# NMHS-FINAL TECHNICAL REPORT (FTR)

| NMHS Grant Ref. No.: | GBPNI/NMHS-2019-20/SG |
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| Date of Submission: | 2 | 2 | 0 | 8 | 2 | 0 | 1 | 9 |
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# WATERFOWL ECOLOGICAL MONITORING AND CONSERVATION THROUGH COMMUNITY PARTICIPATION AND RURAL LIVELIHOOD IN SHALLABUGH WETLAND RESERVE, KASHMIR (J&K)

**Project Duration:** *from* (**22/08/2019**) *to* (**31/03/2022**).

***Submitted to*:**
Er. Kireet Kumar
Scientist 'G' and Nodal Officer, NMHS-PMU
National Mission on Himalayan Studies, GBP NIHE HQs
Ministry of Environment, Forest & Climate Change (MoEF&CC), New Delhi
E-mail: nmhspmu2016@gmail.com; kireet@gbpihed.nic.in; kodali.rk@gov.in

***Submitted by*:**
*Dr. Khursheed Ahmad,*
*Senior Scientist & Head, Division of Wildlife Sciences*
*SKUAST-Kashmir Srinagar J & K*
*Contact No: 9419543879*
*Email: khursheed47@gmail.com*

**NMHS-Final Technical Report (FTR)**

Demand-Driven Action Research Project

*DSL: Date of Sanction Letter*

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## Part A: Project Summary Report

### 1. Project Description

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| i. | Project Grant Ref. No.: | GBPNI/NMHS-2019-20/SG |
| ii. | Project Category: | Small Grant ☐ Medium Grant ■ Large Grant ☐ |
| iii. | Project Title: | "Waterfowl Ecological Monitoring and Conservation through Community Participation and Rural Livelihood in Shallabug Wetland Reserve, Kashmir (J&K)" |
| iv. | Project Sites (IHR States/ UTs covered) (*Location Maps attached*): | Shallabugh Wetland Reserve Ganderbal Jammu & Kashmir 191201-34°09′ N, 74°43′E |
| v. | Scale of Project Operation: | Local ■ Regional ☐ Pan-Himalayan ☐ |
| vi. | Total Budget: | 29,27,899.00 Cr |
| vii. | Lead Agency: | Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir |
| | Lead PI/ Proponent: | Dr. Khursheed Ahmad,<br>Senior Scientist & Head, Division of Wildlife Sciences<br>Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir (SKUAST-Kashmir) Srinagar ( J & K)<br>Email: khursheed47@gmail.com |
| | Co-PI/ Proponent: | 1. Dr. Asad R. Rahmani<br>former Director, Bombay Natural History Society (BNHS)<br>Hornbill House (Opp. Lion Gate), Dr. Salim Ali Chowk, S.B. Singh Road, Mumbai 400 023.<br>Cell:9820516394;7007997504Email;rahmani1.asad@gmail.com<br><br>2. Capt. (Dr.) Parag Nigam,<br>Scientist F, Wildlife Health Management Department<br>Wildlife Institute of India, Dehradun.<br>Tel. 0135-2646219; Cell: 9412974486<br>Email: nigamp@wii.gov.in<br><br>3. Mr. Rashid Y. Naqash, Regional Wildlife Warden, Kashmir Region,<br>Department of Wildlife Protection, J & K Government<br>Email:hangulnaqash@gmail. |
| viii. | Implementing Partners: | Department of Wildlife Protection, Government of Jammu and Kashmir<br>Wildlife Institute of India, Dehradun |
| | Key Persons (Contact Details, Ph. No., E-mail): | Dr. Khursheed Ahmad<br>Email: khursheed47@gmail.com<br>+919419543879 |

## 2. Project Outcomes

### 2.1. Abstract


**Background**

The wetlands of Kashmir, including Shallabugh Wetland Reserve, play a crucial role in sustaining biodiversity and supporting local livelihoods. These wetlands serve as vital stopover sites for long-distance migratory waterfowl, providing them with feeding and resting opportunities. Additionally, they serve as breeding habitats for numerous waterfowl species during the summer months. Despite the Himalayan mountain range acting as a barrier for migration of many species breeding in northern areas and traveling to south for wintering, the wetland attracts a significant number of waterfowl species, surpassing the 1% population threshold determined by Wetlands International (2002). Unfortunately, studies on the ecology of waterfowl, particularly Anatidae, at such staging or stopover wintering sites are often neglected. Therefore, it is imperative to focus on conserving, restoring, and managing these wetlands to benefit waterfowl, wildlife, and local communities.

**Aims** The primary objective of this study was to monitor and assess the population status, nesting and breeding ecology, as well as movement and migratory patterns of resident and migratory water birds, particularly ducks and geese. Additionally, the study aimed to work with fringe communities to develop their capacities for generating alternate livelihoods through ecotourism activities such as waterfowl viewing, nature guiding, campsite management, and homestays.

**Methodology:** To achieve our goals, we conducted regular bird monitoring using standard line transect and point count methods in conjunction with MacKinnon lists in Shallabugh Wetland Reserve during all four seasons (spring, summer, autumn, and winter) over a two-year period. We identified nest sites and monitored breeding ecology of water birds from April to August in both 2020 and 2021. To study movement and migratory patterns, we captured select species of waterfowl (Shoveller and Greylag Goose) using mist nets and traditional leg noose line trapping techniques. We tagged these individuals with Satellite PTTs using a standard backpack Teflon harness and also performed bird ringing.

Efforts were made to engage with local communities, specifically targeting the young and educated youth from fringe communities, to enhance their skills and capacities in ecotourism and bird tourism. The primary objective was to promote the concept of nature-based tourism and empower them through comprehensive training, skill-building, and entrepreneurship development. This initiative was carried out in close collaboration with private players and self-help groups (SHGs) to establish an enabling environment for the promotion of nature-based tourism as a sustainable and improved livelihood opportunity for marginalized communities in the region.

**Results:** Throughout the study period, a total of 76 species of water birds, including 12 species of waterfowl from the Anatidae family of Anseriformes, were recorded visiting and utilizing Shallabugh Wetland Reserve in significant numbers. Encounter rates ranged from

162±64 birds/km in winter to 56.67±1.99 birds/km in summer. The wetland, which supports 29 plant species, is predominantly dominated by *Typha latifolia* (Importance Value Index IVI of 22.8) and *Ceratophyllum demersum* (IVI of 19.2). We identified and monitored a total of 227 nests belonging to six water bird species, namely Mallard (*Anas platyrhynchos*), Common moorhen (*Gallinula chloropus*), Common coot (*Fulica atra*), Grey-headed Swamphen (*Porphyrio porphyrio*), and Little grebe (*Tachybaptus ruficollis*), throughout the breeding seasons. The data revealed that water birds initiated egg-laying in the first week of April, with the last nest completing hatching by the end of August in both study years. The peak nesting period for all five monitored species occurred during May. Mallards exhibited an average clutch size of 8±3, which was the highest among the water birds nesting in the area. Tracking data from a Shoveller (*Spatula clypeata*) tagged with a 22 g Solar Argos/GPS PTT, manufactured by Microwave Telemetry Inc. USA, showed regular movements between major wetlands in the Valley, covering a distance of 14,300 km from March 25 to July 2022. The tagged Shoveller did not migrate from Kashmir, and during monitoring, we observed regular movements of the tagged Shoveller with a group of 15–30 Northern Shoveler and a significant number of Pintail between the Chatlam-Manibugh, Kranchu, and Freshkuri wetlands in Pampore throughout the summer breeding season. The birds spent their daytime in the wetlands and foraged in agricultural fields during the night. However, we did not observe any evidence of nesting or breeding by Shoveller or Pintail in the landscape during the breeding period.

Examinations of the resource reliance, socioeconomics, and attitudes among settlements on the fringes of Shallabugh wetland indicated a heavy dependence of livestock, poultry, and duck-raising families on the wetland. Approximately 77% of these families relied on the wetland marsh for feed, fuelwood, construction materials, and fish. Therefore, improving the economy of wetland fringe communities will contribute to conservation efforts. As part of the capacity-building activities under the project, we provided hands-on training in scientific and business skills related to ecotourism/bird tourism to approximately 15 educated youth from fringe communities surrounding Shallabugh Wetland. This training aimed to equip them with the necessary knowledge and skills to generate respectable livelihoods through the enhanced sustainable opportunity of ecotourism and wildlife and bird guiding. Furthermore, we trained 15 front-line staff members from the JK Govt. Forest/Wildlife Staff in science-based practices, waterfowl monitoring techniques, and wetland management.

**Outcomes and Conclusions:** The research project yielded significant outcomes and conclusions. The key findings are as follows:

Water Bird Diversity: The study recorded a total of 76 species of water birds, including 12 species of waterfowl from the Anatidae family of Anseriformes, visiting Shallabugh Wetland Reserve in significant numbers.

Nesting and Breeding Ecology: The breeding ecology of water birds was closely monitored, and a total of 227 nests belonging to six water bird species were identified and observed throughout the breeding seasons. The data revealed the timing of egg-laying, with the peak

nesting period occurring in May.

Movement and Migration Patterns: Tracking data from a tagged Shoveller revealed regular movements between major wetlands in the Valley, covering a substantial distance. However, nesting or breeding behaviors of Shoveller were not observed during the breeding period.

Wetland Resource Reliance: The study highlighted the heavy dependence of fringe communities on Shallabugh Wetland for resources such as feed, fuelwood, construction materials, and fish, with approximately 77% of families relying on the wetland marsh for their livelihoods.

Capacity Building and Community Engagement: Efforts were made to enhance the skills and capacities of local communities, particularly the young and educated youth, in ecotourism and bird tourism. Training programs were conducted to equip them with scientific, business, and guiding skills related to wildlife and bird tourism.

**Recommendations:** To ensure the year-round availability of water and sustain the wetland's characteristics as a stopover feeding habitat for long-distance migratory water birds and breeding habitat for resident species, we recommend implementing a set of habitat management interventions and measures. The wetland has significant potential to become one of the premier bird tourism attractions in the Valley. Strengthening research on bird monitoring and migration studies, raising awareness, building scientific and business capacities in ecotourism/bird tourism among students and local communities, and organizing regular bird festivals inspired by the Japanese Crane festival are essential steps toward attracting quality high-end tourists to the region, promoting bird conservation and generating income for local communities. These initiatives will contribute to the ecological conservation and sustainable livelihood development of the local fringe communities. By improving the economy of these communities through ecotourism and alternative livelihood opportunities, their dependence on the wetland can be reduced, leading to more effective conservation efforts.

**Exit Strategy:** The research project should focus on transitioning from direct involvement to a sustainable and self-sustaining model. This can be achieved through the following steps:

Knowledge Transfer: Document and publish the research findings, making them accessible to relevant stakeholders, conservation organizations, and local communities. This will ensure the continuity of knowledge and enable informed decision-making for future conservation efforts.

Capacity Building Continuation: Continue providing training programs and capacity-building initiatives for local communities, ensuring that they have the necessary skills and knowledge to sustain the ecotourism and bird tourism activities on their own.

Collaboration and Partnerships: Foster partnerships with governmental and non-governmental organizations, private players, and self-help groups to ensure the continuity and growth of conservation and livelihood development initiatives in the region.

Monitoring and Evaluation: Establish a long-term monitoring and evaluation framework to assess the effectiveness of the implemented recommendations, track the progress of bird populations and habitats, and make necessary adjustments or improvements based on the

findings.
By following these recommendations and having implemented a well-defined exit strategy, the research project has left a lasting impact on waterfowl ecological monitoring, conservation, and the sustainable development of local communities in the Shallabugh Wetland Reserve, Kashmir (J&K)

### 2.2. Objective-wise Major Achievements

| Objectives | Major Achievements |
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| 1. To study and monitor migratory status, movements from wintering to breeding areas and to identify migratory routes, movement patterns and breeding behavior of the major resident and migratory waterfowl species particularly ducks and geese in Shallabugh wetland reserve, Kashmir valley. | •Database generated on the status, distribution, diversity and abundance of 76 Water bird species recorded in the wetland during the study period (January 2020-March 2022). The bird diversity of the wetland was dominated largely by ducks and geese of family Anatidae of which 41 species were resident, 15 were summer migrant, 10 long-distance winter migrants.<br>•Highest bird diversity was seen in spring (Shannon H = 3.8), followed by winter (Shannon H = 3.6), while summer and autumn showed the same diversity (Shannon H = 3.5). The study provides information on the status and ecology of birds for effective management and long-term conservation planning for the avifauna and habitats in the wetland reserve.<br>•Database generated on nesting ecology and breeding biology of 06 species of water birds Mallard (Anas platyrhynchos) Common moorhen (Gallinula chloropus), Common coot (Fulica atra), Grey-headed Swamphen (Porphyrio porphyrio), and Little grebe (Tachibaptis ruficollis) and reed warbler which include and 02 species of forest birds generated through identification, study and monitoring of 227 nests in and around Shallabugh Wetland reserve during the breeding seasons (April to August) 2020 and 2021.<br>•Prepared LULC map of the wetland and mapped all the nest locations and the identified breeding sensitive areas on the LULC for effective management protection and conservation planning.<br>•Successfully captured and tagged two waterfowl species Shoveller and Graylag Goose with 22 g Solar/GPS Satellite-100 PTT Transmitter procured from Microwave Telemetry Inc. USA and ringed dozens of ducks and geese and other water birds and studied and monitored their movement and migratory patterns and behavior. The satellite tracked data of the tagged Shoveller provided valuable information on the movement and migratory patterns and potential diurnal and night roosting/feeding sites of the species across the Kashmir Valley.<br>•The satellite tracking and monitoring data indicated regular movement of the tagged Shoveller between all the major wetlands of the Valley and the bird covered an area of 14300 km2 travelled in around five months from 25th March to August 2022 with maximum distance of 6300 km travelled in May 2022.<br>•During the monitoring and scan sampling we observed the tagged Shoveller with a group of 15–30 Northern shoveller in Manibugh Wetland Pampore. The tagged Shoveller used the wetlands of Pampore regularly |

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| | during day hours and agricultural fields during the night hours.<br>•The tagged bird however, did not show any evidences of nesting or breeding in the landscape during the breeding period. However, in the near future, we anticipate that the Shoveler and the Pintail may nest in the valley. Birds that stayed in Kashmir were seen adapting to the landscape, but they did not appear to be a good fit for the environment<br>•Attempts also put in to assess Genetic characteristics and phylogeographic status of migratory waterfowl and water birds of Rallidae and Anatidae based on mitochondrial analysis of the blood samples collected during bird ringing and satellite tagging activities.<br>•Database generated on the bird beviour, activity patterns of five water birds species. Eurasian coot, Little Grebe, Mallard, Common moorhen, Swamp hen Data indicated water birds spent most of time in Resting 22.6± 5.4 % of total daily time followed by Foraging 17.4±4.6 % and least (9.3±0.7%) in diving<br>•The food and feeding habits observations were recorded through focal animal sampling. The data indicated predominant use of plant matter by the waterfowl. However, Eurasian coot and Little Grebe were observed significantly using Mollusca and small insects.<br>•Database generated on the Species Diversity and Composition of Macrophytes in Shallabugh wetland. The wetland inhabits 39 species of macrophytes belonging to 27 families dominated largely by Typha latifolia showing an Importance Value Index (IVI of 22.8 and Ceratophyllum demersum with an IVI=19.2. The shift in macrophyte community structure is evidenced by the local extinction of Nelumbo nucifera from the Shallabugh wetland and the near-disappearance of some economically important plants such as Trapa natans which showed least IVI of 0.24. The investigations reveals that macrophyte species composition in Shallabugh wetland has witnessed significant changes over the years. |

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| 2. To ensure biodiversity particularly waterfowl conservation through community participation by generating awareness and skill development of the tribal and marginal communities in nature based enhanced alternative livelihood model of ecotourism for socio-economic upliftment. | •Database on the socio-economic and livelihood dependence on the wetland of the fringe villages around Shallabugh generated towards ensuring ecotourism sustainability while reducing impacts on the environment and wildlife.<br>•04 Training/Awareness Programmes Organized for 25 local unemployed youth as the prime beneficiaries along with 15 frontline staff of Forest/wildlife departments.<br>•Around thirty members of the local community participated in our nature guide and bird guide training programmes,<br>•15 educated fringe community youth provided hands on field training and exposure in ecotourism bird tourism, use of websites for marketing and advertisements to help them generate livelihood through this new enhanced livelihood opportunity.<br>•01 Home stay with indigenous culture and cuisine developed as a model in partnership with local entrepreneur.<br>•02 fringe community families given training and motivation for entrepreneurship development in ecotourism.<br>•Trained 15 front line staff of JK Govt. Forest/Wildlife Staff in science based practices and techniques of waterfowl monitoring and wetland management.<br>•Provided hands on training to frontline staff and local youth on use of GPS voice translating APP for monitoring and surveillance<br>•Identified Bird Monitoring Tracks for advertisement for birding around the Wetland.<br>• A mega Shallabugh Bird Festival organized in collaboration with the Stakeholder J & K Govt. Department of Wildlife Protection, District Administration, Ganderbal, Local communities, young budding bird watchers and photographers for bird tourism promotion. |

Further details are summarized in DPR Part-B, Section-5. Supporting is enclosed as appendix separately to the FTR.

**2.3. Outputs in terms of Quantifiable Deliverables***

| S# | Quantifiable Deliverables* | Monitoring Indicators* | Quantified Output/ Outcome achieved | Deviations, if any, & Remarks |
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| 1 | Database on Breeding biology of ten (10) resident migratory waterfowl and water bird species | • Database on breeding biology (Nos.) | A total of 227 nests of 06 species of water birds and 02 species of forest birds were identified in and around Shallabugh Wetland reserve and monitored for breeding biology study.<br>The nest locations have been mapped on LULC map of the wetlands prepared<br>In all the species observed both the parents were involved in nesting and an average of 4-5 days was utilized in nest building by water birds. The Mallard had the highest clutch size of 8.19±2.17 eggs followed by cluch size of 6.69±2.52 eggs and 6.50±0.71 eggs observed in Common moorhen and Grey headed swap hen respectively (Fig. 2.4 & 2.5). The waterfowl showed significantly good chick survival than terrestrial birds. The chicks | |

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| | | | of terrestrial birds (Reed warbler and crow) showed significant chick mortality (25% and 20% respectively) owing to predation. (Table 2.1 & 2.2) | |
| 2 | Database on the movement and migratory pattern of 02-03 Waterfowl species | Database on movement and migratory patterns of waterfowl (Nos) | We successfully attached 22 gm Microwave Satellite Telemeters Solar/GPS PTT-100-animal tracking devices to one male Northern Shoveller and one Graylag Goose to track and understand their movement and migratory patterns and activity patterns and behaviour. The tagged bird began providing movement data immediately after the PTT was installed in March, moving over 5 kilometres from the installation site. MCP activity-range estimates were calculated for day and night and for the months from March to July 2022 when the PTT was functional. The data management tool in ARC MAP, version 3.3 (ESRI, Redlands, California), was used to calculate MCP activity ranges for each satellite-tagged Shoveller.<br>A total of 5867 locations of the PTT were provided by the Argos satellite on a daily basis from March 2022 to August 2022. The data revealed regular movements by the Shoveler between all the major wetlands of the Valley, from the tagging site in Mirgund to Manibugh/Chatlam wetlands, Pampore, Shallabugh Wetland Reserve, Wular Lake through Dal Lake, Nigeen and Anchar Lakes, to Hokersar Wetland Reserve. The activity range varied significantly from one month to the next and from day to night. For example, during May, the Shoveler used the majority of the Valley's area, possibly due to the low availability of food and increased disturbance. We found that water birds spent most of their time feeding on agricultural land at night, while the remaining harvest from the fields in autumn was left over for birds to feed on. Ploughing of lands begins in April, which increases the level of disturbance in agricultural areas, causing birds to move from one location to another in search of food, resulting in an increased local activity range of the birds.<br>We used PTT data to investigate the Thiessen polygons and mapped Shoveled territories regarding territory size, shape and neighborhood. Mostly the area used is pampore wetlands.<br>During the regular bird monitoring we observed a group of 15–30 Northern Shoveller, including the tagged bird in the nearby wetlands in Pampore during | |

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| | | | summer indicating that some population of Northern Shoveller and Northern Pintail did not migrate and remained in Kashmir. This may be a negative effect of global warming, which brought spring to Kashmir earlier than usual. However, we did not find evidence of nesting of these birds in the wetlands of Kashmir during our monitoring.<br>We also attempted to assess Genetic characteristics and phylogeographic status of migratory waterfowl and water birds of Rallidae and Anatidae based on mitochondrial analysis of the blood samples collected during the ringing and tagging of waterfowl in 2018-19 under the previous SERB funded research study. The analysis is in process and we aim to be providing probably first time the genetic characteristics and the phylogeography of maternal ancestry of selected bird species of family Rallidae (Common Moorhen *Gallinula chloropus*; Common coot *Fulica atra*) and Anatidae (Common Teal *Anas crecca*; Northern Shoveler *Spatula clypeata* and Gadwall *Mareca strepera*) for the samples collected during ringing and Satellite tagging mainly from Shallabugh wetland. We are attempting to determine the phylogeographic relationship of species family Rallidae and Anatidae visiting the Kashmir Valley by comparing the data of mt DNA genome available in public domain. | |
| 3 | Database on the Status distribution, diversity and abundance of migratory and resident waterfowl and water bird of Shallabugh Wetland. | Database on the Status distribution, diversity and abundance of migratory and resident waterfowl and water bird assessed and monitored (no). | A total of 76 species of Birds belonging to 35 families and 13 orders which include 17 species of water birds belonging to 6 families viz; *Anatidae, Ardeidae, Rallidae, Scolopacidae, Podicepididae, Halcyonidae* were recorded in Shallabugh Wetland Reserve.<br>The Family Anatidae has the maximum number of recorded species (n=12) as the study area was a wetland ecosystem, and had the highest RDI (15.78).<br>A significant data has been generated on this aspect of waterfowl ecology. The wetland is a wintering habitat for diversity of migratory birds which contributed maximum to the bird composition. The yearly waterfowl population estimates during study period showed wide variations during the reporting period 2019-2021 with an average of 3, 07,011 birds recorded in winters when the wetland blushes with migratory and residential birds (Table 3 & 4: Fig. 4). Average Encounter rate of birds at | |

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| | | | shalabugh was computed 55.8±32 with maximum in winter and minimum during late summer with a Shannon Diversity Index (H) of 3.415. Relative abundance estimation of 31 species which had the significant data indicated predominance of Eurasian coot, common teal and Mallard followed by other waterfowl species in Shallabugh wetland. Graylag Goose showed lowest relative abundance. (Table 3 & 4).<br>We also attempted to study and monitor the bird behavioral and activity patterns and food and feeding habits of waterfowl. A total of 1870 minutes were spent in observing the activity patterns of the Five water birds species. Eurasian coot, Little Grebe, Mallard, Common moorhen, Swamp hen. Data indicated water birds spent most of time in Resting 22.6± 5.4 % of total daily time followed by Foraging 17.4±4.6 % and least in diving 9.3±0.7. (Table 7 Fig. 5)<br>The food and feeding habits observations were recorded through focal animal sampling. The data indicated a predominant use of plant matter by the waterfowl, except Eurasian Coot and Little Grebe, which were observed significantly using mollusks and small insects. Scanning usually demanded rapid assessments on the part of the observers since, especially in foraging flocks, the birds moved rapidly and erratically. (Table 8)<br>We also sampled 131 random plots for vegetation assessment using standard quadrate sampling methodology. Shalabugh wetland reservoir constitutes diverse habitat with different vegetation patches attracting water birds 131 random vegetation plots were initially laid from the reservoir which showed dominance of Emergent vegetation (Table 9; Fig 6). Based on the vegetation sampling land use land cover (LULC) map of the wetland (Fig. 7) and waterfowl distribution and nest location maps were prepared (Fig.8 ) | |
| 4 | (02) Eco tourism-cum Home stays with indigenous culture and cuisine shall be developed around the fringe village of Shallabugh | Home stays Developed (Nos) | **We successfully identified and generated interest in one of the local** youth entrepreneur near the Shallabugh Wetland which resulted in the **Development of 01 Eco tourism-cum Home stay** with indigenous culture and cuisine near the Shallabugh Wetland in partnership with local entrepreneur as a model to promote ecotourism, eco-guiding, Waterfowl viewing and home stay | |

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| | | | as a new enhanced sustainable livelihood opportunity for the local communities.<br>**Efforts were also put in to generate interest in 02 fringe community** families and they were given training and motivation for entrepreneurship development in ecotourism and home stay development. | |
| 5 | Training and skill building of 15 local youth as tourist and wildlife/eco-guides. | Number of Training/Awareness Programme Organized | Conducted two one day awareness-cum-training programmes on Ecotourism and wetland conservation for the fringe communities and frontline staff of forest department to initiate training and skill building of local youth as tourist and wildlife/eco-guides. 25 local fringe community youth of Shallabugh and Wular Lake beside 10 frontline staff of forest department participated in these programs<br>Fifteen (15) educated youth of fringe communities around Shallabugh Wetland were provided hands on training and scientific and business skills in ecotourism/bird tourism to help them generate respectable livelihood through this new enhanced sustainable livelihood opportunity of ecotourism and wildlife and bird guiding.<br>Trained 15 front line staff of JK Govt. Forest/Wildlife Staff in science based practices and techniques of waterfowl monitoring and wetland management. | |
| 6 | Enhancing/doubling the livelihood/income targeted stakeholder from an average of around Rs. 15000/month/family through adoption of this new improved alternative livelihood opportunity of ecotourism, eco-guiding, Waterfowl viewing and home stay. | Number of beneficiaries village/ local people (Nos)<br><br>Increased the income or employment of women farmers (%) | Socio-economic surveys conducted in 200 households around the Shallabugh Wetland Reserve provided valuable data on the income sources of the local community. The survey indicated that 64% of the total fringe community population is largely involved in farming and daily labour besides being dependent on the wetland for generating their income through fishing, wicker willow weaving, NTFP collection, particularly Guchi *Morchella* collection and other activities.<br>Through the adoption of new improved alternative livelihood opportunities such as ecotourism, eco-guiding, waterfowl viewing, and home stays, the project successfully facilitated the diversification of income sources for the targeted daily labour class of the stakeholders. Prior to the project, agriculture was the primary income source, accounting for 22% of total income and daily labour for 42% of the total income. After the project, the income generated by the targeted stakeholders (i.e, 12% daily labour class of the surveyed households) increased by > 20% through adoption of bird guiding, | |

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| | | | ecotourism and related activities as a new enhanced sustainable livelihood opportunity.<br><br>The project attracted a broader group of low to medium budget travelers interested in birding and waterfowl viewing. As a result, the number of tourists visiting the Shallabugh Wetland Reserve for ecotourism purposes or the total number of tourist visits significantly increased **from 10% to 30%** annually during the two year's project duration.<br><br>The project successfully encouraged the local community to adopt ecotourism and bird tourism as an enhanced and sustainable livelihood option. A significant percentage of the targeted stakeholders i.e., the educated fringe community youth (e.g., 20 % of surveyed households) actively engaged in ecotourism-related activities and generated income through waterfowl viewing, eco-guiding, or home stays.<br>The project involved 6 internationally renowned individual experts and 04 renowned wildlife photographers who visited the Shallabugh Wetland Reserve to promote the area and enhance ecotourism, bird tourism and wildlife photography. | |
| | Develop the knowledge products: 01 Policy, 01 manual document and 2-3 publications in well reputed journal | No. of Reports/Research articles/Policy documents prepared and published (Nos.) | • One research Paper under review in BMC Genomics.<br>• Three articles submitted and being published in the ENVIS bulletin *BUCEROS*<br>• Three papers communicated to reputed journals for publication. | |

*As stated in the Sanction Letter issued by the NMHS-PMU.

