ACTION HISTORY OF RTI REQUEST No.WLIOI/R/E/21/00063

Applicant Name	gaurav bansal
Text of Application	Sir, Applicant has learnt that on dated 09, March 2020, Ministry of Environment, Forests and Climate Change in reference to online proposal by Director, Directorate of Civil Aviation, Govt of Uttar Pradesh granted ENVIRONMENTAL CLEARANCE under EIA Notification 2006 for the Development of Greenfield Jewar International Airport in Gautam Budh Nagar, Uttar Pradesh. As per Environmental Clearance dated 09 MARCH, 2020 applicant has learnt that the GJIA landscape not only support 06 different species of Mammals and 60 species of BIRD SPECIES but also have 99 perennial water bodies, Ministry of Environment, Forests and Climate Change, Govt of INDIA directed WILDLIFE INSTITUTE OF INDIA to provide its FINAL REPORT on the issue of CONSERVATION PLAN FOR BIRDS AND FAUNA. In view of the above mentioned facts and circumstances, kindly provide the following information to the applicant under section 06 of the Right to Information Act 2005: 1. Whether Wildlife Institute of INDIA has prepared the FINAL REPORT with respect to CONSERVATION PLAN FOR BIRDS & FAUNA. 2. If yes, please provide certified copy of the said FINAL REPORT. 3. Whether Wildlife Institute of INDIA has done any kind of official communication through email, letter, fax etc with any authority including the project proponent for the implementation of the FINAL REPORT relating to COSERVAION PLAN FOR BIRDS & FAUNA. 4. If yes, please provide the certified copies of the said OFFICIAL COMMUNICATION which WILDLIFE INSTITUTE OF INDIA has done with any authority for the implementation of its FINAL REPORT relating to CONSERVATION PLAN FOR BIRDS & FAUNA. In order to save Public Exchequer, applicant requests you to please provide the soft copy of the Reply on the applicants email id which is emailtogkb@gmail.com. Further, the applicant also requests your goodself to kindly use the window available on the RTIONLINE for additional payment, in case it is required.
Reply of Application	Information provided in annexure

SN.	Action Taken	Date of Action	Action Taken By	Remarks
1	RTI REQUEST RECEIVED	18/09/2021	Nodal Officer	
2	REQUEST FORWARDED TO CPIO	20/09/2021	Nodal Officer	Forwarded to CPIO(s) : (1) Monali Sen
3	REQUEST DISPOSED OF	05/10/2021	Monali Sen-(CPIO)	

Print

सूचना का अधिकार
RIGHT TO INFORMATION

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

No. WII/RTI/CPIO/2021-22 (Qtr-II)/50

Date: 05 October, 2021

To,

Mr. Gaurav Bansal
A,26 Basement, Jangpura Extension,
Near DAV School, Jangpura Extension,
New Delhi, Pin:110014
Email: bansal.gauravkumar3@gmail.com

Sub.: Information under RTI Act, 2005–reg.
Ref.: Your Online RTI No. WLIOI/R/E/21/00063 dated 18/09/2021

Dear Sir,

Please refer to your application cited above under RTI Act, 2005. In this context, the point-wise response to your queries is given below:

Information Sought under RTI	Reply
Applicant has learnt that on dated 09, March 2020, Ministry of Environment, Forests and Climate Change in reference to online proposal by Director, Directorate of Civil Aviation, Govt of Uttar Pradesh granted ENVIRONMENTAL CLEARANCE under EIA Notification 2006 for the Development of Greenfield Jewar International Airport in Gautam Budh Nagar, Uttar Pradesh. As per Environmental Clearance dated 09 MARCH, 2020 applicant has learnt that the GJIA landscape not only support 06 different species of Mammals and 60 species of BIRD SPECIES but also have 99 perennial water bodies, Ministry of Environment, Forests and Climate Change, Govt of INDIA directed WILDLIFE INSTITUTE OF INDIA to provide its FINAL REPORT on the issue of CONSERVATION PLAN FOR BIRDS AND FAUNA. In view of the above mentioned facts and circumstances, kindly provide the following information to the applicant under section 06 of the Right to Information Act 2005:	
Whether Wildlife Institute of INDIA has prepared the FINAL REPORT with respect to CONSERVATION PLAN FOR BIRDS & FAUNA. If yes, please provide certified copy of the said FINAL REPORT.	See the attached report **Annexure –1.**
Whether Wildlife Institute of India has done any kind of official communication through email, letter, fax etc with any authority including the project proponent for the implementation of the FINAL REPORT relating to COSERVAION PLAN FOR BIRDS & FAUNA. If yes, please provide the certified copies of the said OFFICIAL COMMUNICATION which WILDLIFE INSTITUTE OF INDIA has done with any authority for the implementation of its FINAL REPORT relating to CONSERVATION PLAN FOR BIRDS & FAUNA.	See the attaced **Annexure-2** & **Annexure-3**

If you are not satisfied with the aforesaid reply, you may appeal to the **Dr. Dhananjai Mohan, Director & Appellate Authority, Wildlife Institute of India, Post Box 18, Chandrabani, Dehradun – 248 001, Ph. 0135-2640910.**

Thanking you,

Yours faithfully,

NO & CPIO (RTI)

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BIODIVERSITY Conservation Plan 2021

CONSERVATION PLAN FOR BIODIVERSITY LIKELY TO BE IMPACTED BY

GREENFIELD JEWAR INTERNATIONAL AIRPORT

GAUTAM BUDH NAGAR, UTTAR PRADESH, INDIA

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Yamuna Expressway Industrial Development Authority
YEIDA
FUTURE IS HERE

Conservation Plan for Biodiversity likely to be impacted by Greenfield Jewar International Airport, Gautam Budh Nagar, Uttar Pradesh, India

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Design and layout
Dr. Bilal Habib

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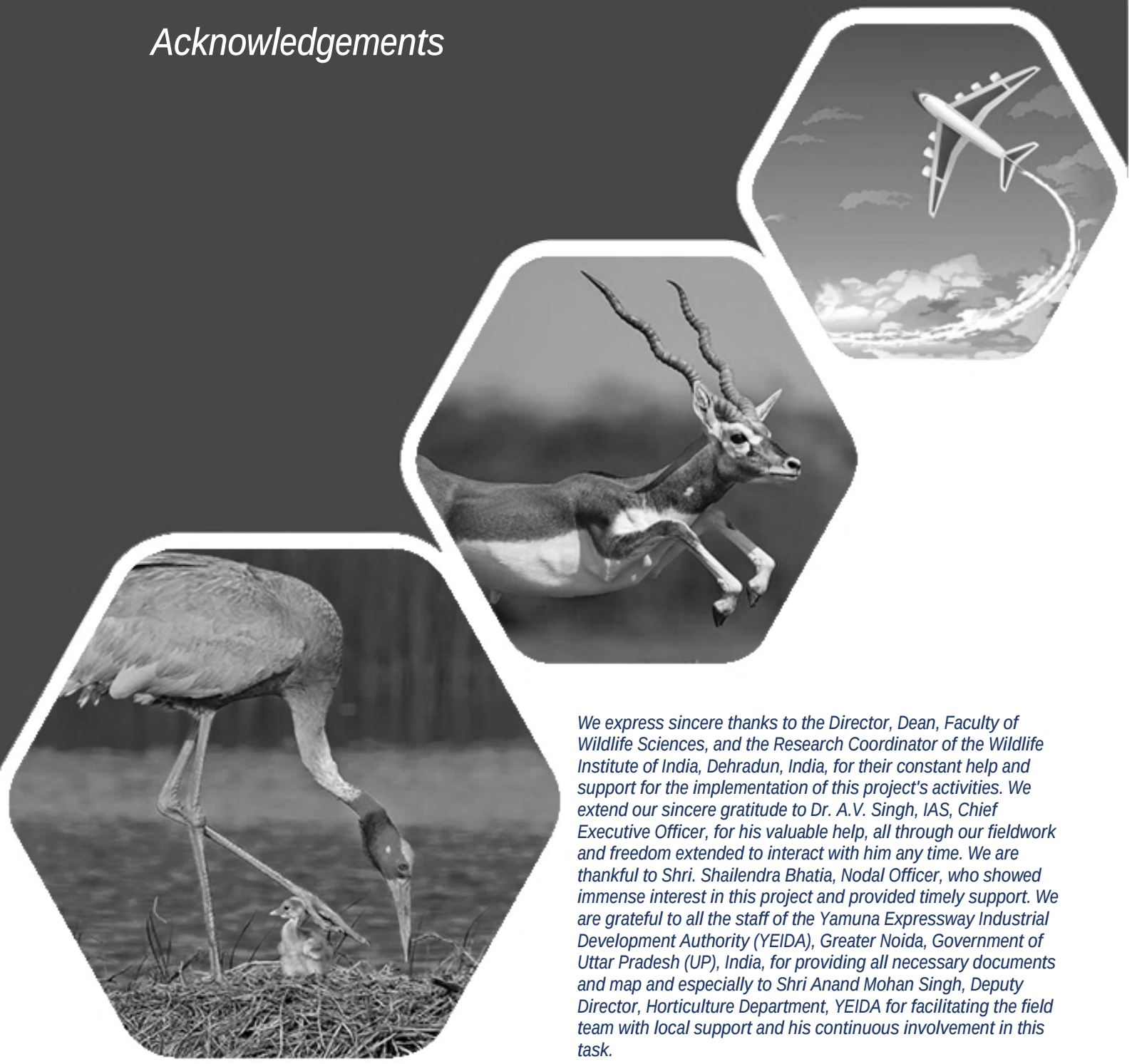
Citation: Wildlife Institute of India (2021) - Conservation Plan for Biodiversity likely to be impacted by Greenfield Jewar International Airport, Gautam Budh Nagar, Uttar Pradesh, India. Technical Report. Wildlife Institute of India, Dehradun 248001, India. Technical Report No. 2021/02. Pp.236.

Acknowledgements



We express sincere thanks to the Director, Dean, Faculty of Wildlife Sciences, and the Research Coordinator of the Wildlife Institute of India, Dehradun, India, for their constant help and support for the implementation of this project's activities. We extend our sincere gratitude to Dr. A.V. Singh, IAS, Chief Executive Officer, for his valuable help, all through our fieldwork and freedom extended to interact with him any time. We are thankful to Shri. Shailendra Bhatia, Nodal Officer, who showed immense interest in this project and provided timely support. We are grateful to all the staff of the Yamuna Expressway Industrial Development Authority (YEIDA), Greater Noida, Government of Uttar Pradesh (UP), India, for providing all necessary documents and map and especially to Shri Anand Mohan Singh, Deputy Director, Horticulture Department, YEIDA for facilitating the field team with local support and his continuous involvement in this task.

We are grateful to the Principal Chief Conservator of Forests and The Chief Wildlife Warden, UP, for necessary permission to carry out the work and all field support. We are thankful to Shri P.K. Srivastav, Divisional Forest Officer, Gautam Budh Nagar, Greater Noida, UP, India who provided valuable support during field exercises and information needed at various stages. We are thankful to the front-line staff of the UP-Forest Department for their support during data collection.

We are immensely thankful to all the participants of our consultation workshops for sharing their personnel experiences in the field of biodiversity conservations around the Greenfield Jewar International Airport landscape. Our special gratitude is to Dr. Asad R. Rahmani, Senior Scientific Advisor, and Former Director of Bombay Natural History Society (BNHS), Lucknow, UP, for sharing his vast experiences of "Sarus Conservation" in Uttar Pradesh.

We acknowledge the support of the Vice Chancellor and Registrar, Gautam Buddha University, Greater Noida, Uttar Pradesh, and their staff in providing the required logistic facility of staying during the project period and organizing the workshop.

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Abbreviations

CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CEC	Conservation Education Centre
CEE	Centre for Environment Education
CEMDE	Centre for Environmental Management of Degraded Ecosystems
CIA	Comprehensive Impact Analysis
CTR	Corbett Tiger Reserve
DDA	Delhi Development Authority
EAC	Expert Appraisal Committee
EIA	Environment Impact Assessment
GIS	Geographical Information Systems
GJIA	Greenfield Jewar International Airport
HWC	Human-Wildlife Conflict
IBA	Important Bird Area
IGI	Indira Gandhi International
IUCN	International Union for Conservation of Nature and Natural Resources
IWPA	Indian Wildlife (Protection) Act – 1972
LULC	Land use and Land cover
MoEFCC	Ministry of Environment, Forest & Climate Change
NBA	National Biodiversity Authority
NCR	National Capital Region
NCT	National Capital Territory
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organisation
PA	Protected Area
PARA	Perimeter to Area Ratio
PwC	PricewaterhouseCoopers Private Limited
RET	Rare, Endangered and Threatened
SEBS	Science Express Biodiversity Special
TCF	The Corbett Foundation
WII	Wildlife Institute of India
YEIDA	Yamuna Expressway Industrial Development Authority

Executive Summary

India has emerged as the fastest-growing major economy and is expected to be one of the top three economic powers in the world over the next 10-15 years. India, like other developing countries, is confronted with the dilemma of securing functionality of different ecosystems ranging from natural to urban habitats alongside the priorities for expanding the transportation infrastructure. Among these, airports are increasing in numbers to cater to the increased demand for air travel for effective connectivity across the country.

With the growing needs for air travel from New Delhi's Indira Gandhi International (IGI) Airport and visualizing its unsustainability in meeting high traffic demand in the future based on the projection, the Government of India has recently initiated a project to build a new airport called "Greenfield Airport" at Jewar, Gautam Budh Nagar, Uttar Pradesh (U.P.). The proposed airport covering an area of 1334 ha is within New Delhi-National Capital Region (NCR). This would facilitate air travel from the region's entire National Capital Territory (NCT) of Delhi, 13 districts of the State of Haryana, eight districts of the State of Uttar Pradesh, and two districts of the State of Rajasthan (Anonymous 2019). With this development and very close proximity to the national capital, it is expected to have several large infrastructure development projects in the landscape. For judicious planning, NCR Planning Board (NCRPB) was created in 1985 to plan the development of the region and to enact harmonized policies for the control of land use and development of infrastructure in the region to avoid any haphazard development of the region as well as conservation of natural resources (Anonymous 1985). The NCRPB's Regional Plan 2021 aims to promote economic growth and develop the entire NCR as a region of global excellence (http://ncrpb.nic.in/regionalplan2021.html). On the same lines, the NCRPB has also envisaged increasing the ambit and has the vision to expand and develop further, for which it is working on a new Regional Plan 2041, which is slated to be, completed soon (http://ncrpb.nic.in).

For Greenfield Jewar International Airport (GJIA), Yamuna Expressway Industrial Development Authority (YEIDA) was appointed as a nodal agency by the Government of Uttar Pradesh state to execute the land acquisition process and other activities about airport development on behalf of the Directorate of Civil Aviation, Government of U.P. The YEIDA has steered a Techno-economic feasibility study by PricewaterhouseCoopers Private Limited (PwC) and an EIA study by GreencIndia Consulting Private Limited. Based on these studies, YEIDA moved the proposal to the Expert Appraisal Committee (EAC) for obtaining "Environmental Clearance" and this was deliberated in the 42nd Meeting convened on 10-12 July 2019. To bridge the gaps between the development and conservation of natural resources, YEIDA was asked to conduct a study for the preparation of "Conservation Plan for Birds and Fauna" in consultation with the Wildlife Institute of India (WII) for further consideration. With the follow-up, a technical proposal titled "Conservation Plan for Biodiversity likely to be impacted by Greenfield Jewar International Airport, Gautam Budh Nagar, Uttar Pradesh" was submitted to YEIDA for consideration and it was accepted. Subsequently, a Memorandum of Agreement (MoA) was signed between WII and YEIDA for a study of Phase-I on 30th August 2019 at Dehradun, India.

The scope of the proposed project was as follows:

a. Identify the key sources of impacts and the nature of impacts (direct and indirect, long term and short term and irreversible impacts if any associated with the airport) that would help guide the preventive, ameliorative, and restorative strategies to be adopted in the conservation planning.

b. Identify the significant biodiversity values represented by rare, endangered and threatened (RET) floral and faunal species belonging to major taxa (herpetofauna, birds, and mammals) within the zone of influence of the project.

c. Assess the vulnerability of habitats and landscape features within a 10 km radius to impacts during different phases of the airport development and the likely implications.

d. Prepare a conservation plan for rare, endangered, and threatened (RET) faunal species that is based on preventive and restorative measures for impact mitigation.

e. Propose the Phase-II plan (Ten Years) for the "Post-Development Monitoring" for the status of RET species.

Consequently, the Wildlife Institute of India mobilized a team of researchers, which started collating desktop-based information on the conservation importance of the taxa and habitats (terrestrial and wetlands) available in the landscape surrounding the airport. We also obtained crucial data, information, and shapefile of the proposed airport from YEIDA. Participatory approaches in conservation have played a pivotal role during the last four decades to fulfill human and ecological/environmental goals. Realizing this, we organized a day “Consultation Workshop” with the stakeholders and knowledge partners at Gautam Buddha University, Greater Noida, Uttar Pradesh on 1st February 2020. Around 32 participants attended the workshop from Non-Governmental Organization, Nongovernmental Individuals, and officials from the Forest Department, YEIDA, MoEFCC, and others. We shared and discussed our envisaged framework of the planning process for the preparation of the “Biodiversity Conservation Plan” with the participants. Based on the valuable suggestions received, we finalized our framework and approaches for the preparation conservation plan.

Landscape conservation planning for biodiversity requires the integration of natural wildlife habitats at different scales so as consider the dispersal capacity of various taxa. Based on collated information and suggestion received during the workshop, we prepared the final framework of our approach for the collection of field data for the preparation of the “Conservation Plan for Biodiversity” for the GJIA landscape. We also reviewed the areas of conservation importance at the landscape level around the GJIA site. The landscape falls under Upper-Gangetic Plain and is a part of the semi-arid biogeographic zone. Because of these mixed habitat features, the landscape is endowed with rich biodiversity because of numerous wetlands created along the river Yamuna and the presence of various Protected Areas/Important Bird Areas (PAs/IBAs) such as Sultanpur National Park, Okhla Bird Sanctuary, Surajpur Bird Sanctuary, and Dhanauri wetland, etc. All these habitats are rich in bird faunal diversity (160 to 300 species) and for migratory birds. Additionally, it has a mosaic of scrub habitats within the agriculture landscape and is the home for two key species of conservation importance besides others such as Indian antelope or Blackbuck (*Antilope cervicapra*) which is Schedule I species of the Wildlife (Protection) Act 1972 and Sarus Crane (*Grus antigone*).

The infrastructure development plan envisaged in the landscape by YEIDA may cause rapid urbanization and land-use changes and may leave its ecological footprint. Thus, it requires the “Cumulative Impact Assessment” (CIA). Therefore, we also consider other areas which may be critical for the biodiversity conservation of this landscape.

Accordingly, we used a standardized methodology for the collection and quantification of field data of species occurrence, habitat characteristics, and characterization of wetlands. Moreover, we also relied on Remote Sensing and GIS analysis for identifying areas of conservation importance based on the field data collected at the landscape level. For the present report, we characterize the wildlife habitats within the GJIA site and its surrounding areas ranging between a 10 and 25 km radius. Hence, we provide information on the occurrence of key wildlife species, wildlife habitats, and wetlands, which are

of conservation importance in the GJIA landscape. Reported literature on the occurrence of different taxa indicated the richness of biodiversity values in this landscape.

Remnant scrubland, forest, and plantation patches are the key wildlife habitat in agro-ecological regions of the GJIA landscape, which provide refuge habitats to several taxa ranging from herpetofauna, birds, and mammals.

Our assessment indicated the presence of 11 patches of scrubland (c. 26 ha) mostly on the eastern boundary of the GJIA site of 1334 ha close to the Rohi and Parhoi villages. Moreover, we found the presence of 48 (546 ha) and 96 (1473 ha) suitable wildlife habitat patches within a 10 and 25 km radius, respectively of the GJIA site. This reveals the presence of a reasonable proportion of wildlife habitats within the ranging behavior of several wildlife species outside the GJIA site and may provide refuge once they are displaced from the GJIA site.

Another key wildlife habitat observed in this landscape is the presence of a large number of wetlands or seasonal and perennial water bodies. However, we considered only perennial water bodies in the present analysis as they have higher wildlife habitat values than the seasonal. Our field survey has indicated that the majority of the wetlands are infested with weeds. Of the eight wetlands observed within the GJIA site, 3 (0.99 ha) and 5 (2.5 ha) were seasonal and perennial respectively. We noted seasonal and perennial wetlands of 172 and 453 within a 10 and 25 km radius of the GJIA site respectively. Of these, 70 to 90 percent were perennial and may be suitable for the wetland birds of this landscape. Our spatial distribution patterns analysis indicated that these wetlands are evenly distributed across the GJIA landscape. Though we may lose 8 wetlands from the GJIA site, moreover wide distribution of wetlands within a 25 km radius of the GJIA site may provide suitable habitat to wetlands fauna. Like key wetlands of conservation importance in NCR, Dhanauri wetland, which is within a 25 km radius of the GJIA site and is of very high conservation priorities for the GJIA landscape. Rahmani et al. (2019) have reported that this wetland has provided habitat to several bird species including migrant, resident, and is a roosting site for Sarus Crane of this landscape. Hence, this wetland is a critical conservation site and is also IBA.

Literature indicated the presence of Blackbuck in and around the GJIA site, therefore, we emphasized gathering of information on the species' distribution and its habitat in the GJIA landscape during our fieldwork (Chapter 5). We recorded 46 independent observations with a total number of 258 Blackbucks and the population ranged between 1 and 31 individuals in a group. We recorded the largest group consisting of 29 individuals on the south-eastern part of GJIA close to Rohi–Parohi villages. Apart from these three main clusters, we also observed Blackbuck at several locations throughout the landscape in smaller groups of 1-5 individuals. The Blackbuck uses the mosaic of scrubland patches within the agriculture landscape as a refuge habitat. Therefore, we determined the spatial configurational and compositional characteristics of these potential scrub habitats using Remote Sensing and GIS analysis across the GJIA landscape. Grasslands and tree species such as *Acacia nilotica*, *Prosopis juliflora*, *Butea monosperma*, *Azadirachta indica*, etc. dominate most of these patches. The spatial configurational analysis of patches indicated that the majority of these were within the ranging behavior of the Blackbuck. Hence, these natural habitats may be used as "stepping-stone" for moving from one to another patch across the landscape. We also describe threats and strategies for conserving Blackbuck in this landscape.

Another conservation important species of this landscape is Sarus Crane and preferred to use wetlands associated with agriculture fields. We recorded 76 Sarus Crane individuals in 31 independent sightings during our survey. Based on the preferred characteristics of wetlands used by Sarus (Rahmani et al., 2019), we quantified and mapped the potential wetlands for the conservation of Sarus in the GJIA

landscape (Chapter 6). Sarus were observed mainly in the north with the largest flock of 11 individuals within the GJIA site. A spatial configurational analysis of wetlands suggests the presence of adequate habitat within the ranging patterns of Sarus outside the GJIA site. Given the bird habitat within a 10 km radius of the GJIA site, which may have a risk of harming the aircraft and human life due to a bird strike. Therefore, we considered wetlands of conservation importance beyond a 10 km radius but within 25 km from the GJIA site. Chapter 6 provides information on threats and strategies for the conservation of Sarus in this landscape.

Chapter 7 deals with other wildlife species observed in the landscape and their conservation strategies. The chapter provides information about Nilgai distribution and group size in the landscape along with Golden Jackal and Jungle Cat as these were the main animal species of conservation concern. Nilgai showed similar distribution as that of Blackbuck. Jackal and Jungle Cat sightings were few. In the case of avifauna, we observed Indian Peafowl and Egyptian Vulture during our survey.

Chapter 8 discusses several aspects of land use policy and implementation around the proposed GJIA site for effective conservation planning.

The landscape around the GJIA site is mainly of the agro-ecological region, which falls under Upper-Gangetic Plain and Semi-arid biogeographic zones. Our data indicate that the landscape has interspersed mosaics mainly of scrubland habitat patches except for a few scattered forest patches and nested with seasonal and perennial wetlands. These habitats support the flora and fauna of these two biogeographic zones. This landscape illustrates conservation importance at the larger landscape level as it provides “stepping-stone” habitats to several species of the adjoining conservation areas of NCR. We observed Blackbuck and Sarus crane as key species of conservation importance and by conserving; the habitat of these two species may enhance and support the overall conservation of the flora and fauna of this landscape. Given this, Chapter 9 provides proposed management conservation strategies in detail for achieving the long-term biodiversity conservation goals for the GJIA landscape.

Key areas of conservation action strategies are as follows:

1. Restoration of the mosaic of scrubland and other wildlife habitats interspersed within the agro-ecological region of GJIA landscape: We identified in overall 45 and 100 key wildlife habitat patches within a 10 and 25 km radius of the GJIA site of conservation importance. These would provide a “stepping-stone” habitat to different faunal species. Additionally, we also identified three scrubland patches of potential wildlife habitat which account c. 39 percent of the total wildlife habitat (572 ha) for intensive management. We suggested different management actions for retaining, restoring, and managing these habitats for blackbuck and other wildlife species.

2. Conservation of Sarus Crane habitat and wetlands: The majority of the Sarus sightings c. 84% were outside the GJIA site. For minimizing bird hazard risk, our habitat evaluation for the conservation of wetlands was restricted to beyond 10 km but within a 25 km radius from the GJIA site. Considering the wetland characteristics suitable for Sarus crane conservation (Rahmani et al. 2019), we identified 145 wetlands, which are of conservation importance. Of the different management, actions suggested, major emphasis has been managing weed infestation, encroachment, and monitor bird abundance bi-annually as per the guidelines of the International Bird Survey and factors affecting the wetland quality.

   “Dhanauri Wetlands” is the roosting site for the Sarus of the GJIA landscape. This being a critical wetland of conservation importance, therefore attempt should be made to declare as a “Wildlife Sanctuary” and prepare a “Management Plan” for effective conservation planning.

3. Financial incentive schemes for conservation support: It is well established that heterogeneity of natural habitat in the agro-ecological region enhances the overall biodiversity. Among the suggested means are retaining hedgerows, keeping fallow land, plantation of natural trees and forest, augmentation of natural vegetation through land sharing/sparing, etc.

   Sarus crane habitat is mainly crop field associated with wetlands and built nest on farmland. Farmers should be encouraged to provide conservation support for protecting the habitat and nest of the Sarus crane.

   We suggested extending financial incentives to the farmers who are willing to participate in conservation support.

4. **Establishment of "Animal Rescue and Rehabilitation Center" n**ear GJIA site: Because of the presence of suitable wildlife habitat within the GJIA site, wildlife may be affected, injured, and require capture during the conservation phase. To provide immediate relief, it is suggested to establish a temporary facility of "Animal Rescue and Rehabilitation Center" for five years with appropriate infra-structure and wildlife trained Veterinary Officers near GJIA site under the supervision of Forest Department, Uttar Pradesh. We also suggest for establishing two "Rapid Response Team" for rescue of wildlife from GJIA.

5. Community-based tourism: Exclusion of wildlife from the agriculture field by using any means of barriers such as fences is not possible in this landscape. An alternate approach for community conservancies is to generate profit through wildlife tourism. State Govt. shall develop suitable schemes to assist with technical, financial, and management support in promoting the "Ecotourism" model in the GJIA landscape for the interested farmers.

6. Public awareness programs: Engage different active NGOs for regular public awareness programs related to the conservation of Blackbuck, Sarus crane, and the significance of flora and fauna in schools, colleges, and among the community of this landscape in collaboration with the Forest Department, Uttar Pradesh.

7. Policy level intervention for planning effective conservation strategies in GJIA landscape: Village/stray dogs are threats to the conservation of the Blackbuck, Sarus crane, and birds of other wetlands. We suggested sterilization of stray/village dogs to reduce threats close to the key wildlife conservation areas in coordination with the State Animal Husbandry Department, Uttar Pradesh. Suggested for "Statue of a pair of dancing Sarus crane" at the entrance of airport.

   Bring policy of "Land sharing and Land sparing" for enhancing natural vegetation in agri-ecological regions.

8. **Creation of "Greenfield Jewar International Air**port Conservation Foundation (GJI**ACF)":** For achieving long-term conservation goals and undertaking the management targeted actions for retaining the biodiversity values of the GJIA landscape, we suggest for creation of the GJIACF with the State Forest Department, Uttar Pradesh. We proposed an allocation of 0.5% of the project cost.

9. Biodiversity offsetting is a conservation strategy: Creation of "Compensatory Conservation Fund" (CCF) for the conservation of Blackbuck and Sarus crane populations and other critical wildlife habitats across Uttar Pradesh: The Government and private sectors often use "Biodiversity offsets" as a conservation strategy to compensate for negative impacts of the developmental projects. Given this, we suggest for creation of a "Compensatory Conservation Fund" for the conservation of Blackbuck, Sarus crane, and other wildlife critical areas across Uttar Pradesh. We

suggest an allocation of 0.25% of the total GJIA project cost for CCF to the Forest Department, Uttar Pradesh.

10. **Annual allocation from "Corporate Social Responsibility** (CSR) initiative: Natural capital activities have been supported through CSR initiatives by the Private Corporation or Public Organizations in India. We suggest the GJIA authority to augment the corpus of the GJIACF from time to time as per the norms of CSR.

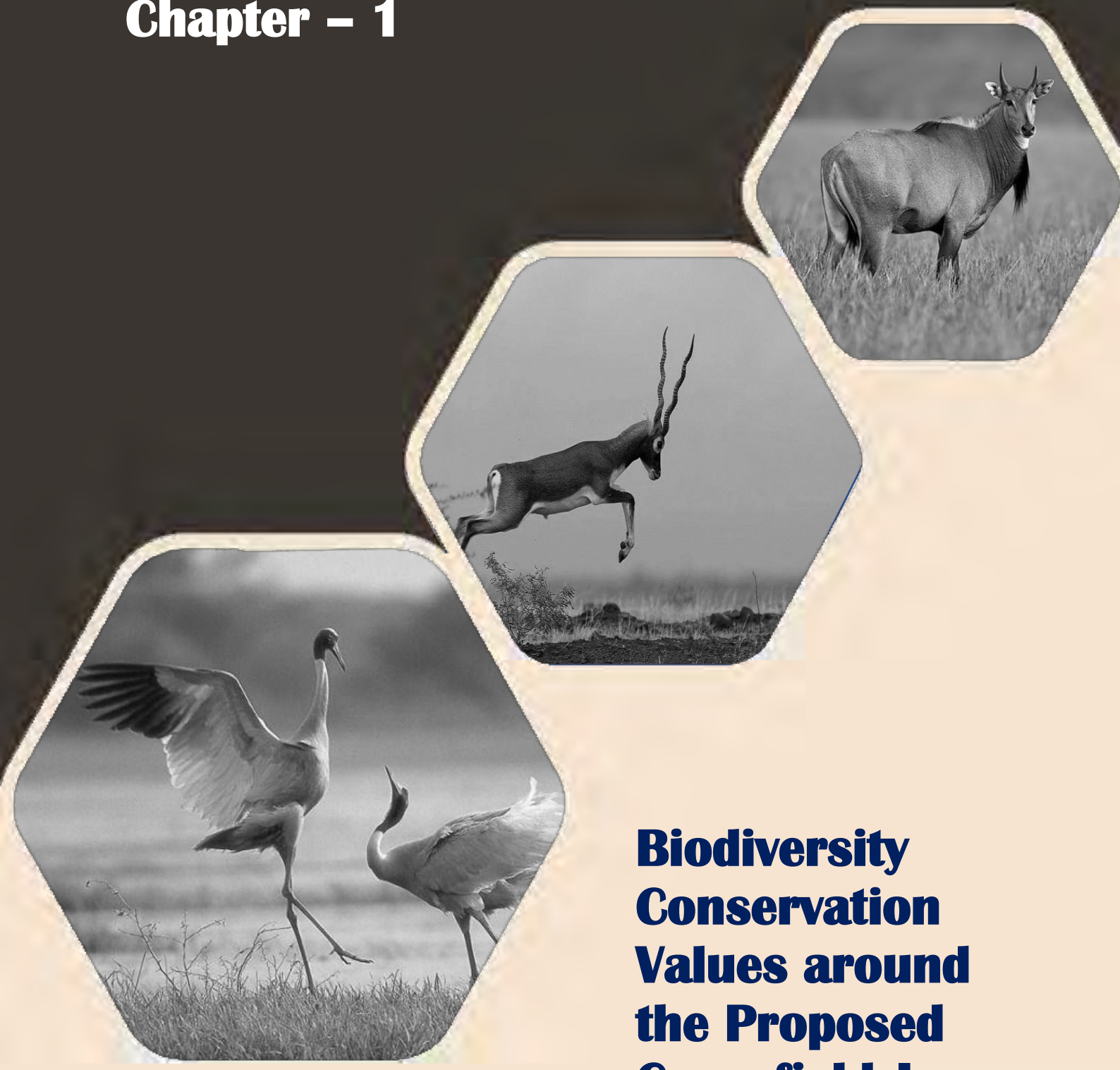
11. Summary of financial allocation for achieving Biodiversity Conservation goals of the GJIA landscape and enhancing the conservation status of wildlife critical habitats of Uttar Pradesh:

S. No.	Category	Cost in Rs.	Agency Responsible	Mandates
1.	Create "GJIA conservation Foundation" for implementation of conservation recommendation for the GJIA landscape	0.5 % of the total cost of the GJIA project	DFO, Gautam Budh Nagar District under supervision of CWLW, U.P.	Undertake activities which enhances conservation value of the GJIA landscape
2.	Create "Compensatory Conservation Fund" * for improvement of Blackbuck and Sarus crane conservation status in Uttar Pradesh	0.25 % of the total cost of the GJIA project	CWLW, U.P.	Enhance conservation status of Blackbuck populations in U.P. Enhance conservation of Sarus crane in U.P. by implementing suggestions made by Rahmani et al. (2019)
3.	Create and run temporary "Animal Rescue and Rehabilitation Center" for five years	500.00 lakhs	CWLW, U.P. and State Animal Husbandry Department of U.P.	Rescue and rehabilitate wild animal for initial five years
4.	Annual allocation from "Corporate Social Responsibility (CSR)" initiative	As per the norms	CWLW, U.P.	Augmentation of "GJIA Conservation Foundation" time to time
5.	Scientific study for "Long-term monitoring of likely impacts on biodiversity values in the landscape during different stages of GJIA" **	2904.75lakhs/ten years	Wildlife Institute of India	Assess likely impacts during different phases of the GJIA on: a. Monitor changes in spatial and temporal biodiversity values using eDNA. b. Study fine-scale ecological requirements of Blackbuck and Sarus crane through ranging behaviour using GPS tagged individuals. c. Suggest fine-scale conservation strategies for GJIA landscape

* It was suggested during stakeholder workshop convened on 1st February 2020.
** As per the "Environmental Clearance" accorded wide letter No. F.No.10-31/2018-1A-111 of the MoEFCC, Govt. of India, dated 9th March 2020 (Annexure – X).

Finally, we shared our suggested "Conservation Strategy" for biodiversity conservation in and around GJIA by organizing a consultation workshop with our stakeholder and knowledge partners through online video conference on 4th January 2021. We incorporated suggestions made by the participants in this final report.

Chapter – 1



Biodiversity Conservation Values around the Proposed Greenfield Jewar International Airport

1.1. Conservation of biodiversity in surrounding areas of the proposed GJIA site: An indispensable need:

During the last few decades, there has been unprecedented growth in the human population and increased New Delhi requirements. This has forced the planning and policymakers to look for avenues to expand the National Capital Territory of Delhi (NCT) spatially and horizontally by paving the way for developing the National Capital Region (NCR). This step is crucial in accommodating the industrial and residential infrastructure requirements for reducing the burden on the NCT. The NCR and the associated National Capital Region Planning Board were created in 1985 to plan the region's development and evolve harmonized policies to control land-uses and development of infrastructure in the region. It encompasses the entire NCT of Delhi and several districts surrounding it from Haryana, Uttar Pradesh, and Rajasthan.

The NCR is emerging swiftly as a global economic hub, contributing to ~7 – 8% of India's total Gross Domestic Product (GDP) (KPMG 2017). Sprawled over 58,332 sq. km area, the NCR is the country's largest planning region with a c. 46 million (KPMG 2017). Numerous infrastructure development projects have been commissioned in the past several years in the region, mainly owing to the strong transportation network. The projects vary in their size and financial requirements, giving impetus to the region's economic growth and the country (Table 1.1). The projects involve developing infrastructure and encouraging tourism opportunities as Delhi's city is home to magnificent monuments, museums, and art galleries that contribute to a thriving cultural scene. Apart from this, bustling upscale supermarkets and malls also provide a wholesome tourist experience.

The NCR contains ecologically sensitive areas like the Aravalli ridge, forests, wildlife, and bird sanctuaries. Therefore, all developmental projects follow the National Capital Region Planning Board (NCRPB) guidelines where they have already outlined policies to conserve the green areas on the lines to achieve the 33% of forest cover of the country according to the National Forest Policy 1988 (NFP 2003) for conserving the biodiversity. Nevertheless, the NCR has witnessed an unplanned spatial growth over the past couple of decades, despite three master plans of Delhi and two regional NCR (Nair 2015). Moreover, the implementation and monitoring of the said guidelines of NCRPB have been a challenge as most of the areas remain to lie entirely in a dynamic human-dominated landscape.

Globally, there is a pressing need to mainstream biodiversity conservation in development planning to maintain a balance and sustainability for humanity's wellbeing. This approach of integrating biodiversity values into the planning would give an impetus for coexistence in this dynamic human-modified landscape. Still, it would also cater to natural aesthetics and sustainability that lie at all development initiatives' core.

1.2. Conservation status in NCR region:

1.2.1. ***The "Green Areas":***

The significance of conserving natural resources has been well defined in the National Forest Policy of 1988 and stated that one-third of the country's total area should be under the forest cover (NFP 2003). Visualizing the importance of conservation of natural resources, the NCRPB's Regional Plan 2021 has defined the "Green Areas" for protection purposes as non-agricultural green areas, including dense and open forest. The open forests include parks, herbal gardens, and highways with green belts. The water bodies, including rivers, streams, canals, drains, lakes/tanks, and ponds, have also been included under green natural areas. All these areas are declared natural resources that need to be protected and conserved (Nanda et al. 2015). However, the green area covers only 3-4% of the total geographic area of the NCR. Hence specific laws, prohibitions, and enforcement are being used to maintain this much area. Felling of trees is prohibited

according to the Delhi Preservation of Tree Act 1994, and for every tree cut, it is mandatory to plant ten new trees.

1.2.2. Biodiversity conservation areas:

The NCR lies between the Upper Gangetic Plains and Semi-arid biogeographic zones of North India (Rodgers et al. 2000). Thus, the region is of paramount importance as far as biodiversity values are concerned, and several areas spread across the NCR, which support high and unique biodiversity. Some of the critical areas include protected areas (PAs) such as Sultanpur National Park in Gurugram, Haryana. In contrast, Asola Bhatti Wildlife Sanctuary of 32.71 sq km area on the Southern Delhi Ridge of Aravalli hill range on Delhi-Haryana border in Southern Delhi has been under continuous mining pressure leading to proposals to de-notify (Rahmani et al. 2016). Other areas to mention include the Aravalis and the Delhi Ridge, and several other lakes and wetlands are key conservation areas in NCR.

Table 1.1. A glimpse of development projects commissioned in the Delhi-NCR during the past decade. Costs and footprint (the targeted length/area of development, excluding the area going to be influenced/impacted due to this development) are approximate.

Project		Footprint (Approx.)	Approx. Cost (₹)
Road Transport	Eastern Peripheral Expressway	135 km	110 billion
	Western Peripheral Expressway	136 km	19.5 billion
	Delhi–Mumbai Expressway	1400 km	1 trillion
	Yamuna Expressway	165 km	12.39 billion
Railways	Delhi metro Rail Extension to NCR	NA	13.4 billion
	Regional Rapid Transport System (RRTS) project of National Capital Region Transport Corporation (NCRTC)	82 km	3.03 trillion (for 1 track of 3 in Phase I)
Airports	GJIA at Jewar	1334 ha	37.54 billion (Phase I)
Other Business Avenues	Different sectors	NA	NA
Recently Announced Projects*	Projects in various sectors	NA	282.1 billion

Source: IBEF (www.ibef.org) & Economic Survey of Delhi 2017-2018.
* https://www.newindianexpress.com/nation/2020/mar/03/up-cm-yogi-adityanath-unveils-19-projects-for-noida-2111355.html (Retrieved on 10, August 2020)

Among the critical conservation areas, Surajpur Bird Sanctuary and Biodiversity Park have been developed in the wetland area around the Yamuna River basin in Dadri Tehsil of Gautam Budh Nagar District, Uttar Pradesh. The wetland is c. 308 ha and very rich in biodiversity values (Ansari & Nawab 2015; Ansari et al. 2016). The flora is represented by ~257 species of vascular plants and ~278 species representing the faunal elements (Table 1.2). The Okhla Bird Sanctuary

is another wetland of c. 400 ha area. It was declared as a sanctuary in the year 1990 (Manral et al. 2013). The other such wetland and a Sanctuary is Sultanpur Jheel, a seasonal freshwater wetland with irregular margins of fluctuating water levels throughout the year. The Sultanpur Jheel was declared as a Sanctuary in 1971 and was upgraded to a National Park in 1991. The total area of Sultanpur National Park (SNP) is 141 ha, and the lake (Jheel) forms the core area (Banerjee & Pal 2017). This protected area falls under Gurugram District of Haryana state. Sheikha Jheel lies in the southeast of the GJIA site ~67 km in Aligarh district. This wetland of 250 ha is also an IBA supporting c. 162 species of birds and c. 100 species of plants (Abbasi 2004) (Table 1.2.; Fig. 1.1). One more important wetland of conservation importance is "Dhanauri," situated in the district of Gautam Budh Nagar (Table 1.2). This wetland is not a legally protected site but has been reported and endorsed as an IBA site due to the high number (~130) of Sarus Cranes (*Grus antigone*) observed there (Rahmani et al. 2019).

Besides, the habitat all along the Yamuna River within the NCR supports several resident birds and attracts several winter migrant bird species. The majority of the wetlands all along the Yamuna River Basin are part of the Important Bird Area (IBA) network (Rahmani et al. 2016). These critical areas of conservation importance elucidate the importance of conserving the natural resources within the NCR.

Table 1.2. Summary of biodiversity values of key conservation importance areas around the proposed GJIA site within 100 km distance in the landscape/region.

Wetland (Biogeographic zone)	Location	Area (ha)	Distance from GJIA (km)	Floral and Faunal Composition	No. of species
Surajpur Bird Sanctuary [a]	28°31'N, 77°29'E	308	38	Plant Species	257
(Gangetic Plain)				Trees	39
				Shrubs	12
				Herbs	144
				Climbers	20
				Grasses	31
				Sedges	11
				Faunal Elements	278
				Mammals	6
				Birds	186
				Herpetofauna	13
				Fish	15
				Invertebrates	58
Okhla Bird Sanctuary[b.c]	28°33'N, 77°18'E	400	48	Plant Species	192
(Semi-arid)				Trees	33
				Shrubs	10
				Herbs	103
				Climbers	12
				Grasses	19
				Sedges	15
				Faunal Elements	367
				Mammals	10
				Birds	302
				Herpetofauna	10
				Fish	15
				Invertebrates	30
Sultanpur National Park[d]	28°28'N, 76°55'E	142	74	Plant Species	NA
(Semi-arid)				Faunal Elements	325
				Mammals	2
				Birds	323
Dhanauri Wetland[e]	28°20'N, 77°37'E	110	17	Plant Species	NA
(Gangetic Plain)				Faunal Elements	204
				Mammals	3
				Birds	200
				Herpetofauna	1
Sheikha Jheel[f]	27°51'N, 78°37'E	250	67	Plant Species	100
(Gangetic Plain)				Faunal Elements	169
				Mammals	7
				Birds	162

a- Ansari & Nawab 2015; Ansari et al 2016: b- Ohkla Bird Sanctuary - Retrieved August 15, 2020, from https://obs-up.com/biodiversity-staus.php : c- Manral et al 2013: d- Banerjee & Prakash 2016: e- Rahmani et al 2016: f- Abbasi 2004.

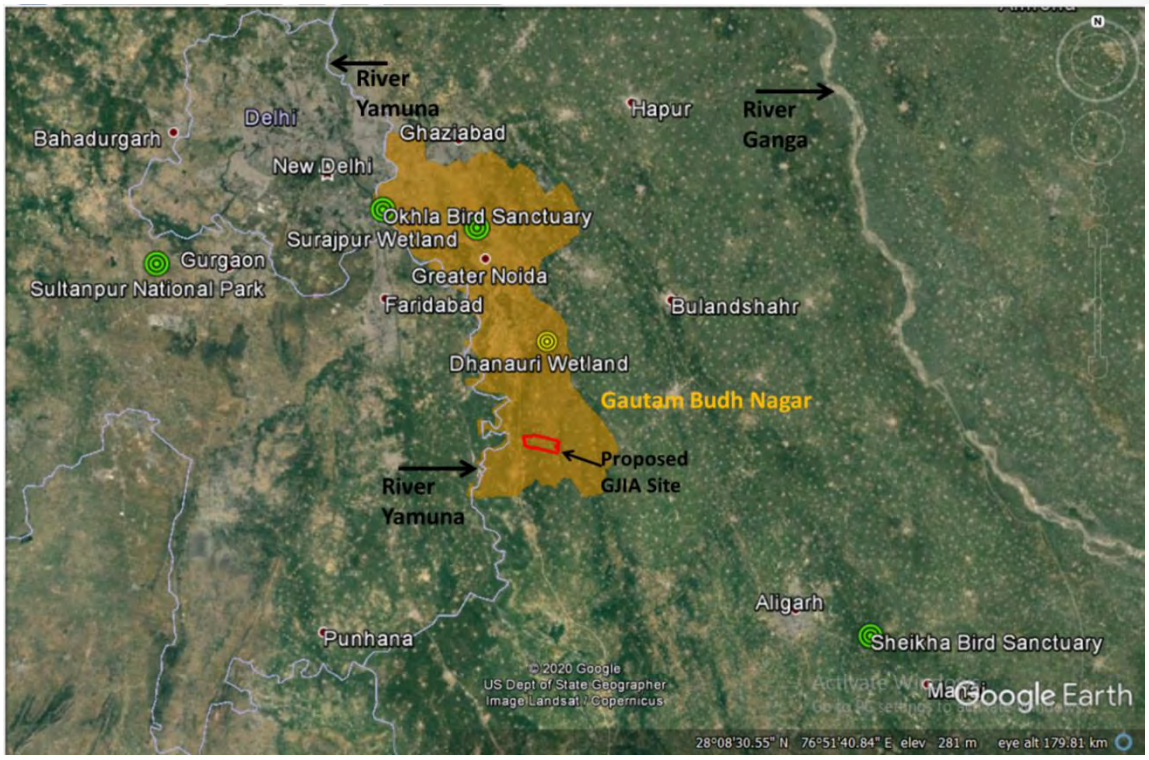


Figure 1.1. Some important biodiversity-rich areas in the south of the proposed GJIA site.

1.2.3. *Initiatives for biodiversity conservation:*

Several initiatives have been undertaken of biodiversity conservation and contributed successfully to the rejuvenation of NCR's natural resources. On the Ministry of Environment, Forests and Climate Change (MoEFCC) directions, the local governments develop master plans to include conservation plans and strategy (GoI, 2014). Accordingly, steps were taken to notify Biodiversity Parks amidst urban locations. This has resulted in the creation of Yamuna and Aravali Biodiversity Parks, which are fully functional and are attracting global attention as models for the conservation of natural heritage having cultural and educational values in urban centers. Currently, the Delhi Development Authority (DDA) and the Centre for Environmental Management of Degraded Ecosystems (CEMDE), University of Delhi, are working tirelessly to restores the biodiversity wealth of the Yamuna and Aravalli Biodiversity Park. Together with various activities, all these initiatives are to strengthen the forest cover like afforestation drives and habitat restoration.

Local environmentalists have also set up several not for profit Non-Governmental Organisations (NGOs), such as the Centre for Environment Education (CEE), Conservation Education Centre (CEC). These organizations spread awareness about the environment in schools, colleges, and other media platforms. To spread awareness amongst the general masses about biodiversity and the environment, the Science Express Biodiversity Special (SEBS) program has been a successful event across the country for bringing awareness for the need of conserving natural resources. Various Eco-Clubs at school and college levels have also contributed to spread awareness among the young generation. Hence, NCR is rich in natural resources, and special measures are needed to ensure their protection and conservation for human wellbeing.

1.3. Conservation importance of the area in and around the GJIA site:

The proposed GJIA site is in the Jewar tehsil of Gautam Budh Nagar district that lies in the upper Gangetic plain biogeographic zone (Rodgers & Panwar 1988; Rodgers et al. 2000) with the proximity of c. 2.5 km from the river Yamuna which marks the western limit of the Gangetic plain. It considers the proximity of the proposed GJIA site to the semi-arid zone, which starts from the river Yamuna towards the west (Rodgers & Panwar 1988; Rodgers et al. 2000) (Fig. 1.2). Hence, the landscape within 25 km from the GJIA site can conserve flora and fauna of two biogeographic zones. Thus, the landscape has two distinct ecology, biome representation, community, and species (Rodgers et al. 2000); therefore, it has a high conservation value.

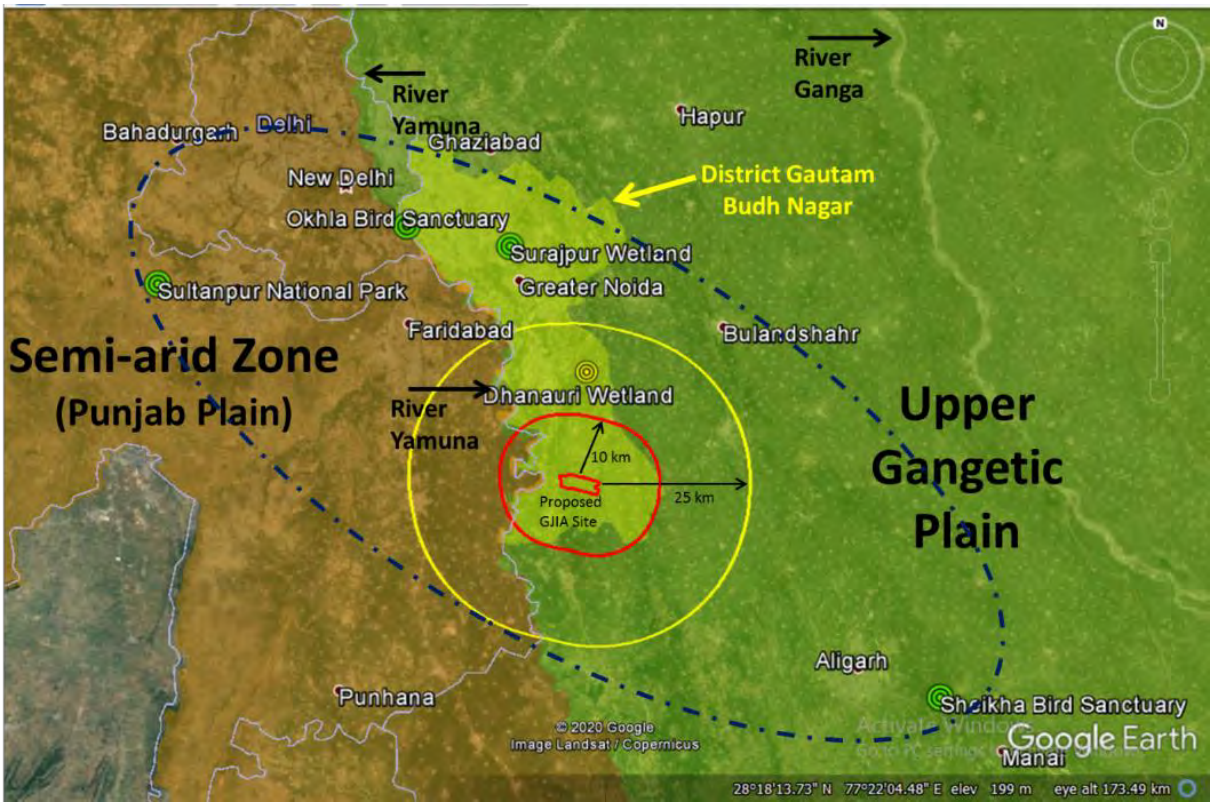


Figure 1. 2. Radius area of 25 km followed around the GJIA site comprised flora and fauna of north India's two biogeographic zones.

The conservation planning in the landscape should have a broader perspective utilizing the knowledge about biodiversity values represented by the eco-region and region (Fig. 1.2). In the case of mammals, commonly observed and reported species in the eco-region include c. 15 species, all of which are listed 'Least Concern' in the International Union for Conservation of Nature (IUCN) Red List (Annexure I). There are c. 349 species of birds in the district of Gautam Budh Nagar as listed on the citizen science-based online platform: e-bird (eBird 2020: Annexure-II), which accounts for ~29% of total birds reported (N=1210) from India (BirdLife International 2020). There are five Important Bird Areas (IBAs) in the region, hot spots for migratory birds and other water birds. Dhanauri Wetland is not a formally protected but important Sarus Crane (*Grus antigone*) area identified by Rahmani et al. (2016). According to Rahmani et al. (2016), the number of bird species reported from these

IBAs varies from 166 to 323 (Fig. 1.3). The total number of bird species belonging to various IUCN conservation categories (Near Threatened (NT), Vulnerable (VU), Endangered (EN) and Critically Endangered (CR) in the region at five IBAs stands at 50 (Rahmani et al. 2016; eBird 2020). Of these 50 species, 13 species are common to IBAs and the district of Gautam Budh Nagar (Fig. 1.4). Also, 48% are Near Threatened, whereas 8% are Endangered, which is relatively high as compared to national statistics of 6% Near Threatened and 1.73% Endangered (Fig. 1.5) (SoIB 2020).

Only a few studies are available on the vegetation of this region. Chaudhary et al. (2012) reported 95 species of grasses and sedges from the district. 257 species of vascular plants were reported from the Surajpur wetland, Gautam Budh Nagar district (Ansari et al., 2016; Ansari 2018). Other faunal elements that have been reported from the Surajpur wetland include 19 species of herpetofauna, 53 species of butterfly, 36 species of odonates, and 15 species of fish (Ansari et al. 2015; Ansari 2017; Ansari 2018 b & c) (Annexure III; A–D).

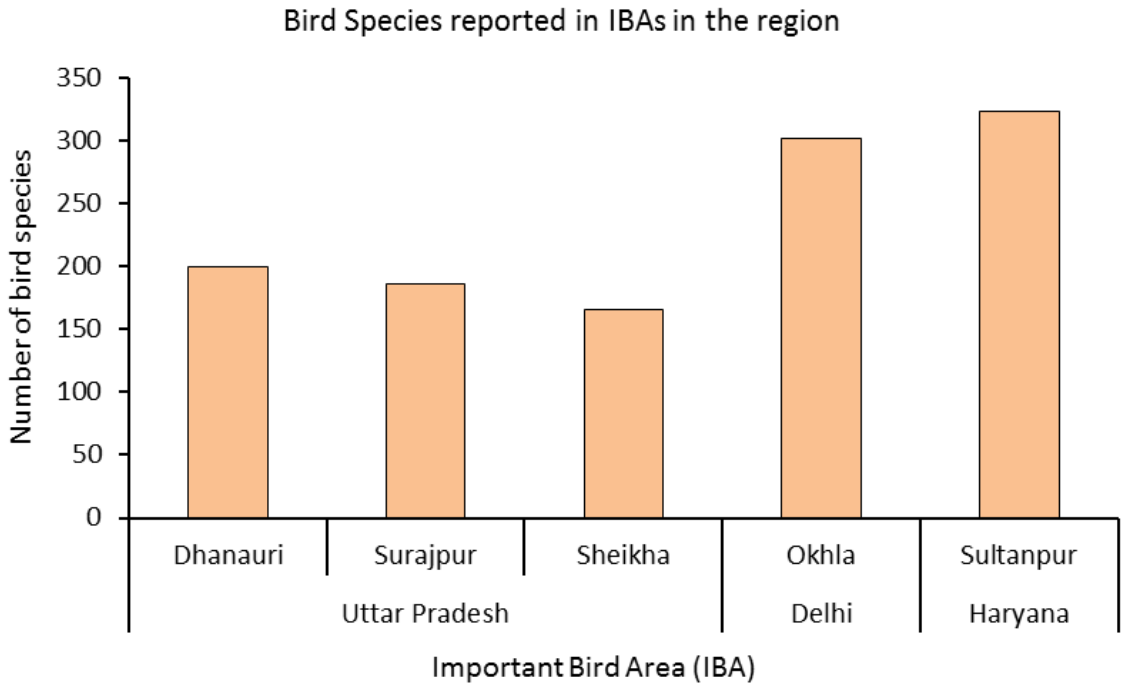


Figure 1.3. The number of bird species reported in different IBAs of this region.

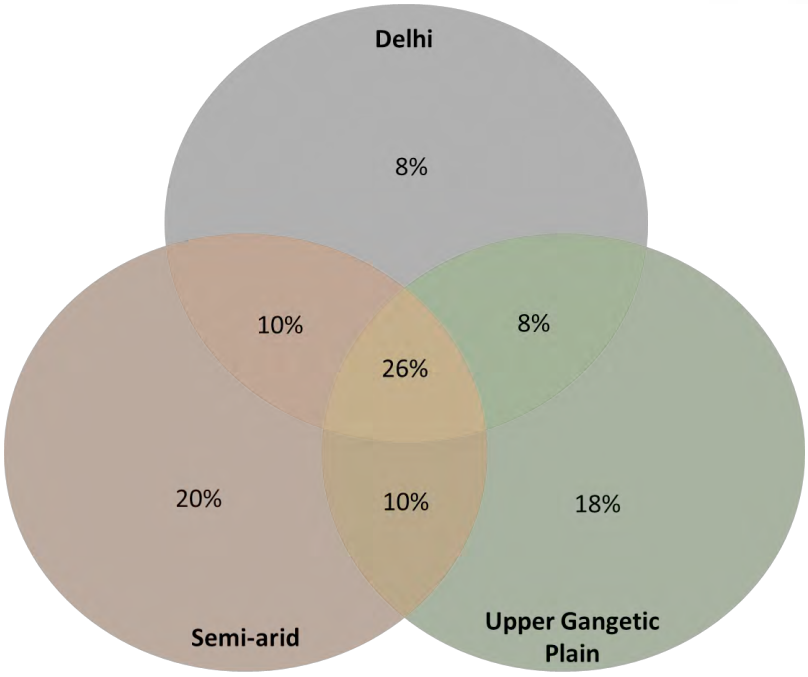


Figure 1.4. The number of species (N=50) as per IUCN conservation status shared between Semi-arid and Upper Gangetic Plain biogeographic zones.

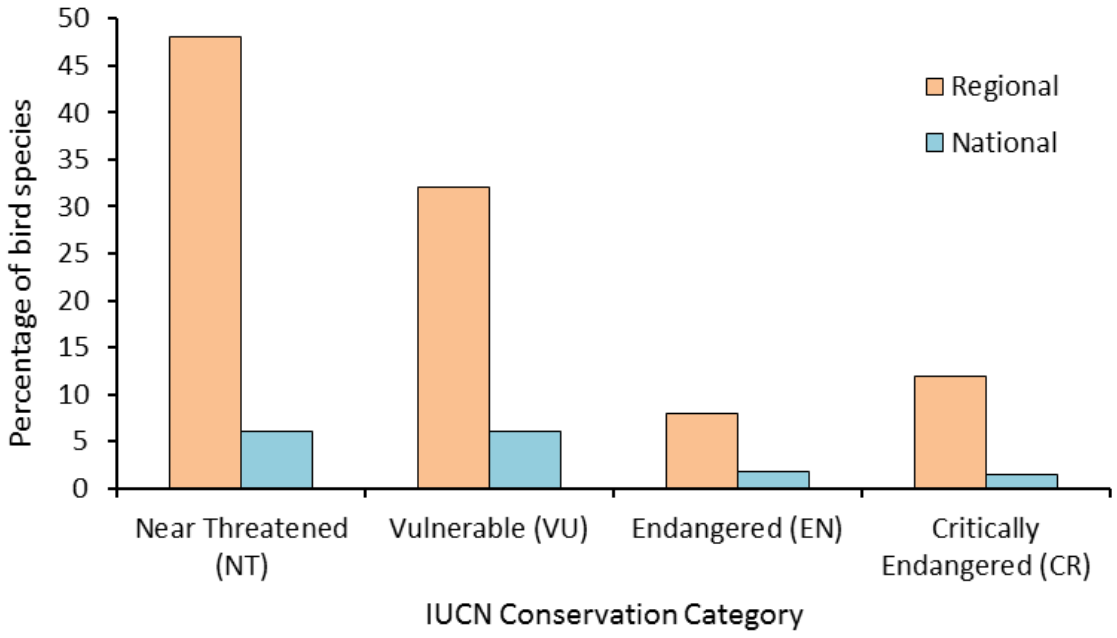


Figure 1.5. The proportion of bird species reported in this region as per IUCN conservation status. (Source: Regional - Rahmani et al 2016 and eBird 2020; National - SoIB 2020).

