (similar to a trickling filter) and functions predominantly aerobically. Although the vertical filter requires only about halftheareaofahorizontalfilterand has better treatment qualities, only the horizontal filter is considered a DEWATS technology for the reason that it has no movable parts and does not require permanent operational control. Flow principle ofHorizontalfilterisgiveninFig.4.



FeasibilityofPondsorLagoons at Gharana Wetlands at J&K:

Ponds (lagoons) are artificial lakes. What happens in ponds closely represents treatment process which takes place in nature. In artificial ponds the different treatment processes are often separated. All ponds are ideal DEWATS and should be given preference over other systems whenever land is available. Ponds are preferred beforeundergroundgravelfiltersif an open pond is acceptable to the surrounding.Incaseoffacultative or anaerobic ponds, the distance to residential houses or working places should be far enough to avoid nuisance by mosquito breading, or bad odour. Polishing ponds can be nearer because the use of fish to control mosquitoes is possible. Fish that belong to Gambusia spp. are commonlyusedformosquitocontrol in tropical countries. Pure pond systems are cheap and need almost no maintenance, even in large size. Ponds may be classified into:

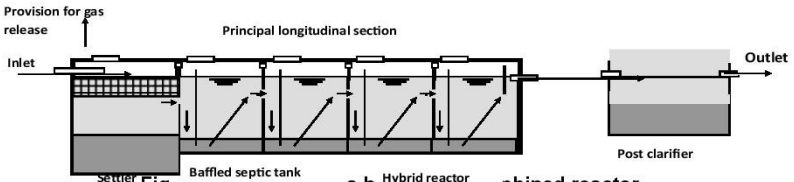


Fig. . a h nbined reactor

- Sedimentation ponds (pre-treatmentpondswithanaerobic sludge stabilization);
- Anaerobicponds(anaerobic stabilization ponds);
- Oxidation ponds (aerobic cum facultativestabilizationponds);
- Polishingponds(post-treatment ponds, placed after stabilization ponds)

Pondsystemsthatareplannedfor full treatment normally consist ofseveralpondsservingdifferent purposes. For instance, a deep anaerobic sedimentation pond forsedimentationcumanaerobic stabilizationofsludge,twoorthree shallow aerobic and facultative oxidation ponds with longer retention times for predominantly aerobic degradation of suspended and dissolved matter and one or severalshallowpolishingpondsfor

final sedimentation of suspended stabilizedsolidsandbacterialmass, wastewater ponds for the purpose offishfarmingmustbeinitiallylow loaded, and in addition, be diluted byfourtofivetimeswithriverwater. Artificially aerated ponds are not considered to be DEWATS and are therefore not dealt here. It may be enough to know that such ponds are1.5–3.5mdeeps,usuallywork with a 5 days hydraulic retention time (HRT) and organic loads of 20 to 30 g BOD/m3d. The energy requirement for aeration is about1–3 W/m3 of pond volume, in caseofonlylittlescumformationonlyth e surface of anaerobic ponds may be aerated to reduce foul smell.

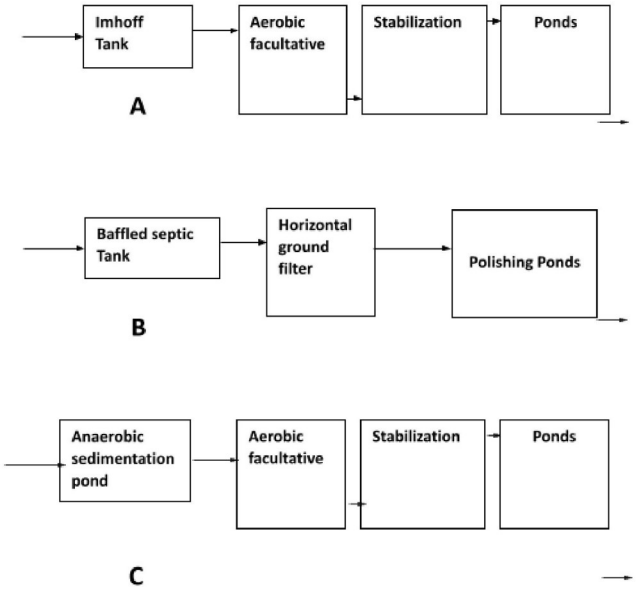
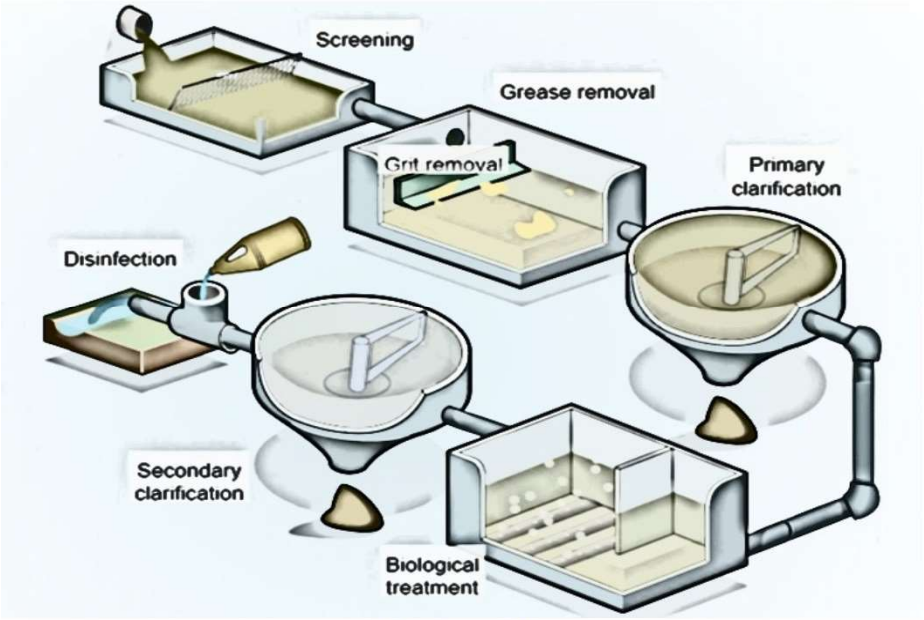


Fig. 6: Typical combinations for full treatment when using DEWATS-technology along with Natural Treatment.

Sewage Treatment Plant

at Gharana Wetland in Jammu (J&K)

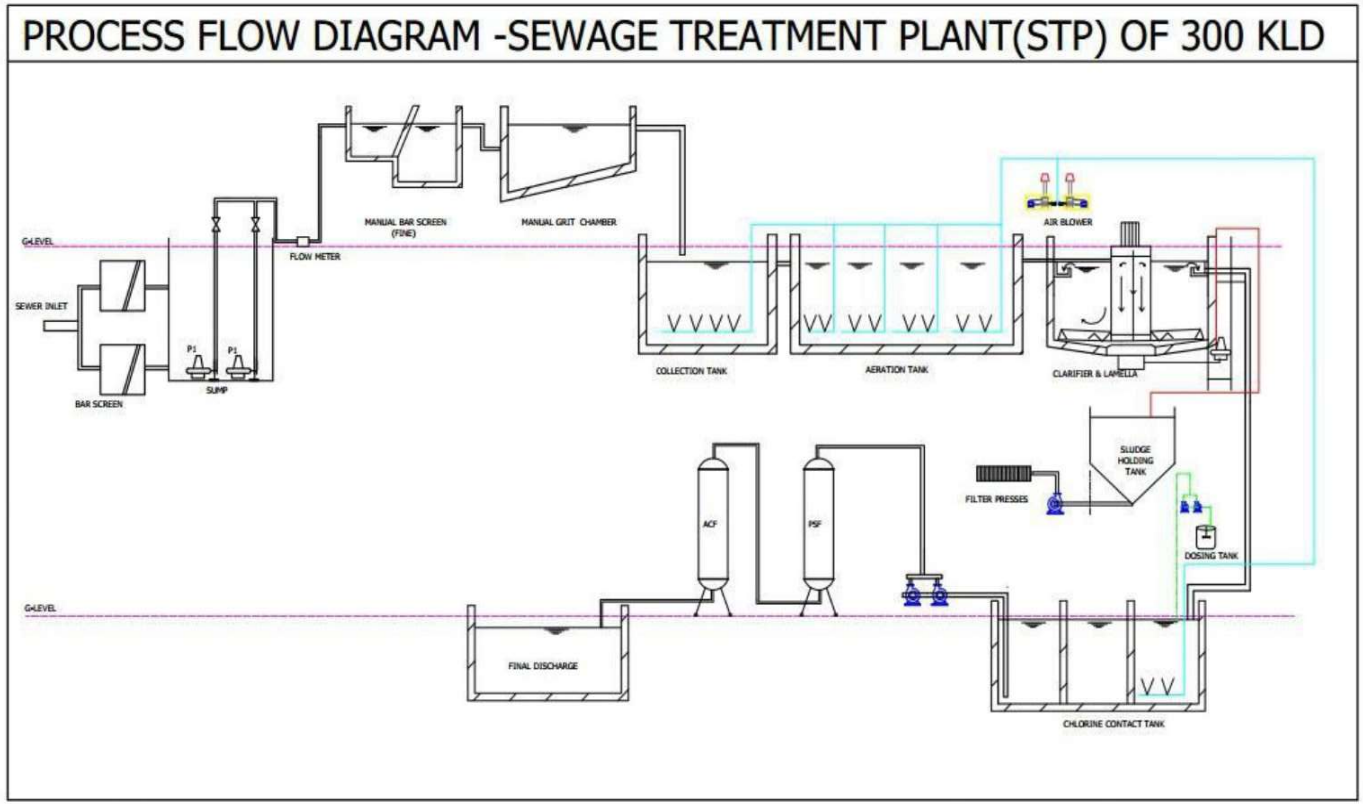


Prepared by

Environmental Pollution Analysis Lab

1/18, UIT Sector, Bhiwadi.
Email: pollutionanalysislab@gmail.com

Annexure I: Process flow and technical design of the STP



AnnexureVII:PredictingthePotentialDistributionof Lissemys punctata and Nilssonia gangetica

Introduction

TheIndianflapshellturtle(Lissemys punctata) and The Indian softshell turtle (Nilssonia gangetica) are twoofthe22turtlespeciesfound in India. Lissemys punctata is a freshwater turtle found in South Asia.Thename"flap-shelled"comes from the fact that the plastron has femoral flaps. When the limbs retreat into the shell, these flaps of skincoverthem.In1975,theIndian flapshellturtlewasaddedtoCITES' Appendix I. It can also be found in India, Bangladesh, Nepal, and Pakistan. L. punctata lives in rivers, streams, marshes, ponds, lakes, irrigation canals, and tanks, where thewaterisshallow,quiet,andoften stagnant. Because of the turtle's proclivity to burrow, waters with sand or mud bottoms are desirable. By eating on snails, insects, and bits of dead animals, the L. punctata turtle helps to minimise pollution inaquaticsettings.L.punctatahas been introduced to the Andaman and Nicobar Islands.

TheIndiansoftshellturtle(Nilssonia gangetica), often known as the Ganges softshell turtle, is a softshell turtle that can be found in rivers such as the Ganges, Indus, and Mahanadi in South Asia. The shell ofthisendangeredturtlecangrow up to 94 centimetres in length (37 in) It eats fish, amphibians and other animal remains, but it alsoeatsaquaticvegetation.This turtle is protected under section II of Schedule I of the Wild Life (Protection) Act, 1972, and its possessionisillegal.N.gangeticais found in Afghanistan, Bangladesh, IndiaSouthernNepal,andPakistan.

Objectivesof the study

Our goals were to define the most up-to-date distribution of Lissemys punctata and Nilssonia gangetica andto evaluate the habitat suitabilityofLissemyspunctataand Nilssonia gangetica in Gharana and its associated wetlands.

Methods

Occurrencedata collectionandfiltering.

We obtained species occurrences from the literature and from online repositories(i.e.GlobalBiodiversity Information Facility (GBIF) and iNaturalist). To prevent any possible effect of sampling bias, we filtered the initial occurrence dataset by applying the spatial thinningprocedureimplemented inthespThinRpackage.Wealso removed unlikely occurrences derived from captive specimens. SincemostpartsoftheIUCNranges were poorly covered by occurrence data from literature and online repositories, we further completed

the dataset by adding an equal number of occurrences (than the online+literature)randomlyselected fromthepolygonsintheIUCNrange maps(fromhttp://www.iucnredlist.org). Fig 1(Lissemys punctata) Fig 2 (Nilssonia gangetica)

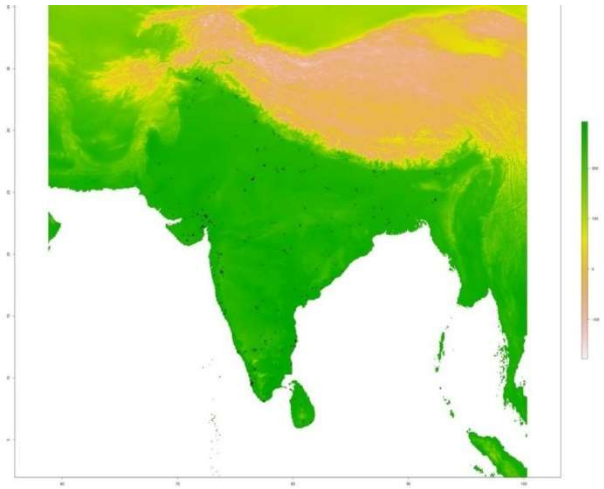


Fig 1. Species occurrence data: ***Lissemys punctata***

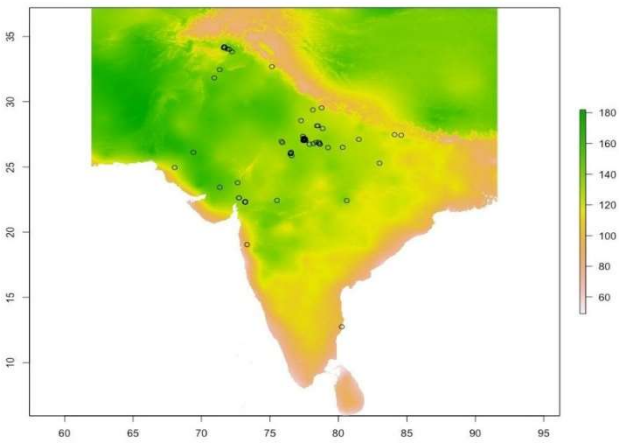


Fig 2. Species occurrence data: ***Nilssonia gangetica***

Environmentalvariables
We used bioclimatic predictions fromtheWORLDCLIMdatabase as environmental variables. At a spatial resolution of 4.5 km, allofthepredictorswererasterized .
Welookedformulticollinearityin thepredictorsbyusingavariance inflation factor of ≤ 7.

Species distribution models:
Thedistributionsofthetwospecies were modelled using the sdm R package's ensemble forecasting approach, which averaged the forecasts of three commonly used modelling techniques: the generalised linear model (GLM), random forest (RF), and maximal entropy (MAXENT) models. Five repetitions were done for each modelling technique, using random setsof70%oftheinitialoccurrences to calibrate the model and the remaining 30% to evaluate its predictive performance. The area under the receiver operatingcharacteristiccurve(ACU) and true skill statistic (TSS) were used to evaluate the models.

Results
The SDMs for the two species achieved excellent predictive performances(Table1)forLissemys punctata AUC valuesranges between 0.87 to 0.95and TSS values between 0.6 to 0.77(Table 1). Lissemys punctata showed a core placed toward high values of Annual Mean Temperature (Bio1), andPrecipitationofWettestMonth (Bio13)andPrecipitationSeasonality (Bio15) (Fig 3) and for Nilssonia gangetica AUC valuesranges between 0.88 to 0.96and TSS values between 0.67 to 0.81(Table 1). Nilssonia gangetica showed a core placed toward high values of PrecipitationofWettestMonth(Bio 13), Mean Diurnal Range (Bio2), Precipitation Seasonality (Bio15) andMeanTemperatureofWarmest Quarter (Bio10) (Fig 4).

	Lissemys punctata		*Nilssonia gangetica.*	
Methods	**AUC**	**TSS**	**AUC**	**TSS**
GLM	0.87	0.6	0.88	0.67
MAXENT	0.89	0.64	0.95	0.79
RF	0.95	0.77	0.96	0.81

Table 1. AUC and TSS model evaluation scores for *Lissemys punctata and Nilssonia gangetica*

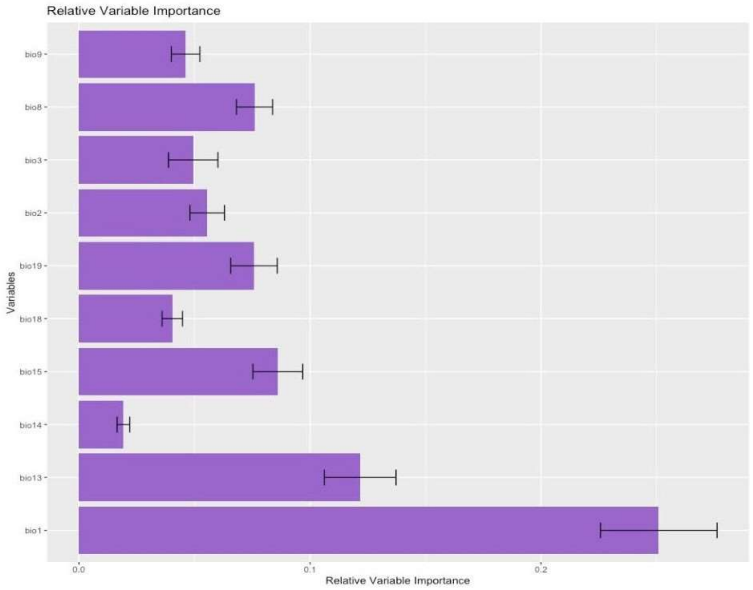


Fig 3. Relative contribution of each predictor used in the SDMs calibration: ***Lissemys punctata***

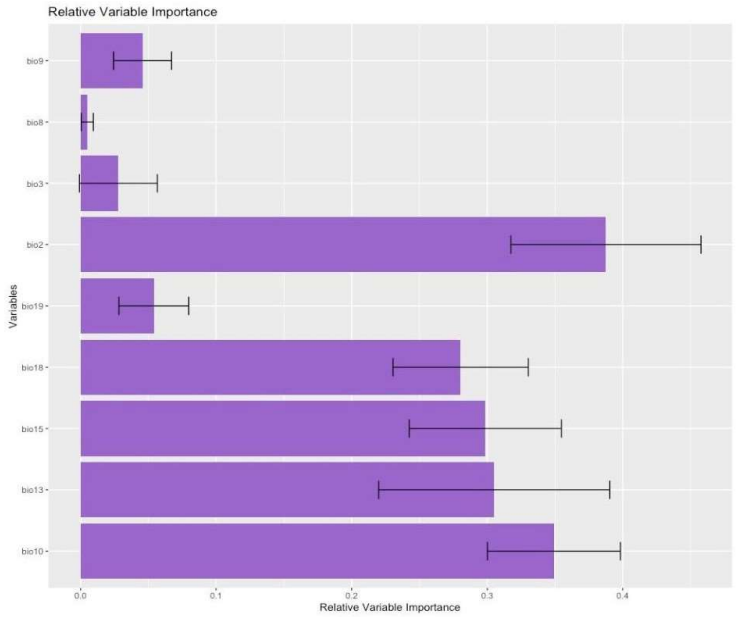


Fig 4. Relative contribution of each predictor used in the SDMs calibration: ***Nilssonia gangetica***

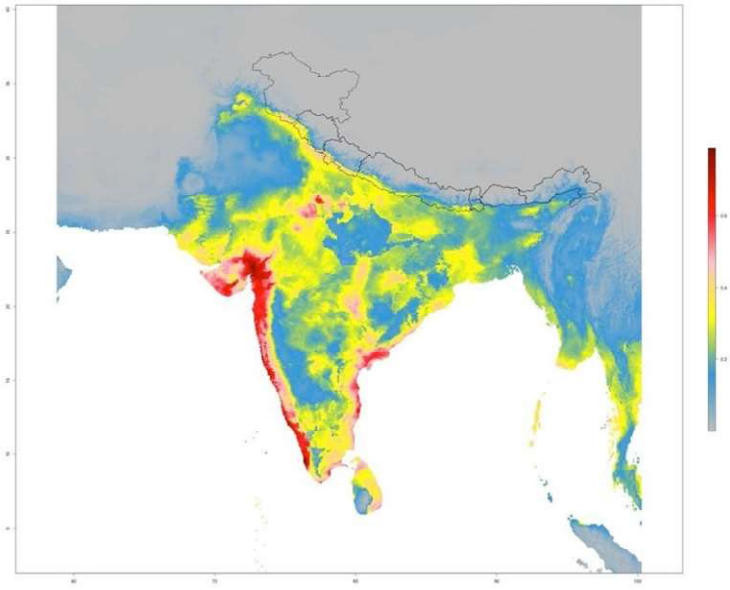


Fig 5. Present-day occurrence probability of *Lissemys punctata*

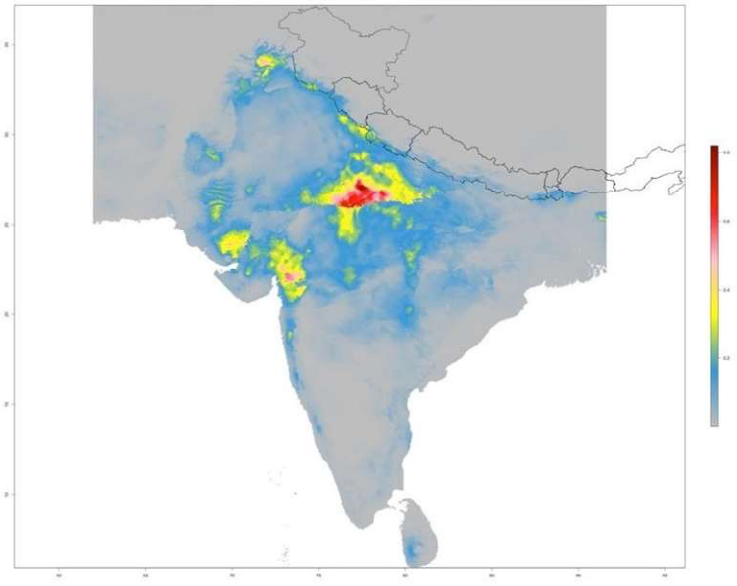


Fig 6. Present-day occurrence probability of *Nilssonia gangetica*

Discussion

In this study, we propose that potential species distribution model SDMs are effective statistical techniques for defining the geographic ranges of species. Ourmodels'highaverageAUCandTSSindicatethattheyhavegoodpredictive ability and can be used to examine the environmental suitability. Our study revealed that multiple parameters influenced the potential distribution of Lissemys punctata and Nilssonia gangetica.According to our findings, Annual Mean Temperature (Bio 1), Precipitation of Wettest Month (Bio 13), and Precipitation Seasonality were the most important variables for Lissemys punctatadistribution andfor NilssoniagangeticaWettestMonthPrecipitation (Bio 13), Mean Diurnal Range (Bio 2), Precipitation Seasonality (Bio 15), and Mean Temperature of the Warmest Quarter (Bio 10) are critical parameters thatdefineitspotentialdistribution.Whenweexaminedpotentialdistribution across the range for the Indian species Lissemys punctata and Nilssonia gangetica (Fig 6 & Fig 7). Our models revealed that in the case of Lissemys punctata, Gharana and its associated wetlands have less suitable climatic habitatthan potentialhabitatin Gujrat, Maharashtra, Goa, Karnataka, Kerala, and some parts of Andhra Pradesh and Orissa, and the same is evident for Nilssonia gangetica.