### 2.4. Strategic Steps with respect to Outcomes

| S# | Particulars | Number/ Brief Details | Remarks/ Attachment |
|---|---|---|---|
| 1. | New Methodology/ Technology developed, *if any*: | 1. Movement and migration pattern of waterfowl studies using advanced Satellite telemetry. Solar/GPS Satellite PTT-100 installed on two waterfowl species Graylag Goose and Northern Shoveler.<br>2. Satellite data will be uploaded to Move bank for international concern with proper acknowledgement of NMHS. | Move bank help animal tracking researchers to manage, share, protect, analyse and archive their data. |

| S# | Particulars | Number/ Brief Details | Remarks/ Attachment |
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| 2. | New Ground Models/ Process/ Strategy developed, *if any*: | Five nos. of nature trails/ Bird Monitoring Tracks Identified and Advertised for birding around the Wetland.<br><br>GPS voice translating APP for monitoring and surveillance developed and Hands on training given to frontline staff and local youth on the use of the APP. | This will help effective monitoring and surveillance of the water birds and assessment of their habitats. |
| 3. | New Species identified, *if any*: | The present study has added 57 bird species to the previous checklist of Wani et al. 2020, which shows a vital contribution of the study. | Checklist of birds attached |
| 4. | New Database established, *if any:* | • Data base generation of the status and distribution of waterfowl in and around the Shallabugh wetland and associated wetlands in the region<br><br>• Established a comprehensive database and checklist of 76 species with their local names.<br><br>• Identified and established a comprehensive database of 225 nests and nesting and breeding ecology of the five water birds and 02 terrestrial forest birds. Studies the conservation and management of nesting sites for these six species of water birds and two forest species. | Check list attached<br><br>Knowledge and experience sharing and learnings on waterfowl ecology and wetland management with the frontline staff of the Stakeholder Forest and Wildlife Department and local communities has been a great learning experience. |

| S# | Particulars | Number/ Brief Details | Remarks/ Attachment |
|---|---|---|---|
| . | New Database established, *if any:* | • Developed sustainable management strategies for the wetland based on species diversity and composition of macrophytes.<br>• Database on the socio-economic and livelihood dependence on the wetland of the fringe villages around Shallabugh generated towards ensuring ecotourism sustainability while reducing impacts on the environment and wildlife.<br>• Promoted sustainable livelihoods based on the socio-economic evaluation of fringe communities living around Shallabugh wetland.<br>• Utilized insights from satellite telemetry to enhance conservation efforts and monitor movement patterns of waterfowl species particularly Norhern Shoveler.<br>• Ensured ecotourism sustainability by using the generated database on socio-economic and livelihood dependence to inform practices.<br>Implement guidelines and regulations to minimize negative impacts of tourism on the environment and wildlife.<br><br>Provided training to local guides and established mechanisms for revenue sharing and community participation in ecotourism activities.<br><br>By implementing these strategies, the project helped to conserve biodiversity, support sustainable livelihoods, protect nesting sites, monitor wildlife movement, promote responsible tourism, and engage local communities in the sustainable management of the wetland. | Through this study, our efforts have yielded positive outcomes in mobilizing the Government Wildlife Protection department to take proactive measures. As a result, we have secured a grant of 100,000 to support bund raising initiatives aimed at ensuring the yearlong retention of water in the Shallabugh wetland. This significant step will contribute to the preservation of the wetland ecosystem and the sustenance of its biodiversity. By collaborating with government agencies and securing funding for essential conservation measures, we are fostering a sense of shared responsibility and taking concrete action towards the long-term protection of this valuable natural resource. |
| 5. | New Patent, *if any*: | NA | |
| | I. Filed (Indian/ International) | | |

| S# | Particulars | Number/ Brief Details | Remarks/ Attachment |
|---|---|---|---|
| | II Technology Transfer, *if any*: | | |
| 6. | Others, *if any* | | |

*Note:* Further details are summarized in DPR Part-B, Section-5. Supporting materials is enclosed as appendix separately to the FTR.

### 3. New Data Generated over the Baseline Data

| S# | New Data Details | Status of Existing Baseline | Addition and Utilisation New data |
|---|---|---|---|
| **1.** | Seasonal abundance checklist of 76 bird species. | Previously studies by Wani et al. (2020) have recorded and listed only 19 species of birds along spatiotemporal gradient in Shallabugh wetland. | Checklist would be helpful in boosting ecotourism in the shallabugh wetland because it will help overcome some of the barriers that exist between residents and tourists while communication is taking place. |
| **2** | A total of 226 nests of the five water bird species was observed and added the data of mallard to the existing nesting bird data. | This wetland was considered as the non-nesting ground of Mallard by an earlier study titled, "Recovery of breeding Mallards (*Anas platyrhynchos*) in Kashmir, India", by Ahanger et al. (2013). | Enhanced the focus of the forest department for the management of the wetland. |
| **3** | Database on the socio-economic and livelihood dependence on the wetland of the fringe villages around Shallabugh generated towards ensuring ecotourism sustainability while reducing impacts on the environment and wildlife. | No earlier studies have been done on the socioeconomic status of the fringe community to check the intensity of dependency on the wetland. | This will help in management of resources efficiently by the forest department and local level organisations |
| **4** | Baseline data generated on the Species Diversity and Composition of Macrophytes | No baseline data | The study highlighted the macrophyte community structure is evidenced by the local extinction of *Nelumbo nucifera* from the Shallabugh wetland area and the near-disappearance of some economically important plants such as *Trapa natans.* This will help in management of the wetland |
| | Five new Bird Monitoring Tracks Identified and Advertised for birding around the Wetland. | | |
| | Hands on training to frontline staff and local youth on use of GPS voice translating APP for monitoring and surveillance | | |
| | Dissemination of Nature based scientific knowledge and experience amongst the SHGs for promotion of the concept as new livelihood opportunity | | |

*Note:* Further details are summarized in DPR Part-B. Database files in the requisite formats (Excel) is enclosed to the specific study part.

## 4. Demonstrative Skill Development and Capacity Building/ Manpower Trained

| S# | Type of Activities | Details with number | Activity Intended for | Participants/Trained | | | |
|---|---|---|---|---|---|---|---|
| | | | | **SC** | **ST** | **Women** | **Total** |
| 1. | Workshops | 7 | Awareness about the conservation of wetland. | 80 | 0 | 30 | 110 |
| 2. | On-Field Trainings | 3 | Bird identification and census techniques | 25 | 0 | 05 | 30 |
| 3. | Skill Development | 2 | Nature and bird guiding training<br>Use of digital platforms for generation of livelihood through ecotourism | 20 | 0 | 5 | 25 |
| 4. | Academic Supports | | | | | | |
| | Others (if any) | | | | | | |

*Note:* Further details are summarized in DPR Part-B. Supporting materials may be enclosed as appendix separately to the FTR.

## 5. Linkages with Regional & National Priorities (SDGs, INDC, etc.)/ Collaborations

| S# | Linkages /collaborations | Detail of activities (No. of Events Held)* | No. of Beneficiaries |
|---|---|---|---|
| 1 | Sustainable Development Goals (SDGs)/ Climate Change/INDC targets addressed | Our project's activities were strategically designed to contribute to regional and national priorities, addressing the SDGs, climate change, INDCs, and sustainable tourism aspects.<br>our activities focused on maintaining the integrity of wetland ecosystems, which play a crucial role in ensuring clean water sources and supporting various species (Goal 6).<br>Through the promotion of sustainable tourism and the development of alternative livelihood opportunities, we aimed to foster economic growth while ensuring decent work conditions for local communities (Goal 8).<br>By monitoring and conserving waterfowl populations and their habitats, we contributed to the preservation of biodiversity and the sustainable use of terrestrial ecosystems (Goal 15).<br>We also gathered valuable data that can contribute to the understanding of how climate change affects these species.<br>Our project's emphasis on community participation and sustainable livelihoods also aligns with the principles of the INDCs, as it promoted local empowerment and resilience in the face of environmental challenges.<br>The promotion of sustainable tourism was a key aspect of our project. By engaging with local communities and building their capacities in ecotourism and bird tourism, we established a | |

| | | | |
|---|---|---|---|
| | | sustainable tourism model that respects the environment, supports conservation efforts, and provides economic benefits to the community. This approach aligns with global efforts to foster sustainable tourism practices, ensuring ecotourism sustainability while reducing impacts on the environment and wildlife as outlined in various global initiatives and frameworks. | |
| 2. | Any other: | | |

*Note:* Further details may be summarized in DPR Part-B, Section-6. Supporting materials may be enclosed as appendix separately to the FTR.

## 6. Project Stakeholders/ Beneficiaries and Impacts

| S# | Stakeholders | Support Activities | Impacts in terms of income generated/green skills built |
|---|---|---|---|
| 1. | Line Agencies/ Gram Panchayats: | Provided training on alternative livelihood concepts that do not rely on the exploitation of natural resources. Developed bird guides and nature guides within the local community. | This will create enhanced sustainable livelihood/income opportunities for individuals and promote sustainable tourism in the region. |
| 2. | Govt Departments (Agriculture/ Forest/ Water): | Offered hands on training programs for frontline staff from the wildlife protection department of Jammu and Kashmir, focusing on water sample collection and bird census techniques. | This will enhance their skills in monitoring and protecting the wetland, leading to better improved surveillance, threat assessment and conservation efforts. |
| 3. | Villagers/ Farmers: | Provided training on alternative livelihood options, enabling them to generate income while preserving the natural resources. Developed young budding bird guides and nature guides within the community. | This will allow the trained youth of the fringe communities to earn income through eco-tourism activities. |
| 4. | SC Community: | NA | |
| 5. | ST Community: | Specific support activities were tailored to the needs and aspirations of the select group of 5 Scheduled Caste community youth including training in eco-tourism or other sustainable livelihood options to enhance their income generation and build green skills. | The targeted support activities for the Scheduled Tribe community will help promote income generation and green skills development, taking into account their unique cultural and ecological contexts. |
| 6. | Women Group: | Provided training and support to women's groups, focusing on income generation activities related to biodiversity conservation and sustainable | This will allow the trained women of the fringe communities to earn income through involvement in these Women-led homestays, |

| | | | |
|---|---|---|---|
| | | tourism. Women-led initiatives such as homestays, handicrafts, or nature-based tourism experiences were promoted among the women SHGs. | handicrafts, or nature-based eco-tourism activities and initiatives. |
| | Others, *if any*: | By engaging with these stakeholders and providing targeted support, our project achieved the aims to enhance income opportunities and build green skills within the community. | These approach initiatives taken in the project promotes sustainable livelihoods, empowers marginalized groups, and contributes to the overall conservation and sustainable development of the Shallabug Wetland Reserve. |

*Note:* Further details are summarized in DPR Part-B. Supporting materials may be enclosed as appendix separately to the FTR.

## 7. Financial Summary (Cumulative)

Please attach the consolidated and audited Utilization Certificate (UC) and Year-wise Statement of Expenditure (SE) separately, *ref*. **Annexure I.**

## 8. Major Equipment/ Peripherals Procured under the Project** (*if any*)

| S# | Name of Equipment | Quantity | Cost (INR) | Utilisation of the Equipment after project |
|---|---|---|---|---|
| 1. | Solar Argos/ GPS-PTT-100 Satellite Transmitters 45 g | 02 Nos | USD $ 11885/- Rs. 900000/- | |
| 2. | Solar Argos/ GPS-PTT-100 Satellite Transmitters 45 g (01 No) | 01 No. | | |

**Details should be provided in details **(***ref.* **Annexure III &IV).**

## 9. Quantification of Overall Project Progress

| S. No. | Parameters | Total (Numeric) | Remarks/ Attachments/ Soft copies of documents |
|---|---|---|---|
| 1. | IHR States/ UTs covered: | 01 | Jammu & Kashmir |
| 2. | Project Sites/ Field Stations Developed: | | Filed research Station, Shallabugh Wetland Reserve |
| 3. | Scientific Manpower Developed (PhD/M.Sc./JRF/SRF/ RA): | *07 including one PhD* | *PhD thesis submitted and degree awarded to one researcher.* |
| 4. | Livelihood Options promoted | *Enhanced sustainable Livelihood options Ecotourism Bird tourism Nature camps Cultural tourism Home stay development Promoted* | |
| 5. | Technical/ Training Manuals prepared | *NA* | |
| 6. | Processing Units established, if any | *.... (attach photos)* | |

| | | | |
|---|---|---|---|
| 7. | No. of Species Collected, if any | *NA* | |
| 8. | No. of New Species identified, if any | *71 bird species identified and added to the existing checklist* | |
| 9. | New Database generated (Types): | *Database on Movement Patterns and home range of Shoveler and activity patterns of Waterfowl*<br>*Database on nesting and breeding ecology of six water birds through monitoring of 2267 nests*<br>*Updated checklist of 71 water bird visiting Shallabugh wetland generated.* | |
| | Others (if any) | | |

*Note:* Further details may be summarized in DPR Part-B. Supporting materials may be enclosed as appendix separately to the FTR.

## 11. Knowledge Products and Publications:

| S# | Publication/ Knowledge Products | *Number* | | *Total Impact Factor* | *Remarks/* Enclosures |
|---|---|---|---|---|---|
| | | National | International | | |
| 1. | Journal – Research Articles/ Special Issue: | 2,Submitted and in review | 1 article under review in BMC Genomics | 4 | Acta Ecologica Sinica \| Journal \| ScienceDirect.com by Elsevier<br><br>Contributions to Indian Sociology - SAGE Journals<br><br>Journal of Threatened Taxa |
| 2. | Book – Chapter(s)/ Monograph/ Contributed: | 03 | | | 03 articles published in special issue of Envis bulletin BUCEROS |
| 3. | Technical Reports: | 02 | | | Final Technical Report |
| 4. | Training Manual (Skill Development/ Capacity Building): | | | | |
| 5. | Papers presented in Conferences/Seminars: | 02 | | | |
| 6. | Policy Drafts/Papers: | - | | | |
| 7. | Others, if any: | | | | |

*Note:* Please append the list of KPs/ publications (with impact factor, DOI, and further details) with due Acknowledgement to NMHS. Supporting materials may be enclosed as appendix separately to the FTR.

## 12. Recommendation on Utility of Project Findings, Replicability and Exit Strategy

| Particulars | Recommendations |
|---|---|

| | |
|---|---|
| Utility of the Project Findings: | The findings of the project on waterfowl ecological monitoring and conservation, as well as community participation and rural livelihood, should be widely disseminated and shared with relevant stakeholders. This includes government agencies, conservation organizations, researchers, and local communities. The data and knowledge gathered can inform policy and decision-making processes related to wetland conservation, sustainable tourism, and livelihood development. |
| Replicability of Project/ Way Forward: | The project's approach and outcomes can serve as a model for similar initiatives in other wetland areas facing similar challenges. It is recommended to document the project methodology, best practices, and lessons learned to facilitate replication and scaling up of the intervention. Sharing the project's success stories and experiences can inspire and guide other communities and organizations interested in implementing similar projects. |
| Exit Strategy: | The exit strategy of the project aims to ensure its long-term sustainability and benefit the stakeholders and local community in the Shallabug Wetland Reserve. The following steps will be taken to achieve this:<br>Capacity Building and Empowerment: Throughout the project duration, capacity building initiatives were undertaken to equip the local community with the necessary skills and knowledge in ecotourism, bird tourism, and wetland management. These initiatives need to be continued and series of comprehensive training programs need to be conducted to further enhance the capacities of key stakeholders, including community members, government staff, and local guides. By empowering the stakeholders with relevant skills, they will be better prepared to take on responsibilities and sustain the project's initiatives.<br>Institutionalizing Community Ownership: The project has focused on promoting community participation and involvement in the conservation and livelihood activities. As part of the exit strategy, efforts will be made to institutionalize community ownership and decision-making processes. |

| | |
|---|---|
| | This can be achieved through the formation of local committees or cooperatives comprising community members and relevant stakeholders. These committees will be responsible for managing and overseeing the continued implementation of conservation measures, sustainable tourism initiatives, and livelihood activities. They will play a crucial role in ensuring the long-term sustainability of the project's outcomes.<br>Creating Sustainable Livelihood Opportunities: One of the primary objectives of the project was to enhance the livelihoods of the local community through the adoption of alternative livelihood options such as ecotourism, bird tourism, and home stays. As the project concluded, focus needs to be shift towards creating self-sustaining livelihood opportunities for the stakeholders. This may involve establishing linkages with tourism agencies, promoting marketing and promotional activities, and facilitating access to financial resources and training programs. By developing viable and sustainable livelihood options, the local community will be able to continue benefiting from the project's initiatives even after its completion.<br>Strengthening Partnerships: Building and maintaining strong partnerships with relevant stakeholders is essential for the sustainability of the project. This includes collaboration with government departments, conservation organizations, tourism agencies, and local communities. The exit strategy involves formalizing these partnerships and establishing clear communication channels to ensure the continued support and collaboration of these stakeholders. By working together, resources can be pooled, knowledge can be shared, and collective efforts can be made to sustain the project's outcomes and address future challenges.<br>Monitoring and Evaluation: A robust monitoring and evaluation framework will be put in place to track the progress and impacts of the project's initiatives post-exit. Regular monitoring will help identify any gaps or areas that require additional support. It will also provide an opportunity to assess the effectiveness of the sustainability measures and make necessary adjustments as required. Monitoring and evaluation will contribute to adaptive management and ensure the long-term success of the project's goals.<br>By implementing this comprehensive exit strategy, the project aims to leave a self-sustaining impact in the Shallabug Wetland Reserve. The community will be empowered, livelihood opportunities will be created, and partnerships will be strengthened to ensure the continued conservation of the wetland, sustainable tourism practices, and the overall well-being of the local stakeholders. |

Dr. Khursheed Ahmad,
Sr. Scientist and Head, Wildlife Sciences
Sher-e-Kashmir University of Agricultural Sciences and Technology – Kashmir, J&K

(**PROJECT PROPONENT/ COORDINATOR**)

**(Signed and Stamped)**

**Place:** SKUAST-Shalimar
**Date:** 20/05/2023

# PART B: DETAILED PROJECT REPORT

## 1. Executive Summary (2-3 pages)

Jammu and Kashmir boasts a vast network of wetland ecosystems, encompassing a total area of 406,780 hectares. This remarkable expanse includes six wetland reserves that have been designated as sites of international importance, known as Ramsar sites. These sites consist of Wular Lake, Hokersar, Haigam, and Shallabugh Wetland Reserve in the picturesque Kashmir Valley, as well as Surinsar-Mansar and Gharana Wetlands in the Jammu region (Islam & Rahmani, 2004; Ahmad et al. 2020). These Ramsar sites serve as critical habitats for a wide array of flora and fauna, playing a vital role in the ecological balance and cultural heritage of the region. These inland wetlands of Kashmir Valley including the pristine Shallabugh Wetland Reserve, besides supporting many species of wetland plants, animals and insects provide critical habitat for the life cycles of millions of waterfowl particularly the ducks, geese, swans and many other water birds (Rahmani et al. 2016; Ahmad et al. 2020). The wetlands of Kashmir valley besides being important wintering habitats for both resident and migratory waterfowl are also extremely important breeding areas for Mallard, Blunt- winged Warbler and Ferruginous Duck and variety of other waterfowl. A total of 555 bird species has been documented from Jammu and Kashmir that includes both resident and non-residents birds of terrestrial and wetland habitats (Suhail, et al. 2020).These inland wetlands of Kashmir Valley also provide buffering of water flows in vulnerable high mountain catchments across the Greater Himalayan regions of Kashmir and are crucial for sustaining biodiversity and local people's livelihoods.

In recent years, concerns have arisen regarding the conservation and management of these inland wetlands particularly the Shallabugh Wetland Reserve. The increasing pressures of urbanization, agricultural expansion, and unsustainable resource utilization have posed significant threats to the wetland's biodiversity and ecological integrity. Loss of natural wetlands in recent decades due to intensification of human activities and environmental changes has been a serious threat to water bird populations (Owen & Black, 1990; Finlayson et al., 1992; van Vessem et al., 1997). Population trend of water birds is linked to the health or sustainable use of a wetland ecosystem (Siriwardena et al., 2001) and many globally threatened avian species depend on them (Green, 1996). It became crucial to conduct scientific research, gather comprehensive scientific data, and engage local communities to develop effective conservation strategies.

Recognizing the immense significance of these wetlands and the urgent need for their conservation and sustainable management, a research project titled "Waterfowl Ecological Monitoring and Conservation through Community Participation and Rural Livelihood in Shallabugh Wetland Reserve, Kashmir (J&K)" was initiated with funding from the National Mission for Himalayan Studies (NMHS). This two-year research endeavor aimed to address crucial knowledge gaps pertaining to the population status of waterfowl, their nesting and breeding ecology, and migratory patterns within the wetland. Moreover, the project was committed to engaging local communities in the conservation process and promoting sustainable livelihood activities to uplift the socio-economic well-being of the fringe communities. By developing effective

conservation strategies, the project sought to safeguard the rich biodiversity and ecological integrity of Shallabugh Wetland Reserve.