1.3.1. Species of conservation importance:

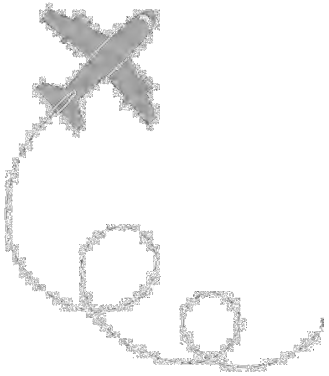
Although there are several species recorded from the region, limited documentation is available on these species' status. Therefore, in view of the present circumstances, we consider the Indian antelope or Blackbuck (*Antilope cervicapra*) as a flagship species for the terrestrial ecosystem and the Sarus Crane (hereafter Sarus; *Grus antigone*) as a flagship for the wetland ecosystem in conservation planning for the proposed GJIA site. Globally, these species are listed as 'Least Concern' and 'Vulnerable' in the IUCN Red List, respectively. However, both are protected at national level in the Indian Wildlife (Protection) Act 1972 of India as 'Scheduled I and IV'. We also discuss the conservation status of other sympatric species with Blackbuck, such as Jungle Cat (*Felis chaus*), Golden Jackal (*Canis aureus*), and Nilgai (*Boselaphus tragocamelus*).

Similarly, the other birds of conservation importance such as Indian Peafowl (*Pavo cristatus*), Egyptian vulture (*Neophron percnopterus*), Indian Spotted Eagle (*Clanga hastata*), and other raptor species also have similar affinities for terrestrial ecosystems. By conserving the terrestrial habitats, these species would also be benefited, and their conservation may be assured. The wetland ecosystems cater to not only the Sarus but several other bird species, including specialist like waders. Thus, conserving these important habitats would ensure protection not only to the flagship species but also to the associated species.

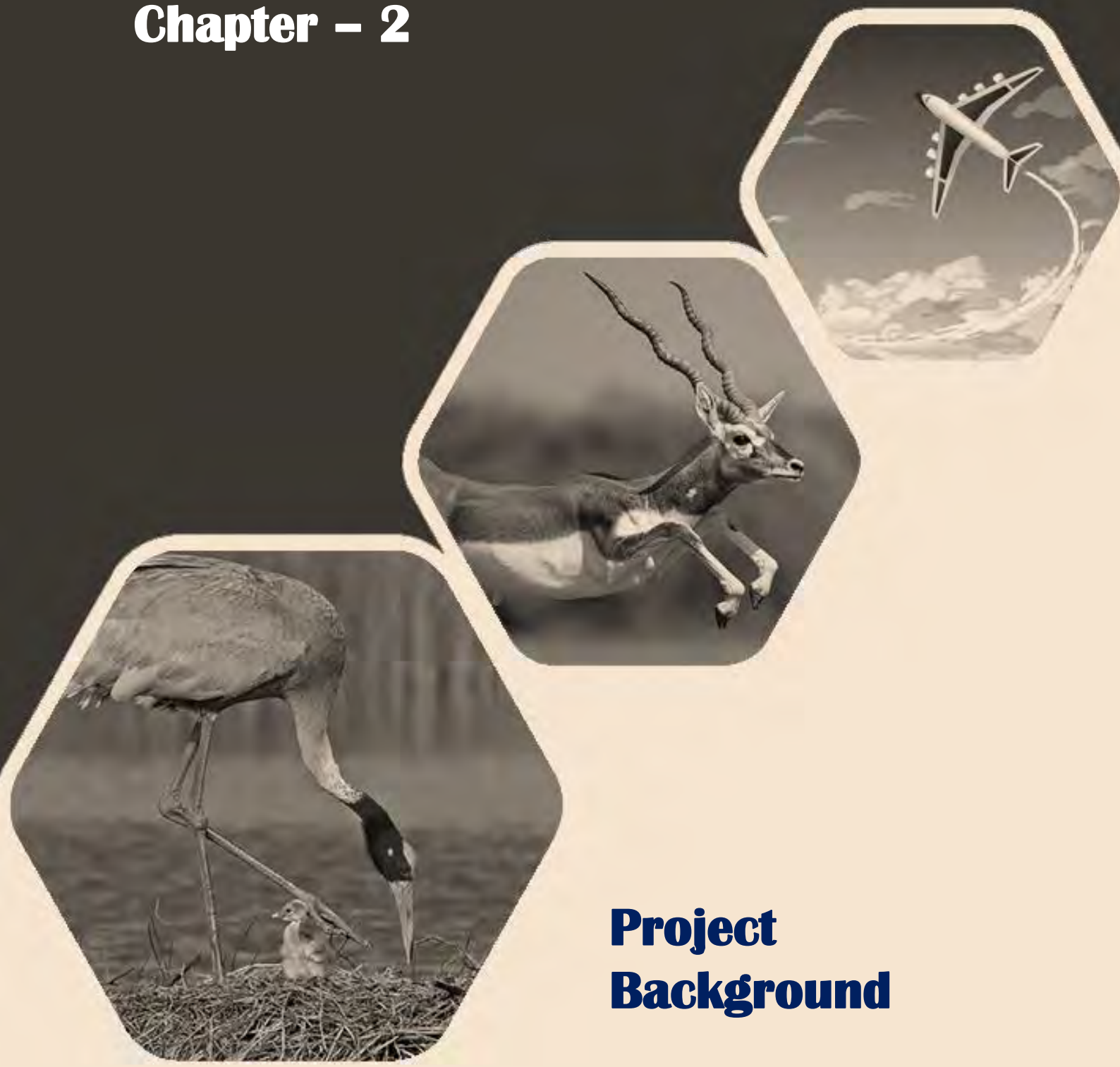
1.3.2. Threats to Biodiversity in the GJIA landscape:

Worldwide, the prime reason for the threat to biodiversity is anthropogenic activities such as agricultural expansion and intensification, logging, and increased urbanization and development. All these affect the conservation of natural resources through habitat fragmentation, degradation, and, ultimately, habitat loss. They have a negative impact on all forms of biodiversity like animals, birds, insects, etc. Other associated threats may include alien-invasive species, over-harvesting or over-exploitation, poaching, pollution and climate change, etc.

NCR's urbanization level had increased from over 56% in 2001 to about 62.5% in 2011. This is nearly double the national urbanization level of 31.2%. The NCT of Delhi has the highest urbanization levels in NCR at 97.5%, while NCR has an urbanization level of 62.5% (KPMG 2017). This fast-paced urbanization will impact the region's natural green heritage, including the forest cover. In 2011, the forest cover in NCR was 6.2% against the national average of 21% (Jayaseelan 2015). The forest cover has seen an increase of c. 2% in the NCR (all India average 2.4%) during 2001–11 (Yadav and Mishra, 2015). However, 6% of forest cover cannot be an environmental safeguard in a region, which is highly urbanized to the extent of 62%. As per the District Survey Report (DSR 2017), there is no thick forest in the Gautam Budh Nagar district area. Yet there was an area of c. 2000 ha covered under forest in the year 2012-13. Out of this total area covered under forest, an area of 1940 ha falls under the rural area, whereas a meager 46 ha is in the district's urban area (DSR 2017). Hence, we believe that the rapid urbanization in this landscape is inevitable and may affect the natural resources of the GJIA landscape.



Chapter – 2



Project Background

2.1. Introduction:

Fast-growing economies such as India have numerous opportunities for growth and development. India has emerged as the fastest-growing major economy. It is expected to be one of the top three economic powers globally over the next 10-15 years (IBEF 2020), which would lead to a lot of infrastructural development. For the past several decades, due to unprecedented transport requirements and achieving economic goals, the need for frequent air traffic has amplified many folds resulting in the necessity to build more and larger airports for effective regional and global connectivity. As the aviation industry continues to expand, more efficient aircraft capable of carrying bigger payloads over greater distances becomes inevitable. This would require the building of more and larger airports, including the existing ones' capacity expansion.

However, the direct impacts from airports and their associated roads and development are becoming increasingly recognized, impacts on biodiversity (wildlife and habitats) (Clements et al. 2014) have tended to be less incorporated in the assessments than the effects of noise, climate change, and air pollution. Airports can have impacts on biodiversity in several ways, including loss, degradation or pollution, alteration of land use and land cover, diversion of drainages, impairment of wildlife movement paths, collisions of bird, and impacts of light and noise pollution on behavioral biology of wildlife species in and around the airport's zone of influence.

India is one of the 17 mega-biodiverse countries globally and rich in a wide variety of flora, fauna, and biodiversity. However, due to the unsustainable use of natural resources and overexploitation, India's biodiversity is under severe pressure and facing numerous challenges and complexities in the face of rapid economic development. Hence, there is a pressing need for conservation and development to go hand in hand, complementing—rather than conflicting. Given the requirements of such actions for the nation's growth, it is essential to harmonize conservation and development for sustained benefits of planned development (WII 2016) and human wellbeing. Hence, it is necessary to have a policy framework, which promotes practices that integrate conservation concerns in infrastructure development. Globally, planners, transportation agencies, and ecologists are universally acknowledging these alike in most developing countries. The need is emerging in India and other developing countries where the challenge of maintaining functional ecosystem services both in natural and urban landscapes for human wellbeing is invariably in conflict with the expanding infrastructure development (WII 2016). It is essential to mainstream biodiversity in large-scale infrastructure development projects such as airports to propose and orient development strategies to ensure conservation prospects apart from economic benefits.

Most of the mainstreaming approaches reflect that biodiversity conservation goals are not seen as distinct from, or contradictory to, the purposes of development and economic growth. Instead, they are intended to shift the focus of development policies and interventions towards better incorporating the biodiversity values to bring in sustainability and economic development. Integration of biodiversity considerations into the location, design, and operation of large infrastructure projects such as airports would not only have the advantage of reducing the environmental, social, and economic costs but of creating win-win results for biodiversity conservation and human safety, which lie at the core of all development initiatives. The considerations can be at different scales, for instance, at site/local level to landscape-scale or eco-region or regional levels, depending upon the development project's size or footprint. This will help in scaling the planning process to develop appropriate strategies at different scales.

The development of conservation plans for airport projects merits significant importance for long-term biodiversity conservation in the wake

of several new airports being planned to promote better connectivity and meet the increasing demand for connectivity. It is well known that such development can pose significant threats for biodiversity and the environment and ultimately affect human wellbeing. The connections between land use, land cover, and wildlife habitat are at the forefront of conserving wildlife around airports. The key consideration that must guide conservation planning development is to contain, address, and eliminate impacts associated with the airports.

This document presents the task envisaged in developing a Conservation Plan for biodiversity likely to be impacted by the proposed "Greenfield International Airport" at Jewar, Gautam Budh Nagar District, Uttar Pradesh, India. This Conservation Plan is premised on the belief that there can be win-win options, i.e., a win for development and a win for conservation.

2.2. Project Background:

With the growing needs for air travel from New Delhi's Indira Gandhi International (IGI) Airport and visualizing its unsustainability in meeting high traffic demand in the future based on the projection, the Government of India recently initiated a project to build a new airport called "Greenfield Airport" at Jewar, Gautam Budh Nagar, Uttar Pradesh, India in an area of 1334 ha. The Greenfield Jewar International Airport (GJIA) landscape is a part of the New Delhi-National Capital Region (NCR). The NCR is a unique example of inter-state regional planning and development, bringing together four administratively independent units. It covers the entire National Capital Territory (NCT) of Delhi, 13 districts of the State of Haryana, eight districts of the State of Uttar Pradesh, and two districts of the State of Rajasthan, with New Delhi, the nation's capital, as its core (Anonymous 2019). The landscape boasts of having reasonable proximity and connectivity to the national capital, paving the way to several large infrastructure development projects in the landscape. Thus, the creation of the NCR Planning Board (NCRPB) took place in 1985 to plan the region's development and enact harmonized policies for the control of land use and development of infrastructure in the region to avoid any haphazard development of the region (Anonymous 1985). The NCRPB's Regional Plan 2021 aims to promote economic growth and development in the entire NCR as a region of global excellence (http://ncrpb.nic.in/regionalplan2021.html). On the same lines, the NCRPB has also envisaged increasing the ambit and has the vision to expand and develop further, for which it is working on a new Regional Plan 2041, which is slated to be, completed soon (http://ncrpb.nic.in).

The Yamuna Expressway Industrial Development Authority (YEIDA) was appointed as a nodal agency by the Government of Uttar Pradesh state to execute the land acquisition process and other activities about airport development on behalf of the Directorate of Civil Aviation, Government of U.P. The YEIDA has steered a Techno-economic feasibility study by PricewaterhouseCoopers Private Limited (PwC) and an EIA study by GreencIndia Consulting Private Limited. Based on these studies, YEIDA moved the proposal to the Expert Appraisal Committee (EAC) for obtaining "Environmental Clearance," and this was deliberated in 42nd Meeting convened on 10-12 July 2019. To bridge the gaps between development and conservation, YEIDA was asked to conduct a study to prepare the "Conservation plan for Birds and Fauna" in consultation with the Wildlife Institute of India (WII) for further consideration. With the follow-up, a technical proposal titled "Conservation Plan for Biodiversity likely to be Impacted by Greenfield Jewar International Airport, Gautam Budh Nagar, Uttar Pradesh" was submitted to YEIDA for consideration and it was accepted. Subsequently, a Memorandum of Agreement (MoA) was signed on 31st August 2019 between WII and YEIDA for a study of Phase-I.

The scope of the proposed project covers the following objectives:

a. Identify the critical sources of impacts and the nature of effects (direct and indirect, long term and short term and irreversible impacts if any associated with the airport) that would help guide the preventive, ameliorative, and restorative strategies to be adopted in the conservation planning,

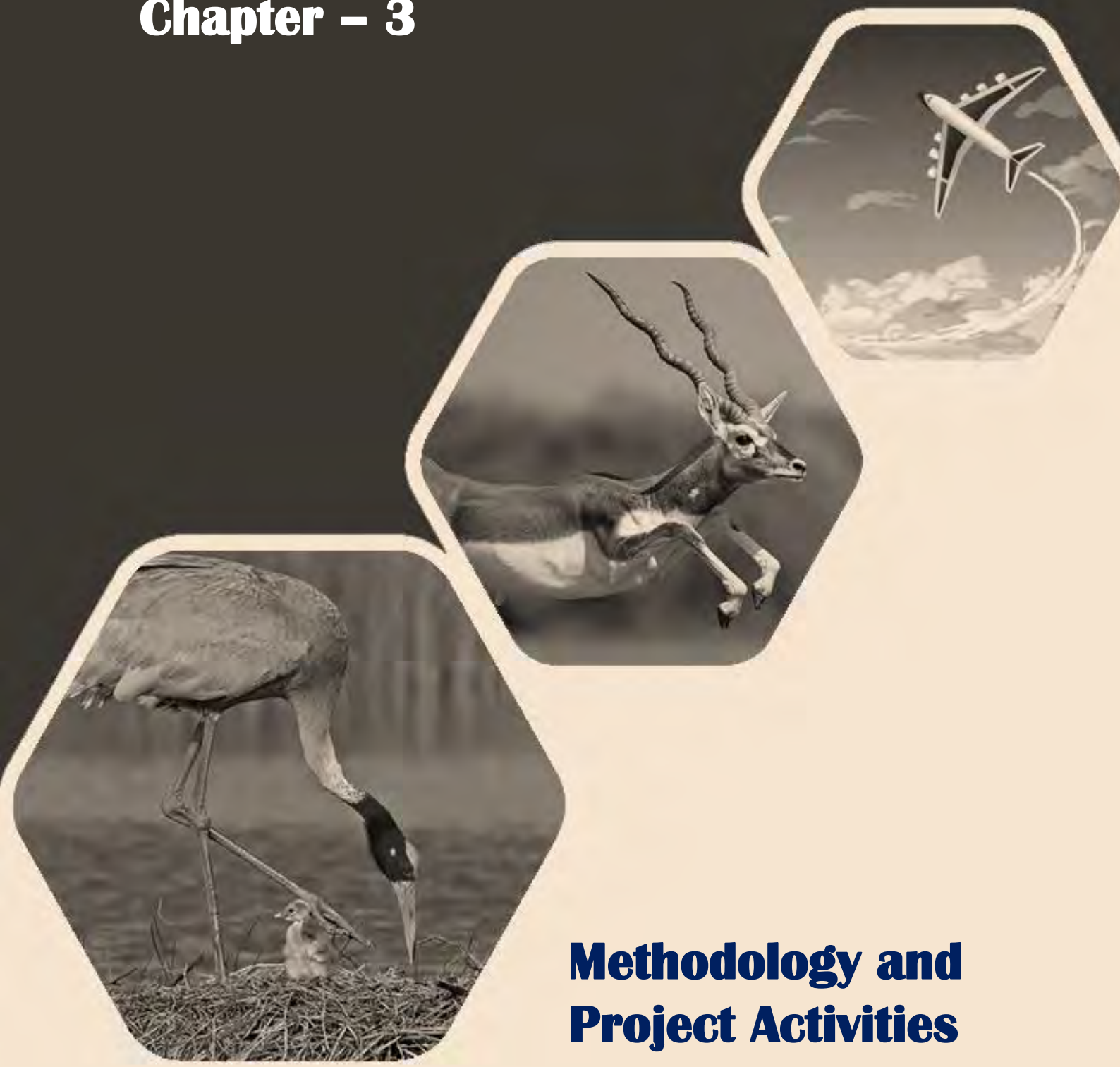
b. Identify the significant biodiversity values represented by rare, endangered and threatened (RET) floral and faunal species belonging to major taxa (herpetofauna, birds, and mammals) within the zone of influence of the project,

c. Assess the vulnerability of habitats and landscape features within a 10 km radius to impacts during different airport development phases and the likely implications,

d. Prepare conservation plan for rare, endangered, and threatened (RET) faunal species based on preventive and restorative measures for impact mitigation

e. Propose the Phase-II plan (Five Years) for the "Post-Development Monitoring" for RET species' status.

Chapter – 3



Methodology and Project Activities

3.1. Conservation Planning: an integrated approach

Conservation planning is the process of locating, configuring, implementing, and maintaining areas that are managed to promote the persistence of biodiversity and other natural values. It is essential because it is a crucial element of sustainable development and conserves natural resources (Pressey et al. 2007). Conservation planning is inherently spatial. The science behind it solves significant spatial problems. Effective conservation planning considers two types of change – first, biodiversity is not static in time or space but generated and maintained by natural processes. Second, humans are altering the planet in diverse ways at ever-faster rates.

Thus, conservation planning for species is a holistic approach that requires integrating species and its environment. Therefore, all necessary ecological, biotic, and abiotic information should be collected and collated to plan conservation priorities, which are based on species' ecological requirements. Thus, the information should include population status, demography, habitat requirements, threats, behavior, etc. Furthermore, the planning process itself should be viewed as adaptive, with continual improvements in both the methods of the steps and the conceptualization of the entire framework.

The collection of required information occurs throughout the planning process from its inception to setting priorities of conservation. We have discussed details in subsequent chapters.

The framework follows steps that begin with the identification of target species for conservation priority. The second step of the process involves identifying and characterizing the habitat associated with the species of conservation priority. The third step consists of improving and upgrading the habitat quality, and if needed, in quantity to sustain the species of conservation priority. And lastly, the recommendations for implementing scientific approaches for species and habitat monitoring and management.

The general scheme of the workflow undertaken (Fig.3.1) for the accomplishment of the project objectives is as follows:

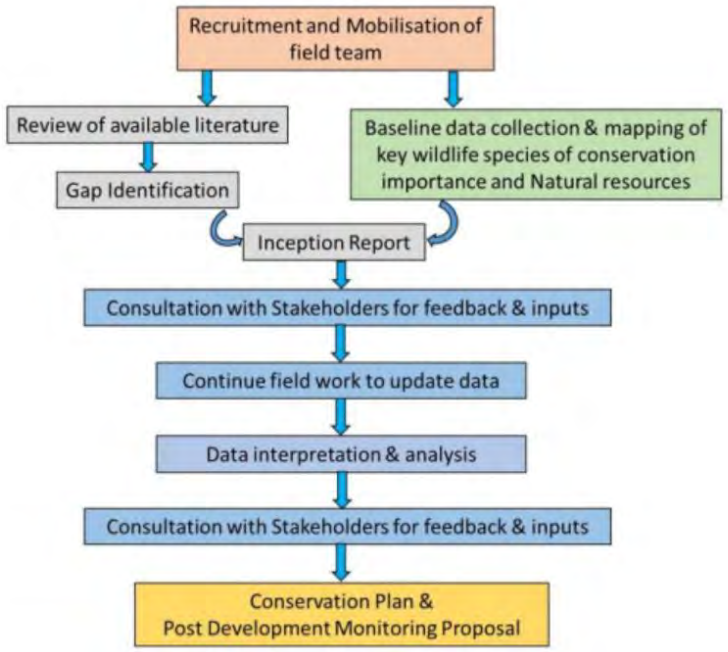


Figure 3.1. General scheme of the workflow followed.

To achieve the goal of preparing a conservation plan for faunal species, a basic flow of steps followed is presented in Fig. 3.2. Each step requires a few sub-steps of the necessary information needed to feed into each of these.

Identification of wildlife species

This is the first step in identifying the key species for which conservation planning is to be done. Determine the distribution, population status, and demography of the sepcies of conservation importance in this landscape.

Identification of wildlife habitat

This is the second step of the process as it involves the designation of the habitat associated with the species of conservation priority. Information needed to include in this step are habitat characteristics including details of vegetation composition and structure, anthropogenic pressures and human dependence on habitat.

Habitat restoration

This step involves improving and upgrading the habitat quality and, if needed, in quantity too. Depending upon the species' ecology, mechanisms of improving the connectivity between habitats can also be considered.

Scientific monitoring and management

This step involves implementing scientific approaches to monitor and review the actions taken previously. This stage will inform about the rate of improvement and success or failure of the previous efforts, and accordingly, management interventions will be considered.

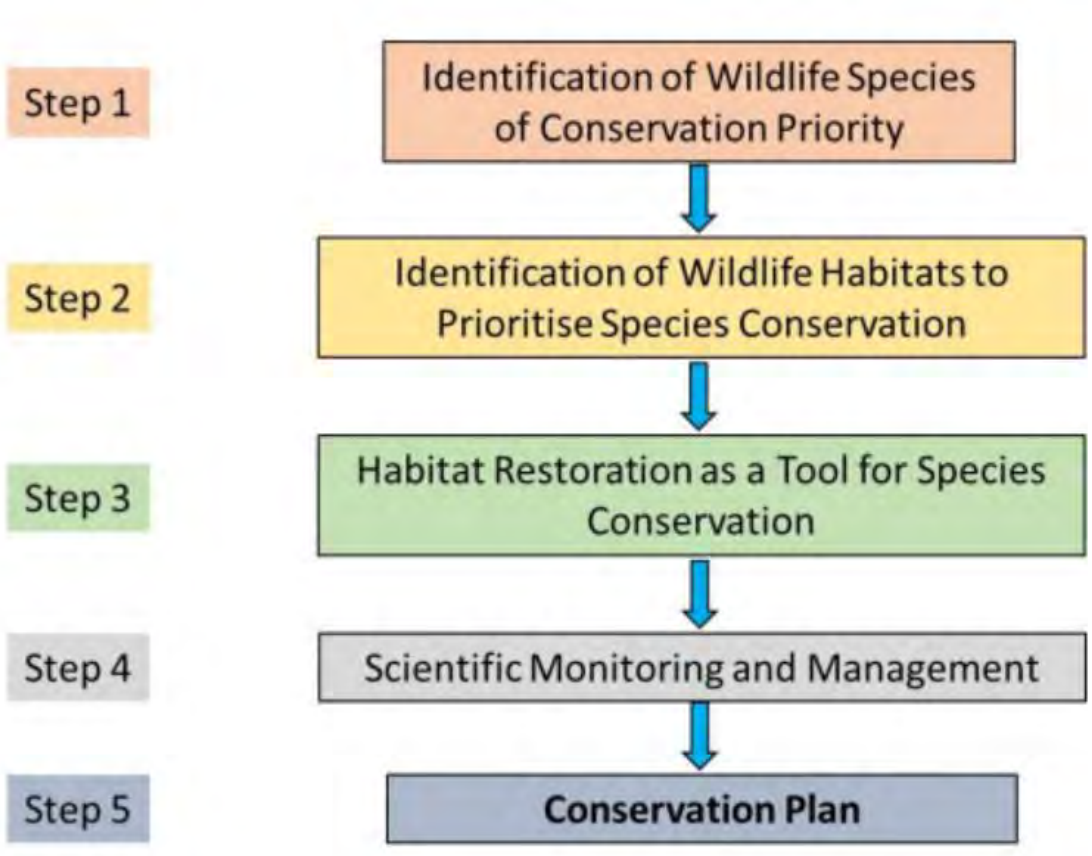


Figure 3.2. Generic conservation plan framework adopted.

3.2. The Proposed Greenfield Jewar International Airport Site:

YEIDA has planned the development of the airport and associated infrastructure in two phases. Phase I is to bring the proposed Greenfield Jewar International Airport (GJIA) of 1334 ha lies between 28°10'09.87"N latitude and 77°38'20.41"E longitude, north of Jewar Village, in Gautam Budh Nagar District of Uttar Pradesh, India (Fig. 3.3). The Yamuna Expressway is located at c. 700 m from the project site. The site is about 70 km from IGI Airport.

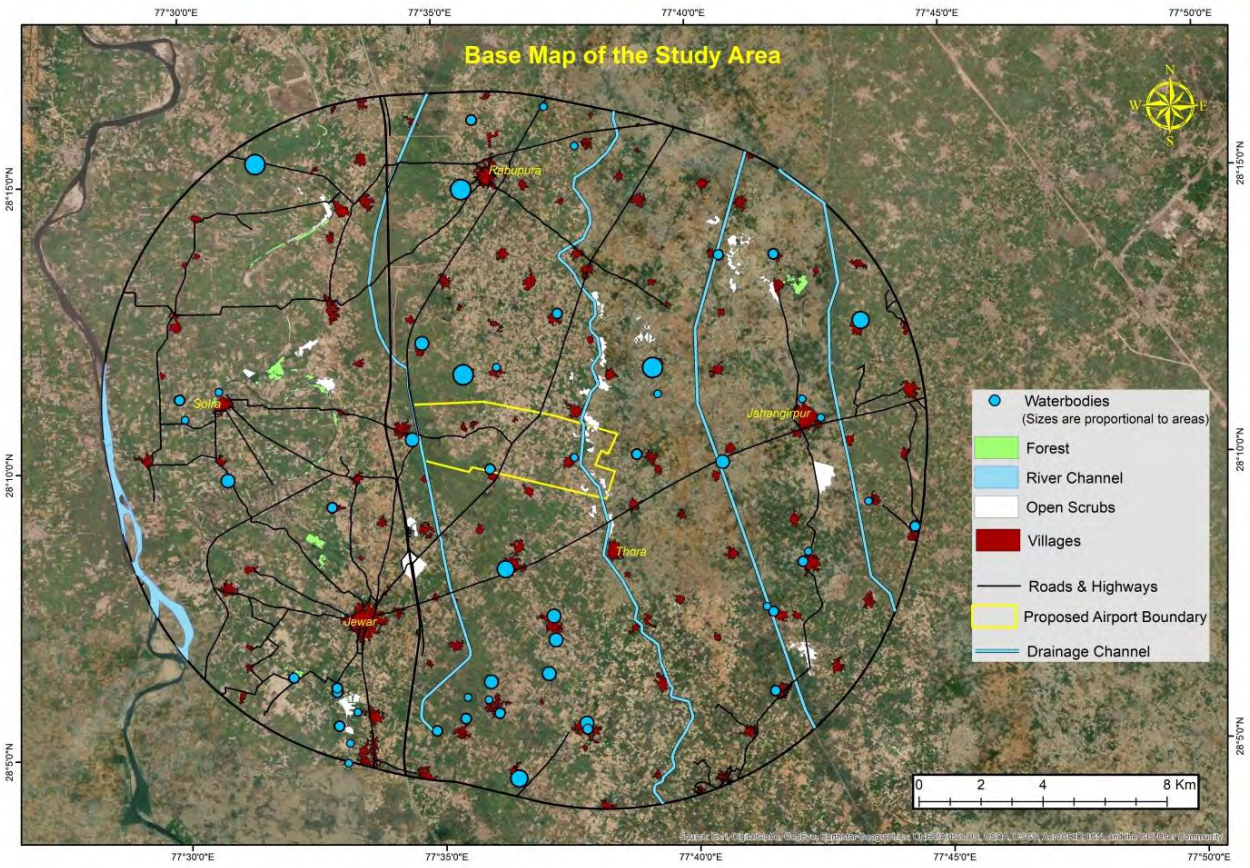


Figure 3.3. Map showing the proposed GJIA location and its surrounding landscape features in Gautam Budh Nagar District, Uttar Pradesh, India.

3.3. Broad study design and focus:

The study area, which encompasses the proposed GJIA site and a 10 km radius area around it, was considered to be surveyed for the wildlife. The whole landscape was overlaid with a grid (n=168) of 2 km X 2 km for systematic data collection (Fig. 3.4). Fifty percent of the total grids were randomly selected for the systematic sampling survey. The overall results and findings obtained from these identified grids will form the basis for preparing the "Conservation Plan." These surveys were aimed to collect information on the distribution pattern of wildlife species present in and around the proposed GJIA site and their habitat supporting these species. Such information shall enable us to design systematic surveys in this landscape and collect data on some aspects of species' biology and ecology. These findings will form the basis while preparing the "Conservation Plan for the birds and fauna." Therefore, surveys were conducted to target distribution for:

✓ Mammals (Blackbuck and Nilgai),

✓ Birds (Sarus crane and Indian Peafowl, raptors and Egyptian vulture),

✓ Habitat Patches (Open scrub, forest patches, grasslands, plantations, etc.)

✓ Waterbodies/Lakes (including village ponds) to ascertain the potential of being or becoming attractive sites for resident or migratory waterfowl, and

✓ Recording ground truth points to generate a precise land use and land cover (LULC) map of the surveyed area

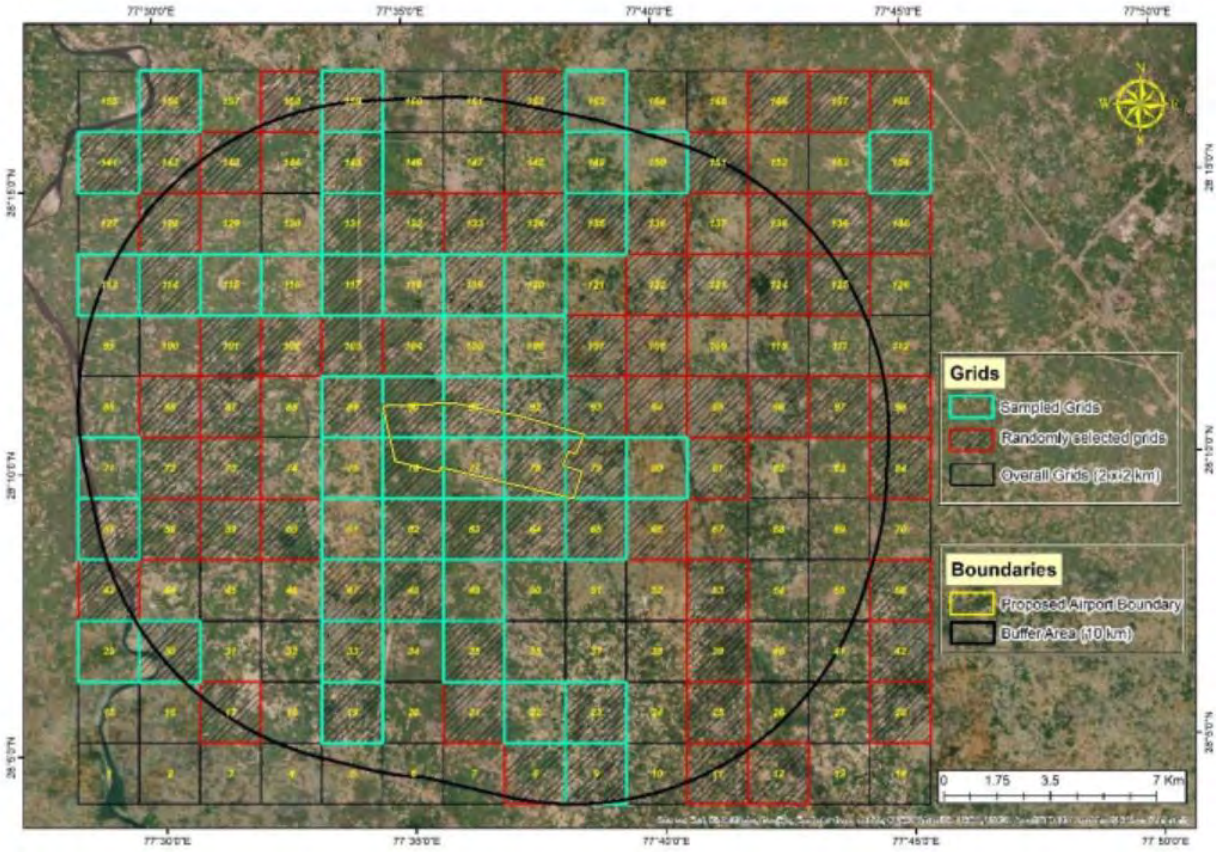


Figure 3.4. Landscape overlaid in 2 x 2 km grid and representing surveyed grids.

3.4. Project activities:

Based on the work undertaken during the project period, key activities accomplished were as follows:

Interim Report:

Just after the MoA is signed, the Institute started working on collecting required secondary information, initiated the recruitment of research personnel, the setting of the base camp at Jewar town, and preparation of the workshop.

An interim report was submitted to YEIDA in October 2019 based on the work undertaken.

Inception Report:

After a series of fieldwork visits and data collected on different facets of biodiversity conservation and Remote Sensing and GIS data analysis, the Institute has submitted an "Inception Report" to the YEIDA during January 2020. The report describes the methodology of the data collections, observed values of biodiversity conservation in the GJIA site.

Accordingly, the plan for data collection was prepared for the rest of the work. Dr. S.P. Goyal, SMS of the Institute, made the presentation to Committee Members of the PCCF and CWLW, Uttar Pradesh at Forest Department Office, Lucknow regarding the project objective, methodology, and expected output. Committee members suggested looking beyond the GJIA site using landscape conservation principles.

Participation in the Environmental Appraisal Committee, MoEFCC, Govt. of India

Based on the request of YEIDA for the participation of WII in the EAC meeting scheduled in February 2020, Dr. S.P. Goyal, Subject Matter Specialist, represented from the Institute. Dr. Goyal appraised the committee members regarding the work accomplished under the project, and committee members appreciated the "Inception Report" submitted by the Institute.

Consultation workshop with the stakeholder:

Under the project, we aimed to integrate the knowledge at an appropriate scale from different stakeholders for developing a conservation plan those successfully mainstreaming interventions. Therefore, we envisaged two such workshops under the project. The first one was proposed before the field data collection commencement to share the approaches, methodology, and expected output of the project with different stakeholders. Whereas the second workshop was planned after the completion of the "Draft Final Report" of the project.

Accordingly, the 1st Consultation workshop on "Planning effective biodiversity conservation strategies around Greenfield Jewar International Airport" was planned on 1st February 2020 at Gautam Buddha University, Greater Noida, Uttar Pradesh. Dr. D. Mohan, Director, WII, and Dr. Asad Rahmani, former Director, Bombay Natural History Society, Mumbai, Chaired the workshop. The workshop was well received and attended by the 32 participants from NGOs, NGI, Forest Department, Uttar Pradesh, MoEFCC, Govt. of India, an official from YEIDA, Greencindia Consulting Private Limited (GCPL), PricewaterhouseCoopers Private Limited (PwC), and others. Besides different presentations during the workshop, we organized a panel discussion on (i) Identify "Ecological Focus Area" (ii) Identify species (terrestrial and water birds) of conservation importance (iii) Identify wetlands for landscape-level conservation planning, (iv) Strategies for mainstreaming conservation goals in the development of Greenfield International Jewar Airport. We received valuable suggestions from the participants. Environmentalist Mr. Arya suggested a priority should be to declare "Dhanauri Wetland" as Protected Area by the Govt. of India for the conservation of this landscape's wetland birds. The detailed workshop report was prepared. Based on the participants' suggestions, we planned our field sampling strategies accordingly, and data were collected subsequently.

Finally, we shared our suggested "Conservation Stargey" for biodiversity conservation in and around GJIA landscape by orgnazining a consultation workshop with our stakeholder and knowledge partners ranging from governmental to non-governmental agencies on 4th January 2021.

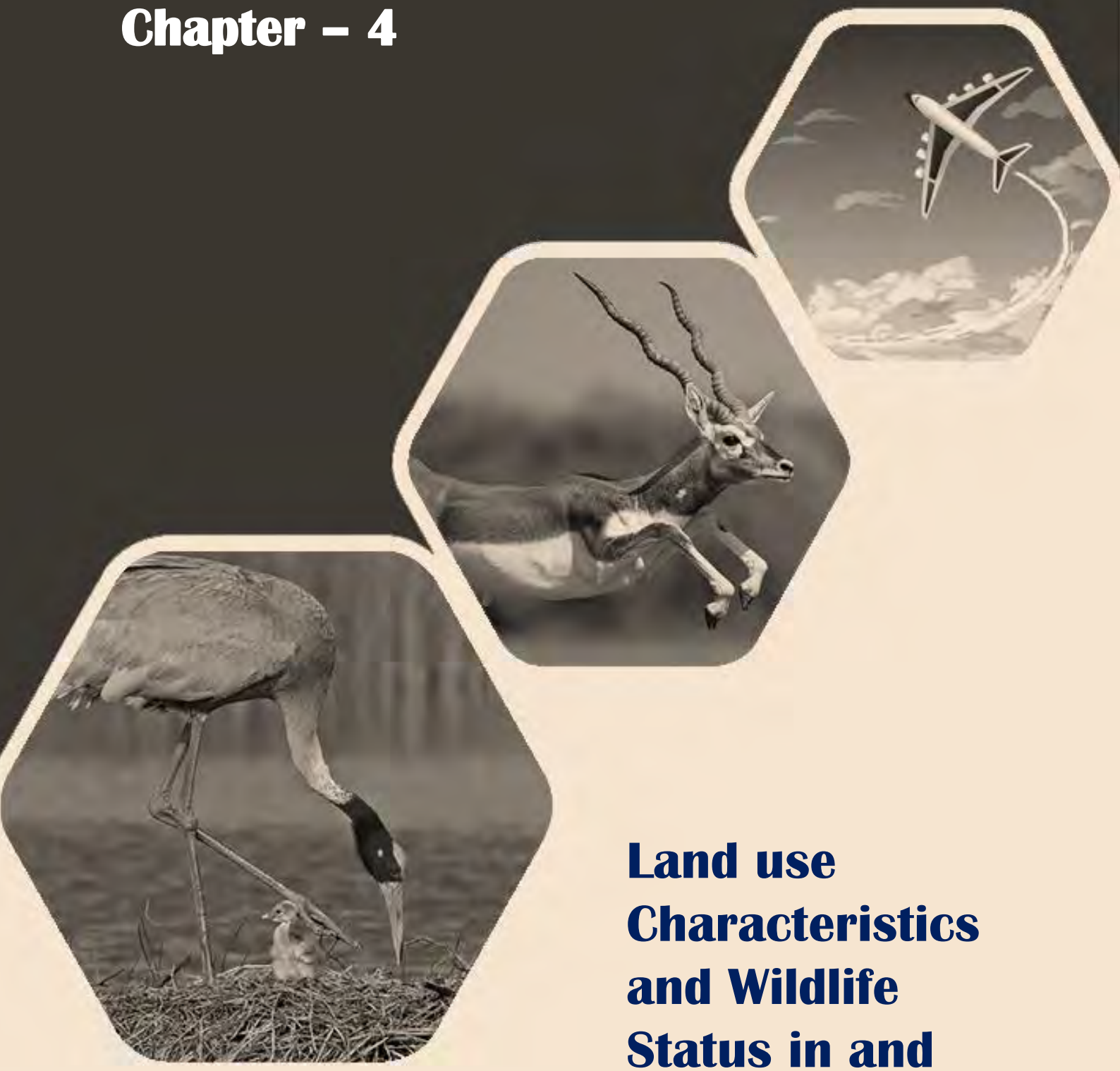
Because of COVID-19, we organized this as a "Virtual Workshop" through online "Video Conferencing." All the suggestions that came during this workshop were incorporated in the Final Report.

Constraints:

Because of the COVID-19, we were constrained by undertaking the fieldwork from March 2020 onwards and has impacted the envisaged project activities, including the delay in submission of the Final Report. Though we were constrained, however, we were privileged with the knowledge acquired through "Citizen Science" by a discussion with several scholars working in this landscape during this period.

Participants during the 1st Consultation workshop on “Planning effective biodiversity conservation strategies around Greenfield Jewar International Airport” was planned on 1st February 2020 at Gautam Buddha University, Greater Noida, Uttar Pradesh.

Chapter – 4



Land use Characteristics and Wildlife Status in and around the Proposed GJIA Site

4.1. Introduction:

Amongst the 105,732 species listed in the International Union for the Conservation of Nature, over a quarter (28,338) are threatened with extinction (IUCN 2019). The most critical threat identified in the report is humans and a range of anthropogenic activities, including but not limited to over-exploitation of the species, habitat loss, the spread of disease, environmental mismanagement associated with human activities, and conflict (IUCN 2019).

Among different natural resources of conservation importance, grasslands are the most valuable and unique biodiversity conservation areas. India lost 31% or 5.65 million hectares (mha) of the grassland area in a decade from 2005 to 2015 (UNCCD 2019). According to the report, the country also lost around 19% of its common lands during the same period. The information also added that the area under common lands (lands that include the grazing grounds, some forest land, ponds, rivers, and the other regions that all members of a rural community can access and use) decreased to 73.02 mha from around 90.5 mha between 2005 and 2015. These common lands provide food, water, fodder, firewood, and livelihood to rural communities while also helping recharge groundwater and maintain the land's ecological balance. Around 4.74 mha of grazing land was diverted as agricultural land across the country. Many common lands also met the same fate c. 29.11 mha of common land was diverted for croplands during the same period (2005 to 2015). Industrialization and conversion of common lands for non-agricultural purposes became a significant cause for the decreasing size of common lands (UNCCD 2019). During the same period, the area under cropland saw nearly an 18% increase to 134.5 mha from 113.6 mha. But even as these lands are being lost to agriculture to feed the growing population, it is worrying to note that their productivity has also declined. The productivity of at least 26 mha of land has decreased, and of this, c. 0.8 mha was grazing land and 5.9 mha common lands. The declining productivity of grasslands also means the low quality of fodder for livestock. Because of different anthropogenic activities, most natural resource areas have fragmented, degraded, and lost. These causes are of great conservation concern in developing countries, where various mega-development projects are being planned.

However, visualizing the conservation concern of natural resources for human beings' wellbeing, the strong emphasis has been integrating conservation even at the planning stage of the development.

4.2. Existing land use pattern in GJIA landscape:

We assessed the landscape features, i.e., Land Use and Land Cover (LULC) within the 10 km radius area around GJIA using GIS and Remote Sensing data. Our LULC analysis reveals that agricultural land and built-up constitutes ~87% and ~11% in the GJIA landscape, respectively (Fig. 4.1). Of the two significant wildlife habitats, i.e., open scrub and forest patches, open scrub is 4.59% and 10.81% inside and outside, respectively, in the GJIA landscape. In contrast, forest cover ranged from 0.29 to 0.85 percent. Water bodies comprising both perennial and seasonal wetlands formed the only c. 0.28% (Fig. 4.1).

Inside the proposed GJIA site, a total of 11 patches of scrubland suitable for wildlife covering an area of ~26 ha (average patch size=2.4 ha; range=0.86–5.0 ha) were identified. These scrub patches are along the eastern boundary of the proposed site, near Rohi and Parohi villages. No forest patch was found inside the GJIA site (Fig. 4.2). These will be lost during the development of GJIA.

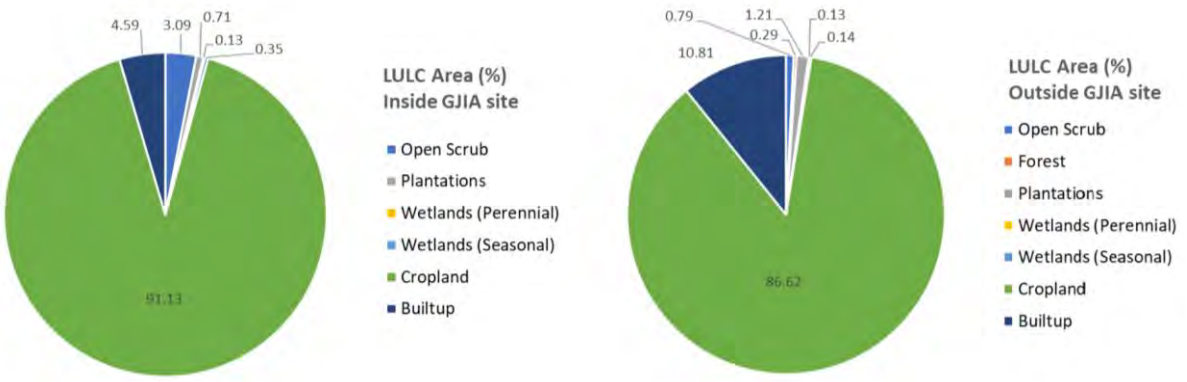


Figure 4.1. Percent Land-use and Land-cover (LULC) categories inside and outside the GJIA site.

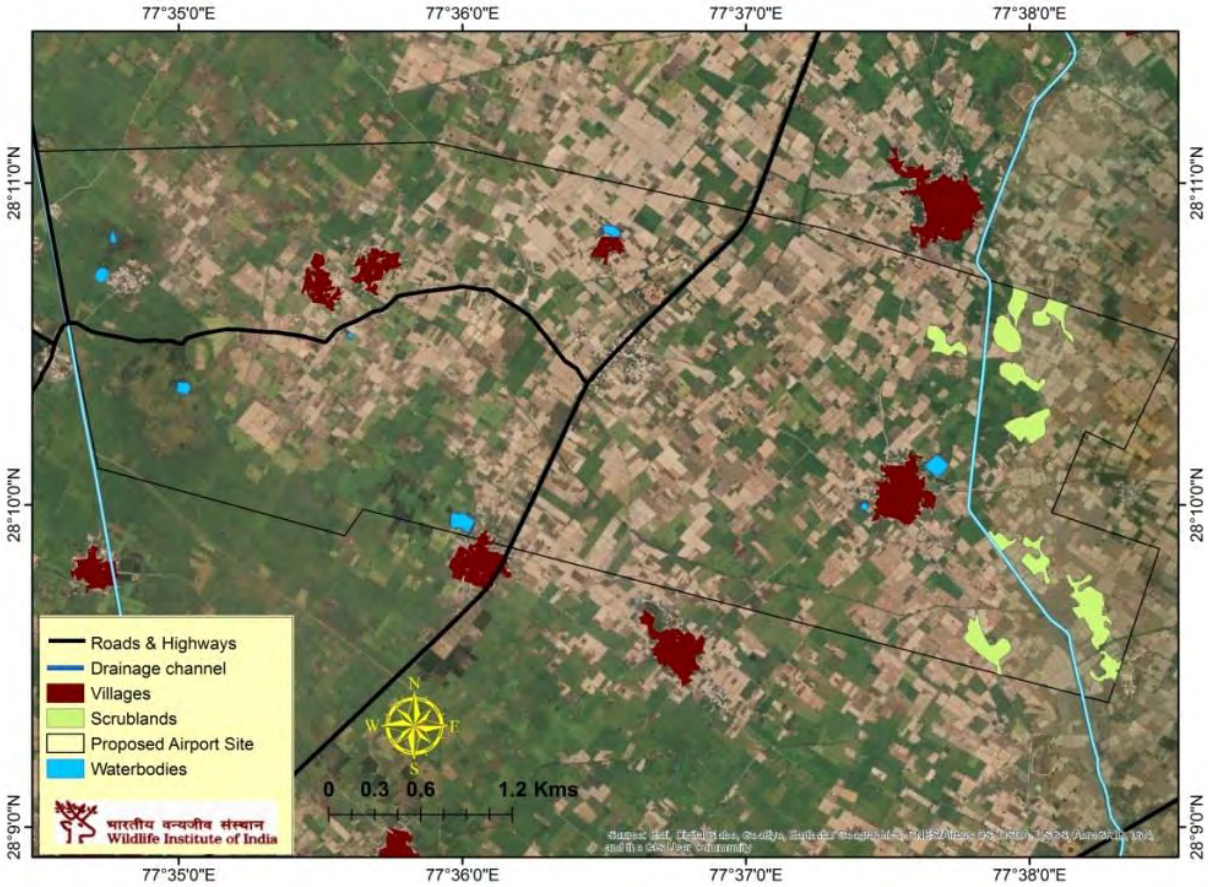


Figure 4.2. Scrubland patches inside the GJIA site.

4.3. Demographic profile:

Gautam Budh Nagar district has a population density of 1,286 persons/km^2 (total population =1,648,115), which is more than the state average of 829 persons/km^2. The district's decadal growth rate is 49.1%, which is higher than the state average of 20.2%. The sex ratio in the community is 851 females per 1000 males. This district ranked 1st in literacy with

80.1%, which is higher than the state average of 67.7%. The rural and urban population is 40.91% and 59.11%, respectively. The proposed GJIA site is in Jewar tehsil (taluka), 370 km², including 331.41 km² rural area and 38.61 km² urban area. Jewar has a population of 2,21,232 people. There are 36,975 houses in the tehsil, spread over 92 villages included in the tehsil (Census, 2011).

4.4. Vegetation type in the landscape:

According to Champion and Seth (1968), natural vegetation in the landscape is classified into babul savanna of saline/alkaline scrub savanna type. The upper canopy is light and continuous in the climax form. There is a considerable intermixture of relatively smaller trees, which in this region form part of the prominent canopy. The ground vegetation in the region takes on an almost luxuriant appearance during the monsoon. The ground is bare, where the concentration of salt is excessive at several places.

4.4.1. Forest:

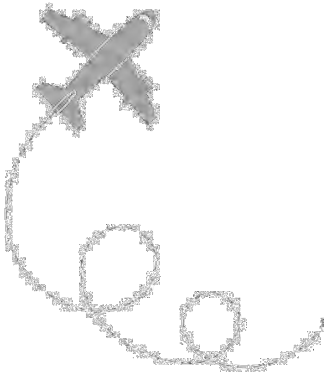
During our survey, we observed forest patches, which were either mainly mono-cultured plantations or planted entirely or partially at some point in time by the Forest Department as a management practice to increase the canopy cover and cater to the local community for the fuelwood requirements. Mostly *Acacia nilotica* and *A. leucophloea* were planted in these patches. At some places, species planted earlier have become dense thorn thickets, whereas we observed sapling of 1-2 m in height at other places showing signs of recent plantation drives by the Forest Department. Other non-thorny associated species include *Azadiracta indica*, *Phoenix sylvestris, Butea monosperma, and Salvadora oleoides*. The shrub layer is mainly composed of species such as *Capparis decidua, C. separia, Calotropis procera, Zizyphus* sps.

4.4.2. *Open Scrub:*

Most of the open scrub vegetation habitat was in small and scattered patches with a few high canopy trees. Trees observed in these patches were mainly of *Prosopis juliflora, P. cineraria, Acacia nilotica*, and *Zizyphus* sps. Among these, *P. juliflora* and *P. cineraria* were most common. Besides, a few scattered trees of *Azadirachta indica*, *Dalbergia sisso*, *Butea monosperma*, and *Phoenix sylvestris* were also found in these patches. Shrub species observed in these patches were *Capparis decidua, C. seperia, Calotropis procera, Opuntia sp.*, and *Salvadora oleoides*.

4.4.3. *Grassland*:

The grassland patches observed around the GJIA site were very small and scattered and mostly abandoned cultivated lands or other community lands. Some grassland patches were interspersed within the forest patches or observed along some water canals and Yamuna riverbank. These grasslands patches were mostly degraded due to anthropogenic factors. The dominant grass species recorded was *Desmostachya bipinnata* followed by other associates included are *Cynodon dactylon, Vetiveria zizanoidis, Digiteria bicornis, Setaria verticillata, Saccharum munja* and *Imperata cylindrica* and *Panicum antidotale*. The common sedges include *Cyperus compressus* and *Cyperus rotundus*.



A dense Forest patch (above) and Open Scrub patch (below) outside the GJIA site

A Grassland patch outside the GJIA site near the village Akalpur

4.4.4 *Agriculture*:

The Gautam Budh Nagar district is one of the seven districts (Saharanpur, Muzaffarnagar, Meerut, Baghpat, Ghaziabad, Gautam Budh Nagar, and Bulandshahar) of the Upper Ganga doab region. This region is the most fertile region of Uttar Pradesh, which lies between the two critical perennial rivers, i.e., the Ganga and the Yamuna. Therefore, it is considered very important for agricultural productivity. Around 60 to 70% of the population of the region is dependent on agriculture and related activities. Though agriculture is the main occupation of the people in this district, however, due to rapid urbanization and industrialization, the land size under cultivation decreases day by day. On average, cultivators and agricultural laborers constitute 12.77% and 8.58% of the district's total workers, whereas Jewar tehsil has the highest (23 to 32%) of all the three tehsils of the district. This suggests the high dependence of the population on the agriculture sector, engaging many workers.

The cropping pattern (the proportion of area under different crops at a given point of time) in the study area is characterized by two main seasons, Kharif (July–October) and Rabi (November–March). The crop cultivated during summer between March–June is called "Zaid' which mainly consists of vegetables and some legumes (Table 4.1).

Annual crops like sugarcane (*Sachharum officinarum*) is grown mostly near and along the Yamuna river bank during the Rabi season in the landscape. Besides, we observed plantations of *Eucalyptus* spp., mango (*Mangifera indica*), poplar (*Populus deltoides*), and guava (*Psidium guajava*) in the landscape.

Table 4.1. Seasonal cropping pattern in the landscape in and around the GJIA site.

Rabi (November–March)	Kharif (July–October)	Zaid (March–June)
Wheat (*Triticum aestivum*)	Maize (*Zea mays*)	Vegetables (Cucumber & Gourds)
Rye (*Brassica juncea*)	Bajra (*Pennisetum glaucum*)	Melon (*Cucumis melo*)
Mustard (*B. compestris*)	Jowar (*Hordeum vulgare*)	Water melon (*Citrullus lanatus*)
Barley (*Sorghum* vulgare)	Rice (*Oryza sativa*)	Lady's finger or Okra (*Abelmoschus esculentus*)
Pea (*Pisum sativum*)	Urd (*Phaseolus mungo*)	Arhar (*Cajanus cajan*)
Gram (*Cicer arietivum*)	Mung (*Vigna radiata*)	Masoor (*Lens esculentus*)

4.5. Waterbodies/wetlands:

According to a recent revenue record report by the district administration, Gautam Budh Nagar is among India's 255 water-stressed districts. Despite this, the landscape is dotted with several water bodies or wetlands of varying sizes, and most of them are in the form of village ponds/lakes. These water bodies serve as critical habitat for mostly resident water birds such as herons, egrets, waders, etc. Common species of plants observed across the water bodies throughout the landscape include *Ipomoea aquatica*, *Typha domingensis, Eichhornia crassipes, Paspalum distichum, Ranunculus sceleratus*, etc. Most of these wetlands are not cleared regularly of weeds such as water hyacinth, and the quality of the wetlands is poor.

Figures 4.1 and 4.3 indicate that perennial and seasonal wetlands formed only c. 0.28%. Inside the proposed GJIA site, a total of 8 wetlands covering a total area of ~3.5 ha (average wetland size=0.44 ha; range=0.06–1.00 ha) were identified. Of these, only three were seasonal wetlands with a total area of ~0.99 ha (average=0.33 ha, range=0.14–0.45 ha), whereas five perennial wetlands with a total area of ~2.5 ha (average=0.50 ha, range=0.06–1.00 ha) (Fig. 4.3). These will be lost during development of the airport.

At least 60% of the ponds listed in the revenue department's records either have been illegally encroached upon or used as dump yards. To ensure that ponds and other water bodies are not destroyed in the future, the Gautam Budh Nagar district administration planned to profile 1,000 ponds across the district for rejuvenation. These ponds make up a total area of 4.5 km^2 (448.418 hectares).

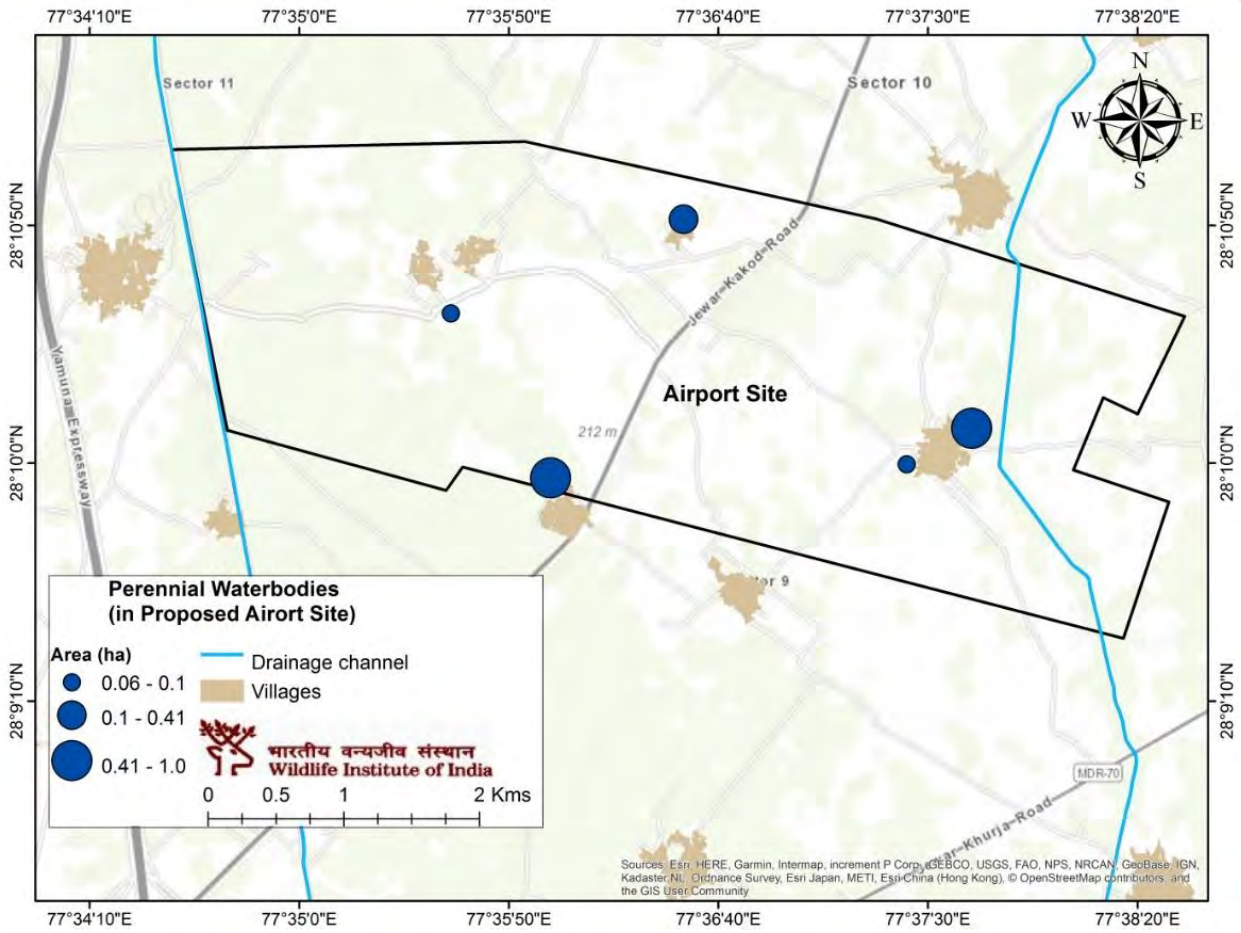


Figure 4.3. Perennial wetlands inside the proposed GJIA site.