GharanaWetland,Jammu,J&K|.169

Annexure VIII

Jamwal *et al. BMC Zoology* (2017) 2:7
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BMC Zoology

RESEARCH ARTICLE Open Access

Survey of avifauna of the Gharana wetland reserve: implications for conservation in a semi-arid agricultural setting on the contested Indo-Pakistan border

Pushpinder S. Jamwal[1], Pankaj Chandan[1], Rohit Rattan[1], Anupam Anand[2], Prameek M. Kannan[3] and Michael H. Parsons[4,5*]

Abstract

Background: The Gharana wetland conservation reserve (GWCR) is a semi-arid wetland adjacent to agricultural areas on the contested Indo-Pakistani border. Despite being declared an Important Bird Area (IBA) by Birdlife International, the occurrence and distribution of birds has not been well-documented in this area. Our aims were to systematically document the composition, relative abundance and feeding guilds of all avian fauna in order to form a baseline to monitor changes from—and to underwrite—future conservation actions.

Results: From 24 surveys over 1 year, we recorded 151 species from 45 families and 15 orders. 41% of species were listed as 'rare' and only 22% were 'very common'. The largest number of families belonged to the order Passeriformes (40%), followed by Charadriiformes (14%) and Coraciiformes (11%). The most species (12%), were found in the family Anatidae (Anseriformes—widely recognized as bio-indicators), followed by Accipitridae (Falconiformes;12%) and Muscicapidae (Passeriformes; 6%). Carnivores and insectivores were the feeding guilds most frequently observed. Indeed, more than 50% of all species fed on the abundant fish, mollusks and insects and larvae. Bark-feeders and nectarivores were the least common.

Conclusions: Winter visitors were frequently found, while summer visitors were rare, reinforcing the importance of GWCR as a wintering site for high-altitude species. The conservation of this wetland is especially crucial for nine globally-threatened species. We have provided baseline documentation to help future monitoring efforts for this region, and a template to initiate the implementation of conservation plans for other remote IBAs.

Keywords: Biodiversity, Biological indicators, Feeding guilds, Relative abundance, Residential status, Wetland conservation

Background

Global avian diversity has been reviewed intermittently over the last 75 years [1–4], and is not complete, especially in Asia. This lack of documentation is especially prominent in India, which has one of the highest biodiversity indices in the world and includes 12% of the world's avifauna fauna. However, almost 25% of the bird species found in India (1224 species belonging to 78 families and 17 orders) are dependent on wetlands [5] at a time when wetland loss is considered the prime threat to waterfowl across the globe [6]. Eighty percent of the population decline in Asian flyways near wetlands are a result of human encroachment, increased agriculture and climate change, and militarization near contested borders [7, 8].

The Gharana wetland conservation reserve (GWCR) is recognized as an Important Bird Area (IBA) by Birdlife International [9]. IBAs ensue from a global network that identifies focal areas for conservation implementation [10]. Criteria for inclusion into an IBA are based on the abundance of avian species, the presence of globally-threatened or restricted-range species, and/or their

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vulnerability to climate change [9] GWCR is especially important because it consists of a semi-arid wetland on the international border between the Indian states and the four provinces of Pakistan, and provides a unique habitat not only for birds, but also for many meso-predators and small carnivores, herbivores, primates and reptiles. The primary threats to this wetland are human encroachment and its corollaries such as cattle grazing, bathing, stray dogs and military shelling across the Indo-Pakistan border.

In order to draft conservation plans for the remaining avifauna in accordance with the IBA designation, it is essential that a number of criteria are documented: including the presence and abundance of bird species across all seasons, and their feeding guilds which relate to food abundance, quality, and availability of perching, roosting and nesting sites. These factors are important, not only because they influence the abundance and diversity of birds, but may have indirect effects on other animal and plant taxa throughout the ecosystem. For instance, granivorous birds can reduce seed survival of plant/crop species [11, 12], while insectivores can decrease the abundance of herbivorous arthropods [13, 14]. Frugivorous birds influence seed dispersal [15, 16] and the survival and reproduction of herbaceous and woody plants. They influence these processes directly through seed predation, and indirectly, by reducing the abundance of herbivorous insects and seed dispersal [17].

The avifauna has been minimally documented in Gharana. Sharma and Saini [18] recorded 21 waterfowl species in the region, while Pandotra and Sahi [19] reported the presence of 57 species of waterfowl and terrestrial birds. No complete documentation has been available, however, and no study has reported feeding guilds for either the resident or visiting species. Thus, it is unclear what resources from the wetland are attracting migrants.

Objectives

Our objectives were to comprehensively document the species composition, relative abundance and feeding guilds of all avian fauna over 1 year in GWCR, inclusive of the surrounding agricultural fields.

Results

The maximum number of families (Table 1) belonged to the order Passeriformes, 18 (40% of total) followed by Charadriiformes, 6 (14%). Most identified species belonged to Anatidae 19 (12%), followed by Accipitridae 18 (12%) and Muscicapidae 9 (6%). After ranking avifauna into three categories based on their cumulative abundance (Fig. 1), we learned that 62 (41% of total) species were rare, 56 species (37% of total) were common, and 33 (22% of total) species were very common. Nine globally-threatened species were identified: Painted Stork *Mycteria leucocephala*, Wooly-necked Stork *Ciconia episcopus*, Black-necked Stork *Ephippiorhynchus asiaticus*, Black-headed (White) Ibis *Threskiomis melanocephalus*, Ferruginous Duck *Aythya nyroca*, Greater Spotted Eagle *Aquila clanga*, Egyptian Vulture *Neophron percnopterus*, Pallid Harrier *Circus macrourus* and Indian River Tern *Sterna aurantia*. Among 151 total species (Table 1), 74 (49%) were winter visitors, 54 (36%) were resident, 11 (7%) were vagrant and 12 (8%) were summer visitors (Fig. 1).

Birds of GWCR primarily utilized eight feeding guilds: herbivores, bark feeders, carnivores, frugivores, granivores, insectivores, nectarivores and omnivores. Among these families, 19 (13%) were herbivores, bark feeders 2 (1%), carnivores 46 (36%), frugivores 6 (4%), graminivores 7 (5%), insectivores 40 (26%), nectarivore 1 (1%) and omnivores 30 (20%).

Discussion

We have provided baseline data for an under-reported, but vulnerable, wetland near a contested border in remote Asia. We recorded 151 species including 62 waterfowl and 89 terrestrial species. This provides a substantial update to the 21 and 57 species already documented [18, 19]. Most of the high-altitude bird species are known to migrate towards lower altitude sites such as GWCR during winter [20], and this was also observed in our study. In particular, the high number of winter visitors likely suggests that Gharana and its adjoining agricultural fields provide appropriate habitat for thousands of winter migratory birds as well as important wintering and stopover site for several other migratory species.

The high prevalence of the Anatidae affirms notions that this region provides particularly suitable habitat and abundant food for ducks, geese and swans. The Accipitridae are ideal indicators of ecosystem health because they are near the top of local trophic levels. As top-order predators, the Accipitridae are key bio-indicators to understanding the dynamics of local ecosystems. In GWCR, their presence likely reflects the greater availability of small mammals, birds, reptiles, amphibians and insects. Indeed, over 70% of the total feeding guilds were carnivorous (36%), insectivorous (26%) or omnivorous (20%).

The regional diversity of birds commonly varies with factors such as climate of the area (temperature, humidity and rainfall), altitude, food availability [21]. While some of these factors were beyond the remit of our study, and will be updated in furture reports, we were able to note the presence of a large number of species of fish, mollusks, amphibians and aquatic insects and their larvae, that these birds fed upon. These resources are important to document as thoroghly as possible because

Table 1 Comprehensive list of bird species recorded utilizing Gharana wetland conservation reserve and associated agricultural fields

Species (no.)	Order	Family	Common name	Scientific name	Residental status	Abundance	Feeding	IUCN status
1	Podicipediformes	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	R	VC	C	LC
2	Pelecaniformes	Phalacrocoracidae	Great Cormorant	*Phalacrocorax carbo*	WV	VC	C	LC
3			Little Cormorant	*Phalacrocorax niger*	WV	VC	C	LC
4	Ciconiiformes	Ardidae	Yellow Bittern	*Ixobrychus sinensis*	WV	R	C	LC
5			Black-crowned Night Heron	*Nycticorax nycticorax*	WV	C	C	LC
6			Indian Pond Heron	*Ardeola grayii*	R	VC	C	LC
7			Cattle Egret	*Bubulcus ibis*	R	VC	C	LC
8			Little Egret	*Egretta garzetta*	R	VC	C	LC
9			Intermediate Egret	*Mesophoyx intermedia*	R	C	C	LC
10			Great Egret	*Casmerodius albus*	WV	C	C	LC
11			Purple Heron	*Ardea purpurea*	R	VC	C	LC
12			Grey Heron	*Ardea cinerea*	R	VC	C	LC
13		Ciconiidae	Painted Stork	*Mycteria leucocephala*	WV	R	C	NT
14			Black Stork	*Ciconia nigra*	WV	R	C	LC
15			Wooly-necked Stork	*Ciconia episcopus*	WV	R	C	VU
16			Black-necked Stork	*Ephippiorhynchus asiaticus*	WV	R	C	NT
17		Threskiornithidae	Black-headed (White) Ibis	*Threskiornis melanocephalus*	WV	R	C	NT
18			Red-naped Ibis	*Pseudibis papillosa*	WV	R	C	LC
19			Glossy ibis	*Plegadis falcinellus*	WV	R	C	LC
20			Eurasian Spoonbill	*Platalea leucorodia*	WV	R	C	LC
21	Anseriformes	Anatidae	Lesser Whistling Duck	*Dendrocygna javanica*	WV	VC	H	LC
22			Greylag Goose	*Anser anser*	WV	R	H	LC
23			Greater White-fronted Goose	*Anser albifrons*	WV	R	H	LC
24			Indian Cotton Teal	*Nettapus coromandelianus*	WV	VC	H	LC
25			Bar-headed Goose	*Anser indicus*	WV	C	H	LC
26			Ruddy Shelduck	*Tadorna ferruginea*	WV	R	H	LC
27			Comb Duck	*Sarkidiornis melanotos*	WV	R	H	LC
28			Eurasian Wigeon	*Anas penelope*	WV	C	H	LC
29			Gadwall	*Anas strepera*	WV	VC	H	LC
30			Eurasian Teal	*Anas crecca*	WV	VC	H	LC
31			Mallard	*Anas platyrhynchos*	WV	R	H	LC
32			Indian Spot-billed Duck	*Anas poecilorhyncha*	WV	R	H	LC
33			Northern Pintail	*Anas acuta*	WV	C	H	LC
34			Garganey	*Anas querquedula*	SV	R	H	LC
35			Northern Shoveler	*Anas clypeata*	WV	VC	H	LC
36			Red-crested Pochard	*Netta rufina*	WV	R	H	LC
37			Common Pochard	*Aythya ferina*	WV	C	H	LC
38			Ferruginous Duck	*Aythya nyroca*	WV	R	H	NT
39			Tufted Duck	*Aythya fuligula*	WV	R	H	LC
40	Falconiformes	Accipitridae	Black-shouldered Kite	*Elanus caeruleus*	R	C	C	LC
41			Black Kite	*Milvus migrans*	R	C	C	LC
42			Steppe Eagle	*Aquila nipalensis*	WV	C	C	LC
43			Greater Spotted Eagle	*Aquila clanga*	WV	R	C	VU

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Table 1 Comprehensive list of bird species recorded utilizing Gharana wetland conservation reserve and associated agricultural fields *(Continued)*

44			Eurasian Marsh-Harrier	*Circus aeruginosus*	WV	R	C	LC
45			Eurasian Sparrowhawk	*Accipiter nisus*	V	R	C	LC
46			Himalyan buzzard	*Buteo buteo*	WV	R	C	LC
47			Long-legged Buzzard	*Buteo rufinus*	WV	R	C	LC
48			Besra	*Accipiter virgatus*	WV	R	C	LC
49			Northern Goshawk	*Accipiter gentilis*	WV	R	C	LC
50			Booted Eagle	Hieraaetus pennatus	WV	R	C	LC
51			Egyptian Vulture	*Neophron percnopterus*	SV	C	C	NT
52			Shikra	*Accipiter badius*	R	C	C	LC
53			Hen Harrier	*Circus cyaneus*	WV	C	C	LC
54			Eurasian Marsh-Harrier	*Circus aeruginosus*	WV	VC	C	LC
55			Pallid Harrier	*Circus macrourus*	WV	R	C	NT
56			Short-toed snake Eagle	*Circaetus gallicus*	WV	C	C	LC
57		Falconidae	Eurasian Hobby	*Falco subbuteo*	WV	R	C	LC
58	Galliformes	Phasianidae	Gray Francolin	*Francolinus pondicerianus*	R	VC	O	LC
59	Gruiformes	Rallidae	Water Rail	*Rallus aquaticus*	WV	C	O	LC
60			White-breasted Waterhen	*Amaurornis phoenicurus*	R	VC	O	LC
61			Common Moorhen	*Gallinula chloropus*	R	VC	O	LC
62			Purple Swamphen	*Porphyrio porphyrio*	R	VC	O	LC
63			Common Coot	*Fulica atra*	WV	C	O	LC
64	Charadriiformes	Jacanidae	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	SV	C	O	LC
65		Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	R	VC	O	LC
66			Little Ringed Plover	*Charadrius dubius*	R	R	O	LC
67			White-tailed Plover	*Vanellus leucurus*	WV	R	O	LC
68		Scolopacidae	Greenshank	*Tringa nebularia*	WV	C	I	LC
69			Common Snipe	*Gallinago gallinago*	WV	R	I	LC
70			Common Redshank	*Tringa totanus*	V	R	I	LC
71			Common Sandpiper	*Actitis hypoleucos*	WV	C	I	LC
72			Green sandpiper	*Tringa ochropus*	WV	R	I	LC
73			Curlew Sandpiper	*Calidris ferruginea*	V	R	I	LC
74			Little Stint	*Calidris minuta*	V	R	I	LC
75			Ruff	*Philomachus pugnax*	WV	VC	I	LC
76		Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	WV	C	I	LC
77		Glareolidae	Oriental Pratincole	*Glareola maldivarum*	V	R	I	LC
78			Little Pratincole	*Glareola lactea*	R	C	I	LC
79		Laridae	Indian River Tern	*Sterna aurantia*	SV	C	C	NT
80			Common Tern	*Sterna hirundo*	V	R	C	LC
81			White-winged Black Tern	*Chlidonias leucopterus*	V	R	C	LC
82	Columbiformes	Columbidae	Eurasian Collared-Dove	*Streptopelia decaocto*	R	VC	O	LC
83			Spotted Dove	*Streptopelia chinensis*	WV	R	O	LC
84			Rock Pigeon	*Columba livia*	R	VC	O	LC
85	Psittaciformes	Psittacidae	Rose-ringed Parakeet	*Psittacula krameri*	R	C	F	LC
86			Plum-headed Parakeet	*Psittacula cyanocephala*	WV	R	F	LC
87	Cuculiformes	Cuculidae	Greater Coucal	*Centropus sinensis*	R	C	C	LC

Table 1 Comprehensive list of bird species recorded utilizing Gharana wetland conservation reserve and associated agricultural fields *(Continued)*

88			Asian Koel	*Eudynamys scolopaceus*	SV	C	O	LC
89			Pied Cuckoo	*Clamator jacobinus*	SV	R	O	LC
90			Eurasian Cuckoo	*Cuculus canorus*	SV	R	O	LC
91	Strigiformes	Strigidae	Spotted Owlet	*Athene brama*	R	C	C	LC
92	Coraciiformes	Alcedinidae	White throated Kingfisher	*Halcyon smyrnensis*	R	VC	C	LC
93			Common Kingfisher	*Alcedo atthis*	WV	C	C	LC
94			Crested Kingfisher	*Megaceryle lugubris*	R	VC	C	LC
95		Meropidae	Green Bee-eater	*Merops orientalis*	R	VC	I	LC
96			Blue-tailed Bee-eater	*Merops philippinus*	SV	C	I	LC
97		Coraciidae	Indian Roller	*Coracias benghalensis*	R	C	I	LC
98		Upupidae	Eurasian Hoopoe	*Upupa epops*	R	C	I	LC
99		Bucerotidae	Indian Grey Hornbill	*Ocyceros birostris*	R	R	F	LC
100	Piciformes	Picidae	Lesser goldenback	*Dinopium benghalense*	R	C	BF	LC
101			Yellow-crowned Woodpecker	*Dendrocopos mahrattensis*	R	R	BF	LC
102		Capitonidae	Coppersmith Barbet	*Megalaima haemacephala*	R	R	F	LC
103	Passeriformes	Alaudidae	Crested Lark	*Galerida cristata*	R	C	O	LC
104		Hirundinidae	Wire-tailed Swallow	*Hirundo smithii*	SV	C	I	LC
105			Barn Swallow	*Hirundo rustica*	WV	R	I	LC
106			Plain Martin	*Riparia paludicola*	R	R	I	LC
107		Motacillidae	Gray Wagtail	*Motacilla cinerea*	WV	C	I	LC
108			Paddyfield Pipit	*Anthus pratensis*	R	C	I	LC
109			Tree Pipit	*Anthus trivialis*	V	R	I	LC
110			Rosy Pipit	*Anthus roseatus*	WV	C	I	LC
111			White Wagtail	*Motacilla alba*	WV	C	I	LC
112			Citrine Wagtail	*Motacilla citreola*	WV	R	I	LC
113			White-browed Wagtail	*Motacilla madaraspatensis*	R	VC	I	LC
114		Campephagidae	Small Minivet	Pericrocotus cinnamomeus	R	R	I	LC
115		Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*	R	VC	F	LC
116		Laniidae	Bay-backed Shrike	*Lanius vittatus*	R	C	O	LC
117			Long-tailed Shrike	*Lanius schach*	SV	C	O	LC
118		Muscicapidae	Pied Bushchat	*Saxicola caprata*	R	C	G	LC
119			Variable Wheatear	*Oenanthe picata*	WV	R	G	LC
120			Isabelline Wheatear	*Oenanthe isabellina*	V	R	G	LC
121			Black Redstart	*Phoenicurus ochruros*	WV	R	I	LC
122			Oriental Magpie-Robin	*Copsychus saularis*	R	VC	I	LC
123			Gray Bushchat	*Saxicola ferreus*	WV	C	I	LC
124			Indian Robin	*Copsychus fulicatus*	R	VC	I	LC
125			Bluethroat	*Luscinia svecica*	R	R	I	LC
126			White-tailed Stonechat	*Saxicola leucurus*	V	R	G	LC
127		Paridae	Great Tit	*Parus major*	WV	C	F	LC
128		Nectariniidae	Purple Sunbird	*Nectarinia asiatica*	SV	C	N	LC
129		Zosteropidae	Oriental White-eye	*Zosterops palpebrosus*	R	C	I	LC
130		Estrildidae	Scaly breasted munia	*Lonchura punctulata*	WV	VC	G	LC
131		Passeridae	House Sparrow	*Passer domesticus*	R	VC	G	LC