Through a multidisciplinary approach encompassing scientific research, community participation, and capacity-building initiatives, this project aimed to lay a solid foundation for fostering community-led conservation efforts and sustainable livelihood activities in the area.

To achieve these objectives, the project team in collaboration with local stakeholders, particularly the Forest and Wildlife Department and local communities, conducted extensive field studies and surveys to gather comprehensive data on waterfowl populations and their ecological interactions within the wetland. The project employed a range of scientific methodologies and tools to gather data on waterfowl populations, nesting patterns, and migratory behaviors. Extensive field surveys were conducted to identify and document the presence of different water bird species, their abundance, and distribution across the wetland. Specialized equipment such as GPS trackers and radio transmitters were used to monitor the movements of selected waterfowl species and track their migration routes.

An integral aspect of the project was the active involvement of the local communities living in the vicinity of Shallabugh Wetland Reserve. Local communities residing in the vicinity of the wetland were actively involved in the research process, including data collection, monitoring activities, and ecological awareness campaigns. The project also focused on building the capacity of community members by providing training in sustainable livelihood practices such as ecotourism and bird tourism, equipping them with the necessary skills to engage in sustainable livelihood activities that would benefit both the wetland habitats and their socio-economic prospects.

The study documented a total of 76 water bird species, including 12 waterfowl species, visiting Shallabugh Wetland Reserve throughout the year. The encounter rates varied seasonally, ranging from 162±64 birds per kilometer in winter to 56.67±1.99 birds per kilometer in summer. Among the recorded species, Mallards exhibited the highest average clutch size of 8±3 eggs. Additionally, the wetland supported 29 plant species, with Typha latifolia and Ceratophyllum demersum being the dominant ones.

A significant aspect of the study focused on the identification and monitoring of water bird nests. A total of 227 nests belonging to five water bird species were observed and documented. The peak nesting period was found to occur in May. The project collected valuable data on nesting patterns, clutch sizes, and incubation periods, providing insights into the breeding ecology of waterfowl in Shallabugh Wetland Reserve.

Furthermore, the project employed satellite tracking technology to monitor the movements and migratory patterns of waterfowl. One Male Shoveller and a Graylag goose were tagged with 22 g Solar/GPS Satellite PTT-100 telemeters manufactured by the Microwave Telemetry Inc. USA. The tagged Shoveller, tracked revealed its regular movements between major wetlands in the Valley, covering an impressive distance of 14,300 kilometers. However, no evidence of nesting or breeding behavior was observed during the breeding period. These findings contribute to a better

understanding of waterfowl movement dynamics and provide valuable information for conservation planning and management.

The project also recognized the critical role of local communities in the conservation of Shallabugh Wetland Reserve. The report highlights that approximately 77% of fringe families rely on the wetland marsh for their livelihoods. To address this, the project implemented training programs in ecotourism and bird tourism, aiming to enhance the skills and capacities of community members. A successful eco-tourism-cum-home-stay model was developed near the wetland, generating sustainable livelihood opportunities and empowering the local communities.

The project's achievements extend beyond ecological monitoring and community engagement. It successfully increased the flow of bird tourism towards the wetlands, contributing to local economic development. Additionally, the project fostered knowledge sharing and capacity building among the frontline staff of the Forest and Wildlife Department, ensuring long-term sustainability and continuity of conservation efforts.

Based on the project's findings, several recommendations are put forth to ensure the conservation and sustainable management of Shallabugh Wetland Reserve. These include implementing habitat management interventions, strengthening research on bird monitoring and migration studies, and organizing regular bird festivals to promote bird conservation and attract tourists. Furthermore, the report emphasizes the importance of developing an exit strategy focused on knowledge transfer, capacity building continuation, collaboration and partnerships, and long-term monitoring and evaluation.

This Final Technical report provides a comprehensive overview and valuable insights into the waterfowl population and ecological dynamics of Shallabugh Wetland, highlighting the importance of conservation efforts and community engagement. This report highlights the key research findings related to waterfowl populations, nesting and breeding behaviors, and migratory patterns. Additionally, it discusses the community participation and sustainable livelihood initiatives undertaken during the project, providing insights into their effectiveness and impact on local communities. Finally, the report outlines a set of recommendations for future conservation strategies, aiming to ensure the sustainable management of Shallabugh Wetland Reserve and its invaluable waterfowl populations. The project's outcomes and recommendations offer a roadmap for sustainable management of the wetland and the development of eco-tourism as a means of livelihood for the local communities. By implementing the recommended strategies and a well-defined exit plan, the project aims to leave a lasting impact on waterfowl ecological monitoring, conservation, and the sustainable development of local communities. The report's findings, outcomes, and recommendations contribute to the ecological conservation and sustainable development of Shallabugh Wetland Reserve and serves as a valuable resource for policymakers, conservation practitioners, and researchers working in the field of wetland management and community-based conservation.

## 2. Introduction

### 2.1. Background:

Shallabugh Wetland Reserve, situated in the scenic Kashmir Valley of Jammu and Kashmir, India, at coordinates 34.16584° N and 074.73505° E, plays a vital role as a significant ecological hotspot and critical habitat for waterfowl. Spanning an area of approximately 1700 hectares at an elevation of 1,545 meters above sea level, this wetland relies on the Sindh naala (stream) originating from a Sonamarg glacier, supplemented by the Anchar naala from the Jhelum River near Sangum. The water depth fluctuates seasonally, ranging from 0.5 to 2 meters, with the highest levels occurring in the summer due to glacier melt. The winter months experience an average temperature between 3.8°C and -5.4°C, with January being the coldest month, while the summer temperatures range from 13°C to 27°C, with July being the warmest month.

Located within the Shallabugh A and Shallabugh B Gram Panchayats in the Ganderbal district of Jammu and Kashmir, this wetland reserve is managed by the Jammu and Kashmir Wildlife Protection Department and holds the distinction of being an Important Bird and Biodiversity Area (IBA) (Rahmani et al., 2016). Serving as a significant wintering and feeding ground for birds migrating from central Asia and Siberia, Shallabugh is a vast bird reserve. To accommodate migratory waterfowl, several compartments have been created within the marshy wetland to retain a substantial amount of water. The wetland also boasts diverse vegetation, including free-floating and submerged plants, such as Willow (Salix alba), Poplar (*Populus deltoides, P. alba*), Mulberry (*Morus sp*.), and emergent reeds like *Typha angustata*, *T. angustifolia*, *Myriophullum aquaticum, Sparganium echtum, Butamus umbellantus, Echniochloa colona*, and *Phragmites australis,* which are utilized by locals for livestock and fencing.

Shallabugh Wetland Reserve is not only ecologically significant for the migratory and resident avifauna but also holds immense social, economic, and cultural value for the local population. It supports a substantial fishery industry, contributing around 30% of the fish yield in the Kashmir region. Approximately 8,000 families residing in the vicinity of the wetland rely on its resources, which include fish, Singhara (*Trapa* sp.), and Lotus (*Nelumbo* sp.). Traditional fishing methods are employed in the nearby streams and wetlands, while the reeds mentioned earlier serve various purposes, from fodder for livestock to fencing materials. However, recent years have seen growing concerns regarding the conservation and management of Shallabugh Wetland Reserve. The rapid pace of urbanization, expansion of agriculture, and unsustainable use of resources

have emerged as significant threats, jeopardizing the wetland's biodiversity and ecological integrity. The dependence of local communities on wetland resources, coupled with limited earnings, has further exacerbated the situation. Additionally, domestic sewage discharged from nearby houses and the adjacent Sheri Kashmir Institute of Medical Sciences has led to pollution in Shallabugh Wetland Reserve.

In light of these pressing conservation challenges and the importance of involving local communities in conservation efforts, the "Waterfowl Ecological Monitoring and Conservation through Community Participation and Rural Livelihood in Shallabug Wetland Reserve, Kashmir (J&K)" project was launched. The project aimed to address crucial knowledge gaps related to waterfowl populations, breeding ecology, and migratory patterns within the wetland, while also promoting community participation and sustainable livelihood opportunities of ecotourism, bird tourism for the fringe communities. By generating comprehensive data on waterfowl populations, breeding ecology, and migratory patterns, the project aimed to enhance our understanding of the wetland's ecological dynamics. Furthermore, through community engagement and sustainable livelihood initiatives, the project aimed to instill a sense of responsibility and stewardship among local communities, establishing a solid foundation for long-term conservation efforts.

The "Waterfowl Ecological Monitoring and Conservation through Community Participation and Rural Livelihood in Shallabug Wetland Reserve, Kashmir (J&K)" project holds immense potential in addressing the challenges faced by Shallabugh Wetland Reserve. Its outcomes will contribute significantly to the conservation and management of the wetland, ensuring the sustainability of waterfowl populations, other wildlife, and the livelihoods of local communities. This report presents the findings, outcomes, and recommendations derived from the project, providing a roadmap for future conservation strategies. The information contained herein is crucial for effective wetland management, guaranteeing the continued existence of this invaluable habitat and its waterfowl populations.

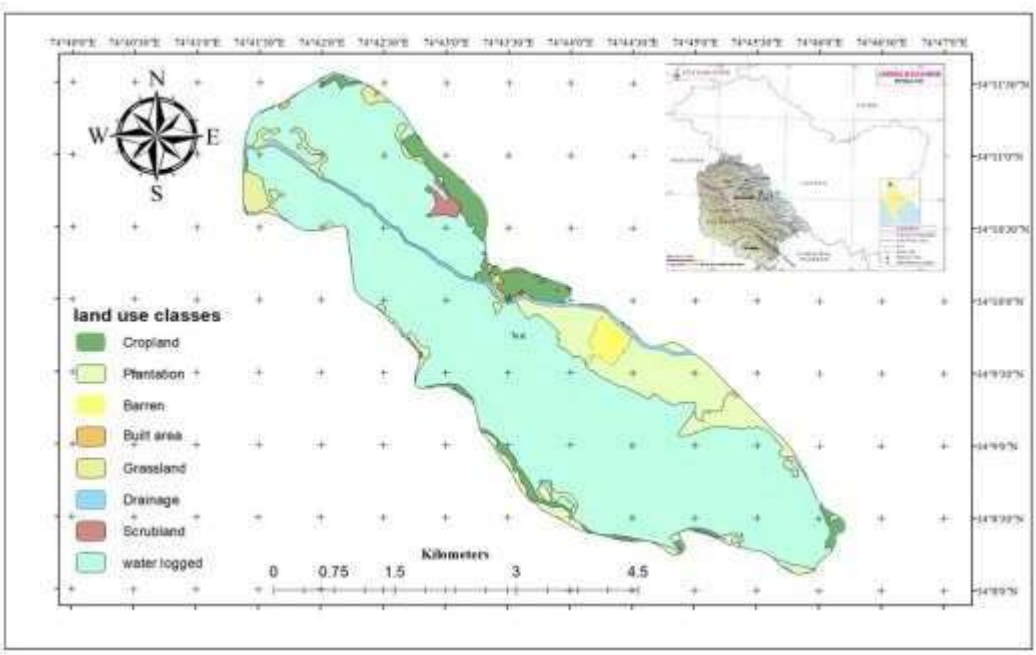



**Figure 1. Map of the Study Area, Shallbugh Wetland Reserve,**

## 2.2. Overview of the Major Issues Addressed:

The Shallabugh Wetland Reserve faces several significant issues that require attention and proactive management. These issues have been identified as critical focal points for the "Waterfowl Ecological Monitoring and Conservation through Community Participation and Rural Livelihood in Shallabug Wetland Reserve, Kashmir (J&K)" project. Understanding and addressing these issues are crucial for the long-term sustainability of the wetland ecosystem and its associated waterfowl populations. The major issues addressed in the project include:

Lack of Data and Monitoring: Limited scientific data and monitoring systems hamper effective conservation and management of the wetland. The studies on the ecology of waterfowl particularly Anatidae at staging or stopover sites such as inland wetlands of Kashmir including Shallabugh wetland is particularly neglected. Little is known about these stopover habitats, time use, microhabitat use, foraging behaviour, food availability, food limitation, diet selection, disturbance and inter-specific relationships. The studies on the ecology of waterfowl particularly Anatidae at these stopover sites have been one of the least studied aspects of avian migration (Lindstrom 1995). Bird Migration across many regions using Satellite telemetry has been studied through 1990s; however, in Indian subcontinent the bird migration studies using this technology have been very limited. Secondly since there have been outbreaks of Avian Influenza in India in recent past, the relevant ecological factors such as the migratory patterns of waterfowl that may affect the risk of individual species bringing HPAI into the country was as such necessary to be studied. There was a need to gather comprehensive information on waterfowl populations, breeding ecology, migratory patterns, and other ecological parameters. This database generated on the movement and migratory patterns, breeding ecology, foraging behavioural and phylogeny and phyllo geography of waterfowl under this project will help in formulating evidence-based

conservation strategies and monitoring the progress of the wetland restoration efforts. Understanding spatial and temporal patterns of bird species is a pre-requisite to understand population dynamics for successful species and habitat conservation. The preparation of a checklist of species is basic to the study of avifauna of a site, because a list indicates basic species presence. The present study explored water bird abundance in wetlands of Kashmir valley particularly Shallabugh wetland reserve.

Habitat Degradation: Urbanization, agricultural expansion, and unsustainable resource utilization have led to the degradation of the wetlands habitat. Encroachment, land conversion, and pollution have resulted in the loss of crucial wetland vegetation and the deterioration of water quality. This has a direct impact on the availability of suitable habitats for waterfowl and other wildlife species. During this project, conducted the habitat evaluation of the wetland and sampled 134 random plots for vegetation assessment using standard quadrate sampling methodology.

Biodiversity Loss: The degradation of wetland habitats has resulted in the decline of biodiversity within the Shallabugh Wetland Reserve. We assessed the status, distribution and population parameters of both migratory and resident water birds in the wetland. Several species of waterfowl, including migratory birds, are facing habitat loss and disruption in their natural life cycles. The loss of biodiversity not only affects the ecological balance of the wetland but also impacts the cultural and economic significance of the reserve.

Unsustainable Resource Use: We assessed the socio-economic status and livelihood dependence on the wetland resources of fringe communities in all the villages falling around 5 km radius from boundary of wetland. The wetland resources are under pressure due to unsustainable practices such as overfishing, excessive harvesting of vegetation, and unregulated tourism activities. These practices threaten the ecological integrity of the wetland and jeopardize the livelihoods of local communities dependent on its resources. In this project, concerted efforts were put towards promotion of enhanced alternative sustainable livelihood opportunity of Ecotourism and Bird tourism through training and skill building and entrepreneurship development in partnership with the fringe communities, private players & SHGs.

## 2.3. Baseline Data and Project Scope:

To address the aforementioned issues, the "Waterfowl Ecological Monitoring and Conservation through Community Participation and Rural Livelihood in Shallabug Wetland Reserve, Kashmir (J&K)" project commenced with a baseline assessment to establish a solid foundation for conservation actions. The project aimed to gather essential data and determine the scope of its activities within the wetland reserve. The key aspects of baseline data and project scope are outlined as follows:

Ecological Baseline Data: We conducted extensive surveys and field assessments to collect baseline data on waterfowl populations, species diversity, nesting and breeding ecology, movement and migratory patterns of waterfowl besides vegetation composition, water quality, and habitat conditions. This data serves as a benchmark for monitoring changes and evaluating the effectiveness of conservation efforts.

Socio-economic Baseline Data: Recognizing the significance of engaging local communities, the project also collected socio-economic baseline data to understand the dependence of local communities on wetland resources and identify potential livelihood opportunities. This information aids in designing sustainable livelihood initiatives and fostering community participation in conservation activities.

Stakeholder Analysis: Understanding their roles, perspectives, and interests is crucial for effective collaboration and coordination in implementing conservation strategies. A comprehensive stakeholder analysis was conducted to identify key stakeholders, including government agencies, local communities, non-governmental organizations, and other relevant entities to develop a participatory management plan that would ensure the preservation of the wetland's ecological values while also addressing the socio-economic needs of the communities.

Project Scope: The project's scope encompassed various components, including ecological monitoring, community engagement, capacity building, policy advocacy, and sustainable livelihood development. It aimed to address the identified issues through a holistic approach that integrates scientific research, community participation, skill building and capacity building training and policy support.

A robust baseline data was established on the population status and distribution of waterbirds particularly the migratory waterfowl and nesting and breeding ecology of the resident waterbirds besides movement and migratory patterns of select waterfowl species. Recognizing the tremendous potential of the Shallabugh Wetland for nature based tourism, efforts were put in for promotion of Ecotourism and Bird tourism through training and skill building and entrepreneurship development in partnership with private players & SHGs. Database on the socio-economic and livelihood dependence on the wetland of the fringe villages around Shallabugh generated towards ensuring ecotourism sustainability while reducing impacts on the environment and wildlife.

By establishing a robust baseline dataset and defining the project scope, the "Waterfowl Ecological Monitoring and Conservation through Community Participation and Rural Livelihood in Shallabug Wetland Reserve, Kashmir (J&K)" project laid the foundations for informed decision-making, targeted interventions, and the sustainable management of the Shallabugh Wetland Reserve. The subsequent sections of this report delve into the specific findings, outcomes, and recommendations derived from the project's implementation, providing a comprehensive roadmap for the conservation and restoration of this invaluable wetland ecosystem.

## 2.4. Project Objectives and Target Deliverables (as per the NMHS-Sanction Order)

| Objectives | Deliverables | Monitoring Indicators |
|---|---|---|
| • Study and monitor migratory status, movements from wintering to breeding areas and to identify migratory routes, movement patterns of the major waterfowl species particularly ducks and geese in Shallabugh wetland reserve, Kashmir valley.<br><br>• To assess the socio-economics of the communities adjoining Shallabugh wetland reserve and Build capacity and scientific and business skill amongst youth of local tribal and marginal communities for enhanced alternative livelihood generation and entrepreneurship development through ecotourism and village wildlife tourism for the local stakeholder communities in consonance with the Indian cultural and socio-ecoomic milieu. | • Database on Breeding biology of ten (06) resident migratory waterfowl and water bird species<br><br>• Database on the movement and migratory pattern of 02 Waterfowl species<br><br>• (02) Eco tourism-cum Home stays with indigenous culture and cuisine shall be developed around the fringe village of Shallabugh in partnership with local communities<br><br>• Training and skill building of 15 local youth as tourist and wildlife/eco-guides.<br><br>• Enhancing/doubling the livelihood/income targeted stakeholder from an average of around Rs. 15000/month/family through adoption of this new improved alternative livelihood opportunity of ecotourism, eco-guiding, Waterfowl viewing and home stay. | • Database on breeding biology (06 Nos.)<br><br>• Home stays Developed (02 Nos.)<br><br>• Increased the income or employment of women farmers (%)<br><br>• Number of Training/Awareness Programme Organized (02-03 Nos.)<br><br>• Number of beneficiaries village/ local people (Nos.)<br><br>• No. of Reports/Research articles/Policy documents prepared and published (04 Nos.) |

## *3.* METHODOLOGIES/STARTEGY/ APPROACH – *supporting documents to be attached.*

### 3.1. Methodologies used (max. 500 words)

To study various aspects of the wetland ecosystem in the Shallabugh Wetland Reserve and ensure accurate data collection and address the project objectives, we employed various methodologies tailored to the specific research areas and target species. This section outlines the methodologies used for studying density and abundances, tracking migration patterns, assessing nesting and breeding ecology of water birds, assessing vegetation composition, and collecting data from local communities. The methodologies were selected based on their suitability for the specific research objectives and previous references in the field.

**Density and Abundances:**

To determine the density and abundances of waterfowl species in the Shallabugh Wetland Reserve, we utilized the Line Transect and point count methods in conjunction with the MacKinnon lists (ML) Method. This approach has been widely used in ornithological studies and is referenced in works by Sutherland (1996), Bibby et al. (2000), Alldredge et al. (2008), and Newson et al. (2008). The Line Transect method involves systematically walking along pre-determined transects within the wetland and recording all bird sightings. The MacKinnon lists (ML) Method, as described by Bibby et al. (2000) and Trainor (2002), was used to estimate species richness and compare abundances between different sites or over time.

**Tracking Migration Patterns:**

To track the migration patterns of waterfowl species passing through the Kashmir Valley, we employed bird ringing and tagging techniques. Two migratory waterfowl species, a male Northern Shoveler (Spatula clypeata) and a Greylag Goose (Anser anser), were captured using noose traps designed specifically for this purpose. This approach has been successfully employed in similar studies and is mentioned in the work of Bibby et al. (2000). The captured waterfowl were fitted with 22 g GPS Solar Argos/GPS PTT-100 Satellite transmitters manufactured by Microwave Telemetry, Inc., USA. These transmitters, referenced in Table 2, allowed us to track the birds' migration routes and identify potential wintering and summering areas. The methodology for capturing and tagging the waterfowl was carried out with technical assistance from BNHS professional bird trappers led by Mr. Ali Hassan.

**Assessing Nesting and Breeding Ecology:**

To assess the nesting and breeding ecology of water birds in the Shallabugh Wetland Reserve, we followed established methodologies referenced in Romanoff and Romanoff (1963) and Hoyt (1979). Boat surveys were conducted in water-dominated areas, while foot surveys were performed in marshes during the breeding seasons from March to August in 2020 and 2021. Nest searches were systematically carried out during regular bird monitoring surveys, following the guidelines and protocols outlined in Barve et al. (2020).

**Assessing Vegetation Composition:**

To evaluate the vegetation composition of the Shallabugh Wetland Reserve, we conducted phytosociological studies during autumn 2020. This timing was chosen as it allowed the plants to reach their final stages of maturity, making them easily identifiable. The methodology for vegetation analysis was based on established techniques referenced in Curtis and McIntosh (1951). Stratified random sampling was employed to ensure representative composition. A total of 209 quadrats measuring 1×1 meter were placed along predefined transects. Within each quadrat, plant counts were recorded, and collar diameters were measured for representative plants. Circumference measurements at breast height were taken for trees with a diameter greater than 10 cm. The Importance Value Index (IVI) was calculated to determine the dominance of plant and tree species.

**Collecting Data from Local Communities:**

To gather qualitative and quantitative data regarding the socio-economic aspects related to the wetland and its fringe communities and assess the livelihood dependence of local communities on the wetland resources, we conducted household surveys and focus group discussions. The methodology for the household surveys involved selecting 20% of the total households, amounting to 200 houses, using a stratified sampling approach based on a census of village households. The questionnaire used in the surveys was developed considering participatory rural appraisal techniques (Adhikari et al., 2004). Focus group discussions were conducted with different age classes of villagers, employing purposive random sampling.

By employing these methodologies and drawing upon the referenced literature, we were able to collect comprehensive data on bird populations, migration patterns, nesting and breeding ecology, vegetation composition, and socio-economic aspects. The methodologies selected were chosen for their suitability to the research objectives and their previous successful application in similar studies. The data collected through these methods formed the basis for subsequent analyses and informed the recommendations presented in this project report.

## 3.2. Data Collected and equipment Utilized (max. 500 words)

The research project involved the collection of various data sets using different methodologies and equipment. The data collected were crucial for analyzing the abundance and diversity of water birds, tracking migration patterns, studying nesting and breeding ecology, assessing vegetation composition, and understanding the socio-economic aspects of the local communities. The following section provides a concise description of the data collected and the equipment utilized for this project.

**Water Bird Population Estimation:**

Population estimation of water birds was conducted through regular surveys using point count, block count, and line transect methods. The surveys involved systematic observations of water bird species and their behaviors. Field binoculars (10x40X) and field guides were utilized for species identification during the surveys. The surveys were conducted during different seasons,

with extensive data collection during the mid-winter seasons. The data collected from these surveys were pooled and used for the analysis of species abundance.