4.6. Status and distribution of wildlife:

We compiled the taxa list in different habitats of Gautam Budh Nagar district (Annexure I, II, and III). These indicate the richness of the biodiversity values in this landscape. The most commonly sighted were six species of mammals within and 10 km radius from the GJIA site (Table 4.2). Annexure II provides reported bird species in the district whereas eighty-one bird species were recorded during the present survey. Table 4.3 provides a list of species having conservation importance in this landscape. The distribution and abundance varied all across the landscape.

Table 4.2. Presence of wildlife species observed in the proposed GJIA site and outside the area during the preliminary survey with their conservation status.

Species	Scientific Name	Observed landscape category	
		Inside GJIA site	Outside GJIA site
Mammals			
Indian Antelope or Blackbuck	*Antilope cervicapra*	+	+
Nilgai or Bluebull	*Boselaphus tragocamelus*	+	+
Jungle Cat	*Felis chaus*	+	-
Golden Jackal	*Canis aureus*	+	+
Rhesus Monkey	*Macaca mulatta*	+	+
Indian Grey Mongoose	*Herpestes edwardsii*	+	+
Birds			
Indian Peafowl	*Pavo cristatus*	+	+
Sarus Crane	*Grus antigone*	+	+
Indian Spotted Eagle	*Clanga hastata*	+	+
Egyptian Vulture	*Neophron percnopterus*	+	+

Table 4.3. Wildlife species were recorded during the preliminary survey with their conservation status.

Species	Scientific Name	Conservation Status	
		IUCN	IWPA – Schedule
Mammals			
Blackbuck	*Antilope cervicapra*	LC	I
Nilgai/Bluebull	*Boselaphus tragocamelus*	LC	III
Jungle Cat	*Felis chaus*	LC	II
Golden Jackal	*Canis aureus*	LC	II
Birds			
Indian Peafowl	*Pavo cristatus*	LC	I
Sarus Crane	*Grus antigone*	VU	IV
Egyptian Vulture	*Neophron percnopterus*	EN	IV

IUCN = International Union for Conservation of Nature and Natural Resources.
IWPA = Indian Wildlife (Protection) Act 1972

Harvested paddy (*Oryza sativa*) and de-husking of paddy in the process during November in the landscape

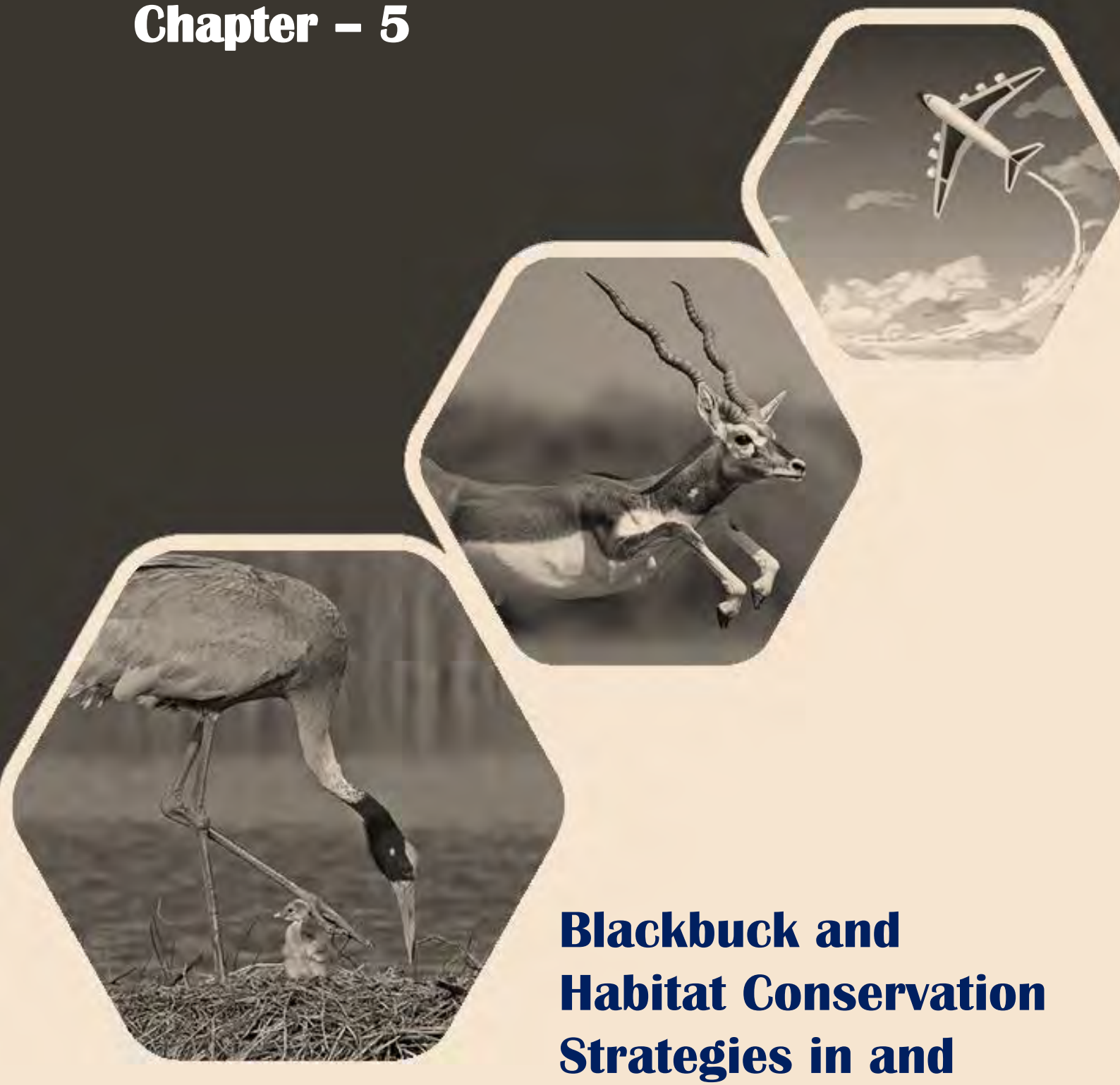
Mustard (*Brassica* sp.) and Marigold (*Tagetes* sp.) cropping in December in the landscape

Wheat (*Triticum aestivum*) (top) and sugar cane (*Sachharum officinarum*) (bottom) crop fields in the landscape during January and February

Banana (bottom; *Musa* sp.), Eucalyptus (top *Eucalyptus* spp.) plantations, and Mango (middle; *Mangifera indica*) in the landscape.

Two wetlands/Village ponds in the landscape, one is cleared regularly (above) while other is infested with weed (below).

Chapter – 5



Blackbuck and Habitat Conservation Strategies in and around the Proposed GJIA Site

5.1. Introduction:

The Indian antelope or Blackbuck (*Antilope cervicapra*) is a tropical antelope endemic to the Indian subcontinent and the only representative of the genus *Antilope* in India. The Blackbuck used to occur across almost the Indian subcontinent south of the Himalayas (Fig. 5.1). A significant decrease in their range during the 20th century led to their extirpation in Bangladesh and Pakistan. In Nepal, Blackbuck is still present in the Terai zone. This species has been introduced to the United States of America (Texas) and Argentina (IUCN 2017). Blackbuck has been listed as a Schedule I species in the Wildlife (Protection) Act, 1972 of India. Although its conservation status in the IUCN Red list category downgraded to Least Concern (IUCN 2017) from Near Threatened (Mallon 2008), as there is no information about its population trend. It has been speculated that the population may have numbered 4 million a couple of centuries ago, but only around 80,000 individuals were estimated in 1947 (see IUCN 2017). The population in India increased from an estimated 22,000-24,000 in the 1970s to an estimated 50,000 (c. 35,000 mature individuals) by 2000, with the largest numbers in the states of Rajasthan, Punjab, Madhya Pradesh, Maharashtra, and Gujarat (Rahmani 2001). However, no systematic census has been conducted, and therefore, no robust population estimates of current population size are available. Nevertheless, it remains widespread and numerous in many places, albeit as scattered populations. Overall, the species has lost most of the areas due to the degradation of suitable habitat throughout its distribution ranges because of various factors, primarily habitat loss, competition with livestock for grazing, historical hunting, and rapid urbanization.

The species inhabits open grassland, dry thorn scrub, scrubland, and the lightly-wooded country and agricultural margins, where it is often seen feeding in fields. They require water daily, restricting their distribution to areas where surface water is available for the more significant part of the year (IUCN 2017). They are mainly sedentary, but in summer may move long distances in search of water and forage (Rahmani 2001). They are primarily grazers but browse when lack of grasses forces a greater dependency on leaf litter, flowers, and fruits.

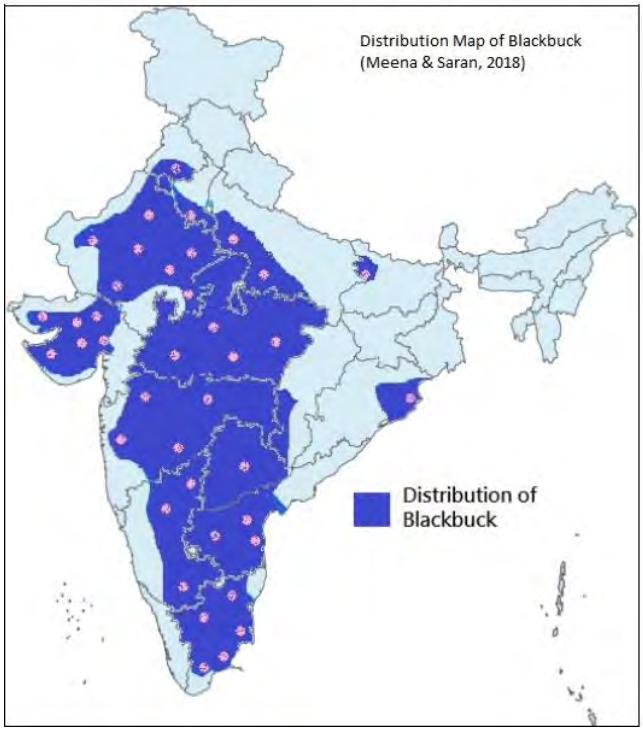


Figure 5.1. Distribution of blackbuck in India.

Blackbuck have often been reported to use agricultural fields in Andhra Pradesh (Prasad & Ramana Rao 1990, Manakadan & Rahmani 1998), Gujarat (Ranjitsinh 1989, Jhala 1993), Haryana (Chauhan & Singh 1990), Madhya Pradesh (Chandra 1997), Maharashtra (Rahmani 1991, Bharucha & Asher 1993), Punjab (Bajwa & Chauhan 2019), Rajasthan (Prakash 1990) and Uttar Pradesh (Rahmani 1991). In some areas, Blackbuck feeds in mosaics of natural scrubs interspersed within agricultural fields and sometimes away from natural habitats during different seasons (Bharucha & Asher 1993, Jhala 1993, Manakadan & Rahmani 1998).

5.2. Potential wildlife habitat of Blackbuck in Uttar Pradesh with reference to the GJIA landscape:

The GJIA landscape of Gautam Budh Nagar spreads across two biogeographic zones viz. upper Gangetic plain and semi-arid, therefore, the vegetation has the broad category of Tropical thorn forest, also known as scrublands and Tropical dry deciduous forest (Champion and Seth 1968). The scrublands are "early successional habitats," created by natural disturbances, extreme physical conditions such as poor soils or harsh climates, the abandonment of agricultural land, and logging (Gilbart 2012). Many ecologists believe that the thorn scrub vegetation represents a degraded stage of the tropical dry forests, modified by human and livestock use over hundreds of years (Puri et al. 1989).

The proposed Greenfield Jewar International Airport (GJIA) site and the surrounding landscape are a part of the North-western "Thorn Scrub Forests" ecoregion. Hence, it has a mosaic of scrublands and waterbodies interspersed with agricultural fields and human habitation. The isolated natural patches mainly comprise of scrub habitat and open woodlands. They are dominated by thorny trees and bushes with short trunks and low branching crowns, spiny and xerophytic shrubs, and dry grasslands. Dominant plant species include Babul (*Acacia nilotica*), Khair (*Acacia catechu*), Amaltas (*Cassia fistula*), Wild dates (*Phoenix sylvestris*), and Indian jujube (*Ziziphus mauritiana*).

Of the three major vegetation types viz. scrublands, natural woodlands, and plantations in the GJIA landscape, the scrublands and natural forests are critically important for several wildlife species of this ecosystem, including terrestrial mammals. These scrublands serve as natural habitats for several wildlife species of arid to the desert ecosystem, and critical wildlife species of conservation importance are Blackbuck, Nilgai (*Boselaphus tragocamelus*), Golden jackal (*Canis aureus*), and the Jungle cat (*Felis chaus*).

The Blackbuck, a Schedule I species of Wildlife (Protection) Act 1972 of India, is the main species of conservation and management concern among large mammals in this landscape. Therefore, the current chapter mainly focuses on identifying and conserving important wildlife habitats, which are crucial to the conservation of Blackbuck and associated species that are likely to be impacted under the development forthcoming in and around the GJIA landscape.

5.3. Methodology:

5.3.1. *Criteria for identification of potential habitat*:

In times of unprecedented needs and demands for development and urbanization, attempts to protect ecosystems from large-scale clearance and land-use changes encounter severe challenges. On a global scale, almost all ecosystems are declining in total size and becoming increasingly fragmented (Saunders et al. 1991; Fischer and Lindenmayer 2007; Laurance et al. 2011). More than 80% of the terrestrial world has been modified by human activities (Sanderson et al., 2002).

Consequently, small patches are now a common feature in many landscapes and represent an increasingly large component of remaining habitat in many ecosystems (Tulloch

et al. 2015). Small patches contribute to short- and long-term species survival. Still, they are often the most vulnerable to further changes (Tulloch et al. 2015) and have been considered essential habitat for conserving biodiversity in the urban ecosystem.

The congruency between landscape patterns and the ecological process is a common notion (Gallardo-Cruz et al. 2018) comprehended in most studies based on the patch-mosaic landscape paradigm (Forman 1995). Emphasis has been on determining the patch characteristics while planning conservation strategies in such an ecosystem. This includes patch size (Fahrig and Jonsen 1998; Gallardo-Cruz et al. 2018), patch shape complexity (Hernandez-Stefanoni 2005; Gallardo-Cruz et al. 2018), patch connectivity or isolation (Fahrig and Jonsen 1998; Hernandez-Stefanoni 2005; Rubio and Saura 2012; Gallardo-Cruz et al. 2018), and patch richness and abundance (Gallardo-Cruz et al. 2018).

Patch size is the most straightforward measure of landscape configuration that represents the spatial character of a patch. The dimension of patches has inherently related consequences. A small patch means a small population with more significant external influence reaching the inner parts of the patch (Ecology Center, 2019). However, this is not always true, as Bender et al. (1998), in a meta-analysis of studies relating patch size to population density, found that the sign of the relationship was positive and negative in almost equal numbers of species (72 positives and 62 negative associations). That being the case, McIntyre and Wiens (1999) suggested that predicting how organisms respond to spatial heterogeneity requires an assessment of how organisms use landscapes, in addition to an evaluation of the structural characteristics of landscapes. Effective conservation relies on measuring the patch connectivity or inter-patch distance, and scholars have suggested that it should be considered while studying habitat-species relationships in addition to the patch size.

Shape complexity relates to patches' geometry, i.e., whether they tend to be compact and straightforward or irregular and convoluted. The shape is a challenging spatial attribute to capture in a metric because of the infinite number of possible patch shapes. Hence, shape metrics generally consider overall shape complexity instead of assigning a value to each unique shape. The shape of patches assumes relevant importance for maintaining the patch *per se* and as recognized habitat for a focal species. Highly fractal patches offer more surface of contact with other patch types. Under conditions of competition or the dominance of the neighboring patches, the border's shape can encourage the subordinate patch to replace the invisible patch. The edge's convolution can be perceived as necessary for some species like Blackbuck when they are foraging at the border between woodland and open grassland. The great extension of the boundaries facilitates edge species and predators (Ecology Center, 2011).

In the context of meta-population ecology, the habitat or patch connectivity is typically related to the migration rate and gene flow among populations and the colonization rate of empty habitat (Moilanen and Hanski, 2001). Hence, the extent of habitat patches connectivity generally refers to the functional connections among patches in conservation planning. It is a crucial metric to evaluate the effects of land-use changes and potential mitigation measures for achieving conservation goals. Hence, we have emphasized the importance of determining patch characteristics while assessing the status of habitat suitable for Blackbuck conservation in the GJIA landscape.

5.3.2. Assessment of Blackbuck distribution in the GJIA landscape:

We assessed Blackbuck's distribution patterns by foot and vehicle transects during the study period within and around the GJIA site. These transects were undertaken mainly during the clear days in the morning (08:00–11:00) and evening (15:00–17:00) hours. Opportunistic

sightings were also recorded. For each sighting on the number of individuals, group composition, GPS location, and immediate habitat type.

5.3.3. Determining spatial distribution of habitat patches and their characteristics:

The natural vegetation patches (other than agriculture) of the GJIA landscape were extracted in three zones, i.e., inside the airport area (i.e., GJIA site), in a 10 and 25 km radius outside the airport. The methodology followed by the satellite data processing was the same as discussed in Chapter 6. The scale of analysis was 1:5000. However, we used one season, i.e., May, to classify scrublands and woodlands based on satellite image data. The month of May is a non-cropping season. Therefore, most of the crop fields were already cleared, therefore, it was to quickly distinguish scrublands and woodlands in the the satellite image. The forests were further categorized into natural woodlands and plantations based on the shapes of the patches. If the patches had a regular shape, i.e., square or rectangle, they were grouped into plantations. On the other hand, woodlands with irregular polygonal shapes were classified as natural woodlands.

The landscape composition was expressed by patch richness and the proportional abundances of scrublands and woodlands in three zones. of Blackbuck, we recorded information The patch richness was quantified as a number of different patch types, i.e., scrublands, natural woodlands, and plantation in the area as follows:

$$Patch\ Richness = n$$

where, n is number of patch types.

The proportional abundance was derived as the proportion of area of the patches relative to the zone area as follows:

$$Patch\ abundance = Area\ of\ patch\ /Zone\ area$$

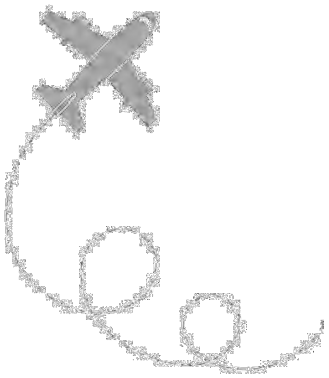
The landscape configuration was quantified by patch size, patch shape complexity (i.e., perimeter to area ratio), and patch connectivity (Euclidean distance) as follows:

$$Patch\ size = Area\ \ of\ patch\ polygon\ (ha)$$

$$Patch\ shape\ complexity = Perimeter\ of\ polygon\ /area\ of\ polygon$$

$$Patch\ connectivity = d(n_1 - n_2, n_2 - n_3, \ldots\ldots n_i)$$

where, d is the function of inter-patch distance.



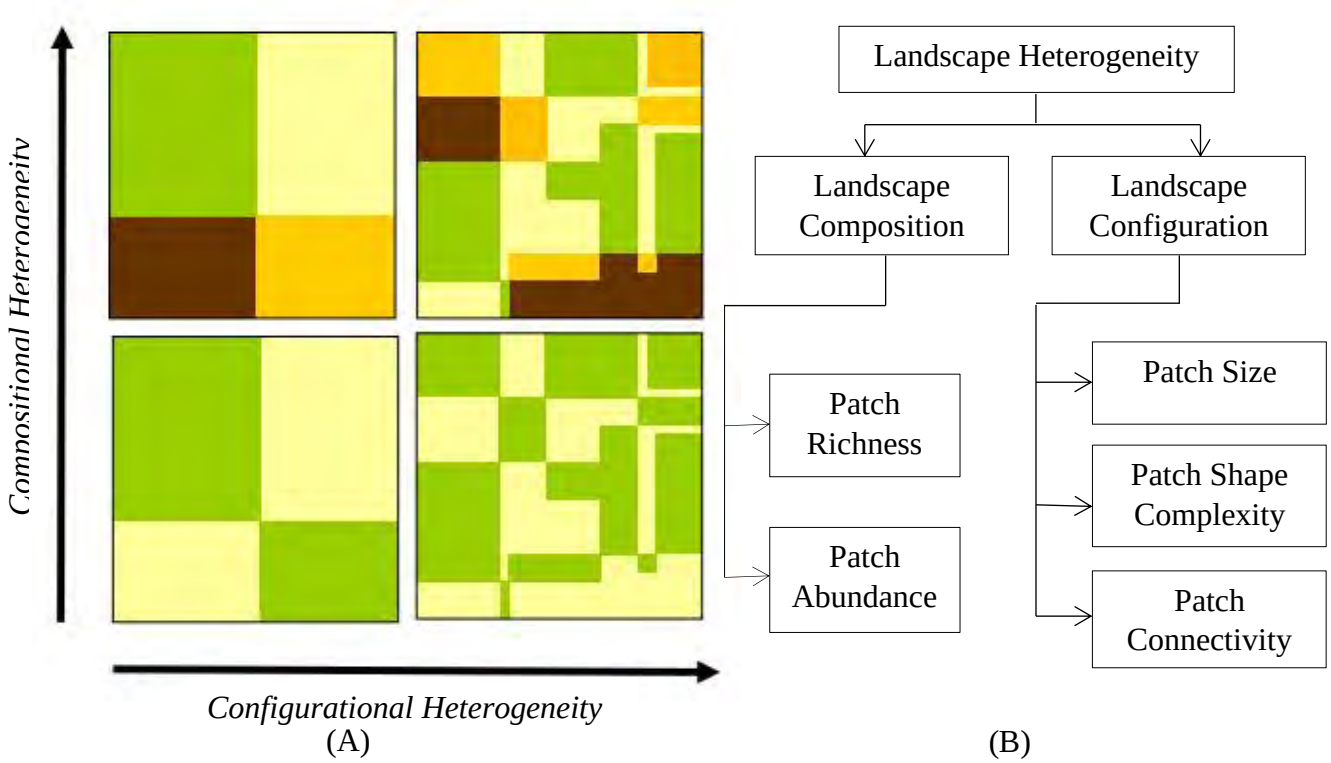


Figure 5.2. (A) Examination of configurational and compositional heterogeneity in assessing landscape heterogeneity (from Fahrig et al., 2011) and (B) Flowchart showing landscape heterogeneity variables derived for characterizing wildlife habitats in the GJIA landscape.

Habitat use by Blackbuck was further assessed by determining mean NDVI, mean elevation, roads, and water bodies in 1 x 1 sq km grids on each sighting within the 10 km radius zone. Based on the patch characteristics and subjective estimation of the factors influencing Blackbuck's presence in the GJIA, we identified some suitable habitats outside the development zone to offset the loss of the habitats currently available to the wildlife species of the area.

5.4. Findings:

5.4.1 Distribution and group size of Blackbuck in the GJIA landscape:

Blackbuck is the prime mammal species of conservation importance identified during the present study and can be observed easily within and outside the proposed GJIA site in the surrounding agricultural fields and open scrublands of the villages. Our observations indicate that the Blackbuck populations are small and scattered throughout the GJIA landscape (Fig. 5.3). We observed at least four subpopulations, which are between 9 and 25 km from each other. Broadly, there are three main clusters of Blackbuck populations, which lie within 10 km radius of the landscape *viz*. lies on the north, south-eastern, and southwest of the GJIA site (Fig. 5.3). Most of the habitats used by the Blackbucks within the GJIA site are the agricultural lands interspersed with scrub habitat belonging to villages include Ranhera, Rohi, Parohi, Banwaribas, and Bankapur (Fig. 5.4). There is a small population outside the 10 km radius area near Palwal (Fig. 5.3).

We observed 46 independent observations with a total number of 258 individuals of Blackbuck during the present survey. The mean group size observed for the Blackbuck was 5.61 (±0.99 SE; Median=2.5), with individuals in a group ranged between 1 and 31 across the GJIA landscape (Fig. 5.5). In the proposed GJIA site, one of the largest groups of 29 individuals was observed in the fields south of Rohi–Parohi villages (Fig. 5.6A). The largest population size (31

individuals) observed lies outside the proposed GJIA site in the agriculture fields between Ranhera and Shahpur Nagla villages. Whereas, in the west of the Jewar town, another large and scattered population comprising ~22 individuals and ~19 individuals were observed in the fields of Shyam Nagar and between Nagla Kanigarhi–Shamsham Nagar (Fig. 5.6B). Apart from these two main clusters of Blackbuck populations, there are several locations throughout the landscape where Blackbuck was observed more frequently (n=28) in small groups of 1-5 individuals, and 50% sightings of these were solitary males. Based on our information collected during the fieldwork, the estimated population of Blackbuck may be between 100 and 120 individuals in this landscape.

Blackbuck is known to occur in groups across distribution range except for territorial males and females with very young calves. The group sizes vary tremendously both within and among populations (Jhala & Isvaran 2016). Group size inside the Protected Areas ranged from 23 individuals to 423 individuals in a herd in Guindy and Velavadar National Parks, respectively (Isvaran 2007). Of the limited studies undertaken outside PAs in agricultural fields, group size is highly variable, ranging from a few individuals to moderately large-sized herds. A few studies have reported that the Blackbuck group size ranged from a minimum of 32 individuals up to 58 individuals in a herd (Prasad 1983; Mahato et al. 2010; Rai & Jyoti 2019). Such variation among populations probably arises from differences between them in ecological conditions, such as habitat structure and resource abundance (Isvaran 2003). The costs and benefits of group-living are likely to change under different ecological conditions and, therefore, the group sizes that are optimal and evolutionarily stable will also vary (Isvaran 2004). We observed small groups comprising only 1–5 individuals in ~61% of the total observations (N=46), which can be attributed to a trade-off to minimize intra and inter-specific competition for forage and other resources in the agricultural landscape. The other possible reason could be to reduce the risk of acquiring diseases from livestock, which may increase with the increase in group size, limiting large group sizes (Isvaran 2004).

Blackbuck mating behavior is very variable both between and within populations. Blackbuck's most commonly reported mating system is “Lekking behavior,” where aggregation of male animals gathered to engage in competitive displays and courtship rituals. During the surveys in the landscape, we did not find any such “lekking ground.” Lack of such behavior has been reported in the areas where the Blackbuck population is in low density (Ranjitsinh, 1982; Khan et al., 2019). Since the Blackbuck population varies with the availability of resources, Isvaran (2005) has also reported other intermediate forms of territorial mating behavior. We did not notice any fawning activity or fawns during the survey.

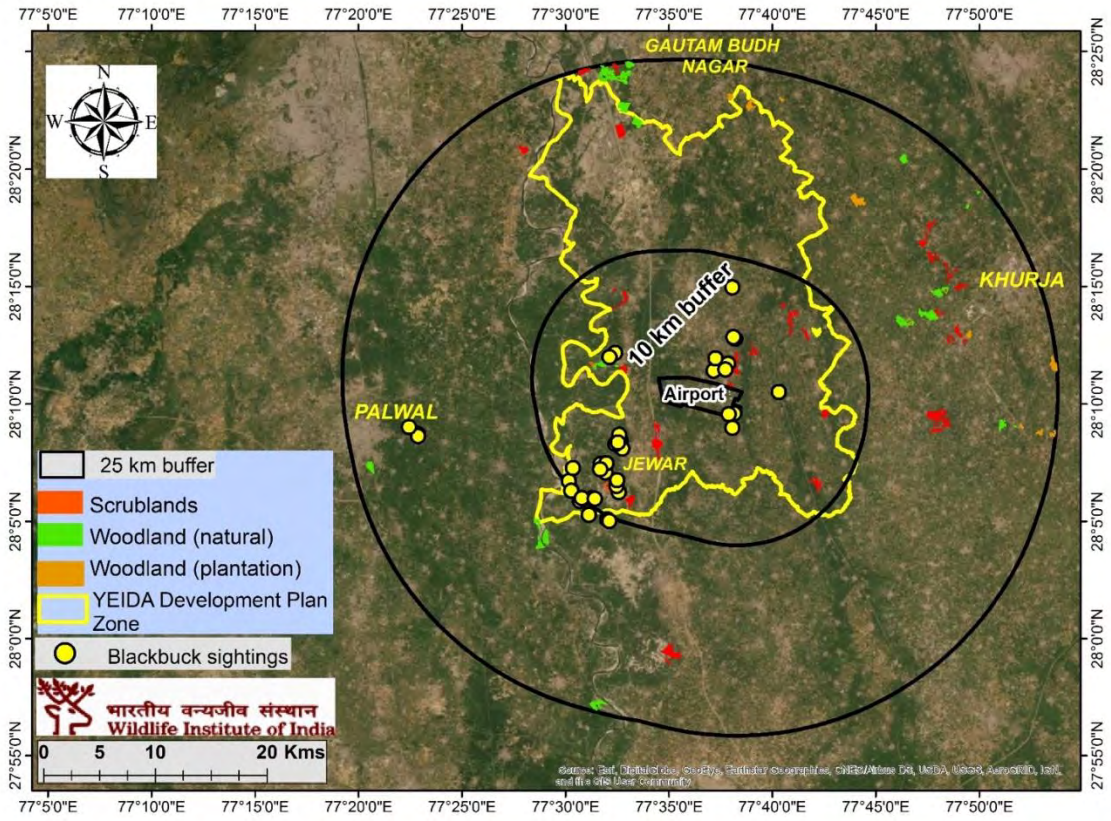


Figure 5.3. Distribution of Blackbuck in the GJIA landscape.

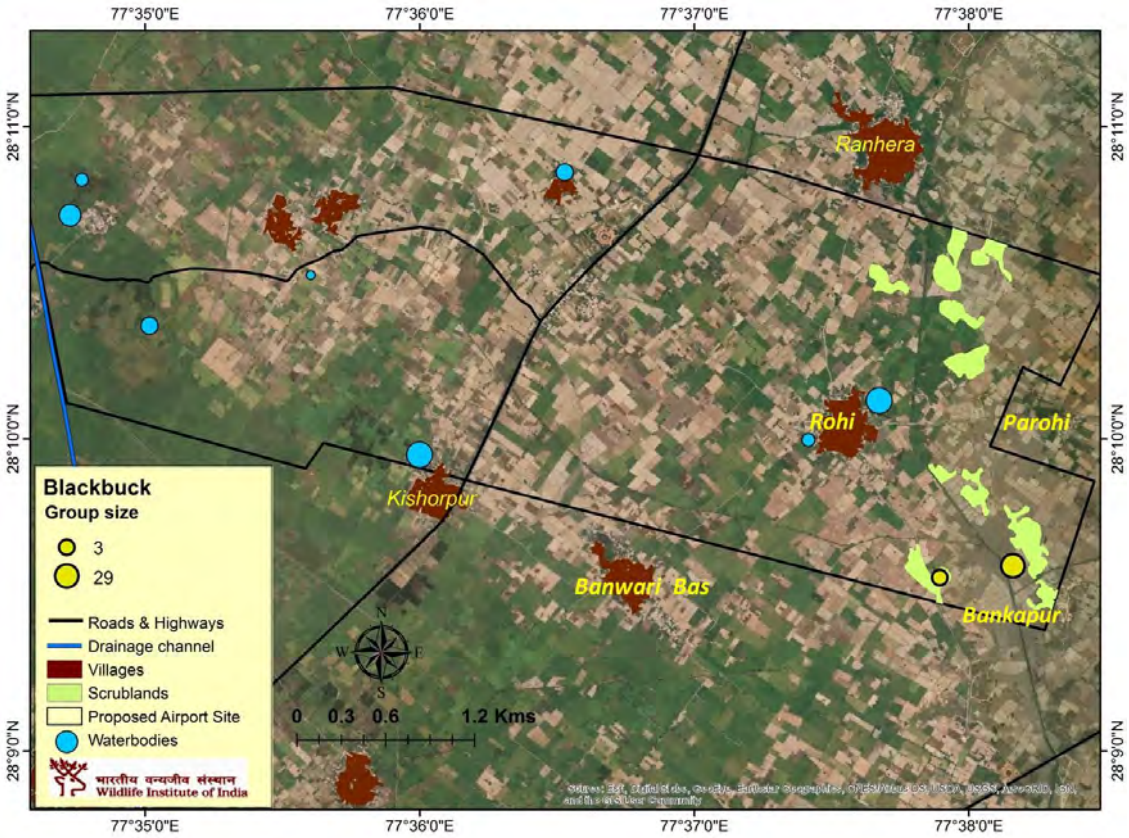


Figure 5.4. Distribution of Blackbuck in the GJIA site.

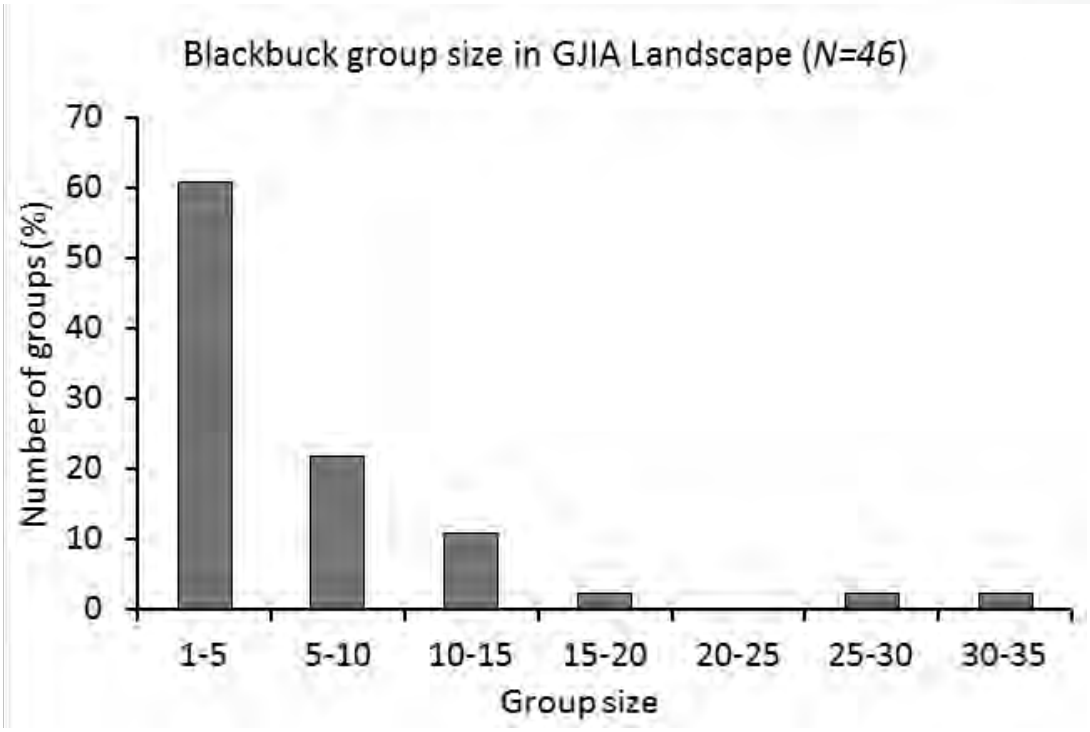


Figure 5.5. Group size of Blackbuck in the GJIA landscape.

A herd of Blackbuck inside the GJIA site

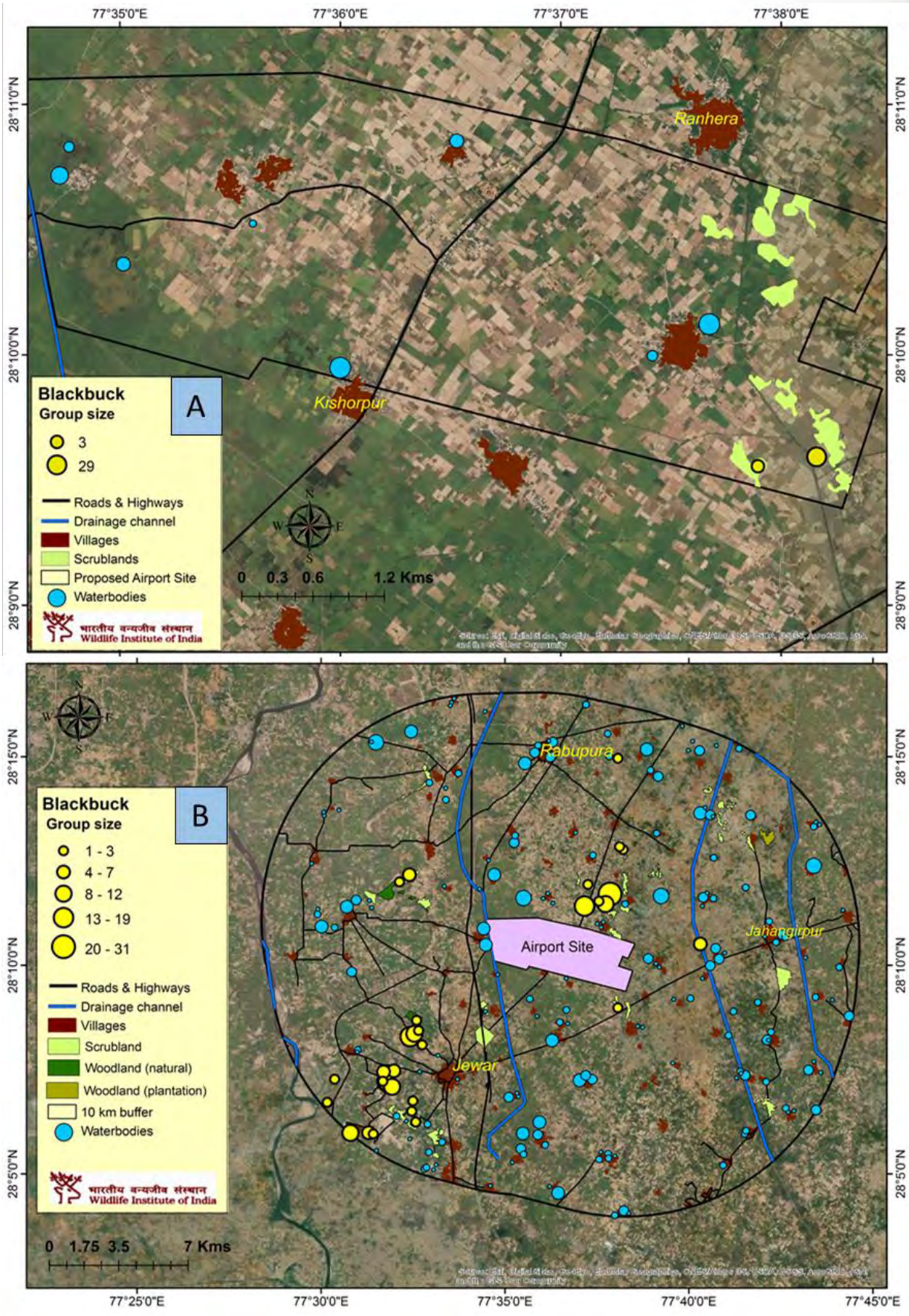


Figure 5.6. Distribution of Blackbuck group size (A) within and (B) 10 km radius outside the GJIA site.

5.4.2. Distribution and characteristics of natural habitat patches for biodiversity conservation:

Matrix of natural vegetation such as scrubland to forest patches is interspersed within the agriculture landscape. It is favored as a refuge and stepping-stone habitat for migration from one area to another by many wildlife species (Perfecto and Vandermeer, 2020). Such patches have provided different ecosystem services such as pollination by insects to seed dispersal, enhancing conservation of biodiversity in the agroecosystem. Given the significance of the matrix of such natural patches in biodiversity conservation, we emphasized our analysis in identifying and determining status of such patches as Blackbucks have used such habitat in the GJIA landscape.

As per the GIS analysis, we identified 155 patches of potential wildlife habitat with a total area of 2045.33 ha across the landscape. Table 5.1 provides a summary of three habitat types identified in terms of areas and mean patch size. Of these, scrubland constituted 111 patches with a total area of 1112.83 ha, natural woodlands or forests included 33 patches with a total area of 715.61 ha, and plantation patches covered an area of 216.89 ha (Table 5.1). Details are provided in Annexure-V.

Table 5.1. Overall wildlife habitat patches identified and their characteristics across GJIA landscape.

Wildife Habitat Type	No. of patches	Total Area (ha)	Mean Patch size (ha)	Median	Range
Scrubland	111	1112.83	10.02 ± 1.47	3.78	0.11 – 89.53
Forest (Natural)	33	715.61	21.68 ± 3.36	16.38	0.19 – 69.38
Plantation	11	216.89	19.71 ± 5.09	14.22	3.68 – 58.12
Overall	155	2045.33	13.19 ± 1.37	5.32	0.11 – 89.53

We noted only 11 wildife habitat patches of scrubland covering an area of ~26 ha within the proposed GJIA site. The minimum patch size inside the airport site was 0.86 ha, and the maximum was 5.0 ha. The perimeter to area ratio (PARA) ranged from 0.02 to 0.05.

There were 48 such patches (total area ~546 ha) that could be considered potential wildlife habitats currently available within the landscapes of 10 km radius. These include 41 patches of open scrubs with 432.09 ha, six forest patches covering 87.88 ha, and plantation covering 26 ha. The smallest patch size was 0.22 ha, and the largest was 47.57 ha. The PARA values ranged from a minimum of 0.007 to a maximum of 0.10.

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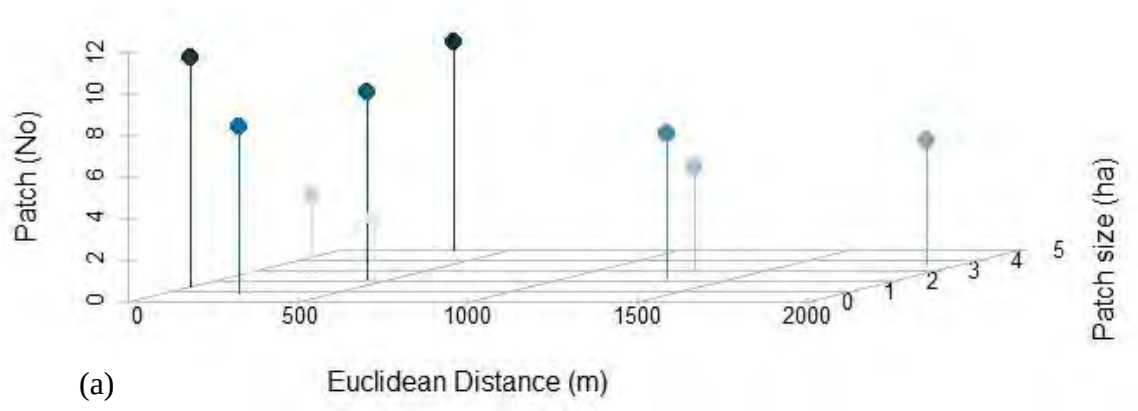
The wildlife habitat within 25 km radius area around the GJIA site comprises 96 patches covering an area of ~1473 ha. Open scrub patches numbered 59 with a total area of 654.55 ha; forest patches covered 627.73 ha with 27 patches. In contrast, plantations comprised nearly ten patches, which covered an area of 190.89 ha. The smallest patch was 0.12 ha in size, while the largest was 89.54 ha. The patches' minimum PARA value in the 25 km radius zone was 0.005, and the maximum was 0.15. Patch size distribution in the GJIA landscape is summarized as the mean patch size (Table 5.2 and Fig. 5.7). The mean patch size increased with the increasing areas of the three zones

Table 5.2. Variations in patch characteristics (composition and configuration) metrics in three different zones within the GJIA Landscape.

Landscape	Patch Richness	Proportional Abundance (ratio)	Mean Patch size (ha)	Mean Patch Perimeter (km)	Mean Shape complexity (ratio)	Mean Euclidean distance (m)
Within Airport site	1	0.03 (3.2%)	2.38±0.34	0.87±0.09	0.04± 0.003	678.30±189.51
10 km radius	3	0.11 (1.13%)	11.37±1.55	2.14±0.22	0.03±0.002	4247.95±845.40
25 km radius	3	0.007 (0.78%)	15.35±2.04	2.23±0.25	0.04±0.003	6190.70±1157.91

The most common shape complexity measures are based on the relative amount of perimeter per unit area, usually indexed in terms of a perimeter to area ratio (McGarigal 2014). In general, higher values mean greater shape complexity. From the PARA results obtained in our study, all three zones' patch shapes are almost similar with less complexity.

While the average inter-patch distance in airport site, 10, and 25 km radius area was about 0.7 km, 4 km, and 6 km, respectively, and most of the patches were located at 0.5–2 km apart in all three zones. Our data indicates the matrix of natural patch habitats and well connected with the shorter distances between patches are adequate to conserve this landscape's biodiversity in the meta-population framework.



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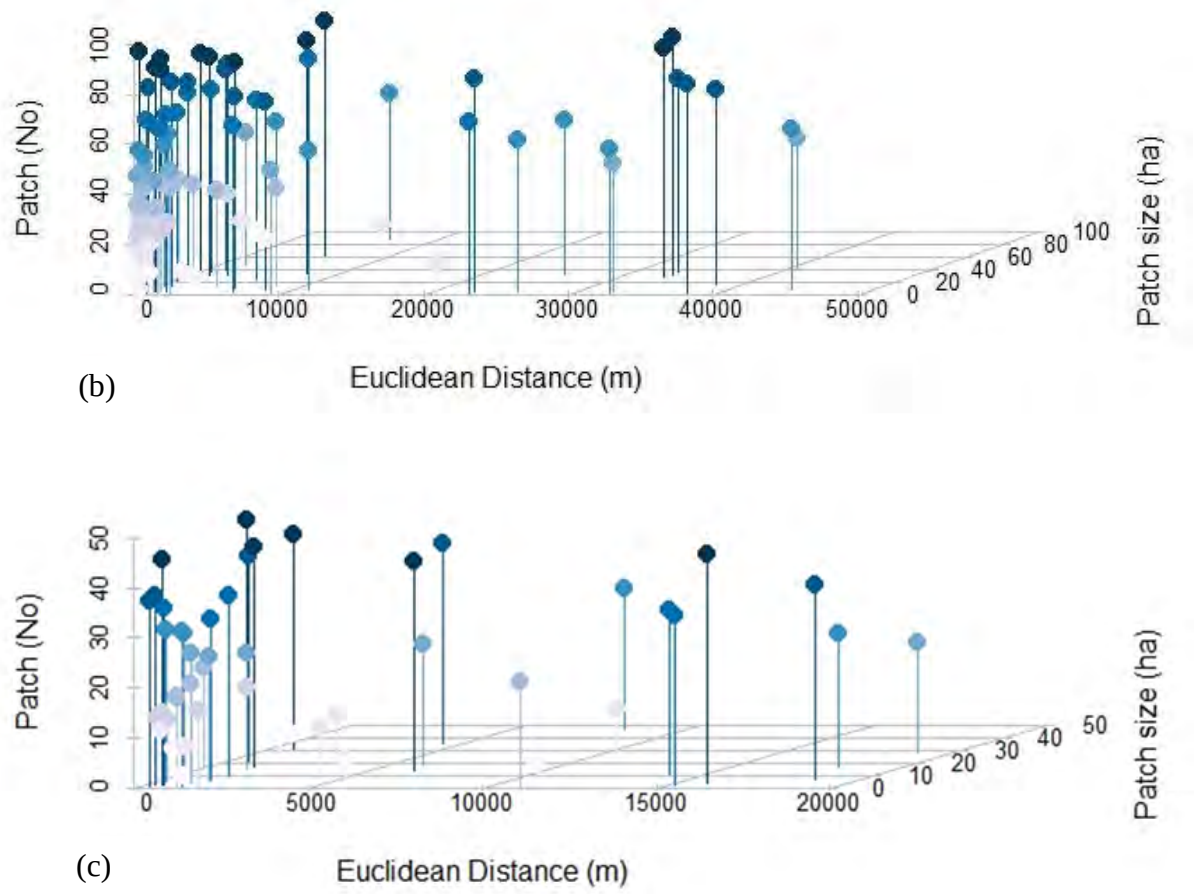


Figure 5.7. 3D-scatterplot showing patches distribution with respect to Euclidean distance and patch size inside the (a) Greenfield Jewar International Airport site (b) 10 km radius zone around the Airport (c) 25 km radius zone around the Airport.

5.4.3. Characteristics of major Blackbuck and wildlife habitats in the GJIA landscape:

During the field survey, Blackbuck and other wildlife were often sighted in some forest and scrubland patches across the GJIA landscape. The study area's elevation ranged from 74 m to 245 m (above mean sea level), whereas the mean elevation is 186±6 m. Our analysis found that Blackbuck in the GJIA landscape was mostly observed in the medium elevation areas, i.e., 175–189 m (Table 5.3). Of the total 1x1 km grids where Blackbucks were sighted, 25% of grids were found to have low intensity built-up (i.e., 1–20% of the whole grid area), 53% of the grids had moderate scrub or forest cover (i.e., 10–50% of the grid area), and 100% of the grids had high agriculture intensity (48–100% of the grid area). Further, only 25% of grids were characterized by the presence of water bodies, whereas 46% of the grids were crisscrossed by road network.

Within the 10 km radius of the GJIA site:

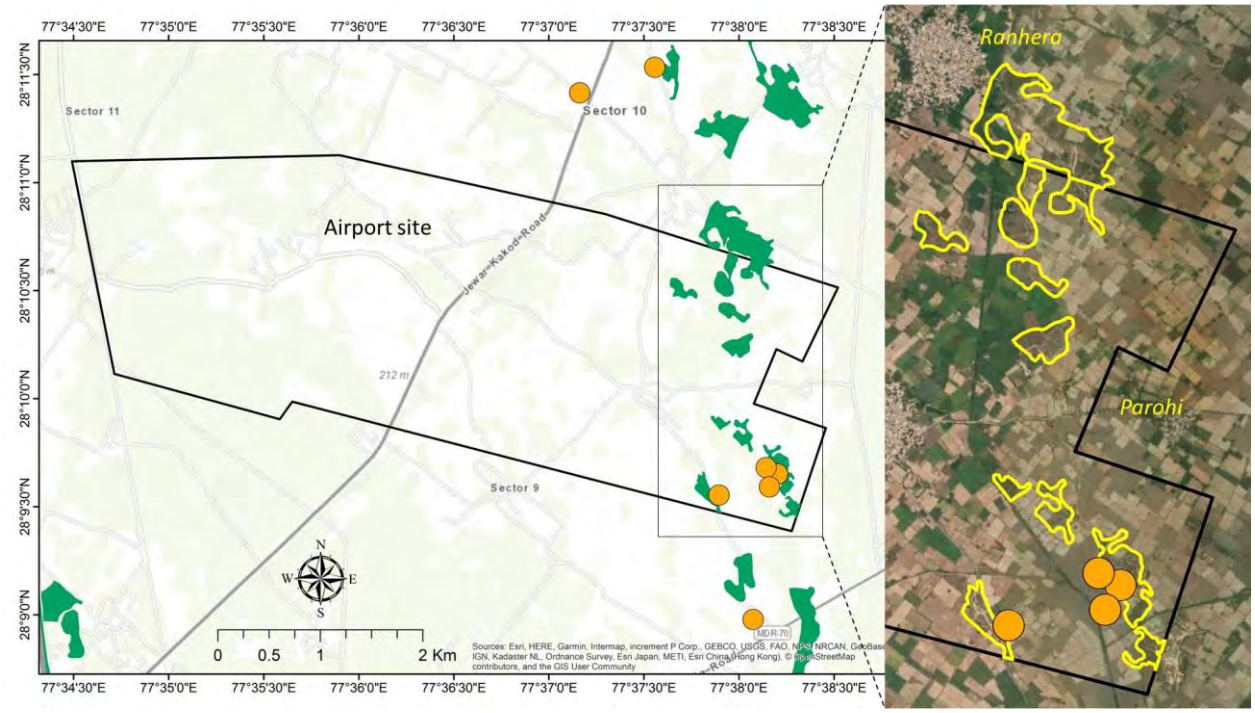
While no forest exists in the airport site, a contiguous scrub patch along the eastern boundary of the GJIA site offers a good foraging ground for Blackbuck and Nilgai. One of the largest Blackbuck group sizes was observed in these scrub patches (Fig. 5.8a). Karauli Khadar (c. 47 ha) is the nearest Protected Forest to the

airport site in the 10 km radius zone. Other such essential patches (non-protected) include Jewar Khadar (c. 35 ha), Bhagwantpur Chhatanga (c. 69.06 ha), and scrublands near Birampur village (c. 71.46 ha) (Fig. 5.8b). The plant species observed in these patches include *Acacia nilotica, Prosopis juliflora, Pithecellobium dulce, Pongamia pinnata, Cassia fistula, Butea monosperma, Azadirachta indica,* and *Albizia lebbeck*. Such forest and scrubland habitats surrounded by agricultural lands provide good temporary refuge to wildlife species, especially Nilgai, Jackal, and Blackbuck. Thus, these are important wildlife habitats in the GJIA landscape, which may be under threat of degradation and reduction in size because of the future's proposed development.

Table 5.3. Observed Land-use Land-cover usage by Blackbuck in the GJIA landscape.

Blackbuck sighting Grids (1 x 1 km)	Elevation (m) (mean)	NDVI (mean)	Built-up (%)	Scrubland (%)	Crop fields (%)	Waterbody (P/A)	Road (P/A)
1	176.61	0.41	10	0	90	0	0
2	176.54	0.49	0	0	100	0	0
3	177.98	0.49	0	0	100	0	0
4	176.17	0.46	20	0	80	0	1
5	177.46	0.36	1	0	99	0	1
6	174.59	0.48	10	30	60	1	0
7	177.97	0.49	5	0	95	1	1
8	176.35	0.43	0	50	50	1	1
9	176.67	0.49	0	0	100	0	1
10	180.64	0.39	0	0	100	1	1
11	178.72	0.36	0	0	100	0	1
12	177.85	0.42	0	0	100	0	0
13	178.17	0.41	5	0	95	0	1
14	177.31	0.44	0	0	100	0	1
15	177.33	0.48	0	10	90	0	1
16	177.75	0.37	0	10	90	1	1
17	176.69	0.52	0	50	50	0	1
18	176.17	0.49	0	25	75	0	0
19	185.53	0.49	0	20	80	0	0
20	183.35	0.58	0	30	70	0	1
21	184.70	0.40	0	30	70	0	0
22	183.12	0.39	0	40	60	0	0
23	182.85	0.49	0	0	100	1	0
24	187.31	0.39	2	0	98	0	1
25	185.17	0.51	2	50	48	1	0
26	182.36	0.43	0	40	60	0	0
27	186.65	0.42	0	15	85	0	1
28	185.49	0.45	0	10	90	0	0
29	179.26	0.54	0	10	90	0	0
30	186.28	0.43	0	30	70	0	0
31	186.88	0.44	0	20	80	0	0
32	189.49	0.51	0	0	100	1	0

P: presence (1), A: absence (0); NDVI: Normalized Difference Vegetation Index



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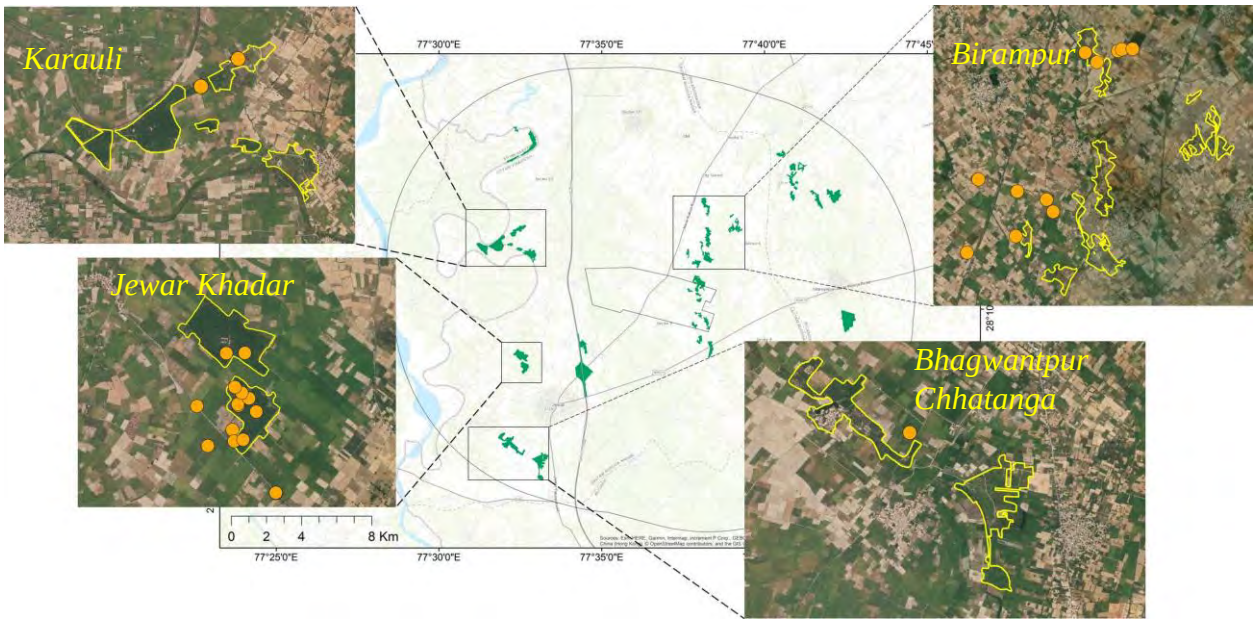


Blackbuck sightings

(b)

Figure 5.8. Important potential wildlife habitats in (a) GJIA site (b) 10 km radius
(zoom images not to scale)

Within the 25 km radius of the GJIA site:

We identified some potential wildlife habitat patches outside the 10 km radius zone. These comprise scrublands, natural woodlands, and a few plantation patches in the 25 km radius zone's northern and eastern side. The patches are arranged in a "stepping-stones" model, which is very important for conserving the species' meta-population framework. These habitat patches would offer Blackbucks and other animals a refuge during dispersal, allowing them to move between agriculture fields and other larger patches of habitat.

In the north of the 25 km radius zone near Murshadpur, a large dense patch of forest covers an area of approximately 180 ha (Fig. 5.9). It also has open canopy areas with few trees and grasses and adjacent scrubland patches. Likewise, the habitat patches near Bichola and Sikri villages are mainly comprised of natural woodlands (219.23 ha), scrublands (405.6 ha), and plantations (138.51 ha). Scattered but substantial scrubland (87.13 ha) and natural forest (125.46) patches are available in the southwest near Uttar Pradesh-Haryana border.

Approximately 92 habitat patches, including 58 scrublands, 25 natural woodlands, and 9 plantations, are available within the 25 km radius area around the airport. These are mostly located within the ranging distance (1 – 5 km apart) of most of the terrestrial wildlife species of this landscape such as Blackbuck, Nilgai, Jungle cat, Jackal, etc. (Fig. 5.10). We analyzed the functional connectivity between patches that are potential habitats for Blackbuck by studying the home ranges and movement patterns (Table 5.4).

Besides, we also examined the available habitat for different Blackbuck populations across its distribution range in India, and Table 5.5 indicates occurrence populations as large as 1400 individuals in a small area of 7 km^2.