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Table 1 Comprehensive list of bird species recorded utilizing Gharana wetland conservation reserve and associated agricultural fields *(Continued)*

132		Sind Sparrow	*Passer pyrrhonotus*	WV	R	G	LC
133	Ploceidae	Baya Weaver	*Ploceus philippinus*	WV	C	O	LC
134		Black-breasted weaver	*Ploceus benghalensis*	WV	R	O	LC
135	Sturnidae	Brahminy Starling	*Temenuchus pagodarum*	WV	R	O	LC
136		Common Starling	*Sturnus vulgaris*	WV	C	O	LC
137		Bank Myna	*Acridotheres ginginianus*	R	VC	O	LC
138		Asian Pied Starling	*Gracupica contra*	V	C	O	LC
139		Common Myna	*Acridotheres tristis*	R	C	O	LC
140	Oriolidae	Eurasian Golden Oriole	*Oriolus oriolu*	WV	R	O	LC
141	Dicruridae	Black Drongo	*Dicrurus macrocercus*	R	C	I	LC
142		Ashy Drongo	*Dicrurus leucophaeus*	SV	C	I	LC
143	Corvidae	House Crow	*Corvus splendens*	R	VC	O	LC
144		Rufous Treepie	*Dendrocitta vagabunda*	R	C	O	LC
145		Large-billed Crow	*Corvus macrorhynchos*	WV	R	O	LC
146	Cisticolidae	Ashy Prinia	*Prinia socialis*	R	C	I	LC
147		Striated Prinia	*Prinia crinigera*	R	C	I	LC
148		Common Tailorbird	*Orthotomus sutorius*	R	C	I	LC
149		Plain Prinia	*Prinia inornata*	R	C	I	LC
150		Common Chiffchaff	*Phylloscopus collybita*	WV	C	I	LC
151		Zitting Cisticola	*Cisticola juncidis*	R	R	I	LC

Residential status: *WV* winter visitors, *R* resident, *V* vagrant and *SV* summer visitors. Abundance: *C* common, *VC* very common, *R* rare. Feeding: *BF* bark feeder, *C* carnivorous, *F* frugivorous, *G* granivorous, *H* herbivorous, *I* insectivorous, *N* nectarivorous, *O* omnivorous. IUCN Status (as of the time of manuscript preperation): *LC* least concern, *NT* near threatened, *VU* = vulnerable

they serve as attractive food sources for resident and migrants. In particular, wader species were found to regularly visits the agricultural fields surrounding GWCR, likely owing to the shallow water and presence of high numbers of aquatic insects.

Importantly, we have documented nine globally threatened species (5% of the total species). These species epitomize the need for further monitoring and conservation actions related to GWCR and its associated agricultural fields. The exceptional arthropod diversity provides abundant food for these guilds, and included a substantial number of unknown arachnids whose description warrants detailed scientific studies. Hence, the Gharana wetland is not only an ideal

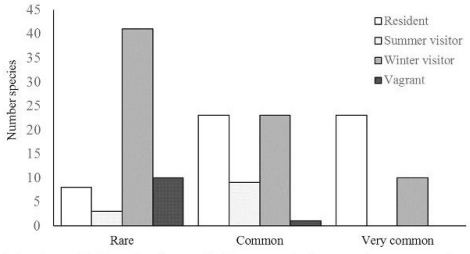

Fig. 1 Residential status and abundance of bird species observed in Gharana wetland conservation reserve and associated agricultural fields in Jammu and Kasmir, India from July 2012 to June 2013

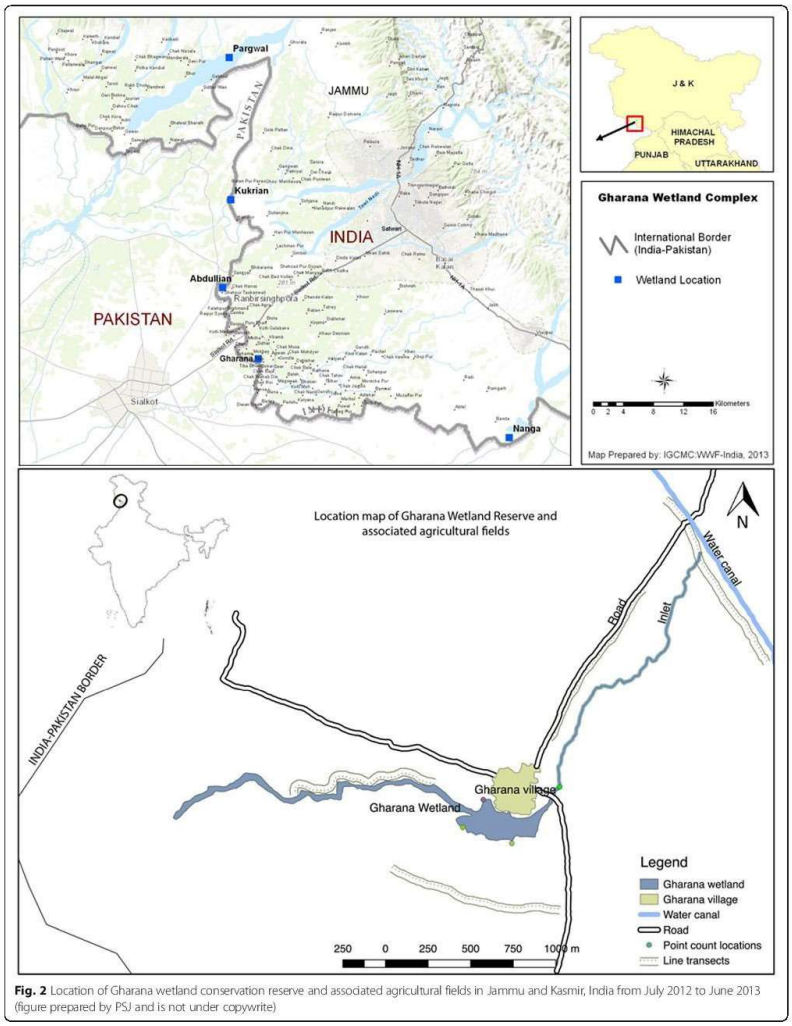

Fig. 2 Location of Gharana wetland conservation reserve and associated agricultural fields in Jammu and Kasmir, India from July 2012 to June 2013 (figure prepared by PSJ and is not under copywrite)

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place for the conservation of endemic and globally threatened birds, but also for a complex array of flora and fauna that attract such a broad range of bird species.

Conclusions

Winter visitors were frequently found in GWCR, while summer visitors were rare, reinforcing the importance of this region as a wintering site for high-altitude species. The conservation of this wetland is especially crucial for nine globally-threatened species. We have provided baseline documentation to help future monitoring efforts for this region, and a template to initiate the implementation of conservation plans for other remote IBAs.

Methods

Study site

Gharana 32°32'28" N; 74°41'27" E; 281 m asl (Fig. 2) is located on the international India-Pakistan border in the south-western part of Jammu province in the Indian state of Jammu and Kashmir. It is a naturally maintained, rain-fed swamp with a bottom surface of loamy clay with decaying vegetation. Surrounding plants include macrophytes such as *Eicchornia spp.* and *Hydrilla spp.* [22] and the Common reed (*Typha spp.*). Additional sources of water are spillover from a nearby canal (the Ranbir Canal) and surface runoff from agricultural areas [19].

This wetland and its adjacent agricultural fields are in the subtropical climatic zone where summer temperatures may reach 46 °C maximum and winter minima decrease to as low as 2 °C. Annual rainfall is around 1331 mm, with most precipitation occurring when the south-western monsoon winds arrive from July-September. The agricultural fields adjacent to Gharana village also provides both suitable habitat, and concomitant threats, for a diverse group of bird taxa. Owing to the wide diversity of avifauna, and also being a wintering ground for many threatened and migratory waterfowl, GWCR was also declared as Important Bird Area (IBA) by the Bombay Natural History Society and BirdLife International [23].

Data collection

We conducted twenty-four surveys from July 2012 to June 2013, covering all seasons; summer (April–June), monsoon (July–Sept), autumn (Oct–Novem) and winter (Dec–March). Our surveys (Fig. 2) followed well established methods including line transects and point count methods, as per [24]. Bird counts were direct visual sightings only. Counts were performed twice per month at all sites by a team of ten individuals in the early morning (07:00–10:00) during the time of highest bird activity [25] and lowest human disturbance. Experts with over 200 h of wetland bird identification and post-doctoral training were consulted throughout the period.

We classified all species as common/rare, resident/migratory status of the birds as per [26] For instance, VC = very common species encountered during 80% of all surveys); C = common species encountered frequently (50–70%) and R = rare species which are encountered less frequently (10–20%). Likewise, if we only documented a particular species between December and March, then we considered it as a winter visitor. Whereas, presence between April and June was documented as a summer visitation. If we documented a bird throughout a year in and around GWCR, then it was considered as a resident. Feeding guilds were identified from the literature, rather than what birds were seen feeding on at the time. Nikon Monarch 10 × 42 binoculars were used during surveys for taking observations and on-the-spot identification. We used photographs and/or video to validate any unidentified species. The checklist was prepared using the standardized common and scientific names assigned in [27]. All data collected were observational and did not involve any manipulation or alteration of any animals, plants or humans.

Limitations

The limitations of our study are due to the lack of hypotheses testing, and is purely descriptive. Post-hoc analyses may be performed using our data set which has been submitted to a public repository (details in the declarative statement).

Abbreviations

GWCR: Gharana wetland conservation reserve; IBA: Important Bird Area

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Availability of data and materials

The datasets generated during and/or analyzed during the current study has been made available in a public digital data repository available at https://doi.pangaea.de/10.1594/PANGAEA.874857.

Authors' contributions

PSJ, PC, RR and AA designed the study and collected all data. PSJ and MHP analyzed and presented the data and drafted the manuscript. PMK assisted the analysis and all drafts of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate
These data are observational only and do not require ethics approval or consent to participate.

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Annexure IX

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Ecological Processes

RESEARCH Open Access

Assessing the bird guild patterns in heterogeneous land use types around Jammu, Jammu and Kashmir, India

Asha Sohil and Neeraj Sharma*

Abstract

Land-use sprawl in the Himalayas has caused the conversion of natural habitat into human-modified habitats, thus degrading ecosystem health. Adaptation of birds to changing physical environment can be well understood by analyzing their habitat preferences, and foraging dynamics explored to a limited extent in the Himalayan region, as yet. To achieve a comprehensive understanding of avian guild structure, we used multivariate statistical techniques to classify bird species according to their similarities in foraging patterns and habitat preferences. Observations based on habitat and diet affinities accounted for rich avian diversity with a total of 208 bird species (about 15% of country's avifauna) recorded from six different sites during 1 year survey. Unweighted pair-group average cluster analysis performed on the families revealed ten feeding and fifteen habitat guilds among 63 bird families observed. Subtropical forests harbored more species followed by urban forests and agricultural landscapes. Insectivorous and omnivorous outnumbered other feeding guilds in the study area. Bird assemblages were richer in protected areas and semi-disturbed landscapes and did not show significant variation between the seasons. Results of the study revealed that different functional groups of birds behaved differently, primarily induced by choice of food. The site heterogeneity favored avifaunal persistence by providing favorable foraging, roosting, and nesting opportunities to birds. Composition of avian guilds indicated level of intactness and ecological integrity of ecosystems studied. This outcome thus sets the background for long-term analysis of bird-habitat relationship and their foraging dynamics. The study has the relevance for decision-makers to integrate avian guild structure as an essential ingredient in formulating conservation strategies.

Keywords: Avian guild, Food resource utilization, Habitat preference, Heterogeneous landscape, Eutrophic wetland, Protected area

Introduction

Identification and analysis of ecological guilds have been fundamental to understand processes that determine the structure and organization of communities (González-Salazar et al. 2014; Kornan and Kropil 2014), and each species fulfills the ecological role according to its use of resources within a community (Ricklefs 2010). The best measure to understand bird community structure is to classify them into feeding guilds and habitat guilds (Thiollay 1995; Clough et al. 2009). Guilds are regulated by the food supply, vegetative cover, predators, and various other ecological factors reflecting temporal variations and diversity gradients (O'Connell 2000; Kissling et al. 2012; Katuwal et al. 2016). Application and utilization of guilds have been widely discussed in animal ecology (Blaum et al. 2011) and extensively studied in birds, among the other taxonomic groups (Sabo and Holmes 1983; Recher et al. 1985; Chettri et al. 2005; Perez-Crespo et al. 2013; González-Salazar et al. 2014; Koli 2014; Mukhopadhyay and Mazumdar 2019). Birds are potential predictors of the integrity and function of habitats (Mukhopadhyay and Mazumdar 2019), ecosystem health, and stress (MacArthur and MacArthur 1961; Taper et al. 1995), richness and

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conservation significance (Pearman 2002; Bensizerara et al. 2013). Bird species composition and guild structure vary spatially (Holmes et al. 1979; Holmes and Recher 1986) as they prefer to live in heterogeneous landscapes to best suit their nesting, perching, roosting, and foraging (Berg 2002; Aggarwal et al. 2008; Veech et al. 2011). The food availability and pattern of food exploitation (Rosenberg 1990; Albrecht and Gotelli 2001; Palmer et al. 2003) in a particular habitat determine bird distributions (Evans and Dugan 1984) and community structure (Gotelli and Colwell 2011; Bonilla et al. 2012). Knowledge of resource utilization (MacNally 1983; Winemiller and Pianka 1990; Bell 2001; Kattan and Franco 2004; López de Casenave et al. 2008) and assessment of foraging guilds and habitat preferences of avian species are vital to analyzing their responses to changing habitats and their conservation policies (Lawton et al. 1998; Sekercioglu 2006). Moreover, the association of birds with their habitats helps to decipher the influence of biotic interactions on bird species distributions (Jankowski et al. 2013).

Studies indicate that bird-habitat selection and its use is mainly governed by landscape structure (Fairbanks 2004; Titeux et al. 2004; Oja et al. 2005; Borges et al. 2017; Mahiga et al. 2019), food competition and availability (Petit and Petit 1996; Chatterjee and Basu 2017), variable climate and human activities (Davis et al. 2000). As different bird guilds respond differently to such changes (Barragan et al. 2011; Phalan et al. 2011; Newbold et al. 2014a), an understanding of such responses is essential to depict their resilience to the changing land use patterns (Chatterjee and Basu 2017). Man-altered environment influences bird communities in positive or negative ways depending on the biology of each functional group (Clough et al. 2009). A major threat to the persistence of birds is human-induced habitat loss and fragmentation driven by urbanization (Isaksson 2018). While several other species fail to persist in fragmented urban landscapes, the birds, because of their mobility and plasticity, have been successful at exploiting the urban habitats (Pennington and Blair 2012). Urban terrestrial bird communities colonize heterogeneous patches of crop fields, woodlands, wetlands, grasslands, and farms with suitable resources for their survival needs (Veech et al. 2011; Berg 2002). Aquatic bird communities with specialized habitat and foraging requirements (Andradea et al. 2018) are structurally more complex in interactions (Albrecht and Gotelli 2001; Palmer et al. 2003) and resource partitioning (López de Casenave et al. 2008). The forest specialists rely on the vegetation type and structure (Gabbe et al. 2002; Earnst and Holmes 2012) as a substrate for food and shelter (Lee and Rotenberry 2005). Generalists are particularly favored during the process of recolonization (Newbold et al. 2014b), while the specialists, being sensitive, become more prone to extinction in forest fragments (Henle et al. 2004).

The Northwestern Himalaya in the Indian Himalayan Region known for distinct physiography, climatic variability, and rich biodiversity (Kumar 2018) constitutes one of the significant ecological amplitudes in the world (Korner 2000; Myers et al. 2000). Erstwhile state of Jammu and Kashmir, home to 555 bird species (Suhail et al. 2020) forms a critical Endemic Bird Area (EBA 128) with 11 restricted-range species (Stattersfield et al. 1998). Status and number of bird species, birding hotspots, and their conservation ranking are currently under revision for the newly carved Union Territory of Jammu and Kashmir (India Code 2020), comprising the current study area. While the valley of Kashmir is home to many residents and migratory birds (Rahmani et al. 2016), the Jammu region holds a rich avifaunal diversity as well (Sharma et al. 2018; Sohil and Sharma 2019; Sohil and Sharma 2020). Though birds have primarily been surveyed for richness, diversity, and distribution (Pandotra and Sahi 2014; Sohil and Sharma 2019; Sohil and Sharma 2020), information on their guild structure and functions is scanty for the region. Intensive surveys were undertaken to enable understanding of habitat preferences and foraging dynamics of birds in mosaic landscapes around Jammu. This study focused on a central question: what are the foraging habits and habitat use of bird assemblages in different sites around Jammu, Jammu and Kashmir? For this study, we hypothesized that (a) bird assemblages vary in terms of their habitat and foraging preferences among different sites in a subtropical region, and (b) habitat choices of birds corresponded to their food preferences.

Materials and methods

Study area

The study was conducted in six different sites with varied physiography in urban-suburban-farmland landscapes around Jammu city (32° 34′ 29″ N to 32° 45′ 08″ N and 74° 40′ 06″ E to 74° 53′ 29″ E, elevation 260–470 m above msl) (Table 1, Fig. 1). Study sites included two aquatic (a) a distributary of river Tawi (Nikki Tawi, NT), and (b) a small eutrophic wetland (Gharana Wetland Conservation Reserve, GWCR) and four terrestrial habitats (c) a protected area (Ramnagar Wildlife Sanctuary, RWLS), (d) reserve forest (Bahu-Mahamaya Forest, BMF), (e) University of Jammu Campus (JU), and (f) suburban landscape comprised of agriculture and fallow land (Southern Open Plains, SOP) (Table 1). Study area is characterized by a typical subtropical climate with four distinct seasons, spring (February–March), summer (April–June), monsoon (July–September), and winter (November–January). The maximum summer temperature ranges between 36 and 42 °C and average

Table 1 Characteristic features of sampling sites with details on geo-features, sampling size, and the level of disturbances

Study Site	Location (acronym)	Lat/long	Grid size (km^2)	Elevation (m above msl)	Site description	Level of disturbance	Transects/PCS no./rad./length	Hours spent/ fortnight
1	Nikki Tawi (NT)	32° 43′ 14″ N 74° 50′ 17″ E	4	290–300	A natural distributary of river Tawi bifurcated close to fourth Tawi bridge southwards of Jammu City with high municipal waste load (Sohil and Sharma 2020)	High	PCS-05 (25 m R*5)	6.5
2	Gharana Wetland Conservation Reserve (GWCR)	32° 34′ 29″ N 74° 40′ 06″ E	1	262	A small eutrophic wetland (185 acres), a designated Important Bird Area (IBA) is home to a number of trans-boundary winter visitors	Moderate	PCS-04 (25 m R *4)	7.0
3	University of Jammu campus (JU)	32° 43′ 08″ N 74° 51′ 58″ E	2	320–335	Sprawled in 118 acres, the campus provides a rich array of bird refuges in the form of lawns, plantations, and hedges with well-maintained botanical and cactus gardens	Moderate	LT-05 (100 m*5)	7.5
4	Ramnagar Wildlife Sanctuary (RWLS)	32° 45′ 08″ N 74° 52′ 15″ E	5	360–450	A well-managed protected area (31 km^2) with intact deciduous forests offers a rich habitat to number of forest specialists	Low	LT-03 (100 m*2 and 300 m*1)	8.0
5	Bahu-Mahamaya forest (BMF)	32° 43′ 43″ N 74° 53′ 29″ E	4	350–470	A typical subtropical mixed patch of deciduous forest (and exotic plantations), along the left bank of river Tawi is a favored bird's destination	Low	LT-03 (500 m*1 and 250 m*2)	7.0
6	Southern open plains (SOP)	32° 45′ 32″ N 74° 48′ 26″ E	4	260–270	A mixed landscape interspersed with agriculture fields, fallow lands, water bodies, and habitations. An ideal habitat for the generalists, aquatic dependent birds and raptors	Moderate	LT-03 (200 m*3)	8.0

PCS point count station (25 m radius), *LT* line transect

annual precipitation of ~ 1000 mm mostly received during monsoon season.