**Migration Tracking and Telemetry:**

To track the migration patterns of waterfowl species passing through the Kashmir Valley, a capture and tagging operation was conducted. Two waterfowl species, including a male Northern Shoveler (Anas clypeata) and a Greylag Goose (Anser Anser), were captured and fitted with 22g Solar/Argos/GPS Satellite PTT-100 telemeters. Specially designed noose traps were used for capturing the birds, and technical assistance from BNHS professional bird trappers was employed. The telemeters, manufactured by Microwave Telemetry, Inc., USA, were attached to the birds using a backpack harness design with a breast band and Teflon Ribbon. The telemeters were programmed to acquire GPS fixes six times a day, and the GPS data were analyzed using customized software and ArcGIS for spatial analysis and mapping.

**Nest Search and Breeding Studies:**

Systematic nest searches were conducted during regular bird monitoring surveys to study the nesting and breeding ecology of water birds. The searches focused on marshes with emergent vegetation and were carried out at least once each year for two consecutive years. A total of 225 nests of five water bird species and two forest bird species were identified and monitored. The nests were visited regularly to record various breeding parameters, including nest site selection, clutch size, incubation period, nesting success, parental care, and fledging success. Observations were made using a 10x50 binoculars and recorded following established protocols.

**Vegetation Surveys:**

Phytosociological studies were conducted during autumn to assess the vegetation composition of the Shallabugh wetland. Quadrat sampling was employed, with 209 quadrants of 1x1 meter laid on predefined transects. The vegetation surveys included counting plants and measuring collar diameters for representative plants. Tree density was estimated using 10-meter circular plots, and the circumference at breast height was measured for trees with a diameter greater than 10 cm. Species dominance and importance value index (IVI) were calculated based on frequency, density, and dominance measurements.

**Socio-economic Surveys:**

To understand the socio-economic aspects of the local communities, household surveys and focus group discussions were conducted. A questionnaire-based survey was carried out, covering 20% of the total households (200 houses) in the fringe communities surrounding the wetland. Stratified sampling techniques were used for selecting households. Focus group discussions were performed with different age classes of villagers, providing in-depth insights into community perspectives and the relationship between the communities and the wetland.

The data collected were compiled and analyzed using Microsoft Excel and IBM SPSS Statistics software. Statistical analysis, correlation analysis, and graphical representations were performed to examine the relationships and patterns within the collected data.

The equipment utilized for data collection included field binoculars (10x40X), field guides for bird identification (Grimmett et al., 2016), GPS satellite telemeters (Solar/Argos/GPS PTT-100), specially designed noose traps, and 10x50 binoculars for nest searches. Additionally, software tools such as ArcGIS, Animal Movement SA, and GraphPad Prism were used for spatial analysis, home range calculation, and graph formation.

### 3.3. Details of Field Survey conducted, if any (max 500 words)

Field surveys were conducted with a consistent methodology, considering factors such as weather conditions, seasonal variations, and the avoidance of double counting of birds. The data collected through these surveys and studies provided valuable insights into the avifauna, migration patterns, breeding ecology, vegetation composition, and socio-economic aspects related to the Shallabugh wetland. This comprehensive dataset formed the foundation for the subsequent analyses and conservation recommendations outlined in this project report.

### 3.4. Strategic Planning for each activity with time frame:

| S.No | Activities | Year 1 | | Year 2 | |
|---|---|---|---|---|---|
| | | 0-06 Month | 06-12 months | 12-18 months | 18-24 Months |
| 1. | Recruitment of project staff, procurement of equipment and initiation of preliminary surveys for stratification of the study area and planning for project implementation | | | | |
| 2. | Regular surveys and monitoring conducted for field data collection on migratory and resident waterfowl and water birds, endemic birds, identification of nesting sites for monitoring breeding ecology and identifying potential habitats and monitoring trails/nature tracks for prioritizing ecotourism areas for the visitors. | | | | |
| 3. | Engagement with the local communities for raising awareness about the importance of wetland and its conservation. and promotion of sustainable Ecotourism, Bird tourism and homestays as alternate livelihood opportunity through training and skill building and entrepreneurship development in partnership with private players & SHGs. | | | | |
| 4. | Undertaking of guided tours for practical learning of trainees in sampling/monitoring in terrestrial and aquatic habitats & attraction of broader group of low to medium budget travellers for birding and waterfowl viewing to promote the bird tourism as sustainable livelihood opportunity, contributing to local economic development. | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 5. | Training and skill building of local educated youth as ecotourism and wildlife/bird guides, development of one Eco tourism-cum Home stays with indigenous culture and cuisine near the Shallabugh Wetland in partnership with local entrepreneur as a model to promote ecotourism in the area. | | | | |
| 6. | Conducted Waterfowl capture and satellite tagging and ringing program. Two waterfowl species, including a male Northern Shoveler and a Graylag Goose were captured and fitted with 22g Solar/Argos/GPS Satellite PTT-100 telemeters, tracked and monitored to understand the migration patterns of waterfowl species passing through the Kashmir Valley | | | | |
| 7. | Data compilation, analysis and preparation of the Final Technical Report –cum- effective conservation plan. | | | | |

## *4.* KEY FINDINGS AND RESULTS – *supporting documents to be attached*

### 4.1. Waterfowl Status, Diversity and abundance:

During the study, a comprehensive survey was conducted in the Shallabugh wetland reserve over a span of two years, resulting in the identification of 76 bird species from 35 families and 13 orders (Appendix 1). Among these, 17 species were water birds belonging to 6 families, namely Anatidae, Ardeidae, Rallidae, Scolopacidae, Podicepididae, and Halcyonidae. The composition of bird species included 41 resident species, 15 summer migrants, 10 winter long-distance migrants, 7 altitudinal migrants, and 3 passage migrants (Annexure 1).

The family Anatidae exhibited the highest number of recorded species (n=12) and hence highest relative diversity index (RDI) due to the wetland ecosystem of the study area, which had a significant impact on the richness and abundance of waterfowl species (Table 1.1). The wetland served as a vital wintering habitat for a diverse array of migratory birds, contributing significantly to the overall bird composition. A total of 307,011 water birds were recorded during the winter season, when the wetland thrived with the presence of both migratory and resident birds.

Table 1.1: Relative diversity Index (RDI) of families in the present study.

| S.No | Family | Species | RDI |
|---|---|---|---|
| **1** | Podicipedidae | 1 | 1.32 |
| **2** | Phalacrocoracidae | 1 | 1.32 |
| **3** | Ardeidae | 5 | 6.58 |
| **4** | Anatidae | 12 | 15.79 |
| **5** | Accipitridae | 3 | 3.95 |
| **6** | Rallidae | 5 | 6.58 |
| **7** | Recurvirostridae | 1 | 1.32 |
| **8** | Charadriidae | 1 | 1.32 |
| **9** | Scolopacidae | 4 | 5.26 |
| **10** | Laridae | 1 | 1.32 |
| **11** | Sternidae | 2 | 2.63 |
| **12** | Columbidae | 3 | 3.95 |
| **13** | Cuculidae | 2 | 2.06 |

| | | | |
|---|---|---|---|
| **14** | Apodidae | 1 | 1.32 |
| **15** | Upupidae | 1 | 1.32 |
| **16** | Alcedinidae | 3 | 3.95 |
| **17** | Meropidae | 1 | 1.32 |
| **18** | Picidae | 3 | 3.95 |
| **19** | Alaudidae | 1 | 1.32 |
| **20** | Hirundinidae | 1 | 1.32 |
| **21** | Motacillidae | 4 | 4.95 |
| **22** | Pycnonotidae | 1 | 1.32 |
| **23** | Laniidae | 1 | 1.32 |
| **24** | Muscicapidae | 4 | 5.26 |
| **25** | Leiothrichidae | 1 | 1.32 |
| **26** | Troglodytidae | 1 | 1.32 |
| **27** | Acrocephalidae | 1 | 1.32 |
| **28** | Paridae | 2 | 2.63 |
| **29** | Certhiidae | 1 | 1.32 |
| **30** | Zosteropidae | 1 | 1.32 |
| **31** | Fringillidae | 1 | 1.32 |
| **32** | Passeridae | 1 | 1.32 |
| **33** | Oriolidae | 1 | 1.32 |
| **34** | Dicruridae | 1 | 1.32 |
| **35** | Corvidae | 4 | 5.26 |

The population trend analysis revealed that 25 of the recorded species exhibited a stable global population trend, while 8 species displayed a declining population trend (Fig. 2). Relative abundance estimation was performed for 35 species, based on significant data availability. The analysis indicated that the Eurasian Coot, Common Teal, and Mallard were the most abundant species, followed by other waterfowl species within the Shallabugh wetland (Appendix II). Among them, the Graylag Goose exhibited the lowest relative abundance.

The highest bird density, both in terms of water and terrestrial birds, was observed during the winter months. The encounter rate and standard deviation of birds, particularly waterfowl, exhibited considerable variation in Shallabugh, potentially due to two reasons: either the birds were utilizing the wetlands as a staging area before further southward migration, or there was a significant exchange of birds among various wetlands in the Kashmir Valley. The mean bird encounter rate varied significantly across different seasons, with the highest average encounter rate recorded during winter (162±64 birds/km) and the lowest during summer (56±1.99 birds/km) when many species were nesting and difficult to observe (Table 1.2). Additionally, reeds dominated the wetland habitat.

**Fig. 2. Global population trend of bird species documented**

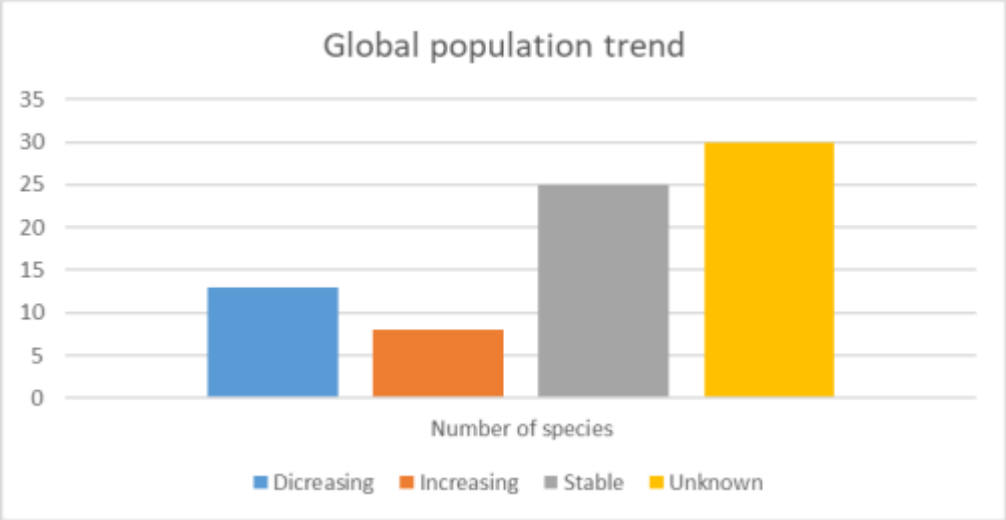



**Table. 1.2. Seasonal encounter rate of birds of Shallabugh.**

| Season | Winter | Spring | Summer | Autumn |
|---|---|---|---|---|
| **Encounter rate** | 162.77 | 85.26 | 56.67 | 93.52 |
| **Standard deviation** | 64.96 | 12.42 | 1.99 | 8.45 |

Furthermore, the abundance of water bird populations exhibited significant variation (One-way ANOVA F = 4.339, p = 0.001, n =78) across different habitats within the wetland. Open water areas recorded the highest number of individuals (n=197,211), while paddy fields had the lowest number (n=102).

Relative abundance estimation of 31 species which had the significant data indicated predominance of Eurasian Coot, Common Teal and Mallard followed by other waterfowl species in Shallabugh wetland. Graylag Goose showed lowest relative abundance. (Table 1.3)

The Shannon diversity index (H) is commonly used to characterize species diversity in a community. Like Simpson's index, Shannon's index accounts for both abundance and evenness of the species present. The Shannon diversity index ranges typically from 1.5 to 3.5 and rarely reaches 4.5. Species evenness refers to how close in numbers each species in an environment or distribution of individuals among species and 1 is highest value.

**Table 1.3. Relative abundance of major Waterfowl species at Shalabugh Wetland Reserve**

| S.No | Species | Scientific Name | Relative Abundance |
|---|---|---|---|
| 1 | Eurasian coot | *Fulica atra* | 0.04843524 |
| 2 | Common Teal | *Anas crecca* | 0.04152412 |
| 3 | Grey Heron | *Ardea cinerea* | 0.039078824 |
| 4 | Grey Tit | *Melaniparus afe* | 0.037264942 |
| 5 | Common Eurasian moorhen | *Gallinula chloropus* | 0.035864349 |
| 6 | Mallard | *Anas platyrhynchos* | 0.035749547 |
| 7 | White Wagtail | *Motacilla alba* | 0.035715106 |
| 8 | House Crow | *Corvus splendens* | 0.036805731 |
| 9 | Pond Heron | *Ardeola grayii* | 0.033040204 |
| 10 | White-Throated Thrush | *Turdus assimilis* | 0.032845039 |
| 11 | Little Grebe | *Tachybaptus ruficollis* | 0.031054118 |
| 12 | Blue Magpie | *Urocissa erythroryncha* | 0.032787638 |
| 13 | Black kite | *Cuncuma leucorypha* | 0.034624481 |
| 14 | Grey Backed Shrike | *Lanius tephronotus* | 0.034303033 |
| 15 | Eurasian wren | *Amaurornis akool* | 0.031938098 |
| 16 | Common Sandpiper | *Actitis hypoleucos* | 0.033706059 |
| 17 | Grey Wagtail | *Motacilla cinerea* | 0.031961059 |
| 18 | Night Heron | *Nycticorax nycticora* | 0.030365302 |
| 19 | Purple Swamphen | *Porphyrio porphyrio* | 0.030353822 |
| 20 | Rock Pigeon | *Columba livia* | 0.032661355 |
| 21 | Little Bunting | *Emberiza pusilla* | 0.033464974 |
| 22 | Northern Pintail | *Anas acuta* | 0.029469841 |
| 23 | White-Throated Kingfisher | *Halcyon smyrnensis* | 0.032339908 |
| 24 | Eurasian Wren | *Troglodytes troglodytes* | 0.031961059 |
| 25 | Pied Kingfisher | *Ceryle rudis* | 0.029263197 |
| 26 | Common Kingisher | *Alcedo atthis* | 0.028034808 |
| 27 | Northern Shoveler | *Spatula clypeata* | 0.026565334 |
| 28 | Gadwal | *Mareca strepera* | 0.025853558 |
| 29 | Common Pochard | *Aythya farina* | 0.025842077 |
| 30 | Tufted Duck | *Aythya fuligula* | 0.025176222 |
| 31 | Greylag Goose | *Anser anser* | 0.011950956 |

Some uncommon bird species observed in Shallabugh included the Himalayan Woodpecker (*Dendrocopos himalayensis*), Eurasian Skylark (*Alauda arvensis*), Green-backed Tit (*Parus monticolus*), Plain Mountain-Finch (*Leucosticte nemoricola*), and Spotted Forktail (*Enicurus maculatus*).

Shallabugh wetland displayed seasonal variations in species diversity. The highest bird diversity was observed during spring (Shannon H = 3.8) in March-April, as the winter migrants were still present, and the summer migrants started arriving. Winter exhibited the second-highest diversity

(Shannon H = 3.6) due to the abundance of migrant waterfowl species. Summer and autumn displayed similar diversity indices (Shannon H = 3.5) (Table 1.4).

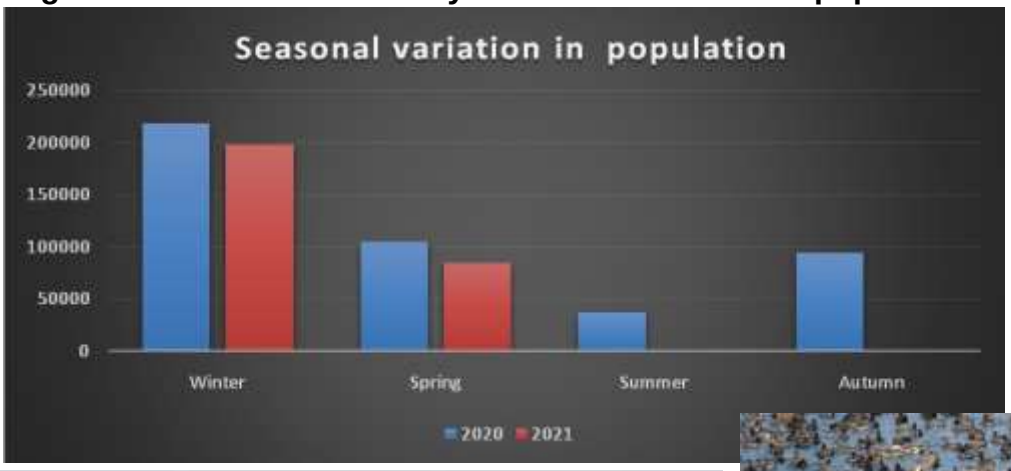
**Table 1.4. Seasonal Diversity Index of the Water birds in Shallabugh Wetland Reserve (Jan 20-March 2022)**

| Indices | Winter | Spring | Summer | Autumn |
|---|---|---|---|---|
| **Species** | 54 | 69 | 52 | 56 |
| **Individuals Sighted** | 133575 | 89600 | 50525 | 51450 |
| **Dominance_ D** | 0.03338 | 0.02792 | 0.0332 | 0.03277 |
| **Simpson_1-D** | 0.9666 | 0.9721 | 0.9668 | 0.9672 |
| **Shannon_H** | 3.603 | 3.803 | 3.534 | 3.591 |
| **Evenness_e^H/S** | 0.6795 | 0.6496 | 0.6591 | 0.648 |

Out of the total 76 recorded species throughout the year, 69 species were observed in spring, while the lowest number of species were recorded in summer (52). The highest number of individuals were sighted during winter (N=133,575), whereas the lowest count occurred during summer (N=50,525) (Table 4).

The population estimation exercise conducted on seasonal basis every year showed higher population count of water birds in 2020 compared to 2021. The water birds populations were highest in winters and lowest in summer (Fig. 3). The water birds migration usually started with the onset of spring and would continue till end of the spring season.

**Figure 3. Seasonal and Yearly variation in water bird populations in Shallabugh Wetland**




Congregation of diverse waterfowl species in Shallabugh Wetland Reserve during winter (above & Right)

A comprehensive study was conducted to examine the nesting and breeding ecology of waterbirds in Shallabugh wetland. A total of 226 nests were identified and monitored, including 135 active nests and 91 abandoned nests. The study focused on six waterbird species: Common Moorhen (*Gallinula chloropus*), Mallard (*Anas platyrhynchos*), Common Coot (*Fulica atra*), Grey-headed Swamphen (*Porphyrio porphyrio*), Little Grebe (*Tachybaptus ruficollis*), and two species of terrestrial birds (Table 2.1 & 2.2).

During the observation period from March to August 2020 and 2021, a total of 125 nests were detected in 2020 and 101 nests in 2021. It was observed that both parents were involved in nesting, and waterbirds took an average of 4-5 days for nest building. Birds were seen in discrete pairs two to four weeks before nest building. Most species completed their nests 2 to 3 days prior to egg-laying. The nest-building period ranged from 4±2 days for Little Grebe to 7±2 days for Grey-headed Swamphen. Mallards took 4 to 9 days to complete their nests (Figure 2.1).

Mallard had the highest clutch size with an average of 8.19±2.17 eggs, followed by Common Moorhen with a clutch size of 6.69±2.52 eggs, and Grey-headed Swamphen with a clutch size of 6.50±0.71 eggs. The survival rate of waterfowl chicks was significantly higher compared to terrestrial birds. Reed warbler chicks had a mortality rate of 25%, and crow chicks had a mortality rate of 20% due to predation (Table 2.3).

The peak hatching period for waterbirds was generally in the first week of June, although hatching occurred sporadically throughout the summer, similar to the nest initiation period. The first nest hatched on 2 June, and the hatching continued until the last nest hatched on 3 August. It was observed that Little Grebe either had double broods or re-nested after the first nest failed. The general peak of nest initiation for all species occurred during the last two weeks of May, with a secondary peak in the last two weeks of June (Figure 2.3).

**Table 2.1. Nesting and hatching Details of Waterfowl in Wetlands of Kashmir**

| S.No. | Species | No of nests identified | Av. eggs laid | Hatching days | No of Hatchlings |
|---|---|---|---|---|---|
| 1 | Mallard | 36 | 14 | 29-30 | 08 |
| 2 | Little Grebe | 03 | 05-07 | 17-18 | 05-07 |
| 3 | Eurasian Coot | 20 | 05-07 | 21-25 | 05-07 |
| 4 | Common Moorhen | 66 | 09-11 | 18-20 | 06-08 |
| 5 | Grey-headed Swamphen | 14 | 07-09 | 19-21 | 06-08 |
| | Total | 139 | | | |

**Figure 2.1. Nest Status of the breeding waterbirds in Shallabugh Wetland during 2020-21 (n=226)**

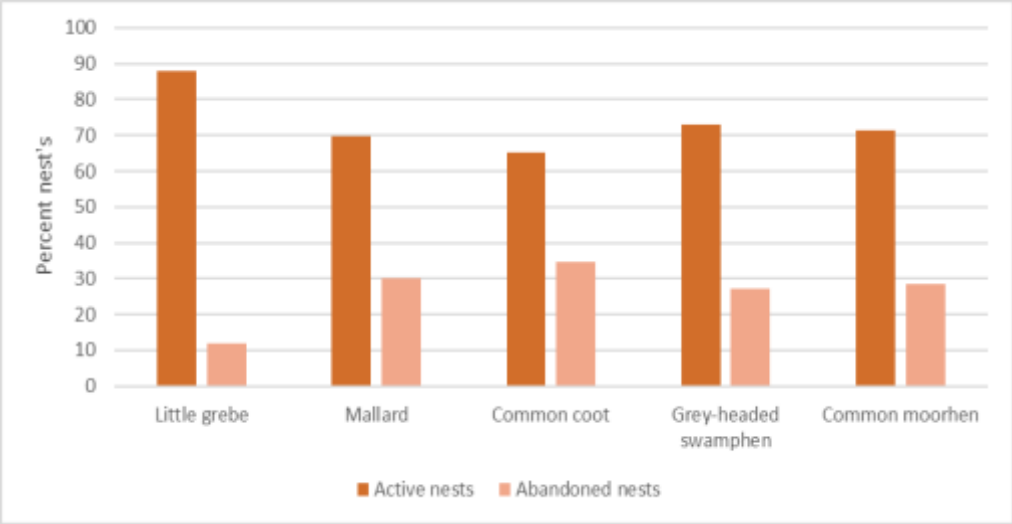



**Table 2.2. Mean Group sizes of waterfowl recorded after hatching in Shallabugh Wetalnd**

| Species | Average Number Of Chicks | Average Group Size | Observed Groups |
|---|---|---|---|
| Eurasian coot | 5.142±1.2 | 7±1.52 | 8 |
| Little Grebe | 3.5±0.5 | 5±0.816 | 4 |
| Mallard | 7.25±1.9 | 9.1±1.9 | 20 |
| Eurasian moorhen | 4.692±1.3 | 6.538±1.89 | 13 |
| Swamp Hen | 4.5±0.5 | 5.666±0.816 | 6 |

Fig. 2.2. Mallard Eggs and chicks in the nest in Shallabugh Wetland

Fig. 2. 3. Eggs of Moorhen in the nest in Shallabugh Wetland (right)

**Table 2.3 Nesting and breeding variables and Behavioral Observations of Waterfowl recorded in Shallabugh Wetlands Reserved during the study period**

| Species | Clamorous Reed Warbler | Eurasian Coot | Crow | Little Grebe | Mallard | Common Moorhen | Grey headed Swamp Hen |
|---|---|---|---|---|---|---|---|
| Abandonee Nest % | 33.33 | 27.78 | 20.00 | 20.00 | 27.03 | 36.21 | 50.00 |
| Average Nest Building Time ( Days) | 7.00±1.20 | 5.00±0.49 | 3.67±0.58 | 3.50±0.71 | 4.84±0.65 | 3.95±0.54 | 5.88±0.50 |
| Nest Building | Male Female | Male Female | Male Female | Male Female | Male Female | Male Female | Male Female |
| Average Length Of Nest Ft. | 0.30±0.10 | 0.98±0.07 | 0.80±1.36 | 0.55±0.07 | 1.00±0.02 | 0.71±0.06 | 1.39±0.18 |
| Average Breadth Of Nest Ft. | 0.60±0.30 | 0.97±0.12 | 0.80±1.36 | 0.40±0.2 | 1.00±0.03 | 0.52±0.09 | 1.32±0.15 |
| Egg Weight Gram | 13.50±2.12 | 39.17±3.54 | 15.33±2.52 | 20.00±0.1 | 50.00±0.003 | 25.00±0.01 | 35.00±0.01 |
| Egg Length Cm | 1.35±0.21 | 5.86±0.59 | 4.00±1.00 | 3.50±0.03 | 6.00±0.001 | 3.68±0.65 | 6.37±0.23 |
| Egg Breadth Cm | 1.10±0.14 | 2.97±0.12 | 1.50±0.09 | 2.25±0.35 | 2.52±0.09 | 2.44±0.17 | 3.00±0.01 |
| Average Eggs in Nest | 4.00±1.41 | 4.33±1.97 | 5.00±2.00 | 5.50±0.71 | 8.19±2.17 | 6.69±2.52 | 6.50±0.71 |
| Total Number Of Nests Observed | 6 | 20 | 5 | 3 | 36 | 66 | 14 |
| Hatch Out IST | 2.50±0.71 | 2.27±2.27 | 3.00±0.02 | 3.00±0.2 | 4.43±1.28 | 4.48±1.65 | 2.50±0.71 |
| Hatch Out 2nd | 2.00±1.50 | 2.00±0.87 | 2.00±0.1 | 2.50±0.71 | 2.29±0.73 | 2.29±1.9 | 4.00±1.41 |
| Average Days Between Two Hatch | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| % Predation Of Chicks | 25.00 | 13.95 | 20.00 | 9.09 | 6.38 | 10.00 | 7.69 |
| Depth Of Water meter | 0.00 | 1.00±0.70 | 0.00 | 2.00±0.71 | 2.63±0.47 | 2.99±0.72 | 3.70±0.59 |
| Height Of Nest | | 0.23 | 5.00 | 3.00 | 1.44 | 1.40 | 1.67 |
| Average Egg Laying days | 14.00 | 12.11 | 11.00 | 12.00 | 15.60 | 10.00 | 20.00 |
| Average Hatching days | 11.00 | 20.78 | 15.00 | 18.50 | 30.00 | 20.00 | 25.00 |

Nests were observed in four different habitats: marsh areas with reed-dominated and floating vegetation, open water areas, plantations, and fallow land. Marshy areas accounted for the highest percentage of nests (46%), while the lowest percentage of nests (7%) was observed in fallow land with terrestrial grasses and high grazing pressure (Figure 6). Different species showed varying preferences for nesting habitats. Common Moorhens were observed using all four habitats, but most nests were found in marshes. Mallard nests were predominantly found in flooded plantations with fallen or bent trees, where the water depth was approximately one meter. Little Grebe nests were primarily located in open water (Figure 7). Common Coot nests were found in open water with an average depth of 117±20 cm, followed by Little Grebe with 91±30 cm (Figure 2.4, 2.5).