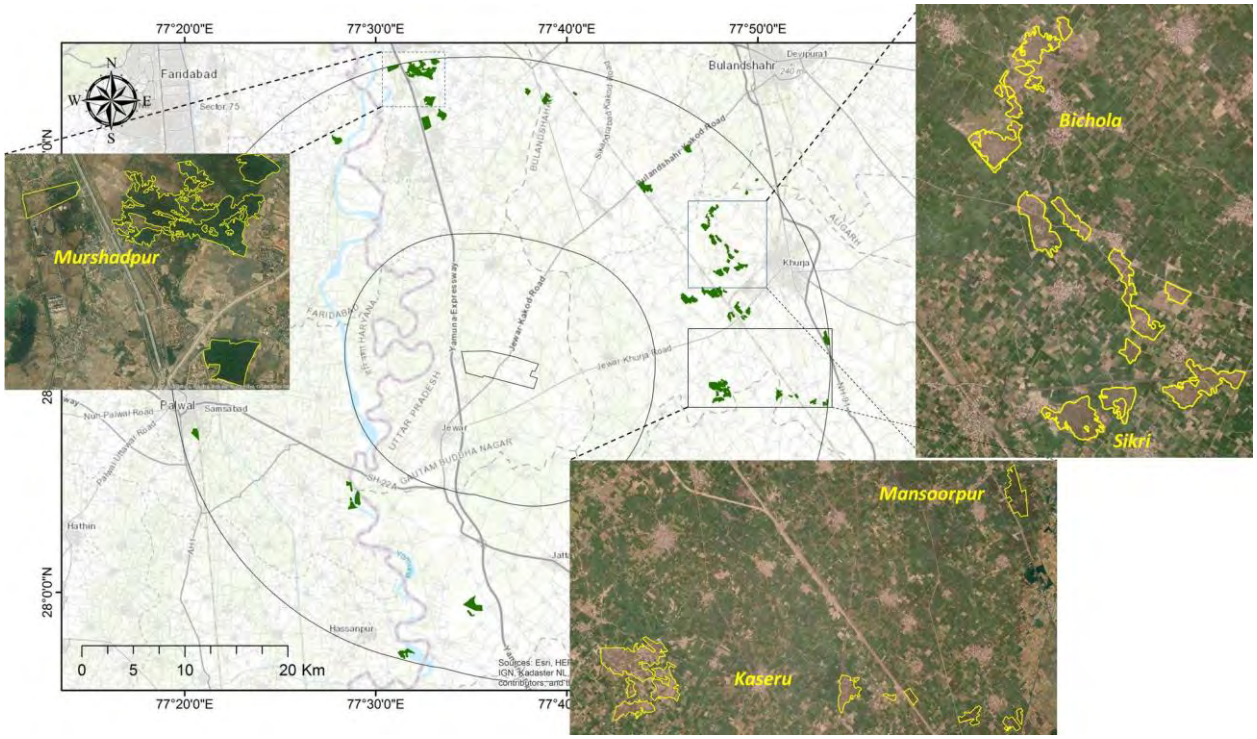


Figure 5.9 Important potential wildlife habitats in 25 km radius zone; (zoomed images not to scale).

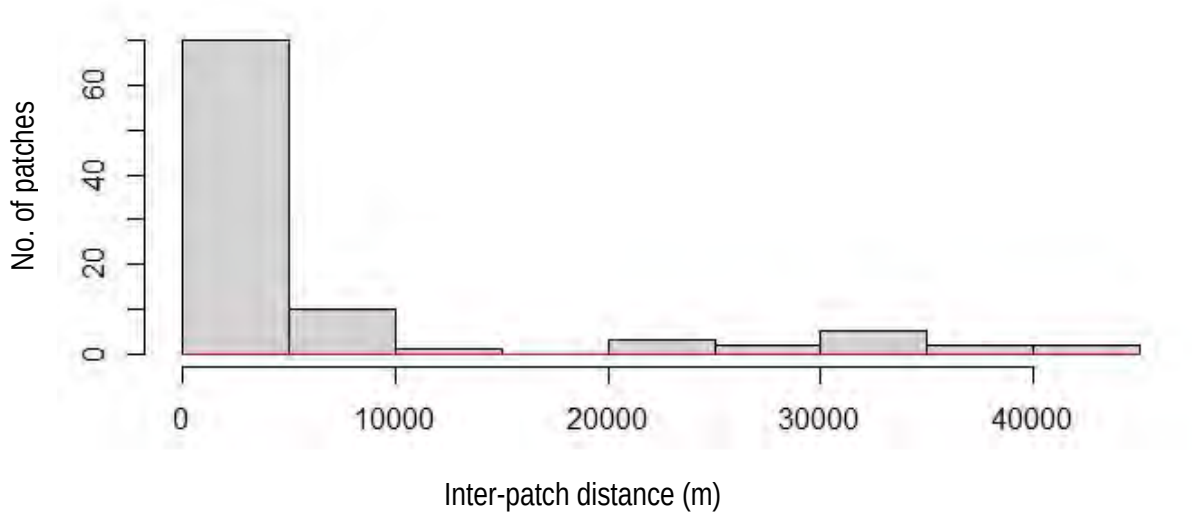


Figure 5.10 Histogram of Inter-patch connectivity between the potential wildlife habitats outside the YEIDA development zone.

Table 5.4. Home range and activity radius (daily diurnal distance moved/day) of Blackbuck inside and outside Protected Areas across its distribution range.

Protection Status, Land use	Sample Size	Home Range (km^2)	Activity Radius (km)*	Reference
		Mean (Min. – Max.)		
Protected Area, Grassland	–	–	1.5–5.7[a]	Jhala & Isvaran 2016
Not Protected, Cultivated field	9	4.5 (3.15–5.4)	1.19 (1.00–1.31)	Mahato et al 2010
Not Protected, Cultivated field	4	5.13 (4.5–5.8)	1.27 (1.19–1.35)	Gautam 1991
Not Protected, Cultivated field	11	7.66 (3.25–13.5)	1.56 (0.84–1.95)[b]	Prasad 1983
Protected Area, Grassland	–	5.18[c]	1.28	Schaller 1967

*- Home range assumed to be circular in area to calculate activity radius.
a- Daily distances recorded by following six herds (30–128 individuals) from dawn to darkness.
b- Actual activity radii provided in the study.
c- Estimate based on a herd of 21 individuals.

Table 5.5. Reported Blackbuck populations from select Protected Areas of India. Estimates are provided envisaging minimum area observed to sustain maximum supported population.

Protected Area (PA)	State	Area (km^2)	Estimated Population	Reference
Guindy	TN	2.7	260	Selvakumar 1979
Mahavir Hiran vanasthali	AP	3.4	100	Rahmani 1991
Rollapadu	AP	6.14	300	Manakadan & Rahmani 1998
Talchhapar	RJ	7	1400	Rahmani 1991
Point Calimere	TN	26.5	590–954	Arandhara et al 2020
Velavadar	GJ	34	2200	Jhala & Isvaran 2016
Sikandra	UP	0.5	32	Rahmani 1991

AP=Andhra Pradesh; RJ=Rajasthan; TN=Tamil Nadu; GJ=Gujarat; UP=Uttar Pradesh

Thus, our data analysis reveals that the matrix of scrubland and forest patches are of the adequate area and present within the ranging behvaiour of Blackbuck population that is appropriate to sustain the existing population within the GJIA landscape. These habitats are suitable for providing foraging area, shelter grounds, and dispersing from one habitat to another to several species of this landscape. Hence, these remaining mosaics of scrubland/forest patches interspersed within the agriculture field are essential for conserving wildlife species in the meta-population framework in the GJIA landscape.

5.4.4. Genetic perspective of the Blackbuck conservation:

Globally, biodiversity conservation strategies are most commonly planned based on geographic units, ecosystems, communities, or species of interest, while genetic diversity is often not prioritized (Coates et al., 2018; Laikre et al., 2010). Genetic variability potentially affects conservation goals. Therefore, genetic diversity is one of the significant factors in maintaining species diversity while having a crucial role in evolutionary processes, adaptation to changing climate, habitat, and emergent diseases (Hoban et al., 2020).

Rapid habitat alteration, shrinkage, and dependence of pastoralist and agro-pastoralist communities on semi-arid grasslands and scrubs are steep challenges in the conservation of critically endangered species, e.g., Great Indian Bustard and Lesser Florican, in addition to the mammals such as the Blackbuck, chinkara, Indian wolf and Indian fox (Vanak et al., 2009). Among all these species, the Blackbuck was once the most abundant wild animal across the Indian subcontinent (Rahmani, 1991) and is now only in fragmented populations across its range due to loss of habitat, change in lands use pattern and poaching. Rahmani (1991) estimated that the Indian province of Uttar Pradesh (U.P.) held only c. 350 blackbuck individuals in small isolated pockets across a vast landscape of ≈3500 km^2.

The viability of such small isolated populations is under constant threat from stochastic destabilizing effects such as inbreeding, demographic changes, and susceptibility to diseases (Lacy, 2000). Moreover, the management of smaller populations with low effective population size (Ne) is necessary to avoid the extinction vortex for the species. In this case, the consensus is maintaining 50 breeding individuals for short-term conservation goals, whereas 500 individuals are required for

the long-term survival of a species (Shaffer, 1981). However, this approach's limitations have recently been discussed (Frankham et al., 2014). The other way to rescue a declining population is to establish connectivity with other populations by establishing a meta-population structure. Maintaining meta-population structures by ensuring genetic connectivity aids the survival of patchily distributed small populations (Akçakaya et al., 2007). In drastic situations, measures such as 'genetic rescue,' introduction of alleles in the population through managed immigration to increase the fitness of the population, has been shown to have a positive impact (Whiteley et al., 2015).

Like most Blackbuck populations in U.P., the GJIA landscape also harbors Blackbucks in scrubland patches and adjacent agricultural fields. To date, no studies on genetic characteristics or connectivity have been carried out on this population. Therefore, we aimed to assess the population's genetic variability to aid the formation of long-term management strategies and conservation plans.

Methods:

We collected blackbuck pellet samples (n=10), visually identified by the distinct grouping and morphology, in and around the GJIA site to use as the source of DNA. We scraped the outside layer, containing sloughed off intestinal epithelial cells, 3-4 pellets from each group, into 2.0 ml polypropylene tubes. After incubation at 56°C in a water bath overnight with stool lysis radius, a silica membrane column-based DNA isolation and purification was performed using QIAGEN Stool DNA Mini Kit. Isolated genomic DNA from the samples was eluted in 1.5 ml sterile tubes and stored at -20°C until amplification.

We amplified three such multiplex panels with Blackbuck fecal DNA (n=10) using standardized PCR protocols (Khan et al., 2019). We used Qiagen Multiplex PCR Kit (2X), 10µg BSA, 1 µL of combined primers constituting respective multiplex panels (Table 5.6), 2µl of DNA extract having variable DNA quantity, and sterile water to make the volume up to 10µl. The thermal profile included an initial denaturation at 95°C for 15 minutes followed by 40 cycles of denaturation at 95°C for the 30s, annealing at panel specific temperature (Table 5.6) for 60s, and extension at 72°C for 40s before a final extension at 60°C for 30m and finally, hold at 4°C. Resultant products (1 µL each) were dissolved in 8.83 µL Hi-Di Formamide (Invitrogen) and 0.07 µL of GS (-500) LIZ size standard (Invitrogen) before capillary injection in an ABI 3530 XL Genetic Analyser for fragment analysis.

The fragment analysis data were analyzed and allele calling was performed using GENEMAPPER 5.0, followed by manual binning of the dataset. We used the R package PopGenReport (Adamack and Gruber, 2014) and MS-Excel add-in GenAlEx (Peakall and Smouse, 2012) to compute the genetic variability statistics for the blackbuck population in the vicinity of the GJIA site.

We computed the genetic distance (GD) matrix between the individuals using GenAlEx (Peakall and Smouse, 2012) and, after that, used POPULATIONS v1.2.32 (Langella, 2002) to construct a neighbor-joining dendrogram. We used FIGTREE v1.4.2 (Rambaut, 2014) to visualize and annotate the dendrogram. Factorial Correspondence Analysis (FCA) was performed using GENETIX 4.05.2 (Belkhir et al., 2004).

Findings:

The mean rate of amplification success across all 12 markers was 70%, while success in two markers (Marker 11 and Marker 12) was less than 10% (Table 5.6). Marker 1 was found to be monomorphic in the study population. Therefore, we decided to proceed with further analyses dropping these three markers. The working dataset contained 9-marker data across ten samples with only a 15.6% gap in the dataset.

The number of alleles across the loci (n=9) varied between three and 10, while the mean number of alleles (MNA) for the population was 5.56±0.07 (Fig. 5.11). Observed (Ho) and expected heterozygosity (He) for the population

were 0.39±0.08 and 0.67±0.05, respectively (Table 5.7). Inbreeding coefficient (FIS) for the GJIA Blackbuck population was calculated as 0.42±0.12 (Table 5.7), indicating heterozygote deficiency. Genetic diversity for the GJIA landscape population was low and similar to our findings across other Blackbuck populations in northern India in Uttar Pradesh, Madhya Pradesh, and Bihar (Khan et al., 2019). Identical to the Jewar population, FIS in north India's other Blackbuck populations was moderately high and positive (between 0.31 and 0.49) (Khan et al., 2019).

Table 5.6. Details of the multiplexed markers (n=12) amplified in blackbuck faecal DNA (n=10).

Sl. No.	Marker	Dye	Success rate (%)	Multiplex	Annealing temperature
1	Marker 1	PET	70	1	57°C
2	Marker 2	6-FAM	100		
3	Marker 3	VIC	80		
4	Marker 4	NED	100		
5	Marker 5	FAM	100	2	51°C
6	Marker 6	M13-NED	90		
7	Marker 7	M13-VIC	90		
8	Marker 8	FAM	100		
9	Marker 9	VIC	50	3	55°C
10	Marker 10	FAM	50		
11	Marker 11	FAM	10		
12	Marker 12	M13-VIC	0		

Table 5.7. Genetic diversity parameters in the blackbuck individuals (n=10) sampled from the surroundings of the GJIA site.

Loci	AR	Ho	He	F_{IS}	P_{ID}	P_{IDsib}
Marker 2	3.83	0.30	0.70	0.57	0.15	0.44
Marker 3	3.33	0.38	0.65	0.42	0.19	0.47
Marker 4	2.58	0.10	0.35	0.71	0.45	0.69
Marker 5	5.16	0.20	0.80	0.75	0.07	0.37
Marker 6	3.97	0.67	0.71	0.06	0.13	0.43
Marker 7	6.14	0.56	0.83	0.33	0.04	0.34
Marker 8	5.61	0.30	0.84	0.64	0.05	0.34
Marker 9	2.95	0.20	0.62	0.68	0.22	0.49
Marker 10	3.48	0.80	0.58	-0.38	0.22	0.52
Overall	4.12±0.41	0.39±0.08	0.67±0.05	0.42±0.12	1.08×10^{-08}	6.84×10^{-04}

AR: Allelic richness, Ho: Observed heterozygosity, He: Expected heterozygosity, F_{IS}: inbreeding coefficient (fixation index), P_{ID}: Probability of identity, P_{IDsib}: sibling probability of identity.

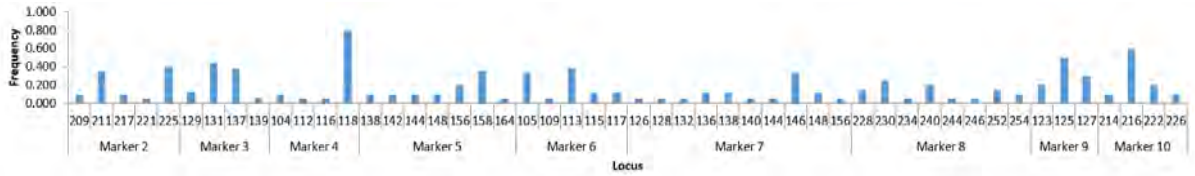


Figure 5.11. Loci-wise allele frequencies in the blackbuck individuals (n=10) sampled from the surroundings of GJIA site.

All ten fecal samples corresponded to different individuals based on nine microsatellite markers. The probability of misidentifying two unrelated individuals as one single individual (P_{ID}) was calculated as 1.08×10^{-08}. In contrast, siblings' misidentification probability as one individual (P_{IDsib}) was 6.84×10^{-04} (Table 5.7, Fig. 5.12), lending sufficient support for correct identification of individuals. In the case of the Jewar population as well as other populations in northern India (Khan et al., 2019), ≥seven microsatellite markers were required to identify individuals with enough resolution.

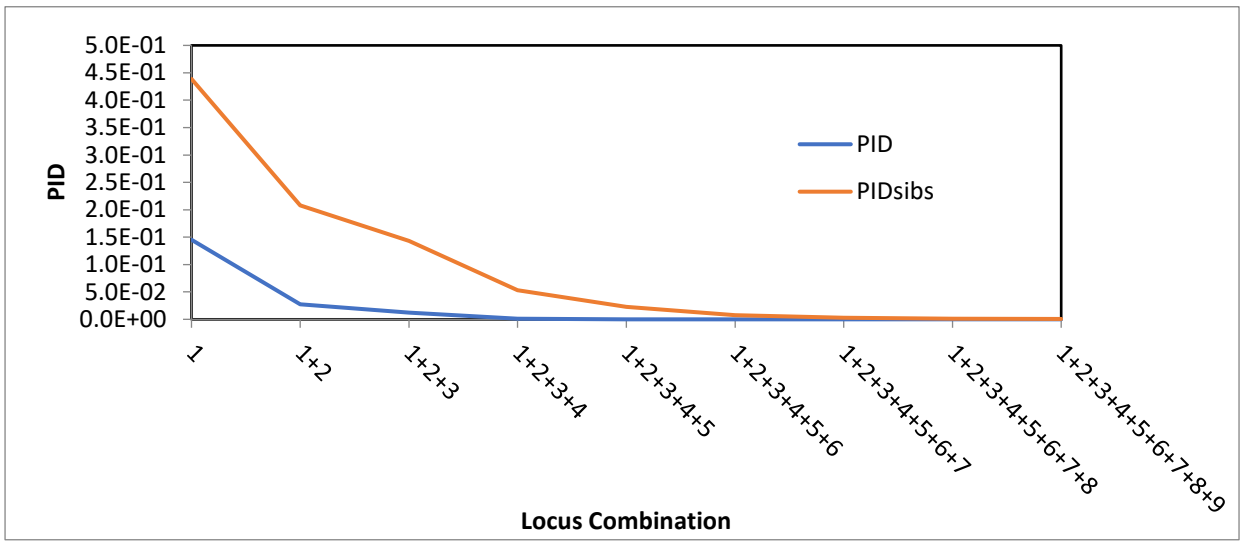


Figure 5.12. Probability of identities with an increasing number of loci for the blackbuck individuals (n=10) sampled from the surroundings of GJIA site.

The neighbor-joining dendrogram constructed from the genetic distance (GD) indicated the presence of three major clusters – two clusters with four individuals each and one cluster with two individuals (Fig. 5.13). Both clusters with four individuals were further subdivided into two sub-clusters each. The uniform distribution of the branching in the dendrogram constructed from pairwise GD indicates a stable, effective population size in the long-term for the Jewar Blackbuck population, as suggested by Spong et al. (2000). However, a larger sample size would be better to elucidate the assumption.

Three dimensional FCA indicated close grouping of three individuals (518, 520, 521) (Fig. 5.14), also grouped in a single cluster based on GD (Fig. 5.13). In contrast, the rest of the individuals did not show any grouping patterns. A similar grouping pattern was observed in other north-Indian blackbuck population using FCA, which did not identify population-based clusters (Khan et al., 2019).

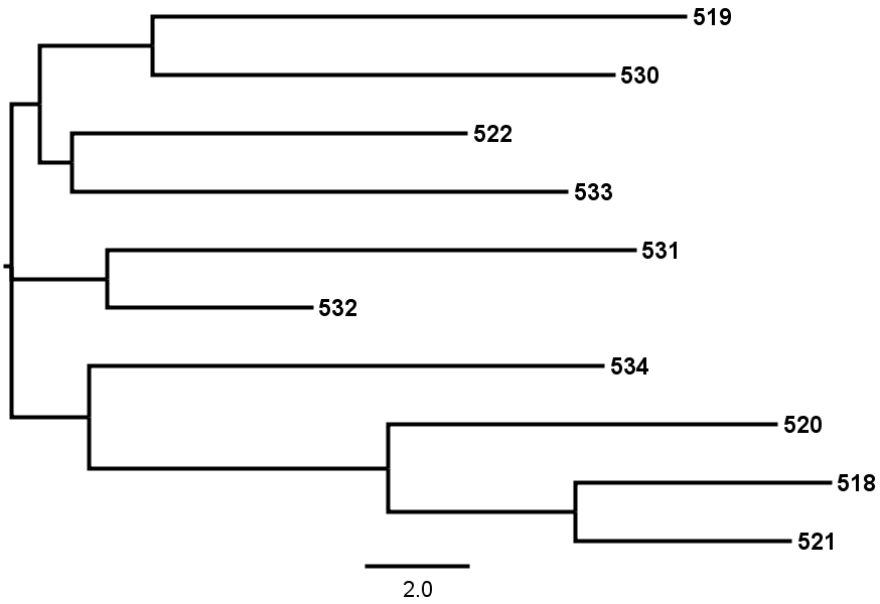


Figure 5.13. Dendrogram of genetic distance (GD) of the blackbuck individuals (n=10) sampled from the GJIA site's surroundings.

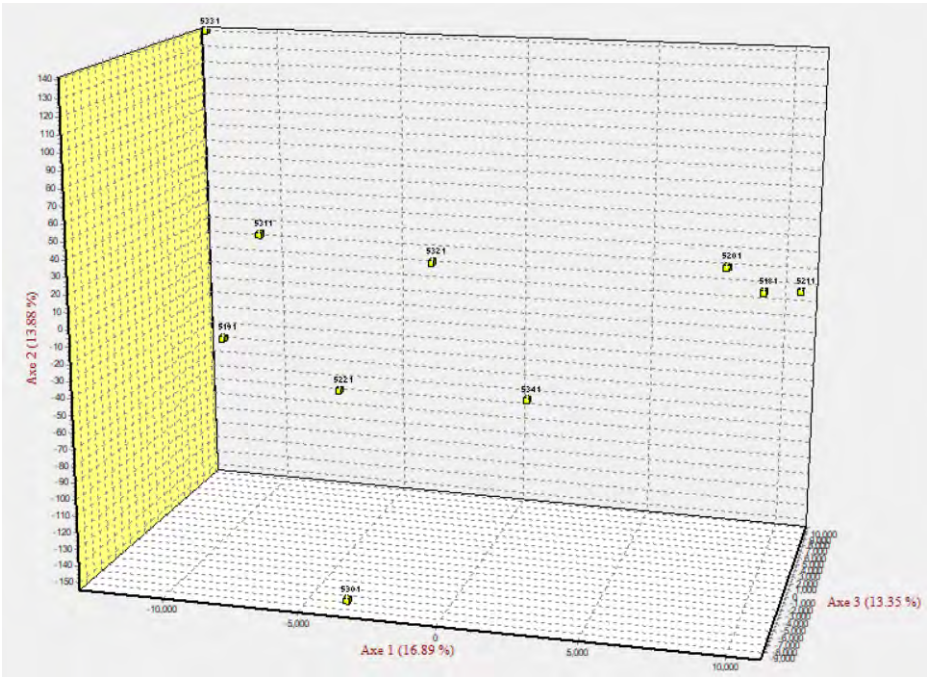


Figure 5.14. Factorial correspondence analysis (FCA) of the blackbuck individuals (n=10) sampled from the GJIA site's surroundings.

A recent study (Shukla et al., 2019) explored the Blackbuck's phylogeography across India using three mtDNA genes and found no evidence of strong population structuring as the clades contained samples of different geographic origins indicative of high historical maternal geneflow across India. A 370 bp fragment of cytochrome b gene produced identical sequences with a single haplotype across Uttar Pradesh, Madhya Pradesh, and Bihar (Khan et al., 2019), which also grouped with sequences from Shukla et al. (2019) originating from Pakistan, Madhya Pradesh, Rajasthan, Gujarat and Maharashtra within a single clade.

Fine-scale genetic data from small isolated populations in human-dominated landscapes of eastern Uttar Pradesh showed signatures of incipient population structuring at <50 km areal distance despite similar ancestry (Khan et al., 2019). Within the GJIA landscape, the blackbuck population has similar genetic diversity surviving in patchy habitats modified heavily by human use. Therefore, it is crucial to ensure genetic exchange with populations in the vicinity through sound management strategies. Besides, we recommend periodic assessment of the GJIA Blackbuck population's genetic diversity, including the surrounding areas facilitating early detection of population structuring and appropriate management intervention. In the future, adaptive management strategies such as translocation of animals and genetic rescue could be considered if a severe loss of gene flow or inbreeding is detected.

5.4.5 Threats to Blackbuck and other wildlife in the GJIA landscape:

Habitat loss, mainly due to unprecedented anthropogenic activities and land-use change, is a significant pervasive threat to large herbivore populations worldwide. Nearly 60% of all extant large herbivore species are today threatened with extinction (Ripple et al. 2015). By modifying habitats, humans influence habitat characteristics and thus may modify wild herbivores' perception of risk. There is increasing evidence that wild animals perceive non-lethal human activities as risks (Frid and Dill 2002). Increased contact between wild herbivores and humans also occurs when animals occasionally feed on crops, resulting in human-wildlife conflict (Rahmani 1991; Bajwa and Chauhan 2019).

Similarly, the landscape is transforming due to rapid urbanization, industrialization, and other infrastructural development activities. All these activities directly threaten wildlife, leading to habitat fragmentation, degradation, and ultimately habitat loss for the wildlife. Competition with other sympatric large mammals like Nilgai, domestic livestock, and feral cattle are also anticipated in the landscape. All these graze in the landscape and are more in abundance than the Blackbuck.

Given the proposed development for the international airport and other associated expansion of the region, we anticipate that all these developments may have several impacts on the overall conservation of biodiversity in this landscape. However, the primary conservation concerns remained due to change in land-use patterns, increased road density with fast traffic, and stray dogs. Changes in land-use patterns would be led to encroachment and deterioration of habitat quality of the existing scrubland/forest patches. Such changes may reduce or cause local extinction of several species and may impede dispersal of species from one area to another, impacting the overall conservation goal. Increased linear infrastructure in this landscape will lead to habitat fragmentation and road accidents, leading to Blackbuck and other species' deaths by speeding vehicles (Kumar et al. 2018). Stray dogs have been significant issues in conserving biodiversity (Gompper, 2013). Studies have pointed out that stray village dogs persecuting Blackbuck. Kumar et al. (2018) reported that ~91% of the total blackbuck deaths (N=627) had been attributed

to stray dogs and fencing (chain link and concertina wire) across nine districts of Haryana (Kumar et al. 2018). We have also noted similar instances of stray dogs chasing Blackbuck in the agriculture fields in the GJIA landscape. At present, there is no natural predator except for jackals, which may be considered as a direct threat to the Blackbuck as jackals are reported to predate on young calves of the Blackbuck (Jhala & Isvaran 2016).

However, with the increased subsidized food due to garbage disposal mismanagement, the population of mesopredators such as Jackal and domestic dogs may increase, leading to the increased conservation threats in this landscape.

Blackbuck and Nilgai sharing the landscape

Feral cattle raiding a crop field and a tribe herder bringing his cattle from drought hit nearby area of Rajasthan for grazing in the GJIA landscape

Blackbuck crossing a connecting road and a stray dog resting after chasing a blackbuck in the landscape

5.5. Conservation stargey and recommendations for Blackbuck in the GJIA landscape:

Understanding the effects of landscape characteristics on species distribution and their abundances provides the potential for conserving the species and maintaining the ecological integrity of their habitats. GJIA landscape still has good remnant natural patches of wildlife habitats within the species' ranging patterns and possible to conserve in the meta-population framework. We also suggest further studies for understanding the fine-scale species-habitat relationships for effective conservation strategies.

We suggest the following measures for the conservation of Blackbuck in the GJIA landscape:

1. The proposed GJIA site has a small Blackbuck population of around 29 individuals in the agriculture fields south of Rohi–Parohi villages (Fig. 5.6A). These animals have a high probability of moving nearby scrubland patches which are within ranging behvaiour of the species during the construction phase.

2. The agroecosystem of the GJIA landscape has a mosaic of scrubland/forest patches, the most suitable refuge areas for the Blackbuck and are within the ranging patterns of all the subpopulation (Fig. 5.7). Hence, these patches surroundings the Blackbuck subpopulations should be managed concerning the species' habitat requirements, i.e., grasslands interspersed with palatable native browse species such as *Prosopis cineraia*. Maintaining and managing landscape heterogeneity of these scrubland patches within the crop fields' mosaic would retain the connectivity among subpopulations in the GJIA landscape. The nearby perennial waterbodies should also be protected and conserved.

3. Emphasis should be on the conservation and restoration of wildlife habitats within the GJIA landscape (Fig. 5.15). Avoid plantation of exotic/invasive species in these wildlife habitats.

4. The genetic assessment indicated moderate genetic diversity as compared with other wildlife species with relatively low heterozygosity. Therefore, we suggest primary emphasis is to protect available habitats from further fragmentation, encroachment, and maintain habitat connectivity in the GJIA landscape. This would ensure the management of the Blackbuck population in the meta-population framework.

5. We recommend periodic assessment of the GJIA blackbuck population's genetic diversity, including the surrounding areas facilitating early detection of population structuring and appropriate management intervention. Adaptive management strategies such as translocation of animals and genetic rescue could be considered if a severe loss of gene flow or inbreeding is detected.

6. Undertake appropriate management intervention if any proliferation of weeds or habitat encroachment by *Prosopis juliflora* is noted.

7. Organize education and awareness on local culture, belief, ethics, and wildlife values to the new generation at school level for improving the relationship between Blackbuck and people. Blackbuck could use sustenance of beliefs and cultural mechanisms as of the Bishnoi community, to increase local people's tolerance of crop damage.

8. An alternative approach for community conservancies to generate benefits from wildlife living on their croplands (adjoining natural scrublands/forests) is to set up wildlife tourism. This approach shall generally be applicable in areas where communities especially want to set up a wildlife tourism program where excluding

wildlife from their lands is not possible. Therefore, encourage community-based ecotourism.

9. Improved awareness among local communities on National policies and laws regarding community development and sustainable utilization of natural resources.

10. Organize regular programs for co-management of Blackbuck conservation involving all landowners, forest department personnel, and NGOs.

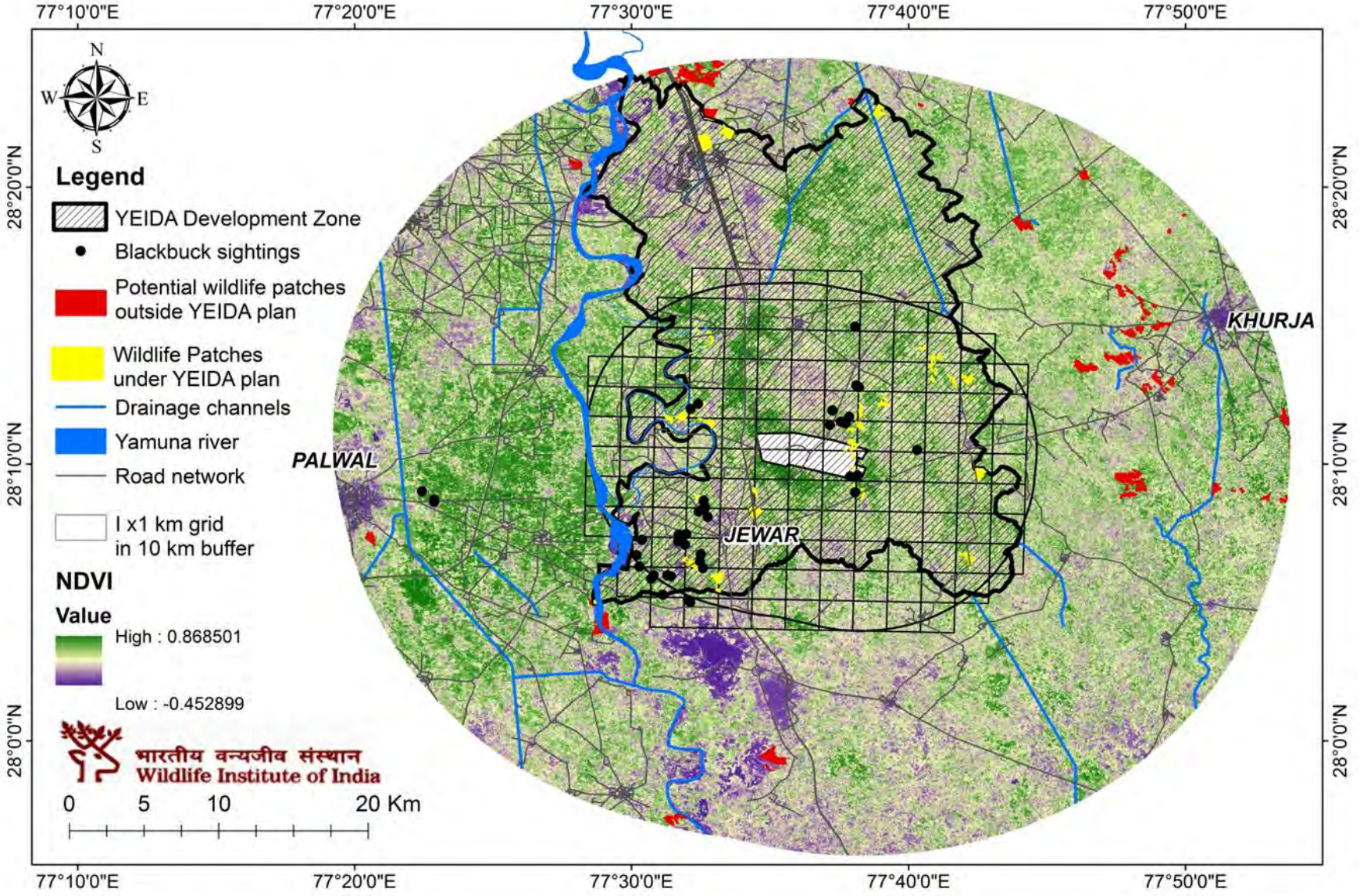
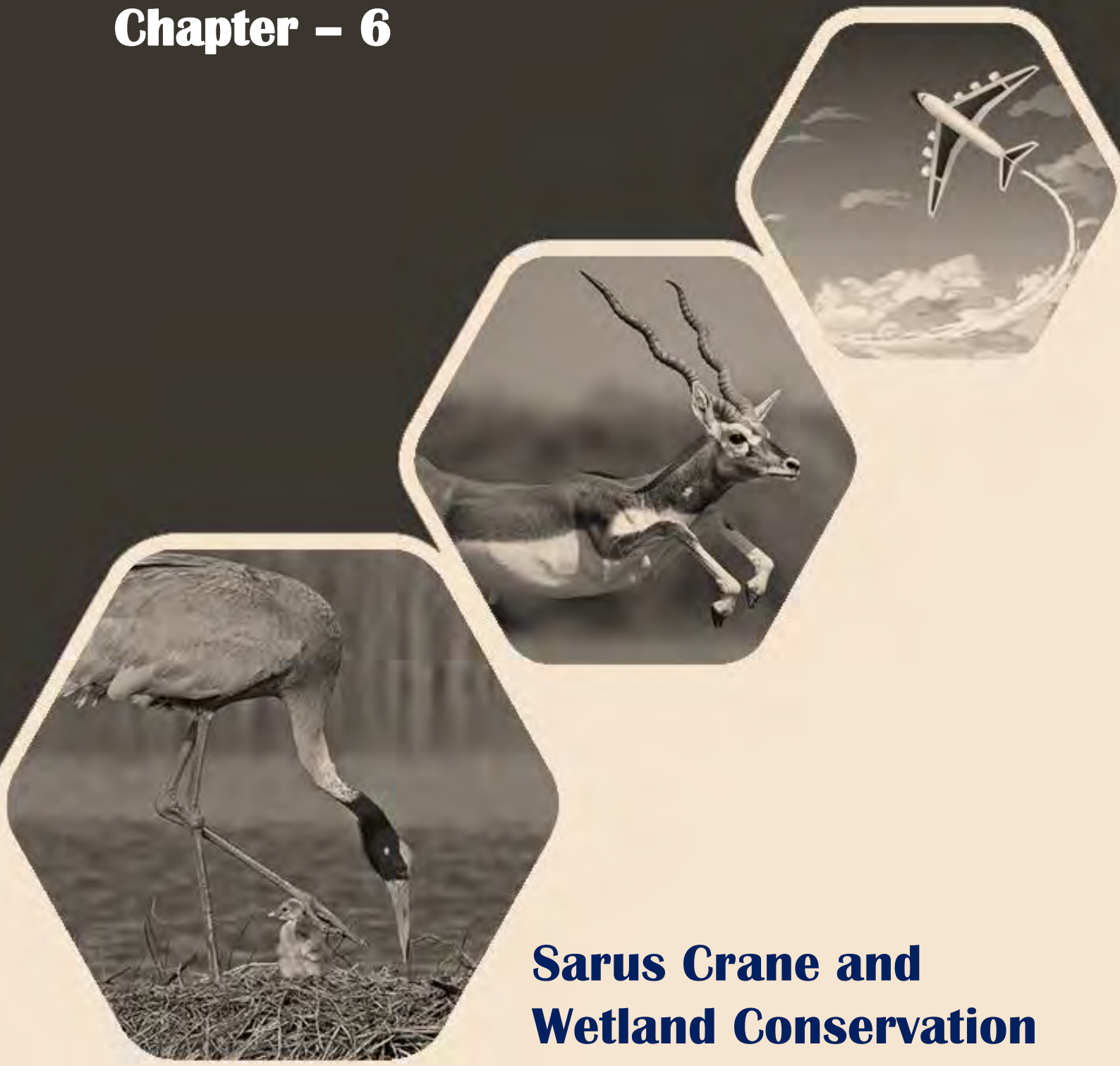


Figure 5.15. Map of potential habitats identified for future conservation in the 25 km radius zone outside the GJIA development zone.

Chapter – 6



Sarus Crane and Wetland Conservation Strategies in and around the Proposed GJIA Site

6.1. Introduction:

The Indian Sarus Crane (*Grus antigone*; hereafter Sarus) is the only resident breeding crane species in India. It is the tallest flying bird in the world and the largest bird in India. It is non-migratory but does show regional movement in response to monsoons and droughts. Sarus is one of the most sedentary species of the crane family. It has been estimated that Sarus has a worldwide population of c. 8,000–10,000 (Meine & Archibald, 1996), more than 90% of which inhabit in India. The Sarus is mainly found in northern, north-western, and central India. It is most common and abundant in the states of Uttar Pradesh, Rajasthan, and Gujarat. Uttar Pradesh alone harbors an estimated 6,000 Sarus and is considered as the Sarus capital of India (Sundar 2008; Rahmani et al. 2019). About 73% of the Sarus population in Uttar Pradesh occurs in only four districts, namely, Mainpuri, Etawah, Etah, and Aligarh (Choudhury et al. 2016). According to recent estimates, Sarus abundance has had a declining trend in abundance over the last two decades (SoIB 2020) (Fig. 6.1).

Sarus' natural habitat includes shallow wetlands such as open marshes and jheels with submerged and emergent vegetation (Rahmani et al. 2019). These wetlands are formed by flooding or accumulation of monsoon waters in shallow depressions. Sarus does not prefer deep and broad wetlands and avoids community-owned/village ponds because of the high level of human disturbance (Rahmani et al. 2019). Owing to large-scale rapid habitat loss and degradation due to agricultural practices, Sarus has been forced to adapt to crop fields as sub-optimal habitat (Sundar 2009). The flooded fields and rice paddies provide surrogate conditions similar to specific natural habitats preferred by Sarus (Rahmani et al. 2019). It is known as an omnivore and feeds in shallow wetlands, inundated crop fields, fallow fields, and river margins. Its diet consists of tubers, roots of several aquatic and semi-aquatic plants, small fish, tadpoles, and aquatic insects. It also frequents harvested paddy/wheat fields to forage fallen grains (Rahmani et al. 2019).

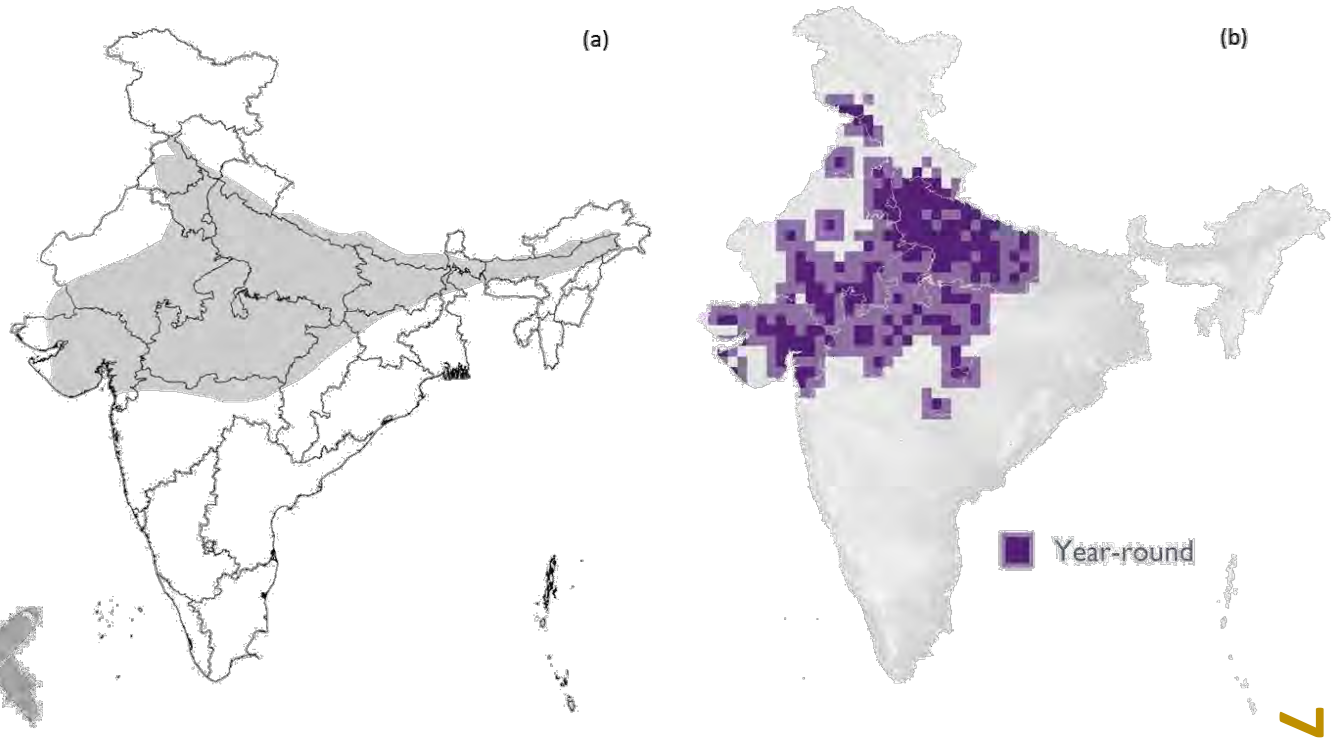


Figure 6.1. Distribution of Sarus Crane in India (Source: (a) IUCN 2017; (b) SoIB 2020)).

The occurrence and breeding success of Sarus is closely related to the availability of water. They breed throughout the year with a peak between July-September, which coincides with Indian monsoons. Sarus requires standing water for nesting. It usually lays two eggs. The incubation period of Sarus is around 30 days. It takes Sarus chicks around 85-100 days to fledge. Thus, Sarus requires water in wetlands or inundated paddy fields for 3-4 months for nesting, laying eggs and incubation, and raising chicks before they can fly (Meine & Archibald, 1996). Rice paddies provide excellent alternative habitat for Sarus for breeding, as paddy cultivation in north India coincides with the Sarus breeding period and requires standing water. Adult pairs use cultivated fields, fallow land as well as flooded areas, and rice paddies. Although Sarus forages in crop fields during the daytime, it requires wetlands in close vicinity for roosting at night (Rahmani et al. 2019).

The majority of Sarus habitat is scattered between privately owned agricultural fields, community or government-owned wetlands, and only a minimal habitat falls in protected area (PA) network. However, the most significant concern for Sarus habitat management is on the privately-owned property where the bird is exposed to several risks. In the Indian scenario, the critical threats to the conservation of Sarus crane are a decrease in wetlands due to expansion of agriculture, use of pesticide, industrial extension, change in land use and land cover, mortality due to power lines, predation by free-ranging dogs and pollution (Meine & Archibald, 1996, Rahmani et al. 2019).

6.2. Importance of wetlands in conservation:

Wetlands are invaluable natural assets that play a crucial role in ensuring food and water security and provide a range of ecological services (tenBrink et al. 2012). More precisely, they help support climate change mitigation and adaptation, support health, and livelihoods (tenBrink et al. 2012), and ensure biodiversity preservation (Leibowitz 2003; tenBrink et al. 2012). Despite their economic, social, and environmental values, wetlands have been and continue to be lost or degraded and ignored in the policy process (Bassi et al. 2014). Substantial numbers of freshwater wetlands have been lost due to the effects of intensive agricultural production, irrigation, water extraction for domestic and industrial use, urbanization, infrastructure, and industrial development and pollution throughout the world (Millennium Ecosystem Assessment 2005; tenBrink et al. 2012). It has been widely reported that at least 50% of the world's wetlands have been lost since 1900 (Davidson 2014).

Wetlands account for nearly 4.7% of the total geographic area of the country. According to the National Wetland Atlas, Government of India, 7,45,370 freshwater wetlands in India were mapped by Space Application Centre, Ahmedabad (Anonymous 2011). Out of which, 6,30,869 wetlands are less than 5 ha (84.64%), 44,007 wetlands are between 5 to 10 ha (5.90%), and 53,710 wetlands are 10-50 ha (7.21%). Hence, almost 98% of the wetlands are less than 50 ha. Such wetlands in the north and central India are essential habitats for Sarus conservation (Rahmani et al. 2019). It is further estimated that nearly one-third of Indian wetlands have been lost and converted for alternate uses since the last three decades (tenBrink et al. 2012).

The freshwater wetlands are often subjected to changes in land use in their catchments, leading to a reduction in inflows and deteriorating water quality as the runoff traverse through agricultural fields and urban areas; many of them act as the "sink" for untreated effluents from urban centers and industries (Bassi et al. 2014). Encroachment of reservoir areas for development activities is another major problem in urban and peri-urban areas (Verma 2001). This has triggered biodiversity loss, changes to ecological functions, and changes to ecosystem service flows with subsequent impacts on the health,

livelihoods, and wellbeing of communities and economic activity (Ministry of Urban Development (MoUD) 2013; Wetlands International 2013). Notwithstanding several policies and Acts for protection and restoration of urban lakes and wetlands, urban water bodies are in an inferior condition. A Centre for Science and Environment (CSE) Report (Kang 2012) reviewed and highlighted the examples of the declining status of urban lakes and wetlands in India. For instance, at the beginning of the 1960s, Bangalore had 262 lakes, now only ten hold water. Another example cited in the study is of Ahmadabad city, where 137 lakes were listed in 2001, and over 65 were reported being already built over (Excreta Matters 2012). To check the changes in water bodies in the last ten years, the status of 44 lakes was ascertained in Delhi in 2010-11, and it was found that 21 out of 44 lakes were dried due to rapid urbanization and falling water tables (Singh & Bhatnagar 2012). One more example is exhibiting this increasing loss of urban water bodies in Hyderabad, where it has lost 3245 ha in the form of lakes and ponds within the last 12 years (Times of India 2012).

According to a recent report by the Ministry of Housing and Urban Affairs, Government of India (2019), Gautam Budh Nagar in Uttar Pradesh is among the 255 water-stressed districts in India (Dixit 2019). The city-based environmentalists assert that at least 60% of the ponds listed in the revenue department's records have either been illegally encroached upon or used as dump yards (Dixit 2019). To ensure that ponds and other water bodies are not destroyed in the future, the Gautam Budh Nagar district administration planned to profile 1,000 ponds across the district for rejuvenation. These ponds make up a total area of 4.5 km^2. Of these, 474 ponds are in Dadri, and at least 150 of them have been encroached and converted into illegal residential colonies. Of the remaining ponds in other regions, i.e., 281 in Jewar and 245 in Sadar, some have been leveled, some have been used for road or railway construction. Simultaneously, some are disputed or encroached upon for building religious places or are being used to dump garbage (Dixit 2019).

Sarus is the state bird of Uttar Pradesh and important conservation species of the GJIA landscape. Realizing wetlands constitutes a significant component of the Sarus habitat and other resident and migrant bird species, therefore, it is imperative to understand the spatial distribution and characteristics of wetlands for effective conservation planning in this landscape.

6.3. Methodlogy:

6.3.1. Determining the status of Sarus, identification, and characterization of wetlands in and around the GJIA site:

As the landscape is dotted with so many waterbodies/wetlands, we did a reconnaissance survey of the landscape. We visited 26 such wetlands, which were located using Survey of India topo map (53-H/12) and Google Earth images. Therefore, wetlands, which included village ponds, canals, and water bodies, were visited to see if they still have water in them, are they weed-infested, and do birds throng these wetlands (Annexure VII). To collect information on the Sarus distribution and status in the GJIA landscape, we surveyed the study area using foot and vehicle transects during the clear days in the morning (08:00–11:00) and evening (15:00–17:00) hours. Opportunistic sightings were also recorded. For each sighting, we recorded the following information: number of individuals, GPS location, and immediate habitat type.

Use of satellite image analysis for wetland mapping:

The GJIA landscape's waterbodies were mapped using Sentinel-2 satellite imageries of pre and post-monsoon seasons, i.e., May and October months, respectively. Sentinel-2 is an Earth observation satellite by European Space Agency launched on 23 June 2015 (Sentinel-2A) and as part of the Copernicus Programme to perform terrestrial observations supporting services such as forest monitoring, land cover

changes detection, and natural disaster management. Sentinel-2 sensor records 13 bands in the visible, near-infrared, and short-wave infrared part of the spectrum. It has a spatial resolution of 10 m, 20 m, and 60 m. The satellite images were downloaded free from the Earth Explorer-USGS portal (https://earthexplorer.usgs.gov/).

Atmospheric corrections to remove any effects of haze were carried out on the downloaded scenes. Since the Sentinel-2 offers datasets are available at variable spatial resolutions, the higher resolution bands (10 m) were used to increase the resolution using PAN sharpening technique. The image tiles were finally clipped for the study site at 10 m spatial resolution.

We carried out wetland mapping in three zones, i.e., within the proposed GJIA site, a 10 km and 25 km radius area around the airport site. We considered all different water bodies, including seasonal marshes, lakes, tanks, and village ponds, like wetlands.

The significant steps involved in wetlands mapping were:

1. Digitizing the atmospherically corrected image at a scale of 1:5,000 via on-screen visual interpretation of Sentinel-2 and Google Earth images as well as background knowledge,
2. Feature generalization of entities indiscernible beyond the scale of digitization; for example, waterbodies < 0.04 ha area (i.e., features with less than 4 pixels) were merged into the significant surrounding classes and,
3. Storing the polygon information, e.g., area and length, into the metadata file.

Assessing spatial and seasonal characteristics:

The seasonality of the wetlands was checked using the two months dataset. Wetlands visible only in October (post-monsoon) image were classified as seasonal. Wetlands visible on both October (post-monsoon) and May image (pre-monsoon) were classified as perennial. Wetlands visible only on May image were further verified on Google Earth's historical images. If these were found to be completely dry at any point in time, they were grouped into seasonal waterbodies or classified as perennial water bodies. The water bodies' spatial characteristics were measured by size, perimeter, area to perimeter ratio, and Euclidean distances.

6.3.2. Identfication of wetlands for the conservation of Sarus and other associated bird species in the GJIA landscape:

Rahmani et al. (2019) undertook a detailed analysis of habitat use by Sarus in the northern part of Uttar Pradesh. They observed that Sarus lives in a matrix of crop fields, fallow fields, and wetlands in a large landscape. Approximately 70% of the Sarus sightings made by them were within 200 m from the roads. Besides, they also found that Sarus preferred mainly smaller water bodies (less than 2 ha). However, during hot summer months, when seasonal wetlands and paddy fields dried up, Sarus congregates in the remaining wetlands, mainly roosting (Rahmani et al. 2019).

Visualizing the importance of green agriculture fields as Sarus habitat, we used the Normalized Difference Vegetation Index (NDVI), an indicator of green vegetation, to identify such crop fields in the GJIA landscape. For estimating NDVI, we used Near Infrared (NIR) and Visible Red (R) bands of Sentinel-2 image (post-monsoon data, when most of the crops were in fully-grown stages). The NDVI was computed using the following formula:

$$NDVI = \frac{NIR - R}{(NIR + R)}$$

A buffer of 500 m was created around each wetland, and the mean NDVI values were calculated in that buffer. NDVI value ranged from minus one (-1) to plus one (+1). A zero means no vegetation, and close to +1 (0.8–0.9) indicates the highest possible density of green leaves. Moderately healthy vegetation tends to

vary between 0.3 and 0.6 (Earth Observing System, 2019). Therefore, we used a threshold value of mean NDVI as greater than or equal to 0.3 to delineate agriculture habitats nearby the wetlands.

Given the information available on habitat selection by the Sarus and other associated bird species, we developed a set of criteria for identifying such wetlands, which might be potential habitat in the GJIA landscape. These are as follows:

1. The wetland should lie in the 25 km radius zone outside the GJIA site and should not be part of the proposed development zone in this landscape,
2. The wetland should be perennial without any weed infestation,
3. The wetland should be less than or equal to 2.5 hectares (ha) in the area,
4. The wetland should be at a minimum distance of 200 m from roads, and
5. The surrounding area of the wetland should be majorly crop fields.

We used different spatial analysis tools to identify such wetlands of conservation importance for Sarus and other bird species within the GJIA landscape, i.e., 25 km radius zone around the airport site. We selected wetlands, which satisfied all the five criteria discussed above and considered as conservation importance of Sarus and other associated bird species in the GJIA landscape.

6.4. Findings:

6.4.1. Distribution of Sarus crane observed during the study period:

In total, 76 Sarus crane individuals were observed in 31 independent sightings, and the mean flock size was 2.45±0.31 (Median=2; Range=1–11 individuals) (Table 6.1). In ~70% of the sightings, Sarus crane was observed in pairs, whereas only 10% of the sightings were of solitary individuals. Although the majority of Sarus sightings (84%) were from outside the GJIA site (within 10 km radius), the two largest flocks were recorded inside the GJIA site (i.e., 5 & 11) (Table 6.1.; Fig.6.2).

6.4.2. Overall spatial distribution and characteristics of wetlands in the GJIA landscape:

As per the GIS analysis, 653 wetlands with a total area of ~524 ha were identified and characterized. Of these, seasonal wetlands consisted 458 wetlands with 410.54 ha, and We used Remote Sensing and Geographic Information System (GIS) analysis following perennial waterbodies comprised of 195 wetlands with a total area of 113.5 ha (Table 6.2). The wetland size ranged between 0.03–25.42 ha with a mean wetland size of 0.80±0.06 ha.

Wetlands inside GJIA site:

The number of wetlands identified based on remote sensing and GIS analysis inside the proposed site boundary is eight. Three are found to be seasonal, and five are perennial water bodies (Fig. 6.3). The three seasonal water bodies are located along the western boundary of the airport. The remaining perennial water bodies are located in the central (three) and towards the airport site's eastern side (two). The area ranged from 0.06 ha (minimum) to 1.00 ha (maximum), and the average size being 0.4 ha (Fig. 6.4a). The smallest water body perimeter inside the airport was approximately 100 m, whereas the largest perimeter was 410 m (Fig. 6.4b). The perimeter to area ratio (PARA), which was worked out by dividing the exposed perimeter and wetland area, ranged from 0.03 to 0.15 (Fig. 6.4c). Figure 6.4(d) indicates that 50% of water bodies are within the ranging distance of most water-dependent wildlife species, and such connectivity is crucial for conservation.

Table 6. 1. Observed Sarus crane sightings during the study period in the GJIA landscape.

Sighting No.	No. of individuals/flock	Surrounding Habitat type
	Within GJIA site	
1	5	Agriculture, seasonal wetland
2	2	Scrubland
3	2	Agriculture, scrubland
4	2	Agriculture
5	11	Agriculture
	Within 10 km	
6	2	Agriculture
7	3	Agriculture, canal
8	2	Agriculture
9	2	Agriculture, forest
10	2	Agriculture
11	2	Agriculture, canal
12	2	Agriculture
13	2	Agriculture
14	2	Agriculture
15	2	Agriculture, canal
16	2	Agriculture
17	2	Scrubland
18	3	Agriculture, scrubland
19	2	Agriculture
20	2	Agriculture, scrubland
21	2	Scrubland
22	1	Agriculture
23	1	Agriculture, scrubland
24	2	Agriculture, Yamuna expressway
25	2	Agriculture, scrubland
	Within 25 km	
26	2	Agriculture
27	4	Agriculture
28	2	Scrubland, Agriculture, wetland (Dhanauri)
29	1	Scrubland, agriculture, road
30	3	Agriculture
31	2	Agriculture, orchards

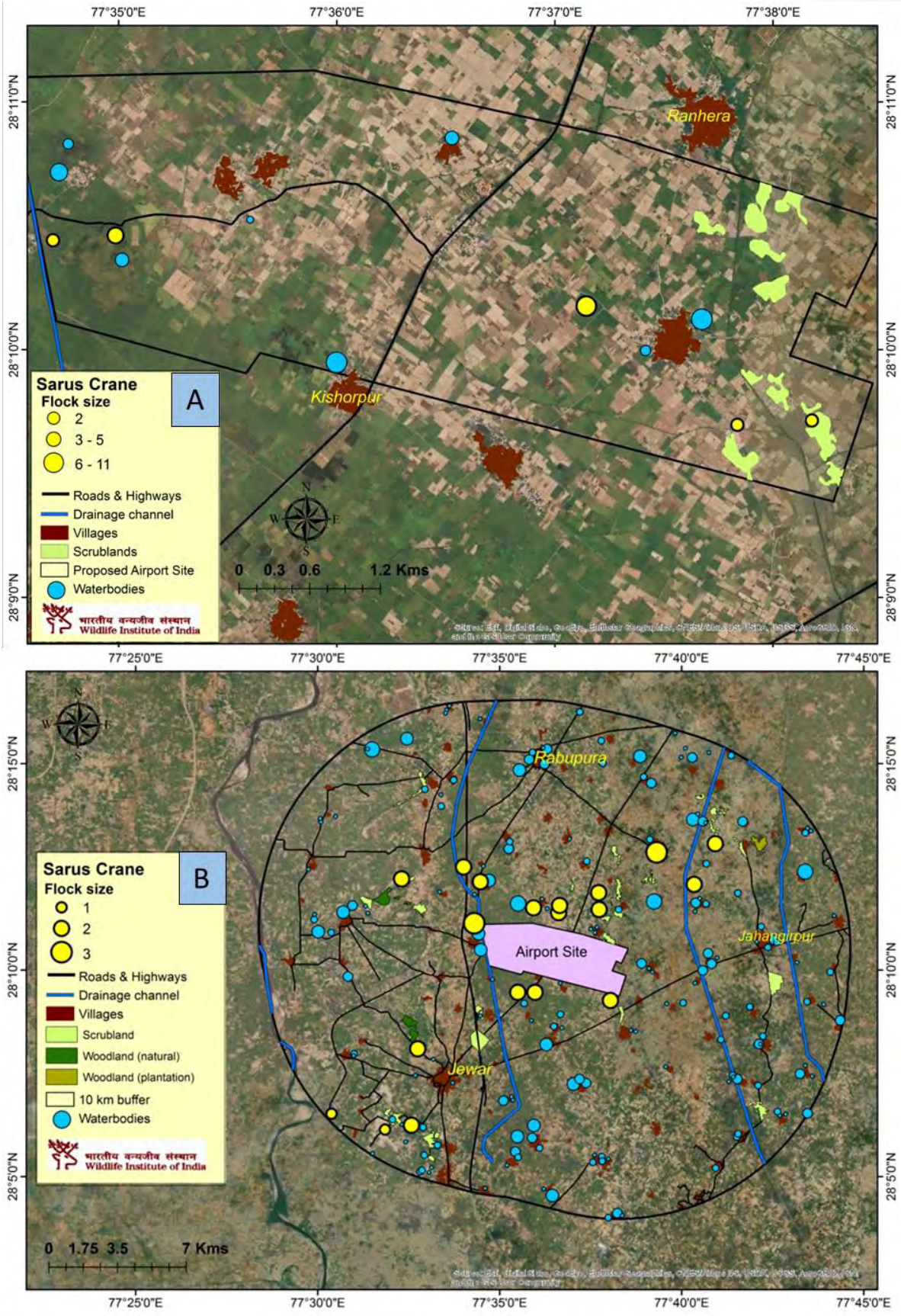


Figure 6.2. Distribution of Sarus flocks observed (A) inside (B) outside the GJIA site in the GJIA landscape.

Table 6.2. Overall wetlands identified and their characteristics across the GJIA landscape.