Study design and birds surveys

Systematic surveys were conducted in 23 sampling units considered as permanent line transects and point count stations for all six sites (Table 1). For this study, 14 linear transects of varying lengths and 9 point count stations were established based on type of habitat, terrain, and access to the site (Table 1). Point count census was performed in a 25-m radius sampling plot (Bibby et al. 2000; Sutherland 2006). All transects were walked/sampled during early morning (30 min after dawn to 10:30 am) and in the late afternoon (from 4:00 pm to 30 min before dusk), twice a month from January 2017 to December 2017, following Bibby et al. (1992) and Karanth et al. (2016). We sampled 552 points in a sampling effort of 1050 h (Table 1). Line transects and point count stations were spaced at least 200 m apart to ensure the interdependence between sampling points. Data were collected during summer (April–June), monsoon (July–August), post-monsoon (September–October), and winter (November–January). No observations were made during inclement weather conditions. Birds were recorded for their species, number, food preferences and type of habitat use in the field by using binoculars and spotting scopes. The images were captured using telephoto mounted digital cameras. Bird identities were established by consulting the field guides (Ali 2002; Grimmett et al. 2011) besides using call and song notes (Grimmett et al. 2013; xeno-canto 2020).

Guild classification

Based on their food preferences, bird species were categorized into mutually exclusive feeding guilds following Gray et al. (2006). These included insectivorous (species feeding on insects, earthworms, small crustaceans, arthropods, etc.), carnivorous (feeding on large animals, their dead bodies/carcasses, etc.), omnivorous (feeding both on animals and plants), granivorous (eating seeds and grains), nectarivorous (feeding on nectar), and frugivorous (fruit-eating species). Species were observed exclusively for the type of food consumed as their principal diet. Secondary online source HBW Alive (2020) was referred to ascertain their food priorities. Likewise, birds were classified into 13 principal habitat guilds corresponding to their habitat preferences limited to perching, feeding, nesting, and mating for this study. These included subtropical scrub forests, subtropical broadleaved forests, subtropical pine forests, urban forests, riverbed, fallow land, garbage dumps, aerial, carcass dump, agricultural fields, aquatic, urban buildings, and littoral zone of wetland. Notably, the foraging information and habitat preferences were used to produce the guild classification for birds.

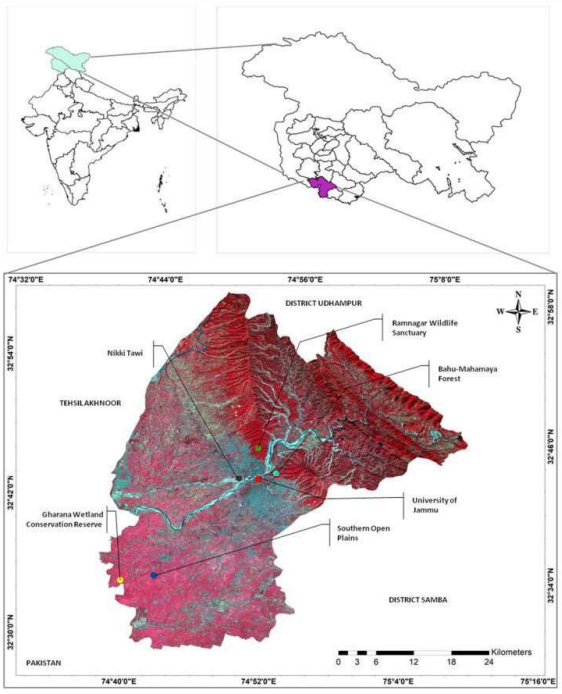

Fig. 1 Map of the study area showing sampling sites

Data analysis

Species richness was considered the pooled number of bird species occupying a particular guild. All birds observed, including the migrants, were considered for analysis as our observations were species oriented and not density driven. Feeding observations and habitat affinities noted for each bird species were consolidated family wise and then integrated into the respective guilds. We classified the bird guilds using the multivariate statistical techniques based on the shared resources (González-Salazar et al. 2014). Agglomerative hierarchical cluster (AHC) analysis was performed following Mukhopadhya and Mazumdar (2019) based on similarity matrix obtained using Jaccard's similarity coefficient (Krebs 1989; Manly 1994) and dendrograms were constructed using unweighted pair-group average (Hammer et al. 2001) to understand the extent of similarity.

Variations in species richness among seasons were compared using one-way ANOVA followed by Tukey's multiple comparison tests. The non-normal data (Shapiro-Wilk normality test $W = 0.92$, df = 60, $p < 0.05$) was transformed to logarithmic scale ($\log_{10}$) before analysis. An equivalent non-parametric Kruskal-Wallis test and Mann-Whitney U test were applied for comparison of species richness ($W = 0.94$, df = 72, $p = 0.03$) among the study sites. Statistical analyses were performed using SPSS-25 and PAST-4.0 (Hammer et al. 2001) software packages and significance was tested at $p = 0.05$.

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Results

Species richness among study sites

Study area comprised of 208 bird species contained in 63 families and 16 orders, of which Ramnagar Wildlife Sanctuary harbored 113 bird species followed by Southern Open Plains (SOP, 109 species), Bahu-Mahamaya forest (BMF, 107 species), Gharana Wetland Conservation Reserve (GWCR, 106 species), University of Jammu Campus (JU, 98 species), and Nikki Tawi (NT, 65 species). Of all, 106 species (51%) belonged to order Passeriformes. The mean monthly species richness among study sites was accounted high for Gharana Wetland Conservation Reserve (Fig. 2).

Kruskal-Wallis test revealed that bird species richness among distinct study sites were significantly different (H = 16.28, df = 5, p = 0.006). Multiple pairwise comparisons (Mann–Whitney U test) showed significant variations ($p < 0.05$) for NT-JU, NT-SOP, NT-BMF, RWLS-SOP, and BMF-SOP (Fig. 2). Family Muscicapidae with 17 species dominated all study sites followed by Accipitridae (12 species). Aquatic families, Anatidae and Scolopacidae (10 species each) were recorded exclusively from Gharana Wetland Conservation Reserve and Nikki Tawi. Mean species richness for different seasons was recorded high for summers and least for the monsoon. Results of one way ANOVA (F = 1.39, df = 3, p = 0.253) indicated that bird species richness did not show any significant variation among the seasons (Fig. 3).

Observation-based guild structure

Birds observed during the study were placed in six diet categories. Insectivores contributed the maximum (90 species, 43.2%) followed by omnivores (55 species, 26.4%), carnivores (45 species, 21.6%), and granivores (10 species, 4.8%). Frugivores (6 species, 2.8%) and nectarivores (2 species, 0.9%) contributed the least. When compared site-wise, insectivores dominated the study area while carnivores were confined to aquatic ecosystems only. Omnivores, frugivores, granivores, and nectarivores occupied the terrestrial habitats (Fig. 4).

Based on the habitat preferences, birds were placed in 13 different habitat types classified as guilds. Among these, subtropical scrub (SS) recorded the highest number of species (115 species, 55.29%) followed by urban forests (UF, 113 species, 54.33%), subtropical broad-leaved forests (BF, 104 species, 50%), agricultural fields (AF, 63 species, 30.29%), aquatic (AQ, 54 species, 25.96%), riverbed (RB, 47 species, 22.60%), subtropical pine forests (PF, 42 species, 20.19%), wetland littoral zone (LZ, 28 species, 13.46%), fallow land (FL, 15 species, 7.21%), aerial (AE, 13 species, 6.25%), garbage dump (GD, 6 species, 2.88%), and carcass dumps (CD, 5 species, 2.40%). Raptors, mostly scavengers, occupied the last two guilds. A hierarchical cluster dendrogram of habitat guilds resulted in three clusters, one comprising forest ecosystems (SS, UF, and BF) occupied mostly by the forest specialists. Second group included mixed habitats (LZ, FL, AE, GD, CD, and UB) shared by generalists and raptors while the third group (AF, AQ, RB, and PF) supported a wide variety, including the aquatic and water-dependent birds (Fig. 5).

UPGA cluster analysis of guild habit

Family wise food preferences were derived by applying the UPGA cluster analysis (Jaksic and Medel 1990; Marti et al. 1993) based on Jaccard's similarity coefficient ≥ 0.54 (Fig. 6). Ten feeding guilds were recognized among 63 families and 208 species indicated in roman numerals as I-nectarivorous (N), II-granivorous (G), IV-insectivorous (I), V-carnivorous (C), Group VII-omnivorous (O), and IX-frugivorous (F). Group III, VI, VIII, and X shared more than one food resources thus categorized as insectivorous-granivorous (I/G),

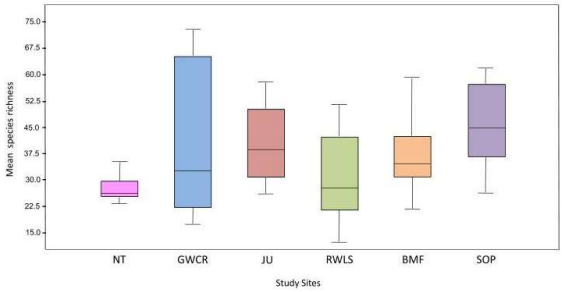

Fig. 2 Observed bird species richness across study sites during the study period

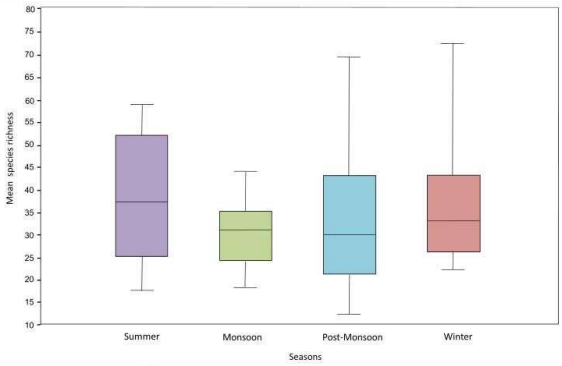

Fig. 3 Observed bird species richness across different seasons during the study period

insectivorous-carnivorous (I/C), omnivorous-carnivorous (O/C), and frugivorous-omnivorous (F/O), respectively. Each food type varied among different feeding guilds but was similar among species belonging to the same guild. Insectivores belonging to 23 avian families constituted the dominant feeding guild in the study area, followed by omnivores (16 families). Bird familial affinities in different trophic guilds are represented in Fig. 6.

Guild response of birds to the type of habitat they belong was obtained using PCA (principal component analysis). Bottom axis of PCA accounts for the dominance of carnivores in aquatic and agriculture dominated landscapes, while the top right axis portrays prevalence of omnivores and insectivores in the terrestrial ecosystems. The granivores, frugivores, and nectarivores were least represented. PCA axes I and II accounted for 92% and 6% of the total variance, respectively (Fig. 7).

We obtained 15 habitat guilds based on the UPGA cluster analysis performed for habitat use with a mean distance of similarity (*J*) $\bar{x}$=0.63 (Fig. 8). Of these, guilds VIII and IX being used by 24 and 9 families were observed to be most occupied. Families Columbidae,

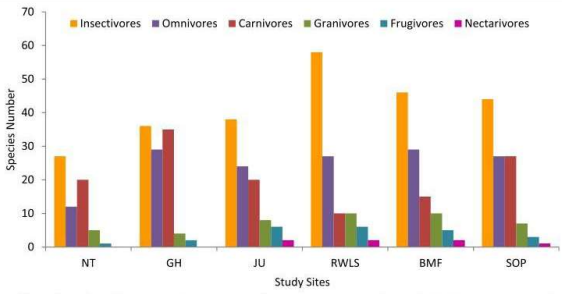

Fig. 4 Bird trophic guilds in the order of dominance. Insectivores and carnivores in aquatic (NT and GWCR); insectivores and omnivores in terrestrial (JU, RWLS, and BMF) and insectivores followed by an equal proportion of omnivores and carnivores in Southern Open Plains (SOP), the mixed ecosystem

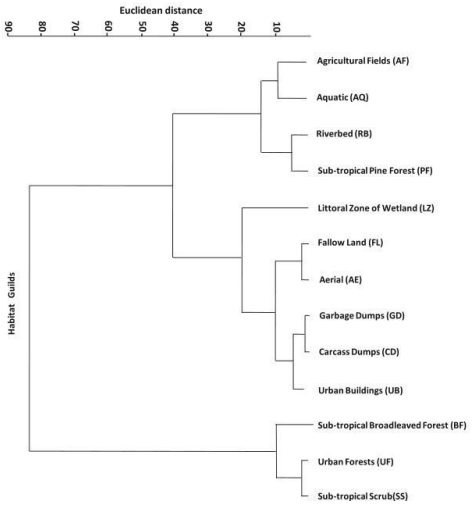

Fig. 5 Habitat guild affinities of birds in the study area

Passeridae, Hirundinidae, Corvidae, Sturnidae, Motacillidae, Muscicapidae, and Accipitridae shared diverse habitat range among others. Waterbird families, Anatidae, Ciconiidae, Gruidae, Jacanidae, Phalacocoracidae, Podicipidae, Laridae, Recurvirostridae, Scolopacidae, Rallidae, Rostratulidae, and Threskiornithidae, mostly confined around the water bodies. Members of Coracidae and Ploceidae restricted to agricultural fields and fallows. These included birds like sunbirds, swallows, martins, prinias, terns, shank, stints, sandpipers, coots, raptors, babblers, egrets, herons in guilds I, II, IV, V, VI, VII, and IX. The aquatic, semi-aquatic, farmland, and forest birds were habitat-specific (guild I, II, III, IV, X, and XV). These included shanks, stints, ducks, geese, cranes, water hens, terns, larks, cormorants, ibises, wagtails, flycatchers, thrushes, babblers, starlings, warblers, redstarts, and buntings. Generalists shared more than one guild (V, VI, VII, VIII, IX, XI, XII, XIII, and XIV). These included the species like *Dicrurus macrocercus*, *Milvus migrans*, *Acridotheres tristis*, *Streptopelia decaocto*, *Merops orientalis*, *Pycnonotus leucogenis*, *Corvus splendens*, *Passer domesticus*, *Oenanthe fusca*, *Saxicola caprata*, *Pycnonotus cafer*, *Columba livia*, *Psittacula krameri*, and *Streptopelia chinensis*.

Discussion

Results revealed that bird assemblages are regulated by the types of habitats rather than seasons. Different functional groups behaved differently in terms of preference, mainly mediated by choice of food. Protected areas shared more guilds than disturbed landscapes. In this study, a total of 15,918 individuals of 208 bird species to 63 families were recorded from diverse habitat types around Jammu. This high species richness may be attributed to the structural complexity, and diverse habitat types as heterogeneous areas are more likely to provide shelter and refuges to birds and promote avifaunal persistence (Seto et al. 2004; Kallimanis et al. 2010; Fjeldsa et al. 2012). Species-rich Ramnagar Wildlife Sanctuary comprises a wide variety of plant assemblages and a mosaic of vegetation types that offer foraging and nesting opportunities to birds (Sohil and Sharma 2020). It corroborates a general observation that vegetation type plays a crucial role in structuring bird communities

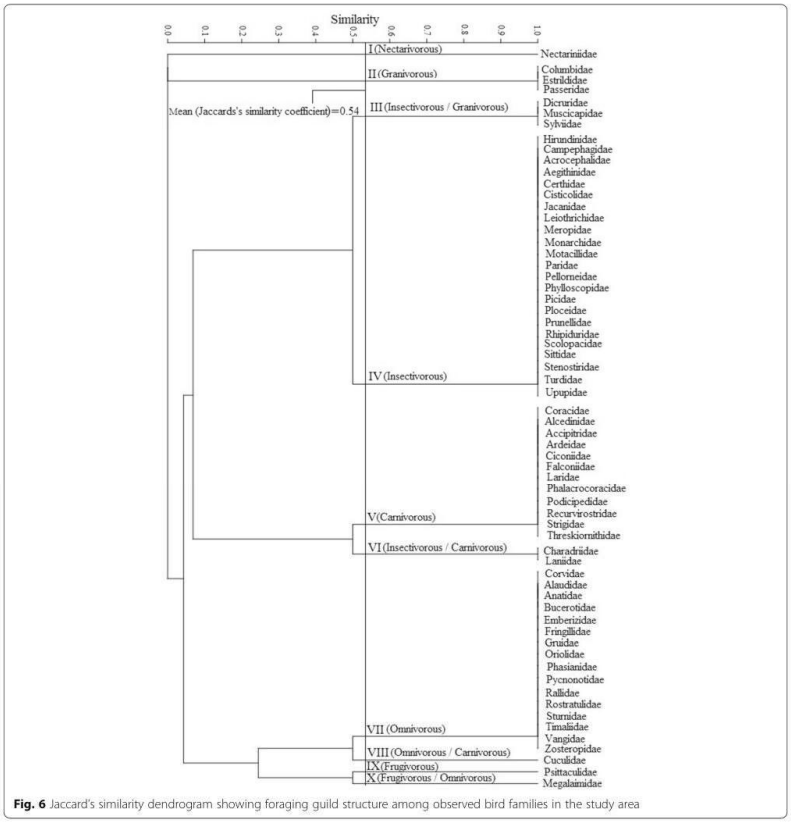

Fig. 6 Jaccard's similarity dendrogram showing foraging guild structure among observed bird families in the study area

(Earnst and Holmes 2012; Draycott et al. 2008; Tanalgo et al. 2015) and maintaining their species richness (Jokimaki and Jokimaki 2012). Mosaic landscapes (Southern Open Plains) and Gharana Wetland Conservation Reserve were reasonably rich in species while Nikki Tawi shared the least. As observed by Melles et al. (2003), Husté et al. (2006), and Shwartz et al. (2008), urban-wetland interfaces are the ideal hotspots for avian communities. The aquatic habitats have been found to support more species as resident, wetland-dependent migratory, and wetland-associated avifauna (Mazumdar et al. 2007, 2008; Mukhopadhyay and Mazumdar 2019) while forested and agriculture landscapes accommodated terrestrial birds mainly the forest specialists and birds of prey. Availability of primary requirements such as food, shelter, resting, roosting, and nesting sites that primarily influence the bird populations (Vaclav et al. 2003; Rompre et al. 2007; Zhou et al. 2007) is not equally available in all the study sites throughout different seasons (Chauhan et al. 2008; Kumar et al. 2010). Low species richness noticed during monsoon is attributed to their dispersal in search of nesting sites (Urfi 1996, 1997; Mazumdar 2019).