Figure 2.4. Nesting habitat of water birds (n=226)

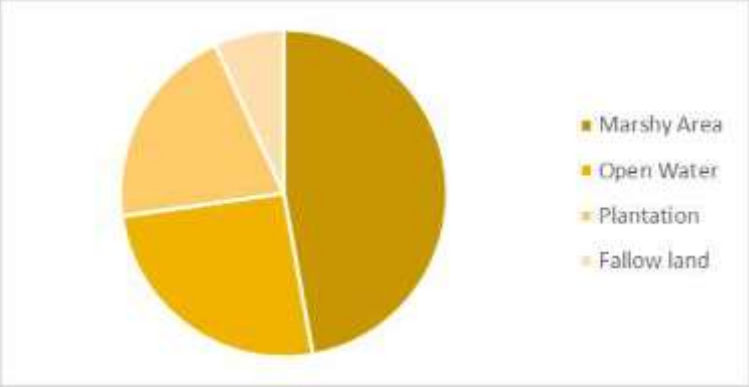
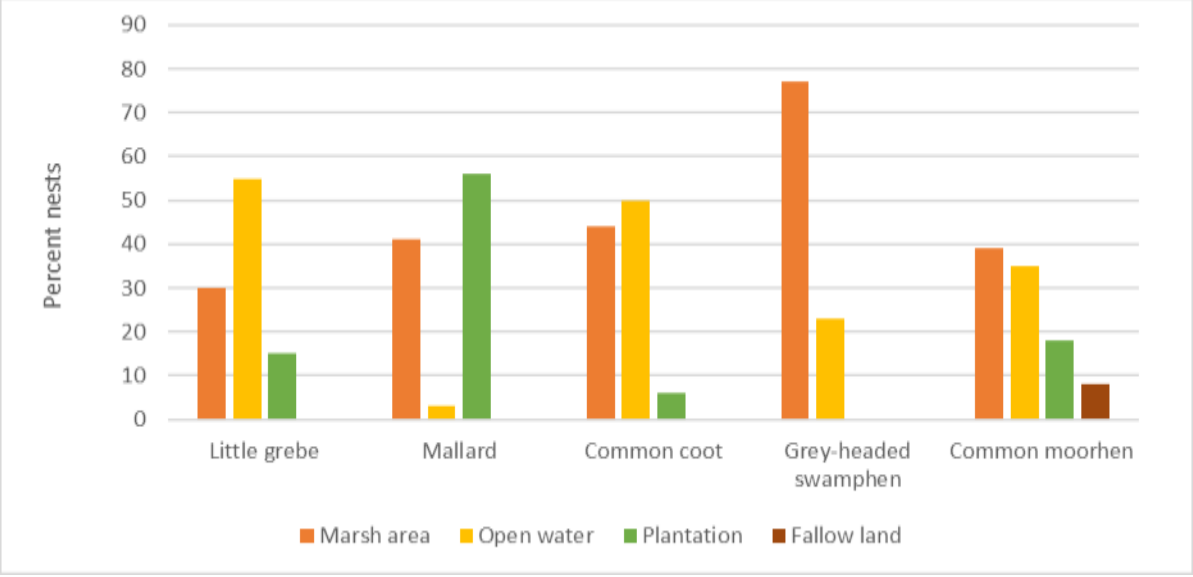


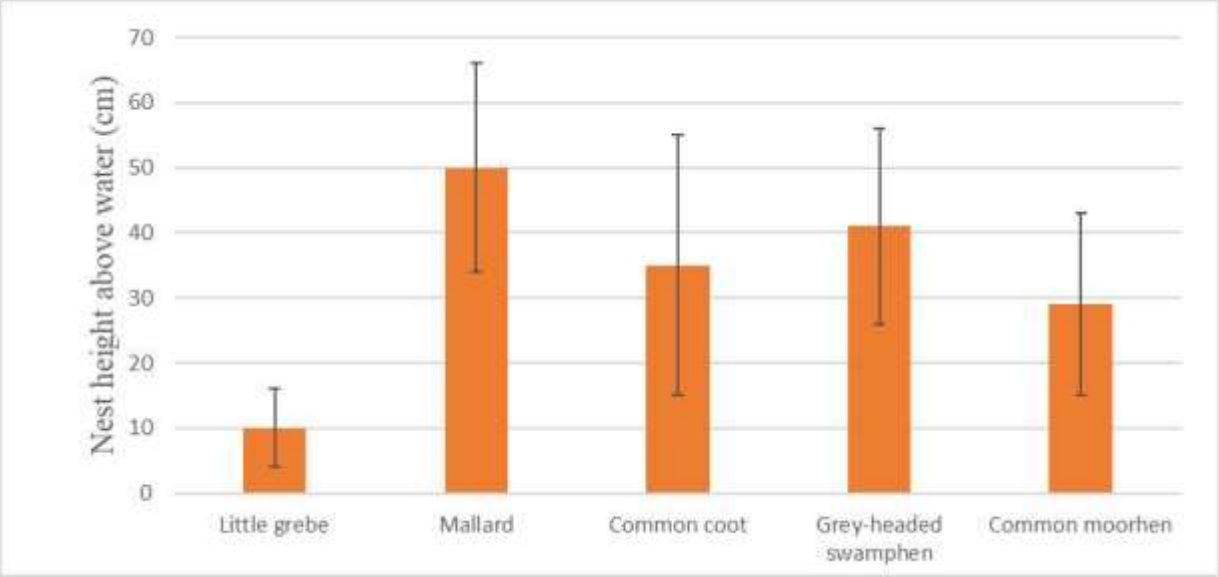

Figure 2.5. Habitat use of different bird species during nesting (n=226)




To avoid inundation, waterbirds built their nests at a height above the surface. In Shallabugh wetland, where water fluctuation is significant, most birds built their nests above the highest fluctuation mark. Mallard nests were found an average of 50±18 cm above the water surface. Little Grebes built floating nests in open water (Ali and Ripley 1987), but some nests were also found above the water surface in flooded plantations or emergent vegetation, with an average

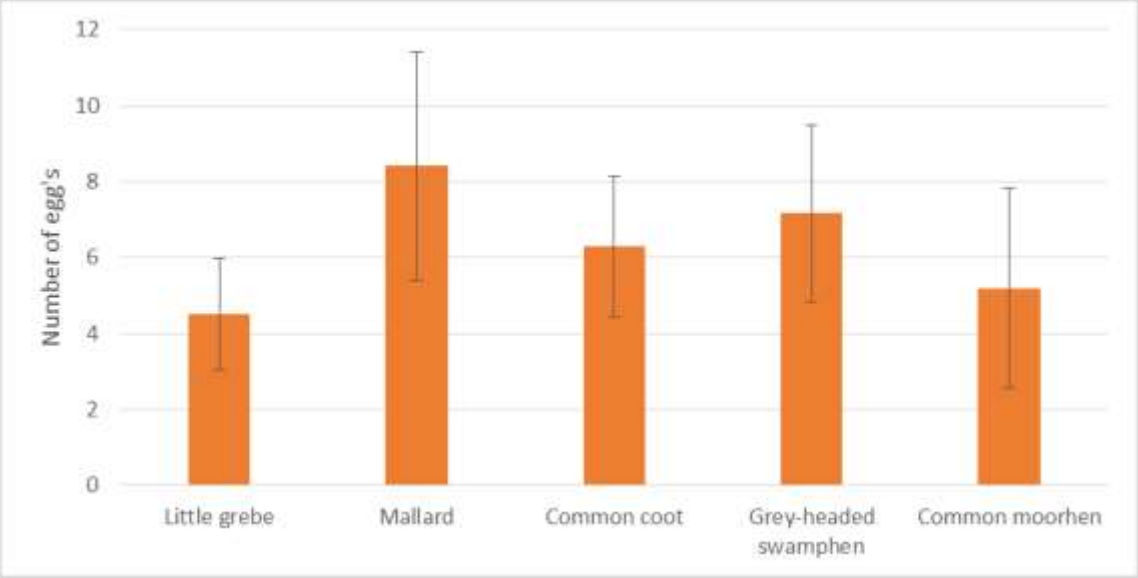
height of 10±4 cm. Other species' nests were observed at different heights above the water (Figure 2.6).

Figure 2.6. Nest Height of Different breeding birds in Shallabugh Wetland (n=226)



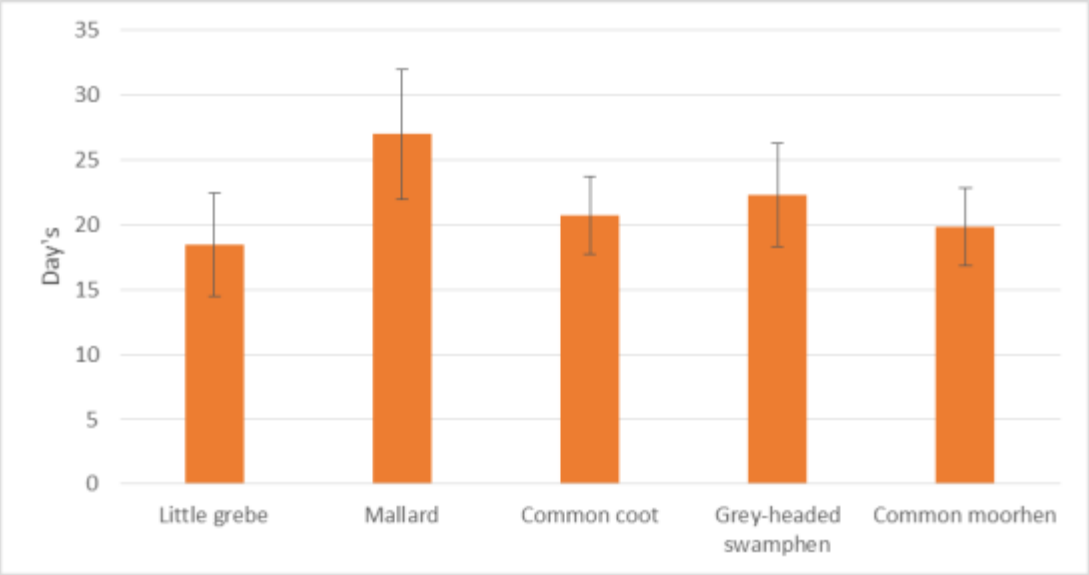

Breeding activities of resident birds in Shallabugh typically commenced in the first week of April. After completing nest construction, egg-laying began and continued until the clutch was completed. Mallards had the highest average clutch size of 8±3 eggs, ranging from 8 to 12 eggs. There was no evidence of more than one egg being laid per day or new eggs being added after the clutch was completed (Figure 2.7).

Figure 2.7. Mean clutch size of different water birds in Shallabugh Wetland during 2020-21 (n=135)



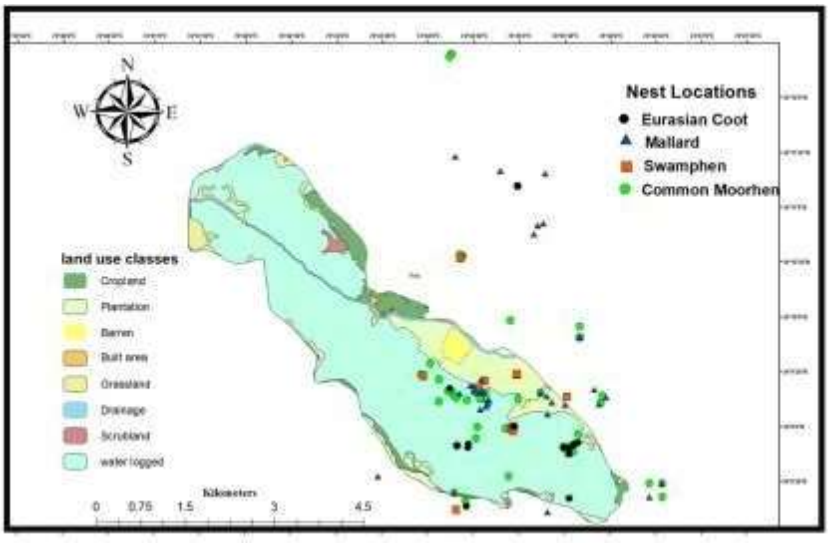

Among the five species studied, Mallards had the longest incubation period, averaging 27±3 days. Mallard chicks were capable of leaving the nest and swimming shortly after hatching (Figure 2.8).

Figure 2.8. Average incubation days of different species of waterbirds in and around Shallabugh wetland Reserve, Kashmir India during 2020-21 (n= 135)




The locations of all nests were recorded and plotted on a land-use land-cover map of Shallabugh after the breeding season. It was found that most nests were located in the main waterlogged area of the reserve, but 23 nests were observed outside the reserve's boundaries. It is recommended that the Wildlife Protection Department of Jammu and Kashmir restrict the extraction of resources, such as reeds, from sensitive areas during the breeding season. Mallards breed exclusively in Kashmir in India, and it is crucial to ensure their successful breeding (Figure 2.9).

**Figure 2.7. Nest locations of different water bird species at Shallabugh wetland reserve**



## Bird Behavioral Activity Patterns

The study also focused on analyzing the time activity budget and diurnal behavioral rhythm of five waterbird species: Eurasian Coot, Little Grebe, Mallard, Common Moorhen, and Grey-headed Swamphen. Thirteen behaviors were classified, including Feeding (pecking while standing, pecking while walking, holding food in the foot), Preening, Bathing, Resting, Alert, Fighting, Chasing, Calling, Swimming, Movement and Locomotion (walking, running, swimming, flying), Wing Expansion, Body Shaking, and Excreting. The habitats were divided into three microhabitats: areas with vegetation, open water areas, and water canals.

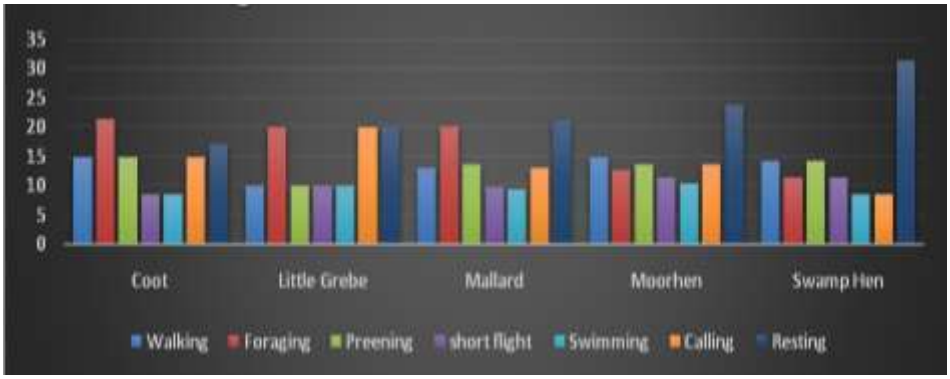
The data were analyzed using the Statistical Package for Social Sciences (SPSS) PC version 25.0 (SPSS 2019) and compared using One-Way ANOVA to calculate mean frequencies of behavioral acts with standard error

A total of 1,870 minutes of observation were conducted in Shallabugh wetland, resulting in a significant baseline dataset. The data were classified into five broad categories: Feeding (including all three styles), Movement and Locomotion, Maintenance behavior (preening, bathing, wing expansion, body shaking, and excretion), Defense behavior (alert, fighting, chasing, and calling), and Rest.

Water birds were found to spend most of their time resting, accounting for 22.6±5.4% of their total daily time. Foraging was the next most frequent activity, occupying 17.4±4.6% of their time, while diving accounted for the least amount of time at 9.3±0.7% (Table 3.1, Figure 3.1).

**Table 3.1 Fig. 3.1 Percentage of major activity pattern of Seven Waterfowl Species observed in Shallabugh Wetland Reserve Kashmir during reporting period**

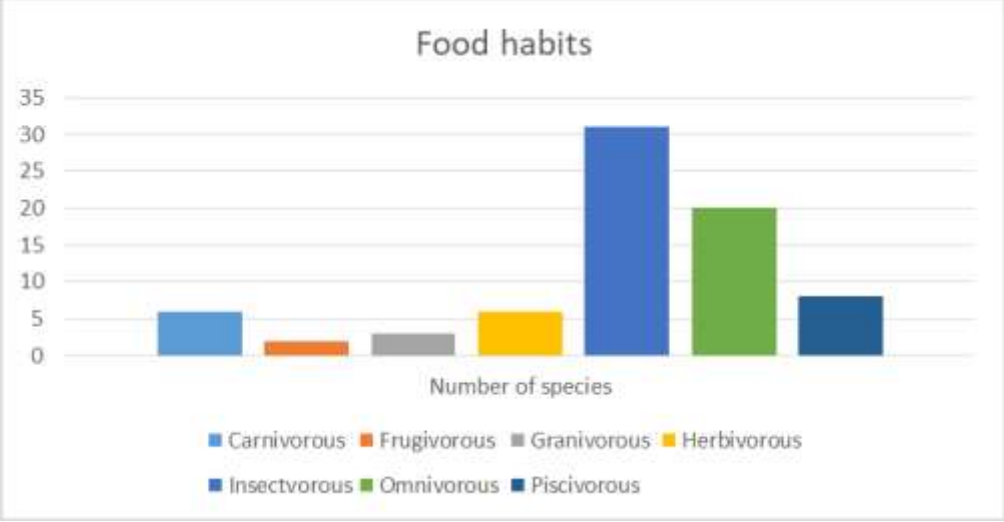
| Species | Walking | Foraging | Preening | Short flight | Diving | Calling | Resting |
|---|---|---|---|---|---|---|---|
| **Eurasian Coot** | 14.89 | 21.28 | 14.89 | 8.51 | 8.51 | 14.89 | 17.02 |
| **Little Grebe** | 10 | 20 | 10 | 10 | 10 | 20 | 20 |
| **Mallard** | 13.04 | 20.11 | 13.59 | 9.78 | 9.24 | 13.04 | 21.2 |
| **Common Moorhen** | 14.77 | 12.5 | 13.64 | 11.36 | 10.23 | 13.64 | 23.86 |
| **Swamp Hen** | 14.29 | 11.43 | 14.29 | 11.43 | 8.57 | 8.57 | 31.43 |




Data and Information on foraging observations was gathered during the study period four fixed vantage points/ stations were selected along the boundary, representing the different habitats. Each vantage point/ station included a defined habitat with adjacent waters of ≤ 5 m depth. In all vantage points, observations were made from a fixed point on the boundary, allowing visual access to the whole defined sampling area. During each observation period, a scan sampling of all water birds feeding and foraging was carried out following Martin and Bateson (1993) using 8 x 40 binoculars and spotting scope (Nikon ED 50 13-30 x 50 mm. All vantage points were sampled at least three times per week. Species identity, foraging and feeding technique of every water bird feeding were recorded in the surveyed area. Only the first foraging observation of each individual was considered, avoiding a sequential feeding observation that induces sample independence complications (Helj 1990; Rech er and Gebsky 1990). The data indicated predominate use of plant matter by the waterfowl except Eurasian Coot and Little Grebe which were observed significantly using Molluscs and small insects (Table 3.2). In terms of dietary preferences, the majority of the species were categorized as insectivorous (n=31), while only 2 species were identified as frugivorous (Fig. 3.2).

**Table 3.2. Percentage frequency of occurrence of food items observed consumed by different waterfowl species in Shallabugh Wetland**

| Waterfowl Species | Plant Matter | Floating Seeds | Molluscs | Insects/fish | Algae |
|---|---|---|---|---|---|
| **Eurasian Coot** | 34.29 | 1.43 | 17.14 | 45.72 | 1.43 |
| **Little Grebe** | 7.84 | 5.88 | 0 | 66.67 | 19.61 |
| **Mallard** | 31.26 | 20.08 | 10.04 | 33.64 | 5 |
| **Eurasian Moorhen** | 60.27 | 19.87 | 0 | 16.83 | 3.03 |
| **Grey-headed Swamp hen** | 48.75 | 1.66 | 27.45 | 22.12 | 0 |



## Movement and Migratory patterns of Waterfowl using Satellite Telemetry

Out of the two waterfowl species tagged with solar/Argos GPS PTTs, we could only track the tagged Greylag Goose for one day, presumably due to transmitter problems or, more likely, poaching of the birds followed by damage to the transmitter by the poachers, as poaching has been rampant during the waterfowl's outmigration period.

However, the tagged Northern Shoveler duck provided data for over five months, from March 25 to August 30, 2020, and its movements were consistently tracked according to the set data acquisition cycle. The bird began providing movement data immediately after the PTT was installed on March 25, 2020, and moved over 5 kilometers from the installation site.

A total of 5867 PTT locations were provided by the Argos satellite on a daily basis from March 2022 to August 2022. To minimize bias over the months, overlapping locations within an hour were truncated, and a total of 1200 locations were used for analysis to ensure an unbiased sample size. The data revealed regular movements by the Shoveler between all the major wetlands of the Valley, from the tagging site in Mirgund to Manibugh/Chatlam wetlands, Pampore, Shallabugh Wetland Reserve, Wular Lake through Dal Lake, Nigeen and Anchar Lakes, to Hokersar Wetland Reserve. The activity range of the Northern Shoveler varied significantly from month to month and between day and night (Table 7.1). For instance, in May, the Shoveler utilized a large portion of the Valley, covering a maximum area of 6300 km2. This could be attributed to the low availability of food and increased disturbance during that time. Our observations showed that the tagged bird predominantly fed on agricultural land at night, taking advantage of the leftover harvest from the fields during autumn. The ploughing of lands, which starts in April, increases disturbance in agricultural areas, prompting the birds to move in search of food and resulting in an expanded local activity range. Details of the monthly activity range area are provided in Table 7.1.