Wetland Type/ Landscape	No. of wetlands	Total Area (ha)	Mean area ± SE (ha)	Range
Perennial				
Inside GJIA site	5	2.5	0.50 ± 0.19	0.06 – 1.00
10 km	113	75.07	0.66 ± 0.06	0.05 – 3.47
25 km	340	332.97	0.97 ± 0.12	0.06 – 25.42
Seasonal				
Inside GJIA site	3	0.99	0.33 ± 0.09	0.14 – 0.45
10 km	59	30.03	0.51 ± 0.05	0.03 – 1.57
25 km	133	82.47	0.62 ± 0.08	0.04 – 7.66
Overall	653	524.03	0.80 ± 0.06	0.03 – 25.42

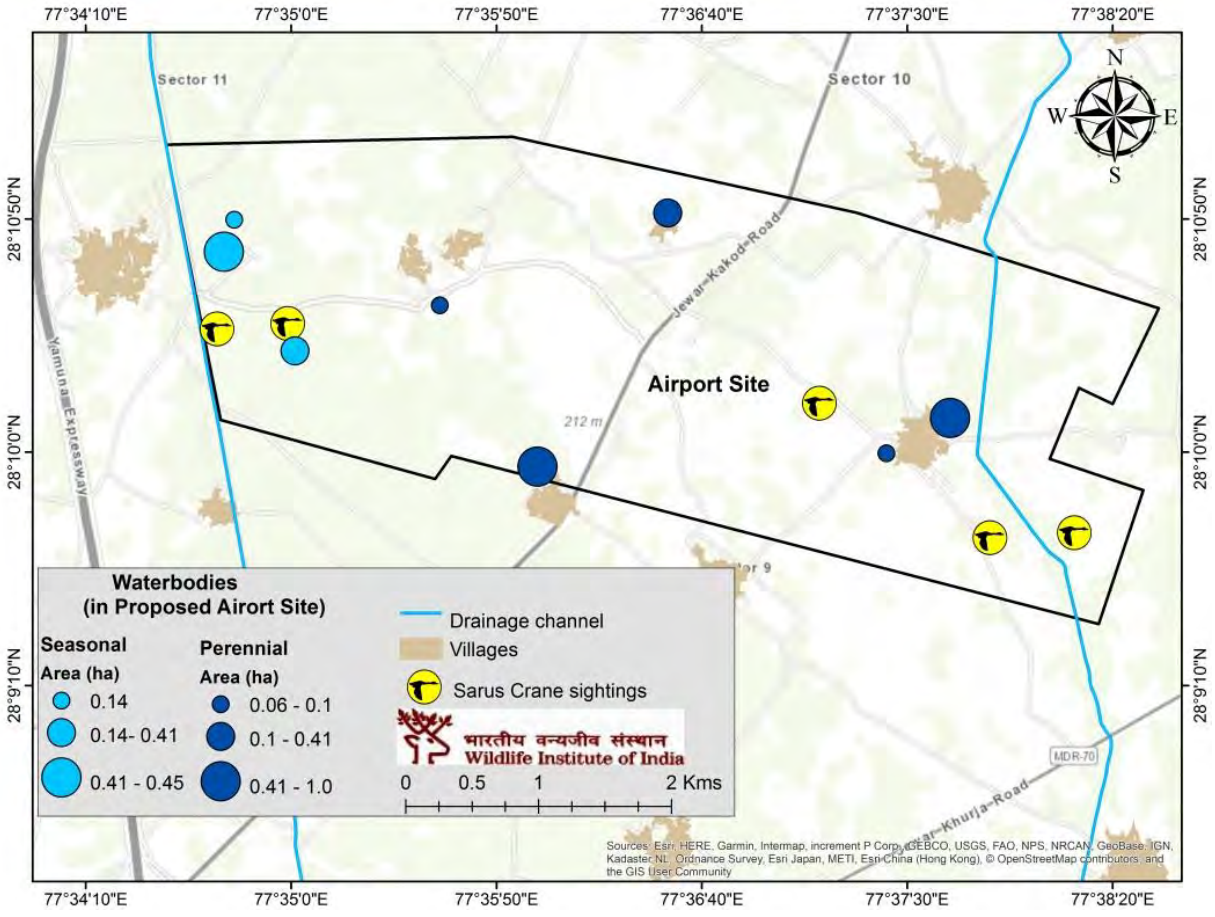


Figure 6.3. Perennial and seasonal water bodies (N=8) inside the GJIA site.

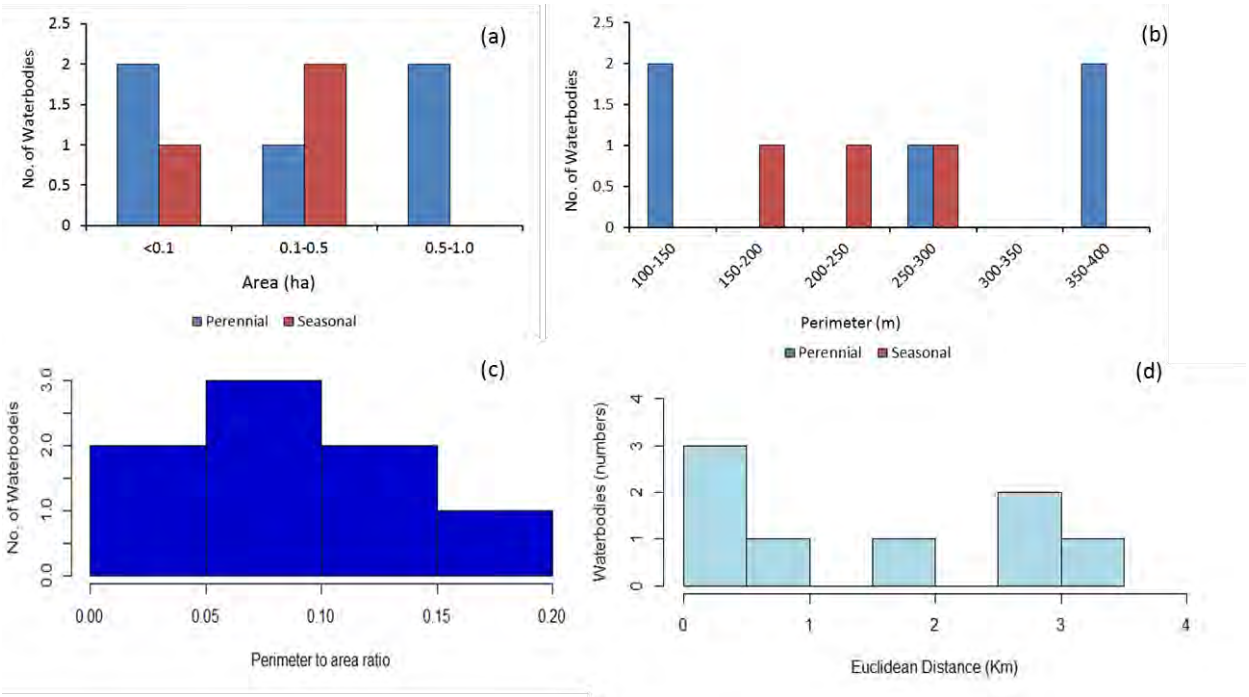


Figure 6.4. Distribution patterns of different configurational characteristics of perennial and seasonal wetlands identified within the GJIA site (a) area (b) perimeter (c) perimeter to area ratio (PARA) and (d) euclidean distance between two water bodies.

Wetlands inside 10 km radius of the GJIA site:

There are about 172 water bodies in the 10 km radius area (48226.1 ha) surrounding the proposed airport boundary. These included 113 perennial and 59 seasonal water bodies (Fig. 6.5). About 53% of seasonal water bodies were infested by weeds or algal blooms on the historical images. The average water bodies' density per square km in this radius area was 0.50, i.e., < 1 water body per square km. The smallest water body was found to be 0.04 ha in the area while the largest was 3.47 ha (average size 0.60 ha) (Fig. 6.6a). The perimeter of waterbodies ranged from a minimum of 71.87 m to a maximum of 1306.3 m (Fig. 6.6b). The perimeter to area ratio values stretched between a minimum of 0.20 to a maximum of 0.19 (Fig. 6.6c). The majority of the water bodies are within 2 km from each other, and such distances are adequate for the movement from one to another habitat in this landscape (Fig. 6.6d).

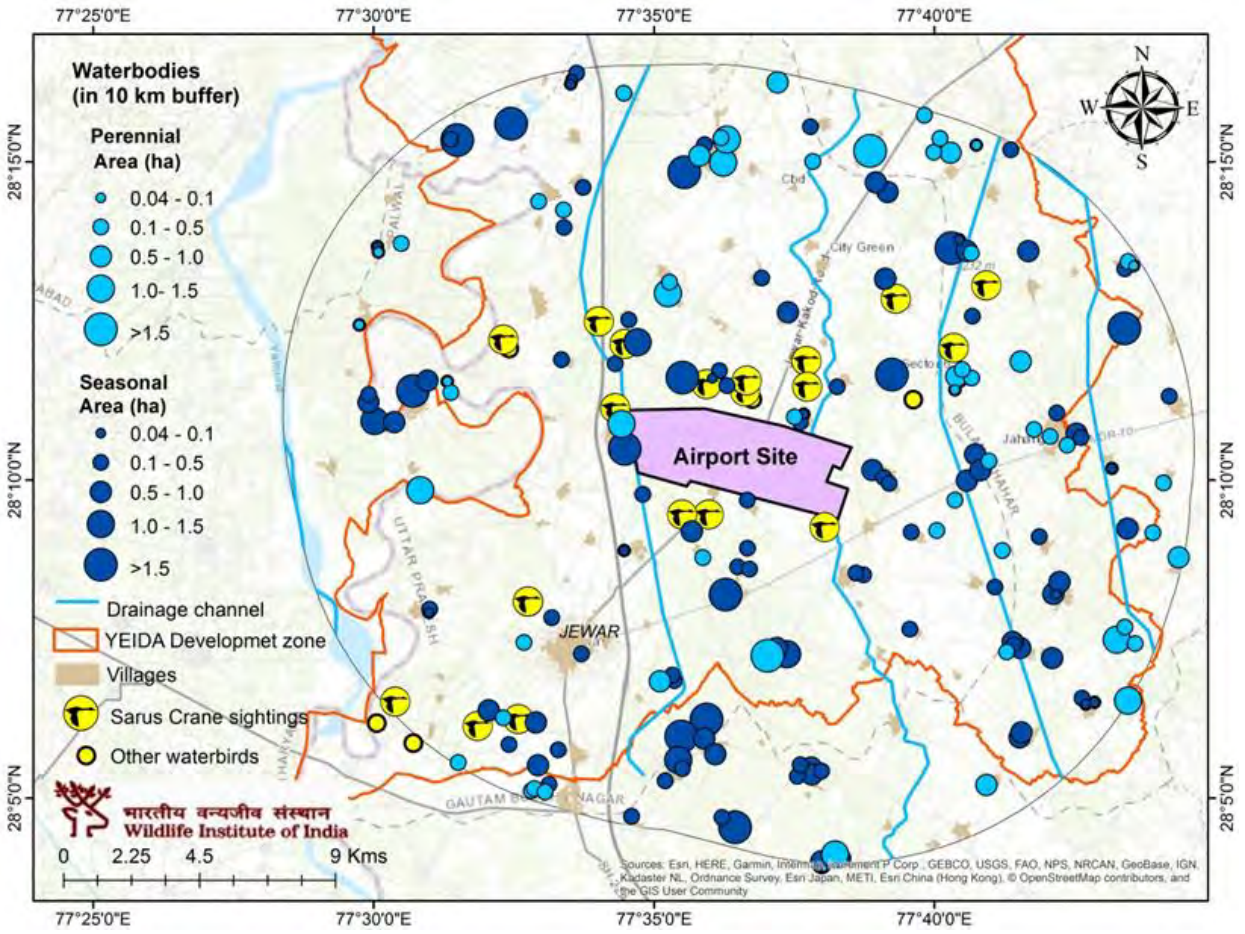


Figure 6.5. Perennial and seasonal water bodies inside a 10 km radius of the GJIA site.

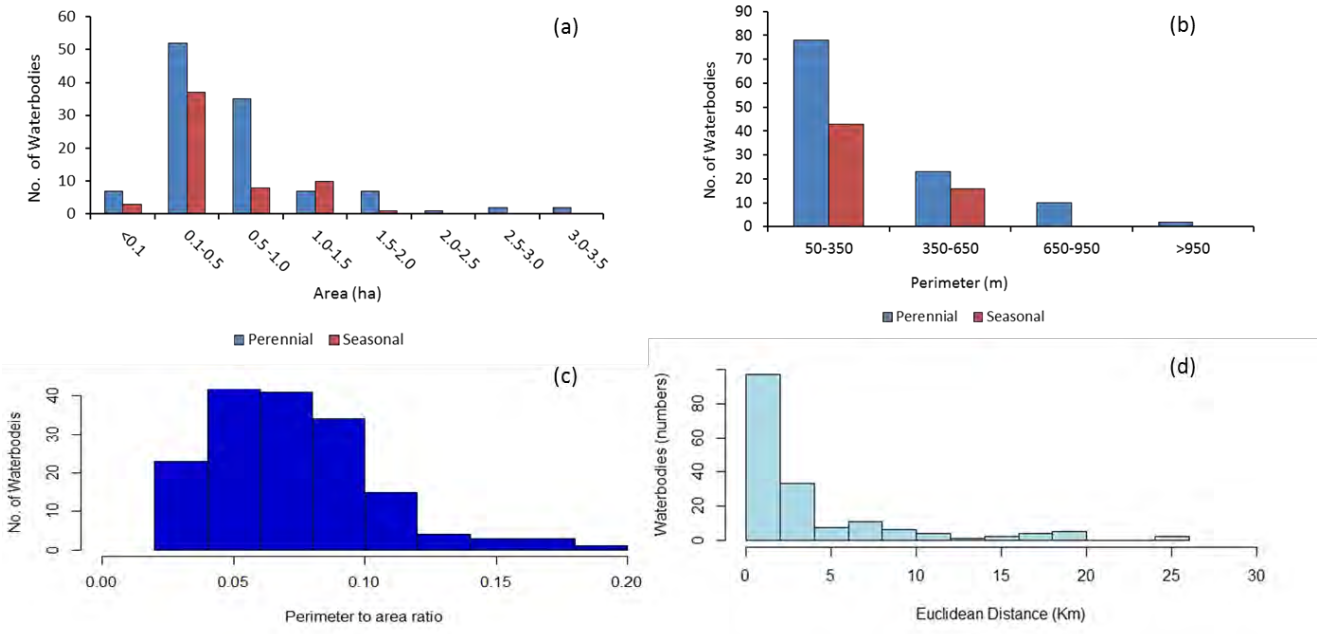


Figure 6.6. Distribution pattern of configurational characteristics of perennial and seasonal wetlands identified within the 10 km radius of the GJIA site. (a) area (b) perimeter (c) perimeter to area ratio (PARA) and (d) euclidan distance between two water bodies.

Wetlands within 25 km radius of the GJIA site:

We observed 473 waterbodies within the 25 km (effectively 15 km) from the GJIA site, excluding those overlapping in the 10 km radius. These comprised of 340 perennial water bodies and 133 seasonal water bodies (Fig. 6.7). The average water body density was 0.43 (0–1.25 numbers per sq. km). The water body's minimum area found in the 25 km radius was 0.04 ha, whereas the maximum was 25.42 ha (average size 0.9 ha) (Fig. 6.8a). The perimeter of these water bodies was 75.24 – 4298.64 m (Fig. 6.8b). The perimeter to area ratio ranged from 0.01 to 0.18 (Fig. 6.8c). Most of these water bodies are within the ranging behavior of terrestrial mammals and wetland birds (Fig. 6.8d). Some perennial water bodies were infested with weed (7%), whereas infestation was high in seasonal water bodies (c. 49%). The heat map indicates the spatial clustering of perennial water bodies inside the GJIA landscape (Fig. 6.9).

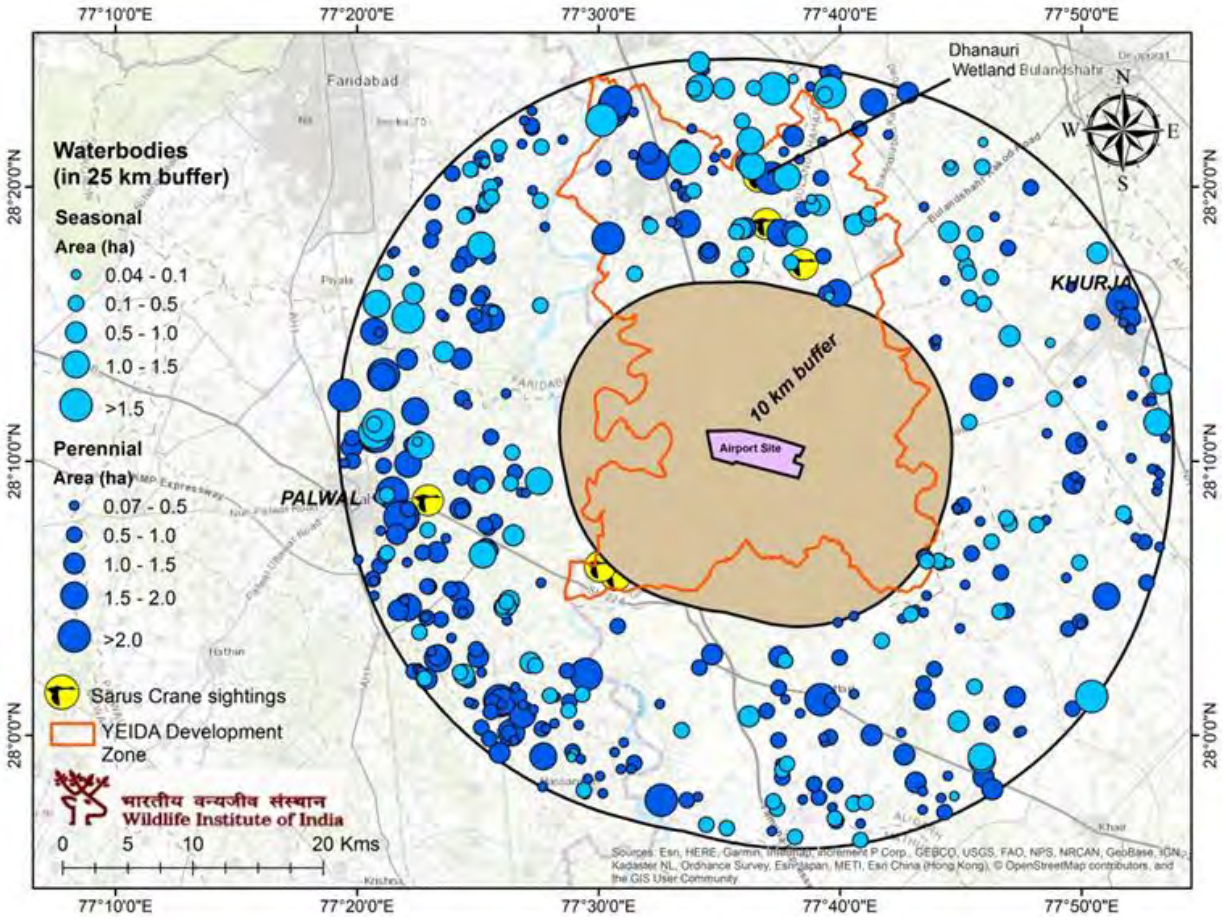


Figure 6.7. Perennial and seasonal water bodies inside 25 km radius of the GJIA site.

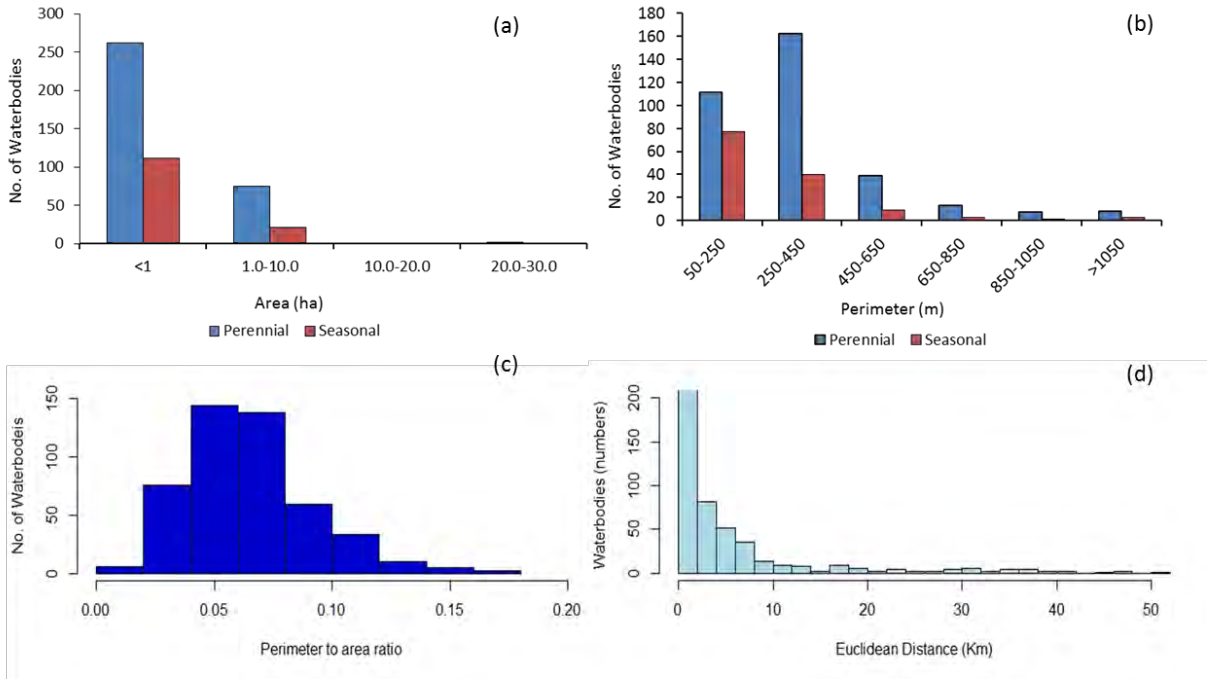


Figure 6.8. Distribution pattern of configurational characteristics of perennial and seasonal wetlands identified within the 25 km radius of the GJIA site. (a) area (b) perimeter (c) perimeter to area ratio (PARA) and (d) euclidan distance between two water bodies.

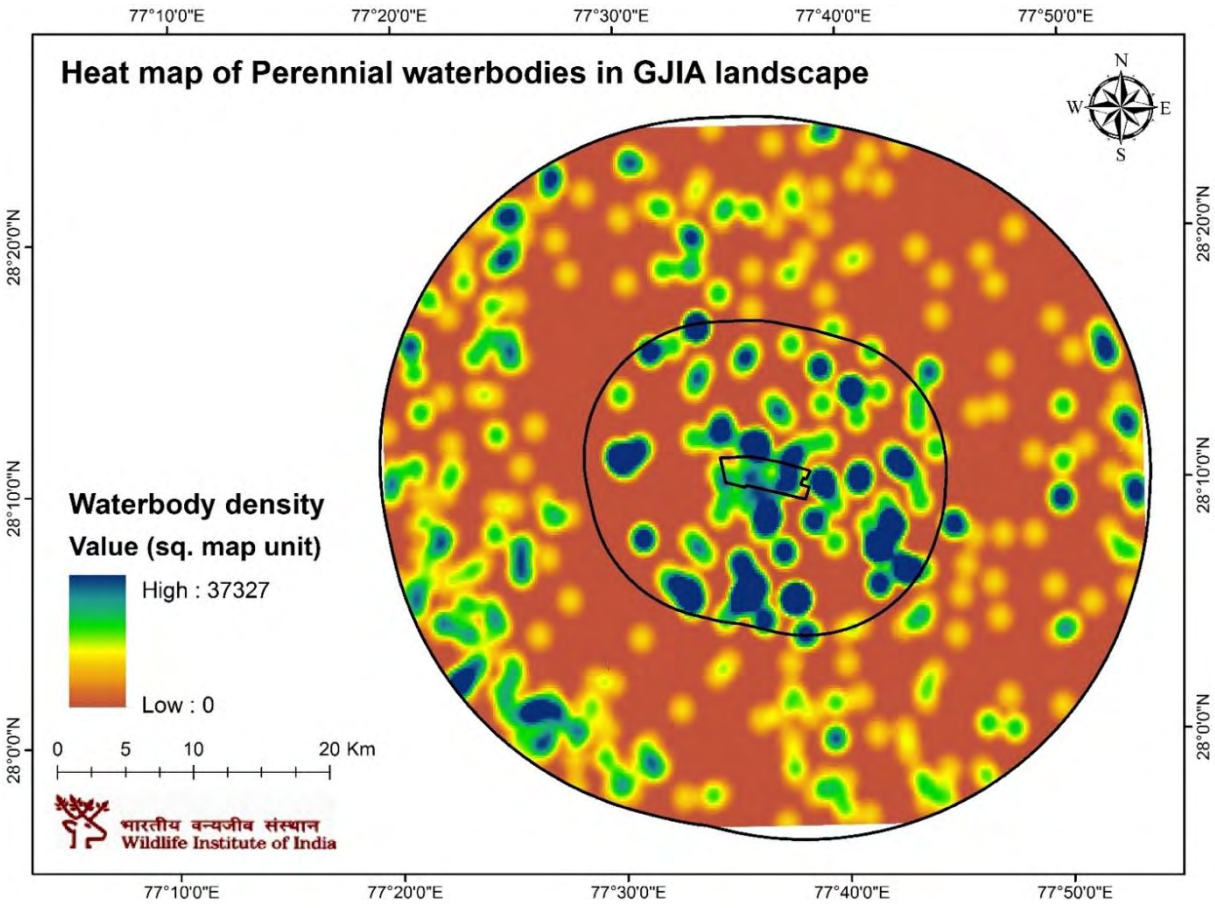


Figure 6.9. Heat map of wetland density in the GJIA landscape.

6.4.3. Wetlands of conservation importance of Sarus and other associated species:

Our analysis to identify essential wetlands for Sarus crane and other water birds was based on the findings of a recent study on Sarus and its habitats by Rahmani et al. (2019) and five criteria selected for GJIA landscape. We identified 145 wetlands of conservation importance, significant for Sarus crane, and other associated wetland birds in the GJIA landscape (Fig. 6.10).

6.5. Conservation significance of wetlands in and around the GJIA landscape:

Spatial characteristics analysis of the water bodies in and around the GJIA landscape indicated that the perennial water bodies are more as compared to seasonal waterbodies, which are mostly dependent on rainfall or seasonal exposures to other sources of water, for example, changes in courses of streams and rivers or overtopping in monsoons. Seasonal water bodies tended to be infested with aquatic weeds and algal blooms. Both types of water body support their own aquatic faunal and floral communities and provide a stepping-stone for several wetland bird species. Hence, these are essential components of the agro-ecological system in the GJIA landscape.

The water bodies in this landscape are mostly village ponds and irrigation tanks amid the croplands, and they tend to be smaller in size except for few wetlands such as Dhanauri wetland (25.27 ha) in the north of the GJIA and another one near Ramgarhi village (25.42 ha) in the south. The Dhanauri wetland spreads over 101.21 hectares, as per a remote sensing exercise in 2015. However, based on our findings from the pre-monsoon image, the wetland's core-wet area is 25 ha. Most of the wetlands are ≤1 ha across the different analysis scales, i.e., inside, 10 km, and 25 km radius zone of the GJIA site. Though many studies have highlighted the importance of wetland size and observed a positive relationship with bird abundance and richness (Celada and Bogliani, 1993; Riffel et al. 2001) whereas other studies suggested no such significant effects of wetland size on wetland bird diversity (Sulaiman et al. 2015; Giosa et al. 2018). Hence, we believe that smaller wetlands in the GJIA landscape may be crucial in supporting biodiversity, especially of the water dependent birds in the agro-ecosystem in the GJIA landscape.

Patch shape complexity has been a critical conservation parameter while planning conservation strategies in the terrestrial ecosystem, as it is a measure of species richness (Moser et al. 2002). Habitat patches with more complex shapes (i.e., high perimeter to area ratio) are more likely to be located by mobile organisms. They are also more likely to be impacted by temporal and spatial effects from their surrounding environment (Hamazaki 1996). Most of the studies correlating patch shape complexities with species richness have been from diverse ecosystems ranging from natural, semi-natural, or agricultural landscapes.

However, literature about understanding the effects of wetland shapes on species richness is still lacking. We believe that the forms of wetland may provide an “edge index,” leading to the diverse niches along the wetland perimeter. The PARA values varied slightly for the water bodies within the GJIA site, whereas it varied significantly outside the area. Hence, the water bodies outside the GJIA site may have high conservation values.

Another spatial characteristic in conservation is the extent of connectivity (measured as Euclidean distance, i.e., straight-line distance) among the wetlands so as species may move from one to another wetland. The variation in Euclidean distances among water bodies is high inside compared to outside the GJIA site. Hence, this implies a regular or uniform distribution of wetlands in the GJIA landscape and has conservation importance value for Sarus and other associated bird species.

Hence, it is essential to understand the fine-scale spatial and temporal distribution,

functional characteristics and the avifaunal diversity for these water bodies' in the GJIA landscape. We suggest conservation focus should be restoration for native biotic communities, abiotic conditions and consider attributes such as size, depth, perimeter to area ratio while planning a restoration or creating wetland in this landscape (Mora et al. 2011). Besides, a detailed investigation is needed for understanding functional parameters such as hydrologic regime and other ecosystem services provided by the wetlands in agricultural landscapes.

6.6. Threats to Sarus conservation in the GJIA landscape:

Rahmani et al. (2019) have described different potential threats to the conservation of Sarus in the agro-ecology system. Hence, the proposed development and unforeseen changes in land use patterns may impact Sarus conservation in the GJIA landscape. A detailed investigation is needed for understanding functional parameters such as hydrologic regime and other ecosystem services provided by the wetlands in agricultural landscapes. Major threats are as follows:

6.6.1. Decrease in habitat quality and modification of wetlands:

Our survey revealed that most wetlands have invasive weed, such as water hyacinth, and these are either fully or partially covered (Annexure VII). Sometimes villagers remove the weed for pisciculture – either way, the wetland becomes unsuitable for Sarus. Given the time and logistical constraints, we could not study the water pollution level of the wetlands. But, we believe that these wetlands may have a high level of pesticides and herbicides because of their prevalence in the surrounding agriculture fields. Rahmani et al. (2019) reported, encroachment is the biggest threat to the all-natural wetlands of Uttar Pradesh, and we noted this kind of problem in this landscape too.

6.6.2. *Stealing of eggs*:

Although we did not directly observe such activity, it has been reported to occur in the region in nearby districts of Uttar Pradesh (Rahmani et al. 2019). Even farmers are said to remove or destroy the Sarus eggs from their agricultural fields (Kaur & Choudhury 2003).

6.6.3. *Free-ranging or stray dogs:*

India has the highest number of free-ranging domestic dogs in the world (Gompper, 2014). Free-ranging dogs or stray dogs thrive on anthropogenic subsidies, indirect feeding by humans, and access to garbage or livestock. Besides, these free-ranging dogs are also known to have access to livestock and wild prey (Lenth et al. 2008). Rahmani et al. (2019) have classified three significant types of threats caused by these free-ranging dogs to Sarus, which are as follows:

1. Predation – where free-ranging dogs pose a direct threat to juveniles and chicks of Sarus as adult birds are not easy to prey on. Apart from this susceptibility of young Sarus, sick and injured birds are also prone to get attacked by free-ranging dogs.
2. Disturbance – often, Sarus get disturbed and distressed because of the presence of dogs in the vicinity. The presence of dogs around may trigger behavioral changes affecting the Sarus. This not only affects birds but blackbuck and other wildlife as well.
3. Multiplier effect – this happens when in the wake of one threat, the bird gets impacted by the other threat in the proximity; for example, a Sarus may not get killed by the dog directly, but it may get electrocuted by power lines while escaping the ground predator.

6.6.4. *Power lines*:

Powerlines are reported as conservation threats to the flying birds and mammals. In a detailed study on the impact of power lines on birds, Mohibuddin (2017) reported that about 18,700 birds die per month in the Thar Desert landscape in Jaisalmer, Rajasthan. A detailed

long-term study is needed to explore the potential of this threat in this landscape. Power line as a potential threat to Sarus was first highlighted by Sundar and Choudhury (2005) in Mainpuri and Etawah districts of Uttar Pradesh, where they reported a death rate ~1% per year for the Sarus population.

6.6.5. *Plastic pollution*:

Unprecedented dependence on plastic and plastic products in our daily use and, more importantly, using single use plastic has been a significant cause of concern as plastic forms a principal constituent of human waste. Most of the landscape's wetlands are turning to dumpsites or waste sinks, especially the village ponds, and impacted the bird communities.

6.7. Conclusion and recommendations:

We observed a few sightings of Sarus within than outside the GJIA site during our study period. Wetlands outside the GJIA site are widely distributed and diverse in configurational structure characteristics than within the proposed site. Hence, these wetlands would provide suitable habitats to birds displaced from the GJIA site as most of these are within their ranging pattern. The conclusion, which emerges through this study, implies that the GJIA landscape is an essential agro-ecological region supporting many wetlands distributed uniformly throughout the landscape. Agriculture field interspersed with wetlands provide suitable habitat to Sarus crane and other several wetland bird species.

Under the existing land use patterns, Rahmani et al. (2019) stated that the conservation of the Sarus should commensurate with the agro-ecology system, and they have suggested several strategies and measures for achieving species' conservation goals. They highlighted that the significant threat to the Sarus conservation in India is habitat degradation and loss due to changes in water regimes and wetlands' encroachment for developmental activities. Thus, the protection and management of the remaining wetlands are vital in areas undergoing intensive land-use changes. Visualizing this, we have identified wetlands based on the habitat requirements of Sarus and are of conservation importance in the GJIA landscape (Fig. 6.10; Annexures VII, VIII) for effective conservation planning.

Based on Sarus and wetland conservation's observed threats, we suggest the following for consideration during developing wetland conservation strategies in the GJIA landscape in the future.

1. Prevent wetland encroachment and reclamation for agriculture and developmental projects by notifying wetlands of the GJIA landscape under Wetlands (Conservation and Management) Rules, 2017, and recording them within state revenue records. Additionally, we propose regular monitoring of the suggested wetlands (Annexure VIII) at least twice a year so that appropriate measures may be taken to avoid any further habitat degradation.

2. The majority of wetlands in the GJIA landscape are infested with water hyacinth (*Eichhornia crassipes*). Forest Department should undertake restoration activities in liaison with the State Fisheries and Irrigation Department for de-weeding, restricting fishing activities, maintaining water quality, and reducing plastic pollution in these wetlands. We emphasize a need for unique conservation and restoration of wetlands surrounded by wheat or paddy fields.

3. Monitor changes in land use land cover and cropping patterns in the GJIA landscape.

4. Minimize the menace of free-ranging dogs in liaison with the State Animal Husbandry Department and NGOs to reduce predation pressure on Sarus eggs and chicks, especially during breeding periods; if required, a dog sterilization program may be undertaken.

5. Implement a financial incentive scheme involving local farmers to secure Sarus nests in their agricultural fields.

6. Adjoining wetland of the GJIA landscape such as “Dhanauri wetland” is used by Sarus as roosting sites and provide habitats for different diverse bird and arthropod species. We suggest preparing the “Conservation Plan” for this wetland. This wetland should be declared as “Wildlife Sanctuary” or “Conservation Reserve” as soon as possible. Encourage to develop as recreational areas for bird watchers.

7. Power lines affect flying birds and caused mortality by electrocution. We did not observe any electrocution of Sarus during the study period. However, we suggest deploying bird diverters/deflectors to reduce mortality in Sarus due to electrocution if the problem is observed.

8. The impact of pesticides and other chemicals on Sarus should be intensively studied. We proposed monitoring water quality of 30 to 40 percent suggested wetlands (Annexures VII, VIII) once a year.

9. Establishment of management strategies which might conserve both wetlands and cultural practices; for example, conducting awareness and stakeholder engagement programs involving local farmers and other stakeholders encouraging not to change the cropping patterns (switching from rice paddy and wheat to intensive sugarcane farming drastically decreased Sarus population in the Terai region of north Uttar Pradesh (Rahmani et al. 2019)). Community-based ecotourism may be encouraged as a compensatory measure to the farmers,

10. Establishment of management practices to reduce point and non-point pollution of the wetlands.

11. Plan regular awareness programs in secondary and high schools and villages in the GJIA landscape to sensitize people about the importance of Sarus and wetland ecosystems for developing a positive attitude towards conservation.

12. We suggest long-term studies such as hydrological, land-use changes, socio-economic, Sarus-habitat requirements, population demography, and limnological changes of wetlands for effective conservation planning of Sarus wetlands in the GJIA landscape.

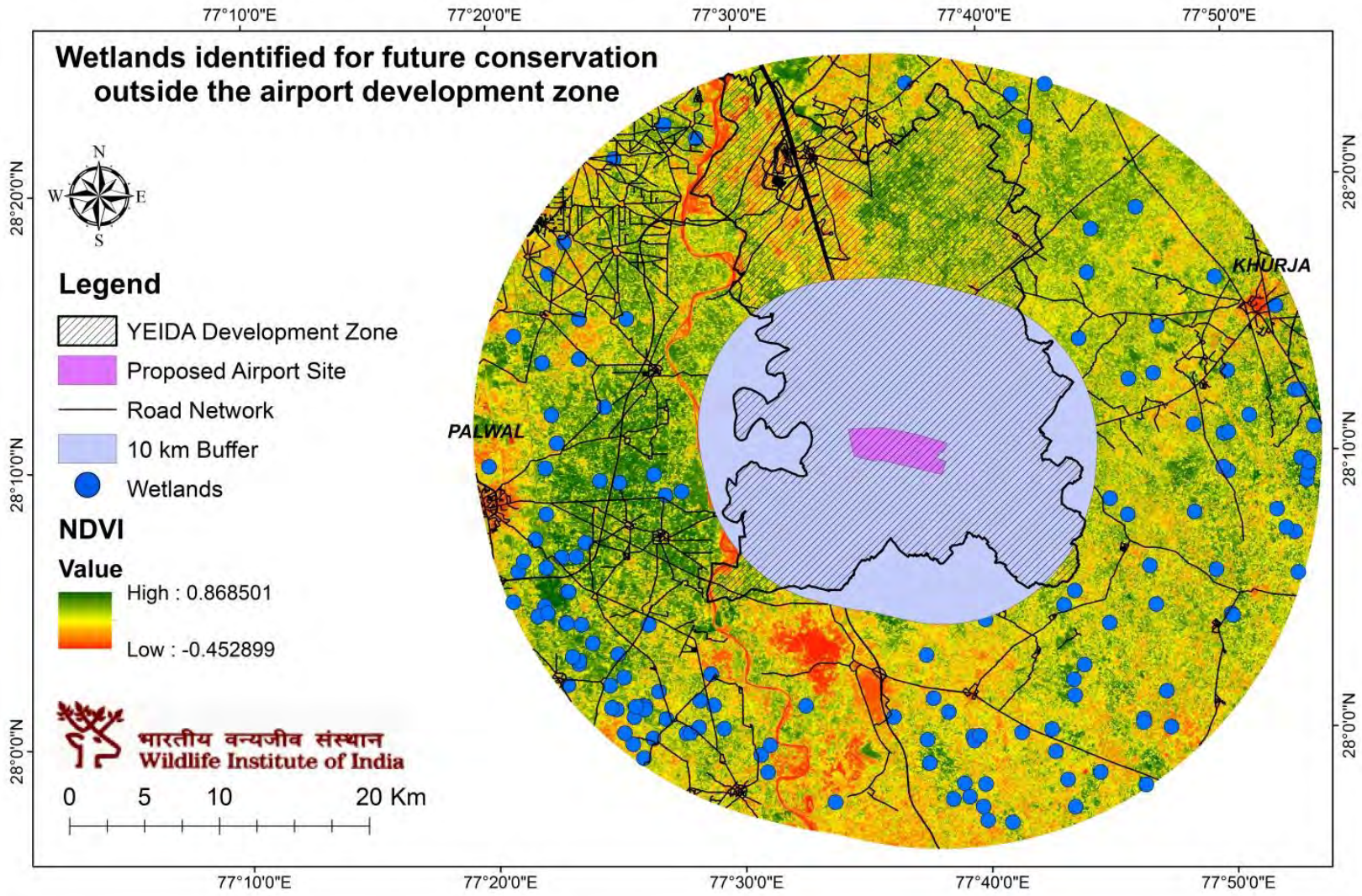
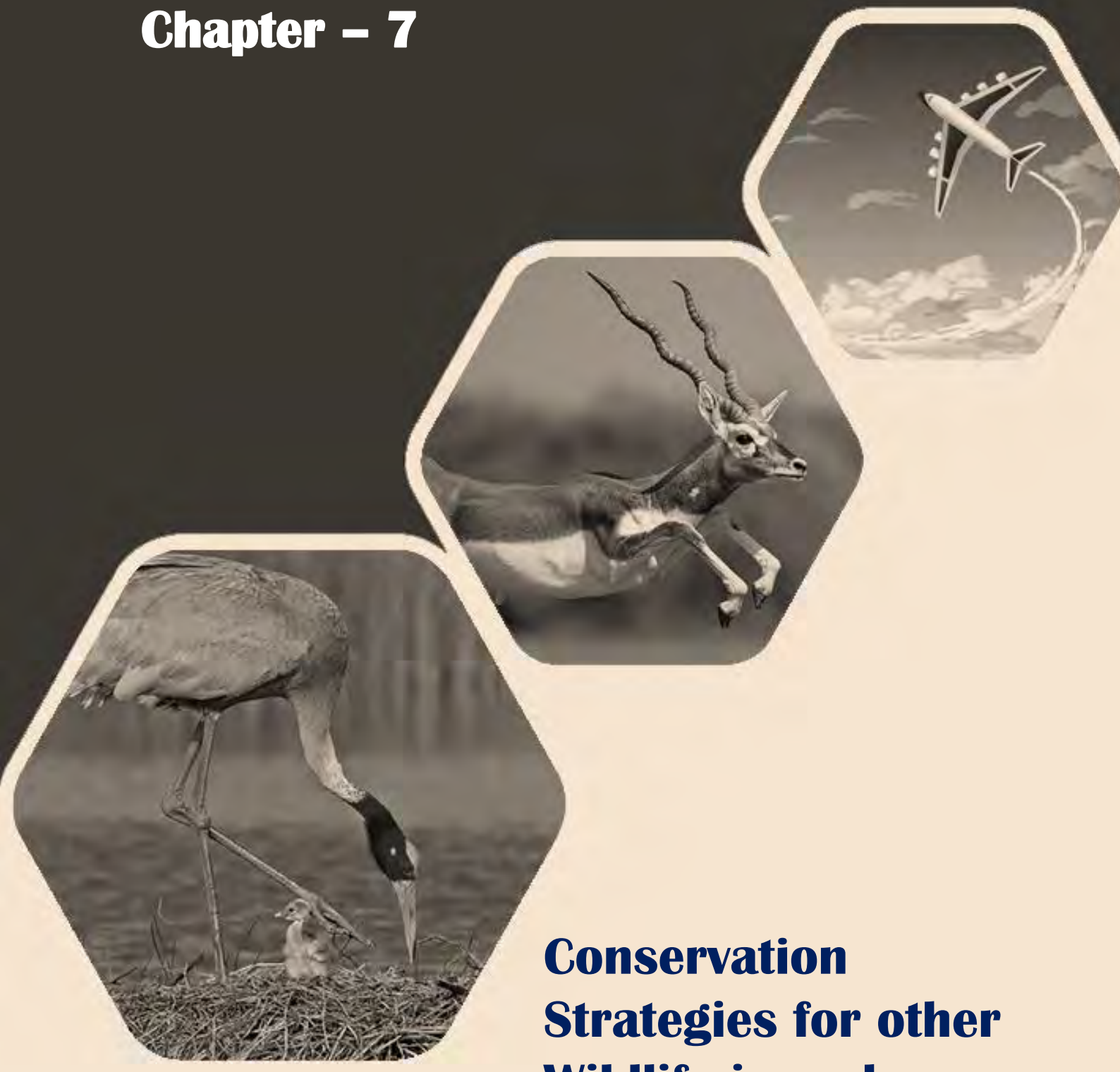


Figure 6.10. Distribution of wetlands of conservation importance, which are less likely to be impacted due to development for Sarus and other associated wetland birds within the the GJIA landscape.

Chapter – 7



Conservation Strategies for other Wildlife in and around the Proposed GJIA Site

7.1. Introduction:

Biodiversity refers to a variety of all life forms, i.e., flora and fauna on earth. These living resources provide a wide range of ecological, economic, social, cultural, educational, scientific, and aesthetic services for humans' wellbeing. Therefore, the emphasis has been on conserving these resources for retaining the evolutionary process and ecosystem services. Because of diverse ecosystems and habitats (Mani, 1974), India is ranked among the top ten species-rich nations globally and accounts for about 7-8% of recorded species of the world (Balasubramanian 2017). India is the home to at least 18,664 species of vascular plants, of which 26.8 percent are endemic. Additionally, India is also rich in faunal diversity such as 59,353 insects, 2,546 fishes, 240 amphibians, 460 reptiles, 1,210 birds, and 397 mammals. Of these, 18.4 and 10.8 percent are endemic and threatened, respectively, and many of them are on the verge of extinction (Balasubramanian 2017; BirdLife International 2020).

Given that it is not possible to plan and address conservation issues for every species of the ecosystem, therefore, the emphasis has been on conserving the species: flagship, keystone, indicator, and top of the food pyramid. Through this process, all species of other trophic levels are conserved. We have discussed the conservation implications of two key species viz. Blackbuck (*Antilope cervicapra*) and the Sarus (*Grus antigone*) of GJIA landscape in earlier chapters. However, we describe the other species' status, which was observed during the survey and requires conservation attention in the GJIA landscape.

7.2. Wildlife species observed in the GJIA landscape:

7.2.1. *Mammalian fauna*:

We collected information on other mammalian species using foot and vehicle-based transects during our survey period and recorded six mammals (Table 7.1). Of these species, four species (Blackbuck, Nilgai, Jungle Cat, and Golden Jackal) were considered prime focus as we had very few direct observations of Indian grey mongoose and rhesus monkey. Moreover, habitat conservation of these focused species would ensure meeting the required habitat by other mammalian species in this landscape. We have already discussed the conservation of Blackbuck in the previous chapter.

Table 7.1. Key species of conservation importance recorded during the study period in the GJIA landscape.

Species	Scientific Name	Conservation Status	
		IUCN	IWPA – Schedule
Blackbuck	*Antilope cervicapra*	LC	I
Nilgai/Bluebull	*Boselaphus tragocamelus*	LC	III
Jungle Cat	*Felis chaus*	LC	II
Golden Jackal	*Canis aureus*	LC	II
Rhesus Monkey	*Macaca mulatta*	LC	II
Indian Grey Mongoose	*Herpestes edwardsii*	LC	II

Nilgai

Nilgai (*Boselaphus tragocamelus*) was abundant and widely distributed wild ungulate species in the GJIA landscape. Nilgai used some of the habitat preferred by the Blackbuck.

We sighted Nilgai on 51 different occasions with 430 individuals (Fig. 7.1). Most of the Nilgai sightings were in agricultural fields, although a few groups (n=5) were recorded inside forest patches and plantation in the GJIA landscape. Nilgai group size varied from solitary males to as many as 35 individuals in a group (Fig. 7.2). The mean group size of Nilgai was 8.43± 1.0.

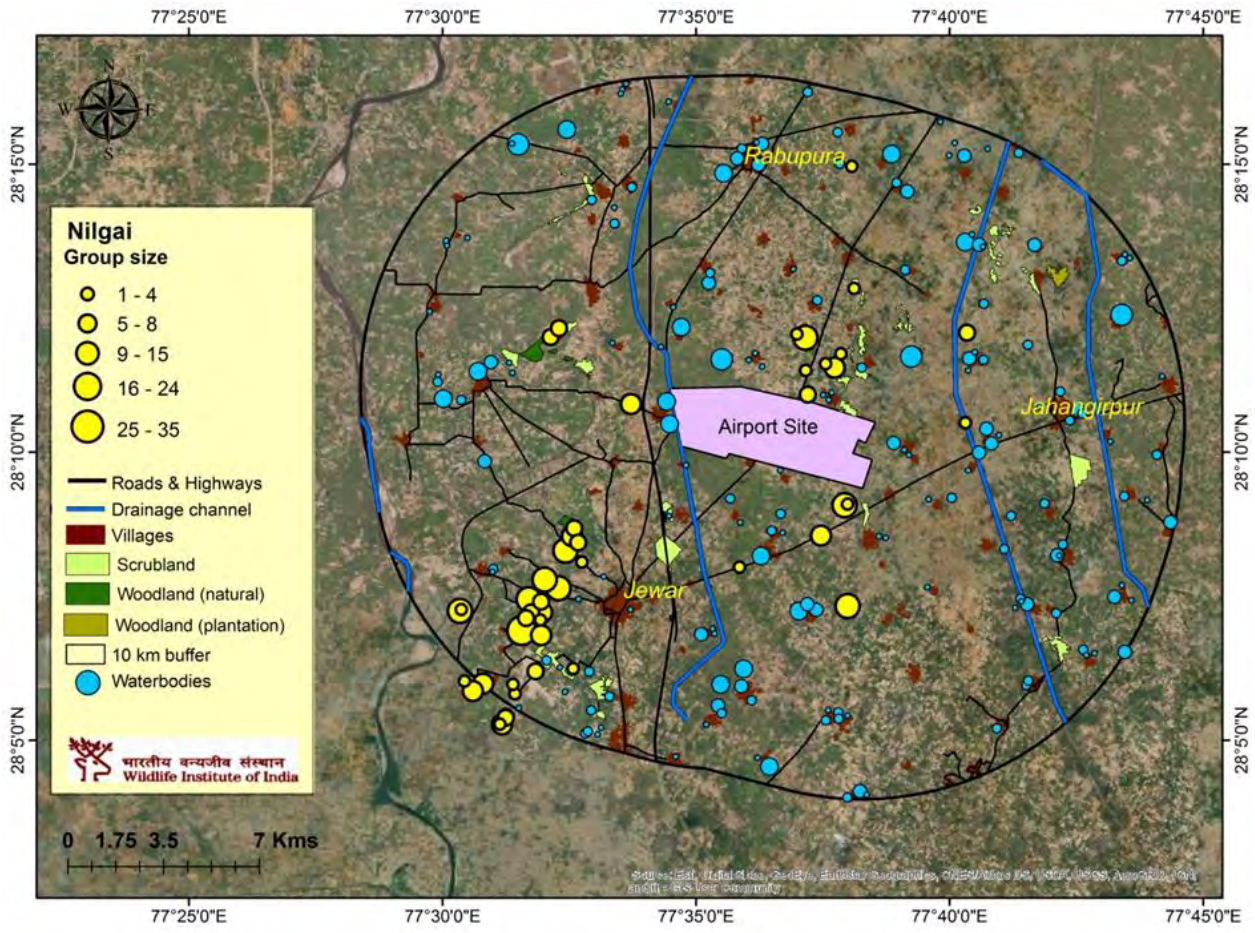


Figure 7.1. Distribution of Nilgai in the GJIA landscape.

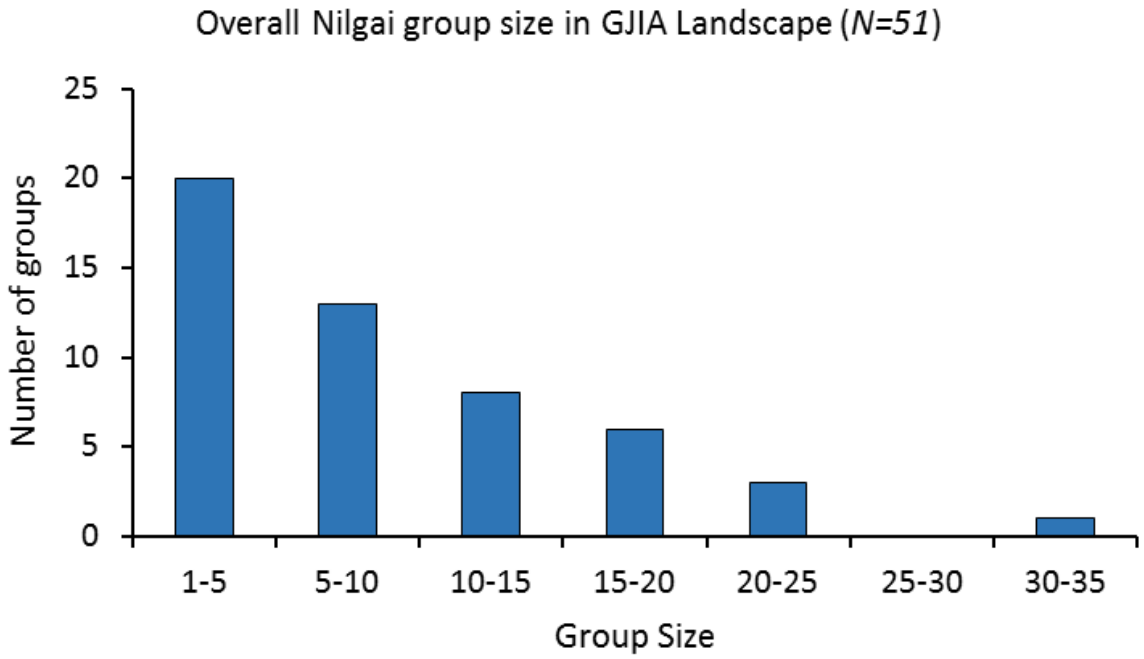


Figure 7.2. Distribution of Nilgai group size in the GJIA landscape.

A herd of Nilgai in a crop field in the GJIA landscape

Other mammals

We also recorded direct sightings of a few individuals of carnivorous mammals such as Golden Jackal (*Canis aureus*) and Jungle cat (*Felis chaus*) in this landscape during our survey. We recorded 13 individuals of golden jackal in four different sightings viz. solitary (n=1), pair (n=1), trio (n=2) and four (n=1) (Fig. 7.3). The golden jackal is omnivores in food habits and widely distributed in varied habitats, ranging from semi-arid environments to forests, mangroves, agriculture, rural and semi-urban habitats in India. Due to its tolerance of dry conditions and omnivorous diet, its occurrence is well known in semi-urban habitats. The solitary individual of Jungle Cat was sighted on four different occasions (Fig. 7.4). One of the sightings was at the south-eastern edge of the GJIA site, whereas the rest were observed in a 10km radius zone. Jungle cats are adapted well in agriculture fields interspersed with the scrub habitats, and such habitats are considered most suitable both for prey species and escape cover. The species is well known for the ecosystem services by controlling the rodents and has conservation importance in this landscape. The presence of adequate scrub habitats patches may indicate the existence of a reasonable population of Jungle cat across this landscape. However, conservation of Jackal and Jungle cat are impacted due to reported high road kills in India.

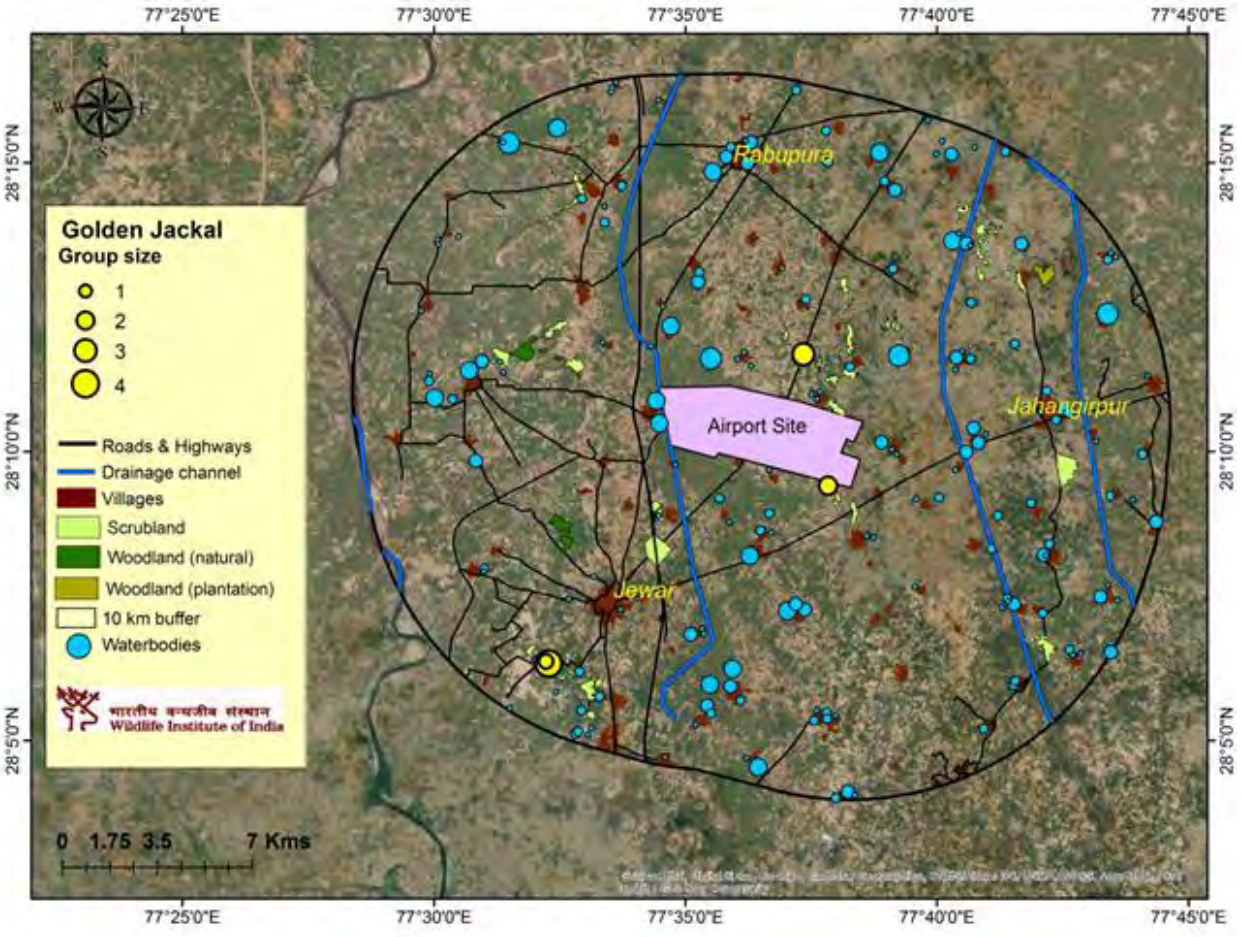


Figure 7.3. Distribution of Golden Jackal observed in the GJIA landscape.