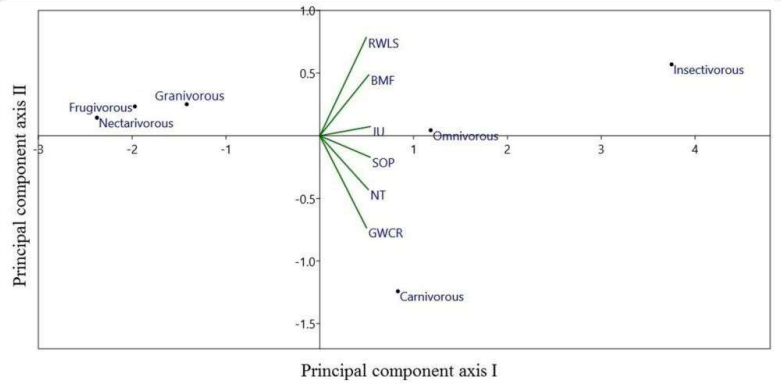

Fig. 7 Representation of bird feeding guilds corresponding to habitat types along two principal component axis among the study sites

It is well known that environmental drivers of richness vary across feeding guilds (Ding et al. 2019). Insectivores emerged as dominant feeding guild in most of the study sites followed by either omnivores or carnivores, a trend observed in several other studies from subtropical habitats (Chatterjee et al. 2013; Kottawa-Arachchi et al. 2015; Mukhopadhyay and Mazumdar 2019). Insectivores constitute most species-rich feeding guild as observed by Styringa et al. (2011), Bonilla et al. (2012), Koli (2014), Kumbar and Ghadage (2014), Ding et al. (2015), and Ding et al. (2019). These are found abundantly in insect-rich landscapes which include streamside areas, forests, and informal settlements (Gatesire et al. 2014). Increased plant productivity reflects the abundance of insects and so the abundance of insectivores (Pettorelli et al. 2011). Increase in shrub canopy in urban areas creates a suitable environment for food and shelter and enhances richness in insectivore guild (Imai and Nakashizuka 2010; Pinotti et al. 2012; Perera et al. 2017; Ferger et al. 2014). Forested landscapes and plantations around Ramnagar Wildlife Sanctuary, Bahu-Mahamaya forest, and the University of Jammu Campus offered moist conditions, high tree density, and dense foliage that harbored abundant insect fauna. Prevalence of insectivores and carnivores in aquatic habitats is attributed to an adequate food base available in nutrient-rich water of Nikki Tawi and Gharana Wetland Conservation Reserve. Santiago-Alarcon (2011), Kumar and Gupta (2013), and Whittington et al. (2013) recorded similar observations in urban aquatic ecosystems. Wetland attracts waterfowl, waders, birds of prey, and several other wetland-dependent birds year-round due to abundant food availability such as insects, crabs, shrimps, molluscs, and indigenous fish (Mukhopadhyay and Mazumdar 2019; Sohil and Sharma 2020). The vast expanse of agricultural fields dotted with villages and water bodies in southern open plains attract many species of raptors. Farmlands and water reservoirs provide enhanced food supply to raptors in the form of diverse fauna including water snakes (Tingay et al. 2010), water birds (Mukherjee and Wilske 2006), and dead fish (Sánchez-Zapata et al. 2016). The omnivore guild appeared the dominant foraging guild for terrestrial birds next to insectivores as observed by Sultana (2013), Katuwal et al. (2016), and Mukhopadhyay and Mazumdar (2019) as well. Omnivores with a tendency to exploit a wide array of natural and novel food resources (Mukhopadhyay and Mazumdar 2019) have expanded their ranges with increased abundance in urban habitats (Jokimäki and Suhonen 1993; Clergeau et al. 1998; Sorace 2002). Granivores and omnivores have higher colonization rates in agricultural degraded landscapes (Frishkoff et al. 2014) and open habitats with larger seed banks (Díaz and Telleria 1996; Chettri et al. 2005). As frugivores are regulated by fruit-bearing plants (Trager and Mistry 2003; Kissling et al. 2007; Pinotti et al. 2012; Chatterjee and Basu 2015) and habitat intactness, their low numbers may be linked to less fruit plant diversity and high level of habitat fragmentation (Gomes et al. 2008). Nectarivores were related to open habitats with the prevalence of flowering plants (Laiolo 2003) strongly regulated by the blooming season (Abrahamczyk and Kessler 2010). Habitat

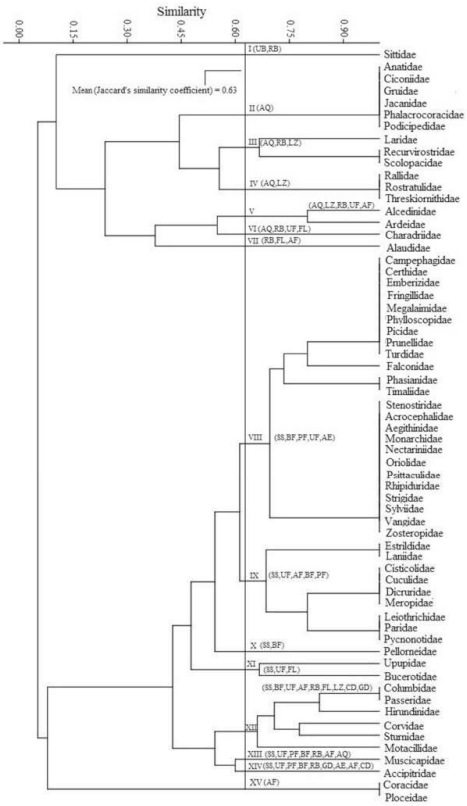

Fig. 8 Jaccard's similarity dendrogram showing habitat guild structure among observed bird families in the study area. Roman numerals refer to guilds and mnemonics in brackets represent the habitat type (see Fig. 5)

interfaces mainly harbored the carnivores comprised of raptors and a few generalists. It may be due to an increased amount of microhabitats, visibility, and prey base (Kottawa-Arachchi et al. 2012; Wijesundara and Wijesundara 2014). It can be concluded that feeding guilds with more ecological tolerance and broader resource utilization respond positively to habitat heterogeneity, whereas the specialized guilds prefer specific habitats (Bonilla et al. 2012).

Thirteen major bird habitat guilds were identified during the surveys. Most of the bird species occupied protected areas, rich in forest cover, close to urban settlements. It is established that like many other animals, birds also require a variety of habitats to live, feed, and breed (Nagy et al. 2017; Ndanganga et al. 2013; Dahal et al. 2014; Morante-Filho et al. 2015, Sharma et al. 2018). Forest type, its size, structure, and limited anthropogenic disturbance play a vital role in avifaunal

community richness and composition (Baral and Inskipp 2005). Subtropical forests were species rich, and the protected areas, Ramnagar Wildlife Sanctuary and Bahu-Mahamaya forest mostly harbored forest specialists. The urban forested areas attracted a large number of migratory as well as resident birds (Grimmett and Inskipp 2007; McKinney 2008; Evans et al. 2009) as the forest fragments (Donnelly and Marzluff 2004), gardens (Gaston et al. 2005; White et al. 2005), tree-lined avenues, and residential yards (Savard et al. 2000; Belaire et al. 2015; Tiwary and Urfi 2016) harbor more bird species. These natural habitats in urban matrix function as a refuge for woodland species (Croci et al. 2008), enhance the abundance of food resources, and provide nesting opportunities including cavities (Mörtberg and Wallentinus 2000). It is well known that birds form an essential part of biodiversity in urban wetlands and associated aquatic habitats (Andradea et al. 2018). Among aquatic habitats, Gharana Wetland Conservation Reserve and Nikki Tawi harbored a large number of aquatic and water-dependent birds. Wetlands provide critical foraging areas for many waterbird species (Chatterjee et al. 2020), and their high productivity enables different bird groups to use similar food resources (Weller 1999). Majority of birds observed in these wetlands were wintering visitors who are champions in resource partitioning (Polla et al. 2018). High prevalence of Anatidae and Accipitridae at Gharana Wetland Conservation Reserve indicated high ecosystem productivity and intactness (Jamwal et al. 2017). The higher number of carnivores and omnivores is attributed to the presence of a variety of aquatic invertebrates, small fishes, and aquatic plants (Sohil and Sharma 2020).

Analysis of resource utilization pattern through cluster analysis showed most of the species shared a wide range of habitat and food type. Generalists were more specious in comparison to the specialists in terms of their feeding affinities. Similar observations were recorded by Perez-Crespo et al. (2013) and Chatterjee et al. (2020). The species occupying a wide array of habitats are better accustomed to habitat changes than the species confined to a few habitat types (Goerck 1997). Specialized habitats in the form of intact forest patches, ecosystem interfaces, and smaller wetlands hence call immediate conservation attention in the region. In the given findings of this study, our hypothesis holds good to be considered. The study signifies that habitat choices govern bird assemblages and their foraging preferences viz-a-viz quality and time of the year, i.e., season. Bird groups with restricted resource utilization were considered specialists.

Conclusions

It was observed that bird species responded differently to habitats in terms of choice of their food. Intact forest patches, protected areas, and wetlands with adequate food base and allied resources were species rich while the patchy landscapes were species scarce. Insectivores and omnivores emerged as the favored feeding guilds and protected areas as the preferred habitats. The findings of this study thus underline the importance of avian guild structure in regulating bird assemblages viz-a-viz their habitat improvement. The study further sets a background for intensive investigations on bird-habitat relationships, more specifically involving the species of high conservation interest. We recommend habitat conservation and improvement measures to be integrated into policy frameworks, especially those related to urban planning.

Supplementary information

Supplementary information accompanies this paper at https://doi.org/10.1186/s13717-020-00250-9.

Additional file 1. Bird species distribution (common and binomial names, familial representation), guild structure and migratory status in mosaic landscapes around Jammu.

Abbreviations

UPGA: Unweighted pair-group average; EBA: Endemic bird area; NT: Nikki Tawi; GWCR: Gharana Wetland Conservation Reserve; RWLS: Ramnagar Wildlife Sanctuary; BMF: Bahu-Mahamaya forest; JU: University of Jammu Campus; SOP: Southern open plains; HBW: Handbook of the birds of the wild; PCA: Principal component analysis; PAST: Paleontological statistics software; SS: Subtropical scrub; BF: Subtropical broadleaved forests; PF: Subtropical pine forests; U: Urban forests; RB: Riverbed; FL: Fallow land; GD: Garbage dumps; AE: Aerial; CD: Carcass dump; AF: Agricultural fields; AQ: Aquatic; UB: Urban buildings; LZ: Littoral zone of wetland; I: Insectivorous; G: Granivorous; C: Carnivorous; O: Omnivorous; F: Frugivorous; N: Nectarivorous

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Authors' contributions

NS conceptualized the study and edited the manuscript. AS collected and analyzed the data and wrote the manuscript. The authors read and approved the final manuscript.

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Availability of data and materials

The checklist of the birds is provided as Additional file.

Ethics approval and consent to participate

All requisite information and data was collected without disturbing the birds and their habitats. Photographic records were collected using a telephoto lens. Birds in nesting were not photographed.

Consent for publication

Not applicable

Competing interests
The authors declare that they have no competing interests.

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Annexure X

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Human Impacts on Gharana Wetland (Reserve), Jammu (J&K, India)

Prabhjot Kaur, Dr. Piyush Malaviya

Abstract: ***Gharana Wetland (reserve) is a 'Border Tourism Site' located close to Indo-Pak border in Jammu district. It is home to thousands of migratory birds during winter season. Various anthropogenic causes have put immense pressure on this wetland and it is on the verge of disappearance. This study puts light on the numerous causes which have led to the shrinkage of this very wetland and also to suggest various steps to be taken for the conservation and management of this important wetland reserve.***

Keywords: Wetland, encroaching, weeds, reserve, pollution

1. Introduction

Wetland ecosystems are the main contributors for the nation's wildlife bio-diversity, productivity and economy (Stanley, 2004). Wetlands are generally distinguished from other water bodies or landforms based on their water level and on the type of plants that thrive within them. Specifically, wetlands are characterized as having a water table that stands at or near the land surface for a long enough period each year to support aquatic plants (Venkataraman, 2008). Wetlands provide many important services to human society, but at the same time ecologically sensitive and adaptive systems (Turner *et al.*, 2000). Wetlands are especially beneficial under extreme drought or flood conditions for their ability to retain water, reduce runoff, filter sediments and provide water purification (Hartig *et al.,* 1997). They comprise both land ecosystems that are strongly influenced by water and aquatic ecosystems with special characteristics due to shallowness and proximity to land. Wetlands play a key role in pollution elimination and flood control, serve as breeding and nursery grounds for many species of fish and wildlife and help maintain ground water supplies and quality (Koc, 2008). Wetlands also act as pollution assimilation agents for nitrate pollution created by upstream agriculture (Rai, 2008).

Man's dependence and association with the wetlands has been started since the beginning of civilization. The increasing world population and over-exploitation of wetland resources demand for human habitation and permanent change of landscape could be identified as the inherited problems during the past few decades (Sarma and Saikia, 2008). Due to anthropogenic concerned threat problems and improper management, these wetlands are reducing in number and area size day by day. People use these wetlands for various purposes like irrigation, catching of fishes/aquaculture, and washing of clothes, bathing animals and also as waste lands for dumping (Kumari and Lal, 2008). Therefore, appropriate measures should be adopted to conserve and save these important natural resources.

Home to thousands of migratory birds during winter season, Gharana Wetland (reserve), located close to Indo-Pak border in Jammu district has been notified as a protected water body and declared 'Important Bird Area' (IBA). The state government has accorded sanction to notify Gharana Wetland (reserve) in the interest of Wildlife preservation and development in Jammu and Kashmir. The Deputy Commissioner of Jammu has declared the area 'Wetland Reserve' under Jammu and Kashmir Wildlife Protection Act, 1978.

The reserve, known as 'Bird Watchers Paradise', supports a population of different species during every winter with most of the species being migratory, endangered or covered under different schedules of the act. Various anthropogenic causes have put immense pressure on this wetland and it is on the verge of disappearance. This condition can be well imagined from the fact that encroachment by the locals being one of the major reasons for wetland shrinkage has reduced the wetland area to less than half its official size. The present study has been done to highlight the various threats being faced by this wetland due to human activities and also to identify the mitigation to these threats.

2. Research Methodology

Study Area

Gharana Wetland (reserve) is located about 30km from Jammu city, extending to the Pakistan border in the west of Gharana village. This wetland is 8km from Ranbir Singh Pura town. Gharana is located between $32^0$50'28"N and $74^0$35'04"E. its altitude is about 400m. This area is located in R.S.Pura tehsil, west to Jammu city (Fig-1). The soil of the area is Coarse Loamy to Fine Loamy. The annual rainfall is about 1,100mm. Important species of plants present in the study area are *Lantana camara* (Jari), *Cannabis sativa* (Bhang), *Melia azadirachta* (Drenk), *Acacia nilotica* (Kikar), *Adhatoda vasica* (Branked), *Calotropis Procera* (Ak), *Dalbergia sisoo* (Tali). Gharana village consists of 100 houses with a population of about 300. The main occupation of the people here is farming.

Figure 1: Satellite image of study area (Gharana wetland)

ethodology

A questionnaire based survey was conducted in the study area where the local residents were asked questions regarding the respective wetland and its various other aspects. Questionnaire was divided into two sections, namely, Social aspect and Environmental aspect. Environmental aspect was further divided into- General awareness and Awareness with respect to Gharana wetland. The respondents were of various age groups, religious denominations, occupations and educational backgrounds. Most of the questionnaires were individually administered, and the questions explained to the respondents. The respondents were allowed ample time to complete the questionnaires. As far as possible, the questionnaires were administered on taboo and communal labour days or weekends in order to keep disruptions of farm work or other socio-economic activities of the inhabitants to the barest minimum.

3. Results

Social Aspect

Besides the majority (60%) of the locals, many of them were also migrants (40%) from POK during 1947 division. They were mostly Hindus (90%) belonging to either schedule caste or schedule tribe (58%). Illiteracy (80%) rate was very high with majority of the families being joint (98%). Farming (90%) was found to be the main occupation of the locals. **(Table 1)**

Environmental Aspect

General awareness- It was seen that locals were ignorant about wetlands (99%) and there benefits (99%) with no idea about pollution (97%) and its effects (97%) as a result of which fertilizers and pesticides were being used with more than prescribed limits in the fields (90%). **(Table 2)**

Perception of respondents about Gharana wetland – for residents of Gharana village, Gharana wetland meant a dumping site (50%) and place for bathing domestic animals (50%). Majority of them were against demarcation (98%) of

wetland and even against the coming of migratory birds to this wetland (100%). Encroachment (96%) was seen as a prominent reason for wetland shrinkage (99%). Military activities have also been seen as a reason for wetland shrinkage. Moreover the employees employed at the Gharana wetland were also not properly trained (40%). **(Table 3)**

Table 1: Socio-economic status of people residing in Gharana wetland

Question	Options	Response (%)
1) Native state	a) Jammu and Kashmir	60
	b) Bihar	NIL
	c) Migrant	40
	d) any other specify	NIL
2) Religion	a) Hindu	90
	b) Sikh	10
	c)Muslim	NIL
	d) Christian	NIL
3) Caste	a) Kshatriya	2
	b) Shudra	40
	c) Brahmins	NIL
	d) SC/ST	58
4) Educational status	a) Literate	2
	b) Illiterate	80
	c) 10th pass	10
	d) 12th pass	8
5) Reasons for leaving school	a) Poverty	90
	b) distance from school	NIL
	c) lack of interest	10
	d) any other reason	NIL
6) Distance from the school	a) at few steps	100
	b) less than 1km	NIL
	c) more than 1km	NIL
	d) more than 10km	NIL
7) Living alone or with family	a) alone	2
	b) with family	98
8) Type of family	a) Nuclear	2
	b) Joint	98
9) Number of family members	a) 1	2
	b) 2	NIL
	c) 4	NIL
	d) more than 4	98
10) Type of migrant	a) Seasonal	NIL
	b) Temporary	NIL
	c) Permanent	100
11) occupation	a) Farming	90
	b) labourer	7
	c) Army	3
	d) any other specify	NIL
12) Daily Income	a) Rs 200	7
	b) Rs 500	3
	c) Rs 1000	NIL
	d) none	90

Table 2: General awareness of Gharana village residents on environmental aspect

Question No.	Options	Response (%)
1) Do you know what wetlands are?	a) Yes	1
	b) No	99
2) Do you know the benefits of wetlands?	a) Yes	1
	b) No	99
3) Do you know what is pollution?	a) Yes	3
	b) No	97
4) Do you know the effects of pollution?	a) Yes	3
	b) No	97
5) Do you apply fertilizers and pesticides in your fields? If so, in what doses?	a) Yes, more than required	90
	b) Yes, less than required	NIL
	c) No	NIL
	d) Sometimes as required	10

Table 3: Perception of respondents regarding Gharana wetland

Question No.	Options	Response (%)
1) significance of Gharana wetland	a) Dumping site	50
	b) Place for bathing animals	50
	c) Nothing	NIL
	d) any other specify	NIL
2) should wetland area bedemarcated	a) Yes	2
	b) No	98
3) Do migratory birds pose any harm to you	a) Yes	100
	b) No	NIL
4) Have any efforts been made by the authorities for awareness regarding wetlands	a) Yes	70
	b) No	30
5) Positive effects of Gharana wetland	a) Good dumping site	40
	b) Good for bathing animals	20
	c) Good for washing Clothes	20
	d) Good for fishing	20
6) should bathing of domestic animals be done in the wetland water	a) Yes	98
	b) No	2
7) Have you never been opposed of doing so	a) Yes	80
	b) No	20
8) why do you pass through the wetland water	a) It is a shortcut	90
	b) To cool themselves	NIL
	c) Just for fun	10
	d) Any other specify	NIL
9) why do you dump the domestic waste along the wetland sides?	a) It is an open area	80
	b) Never opposed of doing so	10
	c) Everyone dump here	10
	d) Any other specify	NIL
10) Don't you find wetland tourism a good source of income	a) Yes	2
	b) No	98
11) Is bursting crackers a good way of avoiding birds	a) Yes	99
	b) No	1
12) why do migratory birds come here?	a) Don't know	90
	b) To destroy crops	5
	c) To drink water	2
	d) To bath	3
13) Are the wetland employees properly trained	a) Yes	1
	b) No	40
	c) Partially trained	40
	d) Don't know	19
14)Do you hunt Water Fowls	a) Yes	95
	b) No	5
15)Do you use wetland water for irrigation of fields	a) Yes	96
	b) No	4
16) Why are the villagers encroaching the wetland area?	a) To increase their field area	95
	b) To grow more crops	50
	c) To dry up the wetland	5
	d) Any other specify	NIL
17) What are the causes of wetland shallowness?	a) Siltation	10
	b) Weed growth	60

	c) Waste dumps	30
	d) Any other specify	NIL
18) Does the Army activities(bunkers) effect the wetland	a) Yes	50
	b) No	50
19) According to you whether the wetland area has shrunken or expanded since the course of time	a) Expanded	NIL
	b) Shrunken	99
	c) Don't know	1
	d) Remained as such	NIL
20) negative effects of Gharana	a) Obstruction in the path to fields	20
	b) Occupies field area	40
	c) Migratory birds come here and destroy crops	40
	d) Nothing	NIL

4. Discussion

On the basis of the results obtained by questionnaire based survey conducted from the fellow residents of Gharana village, it is quite clear that most of the inhabitants around the study site are from economically poor section. Their main occupation is agriculture. The local residents bath and wash their cattle's in the wetland water. The abiotic resources are also being extracted from this wetland and utilized in various ways by local people (Sarma and Saikia,2008). It was also observed during the study that people were totally blank towards the concept of wetlands, there benefits, pollution and its effects. It was also seen that the fertilizers and pesticides so applied were more than the required dose resulting into significant impact on the wetland ecology (Anand *et al.,* 2010; Anwaruzzaman & Khatun, 2012; Bain *et al.,* 2012; Olhan *et al.,* 2009). Many other problems were also witnessed in the Gharana wetland area like dumping of solid waste (Gupta *et al.,* 2012), sewage, siltation, encroachment, eutrophication, weed infestation (Anand *et al.,* 2010; Anwaruzzaman & Khatun, 2012; Gupta *et al.,* 2012) and overgrazing. Fuel wood harvesting has also been seen as a major threat to the tree diversity of many wetlands and so is true for this wetland (Anand *et al.,* 2010; Wuver and Atluquayefio, 2006).

5. Conclusion

The information generated from this study gives us a clear picture depicting the threats of intense anthropogenic pressure on the Gharana wetland. It can be seen that the locals are totally ignorant about the result of their activities on or around the respective wetland. The residents of Gharana village have low social and economic status with farming as the main occupation of most of them. They don't have any idea about pollution. Moreover, Gharana wetland is only a water body for them along which they can dump their waste and in which they can bath their animals. It has been found during the study that 'illiteracy' seems to be the main reason for such an attitude of the locals despite of having a government school in the village itself. The conservation and management of wetlands calls for a comprehensive strategy. Looking at the various threats being faced by Gharana wetland, we must adopt certain ways for its conservation and management which include adopting National Environment Policy,2006; Capacity Building and Community Participation as the main strategies to overcome the problems being faced by the Gharana wetland. Although, many efforts are being made by the state government and the wildlife department of the state, but, such efforts will not pay offunless we at individual levels don't recognise our duties towards NATURE.