Table 7.1. Activity range area of minimum convex polygon

| Month | Area used |
|---|---|
| March | 500 Square-kilometers |
| April | 1800 Square-kilometers |
| May | 6300 Square-kilometers |
| June | 2000 Square-kilometers |
| July | 3700 Square-kilometers |

**Fig 7.1. Minimum convex polygon monthly Northern Shoveler Activity range**

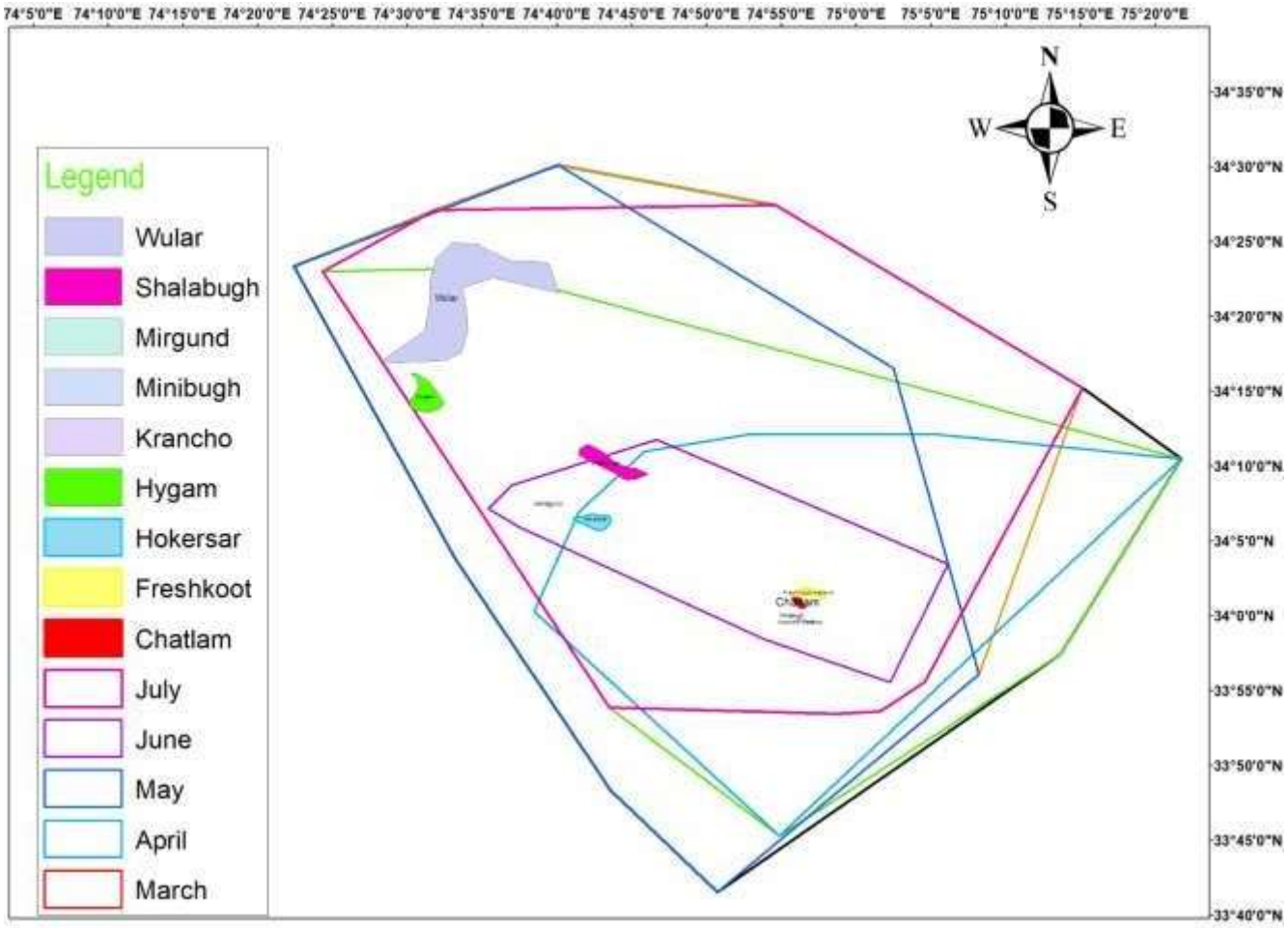
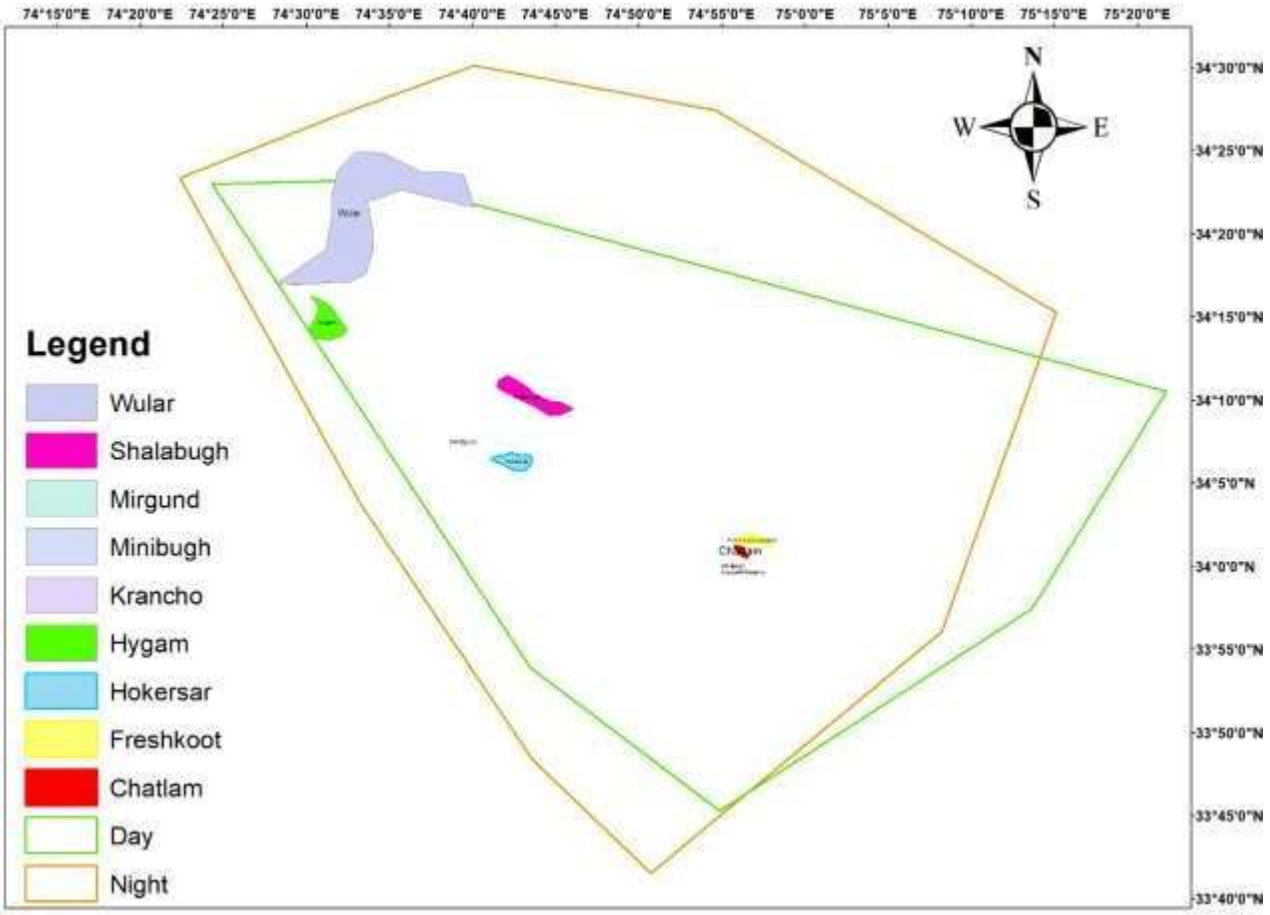


**Fig 7.2. Minimum convex polygon Day Night Northern Shoveler Activity rang**



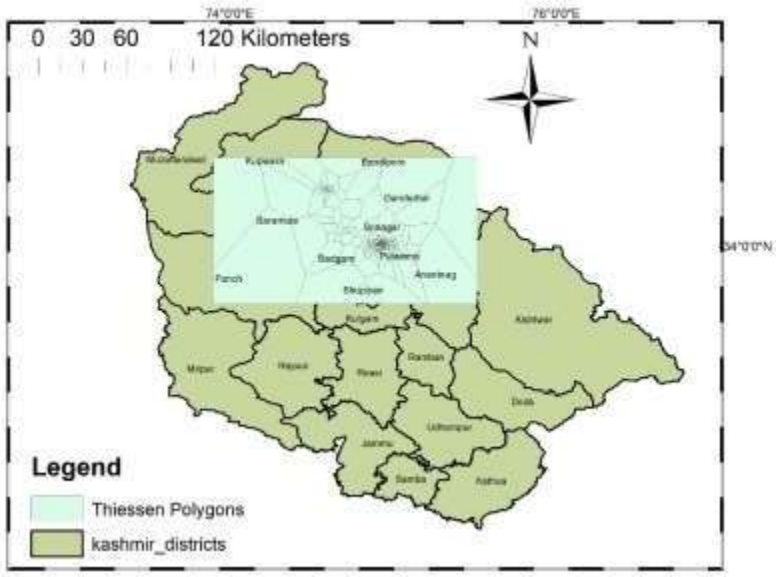

During our regular monitoring, we noticed a group of 15–30 Northern Shovelers, including the tagged Shoveler duck, in the nearby wetlands of Pampore during the summer. This suggests that a portion of the Northern Shoveler and Northern Pintail populations did not migrate and remained in Kashmir. This behavior may be attributed to the negative impact of global warming, which has caused an earlier arrival of spring in Kashmir. However, we did not find evidence of nesting by these birds in the wetlands of Kashmir during our monitoring. Interestingly, our study revealed that the birds utilized a larger area at night compared to during the day, possibly as an adaptation to avoid human poaching, which poses a significant threat to the species. Further investigation is required to determine if the bird's nocturnal feeding behavior contributes to this pattern, and additional telemeters could help in achieving this objective

### 4.1.1. Thiessen Polygons

Thiessen polygons are commonly used to model territorial characteristics, but information on the accuracy of estimates based on these polygons is lacking. To address this, we used PTT data to investigate Thiessen polygons and map the territories of Northern Shovelers in terms of their size,

shape, and neighborhood. Our findings indicate that the birds mostly used the Pampore wetlands area.

**Figure 7.3. Thiessen Polygons**




## Vegetation sampling for assessment of aquatic macrophytes and land use mapping

We sampled 134 random plots for vegetation assessment using standard quadrate sampling methodology. Shalabugh wetland reservoir constitutes diverse habitat with different vegetation patches showing dominance of Emergent vegetation (Annexure III; Fig. 5.1). A total of 23 major plant species were recorded which included 20 non woody and 03 woody species with highest number of plant species belonging to family *Poaceae* (Table 5.1). Shannon diversity index computed for the macrophyte assemblage was 3.19 and the estimate of Simpson diversity index was 6.2 and species richness in the periphery as 3. The species diversity however, varied between habitats with dykes showing highest Shannon diversity index of 3.115 as being an edge habitat between marsh and open water and representing highest (38) number of plant species (Table 5.2 Fig. 4.2). The vegetation composition showed significant differences (F= 5.324; P= 0.0016) between different habits of the wetland reserve. Based on the vegetation sampling, we prepared a landuse, land cover map of the Shallabugh Wetland Reserve (Fig. 5.3).

**Fig. 5.1. Percentage frequency of occurrence of different vegetation types in vegetation plots sampled in Shallabugh wetland Reserve, Kashmir.**

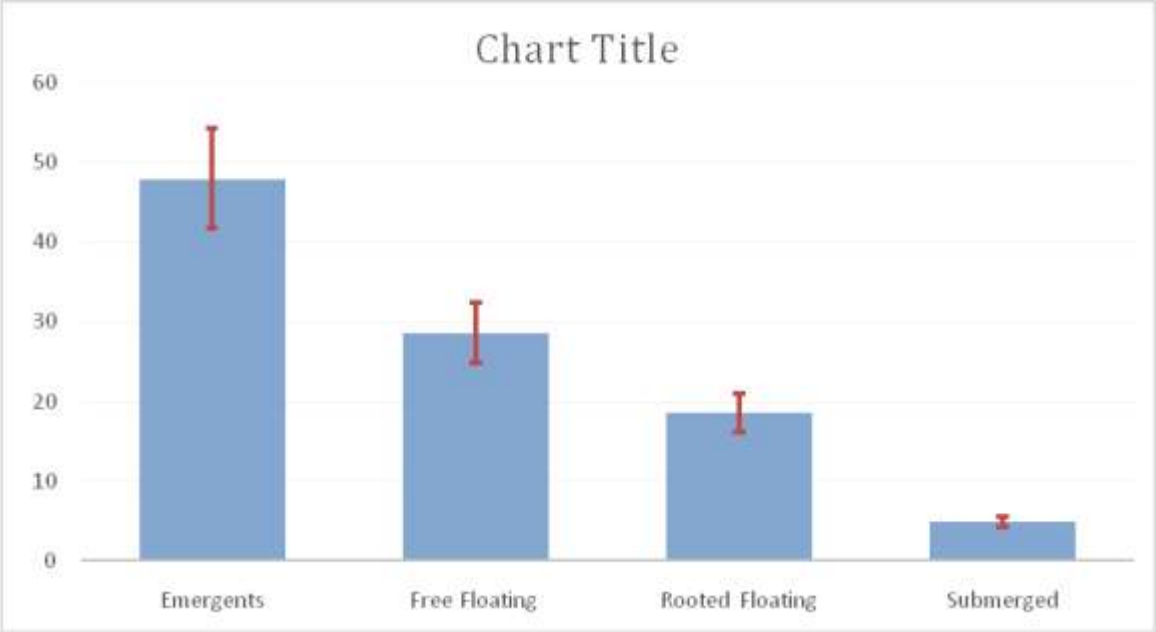
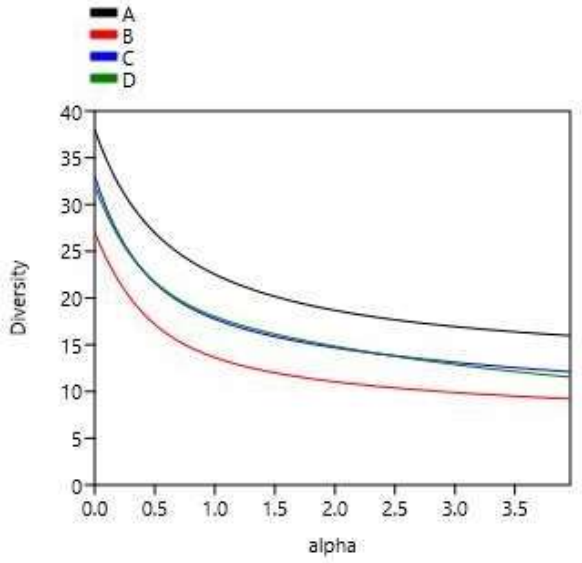


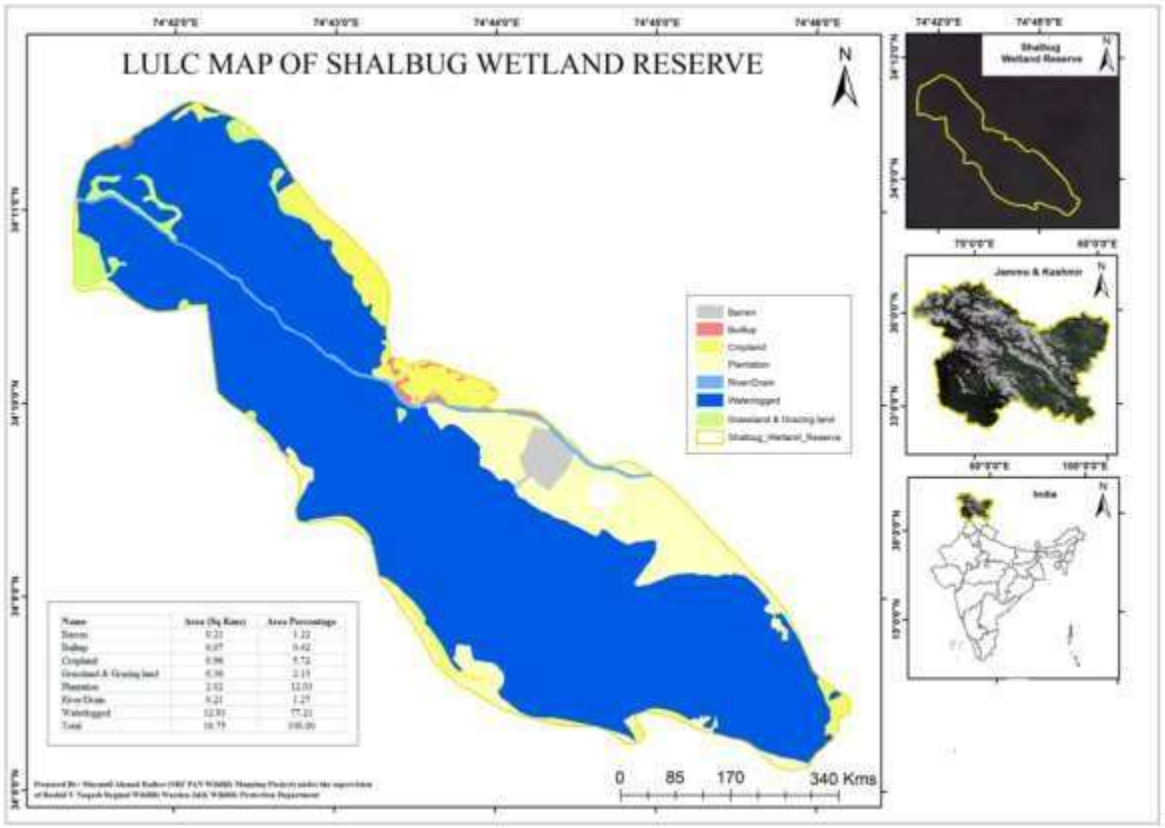

**Table 5.2 Fig 5.2. Diversity Indices of vegetation in different habitats types of Shallbugh Wetland**

| Habitat | Shannon_H | Evenness_e^H/S | Plant Species |
|---|---|---|---|
| Dyke (A) | 3.115 | 0.5931 | 38 |
| Plantation (B) | 2.613 | 0.5049 | 27 |
| Marsh (C) | 2.877 | 0.538 | 33 |
| Grassland (D) | 2.891 | 0.5628 | 32 |




**Vegetation sampling being conducted in Shallabugh Wetland (Above)**

**Fig. 5.3. Land use Land cover (LULC) map of Shallabugh Wetland Reserve**



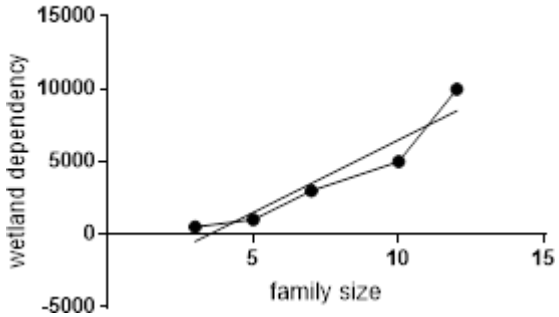
## Human wetland dependency and socio-economic evaluation of the fringe communities:

We conducted a socio-economic evaluation of the communities residing near the Shallabugh wetland, focusing on their dependency on the wetland and their socio-economic characteristics. A total of seven villages located within a 5 km radius of the wetland, including two villages within a 2 km radius, were surveyed. These villages comprised 900 households with a population of 5,200 people.

The findings revealed that the average family size in the surrounding villages was 5.8 ± 2.26, with a balanced male-to-female ratio of 1:1. The population structure exhibited an upward pyramid, with the highest percentage (44%) observed in the age group below 25 years, followed by adults aged 25 to 50 years (36%), and older individuals aged 50 years and above (20%).

A positive Pearson product-moment correlation coefficient (r=0.65; p=0.045) was established between family size and wetland dependency. This correlation indicated that larger households tended to depend more on the wetlands for their income. As a supplement to their income, two or three members of larger families engaged in harvesting resources from the wetland. Conversely, smaller families with three to four individuals lacked the extra manpower to utilize the wetlands, as they relied on employment, daily labor, or other sources (Fig.6.1).

Figure 6.1: Family size and wetland dependency (family annual income in Indian rupees)




The fringe communities of Shallabugh comprised 11 different castes, with the Khanday caste accounting for 46% of the families, followed by Hajam (9.3%), and Sofi representing the lowest percentage at 1.4% (Table 6.1).

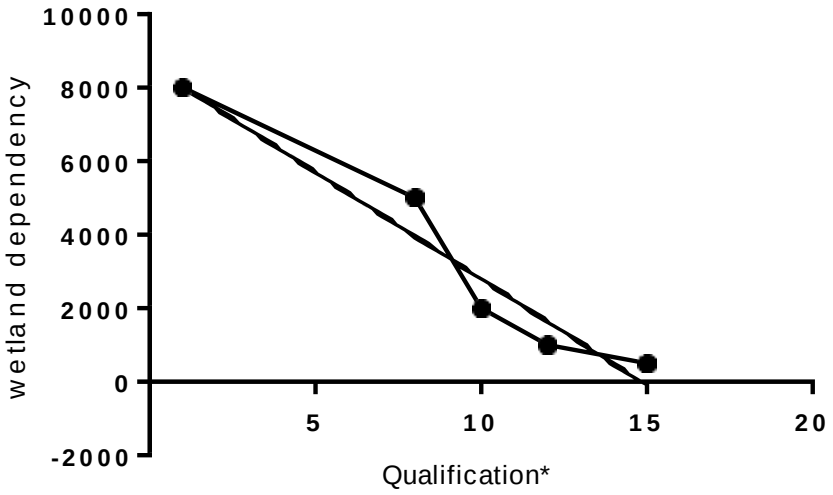
Table 6.1: Percent composition of families of fringe communities in different caste

| S. No | Cast | % Households |
|---|---|---|
| 1 | *Khanday* | 46.87 |
| 2 | *Hajam* | 9.37 |
| 3 | *Khan* | 8.85 |
| 4 | *Sheikh* | 8.85 |
| 5 | *Gaasi* | 6.77 |
| 6 | *Dar* | 5.72 |

| | | |
|---|---|---|
| 7 | *Lone* | 4.68 |
| 8 | *Ganai* | 4.68 |
| 9 | *Malik* | 1.56 |
| 10 | *Wani* | 1.56 |
| 11 | *Sofi* | 1.40 |

We examined the relationship between education and wetland dependency. A negative Pearson product-moment correlation (r=-0.714; p=0.0151) was found between literacy and wetland use, indicating that families with higher levels of education were less dependent on wetland resources compared to those with lower levels of education. The education structure of the community revealed that 25% of the population had no formal education, and 29% had completed education up to the eighth grade (Figure 6.2).

**Figure 6.2: Literacy and wetland dependency (person annual income in INR)**




*The numerical values on the x-axis correspond to different education levels: 5 for primary education, 10 for matriculation completion, 15 for a graduate level, and 20 for postgraduate education.

Further analysis of the data highlighted that 52% of the population had a low level of education, which contributed to high unemployment rates. Consequently, these individuals heavily relied on the wetland system and its various resources for their livelihoods (Table 6.2).