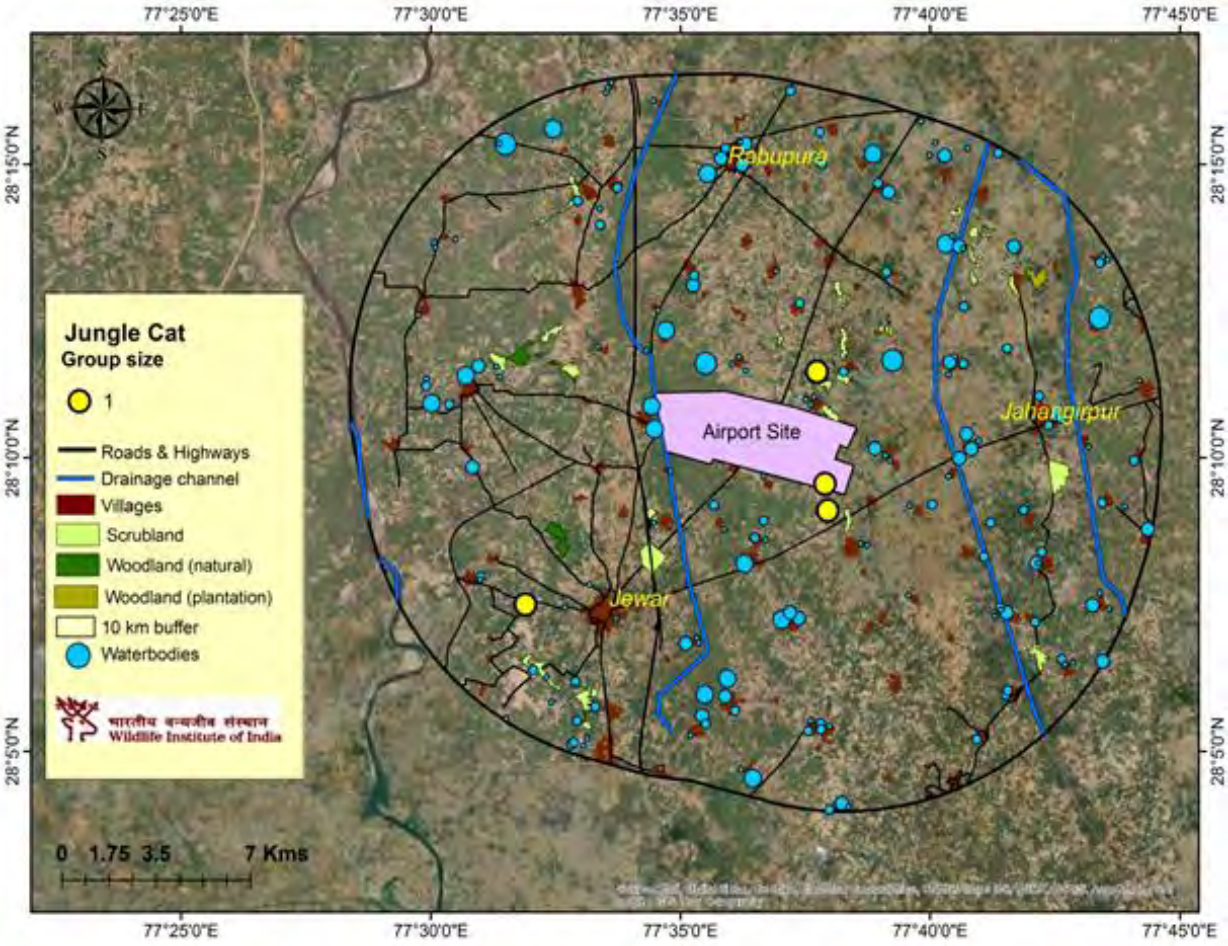


Figure 7.4. Distribution of Jungle Cat observed in the GJIA landscape.

7.2.2. *Avifauna*:

During our survey work (foot and vehicle transect), we recorded several bird species; however, three species viz. Indian peafowl, Egyptian vulture, and Sarus crane were of conservation importance in the GJIA landscape (Table 7.2). We have discussed the measures needed for the conservation of the Sarus crane in an earlier chapter.

Table 7.2. Critical bird species of conservation importance recorded from the GJIA landscape.

Species	Scientific Name	Conservation Status	
		IUCN	IWPA – Schedule
Indian Peafowl	*Pavo cristatus*	LC	I
Sarus Crane	*Grus antigone*	VU	IV
Egyptian Vulture	*Neophron percnopterus*	EN	IV

Indian peafowl

One of the key bird species of conservation importance found in the landscape is the Indian Peafowl (*Pavo cristatus*). It is the national bird of India. It is classified as a Schedule I species under the Wildlife (Protection) Act 1972. It was found to be very abundant and was mostly seen in the agricultural fields in the GJIA landscape, primarily associated with human habitation or settlements. Its flock size was observed to vary from 1 to 11 individuals, and the majority of the sightings were outside the GJIA site (Fig. 7.5). Its population and distribution trend is reported to have increased over the past two decades (SoIB 2020). Our data on distribution patterns reveals the presence of reasonably suitable peafowl habitat across the GJIA landscape.

Egyptian vulture

With the decline of the vulture population crisis during the last two decades, the Egyptian vulture (*Neophron percnopterus*) has been a species of high conservation importance in India. It is categorized as "Endangered" species in the IUCN Red List. Its population and distribution trend is reported to have declined over the past two decades (SoIB 2020). During the survey, it was the only species of vulture recorded from the study area. We observed 10 Egyptian vultures in six independent sightings throughout the study period (Fig. 7.6). Most of the sightings were outside except one, which was closer to the proposed GJIA site. These birds are scavenger, and their low abundance may suggest less availability of animal carcasses in the landscape.

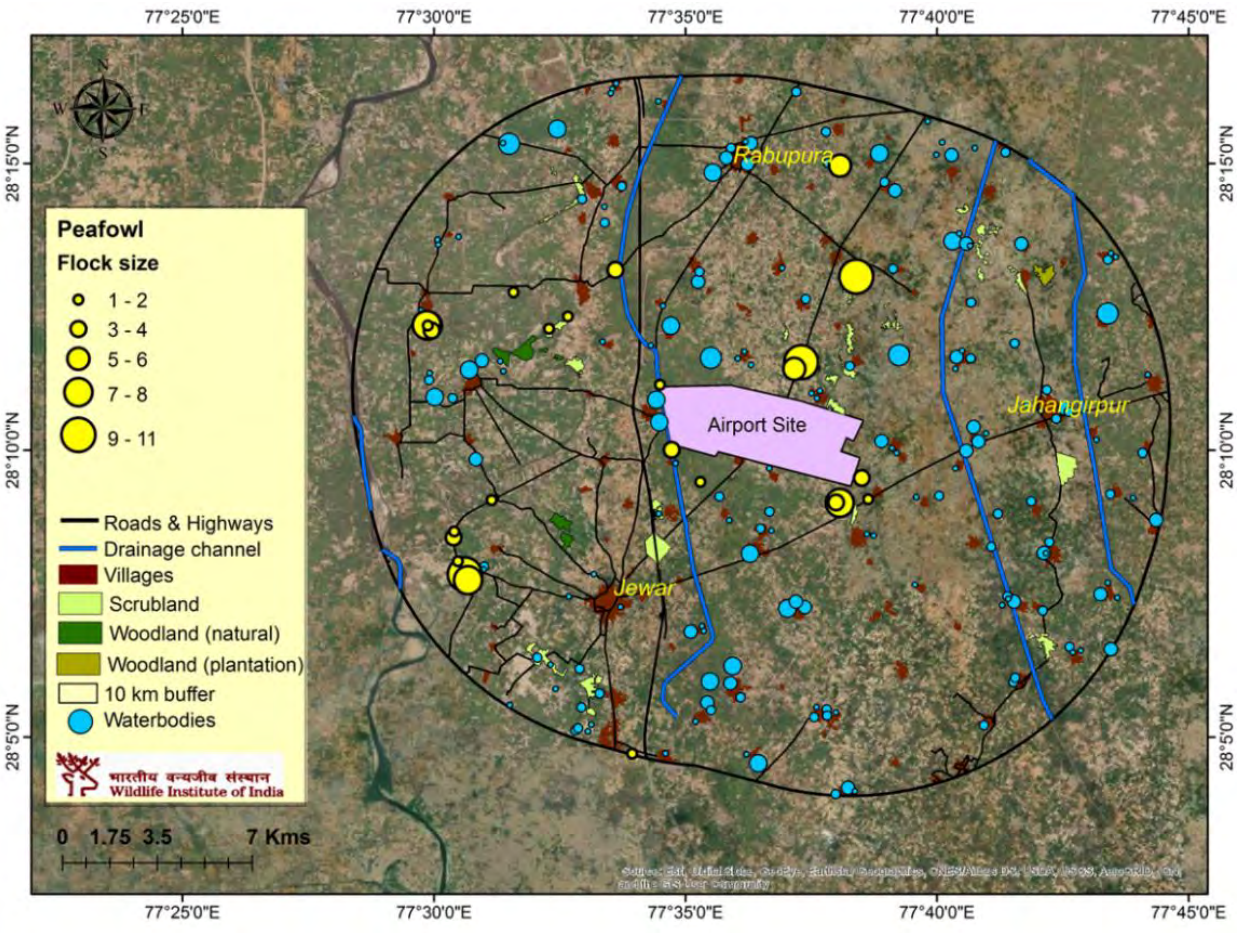


Figure 7.5. Distribution of Indian Peafowl observed in the GJIA landscape.

A flock of peafowl in the GJIA landscape

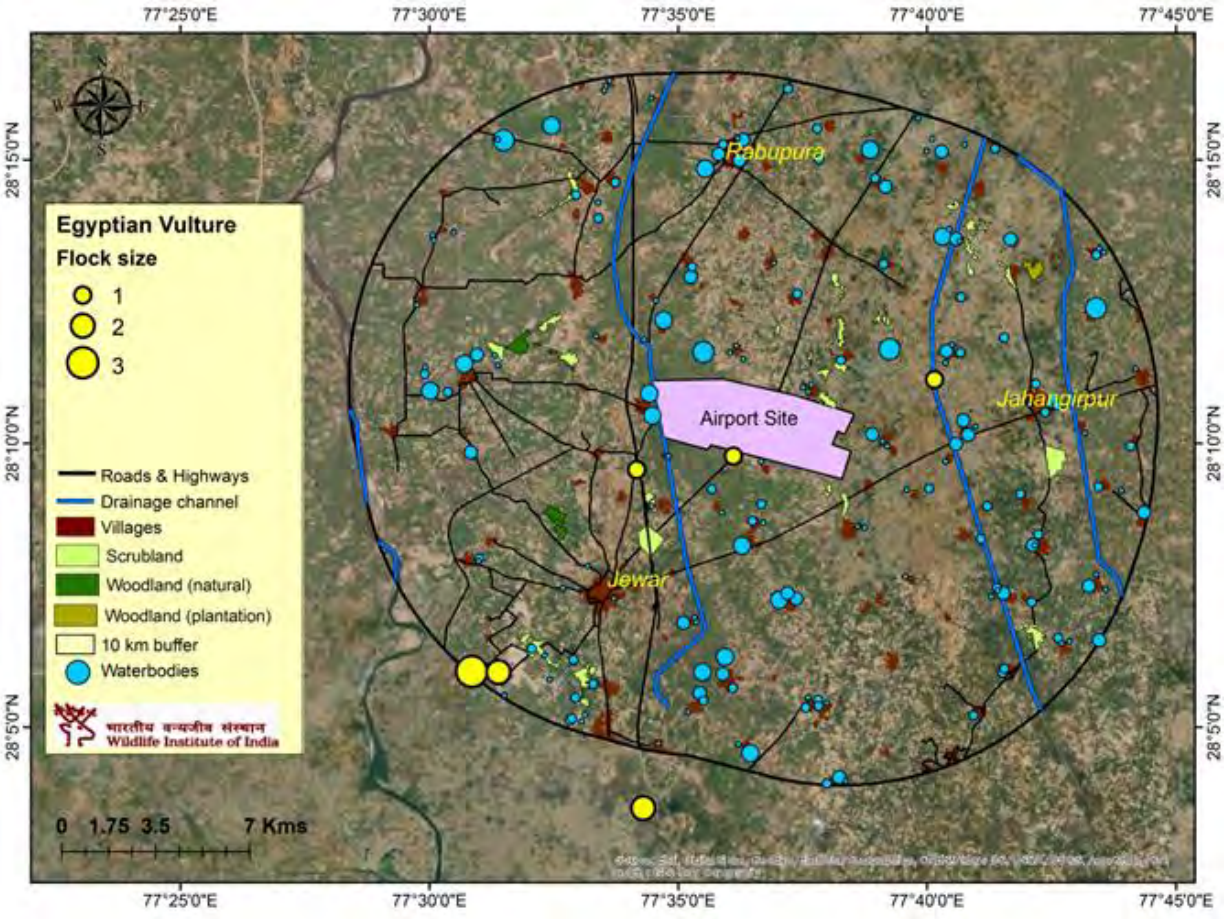


Figure 7.6. Distribution of Egyptian Vulture observed in the GJIA landscape.

An Egyptian Vulture and a Indian Spotted Eagle in the GJIA landscape

Other avifauna

Besides the bird species mentioned above, we also observed a total of 81 species within the GJIA landscape (Table 7.3) during our survey. One species is Vulnerable, six species are Near Threatened, and 74 bird species are listed as Least Concern as per the IUCN Red List (Table 7.3).

Table 7.3. List of bird species recorded based on foot and vehicle transects during our survey across GJIA landscape.

Common name	Scientific name	Family	Status	Occurrence Status	IUCN Status
Black Kite	*Milvus migrans*	Accipitridae	R	C	LC
Black-shouldered Kite	*Elanus caeruleus*	Accipitridae	R	O	LC
Oriental Honey-buzzard	*Pernis ptilorhynchus*	Accipitridae	R	O	LC
Indian Spotted Eagle	*Clanga hastata*	Accipitridae	R	C	VU
Booted Eagle	*Hieraaetus pennatus*	Accipitridae	R	C	LC
Moustached Warbler	*Acrocephalus melanopogon*	Acrocephalidae	R	O	LC
Oriental Skylark	*Alauda gulgula*	Alaudidae	R	C	LC
Common Kingfisher	*Alcedo atthis*	Alcedinidae	R	O	LC

White-breasted Kingfisher	*Halcyon smyrnensis*	Alcedinidae	R	C	LC
Bar-headed Goose	*Anser indicus*	Anatidae	WM	C	LC
Common Pochard	*Aythya ferina*	Anatidae	WM	O	LC
Common Teal	*Anas crecca*	Anatidae	WM	C	LC
Eurasian Wigeon	*Mereca penelope*	Anatidae	WM	C	LC
Gadwall	*Mereca strepera*	Anatidae	WM	C	LC
Garganey	*Querquedula querquedula*	Anatidae	WM	O	LC
Grey lag Goose	*Anser anser*	Anatidae	WM	C	LC
Indian Spot- billed Duck	*Anas poecilorhyncha*	Anatidae	R	C	LC
Lesser Whistling-duck	*Dendrocygna javanica*	Anatidae	SM	C	LC
Northern Pintail	*Anas acuta*	Anatidae	WM	C	LC
Northern Shoveler	*Spatula clypeata*	Anatidae	WM	C	LC
Ruddy Shelduck	*Tadorna ferruginea*	Anatidae	WM	C	LC
Oriental Darter	*Anhinga melanogaster*	Anhingidae	R	O	NT
Great Egret	*Egretta alba*	Ardeidae	R	O	LC
Grey Heron	*Ardea cinerea*	Ardeidae	R	O	LC
Indian Pond- heron	*Ardeola grayii*	Ardeidae	R	C	LC
Intermediate Egret	*Egretta intermedia*	Ardeidae	R	C	LC
Little Egret	*Egretta garzetta*	Ardeidae	R	C	LC
Purple Heron	*Ardea purpurea*	Ardeidae	R	C	LC
Cattle Egret	*Bubulcus ibis*	Ardeidae	R	C	LC
Little Ringed Plover	*Charadrius dubius*	Charadriidae	R	U	LC
Northern Lapwing	*Vanellus vanellus*	Charadriidae	WM	U	LC
Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	R	C	LC
River Lapwing	*Vanellus duvaucelii*	Charadriidae	R	C	NT
Asian Openbill	*Anastomus oscitans*	Ciconidae	R	C	LC
Black-necked Stork	*Ephippiorhynchus asiaticus*	Ciconidae	R	O	NT
Painted Stork	*Mycteria leucocephala*	Ciconidae	R	O	NT
Woolly-necked Stork	*Ciconia episcopus*	Ciconidae	R	C	LC
Yellow-footed Green-pigeon	*Treron phoenicopterus*	Columbidae	R	C	LC
Indian Roller	*Coracias benghalensis*	Coraciidae	R	C	LC
Rufous Treepie	*Dendrocitta vagabunda*	Corvidae	R	O	LC
House Crow	*Corvus splendens*	Corvidae	R	C	LC
Large Billed Crow	*Corvus macrorhynchos*	Corvidae	R	O	LC
Greater Coucal	*Centropus sinensis*	Cuculidae	R	O	LC
Black Drongo	*Dicrurus macrocercus*	Dicruridae	R	C	LC
Indian Silverbill	*Euodice malabarica*	Estrildidae	WM	O	LC
Streak-throated Swallow	*Petrochelidon fluvicola*	Hirundinidae	R	C	LC

Barn Swallow	*Hirundo rustica*	Hirundinidae	R	C	LC
Wire-tailed Swallow	*Hirundo smithii*	Hirundinide	R	O	LC
Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	R	C	LC
River Tern	*Sterna aurantia*	Laridae	R	O	NT
Jungle Babbler	*Turdoides striata*	Leiotrichidae	R	C	LC
Tree Pipit	*Anthus trivialis*	Motacillidae	R	C	LC
Citrine Wagtail	*Motacilla citreola*	Motacillidae	R	C	LC
Grey Wagtail	*Motacilla cinerea*	Motacillidae	WM	O	LC
Paddyfield Pipit	*Anthus rufulus*	Motacillidae	R	C	LC
Oriental Magpie-robin	*Copsychus saularis*	Muscicapidae	R	C	LC
Blue throat	*Luscinia svecica*	Musicapide	WM	O	LC
Striated Babbler	*Turdoides earlei*	Musicapide	R	O	LC
Little Cormorant	*Microcarbo niger*	Phalacrocoracidae	R	C	LC
Grey Francolin	*Francolinus pondicerianus*	Phasianidae	R	C	LC
Little Grebe	*Tachybaptus ruficollis*	Podicipediae	R	O	LC
Common Moorhen	*Gallinula chloropus*	Rallidae	R	C	LC
Eurasian Coot	*Fulica atra*	Rallidae	WM	C	LC
Gray headed Swamphen	*Porphyrio poliocephalus*	Rallidae	R	C	LC
White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	R	O	LC
Black-winged Stilt	*Himantopus himantopus*	Recurvirostridae	R	C	LC
Pied Avocet	*Recurvirostra avosetta*	Recurvirostridae	WM	U	LC
Common Sandpiper	*Actitis hypoleucos*	Scolopacidae	WM	C	LC
Green Sandpiper	*Tringa ochropus*	Scolopacidae	WM	C	LC
Little Stint	*Ereunetes minutus*	Scolopacidae	WM	O	LC
Ruff	*Philomachus pugnax*	Scolopacidae	WM	C	LC
Spotted Redshank	*Tringa erythropus*	Scolopacidae	WM	O	LC
Marsh Sandpiper	*Tringa stagnatilis*	Scolopacidae	WM	O	LC
Spotted Owlet	*Athene brama*	Strigidae	R	C	LC
Common Starling	*Sturnus vulgaris*	Sturnidae	WM	O	LC
Common Myna	*Acridotheres tristis*	Sturnidae	R	C	LC
Bank Myna	*Acridotheres ginginianus*	Sturnidae	R	C	LC
Black-headed Ibis	*Threskiornis melanocephalus*	Threskiornithidae	R	O	NT
Eurasian Spoonbill	*Platalea leucorodia*	Threskiornithidae	WM	O	LC
Indian Black Ibis	*Pseudibis papillosa*	Threskiornithidae	R	C	LC
Common Hoopoe	*Upupa epops*	Upupidae	R	C	LC

Status: R- Resident; SM- Summer migrant; WM- Winter migrant. Occurrence status: C- Common; O- Occasional; U- Uncommon. IUCN Conservation Status: VU- Vulnerable; NT- Near threatened; LC- Least concern; NE- Not evaluated, EN- Endangered

7.3. Suggested conservation strategies for other wildlife observed in the GJIA landscape:

Habitat provides food, water, and shelter, and ensures the evolutionary process. Therefore, understanding the terrestrial and wetlands wildlife species' distribution and habitat characteristics has been a focal issue in conservation planning of the GJIA landscape. We have discussed the significant conservation recommendations and strategies in the previous chapters, and most of these remained the same for other species. They also belonged to the same ecosystems, i.e., wetlands and forest or scrub habitats. Here a set of strategies targeting other wildlife species are as follows:

1. The agro-ecology system, where natural forest and scrubland are interspersed within the agriculture field matrix, is suitable wildlife refuge habitat. Besides, these habitats with native plant species also supplement the diverse micronutrient requirements of the wildlife species, as most of the crops are deficient in different micro-minerals. These micro-minerals are crucial for body function. Nilgai in this landscape showed more tolerance to dense forest in comparison to Blackbuck and was often seen around scrubland. Jungle Cat also prefers the scrublands, which we have already emphasized for protection. Golden Jackals are more adaptable and can be found near human settlements. Given the value of such conservation importance of remaining natural forest patches and scrublands, we suggest retaining the habitat quality by minimizing further degradation and enhance by planting preferred palatable plant species.

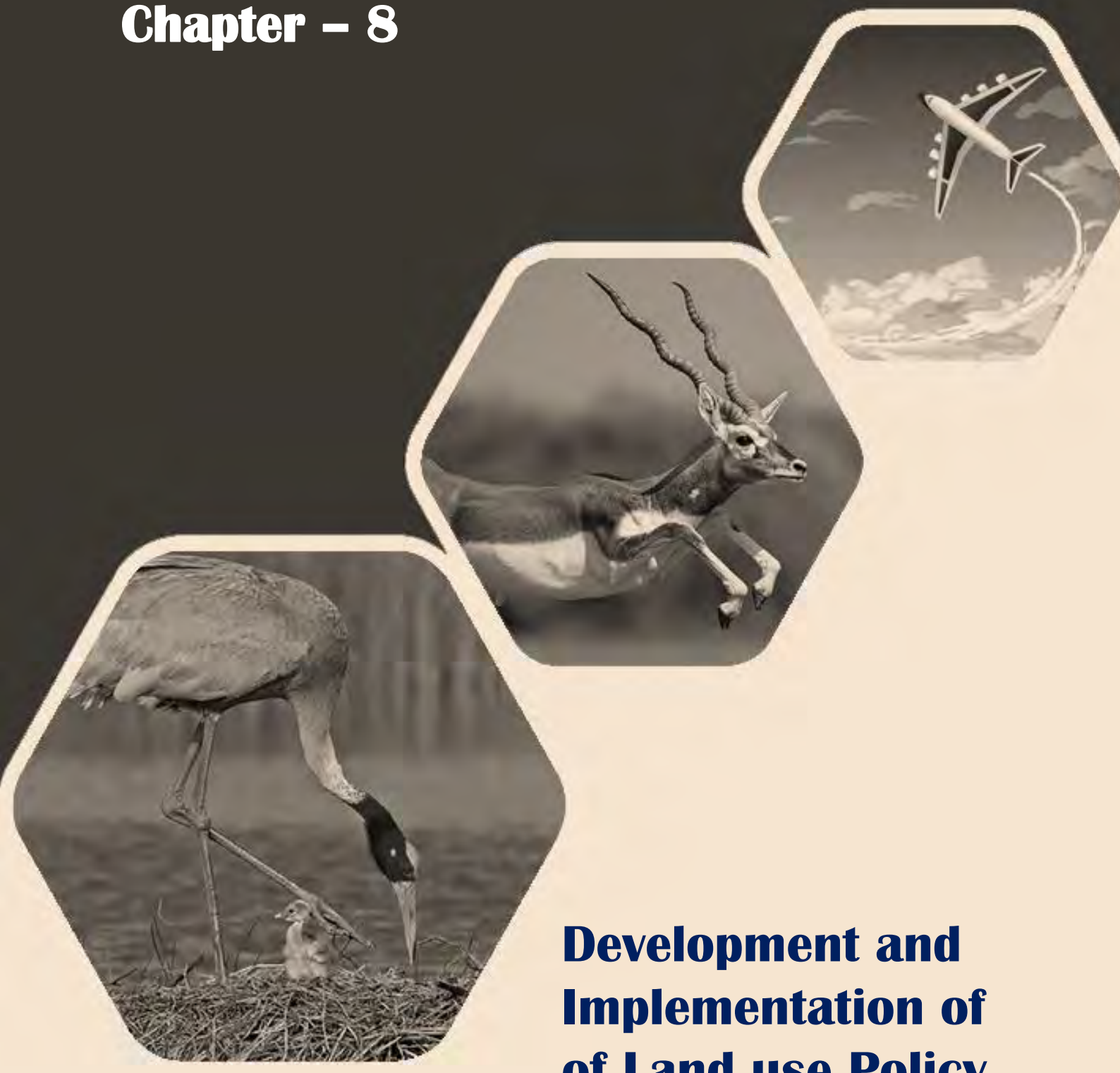
2. Our survey indicates the presence of Egyptian vulture in the GJIA landscape. The use of veterinary drug diclofenac for livestock husbandry in villages has caused the most precipitous decline of vultures in India. Therefore, we suggest State Forest Department should initiate the steps of reducing drug diclofenac, if any, through collaboration with the Animal Husbandry department. Sensitize the local people to refrain from removing any dead livestock within the GJIA landscape and extend the owner's monetary incentive. Undertake regular monitoring of the roosting site.

3. Besides Sarus conservation, we have sighted several other wetland birds in this landscape. Fish has been a significant food constituent for several bird species. However, several wetlands/village ponds are regularly given to locals on lease for fishing. This may threaten the conservation of the birds, which are dependent on fish as food. Hence, we suggest State Forest Department should plan mechanism of withdrawing the lease of fisheries of key wetlands of conservation importance within the GJIA landscape (Annexures VII, VIII). Additionally, we also recommend monitoring pesticide levels in these wetlands once a year to minimize the chances of any mass mortality.

4. According to SoIB (2020) report, scavenging and open-country raptors, migratory shorebirds, gulls and terns, forest and grassland specialists have shown long term declines as far as >50%. Therefore, efforts should be made to understand the causes of the decline of threatened species to plan science-based conservation prioritization and action.

5. The loss of ecological heterogeneity has contributed to the loss of suitable habitats for many species and resulted in significant implications for wild species of flora and fauna in the agro-ecological system. The management of hedgerows and field margins affects the abundance and diversity of flora and fauna. Therefore, we suggest extending financial incentives to the farmers for maintaining the hedgerow network in this landscape. Such habitat would immensely benefit several ground-dwelling birds, rodent species, herpetofauna, etc.

Chapter – 8



Development and Implementation of of Land use Policy around the Proposed GJIA Site

8. 1. Introduction:

The main aim of the current conservation plan is for retaining biodiversity and wildlife by following the best practices visualizing the likely impacts that may come due to proposed GJIA and minimize the risk of wildlife-aircraft strikes and thereby increasing safety concerns of aircraft and human life. The connections between land use, land cover, and wildlife habitat are at the forefront of conserving wildlife around airports (Blackwell et al. 2009). The prime objective of a land use policy for airports should prioritize aircraft safety to secure human lives and property while safeguarding the wildlife conservation aspects.

8.2. Bird and wildlife strikes: Status of threat in India:

Bird or wildlife strike hazard has been a management issue that poses a severe risk to human lives and the aviation industry (Sharma 2017). It is estimated that at least two planes are struck every day in India by airborne birds or animals on the runway leading to accidents (Sharma 2017). According to the Directorate General of Civil Aviation (DGCA), more than 4,000 aircraft suffered wildlife strikes—hit by birds or animals—in about 80 airports over the past five years between 2010 and 2016. The number of such collisions increased substantially from 380 in 2010 to 1244 in 2018 (Fig. 8.1) (Sharma 2017; Haidar 2019). Notably, Indian carriers had 410 aircraft with 8.41 lakh flights operating in 2013-14. In 2017-18 the aircraft traffic increased to 13.01 lakh while total aircraft with Indian carriers were 620 (Haidar 2019). As per available information, the strike rate (a measure of the number of bird hits and animal strikes per 10,000 aircraft movements) was highest (4.98) in 2014, which then had a fluctuation with the lowest rate of 4.57 in 2016 then again peaked to 4.71 in 2017 (Fig. 8.1). Such incidents cause considerable losses to the airline industry besides posing a threat to passenger safety. As per a rough estimate by DGCA, the airline industry loses around ~15-20 crore annually due to bird hits (Haider 2019). The accidents spiked during the rainy months from July to October. Small insects, food resources, and water bodies that attract birds are in abundance during monsoon, probably leading to increased cases (Sharma 2017). Additionally, the growing incidence of bird strikes results from the availability of food resources and suitable habitat in and around airports such as open grassland, ponds, and human habitations that generate tons of human waste. Around 2% of cases are of large mammals such as Nilgai (*Boselaphus tragocamelus*), wild pig (*Sus scrofa*), stray dogs, and jackal (*Canis aureus*) and manage to sneak into airport periphery and occupy the runaways and collide with planes (Sharma 2017).

8.3. Land use and land cover in the YEIDA Master Plan 2021:

The area surrounding the proposed GJIA site is >85% agriculture cover (see Chapter 4). YEIDA's development plan encompasses c. 60490.3 ha of area, which would be developed according to Master Plans (2021 and 2031) in phases (Annexure IV). Table 8.1 indicates different land-use types and their percent areas as per Master Plan 2021 (Fig. 8.2). Agriculture (~61%) and built-up (~7%) areas form a significant portion of the land use. At the same time, land use would change once the development phase for Master Plan 2031 would start.

8.4. A need of planning appropriate land use policy and implementation around the proposed GJIA:

Wildlife is attracted to airports because it provides basic needs – food, shelter/cover, habitat, and water (Narwade et al. 2012). As mentioned above, birds constitute ~98% of wildlife strike cases reported; they often get attracted to airports because of small animals such as rodents, birds, and insects which thrive in poorly maintained open grasslands.

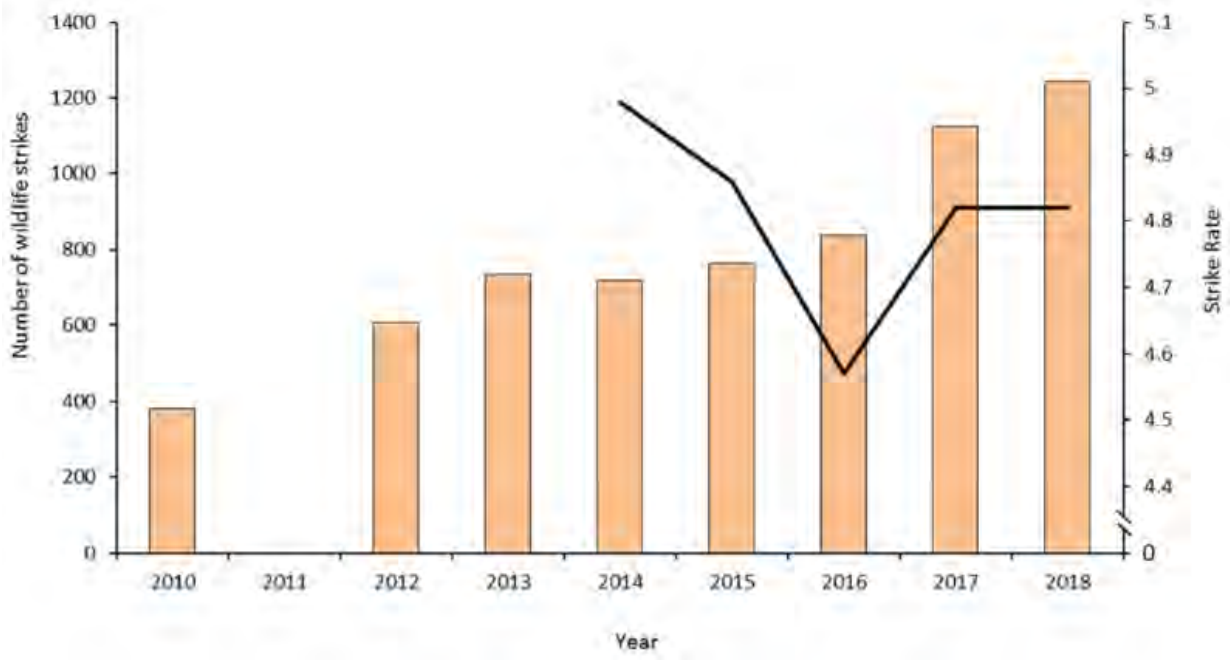


Figure 8.1. The number of wildlife strike cases recorded across 80 airports of India during 2010 and 2017. (Source: Hindustan Times, September 25, 2017).

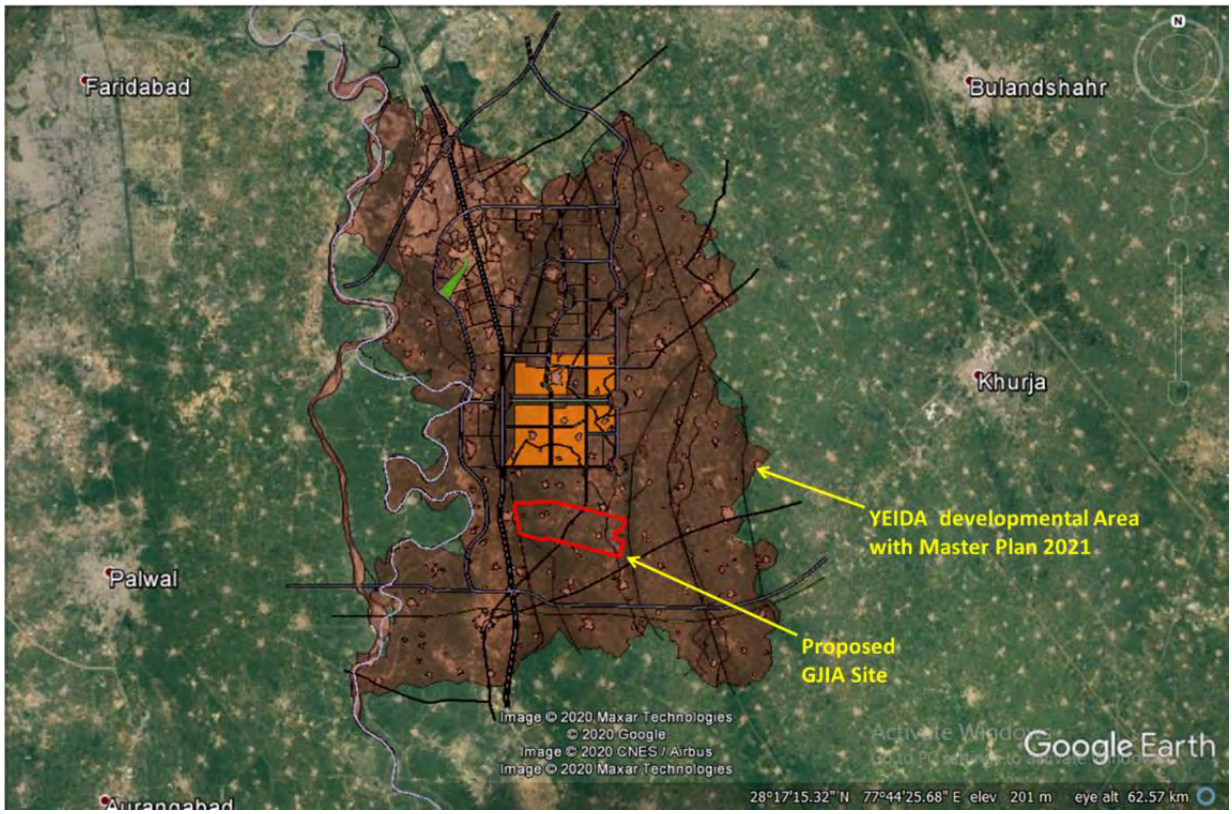


Figure 8.2. YEIDA's Master Plan 2021 for Gautam Budh Nagar and Bulandshahar districts.

Table 8.1. Land use type as per YEIDA's Master Plan 2021.

Land Use	Area (ha)	Percent Area (%)
Agriculture	37099.49	61.33
Residential	4569.76	7.55
Roads	3338.00	5.52
Green belt	2466.74	4.08
Village	2466.10	4.08
Industry	2388.76	3.95
Institution	1595.14	2.64
Commercial	1275.12	2.11
Mixed use	1223.49	2.02
Park	1051.11	1.74
Recreational Green	908.29	1.50
Transport	592.94	0.98
Canal	288.22	0.48
Traffic Islands	287.92	0.48
Drain	108.81	0.18
Forest	103.74	0.17
Drain Greenbelt	100.82	0.17
Canal Greenbelt	93.66	0.15
Pond	57.27	0.09
Facility	29.66	0.05
Nala	20.93	0.03

Source: GIS data provided by YEIDA

These grasslands provide suitable habitat and cover to such species, thereby making themselves attractive food resources for many bird species, including raptors. Birds need cover for resting, loafing, roosting, and nesting. Availability of habitats in the form of trees, scrubland, weed patches, and sometimes airport structures often provide refuge to several wildlife species. Almost any area free from human disturbance may provide a suitable roosting site for one or more bird species. Often small water pools and stagnant water, which mainly come up during the rainy season around the airports, also attract birds. Landfills are usually located on or near airports because both are often built on publicly owned lands. Landfills contribute to bird strike hazards by providing food sources and loafing areas that attract and support thousands of crows, mynas, egrets, and other species (Narwade et al. 2012).

Suggested measures (Narwade et al. 2012) which may be considered for implementation are as follows:

a. Management should cover all related aspects not only within the periphery but around the airport and plan policy in developing strategies and mechanism to avoid future potential bird strikes for safeguarding the aircraft and human life with the active participation of local government bodies such as district municipality.

b. Proper garbage disposal and waste management within the airport property and in the airport's vicinity,

c. Proper management of open sewerage, storm-water drains, canals, and any stagnant water in the vicinity of the airport.

d. Regulation on waste created and disposal from fish or meat market in the area.

e. National/Local regulations which prevent breeding pigeons or racing of homing pigeons in the vicinity of airports.

f. No trees/shrubs shall be allowed on land within 500 ft. of runway centerline as well as runway ends. Rules regarding the existence of trees and bushes in the vicinity of airport India: section 9-A of Indian Aircraft (1934) empowers the Central Government to restrict the construction of buildings and the growth of trees within 20 km aerodrome reference point. Accordingly, the authority should manage habitat within and around the airport, which does not attract wildlife and does not provide any opportunity for any wildlife species to enter inside the airport. This also requires regular monitoring and management of areas which are potential wildlife habitat.

g. Making communities and people in the airport vicinity aware of the importance of keeping their areas clean and the dangerous effects of dumping waste around may have impact flight operations and safety of human life.

h. Boundary walls should be wildlife proof, including burrowing species.

8.4.1. Consider bringing policy for land sharing and sparing and fallow land as means of conservation strategy of natural habitat in agro-ecological region:

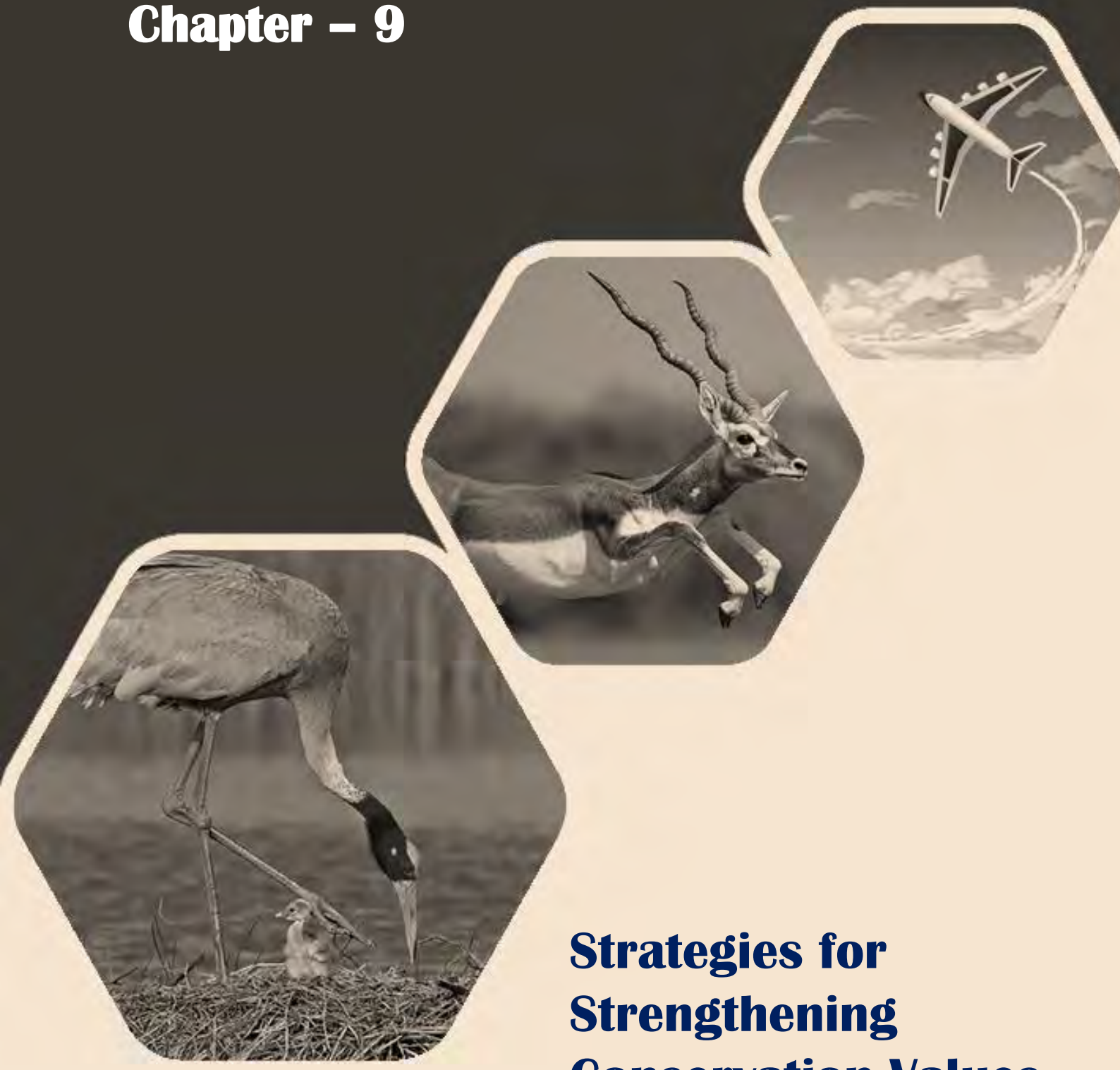
Spatial expansion and intensification of agriculture have been considered the primary cause of the loss of global biodiversity, and the trend may continue as projected for the coming decades. Increased demand for food production across the world has left environmental footprints with decreasing biodiversity. Ample evidence exists in the literature that a loss of biodiversity can affect ecosystem functioning, productivity, resilience, biogeochemical cycles, and human well-being. Alleviating the impact of agriculture on biodiversity is a significant concern for human societies; therefore, efforts have been for sustainable agriculture and retaining biodiversity in agro-ecological regions. An essential part of the scientific and political debate on biodiversity and agriculture in the past decade has revolved around discussions, analyses, applications, and extensions of the land-sparing versus land sharing framework proposed by Green et al. (2005). They suggested that agriculture should focus on intensively farmed land to conserve additional biodiversity-rich natural spaces elsewhere (land sparing) or wildlife-friendly but less productive practices that conserve fewer wild natural spaces elsewhere (land sharing). Based on the empirical studies, scholars have provided ample evidence of increased biodiversity values by using various means such as land-sparing, land sharing, retaining fallow land, hedgerows, plantation of natural endemic trees, etc. in agro-ecological system. Realizing the values of these approaches in enhancing biodiversity, the Agriculture Ministry, Govt. of India, may bring some policy to incentivize the farmers who actively participate in conserving biodiversity on farmland.

8.4.2. Policy to minimize threats of stray/feral dogs to the biodiversity:

Stray/feral dogs have become a signficant menace to wildlife (Gompper 2014) especially outside the Protected Areas (PAs). Agro-ecological regions of Gangetic flood plains are rich in biodiversity and is mostly outside the PAs. Tropical grasslands all along the various rivers and tributaries support at least eleven threatened grassland bird species, and there are nine IBA. Of these, the Sarus crane is of essential conservation species in this ecoregion. Rahmani et al. (2019) reported that breeding success of Sarus crane is impact due to the presence of feral/stray dogs as they predate on chicks and damaged eggs. Therefore, we

strongly suggest bringing the policy to minimize the reported threats to wildlife by stray/feral dogs to the wildlife with the support of local administration and the State Animal Husbandry Department in GJIA landscape as well as in other wildlife areas.

Chapter – 9



Strategies for Strengthening Conservation Values of the Proposed GJIA Site

9.1. Introduction:

Ecosystems and their biological diversity are critical for humans' survival and wellbeing and provide vital "services" essential to national economies. The increasing degradation of ecosystems and wildlife habitats and associated loss of biological diversity due to anthropogenic factors is a global crisis. Such problems are significant in developing countries. Therefore, given the value of ecosystem services, protection of wildlife habitats, and conservation of their floral and faunal values must be recognized as the country's greatest priority. Different developmental activities lead to habitat fragmentation and create barriers for animal movements resulting in decreased genetic fitness. The country's growth is inevitable; therefore, integrating conservation concerns in infrastructure development is universally acknowledged by the planner, developmental agencies, and ecologist in most countries. Different countries are also trying to retrofit the required conservation measures among the already developed infrastructure. Therefore, with the increasing such activities, more significant concern has been to integrate species' conservation plans and ensure that animal passage is not restricted. Govt. of India has circulated the "Eco-Friendly measures to mitigate impacts of Linear Infrastructure on wildlife" (WII, 2016). Hence, addressing this priority inter-alia requires specialized institutions' inputs to conceive, plan, and implement the conservation agenda responsibly and effectively in close partnerships with a range of stakeholders.

Conservation is a strategy for achieving ecological security, human wellbeing, and sustainable development (WII, 2016). While considering the conservation plan, it is of utmost importance to consider that adequate required resources are met to survive a species, i.e., food, water, and cover. Therefore, significant concern has been to assess configurational and compositional heterogeneity of the habitat in the landscape, quality of habitat, extent of anthropogenic factors. Quantification of species-specific habitat requirements has been a challenge; therefore, the best way of ensuring habitat requirements of all taxa of any ecosystem is to consider the species, which are either flagship, keystone, indicator, or top predator of the food pyramid. Such conservation approaches are considered to retain the ecological and evolutionary processes. Additionally, the emphasis has also been given to the species of conservation importance as identified under different Schedules of the Wildlife (Protection) Act 1972 or listed under various categories of IUCN while preparing a conservation plan of the landscape. Thus, common conservation practice protects habitat from fragmentation and degradation due to anthropogenic factors and retain the connectivity among these habitat patches.

The GJIA landscape has flora and fauna of Semi-arid and Upper Gangetic plain eco-regions, therefore, we consider very closely assessing and quantifying terrestrial and wetlands. Additionally, the area is the abode of Indian Blackbuck, Sarus, Egyptian vulture, and all these species are of conservation importance in the country. Moreover, this landscape is nested with a series of water bodies, which provide habitat to several wetland birds.

9.2. Achieving effective conservation strategies in the GJIA landscape through the consultative workshops with stakeholders and knowledge partners:

Stakeholder participation can significantly contribute to strengthening the design, implementation, and assessment of conservation plans (Initiative for Climate Action Transparency (ICAT) Stakeholder Participation Guidance, 2018). Stakeholder participation enhances policies' effectiveness by integrating stakeholder knowledge and perceptions and builds support for systems through increased transparency, accountability, and legitimacy of decision-making (ICAT Stakeholder Participation Guidance, 2018). Considering this in view, a consultation workshop was envisaged at the initial and final stages of the project for integrating the "Citizen Science" knowledge to

commensurate with the conservation of flora and fauna for successfully mainstreaming the interventions in the conservation plan for the GJIA landscape through a participatory process.

9.2.1. 1st Consultation Workshop:

1st Consultation workshop on "Planning effective biodiversity conservation strategies around Greenfield Jewar International Airport" was organized on 1st February 2020 at Gautam Buddha University, Greater Noida, Uttar Pradesh. Thirty-two participants from NGOs, NGI, Forest Department, Uttar Pradesh, MoEFCC, Govt. of India, officials from YEIDA, Greencindia Consulting Private Limited (GCPL), PricewaterhouseCoopers Private Limited (PwC), and others (Fig. 9.1.) attended the workshop.

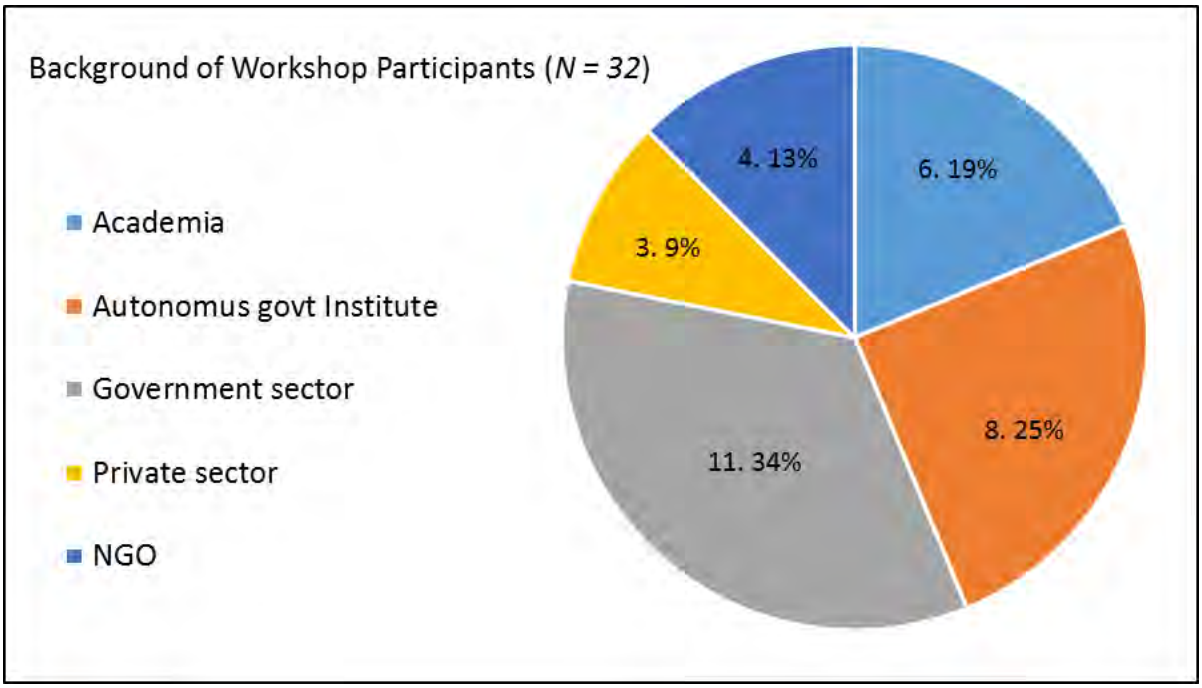


Figure 9.1. Percent distribution of stakeholders and knowledge partners participated in the Consultation Workshop from different organizations.

Objectives and scope of the consultation workshop with stakeholders and knowledge partners were as follows:

- To build understanding, participation, and support for identifying the "Ecological Focus Area."
- To build understanding, participation, and support for identifying species (terrestrial and water birds) of conservation importance.
- To build understanding, participation, and support for identifying wetlands for landscape-level conservation planning.
- To improve the design and implementation of sustainable development policies and assess potential landscape transformational impacts on biodiversity.
- To facilitate the strategies for mainstreaming conservation goals in the development of Greenfield Jewar International Airport (GJIA).

During the workshop, stakeholders and knowledge partners suggested the following key issues while preparing the conservation plan for the GJIA landscape.

- Conserve and ensure adequate protection to the existing forest, scrub, and grassland patches, which are habitat for different ground-dwelling bird species and terrestrial fauna in the GJIA landscape. Improve these patches by eradication of excess *Prosopis juliflora* encroachment and maintain cover in a mosaic pattern.

- Plan adequate measures to conserve the Blackbuck population. If required, translocation may be thought to nearby populations such as "Pallar jheel (falling under Tappal taluka c. 15 km from Jewar), Aligarh and Atrauli. Besides, participants also suggested for a scientific study for the conservation of Blackbuck in the GJIA landscape.

- Assess the status of lesser-known species such as Indian Pangolin (*Manis crassicaudata*), hedgehog (*Hemiechinus* sp.), otters (*Lutra* spp.), and hyena (*Hyaena hyaena*).

- Undertake a detailed study for status and conservation threats to Sarus, such as Electrocution, free-ranging dogs, stress, and impact of pesticides for planning effective conservation strategies in the GJIA landscape.

- Establish a Rescue and Rehabilitation center in the area for animal rescue during the construction phase.

- We planned conservation strategies intitally within a 10 km radius around the GJIA site, and it was suggested to look beyond this.

- Establish a corpus/foundation for wildlife conservation in the GJIA landscape and other adjoining populations.

- Undertake a detailed study to assess likely impacts of the construction and operational phase of the GJIA airport and ancillary infrastructure development on biodiversity and suggest fine-scale management strategies for conservation in the GJIA landscape.

- Involve public or community participation in conservation and plan "Community Tourism".

- It was suggested that YEIDA should have a serious relook at the master plan for development in the area and declare no development around ecologically important areas.

9.2.2. 2nd Consultation Workshop:

- Finally, we shared our suggested "Conservation Stargey" for biodiversity conservation in and around GJIA landscape by orgnazining a consultation workshop with our stakeholder and knowledge partners ranging from governmental to non-governmental agencies on 4th January 2021.

- Because of COVID-19, we organized this as a "Virtual Workshop" through online "Video Conferencing." More than 20 partcipants attended the workshop. Opening remarks were made by Dr. A.V. Singh, CEO, YEIDA/NAIL; Mr. Sunil Pandey, HOF and CWLW, U.P.; Dr. Dhananjai Mohan, Director, WII.

Key suggestions made during workshop for consideration were as follows:

- It was suggested to consider learnings from the Yamuna Biodiversity Park Model" while restoring wildlife habitat and experts may be involved.

- Organize mid-term discussion with stake holder and knowledge partners during Phase-II of the project.

- Suggested to for eradication of *P. juliflora* patches in the GJIA landscape and maintain dry deciduous scrub habitat.

- Manage proliferation of weed infestation in water bodies and marshy places.

- Suggestion was made to declare "Dhanauri wetland" as wildlife sanctuary and Ramsar site as soon as possible. Additionally, it was also suggested to minimize any development around this area.

- Master plan of development agency should recognize the values of wetlands in the GJIA" landscape and should be declared under "Wetland Protection Act".

- Suggested to implement SOP guidelines suggested by MoEFCC for managing stray dogs in tiger reserves for this landscape.

- Suggested to include "Butterflies" as pollinators under phase II project.

All the suggestions that came during this workshop were incorporated in the Final Report.

9.3. Conservation Action Strategies for the GJIA landscape:

The GJIA landscape provides habitat to different flora and fauna of Semi-arid and Upper Gangetic plain eco-regions due to a mosaic of terrestrial and wetland habitats. Therefore, we confine our discussion on the suggested critical strategies of these two habitats.

9.3.1. Loss of wildlife habitat for Blackbucks and Sarus inside GJIA site in context to adjoining areas:

Of the total number of Blackbuck individuals (n=258) sighted in the GJIA landscape, a small sub-population of Blackbuck of c. 29 individuals were sighted on the southern part of GJIA site near Rohi-Parohi villages. Likewise, we found two flocks of Sarus, each of 5 and 11 individuals inside the GJIA site out of the 76 individuals seen in the GJIA landscape. Our analysis indicated a large number of sub-populations of Blackbuck and Sarus crane outside than inside the GJIA site. GJIA site has 11 suitable wildlife habitat patches of c. 26 ha and five perennial water bodies with a total area of 2.5 ha. Compositional and configurational scrub habitat patch analysis revealed that (i) the richness and number of patches are much higher outside than inside the GJIA site, and (ii) adequate habitats for both the species are available within their ranging behaviors of these two species outside the GJIA site. Similarly, the GJIA landscape is also nested with 195 perennial water bodies. Because of the habitat connectivity between the GJIA site and adjoining areas, there is a high probability that both the species may disperse to the adjoining habitat or may join other sub-populations during the construction phase.

9.3.2. *Managing wildlife habitat patches within GJIA landscape: Restoration of scrub habitat interspersed with grasslands*:

The most dominant natural terrestrial vegetation type of wildlife habitat of conservation importance is scrub habitat interspersed within the agro-ecology landscape. These natural habitats provide refuge to the Blackbuck, Jungle cat, Jackal, ground-dwelling birds, and herpetofauna. Thus, these are critical for conservation planning as they provide refuge habitat to several species. Chapter 5 describes the potential habitats of the terrestrial ecosystem that could cater to the needs of the Blackbucks and other associated species. These potential areas represent the good composition (patch richness and abundance) and configuration (patch size, complexity, and connectivity) characteristics. Analysis of configurational and compositional heterogeneity of scrub patches in this landscape revealed that the patches are within the ranging behavior of most of the species of conservation importance in this landscape. The population can be managed in the meta-population framework in the GJIA landscape if the existing scrub patches are retained and manage these patches for meeting the habitat requirements of species of

this landscape. We visualized an increase in the development of infrastructure in the landscape after the operation of the GJIA. Therefore, we have also examined the potential habitat beyond 10 km from the GJIA site for conservation purposes, i.e., within 25 km.

Overall conservation of wildlife habitat:

Scrubland except a few woodland patches is critical wildlife habitats in the agro-ecology region of the GJIA landscape. Of these patches, 45 and 100 are key wildlife habitat areas within 10 and 25 km from the GJIA site (Annexure-V). Distribution patterns and inter-patch distance indicated the possibility of managing wildlife species as "Stepping-Stone" at the landscape level. The inter-patch distance is within the ranging pattern of wildlife species of this landscape.

Besides, there are a series of the canal network in the GJIA landscape and support natural vegetation of the semi-arid regions and provide habitat to several taxa.

Intensive conservation of crucial wildlife habitats:

We observed three sub-populations of the Blackbuck *viz*. north-eastern, south-eastern, and close to Jewar town within 10 km of GJIA site. All these sub-populations are within the ranging pattern observed in Blackbuck in other populations of India. Therefore, we identified four clusters of scrubland patches (Fig. 9.2) for active management related to the habitat restoration, improvement, and management as a model for ecological sustainability in biodiversity conservation planning. These four patches account for 223 ha of a total 572 ha of potential wildlife habitat within a 10 km radius landscape.

Visualizing the increase in infrastructure after the operation of the GJIA and to safeguard the biodiversity values of this landscape, we identified a cluster of three wildlife habitats between 10 km and 25 km from the GJIA site (Fig. 9.3). The protection and management of these critical habitats and other wildlife habitat patches (Annexure-V) may ensure the viability and sustainability of this landscape's biodiversity values.

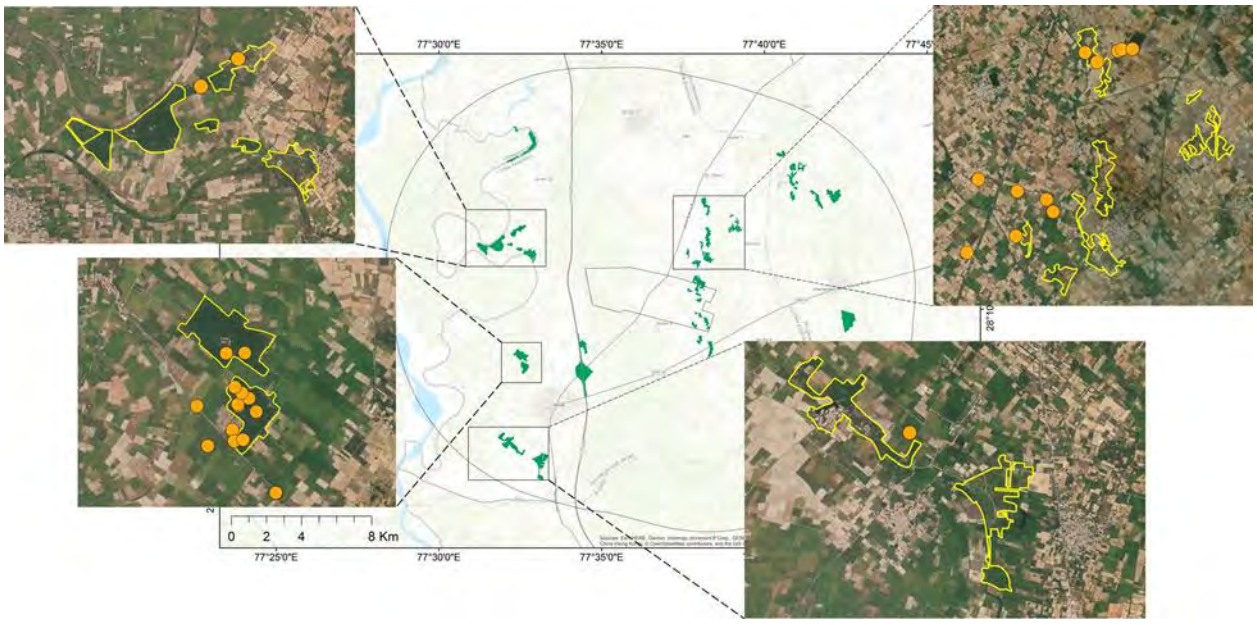


Figure 9.2. Potential wildlife habitat patches within 10 km radius from the GJIA site for conservation planning.