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Annexure XI

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ALLIGATOR WEED (ALTERNANTHERA PHILOXEROIDES) A POTENTIAL INVADER IN GHARANA WETLAND JAMMU, J&K, INDIA

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ABSTRACT

Alligator weed Alternanthera philoxeroides (Mart.) Griseb (Amaranthaceae) is a noxious invasive weed native of Trop. America and widespread throughout the world. Because of its invasiveness, potential for spread and economic and environmental impacts it is a weed of national significance. It is an especially troublesome weed because it invades both land and water, and is very hard to control. When growing on land it displaces other more favourable plants such as crops or native vegetation, and can be harmful to animals. The present study deals with the first time report on the presence and impacts of A.philoxeroides in Gharana wetland reserve of Jammu region which is an important wetland reserve and serves as wintering ground for large number of migratory water birds during their palaearctic to oriental migration.

KEYWORDS: Alternanthera Philoxeroides, New Report, Potential, Invader, Wetland, Gharana.

INTRODUCTION

Invasive species have earned the distinction as the second greatest cause of species extinction. Introduction of species from their native regions to new and previously unoccupied areas, intentionally or unintentionally, dates back to the times when humans started travelling over and between land masses. However, rapid globalization and fast growing transnational trade and commerce have exacerbated the rate and magnitude of alien species introductions several fold, thereby making it a cause of ecological concern globally. The spread of invasive species beyond their home range has many underlying mechanisms and such species are generally detrimental to native biodiversity and ecosystem functioning in the introduced regions, inflicting huge socio-economic damage. Invasive non-native species inflict harmful ecological and economic impacts upon ecosystems in non native regions (Pimentel et al. 2005; Meyerson and Mooney 2007). Of these and other threats, biological invasion has emerged as the most severe one causing substantial damage with

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cascading effects on structural organization and functional integrity of freshwater ecosystems. Early detection and timely exclusion are the most cost effective methods of controlling and preventing invasive species. Control measures often come into play only after the alien species has spread to nuisance proportions (Boylen et al. 2006). Gharana Wetland located close to Indo-Pak border in Jammu district has been notified as a protected water body and declared as Important Bird Area, rich in biodiversity. During the past several decades, there has been continuous introduction of non-native species into the region and A.philoxeroides is one among them. Occurrence of alligator weed A. philoxeroides was recorded during the vegetation survey of Gharana wetland reserve. Alligator weed is known as an invasive species in many parts of the world having a tremendous potential for vegetative reproduction. In India, the species has been reported from Assam, Bihar, West Bengal, Tripura, Manipur, Andhra Pradesh, Karnataka, Maharashtra, Delhi and Punjab (Pramod et al. 2008). The purpose of this paper is to note the invasion of Alternanthera philoxeroides in Gharana wetland and to present some considerations about its potential problems and management.

RESULT AND DISCUSSION

Wetlands are among the most productive ecosystems of the world with specific ecological characteristics, functions and values. They are essential life- supporting systems providing a wide array of benefits to human kind .Their high productivity places them among the richest and most biologically diverse ecosystems in the world. Gharana Wetland an important wetland reserve is situated at Indo-Pak International border in Ranbir Singh Pura sector, Jammu and is about 35 km south of the main Jammu city. Gharana Wetland has derived its name from the village known as 'Gharana' situated on one side of the wetland. The wetland is located at 70□7′ N longitude and 32□34′S latitude. Sandwitched between India and Pakistan. Gharana Wetland is a shallow water body having mean maximum depth of 62.5 cm in monsoon season. Shallow water depth attracted large number of water birds as shallowness of the wetland made the benthic food easily accessible to them. Gharana Wetland attracts thousands of migratory birds from various parts of the globe during winter every year. Alternanthera philoxeroides (Mart.) Griseb. of the family Amaranthaceae is an invasive weed originally from South America (Vogt et al. 1979) and is now widespread throughout the world (Buckingham 1996) is highly invasive in Gharana Wetland. It is a stoloniferous, perennial, mesophytic herb capable of aquatic and terrestrial growth. The stems are prostrate,

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decumbent or ascending, simple or branched and forming dense mats. At maturity stems are hollow and produce roots at nodes. Leaves are opposite, elliptical-oblanceolate and glabrous measuring 2.5–5.0 cm × 0.6–1.7 cm. The inflorescence consists of head with a solitary peduncle at leaf axils, globose ; 0.8–2.0 cm in diameter (Fig-1 and 2).One of the reasons that alligator weed poses such a dramatic threat is its ability to live in both aquatic and terrestrial habitats. It can tolerate brackish (slightly salty) water but thrives in nutrient-rich water. Ideal terrestrial habitats include places that are regularly inundated or that have high rainfall or irrigation. It spreads through vegetative reproduction, when fragments containing at least one node are moved from one place to another and take root in suitable habitat. It is commonly spread downstream when the plant is broken up into smaller fragments (e.g by floods, or following mechanical or chemical control).During the vegetation survey of the wetland , Alternanthera philoxeroides was observed in all the four stations made depending on the presence or absence of anthropogenic activities along with disposal of house-hold and agricultural waste in Gharana wetland. When growing on land Alternanthera philoxeroides displaces other more favourable plants such as crops or native vegetation, and can be harmful to animals. When growing in fresh water, alligator weed can cover the entire water surface, preventing flow, blocking up drainage channels and potentially increasing flood damage. Alligator weed forms large floating mats in the wetland (Fig-3 and 4).Alternanthera philoxeroides forms dense mats and thereby disrupts the aquatic environment by impeding penetration of light and gaseous exchange as well as promoting sedimentation. The weed also provides habitat for mosquitoes. It is an especially troublesome weed and is very hard to control. Alligator weed can be controlled by three principal means; biological, chemical and mechanical. Alligator weed infestations can be reduced with weed harvesters or by manual removal, but small fragments are inevitably left behind or dislodged. These fragments readily create new infestations. In water alligator weed can be treated with a registered herbicide. However, this rarely kills the entire plant, which often breaks up into smaller pieces. These smaller pieces can drift downstream and lead to new infestations. The biological control using the flea beetle Agasicles hygrophila has been quite successful in aquatic ecosystems of warm temperate regions (Centre for Weed Management 2003). The adults and larvae reduce the growth of alligator weed by feeding on the underside of the leaves and aerial parts of the plant. Chemical control using 1% glyphosate for free floating alligator weed was effective, but owing to its weak translocation through roots and stems, it was not effective in terrestrial plants (Ensbey 2005). In Gharana wetland only manual procedures to control alligator weed

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has been attempted as yet. The weed is extremely difficult to control once established and eradication is very expensive, especially in developing countries (Sainty et al. 1998). Proactive inspection and surveillance programs should be encouraged to detect the weed before it becomes established. Awareness programs should be a priority for the locals and those who are registered with the fisheries department can be quite helpful. Unfortunately, there is no aquatic weed management strategy in place for the wetland despite the evident damage to the ecosystems. It is the time to develop and implement the management plan for alligator weed before it assumes nuisance proportions.

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Invasion of Alternanthera philoxeroides

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Annexure XII

Original Research *Kumar et al*

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Volume 1, Issue 1 (2021)

Habitat Types and its impact on Macrobenthos Assemblies Structure in Gharana Wetland

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Abstract: The Gharana, a dying wetland, is a semi-arid wetland adjacent to agricultural areas merely 500m from the international Indo-Pakistani border. The main goal of the current research was to inspect the types of habitat and its impacts on macrobenthos assemblies. Four stations were identified based on different types of habitat i.e. kind of substrate and quality of water. Species richness, abundance, and three diversity indices (Shannon- Weiner, Simpson and evenness index) for macrobenthos were evaluated. Total 29 genera were observed during the current research. Ephemeroptera (8 genera) were the dominant followed by Diptera in comparison to all other orders. The outcomes of the current research clearly specified the populace of macrobenthos species in diverse habitats was pointedly dissimilar. Also, the results obtained by the CCA showed the maximum number of species, their richness, and abundance in zone 1. The diversity indices showed a higher overtone with the types of the habitat of silt-gravel bed substrate followed by sand, and open lotic and seasonal lotic habitat types.

Key words: Macrobenthos, habitat type, water quality, Gharana wetland, Jammu.

Annexure XIII

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Landscape Considerations in Wetland Management Reviving Gharana Wetlands

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ABSTRACT: Wetlands are considered to have unique ecological features which provide numerous products and services to humanity. Ecosystem goods provided by the wetlands mainly include: water for irrigation; fisheries; non-timber forest products; water supply; and recreation. Ghar-ana wetland (meaning welcome home) is paradise of migratory birds. Gharana and its adjoining wetlands of Makwal, Kukdian, Abdullian and Pargwal every year receive about 10000 to 20000 migratory birds in winter. All these wetlands are located along the border with Pakistan. This study follows the example of Gharana Wetlands (Jammu and Kashmir), and how it is under threat and needs to be protected. Also this study aims to propose landscape recommendations for its conservation.

Keywords: Wetland, Gharana, Landscape, Ecology, Conservation.

I. INTRODUCTION

Wetlands are defined as lands transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water.

Wetlands constitute vital components of the regional hydrological cycle. They are highly productive, support exceptionally large biological diversity, and provide a wide range of ecosystem services such as food, fiber, waste assimilation, water purification, flood mitigation, erosion control, groundwater recharge, microclimate regulation, enhance the aesthetics of the landscape, and support many significant recreational, social and cultural activities, aside from being a part of our cultural heritage. It was acknowledged that most urban wetlands are seriously threatened by conversion to non-wetland purposes, encroachment of drainage through landfilling, pollution (discharge of domestic and industrial effluents, disposal of solid wastes), hydrological alterations (water withdrawal and inflow changes), and over-exploitation of their natural resources. This results in loss of biodiversity and disruption in goods and services provided by wetlands.
There are different types of wetlands:
1.Coastal Wetlands
2.Shallow lakes and ponds
3.Bogs
4.Marshes and Swamps
5. Estuaries

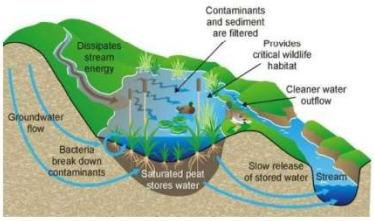

Fig. 1. Wetland[1].

II. NEED OF STUDY

There is a need to carry out a wide range of research into wetlands. This is principally because wetlands provide essential ecosystem functions and services, including regulation of water quality, sustainable control and mitigation of flooding, greenhouse gas reduction, essential habitats for plants and animals, and cultural and recreational facilities.

Wetland management generally involves activities that can be conducted with, in, and around wetlands, both natural and man-made, to protect, restore, manipulate, or provide for their functions and values

III. METHODOLOGY

Methodologies adopted to fulfill the aim and objectives are as follows:
1. Studying Wetlands and their importance

2. Assessment of the Importance of Gharana Wetlands as International Bird Area.
3. Analyze the various impacts on Gharana Wetlands with Ecological and Landscape perspectives
4. Study actions initiated for the conservation of Gharana Wetlands
5 Proposing mitigation measures by providing landscape recommendations for the conservation of Gharana Wetlands.

IV. LANDSCAPE ECOLOGY AND WETLANDS

Landscape Ecology approaches mean sustainable management and manipulation of ecosystems. This requires understanding the spatial scales at which wetland processes operate, including hydrological elements, surface as well as ground.

As Landscape Architects, our homework of understanding the wetlands is especially critical before intervening in sites with such fragile ecosystems because they are a resource from which sustainable development, design and construction benefit.

V. IMPORTANCE OF WETLANDS

Wetlands are considered to have unique ecological features which provide numerous products and services to humanity. Ecosystem goods provided by the wetlands mainly include: water for irrigation; fisheries; non-timber forest products; water supply; and recreation. Major services include: carbon sequestration, flood control, groundwater recharge, nutrient removal, toxics retention and biodiversity maintenance.

A. Biodiversity protection

1) Support a great diversity of species, many of which are unique and rare. Freshwater ecosystems cover only 1% of the Earth's surface but they hold more than 40% of the world's species and 12% of all animal species. Although they cover only 0.2% of the ocean floor, coral reefs may contain 25% of all marine species.

Associated product/service- Providing the transition between the aquatic and terrestrial environment and having features of the two, wetlands are considered amongst the most productive ecosystems in the world:

1. Fish form the primary source of protein for nearly 1 billion people.
2. Rice is the staple diet of 3 billion people – half of the world's population.
3.Other wetlands' products are used as construction material (reeds for thatching, timber for construction); as a source of fuel (plant residues may be formed into briquettes and used in homes, or they may be burnt directly); fibers for textile and paper-making; medicines from bark, leaves and fruits; dyes and tannins used to treat leather, etc.

B. Water storage

Water is stored in the soil or retained in the surface waters of lakes, marshes, etc.

Associated product/service-
1. Flood control.
2. Erosion control – wetland vegetation stabilizes shorelines and protects from storms (by slowing down the wind speed, minimizing the effects of waves, water flow and runoff, and by trapping sediments).
Wetlands reduce the need for expensive engineered structures.

C. Groundwater replenishment

Part of the water filters into the ground and recharges underground aquifers (groundwater reservoirs).

Associated product/service- Groundwater reservoirs store 97% of the world's unfrozen freshwater and provide drinking water to almost a third of the world's people:
1. In Asia alone more than a billion people rely on groundwater for drinking
2.In Europe 65% of public water supplies come from groundwater sources.

D. Sediment retention

By slowing down the force of water, encouraging the deposition of sediments carried in the water.

Associated product/service-
1. Sediment deposition prevention – deposition of sediments may block waterways further downstream.
2. High biological productivity – nutrients are often associated with sediments and can be deposited at the same time. Combined with the unique nature of the wetland ecosystem (a complex of zones with different characteristics), this makes wetlands one of the most productive ecosystems recorded.

E. Retention of nutrients and other substances

Wetland species (esp. plants) effectively remove nutrients (mainly nitrogen and phosphorous from agricultural sources but also from human wastes and industrial discharges).

Associated product/service-
1.High biological productivity – nutrients are often associated with sediments and can be deposited at the same time. This nutrient retention capacity, combined with the unique nature of the wetland ecosystem (a complex of zones with different characteristics) puts wetlands among the most productive ecosystems recorded.

2. Prevention of eutrophication further downstream – eutrophication is most often assigned with algal blooms, which lead to rapid oxygen depletion in the wetland and negatively affects other associated species.
3. Many wetland plants have the capacity to remove toxic substances that have come from agricultural, industrial or other activities. Wetlands prevent high concentrations of nutrients and toxic substances from reaching groundwater supplies or other water sources that may be used for drinking water, thus reducing the costs for its preliminary treatment.

F. Storehouses of Carbon

Associated product/service-Wetlands play at least two critical roles in mitigating the effects of climate change: one in the management of greenhouse gases (especially carbon dioxide, CO^2) and the other in physically buffering climate change impacts:
1. Wetlands act as significant carbon sinks – the destruction of wetlands will release carbon dioxide, a greenhouse gas.
2. Wetlands will play a further role as the frontline defenders of coastal and inland areas as countries deal with the full effects of climate change: increasing frequency of storms, changing rainfall patterns, rising sea-levels and sea surface temperatures.

V. WETLAND ECOSYSTEM

Wetlands are shown to be three component ecosystems. The Hydrology of the landscape influences and changes the Physiochemical Environment, which in turn, along with Hydrology, determines the Biotic Communities that are found in the wetland.

A. Ecology of wetland ecosystem

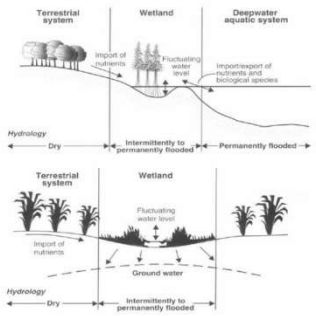

Fig. 2. Ecology of wetland[2].

Wetlands are often described as "kidneys of the landscape [3]. Hydrologic conditions can directly modify or change chemical and physical properties such as nutrient availability, degree of substrate anoxia, soil salinity, sediment properties and pH. These modifications of the physiochemical environment, in turn, have a direct impact on the biotic response in the wetland [4].

IMPORTANT BIRD AREAS

An Important Bird and Biodiversity Area (IBA) is an area recognized as being globally important habitat for the conservation of birds populations. Currently there are about 10,000 IBAs worldwide. The program was developed and sites are identified by Birdlife International. These sites are small enough to be entirely conserved and differ in their character, habitat or ornithological importance from the surrounding habitat.

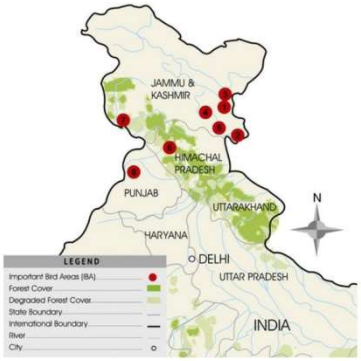

Fig. 3. Important Bird Areas.

Important Bird Areas in J&K

2) Chushul marshes
3) Hanle Plains (Hanle River marshes)
4) Pangong Tso
5) Tso Kar Basin
6) Tso Kar Basin
7) Pong Dam Lake Wildlife Sanctuary,
8) Gharana Wetland Reserve
9) Harike Lake Bird Sanctuary

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VI. AREA OF STUDY

Gharana Wetland Reserve

Fig. 4. India's Location

Fig. 5. Area Location of R.S Pura In J&K.

About 40 kilometers from Jammu town, the winter capital of Jammu and Kashmir, lies Gharana village in R. S. Pura sector, along international border. A marsh area of three hundred acres in this village was notified as Wetland Reserve after a cabinet decision and government order in 1981.

Gharana Wetland (Reserve) is irregular in shape, covering approximately 1km2 surface area and is situated in subtropical Jammu and Kashmir State, North western India (~) 10 miles east of the Indo-Pakistan International border. . It is surrounded by 'Gharana' village on its one half and by agricultural fields along its other side.

The wetland lies along the Palaearctic - Oriental Migratory Route of aquatic birds and serves as a feeding, roosting and wintering grounds for many bird species from Central Asia. The Wetland is declared as 'Important Bird Area' and is under J and K Wildlife Protection Act, 1978.

The notified wetland of Gharana, barring a small patch of marshy pond, and adjoining area, more or less comprises of agriculture fields. Paddy, a good quality basmati variety, is the major crop grown here.

However, by the time the birds arrive in Gharana during winter, the tender shoots of wheat are already in place. This, coupled with marshy patches and a variety of aquatic vegetation, probably qualifies the Gharana as the most sought after habitat of many bird species near Jammu town.

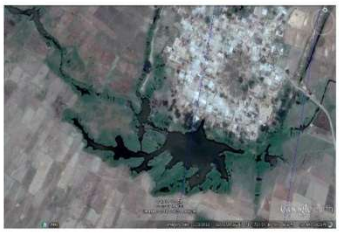


Fig. 6. Google Earth Image of Gharana Wetland.

About twenty thousand birds are estimated to throng this wetland and adjoining area during winter every year. This paradise for bird watchers supports as many as ninety species of birds including winter migrant birds. Common teal, Northern pintail, Northern shoveler, ruddy shelduck, gadwall, lesser whistling duck, purple swamp hen, little cormorant and ruff etc are some of the species conspicuously seen here during winter season. The major attractions include bar-headed geese, comb duck, mallard, Eurasian wigeon, common pochard, lesser whistling duck, spoon bill, black stork, woolly-necked stork and black necked stork. Some of the species like lesser whistling duck and purple swamp hen have been observed breeding in the area for last couple of years.

Fig. 7. Mashy Land At R.S Pura (Gharana).

Fig. 8. Migratory Birds at Gharana Wetland.

VII. VARIOUS WORKS HAVE BEEN CONDUCTED ON GHARANA WETLAND (RESERVE) TO DETERMINE

A. Physico-Chemical Parameters[5]

S .no	Parameter	Range
1.	Air Temperature	14 To 39 c
2.	Water Temperature	13 To 35 c
3.	The Range Of Depth	6.5 To 85 Cm
4.	Transparency	1.5 To 58.5 Cm
5.	Ph	6.6 To 9.6 It indicated an alkaline condition during most of the study period.
6.	Concentration Of Dissolved Oxygen	1.6 To 8.4 Mg/L
7.	Carbon Dioxide	0-40 Mg/L.
8.	Carbonates	Absent
9.	Calcium Concentration	16.04 To 64.16 Mg/L.
10.	Chloride	(518.96 Mg/L)
11.	Magnesium	(94.77 Mg/L)

The study revealed the occurrence of 21 species belonging to 5 orders and 6 families, out of which 6 species were resident, 14 species were migratory and 1 species was occasional visitor. Among migratory aquatic avifauna, 8 species were wintering and 6 species were transients.

Fig. 9. Fields Around Marshy Land In Gharana.

B. Seasonal Diversity

The highest number of species (18 species) was found in November and February. November had the highest (10673 individuals) and July had the lowest (44 individuals) waterbird population. During November, Bar-headed Goose Anser indicus contributed 92.01% (9820 individuals) to the total population of 10673 individuals. Family Anatidae accounts for 87.94% of the waterbird count.

The increase in the number of migratory species in winter is attributed to availability of space and food resources. Rice fields provide important water bird habitat from perspectives of food quality and quantity, as they provide natural food in form of moist soil plant seeds, and green forage.