**Table 6.2: Detailed breakup of qualification percent of different classes**

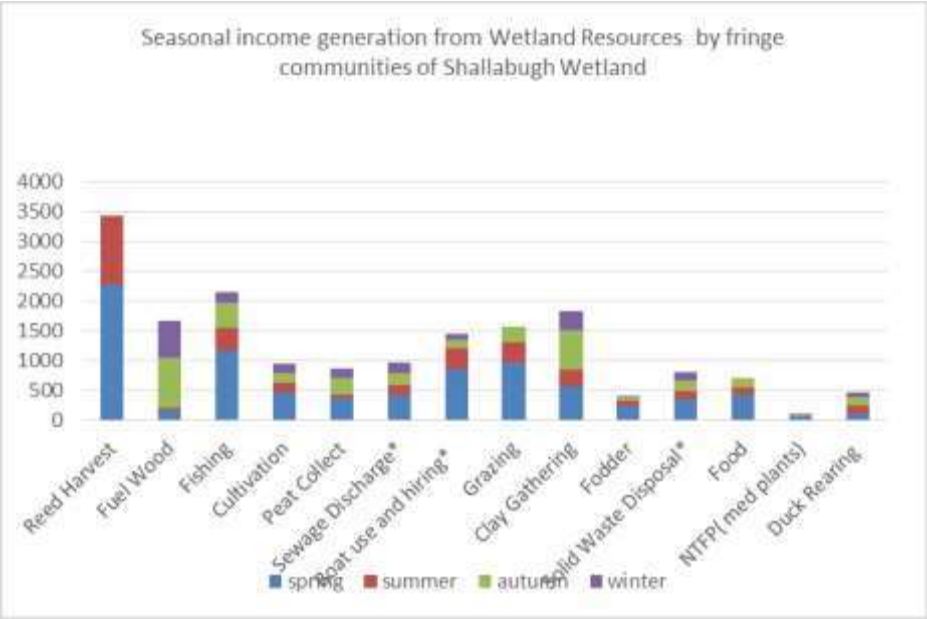
| Classes | No schooling | Unto 8th | 8th to 10th | 10th to 12th | 12th to graduation | Post-graduation |
|---|---|---|---|---|---|---|
| Total | 25% | 29% | 23% | 15% | 3% | 1.5% |
| Male | 8.4% | 18.56% | 16.3% | 11.7% | 2.34% | 1.45% |
| Female | 17.6% | 10.15% | 6.4% | 3.3% | 0.66% | 0.5% |

Regarding assets, the average landholding per household was found to be 4±2 kanal (1 kanal = 0.05 hectare or 500 $m^2$), encompassing agricultural, horticultural, and private plantation land. The per capita residential area averaged 10.6±3.91 marla (1 marla = 25 $m^2$). Mud and cement mix houses accounted for 42% of the total, while mud houses and cemented houses comprised 33% and 25%, respectively. Two-story houses constituted 62% of the total, often housing joint families, while single-story houses were predominantly occupied by nuclear families (38%).

Transportation-wise, around 40% of the families did not have their own means of transport but could easily access public transport. Two-wheelers were owned by 23% of the villagers, and 11% possessed three-wheeler or four-wheeler carriers for livelihood purposes. Only 22% of the households owned cars, typically belonging to businessmen or government employees. Approximately 5% of the households possessed tractors, which were used personally or rented for agricultural activities.

The fringe communities of Shallabugh had good accessibility to various assets and basic amenities necessary for a normal life, including schools and hospitals within reasonable distances.

In terms of livelihood, the occupation structure revealed that the majority of the population (64%) depended on agriculture and daily labor for their income. Additionally, cottage industries such as basket, chair, and tray production from wicker willow (Salix spp.) provided supplemental income. The average annual income per household was approximately Indian Rupees 142,400 ± 11,300, with 62% of families earning less than one hundred thousand per annum. Only 17% of families had an annual income exceeding Indian Rupees 200,000. The ratio of earners to dependents in the households was 1:2.6 (n=200 families), with predominantly male earners.




We assessed the local communities' attitudes towards wetland conservation and management. It revealed widespread local support for the protection of the wetland, demonstrating a mutual understanding between the local people and park staff. Positive attitudes towards conservation were prevalent among local communities, with 62% of the respondents expressing satisfaction with their access to the wetland's resources. Recommendations from the local population included measures such as plugging of bunds to minimize water outflow and preventing garbage from entering the wetland while analyzing water quality.

Regarding capacity building and enhancing livelihoods, the study identified that 65% of respondents were interested in becoming bird guides, and 60% were willing to provide facilities to tourists for income generation. Additionally, 51% of households expressed motivation to offer home stays for tourists (Table 6.3).

Table 6.3. People's attitude towards Management and conservation of wetland and resources.

| Questions | Disagree | Agree | No response |
|---|---|---|---|
| Conservation of wetlands is important | 34 | 66 | 0 |
| Do you know the Department of Wildlife Protection, Jammu & Kashmir protects Shallabugh wetland? | 48 | 38 | 14 |
| Do you feel any sense of responsibility for the protection of diverse flora and fauna | 31 | 47 | 22 |
| Do you care about protecting diverse flora and fauna | 53 | 45 | 2 |
| Will you help the Wildlife Department conserve | 39 | 52 | 9 |

| | | | |
|---|---|---|---|
| Do you face any problems because of the wetland | 27 | 65 | 9 |
| Do you support draining wetland for agriculture and other uses | 55 | 39 | 6 |
| Do you like the wetland maintenance situation | 61 | 28 | 11 |
| Would you cooperate with restrictions on resource use | 50 | 44 | 7 |
| Poaching is illegal and can get you jailed. | 48 | 45 | 7 |
| Is there any need for possession of a licensed gun for the safety of livestock | 50 | 39 | 11 |
| Do you have landholding around wetland for plantation of poplar/willow | 30 | 63 | 7 |
| Excessive reeds in the wetland should be removed | 40 | 50 | 10 |
| De-siltation of the wetland either through dredging or through digging in the wetland | 34 | 49 | 17 |
| Closure of gates to maintain a constant water level | 48 | 50 | 2 |
| Raising around the periphery of the wetland | 39 | 48 | 13 |
| Cutting of the peripheral plantation to enhance wetland | 37 | 52 | 11 |
| More trees for bird breeding and fencing. | 53 | 44 | 4 |
| Awareness among people about the benefits of wetland | 54 | 35 | 12 |
| The prevention of waste from entering wetlands and the analysis of water quality | 52 | 42 | 7 |
| Closing peripheral bund breaches | 53 | 42 | 5 |
| The negative impact of the path through a wetland on the conservation of birds | 49 | 38 | 14 |

**Resource (water chest nut) collection from Shallabugh wetland as source of Livelihood**

## 4.2. Conclusion of the study (max. 500 words)

In conclusion, the research project conducted in Shallabugh wetland Reserve has achieved significant outcomes through its various activities and interventions aimed at studying and conserving the water birds particularly the target Waterfowl species and the habitats of the wetland in the Integrated Himalayan Region (IHR). The study provided valuable insights into the dynamics of waterfowl populations in the study area and the breeding behavior and activity patterns of five water bird species: Eurasian Coot, Little Grebe, Mallard, Common Moorhen, and Grey-headed Swamphen. The study revealed important information about the distribution, abundance, breeding biology, and migratory patterns of waterfowl species, nesting and breeding ecology including the nesting preferences, nesting materials, nesting periods, egg characteristics, clutch sizes, incubation periods, and nesting locations of the above mentioned five species of breeding water birds and two terrestrial birds. Comprehensive data on the population status, nesting and breeding biology, and migratory patterns of the target species have been collected and analyzed. The water birds showed variations in their nesting preferences and materials, with bur-reed being the most commonly used plant for nesting. The nesting period extended over five months, with May being the peak month for nesting activity. Mallards had the largest eggs and the longest incubation period among the studied species. The study also highlighted the importance of protecting sensitive areas during the breeding season to ensure the successful breeding of water birds. Additionally, the study examined the time activity budget and diurnal behavioral rhythm of the waterbird species. Resting was the most frequent activity, followed by foraging, while diving accounted for the least amount of time. These findings contribute to our understanding of the behavior and ecology of waterbirds in Shallabugh wetland.

The project has contributed to the understanding of the species' ecological requirements, distribution, and threats, providing a solid scientific foundation for conservation planning and management. The findings highlight the significance of wetland ecosystems as critical habitats for waterfowl and emphasize the need for their conservation and management. By shedding light on the factors influencing waterfowl populations, the study contributes to the understanding of ecological processes and supports evidence-based conservation strategies.

The project examined the human wetland dependency and socio-economic characteristics of communities residing near the Shallabugh wetland. The findings revealed that larger households and those with lower levels of education tended to have a higher dependency on the wetland for their livelihoods. The communities displayed a diverse caste composition, with the Khanday caste being the most dominant. The study also highlighted the importance of agricultural land for the local population and their engagement in farming and labor-intensive activities. The communities exhibited positive attitudes towards wetland conservation, with widespread local support for its protection. Efforts to enhance livelihoods and promote tourism-related activities were met with interest and motivation from a significant portion of the population. Overall, the study emphasized the complex relationship between local communities and the wetland ecosystem, underlining the socio-economic significance and cultural values associated with the Shallabugh wetland.

Overall, the study provides valuable information for conservation efforts and management strategies to protect and preserve the breeding habitats of waterbirds in Shallabugh wetland.

**Conclusion of the study in bullet points:** The project has contributed significantly towards:

- Data base generation of the status and distribution of waterfowl in and around the Shallabugh wetland and associated wetlands in the region.
- Database and information generated on the daily and seasonal movement patterns and home range of the satellite tagged Northern Shoveller and behavioural activities, time budgeting and feeding habits of the waterbirds.
- Database generated on the nesting and breeding ecology of five species of breeding water birds in and around Shallabugh wetland reserve.
- **Developed 01 Eco tourism-cum Home stay** with indigenous culture and cuisine near the Shallabugh Wetland in partnership with local entrepreneur as a model to promote ecotourism, eco-guiding, Waterfowl viewing and home stay as a new enhanced sustainable livelihood opportunity for the local communities.
- **02 fringe community** families given training and motivation for entrepreneurship development in ecotourism.
- Attracted of broader group of low to medium budget travellers for birding and waterfowl viewing and monitoring which resulted in the ensuring **significant increase in bird tourism flow towards the wetlands from 10% to 30% during last two years.**
- Training and skill building of local educated youth as ecotourism and wildlife/bird guides.
- Knowledge and experience sharing and learnings on waterfowl ecology and wetland management with the frontline staff of the Stakeholder Forest and Wildlife Department has been a great learning experience.
- Building capacity and scientific and business skill amongst students and local communities for entrepreneurship development in ecotourism and bird tourism in consonance with the traditional cultural and socio-economic milieu has been largely appreciated by locals.
- Database on the socio-economic and livelihood dependence on the wetland of the fringe villages around Shallabugh generated towards ensuring ecotourism sustainability while reducing impacts on the environment and wildlife.

## *5.* OVERALL ACHIEVEMENTS – *supporting documents to be attached.*

### 5.1. Achievement on Project Objectives/ Target Deliverables (max. 500 words)

The project successfully achieved its objectives of studying the population status, nesting and breeding biology, and migratory patterns of the target species. Detailed data on the population size, distribution, and trends were collected through rigorous field surveys and monitoring activities. The nesting and breeding biology of the species were thoroughly studied, providing valuable insights into their reproductive behavior, nesting habitats, and success rates. Satellite telemetry activities enabled the tracking of individual birds, revealing important information about their migratory patterns, including routes, stopover sites, and wintering grounds.

The project also successfully examined the human wetland dependency and socio-economic evaluation of communities around the Shallabugh wetland area, contributed to understanding of

the potential of sustainable livelihood practices and highlighted the need for promotion of nature based enhanced sustainable livelihood opportunities of Ecotourism and Bird tourism through training, skill building and entrepreneurship development in partnership with fringe communities, private players, SHGs.

The project delivered comprehensive reports and publications, documenting the findings and recommendations for further conservation actions.

### 5.2. Interventions:

The study can serve as a basis for implementing interventions for effective management and conservation of the wetland and its biodiversity and to support the local communities in the Shallabugh wetland area.

The project identified key interventions to support the conservation and management of the target species.

It recommended the enhancement of the protection and surveillance mechanism to control illegal hunting and poaching, and protection and management of the identified breeding habitats of the species outside the wetland.

Habitat restoration efforts were proposed, focusing on enhancing nesting habitats and providing suitable foraging areas along the migration corridors.

The project emphasized need for Capacity building initiatives to train concerned stakeholder frontline staff in monitoring techniques, conservation strategies, and sustainable ecotourism practices.

It highlights the need for promoting education and reducing wetland dependency through alternative livelihood opportunities.

The research suggests the potential for income generation through cottage industries and tourism-related activities.

The project recommended need for the Interventions that can focus strengthening on capacity building, providing training in bird guiding, ecotourism and creating facilities for tourists, such as homestays.

### 5.3 On-field Demonstration and Value-addition of Products, if any:

The project conducted on-field demonstrations to showcase effective conservation practices and techniques.

It demonstrated habitat restoration methods, such as native vegetation planting and invasive species management, to improve nesting and foraging conditions.

The project also facilitated the development of value-added products, such as bird-friendly agricultural practices or eco-tourism initiatives, homestays, eco bird guides which generate additional income for local communities while promoting conservation.

### 5.4. Green Skills developed in the State/UT:

The project contributed to the development of green skills within the State/UT.

It provided training and capacity building opportunities for local communities, park staff, and researchers in bird monitoring, conservation techniques, and sustainable land management practices.

The project indirectly contributes to the development of green skills by promoting sustainable practices and alternative livelihood options of birding, bird guiding, ecotourism and homestays.

It emphasizes the importance of conserving natural resources and the environment through reduced wetland dependency.

The research also identifies the potential for skill development in cottage industries, such as wicker willow weaving.

The project promoted the development of skills related to ecotourism, bird identification, and habitat restoration, fostering a culture of environmental stewardship and sustainable livelihoods.

### 5.5. Addressing Cross-cutting Issues:

The project addressed various cross-cutting issues, including biodiversity conservation, sustainable development, socio-economic factors, education and community engagement.

It integrated ecological research with socio-economic considerations, recognizing the interdependence between the target species and local communities.

The project engaged stakeholders from multiple sectors, fostering collaboration and knowledge sharing for holistic conservation efforts.

It emphasizes the need for strengthening networking among stakeholders to promote sustainable practices and support local communities.

## 6. PROJECT’S IMPACTS IN IHR - supporting documents to be attached.

The study's impacts in the IHR (Integrated Himalayan Region) are evident through the findings and recommendations presented.

It contributes to the socio-economic development of the area by identifying opportunities for income generation and capacity building.

The research promotes the conservation of natural resources and the environment, highlighting the importance of reducing wetland dependency.

It aids in the conservation of biodiversity and supports land rehabilitation efforts in the Shallabugh wetland area.

### 6.1. Socio-Economic Impact:

The project had significant socio-economic impacts in the Integrated Himalayan Region (IHR).

It contributed to local livelihoods by promoting sustainable ecotourism practices, generating income for communities through bird-watching, bird guiding activities and nature-based tourism.

The project created employment opportunities related to bird monitoring, guiding, and hospitality services in the form of home stays, enhancing socio-economic conditions in the region.

It raised awareness among local communities about the economic value of conserving biodiversity and ecosystems, fostering a sense of stewardship and community involvement.

The study provides insights into the socio-economic conditions of the fringe communities in the Shallabugh wetland area.

It reveals the average annual income per household, the occupation structure, and the challenges faced by the local population.

### 6.2. Impact on Natural Resources/Environment:

The project had a positive impact on natural resources and the environment within the IHR.

Through habitat restoration efforts, it improved nesting and foraging conditions for the target species, benefiting other wildlife and promoting biodiversity conservation.

The project advocated for sustainable land management practices, reducing habitat degradation and the negative impacts of invasive species.

The project emphasizes the impact of wetland dependency on natural resources and the environment.

It promotes the sustainable use of wetlands, reducing the pressure on resources and preserving the ecological balance.

The research contributes to the conservation of natural resources by identifying opportunities for alternative livelihoods and reducing resource exploitation.

It contributed to the overall health and resilience of ecosystems in the IHR by protecting critical habitats and migration corridors.

### 6.3. Conservation of Biodiversity/Land Rehabilitation in IHR:

The project played a crucial role in the conservation of biodiversity and land rehabilitation in the IHR.

The research provides valuable data on population status, movement and migratory patterns and breeding of waterfowl and water birds for conservation efforts, aiding in the preservation of biodiversity. It identified important breeding habitats and proposed conservation measures to protect and restore these areas.

The project contributed to the preservation of the target species, safeguarding their population, feeding/foraging and breeding habitats and genetic diversity.

It emphasizes the need to protect the wetlands for the waterfowl and local communities.

**6.4. Developing Mountain Infrastructures:**

The project recognized the importance of developing mountain infrastructures to support conservation efforts and sustainable development.

*"An increasing number of birdwatchers are traveling to long haul destinations to spot new birds that cannot be seen in their own country or region. "To capitalize on this growing market, however, we have to offer what birdwatchers require, including safety, accessibility, infrastructure, quality of birdlife, and knowledgeable guides.* It recommended the improvement of basic infrastructure such as trails, visitor centers, and information signage to enhance the visitor experience and promote responsible tourism.

The project highlighted the potential for eco-friendly infrastructure development, including eco-lodges and bird observation towers, to attract nature enthusiasts and generate revenue for local communities.

**6.5. Strengthening Networking in State/UT:**

The project actively engaged in strengthening networking among stakeholders in the Shallabugh wetland area and within the State/UT.

It facilitated collaboration and information sharing between local communities, Wetland staff, SHGs and researchers for effective conservation efforts.

The project encouraged the formation of partnerships and networks to enhance the effectiveness of conservation efforts, promote knowledge exchange, and coordinate conservation actions at a larger scale

The research encourages partnerships and cooperation to support sustainable practices and improve the socio-economic conditions of the area.

## 7. EXIT STRATEGY AND SUSTAINABILITY – supporting documents to be attached.

**7.1 Utility of project findings (max. 500 words):**

The findings of the project have significant utility for conservation and sustainable development. The project's findings provide crucial information for understanding the dynamics of waterfowl populations, their habitat requirements and the factors affecting their breeding and nesting

success. This knowledge can guide future conservation efforts and inform policy decisions related to wetland management and habitat protection.

Furthermore, the socio-economic assessment conducted as part of the project sheds light on the dependence of local communities on wetland resources and the potential impacts of conservation measures on their livelihoods. This understanding is essential for designing effective strategies that balance conservation goals with the socio-economic needs of the communities. The capacity building and training provided to the local educated youth can greatly contribute to the promotion of alternate sustainable livelihood options, such as nature-based ecotourism, bird tourism, and homestay opportunities for the local fringe communities. These initiatives have the potential to create enhanced and sustainable livelihood opportunities for the communities in the long run.

The project findings also contribute to the broader scientific knowledge on waterfowl ecology and conservation. They add to the existing research and provide valuable insights into the behavior, ecology, and conservation status of waterfowl species in the study area. These findings can be used by researchers, conservation organizations, and policymakers working in the field of avian conservation and wetland management.

### 7.2 Other Gap Areas (max. 200 words):

While the project has made significant contributions to our understanding of waterfowl populations and their habitats, there are still some gap areas that warrant further investigation. One such area is the long-term monitoring of waterfowl populations and their responses to changing environmental conditions. Long-term monitoring efforts can help identify population trends, assess the effectiveness of conservation interventions, and detect any emerging threats or challenges.

Another gap area is the need for more comprehensive studies on the impacts of climate change on waterfowl populations and their habitats. Climate change poses a significant threat to wetland ecosystems, and understanding its effects on waterfowl is crucial for developing effective adaptation and mitigation strategies.

Additionally, there is a need for more research on the socio-economic aspects of wetland conservation and sustainable livelihood development. Exploring innovative approaches for promoting alternate sustainable livelihood options, such as ecotourism and bird tourism, can contribute to the long-term sustainability of both waterfowl populations and local communities.

### 7.3 Major Recommendations/ Way Forward (max. 200 words):

Based on the project's findings, several recommendations can be made for future conservation and management efforts.To ensure the long-term protection and conservation of wetland habitats, the following actions are recommended:

1. **Enhanced monitoring and surveillance:** Strengthen the monitoring and surveillance activities to effectively protect the bird species and their habitats. This can be achieved through increased patrolling, use of advanced technologies like remote sensing and drones, and collaboration with local communities for reporting any illegal activities.

2. **Sustainable land-use practices:** Implement sustainable land-use practices within and around the wetland reserve. This includes promoting responsible agriculture in the crop fields of fringe villages, avoiding excessive use of pesticides and fertilizers, and adopting measures to prevent encroachments, soil erosion and pollution. These practices will help maintain the yearlong water regime and preserve the essential characteristics of the wetland.

3. **Community-based conservation initiatives:** Foster community participation in wetland conservation by involving local stakeholders in planning and decision-making processes, raising awareness about the importance of wetlands, and providing training and capacity-building opportunities.

4. **Long-term monitoring and research:** Establish long-term monitoring programs to track changes in waterfowl populations, habitat conditions, and the impacts of climate change. This will provide valuable data for adaptive management and informed decision-making.

5. **Community engagement and capacity building:** Encourage the development of ecotourism and bird tourism as sustainable livelihood alternatives for fringe communities This can generate economic benefits, ensuring ecotourism sustainability while promoting the conservation of waterfowl and their habitats and reducing impacts on the environment and wildlife.

6. **Strengthening and enhancement of the initiatives** to Promote community-based eco-tourism, bird-watching, bird tourism activities, and nature-based livelihoods through training, skill building and entrepreneurship development in partnership with communities, private players & SHGs to create a sense of ownership and responsibility among the local residents.

7. Enhancement and strengthened development of sustainable ecotourism models of Park safari, Home stay and camp sites with indigenous cultures and cuisine in the forest fringe villages to promote the concept as a new enhanced sustainable livelihood opportunity for local communities is imperative.

8. Ecotourism awareness, amongst the local communities as well as the local and regional official stakeholders and research and education in ecotourism is imperative.

9. Need to create student trainers for dissemination and expansion of the knowledge, skill on ecotourism among key players for enhanced alternative livelihood generation and entrepreneurship development.

10. Need for promoting guided tours for practical learning of trainees and attraction of broad groups of low, medium and high budget travelers to increase the bird tourism flow towards the wetland.

11. Evaluation of the impact of experiential learning and scientific education in ecotourism on the entrepreneurship competencies of students and local youth for enhanced livelihood development.

12. To capitalize on this growing market of bird based tourism in the region, there is an urgent need for comprehensive infrastructural development and the provision of basic facilities across all wetlands to to offer what birdwatchers require, including safety, accessibility, infrastructure, quality of birdlife, and knowledgeable guides enhance the visitor experience and ensure their comfort and convenience.

13. Need for organizing Bird festivals on regular basis on the patterns of Japanese Crane festival to attract quality high end tourists to IHR to ensure ecological conservation and sustainable livelihood development.

### 7.4 Replication/ Upscaling/ Post-Project Sustainability of Interventions (max. 500 words):

To ensure the long-term sustainability of the interventions implemented during the project, replication and upscaling of successful approaches are essential. This can be achieved through collaboration with relevant stakeholders, including government agencies, non-governmental organizations, higher education Institutions and local communities.

Replication efforts should focus on transferring knowledge, best practices, and lessons learned to other wetland sites facing similar challenges. This can be done through capacity-building workshops, training programs, and the development of guidelines or toolkits for wetland conservation and sustainable livelihood promotion.

Upscaling interventions involve expanding successful initiatives to larger geographical areas or increasing their reach within the current project site. This can be achieved by securing additional funding, building partnerships, and engaging in advocacy and policy dialogue to mainstream conservation and sustainable livelihood practices.

Post-project sustainability can be ensured by integrating the project activities and outcomes into existing institutional frameworks and policies. This includes incorporating wetland conservation considerations into land-use planning processes, promoting the inclusion of wetland conservation in national and regional biodiversity strategies, and fostering collaboration among relevant stakeholders to continue the implementation of conservation measures and sustainable livelihood initiatives.