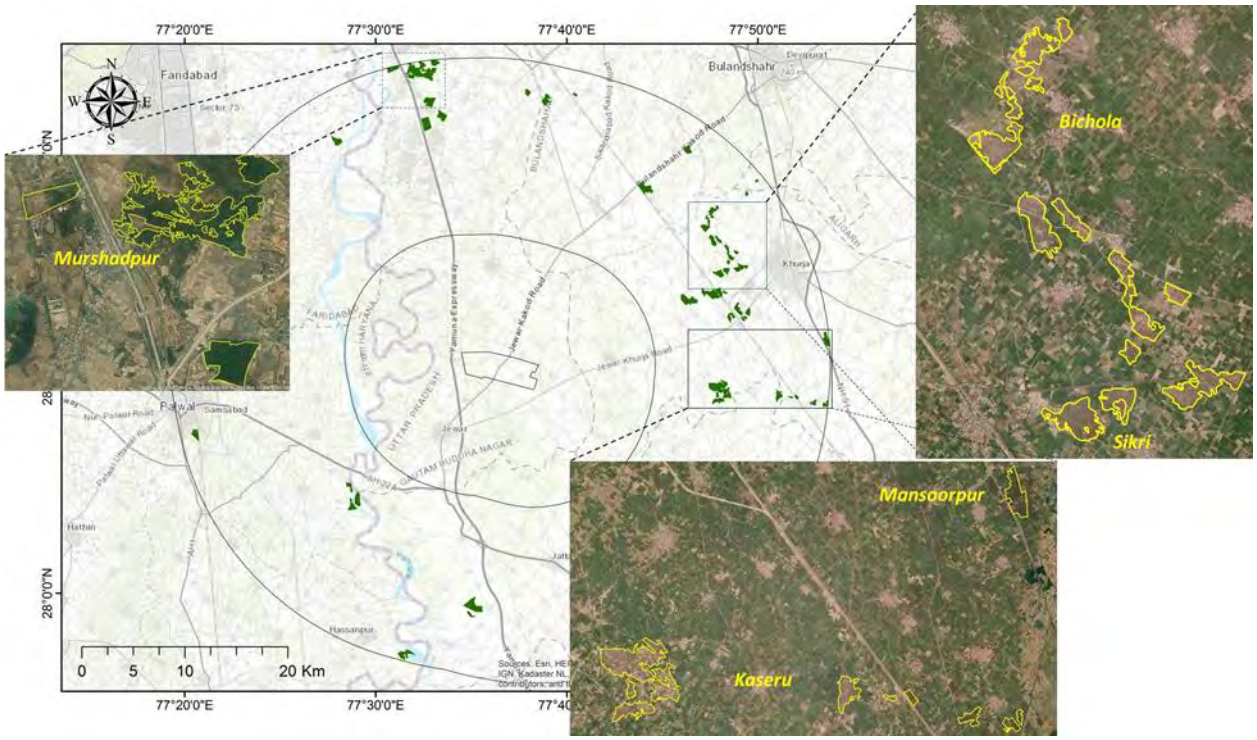


Figure 9.3. Potential wildlife habitat patches within 25 km radius from the GJIA site for conservation planning.

Management strategies:

1. Assess and monitor habitat quality of all the identified wildlife habitat patches (Annexure-V) once a year and undertake appropriate management intervention to restore habitat for Blackbuck populations and other wildlife. Besides, we suggest monitoring the status of recommended critical wildlife habitats patches (three patches) twice a year.

2. It is suggested to protect, manage, and restore natural vegetation through community participation all along canals.

3. Blackbuck populations of this landscape though it is small, genetic analysis, indicated the presence of high allelic diversity despite low heterozygosity. This diversity is comparable with other wild ungulates. Blackbucks are male-biased dispersal. Therefore, conserving the suggested scrubland habitat patches as "Stepping-Stone" may enhance the male dispersal capacity to improve and retain genetic diversity.

4. Monitor the excessive encroachment of the wildlife habitat by woody species and maintain a mosaic of grasslands and scrubland by eradicating woody species sapling.

5. Monitor the habitat's encroachment by *Prosopis juliflora* and control the species' spread by regular removal of the species' sampling.

6. Suppose the wildlife habitat patches are heavily infested with the *P. juliflora*. In that case, it is suggested to eradicate and retain few individuals of species in a mosaic pattern as species provide adequate cover to several wildlife species during summer.

7. Undertake activities to improve the habitat's quality and food availability by planting palatable species endemic to the semi-arid region (Annexure IX).

8. Minimize people's dependency and livestock grazing in suggested "Key Wildlife Habitat patches."

9.3.3. Conservation of Sarus habitat and wetlands:

We surveyed the use of habitat Sarus within 10 km from the GJIA site. Our 84% sightings were outside the GJIA site. We did not find any differences in Land use patterns across the landscape. Therefore, it suggested that the presence of adequate potential Sarus habitat all through across the GJIA landscape. We identified 653 wetlands using Remote Sensing and GIS analysis, of which 30% are perennial across the GJIA landscape. Realizing inevitable growth in infrastructure around the GJIA site and minimizing the chances of "Bird Aircraft Strike Hazard (BASH), we prefer to emphasize conservation of Sarus habitat outside 10 km from the GJIA site. Sarus needs small shallow wetlands to breed, raise chicks, and forage, therefore, protection of small village wetlands are extremely important (Rahmani et al., 2019). Utilizing information on preferred wetlands characteristics by Sarus Crane (Rahmani et al., 2019), we identified 145 perennial wetlands, which are of conservation importance for Sarus in this landscape (Annexure VIII).

Conservation of "Dhanauri wetland":
During the stakeholder workshop convened on 1st February 2020, participants emphasized a need of conserving Dhanauri wetland (DW) close to the GJIA site. This wetland of 140 ha is an IBA site and the most popular place for the Bird watcher Clubs of NCR. This wetland provides habitat to many migrant and resident bird species and is a roosting site for the Sarus Crane population of this landscape. Therefore, it requires high conservation priorities and protection from any developmental activity.

Management strategies:

1. The majority of wetlands monitored by us were infested with weeds such as water hyacinth (*Eichhornia crasssipes*). Therefore,

we suggest monitoring the extent of weed infestation of the proposed 145 perennial wetlands and plan an eradication program in coordination with the State Fisheries and Irrigation Department to create suitable habitats for the wetlands.

2. Prevent identified wetlands from encroachment and reclamation for agriculture purposes. We suggest these proposed wetlands be notified under Wetlands (Conservation and Management) Rules, 2017, for effective conservation.

3. Monitor the changes in land use, hydrological, limnological, water quality, pesticides level of the suggested wetlands once a year. Develop appropriate strategies to minimize the impact, if any, for the conservation of wetland.

4. Prepare the "Management Plan" for the conservation of "Dhanauri wetland" and manage accordingly.

5. Initiate the process of declaring as soon as possible "Dhanauri wetland" as a "Community Reserve" or Wildlife Sanctuary and "Ramsar Site"

6. During May and October, biennially bird survey is being conducted globally by the eBird organization of the International Bird Survey. Likewise, use Citizen Science in coordination with the eBird organization to monitor the bird abundance during May and October each year in the GJIA landscape and contribute to this landscape's global data.

7. Minimize the disturbance level in the 145 identified wetlands to the conservation of wetland faunal diversity and stop fishing and "singhadra" cultivation in coordination with the Fisheries and Irrigation Department of the State.

9.3.4. Financial incentive schemes for conservation support:

Conservation of landscape level biodiversity in agroecosystem:

Meyers et al. (2000) stated that protected areas alone would not be enough to guarantee most of the Earth's biodiversity (Myers et al., 2000). It is necessary to consider enhancing biodiversity conservation within anthropogenic landscapes. Scholars have documented that the agroecosystem's compositional and configurational heterogeneity enhances the overall biodiversity conservation within anthropogenic landscapes along with increased agriculture productivity due to ecosystem services such as pollination, pest control, storm protection, and nutrient cycling, etc. Suggested measures of achieving this through augmenting natural vegetation through land sharing and sparing, plantation of natural trees/forest, hedgerow and field margins, and fallow land. Therefore, we suggest, financial incentives should be extended to the farmers involved and assisting in restoring/retaining the natural vegetation in agroecological region of the GIJA landscape.

Protection of Sarus crane habitat and nest:

Sarus crane is an indicator species of freshwater wetlands, and the preferred habitat is a matrix of crop fields, fallow fields, and wetlands in a large human-dominated landscape. It frequently uses flooded agricultural areas for foraging and nesting. Stealing or destruction of nests is a big problem across the distribution range of the species. Hence, local farmers' support is essential for achieving effective conservation of the agro-ecological region species. Therefore, we suggest extending the appropriate financial incentive to the farmers who protect the nest and secure habitat of Sarus crane in this landscape.

9.3.5. *Establish Animal rescue and rehabilitation facility near GJIA site*:

During stakeholder workshops on 1st February 2020, participants mentioned that it is likely that wildlife may be affected, injured, and require capture during the construction phase of GJIA. Therefore, it was suggested to establish a temporary facility for "Animal Rescue and

rehabilitation of wildlife" near the GJIA site. Participants opined to prioritize Veterinary Officers for the facility who are trained in dealing with such rescue and rehabilitation of wildlife. Therefore, the allocation of Rs. Five hundred lakhs have been suggested for establishing and running the facility for five years.

We also suggest setting of two fully equipped "Rapid Response Team" under this facility to rescue wildlife species whenever is needed.

9.3.6. *Community based ecotourism*:

Ecotourism is tourism based on nature experiences, which involves visiting natural areas to learn, study, or carry out environmentally friendly activities. It focuses primarily on experiencing and learning about nature, its landscape, flora, fauna, and their habitats and cultural artifacts from the locality. Such models enable boost the economic and social development of local communities and gaining partnership of the local community in conservation goals. Such models are successfully operating across several Protected Areas in India.

Exclusion of the wildlife such as Blackbuck, Sarus crane and Nilgai from the agriculture fields using any barrier such as fences is not possible in the GJIA landscape. An alternative approach for community conservancies to generate benefits through wildlife tourism. Therefore, the community shall develop an ecotourism business based on wildlife viewing of their farmland and adjoining scrublands. The community shall be allowed to create low-impact infrastructure such as hiking trails, viewpoints/hides/machans, etc. This model would make people more tolerant of the loss they bear because of wildlife in their agricultural fields.

State Govt. shall develop suitable schemes to assist with technical, financial, and management support as appropriate in promoting such an "Ecotourism Model" in the GJIA landscape.

9.3.7. *Public awareness programmes*:

Sensitizing the public and various other stakeholders related to the development of wildlife is one of the keys to successful conservation planning. The target groups can be schools, colleges, village people, and other staff members. Emphasizing the need and significance of biodiversity and wildlife conservation to humans can broaden their understanding and awareness levels.

We suggest the followings:

1. Organize lectures regularly on "Wildlife Conservation for the wellbeing of human survival" with the support of NGO/Govt. organization in schools and colleges of Gautam Budh Nagar District.

2. Organize "Blackbuck and Sarus Conservation Photography" competition for the schools and colleges of the GJIA landscape during the Wildlife Week and reward winners during a function.

3. Sensitize local farmers in "Understanding the significance of pollinators and natural vegetation" for enhancing crop productivity and "Wetland conservation" with the support of NGOs.

9.3.8. Policy level intervention for planning effective conservation strategies in the GJIA landscape:

- Stray dogs in villages are major conservation threats in agro-ecological regions as they predate on young fawn of the wild ungulate species, remove the egg and kill birds. Therefore, it is suggested to undertake sterilization of stray dogs in and around Blackbuck areas and Sarus supporting wetlands in GJIA landscape, and around "Dhanauri Wetland" by the State Forest Department in coordination with the State Animal Husbandry Department and NGOs to reduce significant predation of Sarus chicks by stray dogs.

- State Forest Department should intiate the process with Ministry of Agriculture, Govt. of India to bring policy of “Land sharing and Land sparing” for retaining the natural vegetation to support diverse pollinators and other predators for biological control of the agriculture pest species.
- Saras crane has been approved as a mascot and emblem of the GJIA. Dr. Asad Rahmani suggested to establish a “Statue of pair of dancing Saras Crane” at the entrance of the airport as done for Japanese crane at Hokkaido Airport, Japan. Policy decision may be taken in this context.

Statue of Japanese Cranes at Hokkaido Airport, Japan
(Photo credit: Dr. Asad Rahmani)

9.3.9. ***Creation of "Greenfield Jewar*** *International Airport Conservation Foundation (GJIACF)":*

Non-Governmental Agencies to secure better human health by preserving natural resources and mainstreaming in the development for achieving the country's growth. Of the different conservations foundations of the world, The Mission of "The Conservation Foundation, USA" is to "improve the health of our communities by preserving and restoring natural areas and open space, protecting rivers and watersheds, and promoting stewardship of our environment." The importance of such a foundation in retaining and conserving natural resources has been acknowledged in today's global context.

To boost tiger conservation in India and realize the value of such a foundation in conservation, the Wildlife (Protection) Amendment Act, 2006, entails that the State Government shall establish a "Tiger Conservation Foundation" for tiger reserves. This is aimed to facilitate and support their management for conservation of tiger and biodiversity and to take initiatives in eco-development by the involvement of people in such a development process.

The GJIA landscape comprises a mosaic of predominantly agricultural fields with natural habitats, which support several wildlife species, and habitats such as small forest patches, scrublands, and water bodies. The key species and habitat of conservation importance of this landscape are Blackbuck, Sarus, and wetlands. Therefore, it is imperative to establish an adequate conservation Fund for the GJIA landscape "Greenfield Jewar International Airport Conservation Foundation" (GJIACF) with the State Forest Department, Uttar Pradesh for implementation of management actions and ensure biodiversity conservation and ecosystem services in the human-dominated landscape.

We propose allocating at least 0.5 % of the total cost of the GJIA project to the "Greenfield Jewar International Airport Conservation Foundation" to carry out targeted actions by the State Forest Department in line with the suggested broad conservation strategies for this landscape and incorporate mid-term suggested conservation strategies if needed.

It is suggested that

(i) State Forest Department, Uttar Pradesh should constitute a committee and include one member each from the YEIDA and the Wildlife Institute of India

(ii) Prepare operational guidelines of the GJIACF, and

(iii) Use only 80% percent/year of the interest accrued on corpus fund of GJIACF for the conservation proposes exclusively for this landscape.

Learnings of "Tiger Conservation Foundation" guidelines may be considered while drafting guidelines for this landscape.

9.3.10. Annual allocation from Corporate Social Responsibility (CSR) initiative:

The challenges of conserving biodiversity can be best met by developing synergies with all sectors of society, including the business that has a central role in the global effort to achieve a truly sustainable form of development. Corporate Social Responsibility (CSR) is a concept, which states that a private corporation or public organization has a responsibility to the society it belongs to. The CSR activities need to be in tune with effective strategic policies so that the aim of sustainable environmental, social, and economic progress may be achieved.

Unique partnerships with business groups for funding conservation initiatives under the CSR and using the experience from such initiatives to design conservation schemes can contribute to successful biodiversity leadership, good governance, informed decision-making, and responsible management of biodiversity resources and ecosystem services. A mutually beneficial partnership with conservation

organizations would help corporate partners fulfill obligations of protecting the natural capital that sustains businesses and provide natural resource managers with financial support vital for strategizing and implementing conservation planning. A successful partnership would result in two essential outputs: (i) implementing conservation actions on the ground for a range of species and diverse habitats, and (ii) capacity, competence, and infrastructure to support initiatives for effective conservation of species or habitat that establish national conservation priority.

Private corporations or public organizations have supported different wildlife conservation and protection of natural capital activities through CSR initiatives (Table 9.1) (Baroth & Mathur 2019). Given that the airport will have a relatively large ecological footprint, the airport must contribute to the overall improvement in prospects of conserving biodiversity and protecting ecosystem services with substantial economic benefits. Therefore, we suggest that the GJIA authority augment the corpus of the GJIACF from time to time as per norms through CSR.

Table 9.1. An indicative list of CSR initiatives undertaken by various industries in India.

Wildlife Conservation Project	Year	Partnering Govt. State Department/NGO	Supporting Industry
Save Asian Lion Project	2008	Gujarat State	Tata Group
Save the Whale shark Initiative	2004	Gujarat State & Wildlife Trust of India (WTI)	Tata Group
Turtle Conservation Programme	2009	Maharashtra & Odisha	Tata Group
Human-Elephant Conflict Management Programme	2015	Assam, Arunachal Pradesh, West Bengal, Uttarakhand, Tamil Nadu & Kerala	Muthoot Group
Red panda and Snow Leopard Conservation	2015	Arunachal Pradesh	Sony India Limited
Eastern Swamp Deer project	2010	Assam & WTI	Oil and Natural Gas Corporation (ONGC)
Mangrove Restoration	2007	Gujarat, Maharashtra & Bombay Natural History Society (BNHS)	Oil and Natural Gas Corporation (ONGC)
Nilgiri Tahr Conservation Programme	2011	Tamil Nadu & Kerala	Nokia India
Vulture Project	2014	Madhya Pradesh & BNHS	Rio Tinto India
Save Our Tigers Project	2008	World Wildlife Fund (WWF), WTI, Wildlife Conservation Trust (WCT) & Sanctuary Asia	Aircel Ltd.
My Ganga, My dolphin	2012	Uttar Pradesh & WWF (with 18 other local NGOs)	Hong Kong and Shanghai Banking Corporation (HSBC)

Source: Baroth & Mathur (2019)

9.3.11. *Biodiversity offsetting as a conservation strategy: Creation of "Compensatory **Conservation Fund**" for the conservation of Blackbuck, Sarus Crane populations and other critical wildlife habitats across Uttar Pradesh*:

It has been well acknowledged globally that the conservation of biodiversity is necessary to ensure the continued survival of species and ecosystems in general for humanity's wellbeing. The development of infrastructure and different projects is imperative for the country's economic growth, and most of these projects cause negative impacts on species and ecosystems. However, biodiversity is not well accounted for while the implementation of these projects. Visualizing negative implications of the project on biodiversity, there is growing interest by governments and the private sector to look for ways of compensating for these biodiversity impacts, and achieve a "No Net Loss (NNL)" and preferably a "Net Gain (NG)" of biodiversity when projects take place (https://www.iucn.org/sites/dev/files/biodiversity_offset_issues_briefs_final_0.pdf) (Apostolopoulou and Adams 2015).

For compensating adverse impacts due to development, governments and the private sector are increasingly using "Biodiversity offsets" as conservation strategies. Biodiversity offsets are defined as 'measurable conservation outcomes designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken' (BBOP, 2012). In effect, offsetting seeks to compensate for losses to biodiversity in one place (and at one time) by creating equivalent gains elsewhere.

Additionally, IUCN's Policy on Biodiversity Offsets is adopted by the Members' Assembly of the World Conservation Congress, which took place 1-10 September 2016 in Hawai. IUCN provides a framework to guide the design, implementation, and governance of biodiversity offset schemes and projects. It also shows where offsets are and are not an appropriate conservation tool to ensure that they lead to positive conservation outcomes (https://www.iucn.org/sites/dev/files/biodiversity_offset_issues_briefs_final_0.pdf).

Since the proposed GJIA project will leave ecological footprints in this landscape, the followings were suggested during the workshop convened with stakeholders and knowledge partners on 1st February 2020 for developing effective Biodiversity Conservation Strategies:

a. Enhance the conservation status of other Blackbuck and Sarus Crane populations of Uttar Pradesh (Fig. 9.4),

b. Implement the conservation measures for Sarus Crane, as suggested by Rahmani et al. (2019),

c. Improve conservation status "Hastinapur Wildlife Sanctuary, Uttar Pradesh through implementing suggestions made by the Management Effectiveness Evaluation (MEE) team, and

d. Support management activities which enhance species or habitat conservation

Therefore, we propose the allocation of at least 0.25 % of the total cost of the GJIA project for Compensatory Conservation Fund" to the Forest Department, Uttar Pradesh

9.3.12. *Research and Monitoring of biodiversity values during pre-construction, construction, and operational stages*:

Globally, it is well known that the majority of the development programs are affecting biodiversity conservation values and disrupting the ecological services, which are critical for the wellbeing of humans due to changes in land-use patterns and ecosystem traits. As far as our best knowledge, the long-term studies for monitoring the extent of the likely impact of such development on biodiversity conservations lack in India. Therefore, monitoring fine-scale spatial

and temporal conservation status of various taxa, habitat conditions, and ecological traits such as microenvironment, hydrological, socioeconomic, and are essential aspects for achieving effective conservation planning of biodiversity.

Visualizing this gap and as per the "Environmental Clearance" accorded by the MoEFCC vide letter no. F.No. 10-31/2018-IA-III dated 09.03.2020 we, propose a long-term study of ten years as Phase II for "Fine-scale assessment of the spatial and temporal changes in biodiversity values and ecological traits during various operational stages of the Greenfield Jewar International Airport." This study will be undertaken during pre-construction, construction and operational stages around GJIA landscape for ten years, as this period is adequate for re-colonizing the species after disturbance. The project will also provide guidelines for assessing the likely impacts of proposed such international airports on the overall conservation of biodiversity values in the future. Detailed proposal is at Annexure XI.

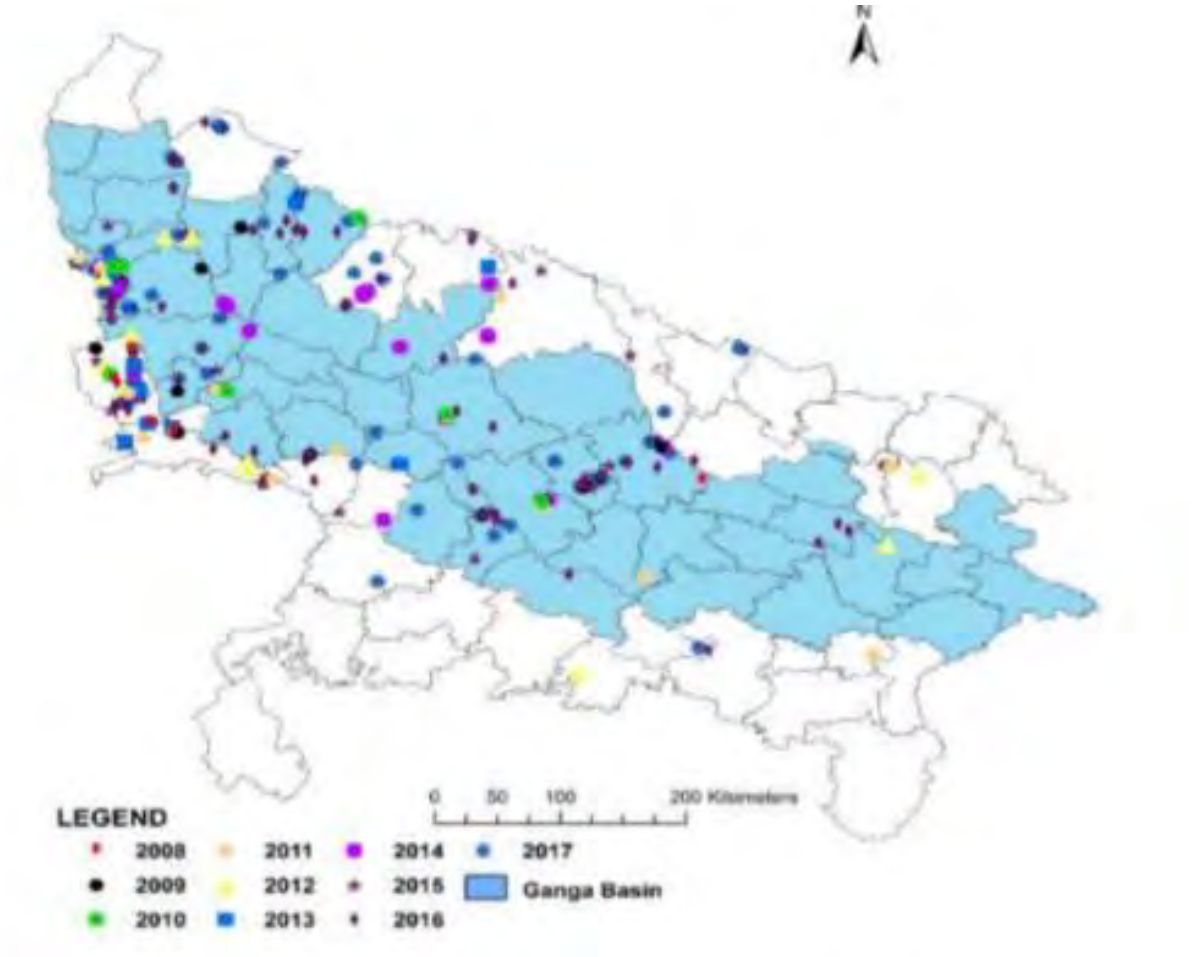


Figure 9.4 (a). Distribution of Sarus crane during 2008-2017 in Uttar Pradesh (Adopted from Kumar et al., 2019).

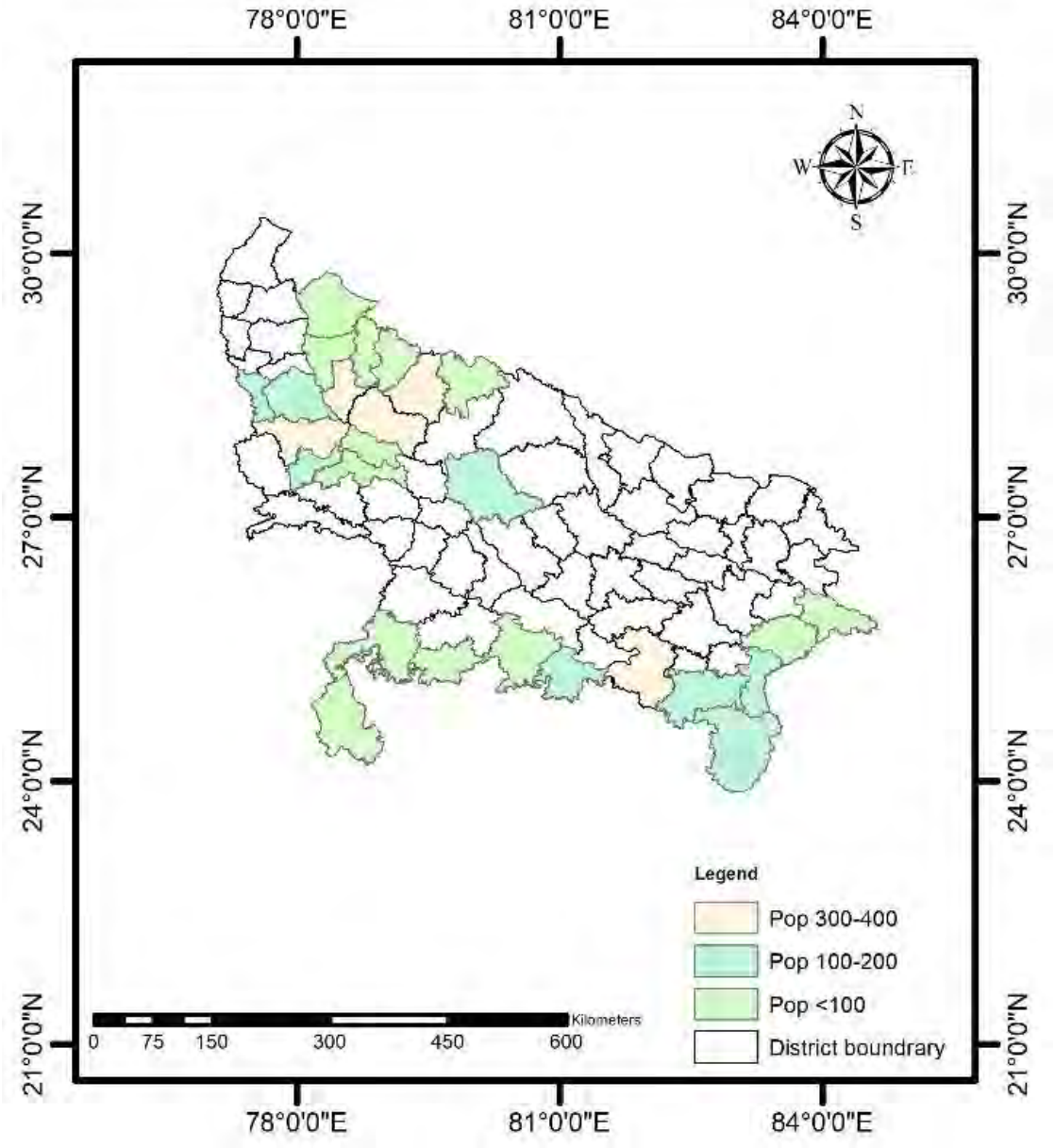


Figure 9.4.(b). Distribution pattern of Blackbuck in Uttar Pradesh. (Khursheed unpublished)

a. Determine the extent of fine-scale spatial and temporal change in biodiversity values:

We propose to detect changes in the insect pollinators, herpetofauna, birds, and mammals due to spatial and temporal changes in the microenvironment, land use patterns, socioeconomic, subsidized food. Besides using a standard biodiversity monitoring tool, we proposed using recently evolved state-of-the-art Environmental DNA (eDNA) to improve the biodiversity assessment.

Expected output:
Identify extent of impacts in identified hotspot areas of conservation importance and suggest long-term goals for retaining ecosystem services in the agro-ecological region around the GJIA.

b. Ecology of Blackbuck and Sarus crane in the GJIA landscape:

The Blackbuck and Sarus crane are two flagship species of conservation importance in

the agro-ecological region of the GIJIA landscape. Fine-scale insight into the species' responses to the different developmental phases is needed for effective conservation planning and achieving long-term conservation goals. Therefore, we aimed to obtain information on the species' critical ecological and biological aspects.

Assess the fine-scale ranging behavior of Blackbuck and Sarus crane using GPS tagged individuals concerning habitat and disturbance levels:

Effective conservation strategies of Blackbuck and Sarus crane in the GJIA landscape requires the fine-scale insight of the species' response to the habitat characteristics and extent of disturbance level. We propose monitoring GPS tagged ten individuals of each species to obtain fine-scale preferred habitats in agro-ecological systems during different phases of GJIA.

Population demography and growth rate:
We will determine group size, sex and age structure, reproductive traits during the study period concerning habitat structure and extent of human disturbance. We will identify and quantify the factors responsible for spatial and temporal differences due to different phases of GJIA using multivariate analysis.

Expected Output:
The objective will provide baseline information on the growth rate of Sarus and Blackbuck. We will assess the Blackbuck and Sarus crane's carrying capacity based on the available suitable habitat and the probability of colonizing to other suitable habitats in the GJIA landscape for long-term conservation goals.

c. Conservation status of wetlands:

The GJIA landscape is nested with reasonable number of wetlands, which are of conservation importance. The status of 50 to 60 percent wetlands will be regularly monitored during the study periods for temporal variation in bird species (resident/migrant) concerning shape characteristics, water quality, habitat characteristics, hydrology, limnological, and extent of pesticides.

Expected output:
We would suggest measures for retaining hydrological and conservation values of critical wetlands in the GJIA landscape.

d. Ecology of **bird's** prey in the GJIA landscape:

Of the different species reported in bird strikes, vultures, and birds of prey such as raptors have been significant threats to the aircraft. We will assess these species' abundances, distribution of food resources, and ranging behavior using GPS tagged vultures and raptors. Their distribution and abundance pattern will be correlated with people's socioeconomic status, distribution of food resources, and type of habitats that support such resources.

Expected output:
We will determine the factors responsible for the distribution, abundance, and ranging behavior to suggest measures to minimize the probability of strike hazard due to these birds.

e. Determine the compositional and configuration pattern of preferred habitats, the extent of disturbance factors, socioeconomic aspects, and extent of the functional connectivity for long-term biodiversity conservation goals:

Assuring long-term conservation planning requires assessing the functional connectivity in meta-population or stepping-stone of the mosaics of preferred habitats of the species in the agro-ecology landscape. We will identify the critical conservation area based on the spatial and temporal patterns of biodiversity values and preferred habitat characteristics by different taxa. These areas' functional connectivity will be further assessed using the extent of gene flow of the few critical species of different taxa for long term conservation goals.

Expected output:

Map the hotspots of crucial conservation habitats, which supports multi taxa's functional connectivity and suggest measures for retaining biodiversity values.

f. Training for frontline staff and university students:

We will organize different training programs for the front-line staff and graduate students of various colleges to monitor the birds, Blackbuck populations, Sarus crane nesting, and habitat quantifications.

g. Assess the extent of the likely impact of the airport during different phases and suggest measures for achieving long term biodiversity conservation goals in the GJIA landscape:

Identify habitats of conservation importance of multi-species guilds based on the information collected on fine scales spatial-temporal distribution patterns, species-specific habitat requirements, population demography, growth rate, ranging behavior, anthropogenic factors, and socioeconomic status and suggest specific conservation measures for retaining the ecosystem services in the agro-ecological region of GJIA landscape.

h. Financial layout:

S. No.	Head	No. of position	Unit cost, Rs. lakhs	Cost, Rs. Lakhs/ 10 years
1.	Salary and wages			
	Faculty Time	2 (Part Time)	0.9	271.68
	Project Scientist/Post Doc	3	0.78	341.49
	Project Associate I	5	0.31	262.68
	Senior Project Associate	2	0.42	117.6
	Subject Matter Specialist	1	1.2	144
	Lab Technician	1	0.20	33.24
	Project Coordinator	1	0.5	69.6
	Field Assistants/Interns/Volunteers	10	0.15	180
2.	Base Camp Setup including house rent	LS	3	30
3.	Travel, hiring of vehicle for field work and POL including PI travel	2	05/0.3/2	263.80
4.	Equipments/RS and GIS Data/Chemicals/Consumables			
	Camera Traps and other accessories etc		250 x 2 Times	100
	40 GPS Tags (10 for each species namely Blackbuck, Sarus Crane, Vulture and Raptors, etc)		20 x 4 times	240
	Digital Camera		3	1.5
	Field Equipment including GPS/Binoculars etc.,		LS	10
	Water quality testing kit and other equipments including capture equipments and essentials and capture operations		LS	20
	Remote Sensing Data		LS	10
	Chemicals for eDNA work and others		LS	100
	Satellite Data Cost and WPC Licenses		LS	50
	DNA Analysis Equipments		LS	80
	Batteries and other Chemicals		LS	30
5.	Miscellaneous		LS	30
6.	Contingency		LS	20
	Sub Total (A)			2405.59
	5% Inflation Cost			120.28
	Sub Total (B)			2525.87
	15% Institutional Charges			378.88
	Grand Total			2904.75

LS= Lump sum

i. Timeline:

S. No.	Activity	Pre-construction	Construction			Post-Construction					
		Year									
		1	2	3	4	5	6	7	8	9	10
1.	Recruitment of Research Personnel										
2.	Purchase of equipment										
3.	Establishment of Field Base camp										
4.	Spatial and temporal distribution of biodiversity										
5.	Map fine-scale habitat, change in land- use patterns, and extent of anthropogenic factors										
6.	GPS Tagging of Blackbuck, Sarus crane, vulture, and birds of prey										
7.	Monitor wetlands for bird abundance and water quality										
8.	Determine socio-economic status										
9.	Determine fine-scale biodiversity conservation values in relation to impact during different phases and suggest mid-term measures if needed										
10.	Annual Report										
11.	Final Report										

9.3.13. Summary of financial layout for achieving Biodiversity conservation goals of the GJIA landscape and enhancing conservation status of Blackbuck and Sarus Crane populations and other critical wildlife habitats in Uttar Pradesh:

S. No.	Category	Cost in Rs.	Agency responsible	Mandates
1.	Creation of "GJIA conservation Foundation"	0.5 % of the total cost of the GJIA project	DFO, Gautam Budh Nagar District under supervision of CWLW, U.P.	Undertake activities which enhances conservation value of the GJIA landscape
2.	Biodiversity offsetting as a conservation strategy: Creation of "Compensatory Conservation Fund" *	0.25 % of the total cost of the GJIA project	CWLW, U.P.	Enhance conservation status of Blackbuck populations in U.P. Enhance conservation of Sarus crane in U.P. by implementing suggestions made by Rahmani et al. (2019)
3.	Establish and run temporary "Animal Rescue and Rehabilitation Center" for five years*	500.00 lakhs	CWLP, U.P. and State Animal Husbandry Department of U.P.	Rescue and rehabilitate wild animal for initial five years Establish 2 Rapid Response Teams to rescue wildlife species impacted due to airport construction in different phases
4.	Annual allocation from "Corporate Social Responsibility (CSR)" initiative	As per applicable norms	CWLW, U.P.	Augmentation of "GJIA Conservation Foundation" time to time
5.	Initiate long term scientific study for "Monitoring likely impacts on fine-scale biodiversity values in landscape during different phases of GJIA" for ten years**	2904.75 lakhs/ ten years	Wildlife Institute of India	Assess likely impacts during different phases of the GJIA on: a. Monitor changes in spatial and temporal biodiversity values using eDNA. b. Study fine scale ecological requirements of Blackbuck and Sarus crane through ranging behaviour using GPS tagged individuals. c. Suggest fine-scale conservation strategies for GJIA landscape

* Suggested during the Stakeholder Workshop
** As per the "Environmental Clearance" accorded wide letter No. F.No.10-31/2018-1A-111 of the MoEFCC, Govt. of India, dated 9th March, 2020 (Annexure X).

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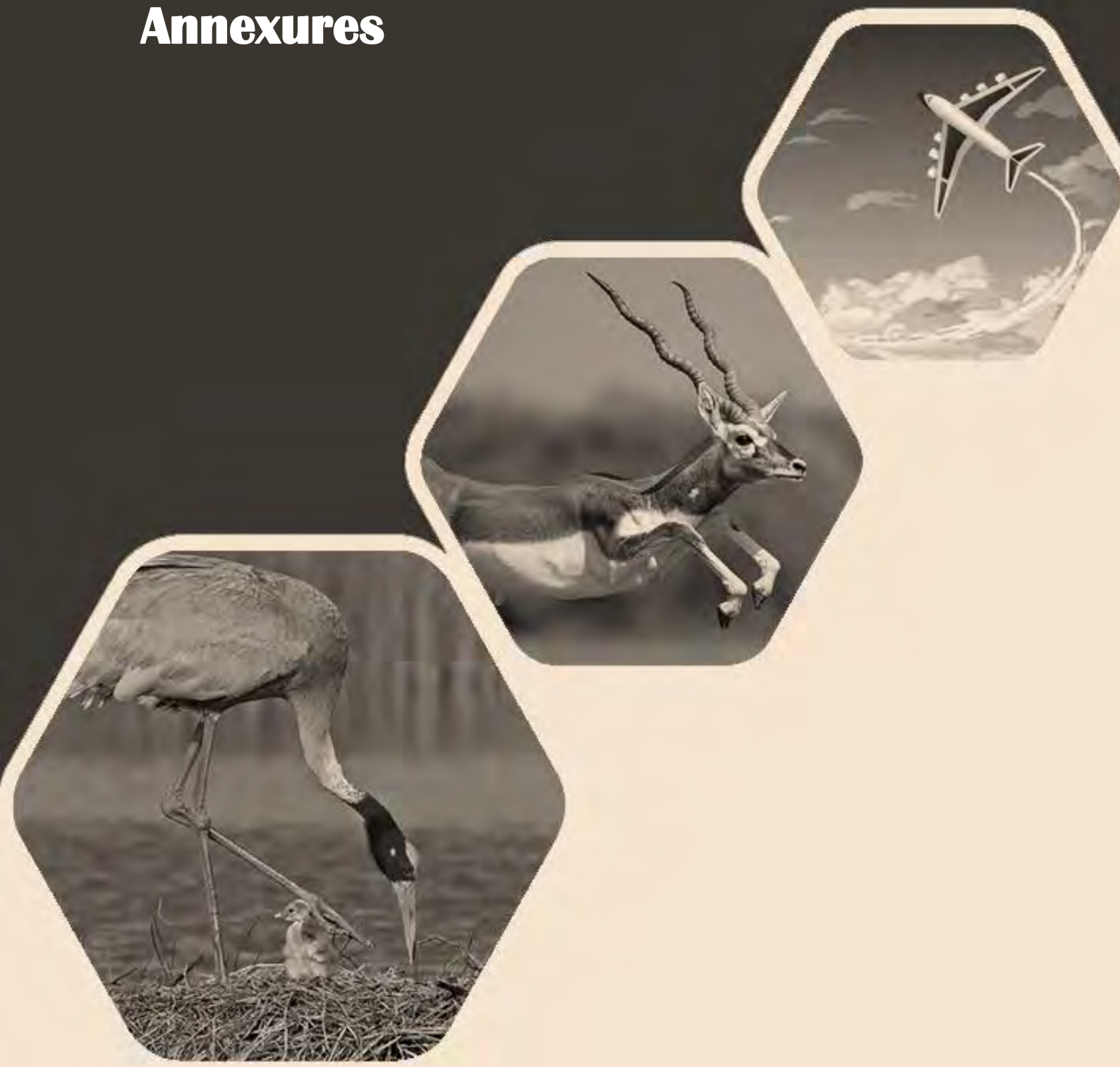
Annexures



ANNEXURE I

List of mammals reported and observed in the region in and around the GJIA site.

S. No.	Common Name	Scientific Name	Abundance	IUCN Status	IWP Act (1972)
1.	Northern Palm Squirrel	*Funambulus pennantii*	A	LC	IV
2.	Lesser Bandicoot Rat	*Bandicota benghalensis*	C	LC	V
3.	Greater Bandicoot Rat	*Bandicota indica*	U	LC	V
4.	Indian Gerbil	*Tatera indica*	C	LC	V
5.	Indian Hare	*Lepus nigricollis*	U	LC	IV
6.	Asian Musk Shrew	*Suncus murinus*	C	LC	V
7.	Indian Flying Fox	*Pteropus giganteus*	C	LC	V
8.	Leschenault's Rousette (Fulvous Fruit Bat)	*Rousettus eschenaultia*	U	LC	V
9.	Jungle Cat	*Felis chaus*	U	LC	I
10.	Indian Grey Mongoose	*Herpestes edwardsii*	A	LC	II
11.	Golden Jackal	*Canis aureus*	U	LC	II
12	Wild Pig	*Sus scrofa*	U	LC	III
.13	Nilgai or Bluebull	*Boselaphus tragocamelus*	A	LC	III
14.	Blackbuck or Indian Antelope	*Antilope cervicapra*	C	LC	I
15.	Rhesus Monkey	*Macaca mulatta*	C	LC	II

ANNEXURE II

List of bird species reported in Gautam Budh Nagar district.

S. No.	Species	Scientific Name	Order	IUCN Status
1	Lesser Whistling-Duck	*Dendrocygna javanica*	Anseriformes	LC
2	Bar-headed Goose	*Anser indicus*	Anseriformes	LC
3	Graylag Goose	*Anser anser*	Anseriformes	LC
4	Greater White-fronted Goose	*Anser albifrons*	Anseriformes	LC
5	Knob-billed Duck	*Sarkidiornis melanotos*	Anseriformes	LC
6	Ruddy Shelduck	*Tadorna ferruginea*	Anseriformes	LC
7	Common Shelduck	*Tadorna tadorna*	Anseriformes	LC
8	Cotton Pygmy-Goose	*Nettapus coromandelianus*	Anseriformes	LC
9	Garganey	*Spatula querquedula*	Anseriformes	LC
10	Northern Shoveler	*Spatula clypeata*	Anseriformes	LC
11	Gadwall	*Mareca strepera*	Anseriformes	LC
12	Eurasian Wigeon	*Mareca penelope*	Anseriformes	LC
13	Indian Spot-billed Duck	*Anas poecilorhyncha*	Anseriformes	LC
14	Mallard	*Anas platyrhynchos*	Anseriformes	LC
15	Northern Pintail	*Anas acuta*	Anseriformes	LC
16	Green-winged Teal	*Anas crecca*	Anseriformes	LC
17	Red-crested Pochard	*Netta rufina*	Anseriformes	LC
18	Common Pochard	*Aythya ferina*	Anseriformes	VU
19	Ferruginous Duck	*Aythya nyroca*	Anseriformes	NT
20	Tufted Duck	*Aythya fuligula*	Anseriformes	LC
21	Greater Scaup	*Aythya marila*	Anseriformes	LC
22	Indian Peafowl	*Pavo cristatus*	Galliformes	LC
23	Common Quail	*Coturnix coturnix*	Galliformes	LC
24	Rain Quail	*Coturnix coromandelica*	Galliformes	LC
25	Black Francolin	*Francolinus francolinus*	Galliformes	LC
26	Gray Francolin	*Francolinus pondicerianus*	Galliformes	LC
27	Greater Flamingo	*Phoenicopterus roseus*	Phoenicopteriformes	LC
28	Little Grebe	*Tachybaptus ruficollis*	Podicipediformes	LC
29	Great Crested Grebe	*Podiceps cristatus*	Podicipediformes	LC
30	Eared Grebe	*Podiceps nigricollis*	Podicipediformes	LC
31	Rock Pigeon	*Columba livia*	Columbiformes	LC
32	Oriental Turtle-Dove	*Streptopelia orientalis*	Columbiformes	LC
33	Eurasian Collared-Dove	*Streptopelia decaocto*	Columbiformes	LC
34	Red Collared-Dove	*Streptopelia tranquebarica*	Columbiformes	LC
35	Spotted Dove	*Streptopelia chinensis*	Columbiformes	LC
36	Laughing Dove	*Streptopelia senegalensis*	Columbiformes	LC
37	Orange-breasted Green-Pigeon	*Treron bicinctus*	Columbiformes	LC
38	Yellow-footed Green-Pigeon	*Treron phoenicopterus*	Columbiformes	LC
39	Chestnut-bellied Sandgrouse	*Pterocles exustus*	Pterocliformes	LC
40	Greater Coucal	*Centropus sinensis*	Cuculiformes	LC
41	Sirkeer Malkoha	*Taccocua leschenaultii*	Cuculiformes	LC
42	Pied Cuckoo	*Clamator jacobinus*	Cuculiformes	LC
43	Asian Koel	*Eudynamys scolopaceus*	Cuculiformes	LC
44	Gray-bellied Cuckoo	*Cacomantis passerinus*	Cuculiformes	LC
45	Common Hawk-Cuckoo	*Hierococcyx varius*	Cuculiformes	LC
46	Common Cuckoo	*Cuculus canorus*	Cuculiformes	LC
47	Savanna Nightjar	*Caprimulgus affinis*	Caprimulgiformes	LC

48	Alpine Swift	*Apus melba*	Apodiformes	LC
49	Little Swift	*Apus affinis*	Apodiformes	LC
50	Water Rail	*Rallus aquaticus*	Gruiformes	LC
51	Spotted Crake	*Porzana porzana*	Gruiformes	LC
52	Eurasian Moorhen	*Gallinula chloropus*	Gruiformes	LC
53	Eurasian Coot	*Fulica atra*	Gruiformes	LC
54	Gray-headed Swamphen	*Porphyrio poliocephalus*	Gruiformes	LC
55	Watercock	*Gallicrex cinerea*	Gruiformes	LC
56	White-breasted Waterhen	*Amaurornis phoenicurus*	Gruiformes	LC
57	Ruddy-breasted Crake	*Zapornia fusca*	Gruiformes	LC
58	Brown Crake	*Zapornia akool*	Gruiformes	LC
59	Baillon's Crake	*Zapornia pusilla*	Gruiformes	LC
60	Demoiselle Crane	*Anthropoides virgo*	Gruiformes	LC
61	Sarus Crane	*Antigone antigone*	Gruiformes	VU
62	Common Crane	*Grus grus*	Gruiformes	LC
63	Indian Thick-knee	*Burhinus indicus*	Charadriiformes	LC
64	Black-winged Stilt	*Himantopus himantopus*	Charadriiformes	LC
65	Pied Avocet	*Recurvirostra avosetta*	Charadriiformes	LC
66	Black-bellied Plover	*Pluvialis squatarola*	Charadriiformes	LC
67	Pacific Golden-Plover	*Pluvialis fulva*	Charadriiformes	LC
68	Northern Lapwing	*Vanellus vanellus*	Charadriiformes	NT
69	River Lapwing	*Vanellus duvaucelii*	Charadriiformes	NT
70	Yellow-wattled Lapwing	*Vanellus malabaricus*	Charadriiformes	LC
71	Gray-headed Lapwing	*Vanellus cinereus*	Charadriiformes	LC
72	Red-wattled Lapwing	*Vanellus indicus*	Charadriiformes	LC
73	White-tailed Lapwing	*Vanellus leucurus*	Charadriiformes	LC
74	Lesser Sand-Plover	*Charadrius mongolus*	Charadriiformes	LC
75	Kentish Plover	*Charadrius alexandrinus*	Charadriiformes	LC
76	Common Ringed Plover	*Charadrius hiaticula*	Charadriiformes	LC
77	Little Ringed Plover	*Charadrius dubius*	Charadriiformes	LC
78	Greater Painted-Snipe	*Rostratula benghalensis*	Charadriiformes	LC
79	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	Charadriiformes	LC
80	Bronze-winged Jacana	*Metopidius indicus*	Charadriiformes	LC
81	Eurasian Curlew	*Numenius arquata*	Charadriiformes	NT
82	Black-tailed Godwit	*Limosa limosa*	Charadriiformes	NT
83	Ruff	*Calidris pugnax*	Charadriiformes	LC
84	Curlew Sandpiper	*Calidris ferruginea*	Charadriiformes	NT
85	Temminck's Stint	*Calidris temminckii*	Charadriiformes	LC
86	Dunlin	*Calidris alpina*	Charadriiformes	LC
87	Little Stint	*Calidris minuta*	Charadriiformes	LC
88	Jack Snipe	*Lymnocryptes minimus*	Charadriiformes	LC
89	Common Snipe	*Gallinago gallinago*	Charadriiformes	LC
90	Terek Sandpiper	*Xenus cinereus*	Charadriiformes	LC
91	Common Sandpiper	*Actitis hypoleucos*	Charadriiformes	LC
92	Green Sandpiper	*Tringa ochropus*	Charadriiformes	LC
93	Spotted Redshank	*Tringa erythropus*	Charadriiformes	LC
94	Common Greenshank	*Tringa nebularia*	Charadriiformes	LC
95	Marsh Sandpiper	*Tringa stagnatilis*	Charadriiformes	LC
96	Wood Sandpiper	*Tringa glareola*	Charadriiformes	LC
97	Common Redshank	*Tringa totanus*	Charadriiformes	LC
98	Barred Buttonquail	*Turnix suscitator*	Charadriiformes	LC
99	Oriental Pratincole	*Glareola maldivarum*	Charadriiformes	LC

100	Small Pratincole	*Glareola lactea*	Charadriiformes	LC
101	Slender-billed Gull	*Chroicocephalus genei*	Charadriiformes	LC
102	Black-headed Gull	*Chroicocephalus ridibundus*	Charadriiformes	LC
103	Brown-headed Gull	*Chroicocephalus brunnicephalus*	Charadriiformes	LC
104	Little Gull	*Hydrocoloeus minutus*	Charadriiformes	LC
105	Pallas's Gull	*Ichthyaetus ichthyaetus*	Charadriiformes	LC
106	Caspian Gull	*Larus cachinnans*	Charadriiformes	LC
107	Lesser Black-backed Gull	*Larus fuscus*	Charadriiformes	LC
108	Little Tern	*Sternula albifrons*	Charadriiformes	LC
109	Gull-billed Tern	*Gelochelidon nilotica*	Charadriiformes	LC
110	White-winged Tern	*Chlidonias leucopterus*	Charadriiformes	LC
111	Whiskered Tern	*Chlidonias hybrida*	Charadriiformes	LC
112	Black-bellied Tern	*Sterna acuticauda*	Charadriiformes	EN
113	River Tern	*Sterna aurantia*	Charadriiformes	NT
114	Indian Skimmer	*Rynchops albicollis*	Charadriiformes	VU
115	Asian Openbill	*Anastomus oscitans*	Ciconiiformes	LC
116	Black Stork	*Ciconia nigra*	Ciconiiformes	LC
117	Woolly-necked Stork	*Ciconia episcopus*	Ciconiiformes	LC
118	White Stork	*Ciconia ciconia*	Ciconiiformes	LC
119	Black-necked Stork	*Ephippiorhynchus asiaticus*	Ciconiiformes	NT
120	Painted Stork	*Mycteria leucocephala*	Ciconiiformes	NT
121	Oriental Darter	*Anhinga melanogaster*	Suliformes	NT
122	Little Cormorant	*Microcarbo niger*	Suliformes	LC
123	Great Cormorant	*Phalacrocorax carbo*	Suliformes	LC
124	Indian Cormorant	*Phalacrocorax fuscicollis*	Suliformes	LC
125	Great White Pelican	*Pelecanus onocrotalus*	Pelecaniformes	LC
126	Great Bittern	*Botaurus stellaris*	Pelecaniformes	LC
127	Yellow Bittern	*Ixobrychus sinensis*	Pelecaniformes	LC
128	Cinnamon Bittern	*Ixobrychus cinnamomeus*	Pelecaniformes	LC
129	Black Bittern	*Ixobrychus flavicollis*	Pelecaniformes	LC
130	Gray Heron	*Ardea cinerea*	Pelecaniformes	LC
131	Purple Heron	*Ardea purpurea*	Pelecaniformes	LC
132	Great Egret	*Ardea alba*	Pelecaniformes	LC
133	Intermediate Egret	*Ardea intermedia*	Pelecaniformes	LC
134	Little Egret	*Egretta garzetta*	Pelecaniformes	LC
135	Cattle Egret	*Bubulcus ibis*	Pelecaniformes	LC
136	Indian Pond-Heron	*Ardeola grayii*	Pelecaniformes	LC
137	Striated Heron	*Butorides striata*	Pelecaniformes	LC
138	Black-crowned Night-Heron	*Nycticorax nycticorax*	Pelecaniformes	LC
139	Glossy Ibis	*Plegadis falcinellus*	Pelecaniformes	LC
140	Black-headed Ibis	*Threskiornis melanocephalus*	Pelecaniformes	NT
141	Red-naped Ibis	*Pseudibis papillosa*	Pelecaniformes	LC
142	Eurasian Spoonbill	*Platalea leucorodia*	Pelecaniformes	LC
143	Osprey	*Pandion haliaetus*	Accipitriformes	LC
144	Black-winged Kite	*Elanus caeruleus*	Accipitriformes	LC
145	Egyptian Vulture	*Neophron percnopterus*	Accipitriformes	EN
146	Oriental Honey-buzzard	*Pernis ptilorhynchus*	Accipitriformes	LC
147	Red-headed Vulture	*Sarcogyps calvus*	Accipitriformes	CR
148	White-rumped Vulture	*Gyps bengalensis*	Accipitriformes	CR
149	Eurasian Griffon	*Gyps fulvus*	Accipitriformes	LC
150	Crested Serpent-Eagle	*Spilornis cheela*	Accipitriformes	LC
151	Short-toed Snake-Eagle	*Circaetus gallicus*	Accipitriformes	LC

152	Black Eagle	*Ictinaetus malaiensis*	Accipitriformes	LC
153	Indian Spotted Eagle	*Clanga hastata*	Accipitriformes	VU
154	Greater Spotted Eagle	*Clanga clanga*	Accipitriformes	VU
155	Booted Eagle	*Hieraaetus pennatus*	Accipitriformes	LC
156	Tawny Eagle	*Aquila rapax*	Accipitriformes	VU
157	Steppe Eagle	*Aquila nipalensis*	Accipitriformes	EN
158	Imperial Eagle	*Aquila heliaca*	Accipitriformes	LC
159	Bonelli's Eagle	*Aquila fasciata*	Accipitriformes	LC
160	White-eyed Buzzard	*Butastur teesa*	Accipitriformes	LC
161	Eurasian Marsh-Harrier	*Circus aeruginosus*	Accipitriformes	LC
162	Hen Harrier	*Circus cyaneus*	Accipitriformes	LC
163	Pallid Harrier	*Circus macrourus*	Accipitriformes	NT
164	Shikra	*Accipiter badius*	Accipitriformes	LC
165	Eurasian Sparrowhawk	*Accipiter nisus*	Accipitriformes	LC
166	Black Kite	*Milvus migrans*	Accipitriformes	LC
167	Brahminy Kite	*Haliastur indus*	Accipitriformes	LC
168	Common Buzzard	*Buteo buteo*	Accipitriformes	LC
169	Himalayan Buzzard	*Buteo refectus*	Accipitriformes	LC
170	Long-legged Buzzard	*Buteo rufinus*	Accipitriformes	LC
171	Barn Owl	*Tyto alba*	Strigiformes	LC
172	Indian Scops-Owl	*Otus bakkamoena*	Strigiformes	LC
173	Pallid Scops-Owl	*Otus brucei*	Strigiformes	LC
174	Rock Eagle-Owl	*Bubo bengalensis*	Strigiformes	LC
175	Brown Fish-Owl	*Ketupa zeylonensis*	Strigiformes	LC
176	Spotted Owlet	*Athene brama*	Strigiformes	LC
177	Short-eared Owl	*Asio flammeus*	Strigiformes	LC
178	Brown Boobook	*Ninox scutulata*	Strigiformes	LC
179	Eurasian Hoopoe	*Upupa epops*	Bucerotiformes	LC
180	Indian Grey Hornbill	*Ocyceros birostris*	Bucerotiformes	LC
181	Oriental Pied-Hornbill	*Anthracoceros albirostris*	Bucerotiformes	LC
182	Common Kingfisher	*Alcedo atthis*	Coraciiformes	LC
183	White-throated Kingfisher	*Halcyon smyrnensis*	Coraciiformes	LC
184	Pied Kingfisher	*Ceryle rudis*	Coraciiformes	LC
185	Green Bee-eater	*Merops orientalis*	Coraciiformes	LC
186	Blue-cheeked Bee-eater	*Merops persicus*	Coraciiformes	LC
187	Blue-tailed Bee-eater	*Merops philippinus*	Coraciiformes	LC
188	Chestnut-headed Bee-eater	*Merops leschenaulti*	Coraciiformes	LC
189	European Roller	*Coracias garrulus*	Coraciiformes	LC
190	Indian Roller	*Coracias benghalensis*	Coraciiformes	LC
191	Coppersmith Barbet	*Psilopogon haemacephalus*	Piciformes	LC
192	Brown-headed Barbet	*Psilopogon zeylanicus*	Piciformes	LC
193	Eurasian Wryneck	*Jynx torquilla*	Piciformes	LC
194	Yellow-crowned Woodpecker	*Leiopicus mahrattensis*	Piciformes	LC
195	White-naped Woodpecker	*Chrysocolaptes festivus*	Piciformes	LC
196	Black-rumped Flameback	*Dinopium benghalense*	Piciformes	LC
197	Eurasian Kestrel	*Falco tinnunculus*	Falconiformes	LC
198	Red-necked Falcon	*Falco chicquera*	Falconiformes	LC
199	Eurasian Hobby	*Falco subbuteo*	Falconiformes	LC
200	Laggar Falcon	*Falco jugger*	Falconiformes	NT
201	Peregrine Falcon	*Falco peregrinus*	Falconiformes	LC
202	Alexandrine Parakeet	*Psittacula eupatria*	Psittaciformes	NT
203	Rose-ringed Parakeet	*Psittacula krameri*	Psittaciformes	LC