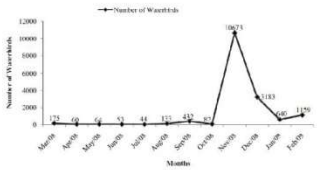


Fig. 10. Monthly Variation in Aquatic Avifauna of Gharana wetland [6].

Fig. 11. Habitat for Migratory Birds.

C. Avifaunal Diversity And Their Feeding Guilds[7]

Thus Gharana Wetland provides diverse food resources to the birds in form of plants and animals. Some birds find food in wetland soil and others in water column. Aquatic vegetation, abundance of benthic invertebrates, dipteran larvae, variety of insects and a wide stretch of paddy fields adjoining the wetland attributes to the different types of feeding guilds which were employed by various bird species.A wide stretch of agricultural fields skirting the wetland along with native trees provide additional food to birds in form of seeds, tree-fruits, bees, and animal feeds. So the birds like Red Wattled Lapwing, Indian Myna, White Wagtail, Grey Wagtail, Red Vented Bulbul showing multiple feeding guilds inhabit this area.

Availability of food in good quantity and quality constitutes one of the prime requisite of bird species in an area. Out of total 57 avian species reported, 16 species were carnivorous, 6 were grainivorous, 1 was frugivorous, 2 were omnivorous, 7 were insectivorous, 8 were herbivorous and 17 species used multiple feeding guilds [3].

VIII. THREATS TO GHARANA WETLAND

1. Military Activities : *Being located on the border, shelling by security people across the border is a constant problem.*

2. Invasive Species: The wetland is infested with *Water Hyacinth Eichhornia crassipes* and *Typha*. While the later may not be an issue as it is a native plant, the former is one of the most pernicious invasive weeds of India and has destroyed many wetlands.

This has caused profound changes in wetland structure, which could make those wetlands unsuitable for some species of birds.

3. Poaching: Poaching though hunting has been banned here even then it was prevalent here till the last few years.

4. Encroachment: Till now, no official demarcation exists between agriculture fields and the wetlands. This has progressively led to encroachments by the villagers. This agricultural expansion has negatively affected the wildlife especially the waterfowl.

Fig. 12. Land filling for increasing agriculture.

5. Other Threats and Issues

a) The basic facilities including road to the wetland is in most dilapidated condition. The road stretch from R S Pura to Gharana Wetland has hundreds of potholes and wretched stretches that give tourists quite a bumpy ride to remember.

b) There are no arrangements for bird watchers due to which the only guest house constructed by wild life department of the state government gets crowded with tourists that threatens birds and their very existence.

Fig. 13. Bird watching at Gharana.

c) Being adjacent to the village, various anthropogenic activities are carried out like cattle bathing, washing of vehicles, laundry, entry of domestic sewage and cattle waste, drawing of water by electric motor, hunting, fishing, expansion of agricultural fields towards wetland etc. . Regular interference of villagers keep the waterbirds away from the edge.

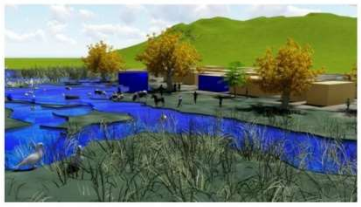


Fig. 14. Anthropogenic activities carried out at Gharana.

d)Due to the shallowness of the wetland they access their agricultural fields by passing through the wetland. It was further observed that such anthropogenic influences restricted the use by water birds. Very few water birds were recorded who came to the shore throughout the year for foraging and they prefer the centre of this wetland in order to avoid disturbances.

e) Direct approaches of people on foot were very disruptive to the water birds causing flight and reducing their foraging times (Burger and Gochfeld, 1993; Thomas et al., 2003; Marcum, 2005). Stolen (2003) and Blanc et al. (2006) also revealed negative impact of human disturbance on waterbirds by reducing their feeding times.

IX. PROPOSAL

A. Landscape Ecology Approach

Looking at a landscape ecological approach, there are several landscape scale features useful to have clarified.The ideal landscape texture is a coarse-grained matrix containing fine-grained areas providing for:

1.Large-patch ecological benefits

2. Multi-habitat species including humans

3. Maximum effective delivery of ecosystem services.

And, of course, wetlands can be coarse grained, or fine.

1) Landscape change is land or water being transformed by several spatial processes overlapping in order, including

1. perforation,

2. fragmentation and attrition, which increase habitat loss and isolation, causing very different effects on spatial pattern and ecological processes.

2) Landscape design is best done by aggregating land uses, and maintaining small patches and corridors of "nature" throughout developed areas, as well as some human activity spatially scattered in the broader matrix. Ideally, all such design should incorporate wetlands.

Landscape ecology approaches mean more possible management manipulation of ecosystems.

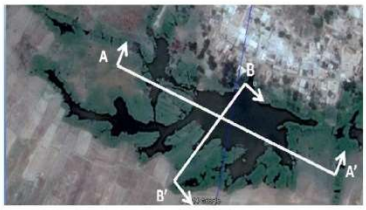
In part understanding and recognition of the emergence of semi-stable and stable novel ecosystems (Hobbs *et al* 2006) and planning for a Global Garden vision (Bridgewater, 1997). All this means understanding the spatial scales at which wetland processes operate, including hydrological elements, surface as well as ground.

B. Landscape-Level Management

Since wildlife don't recognize property boundaries like humans do, it is important to consider the bigger picture of how a particular site or tract of land works with the surrounding landscape to provide regional habitat. No field or piece of land exists in a void. The animals and plants in and around the site are affected by and interact with the surrounding landscape. The landscape-level considerations discussed here should always be evaluated in creating and managing wetland habitat.

Linear patches of aquatic habitat are usually less desirable than unevenly shaped ones. Irregular edges often create varied habitat along the perimeters of wetlands, making niches in which different types of plants can establish. More diverse plant life can in turn attract and support a larger variety of wildlife. If you have an existing pond or marsh with symmetrical borders, you can take steps to vary the habitat. Creating peninsulas and coves, forming islands, and creating plant mosaics can increase the complexity of your wetland and its attractiveness to wildlife.

Land profile



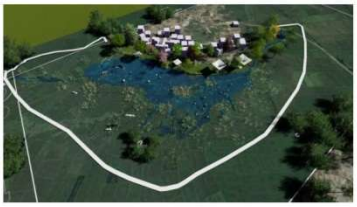
The wetland can grow parallel to the village

Section at A-A'

Section at B-B'

Two main management criteria need to be considered on Gharana wetland site:

1. Demarcation of wetland from the village.



2. Creating buffer zone

1.WETLAND ZONE 2.BUFFER
3.RESIDENTIAL 4.WATER FILTER

X. RESULTS

Ecological balance and harmony

XI. CONCLUSION

Public perceptions of wetlands have come a long way in the past few decades, yet wetlands are still being lost throughout the country. Habitat loss can directly impact birds using these areas by potentially influencing bird abundance and habitat use, reproduction, and survival.

A. Ecological Restoration As Mitigation

Worldwide, ecological restoration is a growing scientifically based discipline. More strictly defined, restoration is one level of rehabilitation of natural ecosystems. Rehabilitation may involve regeneration, restoration or reinstatement (often in combination) that represents progressively greater degrees of human intervention.

- **Regeneration** means the natural recovery of natural integrity following disturbance or degradation.
- **Restoration** means returning existing habitats to a known past state or to an approximation of the natural condition by repairing degradation, by removing introduced species or by reinstatement.
- **Reinstatement** means to introduce to a place one or more species or elements of habitat or geo diversity that are known to have existed there naturally at a previous time, but that can no longer be found at that place.

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Annexure XVI

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Impact of anthropogenic pressure on habitat utilization by the waterbirds in Gharana Wetland (reserve), Jammu (J&K, India)

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ABSTRACT

An attempt has been made to study the impact of anthropogenic pressure over the abundance of waterbirds in Gharana Wetland with respect to their habitat utilization at five different stations from March, 2008 to February, 2009. A total of 21 species of waterbirds were identified in the wetland and their annual abundance was observed to be 43, 768, 2750, 1751 and 11386 at St I, II, III, IV and V respectively. The order of utilization of different stations of the wetland by waterbirds was recorded as St V > St III > St IV > St II > St I. The variations in the abundance of waterbirds at different sites were the consequence of severe anthropogenic stress resulting in the highest abundance at the least disturbed site (St V) and lowest at the site (St I) that was under the influence of intense human activities.

Keywords: Wetland, Abundance, Waterbirds, Anthropogenic pressure.

1. Introduction

Waterbirds not only constitute the most prominent group which attract people to wetlands, but also are good bioindicators and useful models for studying a variety of environmental problems (Urfi et al., 2005).The species richness and relative abundance of birds depend upon wetland characteristics such as size, water level, quality of water, availability and distribution of food resources, presence of suitable roosting and nursery sites (Wiens, 1989). Wetlands harbour a large number of threatened birds, in addition to a variety of wildlife which are vital to their conservation (Kumar et al., 2005) but variation in habitat condition may cause changes in relative abundance of bird species composition (Garcia et al., 2007; Caziani and Derlindati, 2000). Wetlands have profound ecological and economic importance. Mostly they are highly productive but ecologically fragile, liable to degradation and degeneration under the prevailing anthropogenic pressure (Gupta and Singh, 2003) which in turn affects the avian diversity around them (Mohan and Gaur, 2008). Changes in waterbird abundance on a wetland may be a response to changes at the wetland, catchment or landscape scale. On individual wetlands, abundance of waterbirds may vary in response to food availability, availability of nest sites, predation risk or some other factor (Halse et al., 1993; Kingsford and Porter 1994; Savard, Boyd and Smith 1994; Murkin, Murkin and Ball 1997; Timms 1997). Wetlands in India, as elsewhere, are facing tremendous anthropogenic pressures (Prasad et al., 2002), which can greatly influence the structure of bird community (Kler, 2002; Verma et al., 2004; Reginald et al., 2007). Gharana Wetland (Reserve) is an important wintering and stopover site for migratory waterbirds in Jammu and Kashmir State of northern India. This wetland has been subjected to continuous anthropogenic stress which ultimately has affected the habitat utilization by the waterbirds of the wetland. In this paper, an attempt has been made to identify the variations in the abundance of waterbirds at different sites of the wetland subjecting to varying degrees of anthropogenic pressure.

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2. Materials and method

2.1 Study Area

Gharana Wetland (Reserve) 32º 32′ 26″ N, 74º 41′ 24″ E is situated in subtropical Jammu and Kashmir State, Northwestern India (~) 10 miles east of the Indo-Pakistan International border (Fig. 1). Gharana Wetland is under J&K Wildlife Protection Act, 1978 and is declared as 'Important Bird Area'. It is irregular in shape and covers approximately 1km^2 surface area. This wetland lies along the Palaearctic - Oriental migratory route of aquatic birds and serves as a wintering ground for many bird species from Central Asia.

Figure 1: Map of Gharana Wetland (from Google).

During the period of present study (March, 2008 to February, 2009), Gharana Wetland was divided into five stations:

St I: This station lies close to Gharana village and is under continuous stress of anthropogenic influences. Cattle-bathing, washing of vehicles and disposal of cow-dung along with other house-hold waste materials are the common activities occurring at this station.

St II: It is about 300 m away from St I. Despite being very close to Gharana village, this station is not under much anthropogenic stress as compared to Station I.

St III: It is situated exactly opposite to St I and is about 600 m away from St II. It is bordered by large agricultural fields and thus receives agricultural run-off from these fields.

St IV: It is about 530 m away from St I and is situated on the road side.

St V: It is the centre of the wetland with least disturbance.

2.2 Identification

Survey of the wetland to study the aquatic avifauna was conducted by using binocular (Bushnell Costom 10X50) mounted on a tripod at 4-5 day intervals. Birds were counted by four 'main' observers at a time from the terrace of houses near the wetland. An experienced observer was deployed to each 'main' observer to avoid double counting of the birds while they move. Due to the lack of emergent vegetation, it did not interfere with the visibility of the birds during counting. The avifauna thus, observed was identified with the help of pertinent literature: "Birds of the Indian Subcontinent" (Grimmet, 1998), "A Field Guide to the Birds of India" (Kazmierczak and Perlo, 2000), "Waterbirds of Northern India" (Alfred et al., 2002), "The Book of Indian Birds" (Ali, 2002) and "A Photographic Guide to the Birds of India" (Grewal, 2002).

2.3 Census

Census of aquatic avifauna was made during day-time, from 0930h to 1700h, with the help of binocular by Line Transect method (Verner, 1985; Singh, 2009). Four transects each of 500 m were traversed for counting the birds. Block Count method (Singh, 2009) was adopted for estimating aquatic birds present in dense flocks either in flight or on ground and each block was about 200 m^2.

2.4 Statistical methods

To compare the waterbird community, we calculated various indices each month at each station. Species diversity was determined by applying Shannon-Weaver Diversity Index (Shannon and Weaver, 1949), $H' = -\sum_{i=1}^{S} p_i \ln(p_i)$, in which H' is the information content of sample (bits/individuals), S is the number of species and p_i is the proportion of total species belonging to i^{th} species. Simpson's Index of dominance (C) was calculated according to Stone and Pence (1978), $C = \sum_{i=1}^{S} p_i^2$, where p_i is the proportion of total number of individuals of each species. Species richness was determined applying Marglef's Index (Marglef, 1968), $d' = S - 1/\text{Log}_n (N)$, in which S is the total number of species, N is the total number of individuals in sample and Log_n is the Natural log. Evenness was calculated using the Pielou's Index, E = H'/ln S (Pielou, 1969), where H' is the Index of diversity of Shannon-Weaver, ln is the Natural log and S is the total number of species. Percentage similarity of the bird communities at different stations was calculated by Sorenson's Quotient of Similarity (Sorenson, 1948), Q/S = (2j/a+b) 100, where j is the number of species common to both samples, a is the total number of species in sample 1 and b is the total number of species in sample 2. Morisita-Horn Index (Wolda, 1983) was applied to determine the similarity of bird communities in different stations in terms of abundance using the formula: $MH = 2 \sum_{i=1}^{n} (N_{ia} N_{ib}) / (da + db) N_a N_b$, in which N_{ia} & N_{ib} are number of individuals of species 'i' in the samples for site a and b, N_a & N_b are the number of individuals in the samples from sites a and b and n is the total number of species. Diversity indices were correlated using Karl Pearson's Coefficient of Correlation which was tested at 5% level using Student-t test. Two-way ANOVA was calculated to determine the temporal variation in the various parameters among different stations as well as months. Correlation Coefficient, Student-t test and Two-

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way ANOVA was calculated with the help of Microsoft Excel (MS Office, 2007) and SPSS Software (Ver. 16.0).

3. Results and discussion

During the present investigations, a total of 21 species of waterbirds belonging to 5 orders and 6 families were identified (Table 1). Family Ardeidae dominated the waterbird community (33.33%) whereas remaining families exhibited the lower percentages viz. Anatidae (28.57%), Rallidae (14.29%), Charadriidae (14.29%), Phalacrocoracidae (4.76%) and Laridae (4.76%). Not all the species were recorded at every station and annual species richness ranged from 4 (at St I) to 18 (at St III). St II inhabited 15 species while St IV and St V had 14 species each.

Table 1: Checklist of aquatic avifauna inhabiting gharana wetland

Name of the Bird	Order	Family
Amaurornis phoenicurus (White-breasted Waterhen)	Gruiformes	Rallidae
Porphyrio porphyrio (Purple Moorhen)	Gruiformes	Rallidae
Fulica atra (Common Coot)	Gruiformes	Rallidae
Anas crecca (Common Teal)	Anseriformes	Anatidae
Anas strepera (Gadwall)	Anseriformes	Anatidae
Anas clypeata (Northern Shoveller)	Anseriformes	Anatidae
Anas Penelope (Eurasian Wigeon)	Anseriformes	Anatidae
Anas acuta (Northern Pintail)	Anseriformes	Anatidae
Anser indicus (Bar-headed Goose)	Anseriformes	Anatidae
Ardea cinerea (Grey Heron)	Ciconiformes	Ardeidae
Ardea purpurea (Purple Heron)	Ciconiformes	Ardeidae
Ardeola grayii (Pond Heron)	Ciconiformes	Ardeidae
Bubulcus ibis (Cattle Egret)	Ciconiformes	Ardeidae
Casmerodius alba (Large Egret)	Ciconiformes	Ardeidae
Egretta garzetta (Intermediate Egret)	Ciconiformes	Ardeidae
Egretta intermedia (Little Egret)	Ciconiformes	Ardeidae
Phalacrocorax niger (Little Cormorant)	Pelecaniformes	Phalacrocoracidae
Vanellus indicus (Red Wattled Lapwing)	Charadriiformes	Charadriidae
Vanellus leucurus (White tailed Lapwing)	Charadriiformes	Charadriidae
Tringa tetanus (Common Red Shank)	Charadriiformes	Charadriidae
Sterna aurantia (Indian River Tern)	Charadriiformes	Laridae

Aquatic avifauna utilized all the five stations of Gharana Wetland, although their abundance at different stations was found to vary a lot. Annual abundance of waterbirds was observed to be 43, 768, 2750, 1751 and 11386 at St I, II, III, IV and V respectively (Table 2).

Table 2: Annual abundance of aquatic avifauna of gharana wetland.

Name of the Bird	St I	St II	St III	St IV	St V
White-breasted Waterhen	8	2	3	3	0
Purple Moorhen	0	95	0	52	0
Common Coot	0	0	12	0	119
Common Teal	0	52	103	91	391
Gadwall	0	27	27	37	305
Northern Shoveller	0	0	15	0	284
Eurasian Wigeon	0	11	2	0	95
Northern Pintail	0	0	3	0	29
Bar-headed Goose	0	317	2399	1391	9105

Grey Heron	0	0	8	4	0
Purple Heron	0	5	9	4	0
Pond Heron	7	11	26	18	0
Cattle Egret	25	61	69	79	12
Large Egret	0	5	5	5	3
Intermediate Egret	0	1	2	1	1
Little Egret	0	19	19	24	2
Little Cormorant	0	55	9	9	384
Red Wattled Lapwing	3	31	37	33	0
White tailed Lapwing	0	76	0	0	654
Common Red Shank	0	0	2	0	0
Indian River Tern	0	0	0	0	2
Total Avifauna Count	**43**	**768**	**2750**	**1751**	**11386**

The order of utilization of different stations of Gharana Wetland by waterbirds was recorded as St V > St III > St IV > St II > St I. Maximum number of aquatic avifauna was recorded in the centre (St V) of Gharana Wetland which may be due to the lower anthropogenic pressure. Moreover, there existed a condition of open water and emergent vegetation and such a condition of the site of a water body supporting greater densities and diversity of macrobenthic invertebrates has been well documented by Kaminski and Prince (1981) and Murkin et al. (1982) who indicated that this happens when the ratio of emergent vegetation and open water is 50:50. Moreover, macrobenthic invertebrates which constitute the principle diet for waterfowl (Nilson, 1972; Stott and Olsson, 1973; Bellrose, 1980; Jones and Drobney, 1986; Chick and McIvor, 1994) were more closely associated with aquatic vegetation than the barren substrate (Swanson et al., 1974; Joyner, 1980) as decomposition of the vegetation provided an additional nutrients and surface for the proliferation and habitation of macroinvertebrates (Kaminski and Prince, 1981; Mcknight and Low, 1969; Whitman, 1976; Murkin et al., 1982). Nilsson (1972), Stott and Olson (1973), Bellrose (1980) and Jones and Drobney (1986) also reported that waterbird foraged heavily on benthic macroinvertebrates which confirmed the present observation. Decline in the density and productivity of macroinvertebrates due to their predation by waterbirds has been well documented by O'Connors and Brown (1977), Evans et al. (1979), Goss-Custard (1980), Pedroli (1981), Schneider and Harrington (1981), Zwarts and Drent (1981), Quamman (1984), Marsh (1986), Thorp and Covich (1991), Suter and Van Eerden (1992) and Hamilton et al. (1994).

St III was near agricultural fields and was observed to be the less disturbed station which could be the plausible reason of having greater number of waterbirds at this station. Rice fields can provide important waterbird habitat from perspectives of food quality and quantity (Reinecke et al., 1989; Huttink and Siebenmorgen, 1996) as they provide natural food like moist-soil plant seeds, aquatic invertebrates and green forage (Manley et al., 2004). Waterbirds in Gharana Wetland used to procure their additional food from the rice fields flanking the wetland. Greater number of waterbirds at the least disturbed site has been well documented by Quan et al. (2002). Luxuriant growth of macrophytes at St III also attracted a large number of waterbirds for forage and cover. Kaminski and Prince (1981) and Merendino et al. (1995) reported that waterbirds preferred wetland with vegetational characteristics thereby providing cover and foraging area to them. Moreover, Swanson et al. (1974) and Joyner (1980) documented that invertebrates in shallow waterbodies were more closely associated with aquatic vegetation than the barren substrate.