By focusing on replication, upscaling, and post-project sustainability, the project's interventions can have a lasting impact on waterfowl populations, wetland ecosystems, and the well-being of local communities. It will contribute to the long-term conservation and sustainable development of the Shallabugh Wetland Reserve and serve as a model for similar initiatives in other regions

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## Appendix 1: Checklist of the Bird species recorded in the Shallabugh wetland during January 2020-March 2022) with scientific name, local name, migratory status, habitat Feeding habit and Global Trend.

| S.No | Species | Scientific name | Local Name | Status | Feeding habit | Habitat | Global trend |
|---|---|---|---|---|---|---|---|
| **1** | Little grebe | *Tachybaptus ruficollis* | *Pind* | Resident | Insectivorous | WL | Unknown |
| **2** | Greater cormorant | *Phalacrocorax carbo* | *Mong* | Resident | Piscivorous | WL | Stable |
| **3** | Little bittern | *Ixobrychus minutus* | *Gui* | Summer migrants | Insectivorous | SH | Unknown |
| **4** | Black-crowned night- heron | *Nycticorax nycticorax* | *Brog* | Resident | Piscivorous | SH | Unknown |
| **5** | Indian pond heron | *Ardeola grayii* | *Broku* | Resident | Piscivorous | SH | Unknown |
| **6** | Grey heron | *Ardea cinerea* | *Brag* | Resident | Piscivorous | SH | Unknown |
| **7** | Little egret | *Egretta garzetta* | *Brate* | Resident | Piscivorous | SH | Increasing |
| **8** | Greylag goose | *Anser indicus* | *Aenz* | Winter migrants | Herbivorous | WL | Decreasing |
| **9** | Ruddy shelduck | *Tadorna ferruginea* | *Sankaw* | Winter migrants | Herbivorous | WL | Unknown |
| **10** | Red-crested pochard | *Netta rufina* | *Khrokh* | Winter migrants | Omnivorous | WL | Decreasing |
| **11** | Common pochard | *Aythya ferina* | *Khrokh* | Winter migrants | Omnivorous | WL | Decreasing |
| **12** | Ferruginous duck | *Aythya nyroca* | *Khrokh* | Winter migrants | Omnivorous | WL | Decreasing |
| **13** | Tufted duck | *Aythya fuligula* | *Pachin* | Passage migrants | Omnivorous | WL | Unknown |
| **14** | Northern shoveler | *Anas clypeata* | *Honk* | Winter migrants | Omnivorous | WL | Unknown |
| **15** | Gadwall | *Anas strepera* | *Badeaun* | Winter migrants | Omnivorous | WL | Unknown |
| **16** | Eurasian wigeon | *Anas Penelope* | *Naier* | Passage migrants | Omnivorous | WL | Decreasing |
| **17** | Mallard | *Anas platyrhychos* | *Nulij/ thuj* | Resident | Herbivorous | WL | Increasing |
| **18** | Northern pintail | *Anas acuta* | *Pachin* | Winter migrants | Omnivorous | WL | Stable |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **19** | Eurasian teal | *Anas crecca* | *Khieaus* | Winter migrants | Omnivorous | WL | Unknown |
| **20** | Eurasian marsh harrier | *Circus aeruginosus* | *Gaant* | Altitudinal migrants | Carnivorous | TH | Unknown |
| **21** | Eurasian sparrowhawk | *Accipiter nisus* | *Tseri Seah* | Resident | Insectivorous | TH | Stable |
| **22** | Black kite | *Milvus migrans* | *Gaant* | Resident | Carnivorous | TH | Unknown |
| **23** | Water rail | *Rallus aquaticus* | *Gill* | Winter migrants | Omnivorous | TH | Decreasing |
| **24** | Ruddy crake | *Porzana fusca* | *Gill* | Resident | Insectivorous | SH | Unknown |
| **25** | Grey-headed Swamphen | *Porphyrio porphyrio* | *Wan Teach* | Resident | Herbivorous | WL | Unknown |
| **26** | Common moorhen | *Gallinula chloropus* | *Tech* | Resident | Herbivorous | SH | Stable |
| **27** | Common coot | *Fulica atra* | *Kolur* | Resident | Omnivorous | WL | Unknown |
| **28** | Black-winged stilt | *Himantopus himantopus* | *Longzeeth* | Resident | Insectivorous | SH | Stable |
| **29** | Little ring plover | *Charadrius dubiu* | | Summer migrants | Insectivorous | SH | Unknown |
| **30** | Black-tailed godwit | *Limosa limosa* | | Summer migrants | Omnivorous | SH | Stable |
| **31** | Common sandpiper | *Actitis hypoleucos* | *Chover* | Summer migrants | Omnivorous | SH | Decreasing |
| **32** | Green sandpiper | *Tringa ochropus* | *Chover* | Passage migrants | Omnivorous | SH | Increasing |
| **33** | Wood sandpiper | *Tringa glareola* | *Chover* | Altitudinal migrants | Omnivorous | SH | Decreasing |
| **34** | Whiskered tern | *Chlidonias hybridus* | *Krish* | Summer migrants | Insectivorous | SH | Stable |
| **35** | European starling | *Sturnus vulgaris* | *Tcin Hangur* | Resident | Frugivorous | TH | Decreasing |
| **36** | Common myna | *Acridotheres tristis* | *Haer* | Resident | Insectivorous | TH | Increasing |
| **37** | Feral pigeon | *Columba livia* | *Kotur* | Resident | Granivorous | TH | Increasing |
| **38** | Oriental turtle dove | *Streptopelia orientalis* | *Wan Kukil* | Resident | Granivorous | TH | Stable |
| **39** | Eurasian collar dove | *Streptopelia decaocto* | *Kukil* | Summer migrants | Granivorous | TH | Increasing |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **40** | Himalayan cuckoo | *Cuculus canorus* | *Shah Kok* | Summer migrants | Insectivorous | TH | Decreasing |
| **41** | Common swift | *Apus apus* | *Katej* | Summer migrants | Frugivorous | TH | Stable |
| **42** | Common hoopoe | *Upupa epops* | *Satut* | Summer migrants | Omnivorous | SH | Stable |
| **43** | Common kingfisher | *Alcedo atthis* | *Kol toont* | Resident | Piscivorous | SH | Stable |
| **44** | Pied kingfisher | *Ceryle rudis* | *Doad Toont* | Resident | Piscivorous | SH | Decreasing |
| **45** | White-throated kingfisher | *Halcyon smyernensis* | *Boad Toont* | Resident | Piscivorous | SH | Increasing |
| **46** | European bee-eater | *Merops apiaster* | *Tulri Kaaw* | Summer migrants | Insectivorous | TH | Unknown |
| **47** | Eurasian wryneck | *Jynx torquilla* | *Viri mot* | Summer migrants | Insectivorous | TH | Unknown |
| **48** | Scaly-bellied woodpecker | *Picus squamatus* | *Makotz* | Altitudinal migrants | Insectivorous | TH | Stable |
| **49** | Himalayan woodpecker | *Dendrocopos himalayensis* | *Hor Koel* | Altitudinal migrants | Insectivorous | TH | Unknown |
| **50** | Eurasian skylark | *Alauda arvensis* | *Tcher* | Summer migrants | Insectivorous | TH | Stable |
| **51** | Wire-tailed swallow | *Hirundo Smithii* | *Katej* | Summer migrants | Insectivorous | TH | Increasing |
| **52** | Rosy pipet | *Anthus roseatus* | *Rang tcher* | Resident | Insectivorous | TH | Unknown |
| **53** | Grey wagtail | *Motacilla cinerea* | *Kahak Dob bai* | Resident | Insectivorous | SH | Stable |
| **54** | Citrine wagtail | *Motacilla citreola* | *Lidur Dob-bai* | Resident | Insectivorous | SH | Stable |
| **55** | White wagtail | *Motacilla alba* | *Dabai* | Resident | Insectivorous | SH | Stable |
| **56** | Himalayan bulbul | *Pycnonotus leucogenys* | *BulBul/ Bilbechur* | Resident | Insectivorous | TH | Stable |
| **57** | Long-tail shrike | *Lanius schach* | *Har watej* | Resident | Insectivorous | TH | Unknown |
| **58** | Verditer flycatcher | *Eumyias thalassinus* | *Rang Tchar* | Resident | Insectivorous | TH | Stable |
| **59** | Spotted Forktail | *Enicurus maculatus* | *Shahkol lot* | Altitudinal migrants | Insectivorous | TH | Unknown |
| **60** | Blue-whistling thrush | *Myophonus caeruleus* | *Hazar daastan* | Resident | Omnivorous | TH | Unknown |
| **61** | Grey bushchat | *Saxicola ferrea* | | Resident | Insectivorous | TH | Unknown |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **62** | Streaked laughingthrush | *Garrulax lineatus* | *Sheen pipin* | Resident | Insectivorous | TH | Unknown |
| **63** | Winter wren | *Troglodytes troglodytes* | | Altitudinal migrants | Insectivorous | TH | Unknown |
| **64** | Clamorous reed warbler | *Acrocephalus stentoreus* | *Korkut* | Resident | Herbivorous | WL | Unknown |
| **65** | Green-backed tit | *Parus monticolus* | *Rang Tcher* | Resident | Insectivorous | TH | Stable |
| **66** | Cinereous tit | *Parus cinereus* | *Pinchkean* | Resident | Insectivorous | TH | Unknown |
| **67** | Hodgson's tree creeper | *Certhia hodgsoni* | *Kul dader* | Alttitudnal migrants | Insectivorous | TH | Unknown |
| **68** | Oriental white-eye | *Zosterops palpebrosus* | *Rang Tcher* | Resident | Insectivorous | TH | Stable |
| **69** | Plain mountain finch | *Leucosticte nemoricola* | *Pinchkean* | Resident | Omnivorous | TH | Unknown |
| **70** | House sparrow | *Passer domesticus* | *Tcher* | Resident | Insectivorous | TH | Decreasing |
| **71** | Eurasian golden oriole | *Oriolus oriolus* | *Posh nool* | Summer migrants | Omnivorous | TH | Decreasing |
| **72** | Ashy drongo | *Dicrurus leucophaeus* | *Gunkots/Telakots* | Summer migrants | Insectivorous | TH | Stable |
| **73** | Yellow-billed blue-magpie | *Urocissa flavirostris* | *Lot Raz* | Resident | Omnivorous | TH | Stable |
| **74** | Jungle crow | *Corvus macrorynchos* | *wan kaw* | Resident | Omnivorous | TH | Stable |
| **75** | House crow | *Corvus splendens* | *Kaw* | Resident | Omnivorous | TH | Stable |
| **76** | Eurasian jackdaw | *Corvus monedula* | *kawin* | Resident | Omnivorous | TH | Stable |

TH: Terrestrial habitat; SH: Shore Habitat; WL: Wetland

## Appendix II. Seasonal relative abundance of birds of Shallabugh Wetland Reserve

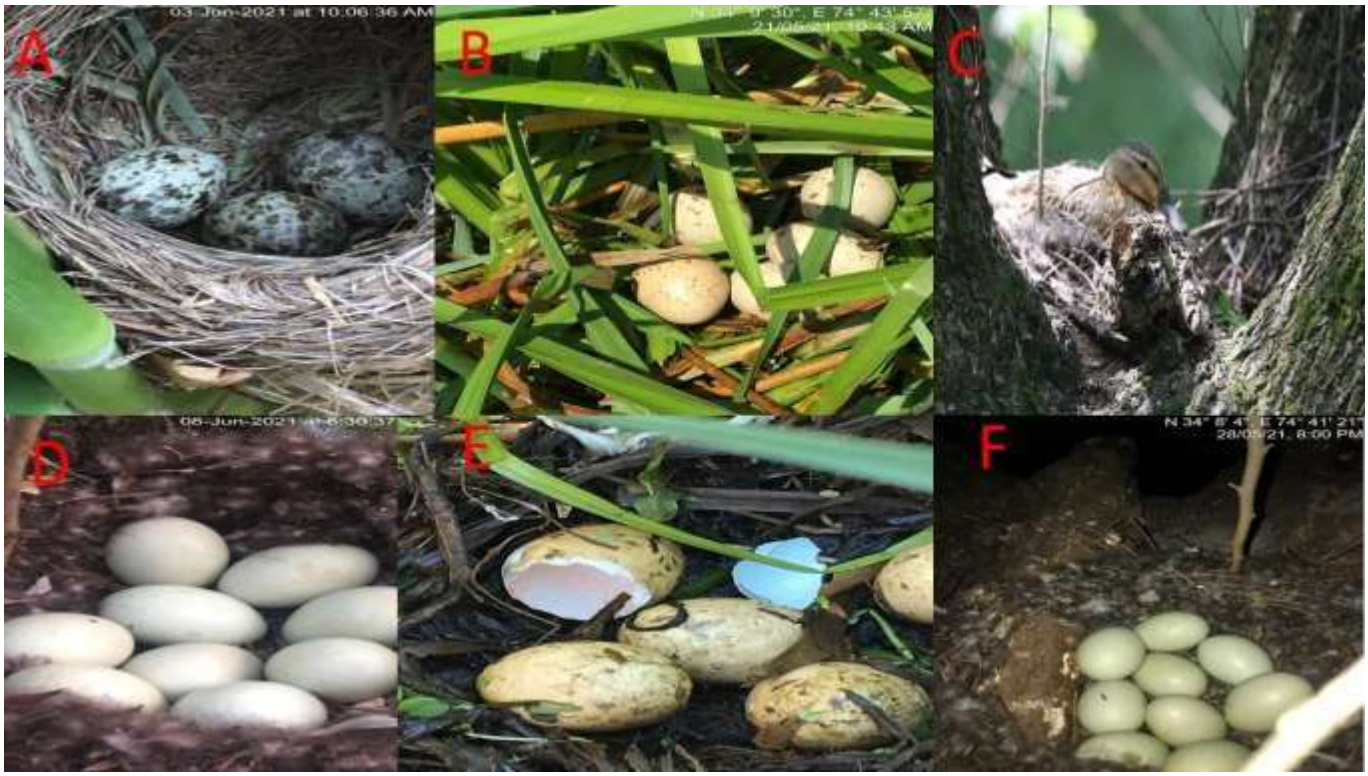
| S.No | Species | Scientific name | Winter | Spring | Sumer | Autumn |
|---|---|---|---|---|---|---|
| **1** | Little grebe | *Tachybaptus ruficollis* | 2.24 | 3.48 | 2.9 | 3.16 |
| **2** | Greater cormorant | *Phalacrocorax carbo* | 1.7 | 0.33 | 0 | 0.89 |
| **3** | Little bittern | *Ixobrychus minutus* | 0 | 0.52 | 0.6 | 0.89 |
| **4** | Black-crowned night-heron | *Nycticorax nycticorax* | 2.77 | 1.5 | 2.71 | 2.68 |
| **5** | Indian pond heron | *Ardeola grayii* | 2.75 | 2.81 | 2.6 | 3.78 |
| **6** | Grey heron | *Ardea cinerea* | 0.5 | 1.61 | 1.62 | 2.96 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **7** | Little egret | *Egretta garzetta* | 1.68 | 1.42 | 2.41 | 2.29 |
| **8** | Greylag goose | *Anser anser* | 0.91 | 1.18 | 0 | 0 |
| **9** | Ruddy shelduck | *Tadorna ferruginea* | 0.63 | 0.3 | 0 | 0.18 |
| **10** | Common pochard | *Aythya ferina* | 0.82 | 0.88 | 0 | 0.04 |
| **11** | Ferruginous duck | *Aythya nyroca* | 0.7 | 0.1 | 0 | 0 |
| **12** | Red-crested pochard | *Netta rufina* | 0.82 | 0.63 | 0 | 0 |
| **13** | Tufted duck | *Aythya fuligula* | 1.37 | 0 | 0 | 0 |
| **14** | Northern shoveler | *Spatula clypeata* | 2.17 | 2.84 | 0 | 0 |
| **15** | Gadwall | *Mareca strepera* | 3.24 | 2.62 | 0 | 0 |
| **16** | Eurasian wigeon | *Anas penelope* | 0.71 | 1.9 | 0 | 0 |
| **17** | Mallard | *Anas platyrhynchos* | 6.32 | 4.22 | 0.51 | 1.5 |
| **18** | Northern pintail | *Anas acuta* | 0.5 | 2.03 | 0 | 0.25 |
| **19** | Eurasian teal | *Anas crecca* | 2.37 | 4.48 | 0 | 0.11 |
| **20** | Eurasian marsh harrier | *Circus aeruginosus* | 0.71 | 0 | 0 | 0.4 |
| **21** | Eurasian sparrowhawk | *Accipiter nisus* | 0.45 | 0.05 | 0 | 0 |
| **22** | Black kite | *Milvus migrans* | 3.19 | 3.85 | 4.87 | 2.52 |
| **23** | Water rail | *Rallus aquaticus* | 0.24 | 0.25 | 0 | 0 |
| **24** | Ruddy crake | *Porzana fusca* | 0.01 | 0.14 | 0 | 0 |
| **25** | Grey-headed Swamphen | *Porphyrio porphyrio* | 2.69 | 1.5 | 3.08 | 4.44 |
| **26** | Common moorhen | *Gallinula chloropus* | 3.30 | 8.43 | 3.37 | 4.69 |
| **27** | Common coot | *Fulica atra* | 4.42 | 13.28 | 3.29 | 4.4 |
| **28** | Black-winged stilt | *Himantopus himantopus* | 0 | 0 | 1.22 | 0.29 |
| **29** | Little ring plover | *Charadrius dubius* | 0 | 0.48 | 0 | 0.14 |
| **30** | Black-tailed godwit | *Limosa limosa* | 0 | 0 | 0.15 | 0.18 |
| **31** | Common sandpiper | *Actitis hypoleucos* | 1.88 | 1.58 | 1.93 | 1.64 |
| **32** | Green sandpiper | *Tringa ochropus* | 0 | 0.14 | 0.76 | 0.25 |
| **33** | Wood sandpiper | *Tringa glareola* | 3.91 | 1.24 | 3.32 | 3.35 |
| **34** | Whiskered tern | *Chlidonias hybridus* | 0 | 0.78 | 3.45 | 2.57 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **35** | European starling | *Sturnus vulgaris* | 0.92 | 1.03 | 3.38 | 3.17 |
| **36** | Common myna | *Acridotheres tristis* | 3.79 | 2.07 | 3.87 | 4.02 |
| **37** | Feral pigeon | *Columba livia* | 3.09 | 1.43 | 4.23 | 3.43 |
| **38** | Oriental turtle dove | *Streptopelia orientalis* | 0.5 | 0.74 | 2.26 | 0.35 |
| **39** | Eurasian collar dove | *Streptopelia decaocto* | 1.39 | 1.29 | 2.97 | 2.06 |
| **40** | Himalayan cuckoo | *Cuculus canorus* | 0 | 0.07 | 0 | 0.21 |
| **41** | Common swift | *Apus apus* | 0.06 | 0.33 | 0.68 | 0.04 |
| **42** | Common hoopoe | *Upupa epops* | 0 | 0.2 | 0.57 | 0.53 |
| **43** | Common kingfisher | *Alcedo atthis* | 1.28 | 1.13 | 2.52 | 2.62 |
| **44** | Pied kingfisher | *Ceryle rudis* | 1.61 | 1.56 | 2.36 | 2.44 |
| **45** | White-throated kingfisher | *Halcyon smyernensis* | 2.52 | 1.31 | 2.72 | 3.89 |
| **46** | European bee-eater | *Merops apiaster* | 0 | 0.17 | 0.03 | 0 |
| **47** | Eurasian wryneck | *Jynx torquilla* | 0 | 0 | 0.6 | 0.49 |
| **48** | Scaly-bellied woodpecker | *Picus squamatus* | 0.74 | 0.98 | 0 | 0.61 |
| **49** | Himalayan woodpecker | *Dendrocopos himalayensis* | 0.18 | 0.01 | 0 | 0.14 |
| **50** | Eurasian skylark | *Alauda arvensis* | 0 | 0.07 | 0 | 0 |
| **51** | Wire-tailed swallow | *Hirundo Smithii* | 0.9 | 1.22 | 3.16 | 1.58 |
| **52** | Rosy pipet | *Anthus roseatus* | 0 | 0.02 | 0.25 | 0 |
| **53** | Grey wagtail | *Motacilla cinerea* | 0 | 0.24 | 0.03 | 0 |
| **54** | Citrine wagtail | *Motacilla citreola* | 1.2 | 0.98 | 2.43 | 2.76 |
| **55** | White wagtail | *Motacilla alba* | 3.55 | 1.66 | 2.21 | 2.59 |
| **56** | Himalayan bulbul | *Pycnonotus leucogenis* | 2.53 | 1.32 | 1.47 | 1.96 |
| **57** | Long-tail shrike | *Lanius schach* | 2.38 | 1.16 | 2.21 | 1.54 |
| **58** | Verditer flycatcher | *Eumyias thalassinus* | 0 | 0.04 | 0.03 | 0.04 |
| **59** | Spotted Forktail | *Enicurus maculatus* | 0 | 0.15 | 0.22 | 0.07 |
| **60** | Blue-whistling thrush | *Myophonus caeruleus* | 2.8 | 1.8 | 2.67 | 1.75 |
| **61** | Grey bushchat | *Saxicola ferrea* | 0 | 0 | 0.04 | 0.12 |
| **62** | Streaked laughingthrush | *Garrulax lineatus* | 0.48 | 0.61 | 0.16 | 0.41 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **63** | Winter wren | *Troglodytes troglodytes* | 1.01 | 0.93 | 0 | 0.32 |
| **64** | Clamorous reed warbler | *Acrocephalus stentoreus* | 1.38 | 1.09 | 3.66 | 2.6 |
| **65** | Green-backed tit | *Parus monticolus* | 0 | 0.15 | 0 | 0 |
| **66** | Cinereous tit | *Parus cinereus* | 2.14 | 1.12 | 2.38 | 2.52 |
| **67** | Hodgson's tree creeper | *Certhia hodgsoni* | 1.29 | 0.18 | 0 | 0 |
| **68** | Oriental white-eye | *Zosterops palpebrosus* | 0 | 0.38 | 0.07 | 0 |
| **69** | Plain mountain finch | *Leucosticte nemoricola* | 0 | 0.02 | 0.03 | 0 |
| **70** | House sparrow | *Passer domesticus* | 1.84 | 1.71 | 5.27 | 3.22 |
| **71** | Eurasian golden oriole | *Oriolus oriolus* | 0.42 | 0.7 | 0.78 | 0.74 |
| **72** | Ashy drongo | *Dicrurus leucophaeus* | 0 | 0.14 | 0.19 | 0 |
| **73** | Yellow-billed blue-magpie | *Urocissa flavirostris* | 1.48 | 1.25 | 2.45 | 2.27 |
| **74** | Jungle crow | *Corvus macrorynchos* | 2.21 | 2.89 | 2.6 | 3.53 |
| **75** | House crow | *Corvus splendens* | 4.2 | 2.6 | 2.39 | 3.58 |
| **76** | Eurasian jackdaw | *Corvus monedula* | 1.9 | 1.25 | 0.62 | 1.12 |

## Appendix III Photographs of nests of different breeding birds with eggs



## Appendix IV: Waterfowl species Northern Shoveler being tagged with Satellite PTT


## Appendix V: Satellite Tagging of Graylag Goose and Waterfowl ringing in the Shallabugh Wetland Reserve and adjoining wetlands of Kashmir.

**Shallabugh Bird Festival Organized in collaboration with Department of Wildlife Protection, District Administration and budding birders of Local Kashmir Birdwatch Group (below).**


**An event to launch SKUAST-Kashmir-Kashmir Birdwatch Calendar- 2023 organized by SKUAST-Kashmir and the budding birders club- the Kashmir Birdwatch showcasing the bird diversity of the region which has been documented by the budding Birders of Club from across Jammu & Kashmir (Below).**


**Appendix VI: Birding and Bird Photography event organized with local communities and frontline staff (above) and awareness and capacity building training program on nature based livelihood opportunities organized for the educated youth and fringe/tribal communities (below).**




## Appendix VII: Visit of renowned ornithologists and wildlife photographers to Shallabugh Wetland for birding and promotion of bird tourism and wicker willow crafting


**Appendix VIII: Training Workshop on "Ecotourism and Conservation of Wetland Ecosystems" organized on January 04 & 08, 2020 for fringe communities and frontline field staff of Shallabugh wetland under the NMHS Project.**

Consultations with Wildlife Department frontline staff

## Appendix IX

**Ecotourism Model and Home stay with indigenous culture and cuisine developed as a model in partnership with local entrepreneur.**

A view of Shallabugh Wetland Reserve (Above) With migratory waterfowl in flight (below)