St IV was adjacent to the agricultural fields. At about 50 m from St IV on the road, a considerable amount of anthropogenic activity was noticed as the road was traversed by

pedestrians and occasionally by vehicles. Waterbirds feeding near the periphery of St IV were observed to fly away after having disturbed by the pedestrians and vehicles and started foraging somewhat away from the peripheral region. This may be the plausible reason for less number of waterbirds at this station as compared to St III. Stolen (2003), Thomas et al. (2003) and Blanc et al. (2006) also reported that human disturbance negatively impacted waterbirds by reducing their feeding times.

St II ranked fourth in the habitat utilization by the waterbirds. This station was adjacent to the village while the opposite shore of this station was flanked by agricultural fields. Villagers use this station for laundry and due to the shallowness of the wetland they access to their agricultural fields by passing through the wetland. It was further observed that such anthropogenic influences restricted the use of this station by waterbirds. Very few waterbirds were recorded who came to the shore of this station throughout the year for foraging and they prefer the centre of this station in order to avoid disturbances. Direct approaches of people on foot were very disruptive to the waterbirds causing flight and reducing their foraging times (Burger and Gochfeld, 1993; Thomas et al., 2003; Marcum, 2005). Stolen (2003) and Blanc et al. (2006) also revealed negative impact of human disturbance on waterbirds by reducing their feeding times.

St I was observed to be the least used station by most of the waterbirds. One plausible reason for the avoidance of this station by waterbirds was due to higher anthropogenic stress. Being adjacent to the village, various anthropogenic activities were carried out at this station like cattle bathing, washing of vehicles, entry of domestic sewage and cattle waste, drawing of water by electric motor etc. Regular interference of villagers kept the waterbirds away from this station. Decline in the number of waterbirds due to human disturbance has been well opined by Razafimanjato et al. (2007). Moreover, highest annual macrobenthic count recorded at this station clearly demonstrated that this station was least used by the waterbirds.

The distance from the source of disturbance was greater at St V followed by St III, St IV, St II and St I which may probably be the reason for more number of waterbirds at St V as compared to rest of the stations. Pease et al. (2005) suggested similar relationship between distance from source of disturbance and waterbirds abundance. Sensitivity of birds to human activity varies species to species. Genus *Anas* shows high incidence of flight response due to disturbance from humans (Pease et al., 2005). Non-utilization of some sites of the wetland by Genus *Anas* could be the consequence of greater anthropogenic pressure on them. Erwin (1980) and Guthery et al. (1984) documented that average use of a particular site by the waterbirds was higher where human interference was lower.

These observations revealed that affinity of waterbirds towards different stations varied and most preferable site for the waterbirds was observed to be St V i.e. the centre of the wetland which was the least disturbed and supported maximum number of waterbirds.

The Shannon Index of diversity dropped from 1.975 at St II to 0.665 at St III (Table 3). Monthly Shannon diversity at different stations has been given in Fig. 2. Two-Way ANOVA recorded significant temporal variations in diversity among stations ($F_{4,44} = 10.812$, $p<0.05$) but registered insignificant variations among months. Index of dominance was greater at St III (0.764) and lowest at St II (0.216) (Table 3). Simpson's dominance values exhibited wider monthly variations (Fig. 2). F-Value registered significant temporal variations in dominance among stations ($F_{4,44} = 6.25$, $p<0.05$) but recorded insignificant variations among months. Dominance was found inversely related to the diversity of the community which is in consonance with the observations of Simpson (1949) and Green (1993) who suggested the

same trend. Evenness Index showed maximum evenness at St I (0.800) and minimum at St III (0.230) (Table 3). Pielou's evenness in different months at all the stations has been tabulated in Fig. 2. Two-Way ANOVA recorded significant temporal variation in evenness among stations ($F_{4,44}$ = 20.870, $p<0.05$) as well as among months ($F_{11,44}$ = 2.604, $p<0.05$). The highest Marglef's value of 2.147 was calculated at St III, followed by St II (2.107), St IV (1.741), St V (1.392) and St I (0.798) (Table 3). Highest Marglef's species richness index (which considers both abundance and species number) at St III revealed that this site harbored a good number of waterbird taxa. Richness varies monthly at all the stations which have been clearly depicted in Fig. 2. Two-way ANOVA recorded insignificant temporal variations in richness among stations as well as among months.

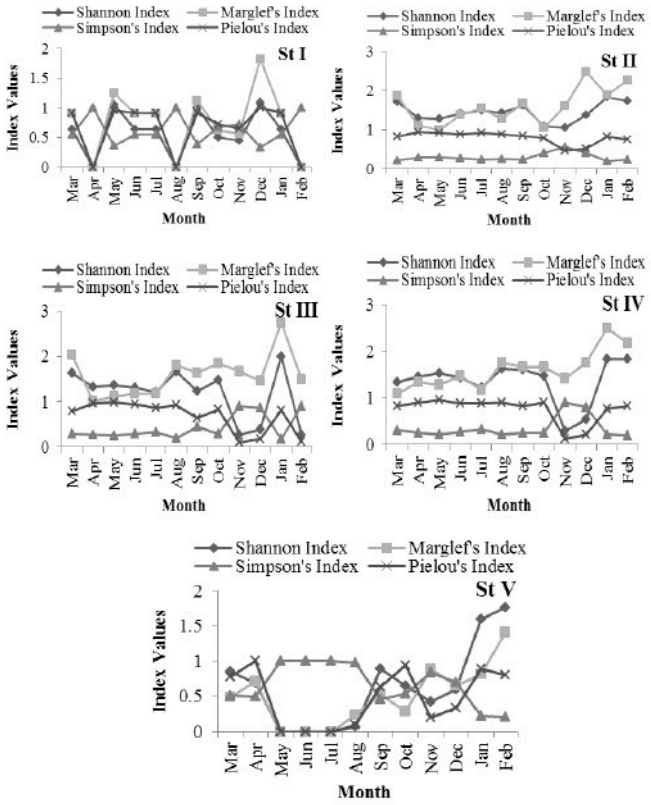

Figure 2: Different diversity indices of five stations.

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Table 3: Diversity indices of waterbird community in five stations

Diversity Indices	St I	St II	St III	St IV	St V
Shanon-Weaver Index	1.109	1.975	0.665	0.930	0.878
Simpson's Index	0.404	0.216	0.764	0.638	0.647
Marglef's Index	0.798	2.107	2.147	1.741	1.392
Pielou's Index	0.800	0.729	0.230	0.352	0.334

When comparison between stations was made by using qualitative presence-absence type, Sorenson's Quotient of similarity (Q/S), St II and IV were found more similar with highest value of 89.66% whereas low similarity (11.11%) was calculated between St I and V (Table 4). Based on meristic data i.e. counts of individuals referring quantitative indices, Morisita-Horn Index showed maximum values of similarity between St III and IV (MH = 0.994) while minimum similarity was found among St I and V (MH = 0.001) (Table 4). Mathews (1986) concluded that Morisita Horn Index below 0.50 indicate low similarities in the relative abundance of species, whereas index above 0.75 indicate high similarities, thereby confirming the high similarity between St III and IV.

Table 4: Different similarity indices to compare the community structure of five stations

Compared Stations	Sorenson's Quotient	Morisita-Horn Index
St I vs. St II	42.11 %	0.167
St I vs. St III	36.36 %	0.030
St I vs. St IV	44.44 %	0.060
St I vs. St V	11.11 %	0.001
St II vs. St III	78.79 %	0.748
St II vs. St IV	89.66 %	0.800
St II vs. St V	68.97 %	0.793
St III vs. St IV	81.25 %	0.994
St III vs. St V	75.00 %	0.991
St IV vs. St V	57.14 %	0.993

4. Conclusion

The information generated from this study gives us a clear picture depicting the effect of intense anthropogenic pressure over the waterbirds of Gharana Wetland, thereby restricting the utilization of wetland by waterbirds to some particular sites instead of exploiting the whole wetland. This piece of work will facilitate to fulfil the great need of framing the diverse conservatory strategies for the reduction of various forms of anthropogenic influence over the waterbirds and their habitat.

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Annexure XV

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Feeding Guilds of Avifauna of Gharana Wetland Reserve-Jammu (J&K), India

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Abstract

An avian survey was carried out in Gharana wetland reserve from Jan 2012 to Jan 2014 to record the avifaunal diversity and their feeding guilds. Gharana wetland Reserve is one of the most important wetland reserve of Jammu region of Jammu and Kashmir state and serves as feeding, roosting and wintering grounds for large number of migratory water birds during their palaeartic to oriental migration. It lies between 32^{0}36' 51.52" N latitude and 74^{0}38'58.15E longitudes. The study documents 57 species of birds. Feeding guilds were divided into 6 major categories viz carnivorous, grainivorous, frugivorous, omnivorous, insectivorous, herbivorous. The highest number of bird species was observed to utilize more than one feeding guild followed by carnivorous, herbivorous, insectivorous, grainivorous, omnivorous and frugivorous. The gharana wetland provides a rich feeding ground to both migratory as well as resident birds.

Keywords: Wetland, Feeding guild, aquatic waterfowl, Jammu.

Introduction

A wetland is a land area that is saturated with water, either permanently or seasonally such that it takes on the characteristics of distinct ecosystem, which is biologically diverse and serves as home to wide range of plant and animal life. Wetlands are natural areas where water helps in development of aquatic and plant life. In India, there are many wetlands of international, national and regional importance[1]. Wetlands of India are very diverse and range from lakes to lagoons, playing a vital role in maintaining biodiversity[2]. The wetland is used by a diverse number of bird species for foraging, nesting and roosting due to their heterogeneity of microhabitats and available rich food resources[3-4]. Wetland birds utilize the wetland habitat to meet their needs. Thus degradation of wetlands have affected the bird populations. There is a global need for recognition of value of wetlands. Wetland management practices should consider the value of wetland as well as various aspects of the effect of human activities on the water quality[5]. Birds are highly mobile and seasonal. The species composition of a particular area may change due to influx of migratory birds. Birds vary a great deal, however, in the extent to which they specialize in a particular environment and a particular item of food. As long as the environment remains unaltered, its conditions regulate the type of species and their numbers. This is a complex and delicate web of life in which all the constituent parts are interdependent, depending upon the three factors of primary importance i.e occurrence of food, nesting places, and predators. A feeding guild can be defined as "a group of species that exploits the same class of environmental resources in the same way[6]. Avian feeding guilds have been suggested as a suitable indicator to monitor all components and interactions of an ecosystem[7]. For birds, food is usually considered to be the most important resource and the feeding guilds have been used extensively by ornithologists in interpreting the assemblages of species. Birds are tolerant of habitat change and they show wide range of feeding guilds[8].

Material and Methods

Study area: The study area i.e. Gharana Wetland is situated between the 32^{0}36'51. 52" N latitudes and 74^{0}38'58.15 E longitudes. It is located at an elevation of 270 meters above sea level. The station is situated near the Indo-Pak International Border in R.S. Pura Tehsil of Jammu District and is at a distance of 35 km from Jammu City. Main sources of water to this wetland are spill over water from Ranbir Canal and surface run-off from agricultural fields. Village Gharana is situated very near to the wetland and lies along the North-South fly way Palaeartic-Oriental migratory route of waterfowls. This reserve is famous for migratory waterfowls. The notified area of Gharana, barring a small patch of marshy pond and adjoining area, more or less comprises of agricultural fields. It is irregular in shape and is declared as "Important Bird Area" and is under wildlife protection Act J&K (1978). The climate is subtropical. Gharana wetland is a naturally maintained swamp surrounded by various macrophytes like Eicchornia sp, hydrilla sp, and Typha i.e. common reed. Area is infested with weeds and is rain fed. The bottom surface comprises loamy clay with decaying vegetation. The reserve area is surrounded with crop fields. Paddy and wheat are the main crops grown by villagers.

Methodology: A through survey was done to study the avian diversity and feeding guilds of the study area from Jan 2012 to Jan 2014. For analysis of avian fauna, Line transect[9] and point

transect[10] methods were used. Identification of the recorded bird species was done with help of field guides and reference books[11-14]. Bird watching and their feeding behaviour were done early in the morning and before sunset in the evening. Besides this, several irregular visits were also made during different hours of the day. Binocular (Bushnell make) was used to record the feeding behaviour of the bird from the distance in order to avoid any distance to them. Photographs were taken with help of 36 X optical zoom camera (Nikon) for easy and correct identification of bird species.

Map of India

Map of Jammu & Kashmir

Location Of Gharana Wetland Reserve - R.S. PURA (Jammu)

Figure-1
Map of Study Area i.e. Gharana Wetland

Figure-2
A View of Gharana Wetland Reserve

Figure-3
A Feeding Flock of Bar Headed Geese

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Figure-4
Different Migratory Ducks in the Wetland

Results and Discussion

The present study was carried out with the aim to analyze the different feeding guilds of the birds in the Gharana Wetland Reserve. Birds are tolerant of habitat change and they show a wide range of feeding guilds[15]. Availability of food in good quantity and quality constitutes one of the prime requisite of bird species in an area. During the present study, records were made of the feeding guilds of 57 avian species. Out of total 57 avian species reported, 16 species were carnivorous, 6 were grainivorous, 1 was frugivorous, 2 were omnivorous, 7 were insectivorous, 8 were herbivorous and 17 species used multiple feeding guilds. A wide stretch of agricultural fields skirting the wetland along with native trees provide additional food to birds in form of seeds, tree-fruits, bees, and animal feeds. So the birds like Red Wattled Lapwing, Indian Myna, White Wagtail, Grey Wagtail, Red Vented Bulbul showing multiple feeding guilds inhabit this area.

Birds of prey such as Pariah Kite, Black Winged Kite, Indian Shikra. Marsh Harrier are completely carnivorous. Their diet consist of fish, eggs and young ones of small birds. Heron primarily feed on fish, it uses its long pointed beak to snatch its prey out of water or from ground. Egrets eat fish, insects, and amphibians. They stalk their prey in shallow water, shuffling its feet to disturb small fish. They may stand still and wait to ambush prey. King fishers eat all aquatic fare like tadpole and fish. Wetland bank and adjoining trees are their seats where they eagerly wait for their prey i.e. fish. Insectivore such as Black Drongo feed on insects. They congregate in adjoining agricultural fields that are ploughed, picking up exposed caterpillars and beetle grubs. Collared pratincole finds its prey in swarming insects, picking the prey from air with a elegance in ploughed fields. House crow feeds in the rice fields because of the greater availability of more number of prey items and also share their feeding sites with Mynas and Cattle Egrets[16].

Ducks, Moorhens and Coots use open water and feed in emergent vegetation. Cormorants and Grebes are known as diving birds as they dive for bottom dwelling animals. White Breasted Waterhen feeds on worms, insects and grain seeds.

Gharana wetland is an avian splendour for the migratory waterfowls such as Bar Headed Geese, Northern Pintail, Northern Shovellar, Gadwall, Lesser Whistling duck and Eurasian Wigeon. About fifteen to twenty thousand birds pass their winters at Gharana. This wetland is on the migration path of waterfowls. Vegetarian birds eat the fruits, tubers and leaves of wetland plants. The increase in the number of migratory species in winter is attributed to availability of space and food resources. Rice fields provide important water bird habitat from perspectives of food quality and quantity, as they provide natural food in form of moist soil plant seeds, and green forage.

Thus Gharana Wetland provides diverse food resources to the birds in form of plants and animals. Some birds find food in wetland soil and others in water column. Aquatic vegetation, abundance of benthic invertebrates, dipteran larvae, variety of insects and a wide stretch of paddy fields adjoining the wetland attributes to the different types of feeding guilds which were employed by various bird species.

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Table-1
Feeding guilds of avian fauna of Gharana Wetland, Jammu

S No	Name of Bird	Scientific Name	Feeding guild
	I Carnivorous		
1.	Little Grebe	*Podiceps rudicolles*	DC
2.	Little Cormorant	*Phalacrocorax niger*	WC
3.	Large Cormorant	*Phalacrocorax carbo*	WC
4.	Night Heron	*Nycticorax nycticorax*	WC
5.	Indian Pond Heron	*Ardeola grayii grayii*	WC
6.	Grey Heron	*Ardea cinerea*	WC
7.	Pariah kite	*Milvis migrans*	ATC
8.	Black Winged Kite	*Falco vociferous*	ATC
9.	Indian Shikra	*Accipiter badius*	ATC
10.	Northern Spotted Owlet	*Athene brama*	ATC
11.	Common Kingfisher	*Alcedo atthisbengalsis*	AAqC
12.	Pied Kingfisher	*Cercyle rudius*	AAqC
13.	Indian Roller	*Coracias bengalensis*	ATC
14.	Rufous Backed Shrike	*Lanius scahach*	ATC
15.	Little Egret	*Egretta garzetta*	WC
16.	Marsh Harrier	*Cercus aeroginous*	ATC
	II Grainivorous		
1.	Indian Blue Rock Pigeon	*Columbia livia*	G
2.	Indian Ring Dove	*Streptopelia decocota*	G
3.	Indian Spotted Dove	*Streptopelia chinensis*	G
4.	Indian Brown Dove	*S. cambayensis*	G
5.	Spotted Munia	*Lonchura punctulata*	G
6.	Baya Weaver	*Ploceus phillipinus*	G
	III. Frugivorous		
1.	Rose Ringed Parakeet	*Psittacula krameri*	F
	IV. Omnivorous		
1.	House Crow	*Crovus splendenes*	ATO
2.	Indian Jungle Crow	*Corvus macrorhynchos*	ATO
	V. Insectivorous		
1.	Indian Green Bee Eater	*Merops orientalis*	AI
2.	Common Sand Piper	*Actitis hypoleucos*	SIP
3.	Black Drongo	*Dicrurus adsimilis*	AI
4.	Indian Robin	*Saxiccoloides fulicata*	TI
5.	Indian Magpie Robin	*Copsychus saularis*	TI
6.	Jungle Babbler	*Turdoides striatus*	UI
7.	Collared Pratincole	*Glareola pratincola*	AI
	VI. Herbivorous		
1.	Bar Headed Geese	*Anser indicus*	H
2.	Northern Pintail	*Anas acuta*	DH
3.	Northern Shovellar	*Anas clypeata*	DH
4.	Common Teal	*Anas crecca*	DH
5.	Gadwell	*Anas stepra*	DH
6.	Eurasian Wigeon	*Anas penelope*	DH
7.	Common Coot	*Fulica atra*	DH
8.	Lesser Whistling duck	*Dendrocygninae javanica*	H
	VII. Birds Using Multiple guilds		
1.	Cattle Egret	*Bubulcusibis coromandus*	WC/UI
2.	Red wattled lapwing	*Vanellus indicus*	SIP/TI
3.	White Breasted Kingfisher	*Halcyon smyrensis*	ATC/AAqC
4.	Indian Koel	*Eudynamys scolopacea*	F/I

5.	Crow Pheasant	*Centropus sinensis*	CI/UI/TO
6.	Bank Myna	*Acridotheres ginginnianus*	G/F/I
7.	Indian Myna	*Acridotheres tristis*	G/F/I
8.	Red Vented Bulbul	*Pycnonotus cafer*	F/I
9.	White Wagtail	*Motacilla alba*	SIP/TI
10.	Yellow Wagtail	*Motacilla flava*	SIP/TI
11.	Indian House Sparrow	*Passer domesticus*	G/I
12.	Indian Moorhen	*Gallinula chloropus*	WC/SIP
13.	Purple Moorhen	*Porphyrio porphyrio*	WC/SIP
14.	Black Winged Stilt	*Himanotapus himantopus*	SIP/AqC
15.	Indian White Breasted Waterhen	*Amaurornus pheoenicurus*	WC/SIP/TI
16.	Indian Large Pied Wagtail	*Motacilla maderapatensis*	SIP/TI
17.	Grey Wagtail	*Motacilla caspica*	SIP/TI

Main Feeding guilds: C- Carnivorous,G – Granivorous, F – Frugivorous, O – Omnivorous I – Insectivorous, H – Herbivorous.

Sub feeding guilds: WC- Wading carnivore, DC – Diving carnivore, ATC – Arboreal Terrestrial Carnivore, AAqC – Arboreal Aquatic Carnivore, AI – Aerial Insectivore, SIP – Shore Insect Plover, TI – Terrestrial insectivore, UI – Understorey insectivore, DH – Diving Herbivore, ATO – Arboreal Terrestrial Omnivore.

Carnivore: Feeding on animal matter like fish, amphibians, reptiles, buds and small mammals.

Grainvore: Feeding on grains

Frugivore: Feeding on fruits

Insectivore: Feeding on insects

Herbivore: Feeding on young shoots, roots, leaves and sprouts of vegetation.

Omnivore: Feeding on all types of food including vegetable matter, fruit, insects and other animal matter.

Conclusion

Gharana Wetland is biologically very productive and provides feeding grounds for a diverse range of resident and migratory birds. Thus in birds, feeding guilds provide insight into the ecology of species and are particularly useful in studies that assess specific ecological drivers of community change. Species belonging to the same guild utilize the same kind of resource in a similar manner. Guild categorization among birds emphasizes upon functional component of community in an ecosystem[17]. Feeding is an important activity in the life of the bird which is indispensible for their survival[18].

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