204	Plum-headed Parakeet	*Psittacula cyanocephala*	Psittaciformes	LC
205	Small Minivet	*Pericrocotus cinnamomeus*	Passeriformes	LC
206	Long-tailed Minivet	*Pericrocotus ethologus*	Passeriformes	LC
207	Large Cuckooshrike	*Coracina macei*	Passeriformes	LC
208	Indian Golden Oriole	*Oriolus kundoo*	Passeriformes	LC
209	Black-hooded Oriole	*Oriolus xanthornus*	Passeriformes	LC
210	Common Woodshrike	*Tephrodornis pondicerianus*	Passeriformes	LC
211	White-browed Fantail	*Rhipidura aureola*	Passeriformes	LC
212	Black Drongo	*Dicrurus macrocercus*	Passeriformes	LC
213	Ashy Drongo	*Dicrurus leucophaeus*	Passeriformes	LC
214	White-bellied Drongo	*Dicrurus caerulescens*	Passeriformes	LC
215	Indian Paradise-Flycatcher	*Terpsiphone paradisi*	Passeriformes	LC
216	Isabelline Shrike	*Lanius isabellinus*	Passeriformes	LC
217	Brown Shrike	*Lanius cristatus*	Passeriformes	LC
218	Bay-backed Shrike	*Lanius vittatus*	Passeriformes	LC
219	Long-tailed Shrike	*Lanius schach*	Passeriformes	LC
220	Great Gray Shrike	*Lanius excubitor*	Passeriformes	LC
221	Rufous Treepie	*Dendrocitta vagabunda*	Passeriformes	LC
222	House Crow	*Corvus splendens*	Passeriformes	LC
223	Large-billed Crow	*Corvus macrorhynchos*	Passeriformes	LC
224	Gray-headed Canary-Flycatcher	*Culicicapa ceylonensis*	Passeriformes	LC
225	Cinereous Tit	*Parus cinereus*	Passeriformes	LC
226	White-crowned Penduline-Tit	*Remiz coronatus*	Passeriformes	LC
227	Rufous-tailed Lark	*Ammomanes phoenicura*	Passeriformes	LC
228	Ashy-crowned Sparrow-Lark	*Eremopterix griseus*	Passeriformes	LC
229	Singing Bushlark	*Mirafra cantillans*	Passeriformes	LC
230	Bengal Bushlark	*Mirafra assamica*	Passeriformes	LC
231	Indian Bushlark	*Mirafra erythroptera*	Passeriformes	LC
232	Greater Short-toed Lark	*Calandrella brachydactyla*	Passeriformes	LC
233	Hume's Lark	*Calandrella acutirostris*	Passeriformes	LC
234	Bimaculated Lark	*Melanocorypha bimaculata*	Passeriformes	LC
235	Sand Lark	*Alaudala raytal*	Passeriformes	LC
236	Oriental Skylark	*Alauda gulgula*	Passeriformes	LC
237	Crested Lark	*Galerida cristata*	Passeriformes	LC
238	Common Tailorbird	*Orthotomus sutorius*	Passeriformes	LC
239	Rufous-fronted Prinia	*Prinia buchanani*	Passeriformes	LC
240	Gray-breasted Prinia	*Prinia hodgsonii*	Passeriformes	LC
241	Graceful Prinia	*Prinia gracilis*	Passeriformes	LC
242	Jungle Prinia	*Prinia sylvatica*	Passeriformes	LC
243	Yellow-bellied Prinia	*Prinia flaviventris*	Passeriformes	LC
244	Ashy Prinia	*Prinia socialis*	Passeriformes	LC
245	Plain Prinia	*Prinia inornata*	Passeriformes	LC
246	Zitting Cisticola	*Cisticola juncidis*	Passeriformes	LC
247	Booted Warbler	*Iduna caligata*	Passeriformes	LC
248	Sykes's Warbler	*Iduna rama*	Passeriformes	LC
249	Moustached Warbler	*Acrocephalus melanopogon*	Passeriformes	LC
250	Paddyfield Warbler	*Acrocephalus agricola*	Passeriformes	LC
251	Blyth's Reed Warbler	*Acrocephalus dumetorum*	Passeriformes	LC
252	Clamorous Reed Warbler	*Acrocephalus stentoreus*	Passeriformes	LC
253	Striated Grassbird	*Megalurus palustris*	Passeriformes	LC
254	Bristled Grassbird	*Chaetornis striata*	Passeriformes	VU

255	Gray-throated Martin	*Riparia chinensis*	Passeriformes	LC
256	Bank Swallow	*Riparia riparia*	Passeriformes	LC
257	Pale Sand Martin	*Riparia diluta*	Passeriformes	LC
258	Dusky Crag-Martin	*Ptyonoprogne concolor*	Passeriformes	LC
259	Barn Swallow	*Hirundo rustica*	Passeriformes	LC
260	Wire-tailed Swallow	*Hirundo smithii*	Passeriformes	LC
261	Red-rumped Swallow	*Cecropis daurica*	Passeriformes	LC
262	Streak-throated Swallow	*Petrochelidon fluvicola*	Passeriformes	LC
263	Common House-Martin	*Delichon urbicum*	Passeriformes	LC
264	Red-vented Bulbul	*Pycnonotus cafer*	Passeriformes	LC
265	Red-whiskered Bulbul	*Pycnonotus jocosus*	Passeriformes	LC
266	White-eared Bulbul	*Pycnonotus leucotis*	Passeriformes	LC
267	Hume's Warbler	*Phylloscopus humei*	Passeriformes	LC
268	Brooks's Leaf Warbler	*Phylloscopus subviridis*	Passeriformes	LC
269	Sulphur-bellied Warbler	*Phylloscopus griseolus*	Passeriformes	LC
270	Tickell's Leaf Warbler	*Phylloscopus affinis*	Passeriformes	LC
271	Dusky Warbler	*Phylloscopus fuscatus*	Passeriformes	LC
272	Smoky Warbler	*Phylloscopus fuligiventer*	Passeriformes	LC
273	Common Chiffchaff	*Phylloscopus collybita*	Passeriformes	LC
274	Green Warbler	*Phylloscopus nitidus*	Passeriformes	LC
275	Greenish Warbler	*Phylloscopus trochiloides*	Passeriformes	LC
276	Cetti's Warbler	*Cettia cetti*	Passeriformes	LC
277	Asian Desert Warbler	*Sylvia nana*	Passeriformes	LC
278	Lesser Whitethroat	*Sylvia curruca*	Passeriformes	LC
279	Eastern Orphean Warbler	*Sylvia crassirostris*	Passeriformes	LC
280	Yellow-eyed Babbler	*Chrysomma sinense*	Passeriformes	LC
281	Indian White-eye	*Zosterops palpebrosus*	Passeriformes	LC
282	Common Babbler	*Turdoides caudata*	Passeriformes	LC
283	Striated Babbler	*Turdoides earlei*	Passeriformes	LC
284	Large Gray Babbler	*Turdoides malcolmi*	Passeriformes	LC
285	Jungle Babbler	*Turdoides striata*	Passeriformes	LC
286	European Starling	*Sturnus vulgaris*	Passeriformes	LC
287	Rosy Starling	*Pastor roseus*	Passeriformes	LC
288	Asian Pied Starling	*Gracupica contra*	Passeriformes	LC
289	Brahminy Starling	*Sturnia pagodarum*	Passeriformes	LC
290	Chestnut-tailed Starling	*Sturnia malabarica*	Passeriformes	LC
291	Common Myna	*Acridotheres tristis*	Passeriformes	LC
292	Bank Myna	*Acridotheres ginginianus*	Passeriformes	LC
293	Orange-headed Thrush	*Geokichla citrina*	Passeriformes	LC
294	Gray-winged Blackbird	*Turdus boulboul*	Passeriformes	LC
295	Tickell's Thrush	*Turdus unicolor*	Passeriformes	LC
296	Black-throated Thrush	*Turdus atrogularis*	Passeriformes	LC
297	Asian Brown Flycatcher	*Muscicapa dauurica*	Passeriformes	LC
298	Rufous-tailed Scrub-Robin	*Cercotrichas galactotes*	Passeriformes	LC
299	Indian Robin	*Copsychus fulicatus*	Passeriformes	LC
300	Oriental Magpie-Robin	*Copsychus saularis*	Passeriformes	LC
301	Verditer Flycatcher	*Eumyias thalassinus*	Passeriformes	LC
302	Bluethroat	*Luscinia svecica*	Passeriformes	LC
303	Ultramarine Flycatcher	*Ficedula superciliaris*	Passeriformes	LC
304	Taiga Flycatcher	*Ficedula albicilla*	Passeriformes	LC
305	Red-breasted Flycatcher	*Ficedula parva*	Passeriformes	LC
306	Black Redstart	*Phoenicurus ochruros*	Passeriformes	LC

307	Blue-capped Rock-Thrush	*Monticola cinclorhyncha*	Passeriformes	LC
308	Blue Rock-Thrush	*Monticola solitarius*	Passeriformes	LC
309	Siberian Stonechat	*Saxicola maurus*	Passeriformes	LC
310	White-tailed Stonechat	*Saxicola leucurus*	Passeriformes	LC
311	Pied Bushchat	*Saxicola caprata*	Passeriformes	LC
312	Gray Bushchat	*Saxicola ferreus*	Passeriformes	LC
313	Isabelline Wheatear	*Oenanthe isabellina*	Passeriformes	LC
314	Desert Wheatear	*Oenanthe deserti*	Passeriformes	LC
315	Brown Rock Chat	*Oenanthe fusca*	Passeriformes	LC
316	Variable Wheatear	*Oenanthe picata*	Passeriformes	LC
317	Purple Sunbird	*Cinnyris asiaticus*	Passeriformes	LC
318	Streaked Weaver	*Ploceus manyar*	Passeriformes	LC
319	Baya Weaver	*Ploceus philippinus*	Passeriformes	LC
320	Black-breasted Weaver	*Ploceus benghalensis*	Passeriformes	LC
321	Red Avadavat	*Amandava amandava*	Passeriformes	LC
322	Indian Silverbill	*Euodice malabarica*	Passeriformes	LC
323	Scaly-breasted Munia	*Lonchura punctulata*	Passeriformes	LC
324	Tricolored Munia	*Lonchura malacca*	Passeriformes	LC
325	Chestnut Munia	*Lonchura atricapilla*	Passeriformes	LC
326	House Sparrow	*Passer domesticus*	Passeriformes	LC
327	Spanish Sparrow	*Passer hispaniolensis*	Passeriformes	LC
328	Yellow-throated Sparrow	*Gymnoris xanthocollis*	Passeriformes	LC
329	Forest Wagtail	*Dendronanthus indicus*	Passeriformes	LC
330	Gray Wagtail	*Motacilla cinerea*	Passeriformes	LC
331	Western Yellow Wagtail	*Motacilla flava*	Passeriformes	LC
332	Citrine Wagtail	*Motacilla citreola*	Passeriformes	LC
333	White-browed Wagtail	*Motacilla maderaspatensis*	Passeriformes	LC
334	White Wagtail	*Motacilla alba*	Passeriformes	LC
335	Richard's Pipit	*Anthus richardi*	Passeriformes	LC
336	Paddyfield Pipit	*Anthus rufulus*	Passeriformes	LC
337	Long-billed Pipit	*Anthus similis*	Passeriformes	LC
338	Blyth's Pipit	*Anthus godlewskii*	Passeriformes	LC
339	Tawny Pipit	*Anthus campestris*	Passeriformes	LC
340	Rosy Pipit	*Anthus roseatus*	Passeriformes	LC
341	Tree Pipit	*Anthus trivialis*	Passeriformes	LC
342	Olive-backed Pipit	*Anthus hodgsoni*	Passeriformes	LC
343	Red-throated Pipit	*Anthus cervinus*	Passeriformes	LC
344	Water Pipit	*Anthus spinoletta*	Passeriformes	LC
345	Common Rosefinch	*Carpodacus erythrinus*	Passeriformes	LC
346	Crested Bunting	*Emberiza lathami*	Passeriformes	LC
347	Red-headed Bunting	*Emberiza bruniceps*	Passeriformes	LC
348	White-capped Bunting	*Emberiza stewarti*	Passeriformes	LC
349	Gray-necked Bunting	*Emberiza buchanani*	Passeriformes	LC

ANNEXURE III

List of herpetofauna, butterfly, odonates and fish species reported from Surajpur wetland, Gautam Budh Nagar district.

A – Herpetofauna

S. No.	Common name	Scientific name	Order	Family	Habitat	Abundance status	IUCN Status	IWPA Status
	AMBHIBIANS							
1	Asian Common Toad	*Duttaphrynus melanostictus*	Anura	Bufonidae	Marshland	C	LC	IV
2	Indian Bullfrog	*Hoplobatrachus tigerinus*	Anura	Dicroglossidae	Marshland	C	LC	IV
3	Skittering Frog	*Euphlyctis cyanophlyctis*	Anura	Dicroglossidae	Marshland	C	LC	IV
4	Ornamented Pygmy Frog	*Microhyla ornata*	Anura	Microhylidae	Marshland	U	LC	Not listed
5	Field Frog	*Fejervarya limnocharis*	Anura	Ranidae	Marshland	R	LC	IV
6	Common Tree Frog	*Polypedates maculatus*	Anura	Rhacophoridae	Woodland	U	LC	Not listed
	REPTILES							
1	Indian Roofed Turtle	*Pangshura tectum*	Testudines	Bataguridae	Wetland	R	LC	I
2	Indian Flapshell Turtle	*Lissemys punctata*	Testudines	Trionychidae	Wetland	C	LC	I
3	Indian Garden Lizard	*Calotes versicolor*	Squamata (Sub-order Sauria)	Agamidae	Woodland	C	NE	IV
4	Yellow Green House Gecko	*Hemidactylus flaviviridis*	Squamata (Sub-order Sauria)	Gekkonidae	Woodland	C	NE	Not Listed
5	Common Keeled Skink	*Eutropis carinata*	Squamata (Sub-order Sauria)	Scincidae	Grassland	R	LC	IV
6	Spotted Supple Skink	*Lygosoma punctata*	Squamata (Sub-order Sauria)	Scincidae	Grassland	C	NE	I
7	Bengal Monitor	*Varanus bengalensis*	Squamata (Sub-order Sauria)	Varanidae	Grassland	U	LC	I
8	Red Sand Boa	*Eryx johnii*	Squamata (Sub-order Serpentes)	Boidae	Woodland	R	NE	IV
9	Indian Ratsnake	*Ptyas mucosa*	Squamata (Sub-order Serpentes)	Colubridae	Woodland, Grassland	U	NE	II
10	Common Wolf Snake	*Lycodon aulicus*	Squamata (Sub-order Serpentes)	Colubridae	Woodland,Grassland	R	NE	IV
11	Checkered Keelback	*Xenochrophis piscator*	Squamata (Sub-order Serpentes)	Colubridae	Wetland	C	NE	II
12	Common Indian Krait	*Bungarus caeruleus*	Squamata (Sub-order Serpentes)	Elapidae	Woodland	R	NE	IV
13	Spectacled cobra	*Naja naja*	Squamata (Sub-order Serpentes)	Elapidae	Woodland	R	NE	II

B – Butterfly species

Sr. No.	Common English name	Scientific name	Abundance status	Habitat status	Seasonal status	IUCN status
	Papilionidae					
1	Common Mormon	*Papilio polytes*	O	WD	M	NE
2	Common Rose	*Pachliopta aristolochiae*	C	WD	M	NE
3	Lime Butterfly	*Papilio demoleus*	O	WD	M	NE
	Pieridae					
4	Common Emigrant	*Catopsilia pomona*	A	WT	M	NE
5	Common Grass Yellow	*Eurema hecabe*	A	WD-GR	W	NE
6	Common Gull	*Cepora nerissa*	R	WT	SMW	NE
7	Indian Cabbage White	*Pieris canidia*	C	WD	SW	NE
8	Large Cabbage White	*Pieris brassicae*	O	WD-WT	SW	NE
9	Mottled Emigrant	*Catopsilia pyranthe*	F	WT	SMW	NE
10	One Spot Grass Yellow	*Eurema andersoni*	A	WD-GR	MW	LC
11	Poineer	*Belenois aurota*	F	WD-GR-WT	SMW	NE
12	Small Grass Yellow	*Eurema brigitta*	A	GR	SMW	LC
13	Spotless Grass Yellow	*Eurema laeta*	A	WD-GR	SMW	NE
14	White Orange Tip	*Ixias marianne*	R	WD	SM	NE
15	Yellow Orange Tip	*Ixias pyrene*	R	WD-GR	SM	NE
	Nymphalidae					
16	Blue Pansy	*Junonia orithiya*	A	GR	SMW	NE
17	Chocolate Pansy	*Junonia iphita*	R	WD	SM	NE
18	Common Bushbrown	*Mycalesis perseus*	R	WD	M	NE
19	Common Castor	*Ariadne merione*	F	WD	M	NE
20	Common Evening Brown	*Melanitis leda*	A	WD	SMW	NE
21	Common Fourring	*Ypthima huebneri*	O	WD-GR-WT	SMW	NE
22	Common Indian Crow	*Euploea core*	F	WD	M	LC
23	Common Leopard	*Phalanta phalantha*	F	WT	MW	NE
24	Danied Eggfly	*Hypolimnas misippus*	C	WD	MW	NE
25	Dark brand Bushbrown	*Mycalesis mineus*	R	WD	M	NE
26	Glassy Tiger	*Parantica aglea*	O	WT	M	NE
27	Great Eggfly	*Hypolimnas bolina*	O	WD-WT	MW	NE
28	Grey Pansy	*Junonia atlites*	C	WD	SMW	NE

29	Large Threering	*Ypthima nareda*	C	WD-GR-WT	SMW	NE
30	Lemon Pansy	*Junonia lemonias*	C	WD	SMW	NE
31	Painted Lady	*Vanessa cardui*	O	WD	SMW	NE
32	Pallid Argus	*Callerebia scanda*	R	WD	W	NE
33	Peacock Pansy	*Junonia almana*	A	WD-WT	SMW	LC
34	Plain Tiger	*Danaus chrysippus*	A	WD-GR	SMW	NE
35	Ringed Argus	*Callerebia ananda*	R	GR	SW	NE
36	Striped Tiger	*Danaus genutia*	C	WT	SMW	NE
37	Tawny Coster	*Acraea violae*	O	WD	S	NE
38	Yellow Pansy	*Junonia hierta*	O	WD	MW	LC
	Lycanidae					
39	Common Cerulean	*Jamides celeno*	F	GR	SMW	NE
40	Common Pierrot	*Castalius rosimon*	F	WD	S	NE
41	Dark Grass Blue	*Pseudozizeeria maha*	F	GR	M	NE
42	Forget-Me-Not	*Catochrysops strabo*	C	GR-WT	S	NE
43	Pale Grass Blue	*Pseudozizeeria maha*	C	WD-GR	S	NE
44	Pea Blue	*Lampides boeticus*	O	WD	SW	NE
45	Rounded Pierrot	*Tarucus nara*	C	WD-GR	SW	NE
46	Tiny Grass Blue	*Zizula hylax*	O	WD-GR-WT	M	NE
	Hesperiidae					
47	Common Banded Awl	*Hasora chromus*	R	WD-GR	S	NE
48	Grass Demon	*Udaspes folus*	R	WD-GR	W	NE
49	Great Swift	*Pelopidas assamensis*	R	WD-GR	S	NE
50	Indian Ace	*Halpe homolea*	O	GR	SM	NE
51	Indian Skipper	*Spialia galba*	O	WD-GR	M	NE
52	Spotted Angle	*Caprona agama*	R	GR	W	NE
53	Yellow Spot Swift	*Polytremis eltola*	O	WD-GR	SW	NE

C – Odonates

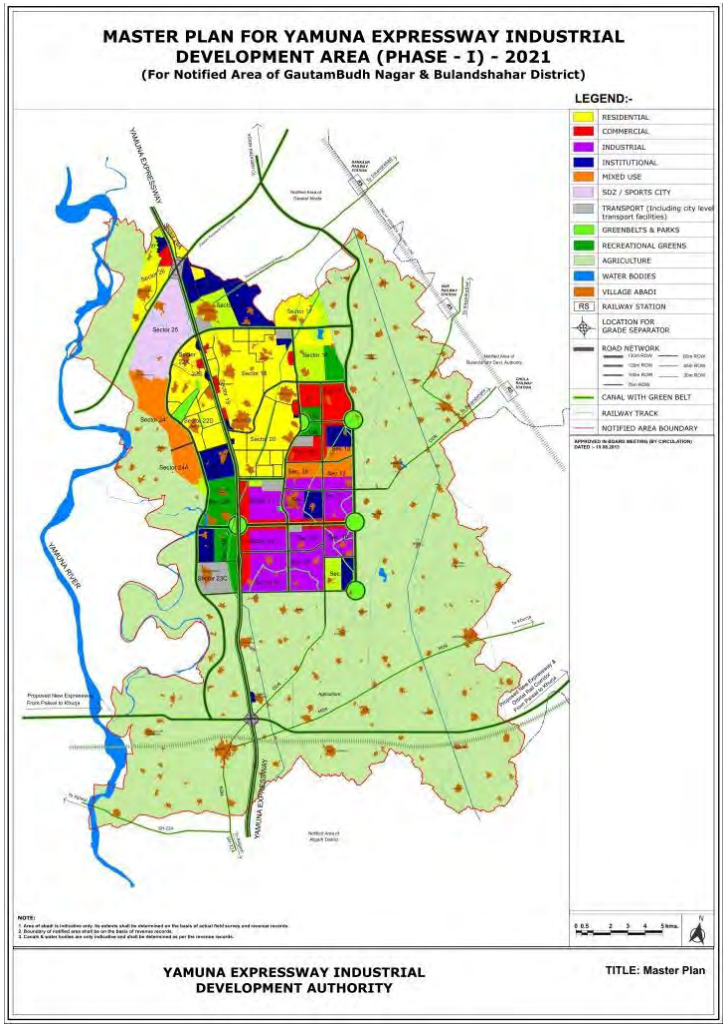
S. No.	Common Name	Scientific Name and Family	Family:	Abundance
1	Common Club-Tail	*Ictinogomphus rapax*	Gomphidae	Common
2	Common Hooktail	*Paragomphus lineatus*	Gomphidae	Occasional
3	Rusty Darner	*Anaciaeschna jaspidea*	Aeshnidae	Common
4	Blue–tailed Green Darner	*Anax guttatus*	Aeshnidae	Common
5	Blue Darner	*Anax immaculifrons*	Aeshnidae	Common
6	Trumpet Tail	*Acisoma panorpoides*	Libellulidae	Very Common
7	Little Blue Marsh Hawk	*Brachydiplax sobrina*	Libellulidae	Very Common
8	Ditch Jewel	*Brachythemis contaminata*	Libellulidae	Very Common
9	Granite Ghost	*Bradinopyga geminata*	Libellulidae	Occasional
10	Ruddy Marsh Skimmer	*Crocothemis servilia*	Libellulidae	Very common
11	Ground Skimmer	*Diplacodes trivialis*	Libellulidae	Common
12	Asiatic Blood tail	*Lathrecista asiatica*	Libellulidae	Rare
13	Ruddy Meadow Skimmer	*Neurothemis intermedia*	Libellulidae	Common
14	Pied paddy Skimmer	*Neurothemis tullia*	Libellulidae	Very common
15	Green marsh hawk	*Orthetrum sabina*	Libellulidae	Common
16	Blue-tailed Yellow Skimmer	*Palpopleura sexmaculata*	Libellulidae	Common
17	Wandering Glider	*Pantala flavescens*	Libellulidae	Very common
18	Common Picturewing	*Rhyothemis variegata*	Libellulidae	Very common
19	Pigmy Skimmer	*Tetrathemis platyptera*	Libellulidae	Rare
20	Coral-tailed Cloud Wings	*Tholymis tillarga*	Libellulidae	Rare
21	Red Marsh Trotter	*Tramea basilaris*	Libellulidae	Occasional
22	Black Marsh Trotter	*Tramea limbata*	Libellulidae	Occasional
23	Crimson Marsh Glider	*Trithemis aurora*	Libellulidae	Very common
24	Long-Legged Marsh Glider	*Trithemis pallidinervis*	Libellulidae	Common
25	Greater Crimson Glider	*Urothemis signata*	Libellulidae	Common
26	Green-striped Slender Dartlet	*Aciagrion occidentale*	Coenagrionidae	Occasional
27	Pigmy Dartlet	*Agriocnemis pygmaea*	Coenagrionidae	Common
28	Coromandel Marsh Dart	*Ceriagrion coromandelianum*	Coenagrionidae	Very common
29	Orange-Tailed Marsh Dart	*Ceriagrion cerinorubellum*	Coenagrionidae	Common
30	Azure Dartlet	*Enallagma parvum*	Coenagrionidae	Occasional
31	Golden Dartless	*Ischnura aurora*	Coenagrionidae	Common
32	Senegal Golden Dartlet	*Ischnura senegalensis*	Coenagrionidae	Very common
33	Three-Lined Dart	*Pseudagrion decorum*	Coenagrionidae	Very common
34	Blue Grass Dartlet	*Pseudagrion microcephalum*	Coenagrionidae	Occasional
35	Pixie Dartlet	*Rhodischnura nursei*	Coenagrionidae	Very rare
36	Yellow Bush-Dart	*Copera marginipes*	Platycnemididae	Common

D – Fish species

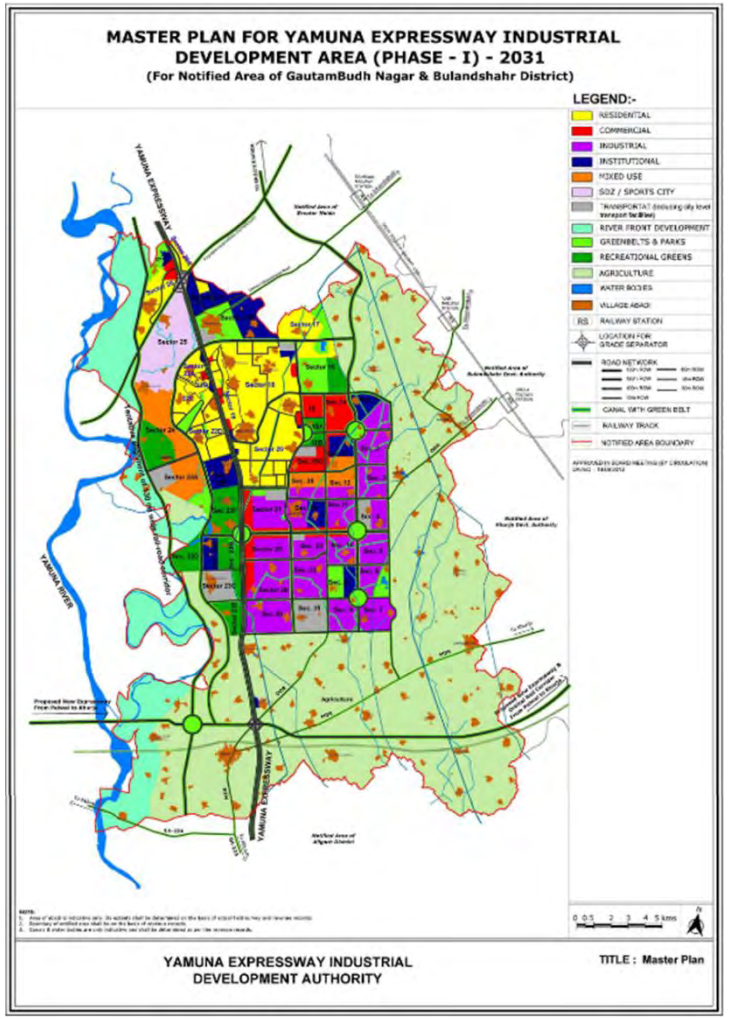
S. No.	Common/ English Local Name	Scientific Name	Family	Abundance Status	IUCN status
1	Black lined loach Baatta	*Nemacheilus anguilla*	Balitoridae	R	LC
2	Cuchia cuchia Bam	*Monopterus cuchia*	Amphipnoidae	R	NE
3	Bighead carp Biggread	*Hypophthalmichthys nobilis*	Cyprinidae	R	DD
4	Indian glass barb Chilwa	*Laubuka laubuca*	Cyprinidae	A	NE
5	Climbing perch Kawai	*Anabas testudineus*	Anabantidae	R	DD
6	Banded gourami Kharda	*Trichogaster fasciata*	Osphronemidae	F	NE
7	Boel Lauch/Barari	*Wallagao attu*	Siluridae	R	NT
8	Magur Mangur	*Clarias batrachus*	Clariidae	O	LC
9	Spot-fin swamp barb Putti	*Puntius sopohore*	Cyprinidae	C	LC
10	Chola barb Putti	*Puntius chola*	Cyprinidae	C	LC
11	Rohu Rohu	*Labeo rohita*	Cyprinidae	R	LC
12	Striped snakehead Shol	*Channa striata*	Chaniidae	O	NE
13	Spotted snakehead Shol	*Channa punctata*	Chaniidae	O	NE
14	Stinging catfish Singhi	*Heteropneustes fossilis*	Heteropneustidae	F	LC
15	Day's mystus Tengna	*Mystus bleekeri*	Bagridae	R	LC

ANNEXURE IV

A – Master Plan 2021, YEIDA



B – Master Plan 2031, YEIDA



ANNEXURE V

Location of potential habitat patches and their characteristics across three landscape categories (Inside GJIA site, 10 km radius and 25 km radius)

ID	Habitat Type/Class	Landscape	Area (ha)	Area (sq. m)	Perimeter (m)	PARA	Latitude	Longitude	Inside YEIDA Extent
1	Scrubland	GJIA site	1.465	14645.800	572.109	0.03906	28.177	77.6325989	Yes
2	Scrubland	GJIA site	2.485	24847.699	602.215	0.02424	28.1755	77.6320038	Yes
3	Scrubland	GJIA site	1.968	19681.900	770.024	0.03912	28.1751	77.6284027	Yes
4	Scrubland	GJIA site	2.077	20773.100	761.821	0.03667	28.1733	77.6327972	Yes
5	Scrubland	GJIA site	3.056	30556.199	782.835	0.02562	28.1708	77.6332016	Yes
6	Scrubland	GJIA site	3.481	34812.602	1108.740	0.03185	28.1594	77.6307983	Yes
7	Scrubland	GJIA site	2.203	22026.900	1008.470	0.04578	28.1763	77.634697	Yes
8	Scrubland	GJIA site	0.856	8558.270	479.888	0.05607	28.1648	77.6316986	Yes
9	Scrubland	GJIA site	2.143	21429.900	1058.500	0.04939	28.1639	77.6336975	Yes
10	Scrubland	GJIA site	4.997	49965.398	1591.230	0.03185	28.1612	77.6369019	Yes
11	Scrubland	GJIA site	1.464	14640.000	844.091	0.05766	28.1583	77.6379013	Yes
1	Scrubland	10 km	5.586	55859.500	1372.990	0.02458	28.1529	77.6334991	Yes
2	Scrubland	10 km	10.903	109032.000	1993.810	0.01829	28.1487	77.6390991	Yes
3	Scrubland	10 km	27.555	275547.000	4772.990	0.01732	28.0983	77.5519028	Yes
4	Scrubland	10 km	5.910	59101.000	1627.730	0.02754	28.0914	77.552002	Yes
5	Scrubland	10 km	23.127	231266.000	3801.010	0.01644	28.1363	77.572197	Yes
6	Scrubland	10 km	6.718	67182.602	1131.930	0.01685	28.151	77.5737	Yes
7	Scrubland	10 km	4.678	46781.801	1079.450	0.02307	28.1485	77.5748978	Yes
8	Scrubland	10 km	30.266	302657.000	6833.690	0.02258	28.14	77.5749969	Yes
9	Scrubland	10 km	12.863	128632.000	3059.220	0.02378	28.2132	77.6364975	Yes
10	Scrubland	10 km	15.392	153925.000	3018.300	0.01961	28.1794	77.6331024	Yes
11	Scrubland	10 km	1.289	12889.700	595.421	0.04619	28.2087	77.6499023	Yes
12	Scrubland	10 km	5.618	56182.199	2077.840	0.03698	28.2032	77.6499023	Yes
13	Scrubland	10 km	3.544	35436.102	1368.500	0.03862	28.2042	77.652298	Yes
14	Scrubland	10 km	3.290	32900.199	1056.980	0.03213	28.2027	77.6539993	Yes
15	Scrubland	10 km	1.329	13287.200	773.635	0.05822	28.2062	77.6529007	Yes
16	Scrubland	10 km	15.552	155524.000	3143.420	0.02021	28.1992	77.6378021	Yes
17	Scrubland	10 km	3.131	31308.000	1286.440	0.04109	28.192	77.6274033	Yes
18	Scrubland	10 km	1.095	10954.400	467.319	0.04266	28.1967	77.6343994	Yes
19	Scrubland	10 km	7.593	75929.602	1651.750	0.02175	28.1872	77.631897	Yes
20	Scrubland	10 km	15.768	157681.000	3823.100	0.02425	28.1911	77.6372986	Yes
21	Scrubland	10 km	0.293	2928.660	238.849	0.08156	28.1915	77.6376038	Yes

22	Scrubland	10 km	28.688	286875.000	6059.690	0.02112	28.1094	77.7020035	Yes
23	Scrubland	10 km	15.151	151515.000	2480.510	0.01637	28.2021	77.5403976	Yes
24	Scrubland	10 km	18.144	181444.000	3123.780	0.01722	28.1911	77.5466995	Yes
25	Scrubland	10 km	4.726	47263.602	1349.480	0.02855	28.2456	77.5474014	Yes
26	Scrubland	10 km	4.231	42311.102	1588.820	0.03755	28.2342	77.5378036	Yes
27	Scrubland	10 km	16.055	160552.000	3301.830	0.02057	28.2404	77.5466003	Yes
28	Scrubland	10 km	47.571	475714.000	3301.230	0.00694	28.1615	77.7095032	Yes
29	Scrubland	10 km	8.007	80066.102	1185.030	0.01480	28.2307	77.6811981	Yes
30	Scrubland	10 km	5.793	57929.301	2398.610	0.04141	28.231	77.6856995	Yes
31	Scrubland	10 km	0.220	2202.320	215.793	0.09798	28.2291	77.685997	Yes
32	Scrubland	10 km	6.745	67454.703	1625.520	0.02410	28.2367	77.6752014	Yes
33	Scrubland	10 km	10.332	103322.000	2989.950	0.02894	28.2255	77.6808014	Yes
34	Scrubland	10 km	2.220	22202.500	979.557	0.04412	28.2477	77.5394974	Yes
35	Scrubland	10 km	3.045	30445.100	1102.660	0.03622	28.2192	77.6917038	Yes
36	Scrubland	10 km	10.180	101800.000	2145.790	0.02108	28.2153	77.694397	Yes
37	Scrubland	10 km	1.418	14180.100	534.970	0.03773	28.2237	77.6830978	Yes
38	Scrubland	10 km	1.736	17363.100	568.823	0.03276	28.2213	77.6827011	Yes
39	Scrubland	10 km	6.097	60971.699	1333.370	0.02187	28.2177	77.6809998	Yes
40	Scrubland	10 km	4.633	46326.801	1457.900	0.03147	28.2009	77.6166	Yes
41	Scrubland	10 km	35.598	355981.000	5788.260	0.01626	28.106	77.5367966	Yes
42	Woodland (natural)	10 km	21.270	212700.000	2481.560	0.01167	28.1458	77.5419998	Yes
43	Woodland (natural)	10 km	13.661	136612.000	1840.620	0.01347	28.1404	77.5438995	Yes
44	Woodland (natural)	10 km	30.605	306054.000	2687.980	0.00878	28.1961	77.5298996	Yes
45	Woodland (natural)	10 km	16.386	163857.000	1853.770	0.01131	28.194	77.5223007	Yes
46	Woodland (natural)	10 km	2.609	26094.900	751.003	0.02878	28.1958	77.5363998	Yes
47	Woodland (natural)	10 km	3.350	33495.500	985.618	0.02943	28.1937	77.5411987	Yes
48	Woodland (plantation)	10 km	26.005	260046.000	3224.430	0.01240	28.2178	77.702301	Yes
1	Woodland (natural)	25 km	24.379	243789.000	2428.580	0.00996	28.4073	77.5516968	No
2	Scrubland	25 km	0.452	4521.630	345.280	0.07636	28.408	77.5394974	No
3	Scrubland	25 km	0.743	7427.320	543.232	0.07314	28.4055	77.5406036	No
4	Scrubland	25 km	19.857	198570.000	5921.110	0.02982	28.4047	77.5410004	No
5	Woodland (natural)	25 km	69.383	693832.000	15239.300	0.02196	28.4008	77.5326996	No
6	Scrubland	25 km	0.383	3834.600	332.380	0.08668	28.3986	77.5365982	No
7	Scrubland	25 km	0.492	4915.540	546.098	0.11110	28.3991	77.5389023	No
8	Scrubland	25 km	1.731	17314.900	1142.660	0.06599	28.3999	77.5353012	No
9	Woodland (natural)	25 km	65.992	659924.000	11485.800	0.01740	28.3984	77.5450974	No
10	Scrubland	25 km	0.810	8104.590	392.820	0.04847	28.3978	77.5423965	No

11	Scrubland	25 km	1.202	12022.600	643.664	0.05354	28.3973	77.5438995	No
12	Scrubland	25 km	0.752	7517.800	527.120	0.07012	28.3973	77.5467987	No
13	Woodland (plantation)	25 km	58.123	581228.000	5110.040	0.00879	28.3112	77.7353973	No
15	Woodland (natural)	25 km	0.196	1955.000	179.755	0.09195	28.2261	77.7664032	No
16	Woodland (natural)	25 km	56.769	567694.000	10401.800	0.01832	28.2254	77.7729034	No
17	Scrubland (open woodland)	25 km	0.260	2596.970	202.953	0.07815	28.227	77.7689972	No
18	Scrubland (open woodland)	25 km	2.206	22057.500	921.958	0.04180	28.2248	77.7761002	No
19	Scrubland (open woodland)	25 km	0.164	1639.460	242.836	0.14812	28.2252	77.7751999	No
20	Scrubland (open woodland)	25 km	2.409	24092.600	1916.220	0.07954	28.2246	77.7779999	No
21	Scrubland (open woodland)	25 km	0.365	3647.990	368.087	0.10090	28.2252	77.7696991	No
22	Scrubland (open woodland)	25 km	0.166	1658.330	186.039	0.11218	28.2253	77.7729034	No
23	Scrubland (open woodland)	25 km	0.498	4978.660	408.547	0.08206	28.2265	77.7761002	No
24	Scrubland (open woodland)	25 km	0.116	1163.890	152.128	0.13071	28.2247	77.7734985	No
25	Scrubland (open woodland)	25 km	0.209	2092.750	284.464	0.13593	28.2227	77.7715988	No
27	Woodland (natural)	25 km	13.264	132642.000	2528.890	0.01907	28.2313	77.786499	No
28	Woodland (natural)	25 km	1.537	15367.600	740.285	0.04817	28.2311	77.7932968	No
29	Scrubland (open woodland)	25 km	0.213	2134.470	202.311	0.09478	28.229	77.7975006	No
30	Woodland (natural)	25 km	47.377	473766.000	4961.030	0.01047	28.2297	77.7945023	No
31	Scrubland	25 km	6.181	61808.000	1292.160	0.02091	28.2322	77.7987976	No
32	Scrubland	25 km	3.537	35372.602	1713.940	0.04845	28.2313	77.8048019	No
33	Scrubland	25 km	1.107	11066.200	458.400	0.04142	28.2333	77.7994995	No
35	Scrubland	25 km	6.193	61930.500	2988.430	0.04825	28.2298	77.8003998	No
36	Scrubland	25 km	1.188	11884.400	898.949	0.07564	28.2323	77.8006973	No
37	Scrubland	25 km	1.106	11055.700	1231.770	0.11141	28.2337	77.7995987	No
38	Scrubland (open woodland)	25 km	0.225	2253.890	188.424	0.08360	28.2461	77.7955017	No
39	Scrubland (open woodland)	25 km	0.274	2736.130	240.199	0.08779	28.2443	77.8012009	No

40	Woodland (natural)	25 km	28.047	280472.000	3877.820	0.01383	28.2456	77.7994003	No
41	Woodland (natural)	25 km	13.816	138155.000	2954.880	0.02139	28.2476	77.8058014	No
42	Woodland (plantation)	25 km	14.228	142284.000	2461.600	0.01730	28.2161	77.8248978	No
43	Scrubland	25 km	22.621	226210.000	3278.110	0.01449	28.2812	77.788002	No
44	Scrubland	25 km	2.120	21195.400	764.015	0.03605	28.2819	77.7845993	No
45	Scrubland	25 km	2.036	20357.199	1608.220	0.07900	28.2792	77.7867966	No
46	Scrubland	25 km	4.241	42406.801	889.728	0.02098	28.2963	77.7978973	No
47	Scrubland	25 km	3.890	38901.301	1062.110	0.02730	28.286	77.7903976	No
48	Scrubland	25 km	16.938	169382.000	3485.950	0.02058	28.294	77.7937012	No
49	Scrubland	25 km	2.447	24469.400	654.499	0.02675	28.2909	77.792099	No
50	Scrubland	25 km	1.056	10556.400	453.577	0.04297	28.2882	77.7882004	No
51	Scrubland	25 km	2.112	21124.600	992.298	0.04697	28.2889	77.7893982	No
52	Scrubland	25 km	3.171	31712.400	1233.210	0.03889	28.2891	77.7934036	No
53	Scrubland	25 km	3.786	37862.000	1059.960	0.02800	28.2106	77.8205032	No
54	Scrubland	25 km	4.279	42788.699	1002.680	0.02343	28.2119	77.8223038	No
55	Woodland (natural)	25 km	49.273	492730.000	3536.340	0.00718	28.3772	77.5470963	No
57	Woodland (plantation)	25 km	3.687	36865.801	1017.800	0.02761	28.1465	77.8939972	No
58	Woodland (plantation)	25 km	8.290	82898.797	1752.300	0.02114	28.1448	77.8918991	No
59	Scrubland	25 km	14.718	147183.000	4048.810	0.02751	28.2126	77.8099976	No
60	Scrubland	25 km	1.810	18096.699	595.146	0.03289	28.2111	77.808197	No
61	Scrubland	25 km	1.239	12387.000	912.097	0.07363	28.2093	77.8090973	No
62	Scrubland	25 km	87.132	871322.000	5025.290	0.00577	27.9909	77.5849991	No
63	Woodland	25 km	16.031	160313.000	2363.900	0.01475	27.9546	77.5294037	No
64	Woodland	25 km	3.295	32949.199	904.957	0.02747	27.9514	77.5270996	No
65	Woodland	25 km	31.909	319091.000	2707.370	0.00848	28.1218	77.3427963	No
66	Woodland	25 km	23.709	237093.000	3080.920	0.01299	27.9523	77.5226974	No
67	Scrubland	25 km	9.050	90504.297	1789.560	0.01977	27.9838	77.5828018	No
68	Woodland	25 km	3.309	33086.801	819.677	0.02477	28.3167	77.8324966	No
69	Woodland	25 km	5.033	50334.000	1064.580	0.02115	28.3068	77.8236008	No
70	Woodland	25 km	22.779	227790.000	2064.390	0.00906	28.3405	77.7722015	No
71	Woodland	25 km	2.487	24869.900	1614.540	0.06492	28.3412	77.7741013	No
72	Woodland (natural)	25 km	2.725	27246.600	861.182	0.03161	28.1507	77.8619995	No
73	Woodland (plantation)	25 km	5.875	58748.602	1080.870	0.01840	28.1507	77.8672028	No
74	Woodland (natural)	25 km	26.112	261122.000	3378.270	0.01294	28.1516	77.851799	No
75	Scrubland	25 km	89.537	895374.000	7612.100	0.00850	28.1588	77.7987976	No
76	Scrubland	25 km	35.298	352977.000	5043.430	0.01429	28.1537	77.8066025	No
77	Scrubland	25 km	25.279	252788.000	3560.730	0.01409	28.1479	77.7987976	No

78	Scrubland	25 km	6.459	64594.500	1413.190	0.02188	28.1526	77.7981033	No
79	Woodland (plantation)	25 km	11.666	116662.000	2256.740	0.01934	28.1465	77.881897	No
80	Woodland (plantation)	25 km	36.642	366417.000	3730.590	0.01018	28.1951	77.8930969	No
81	Woodland (plantation)	25 km	15.171	151707.000	1734.600	0.01143	28.3844	77.6325989	No
82	Woodland (natural)	25 km	23.782	237821.000	2414.460	0.01015	28.0666	77.479599	No
83	Woodland (natural)	25 km	38.895	388950.000	2853.960	0.00734	28.0722	77.4841995	No
84	Woodland (natural)	25 km	5.001	50014.801	1015.970	0.02031	28.0837	77.4753036	No
85	Woodland (natural)	25 km	11.966	119659.000	2125.940	0.01777	28.0815	77.4779968	No
86	Woodland (natural)	25 km	2.785	27854.100	704.698	0.02530	28.0716	77.4785004	Yes
87	Woodland (plantation)	25 km	32.066	320663.000	4606.270	0.01436	28.3789	77.6490021	No
88	Woodland (plantation)	25 km	5.143	51434.102	957.804	0.01862	28.3828	77.6740036	No
89	Scrubland	25 km	27.692	276917.000	3681.820	0.01330	28.2183	77.8162994	No
90	Scrubland	25 km	30.926	309256.000	4797.620	0.01551	28.2501	77.8183975	No
91	Scrubland	25 km	6.479	64791.301	1096.290	0.01692	28.2619	77.8145981	No
92	Scrubland	25 km	5.324	53242.000	1064.230	0.01999	28.2544	77.8076019	No
93	Scrubland	25 km	25.049	250492.000	4381.370	0.01749	28.2614	77.8082962	No
94	Scrubland	25 km	11.188	111884.000	1935.310	0.01730	28.2715	77.7988968	No
95	Scrubland	25 km	26.665	266652.000	2881.610	0.01081	28.2709	77.7940979	No
96	Scrubland	25 km	33.183	331828.000	3041.060	0.00916	28.3473	77.4662018	No
97	Scrubland	25 km	31.020	310195.000	2592.600	0.00836	28.4024	77.5149994	Yes
98	Scrubland (open woodland)	25 km	2.845	28449.600	863.783	0.03036	28.2471	77.8060989	No
99	Scrubland	25 km	62.120	621203.000	3234.350	0.00521	28.3604	77.5440979	No
100	Woodland (natural)	25 km	37.877	378770.000	3059.280	0.00808	28.3666	77.5577011	No

ANNEXURE VI

List of wetlands and their characteristics across three landscape categories (Inside GJIA site, 10 km radius and 25 km radius)

ID	Water body (Seasonal/Perennial)	Landscape	Area (ha)	Area (sq. m)	Perimeter (m)	PARA	Latitude	Longitude	Inside YEIDA Extent
1	Seasonal (weed infested)	GJIA site	0.408	4082.8401	250.246	0.06	28.1727	77.5836	Yes
2	Seasonal (weed infested)	GJIA site	0.451	4513.8999	246.511	0.05	28.1786	77.5788	Yes
3	Seasonal (weed infested)	GJIA site	0.140	1395.45	165.163	0.12	28.1805	77.5795	Yes
4	Perennial	GJIA site	1.002	10021.4	409.891	0.04	28.1658	77.6	Yes
5	Perennial	GJIA site	0.908	9079.5996	359.087	0.04	28.1687	77.6279	Yes
6	Perennial	GJIA site	0.120	1198.73	128.740	0.11	28.1666	77.6236	Yes
7	Perennial	GJIA site	0.065	645.63501	100.514	0.16	28.1754	77.5934	Yes
8	Perennial	GJIA site	0.409	4086.45	261.065	0.06	28.1809	77.6088	Yes
1	Seasonal (weed infested)	10 km	0.03679	367.944	71.877	0.20	28.2228	77.7259	No
2	Perennial	10 km	0.05427	542.677	87.525	0.16	28.1933	77.6007	Yes
3	Perennial	10 km	0.06622	662.173	102.064	0.15	28.2278	77.5012	No
4	Perennial	10 km	0.06754	675.404	99.392	0.15	28.2704	77.5586	Yes
5	Perennial	10 km	0.07211	721.082	107.750	0.15	28.132	77.5165	Yes
6	Perennial	10 km	0.07401	740.063	121.778	0.16	28.1839	77.6279	Yes
7	Seasonal	10 km	0.07734	773.411	107.034	0.14	28.1903	77.6728	Yes
8	Seasonal (weed infested)	10 km	0.07806	780.621	102.012	0.13	28.2264	77.5015	No
9	Perennial	10 km	0.09092	909.186	117.562	0.13	28.1079	77.7117	Yes
10	Perennial	10 km	0.09617	961.689	120.260	0.13	28.1084	77.7143	Yes
11	Perennial	10 km	0.11262	1126.230	130.056	0.12	28.2716	77.5591	Yes
12	Seasonal	10 km	0.11463	1146.330	125.892	0.11	28.2073	77.4958	No
13	Seasonal	10 km	0.12078	1207.790	127.990	0.11	28.1925	77.522	Yes
14	Perennial	10 km	0.12207	1220.700	133.434	0.11	28.2296	77.6741	Yes
15	Seasonal	10 km	0.12527	1252.650	133.714	0.11	28.2544	77.6792	Yes
16	Perennial	10 km	0.12995	1299.460	146.714	0.11	28.1697	77.7195	No
17	Perennial	10 km	0.13021	1302.090	146.298	0.11	28.1367	77.7028	Yes
18	Perennial	10 km	0.13998	1399.800	156.346	0.11	28.1482	77.5745	Yes
19	Perennial	10 km	0.14298	1429.840	138.380	0.10	28.153	77.6598	Yes
20	Seasonal	10 km	0.14970	1497.000	144.288	0.10	28.0926	77.5252	Yes
21	Perennial	10 km	0.15071	1507.060	145.069	0.10	28.1423	77.6434	Yes
22	Perennial	10 km	0.15093	1509.300	154.054	0.10	28.1234	77.6903	Yes

23	Seasonal	10 km	0.15272	1527.220	148.882	0.10	28.1238	77.7264	Yes
24	Seasonal (weed infested)	10 km	0.15356	1535.620	172.267	0.11	28.2239	77.7243	No
25	Perennial	10 km	0.16022	1602.230	148.547	0.09	28.1306	77.553	Yes
26	Perennial	10 km	0.16348	1634.750	154.457	0.09	28.1276	77.6594	Yes
27	Seasonal	10 km	0.16435	1643.460	151.064	0.09	28.2261	77.6777	Yes
28	Seasonal	10 km	0.16436	1643.570	155.166	0.09	28.1043	77.5386	Yes
29	Perennial	10 km	0.16818	1681.790	156.713	0.09	28.1155	77.5888	Yes
30	Perennial	10 km	0.16902	1690.190	165.228	0.10	28.2559	77.5229	Yes
31	Seasonal (weed infested)	10 km	0.17238	1723.790	178.723	0.10	28.1614	77.6728	Yes
32	Seasonal (weed infested)	10 km	0.17580	1757.960	159.071	0.09	28.1463	77.5979	Yes
33	Seasonal (weed infested)	10 km	0.17805	1780.500	172.110	0.10	28.1216	77.6882	Yes
34	Perennial	10 km	0.18319	1831.880	189.637	0.10	28.0675	77.6395	No
35	Perennial	10 km	0.18851	1885.090	205.585	0.11	28.1818	77.6269	Yes
36	Perennial	10 km	0.19249	1924.910	165.970	0.09	28.2086	77.5759	Yes
37	Perennial	10 km	0.19450	1945.010	176.516	0.09	28.0973	77.5403	Yes
38	Perennial	10 km	0.19564	1956.410	167.213	0.09	28.092	77.6268	No
39	Seasonal	10 km	0.19573	1957.330	165.772	0.08	28.268	77.5744	Yes
40	Perennial	10 km	0.19676	1967.620	168.220	0.09	28.1418	77.6457	Yes
41	Seasonal	10 km	0.19746	1974.550	176.360	0.09	28.2622	77.6637	Yes
42	Perennial	10 km	0.21172	2117.200	172.503	0.08	28.1658	77.6533	Yes
43	Perennial	10 km	0.21660	2165.990	361.377	0.17	28.0869	77.5522	No
44	Seasonal	10 km	0.22017	2201.680	171.322	0.08	28.2374	77.5565	Yes
45	Seasonal	10 km	0.22130	2213.020	174.900	0.08	28.2561	77.6684	Yes
46	Seasonal (weed infested)	10 km	0.22685	2268.470	198.926	0.09	28.2525	77.6665	Yes
47	Perennial	10 km	0.22820	2282.010	181.117	0.08	28.1614	77.6111	Yes
48	Perennial	10 km	0.22838	2283.830	237.498	0.10	28.2732	77.5604	Yes
49	Seasonal	10 km	0.23214	2321.350	219.905	0.09	28.2563	77.6033	Yes
50	Seasonal	10 km	0.23916	2391.640	208.182	0.09	28.2286	77.5082	No
51	Seasonal (weed infested)	10 km	0.24933	2493.280	195.647	0.08	28.1241	77.5447	Yes
52	Perennial	10 km	0.26210	2620.980	217.153	0.08	28.1914	77.6051	Yes
53	Perennial	10 km	0.26742	2674.180	201.908	0.08	28.1141	77.5894	Yes
54	Perennial	10 km	0.26893	2689.330	194.453	0.07	28.0782	77.6036	No
55	Perennial	10 km	0.27274	2727.380	189.874	0.07	28.2196	77.6154	Yes
56	Seasonal	10 km	0.27295	2729.520	193.212	0.07	28.1716	77.6829	Yes
57	Perennial	10 km	0.27577	2757.740	225.789	0.08	28.0904	77.6332	No
58	Perennial	10 km	0.28299	2829.940	204.476	0.07	28.1982	77.5559	Yes
59	Perennial	10 km	0.30003	3000.260	202.307	0.07	28.0878	77.5867	No

60	Perennial	10 km	0.30103	3010.340	213.426	0.07	28.1886	77.7365	No
61	Perennial	10 km	0.30488	3048.840	226.189	0.07	28.1629	77.5801	Yes
62	Perennial	10 km	0.30723	3072.330	207.266	0.07	28.1971	77.5719	Yes
63	Seasonal (weed infested)	10 km	0.30759	3075.860	240.112	0.08	28.1956	77.675	Yes
64	Perennial	10 km	0.30789	3078.890	234.308	0.08	28.1673	77.6517	Yes
65	Perennial	10 km	0.31401	3140.130	221.485	0.07	28.1953	77.6028	Yes
66	Seasonal (weed infested)	10 km	0.31916	3191.550	281.523	0.09	28.1832	77.6251	Yes
67	Perennial	10 km	0.32261	3226.130	221.921	0.07	28.1433	77.6118	Yes
68	Perennial	10 km	0.32327	3232.680	264.993	0.08	28.1211	77.5618	Yes
69	Seasonal	10 km	0.33033	3303.340	216.305	0.07	28.1528	77.7317	Yes
70	Perennial	10 km	0.33042	3304.220	283.386	0.09	28.1891	77.4986	Yes
71	Seasonal (weed infested)	10 km	0.33182	3318.220	246.564	0.07	28.1781	77.7011	Yes
72	Perennial	10 km	0.33184	3318.350	231.398	0.07	28.0785	77.5767	No
73	Seasonal (weed infested)	10 km	0.33447	3344.690	225.252	0.07	28.1281	77.7233	Yes
74	Seasonal	10 km	0.34363	3436.250	225.307	0.07	28.1896	77.523	Yes
75	Seasonal	10 km	0.34637	3463.700	261.365	0.08	28.1799	77.6963	Yes
76	Seasonal	10 km	0.34816	3481.610	287.609	0.08	28.0849	77.551	No
77	Perennial	10 km	0.37103	3710.310	228.470	0.06	28.2433	77.5623	Yes
78	Seasonal	10 km	0.37467	3746.650	310.489	0.08	28.0858	77.5478	No
79	Perennial	10 km	0.38004	3800.380	238.033	0.06	28.1095	77.7106	Yes
80	Perennial	10 km	0.38458	3845.840	227.418	0.06	28.1518	77.6979	Yes
81	Seasonal (weed infested)	10 km	0.38522	3852.220	236.943	0.06	28.2185	77.588	Yes
82	Perennial	10 km	0.38537	3853.650	350.238	0.09	28.1328	77.5167	Yes
83	Seasonal (weed infested)	10 km	0.39106	3910.630	260.785	0.07	28.2501	77.6306	Yes
84	Perennial	10 km	0.39561	3956.100	244.099	0.06	28.1842	77.7031	Yes
85	Perennial	10 km	0.39735	3973.460	303.393	0.08	28.222	77.7233	No
86	Perennial	10 km	0.39888	3988.790	278.694	0.07	28.091	77.5918	No
87	Seasonal (weed infested)	10 km	0.40058	4005.810	235.272	0.06	28.1482	77.6869	Yes
88	Perennial	10 km	0.40087	4008.740	237.498	0.06	28.2592	77.6299	Yes
89	Seasonal (weed infested)	10 km	0.41286	4128.590	259.817	0.06	28.1758	77.7062	Yes
90	Seasonal (weed infested)	10 km	0.41353	4135.310	239.132	0.06	28.1659	77.7348	No
91	Seasonal	10 km	0.41538	4153.790	258.373	0.06	28.0852	77.5469	No
92	Seasonal (weed infested)	10 km	0.42712	4271.160	251.870	0.06	28.1534	77.6674	Yes
93	Perennial	10 km	0.43302	4330.220	245.346	0.06	28.089	77.626	No
94	Perennial	10 km	0.43357	4335.690	245.796	0.06	28.1911	77.6378	Yes
95	Seasonal (weed infested)	10 km	0.43649	4364.930	357.932	0.08	28.1934	77.6778	Yes
96	Perennial	10 km	0.43854	4385.370	292.876	0.07	28.1439	77.6082	Yes

97	Perennial	10 km	0.44138	4413.790	249.181	0.06	28.1386	77.6847	Yes
98	Perennial	10 km	0.44517	4451.730	278.647	0.06	28.1488	77.6112	Yes
99	Perennial	10 km	0.45433	4543.300	271.209	0.06	28.2532	77.6894	Yes
100	Perennial	10 km	0.46154	4615.370	255.250	0.06	28.2545	77.5984	Yes
101	Perennial	10 km	0.46850	4684.990	283.461	0.06	28.2328	77.5566	Yes
102	Perennial	10 km	0.48373	4837.320	278.892	0.06	28.2096	77.678	Yes
103	Perennial	10 km	0.50846	5084.580	295.323	0.06	28.1778	77.7103	No
104	Seasonal	10 km	0.51365	5136.520	292.734	0.06	28.2396	77.5491	Yes
105	Perennial	10 km	0.52276	5227.600	438.809	0.08	28.0959	77.5549	Yes
106	Perennial	10 km	0.54521	5452.050	277.203	0.05	28.0895	77.6303	No
107	Perennial	10 km	0.54542	5454.230	292.552	0.05	28.1031	77.5483	Yes
108	Perennial	10 km	0.55651	5565.090	293.921	0.05	28.1242	77.69	Yes
109	Perennial	10 km	0.56590	5659.000	280.294	0.05	28.2446	77.6493	Yes
110	Perennial	10 km	0.58023	5802.290	297.022	0.05	28.2194	77.6521	Yes
111	Perennial	10 km	0.58305	5830.510	463.945	0.08	28.1005	77.6926	Yes
112	Perennial	10 km	0.58600	5860.010	606.713	0.10	28.1818	77.5062	Yes
113	Seasonal	10 km	0.58733	5873.250	283.495	0.05	28.2708	77.6201	Yes
114	Perennial	10 km	0.60702	6070.240	321.493	0.05	28.12	77.7017	Yes
115	Perennial	10 km	0.60761	6076.120	313.685	0.05	28.1539	77.7241	Yes
116	Perennial	10 km	0.61442	6144.160	299.119	0.05	28.1399	77.7039	Yes
117	Seasonal	10 km	0.63150	6314.980	307.754	0.05	28.1977	77.6924	Yes
118	Perennial	10 km	0.65452	6545.150	610.796	0.09	28.187	77.4985	Yes
119	Perennial	10 km	0.67290	6728.980	337.548	0.05	28.0913	77.6301	No
120	Perennial	10 km	0.67344	6734.440	326.755	0.05	28.0992	77.692	Yes
121	Perennial	10 km	0.69655	6965.490	334.814	0.05	28.0667	77.6331	No
122	Perennial	10 km	0.70061	7006.060	334.928	0.05	28.2106	77.6232	Yes
123	Perennial	10 km	0.71578	7157.760	324.567	0.05	28.0948	77.6016	No
124	Perennial	10 km	0.71780	7178.000	582.239	0.08	28.1063	77.5343	Yes
125	Seasonal (weed infested)	10 km	0.73091	7309.110	359.243	0.05	28.0867	77.6822	No
126	Perennial	10 km	0.75252	7525.220	354.124	0.05	28.1532	77.5946	Yes
127	Perennial	10 km	0.75520	7552.000	343.313	0.05	28.0919	77.5489	Yes
128	Seasonal (weed infested)	10 km	0.79296	7929.560	365.257	0.05	28.1938	77.6732	Yes
129	Seasonal (weed infested)	10 km	0.80969	8096.910	343.605	0.04	28.2524	77.6715	Yes
130	Perennial	10 km	0.81653	8165.340	346.715	0.04	28.2266	77.6946	Yes
131	Perennial	10 km	0.82606	8260.550	424.378	0.05	28.1368	77.7021	Yes
132	Perennial	10 km	0.86057	8605.670	348.561	0.04	28.2421	77.6528	Yes
133	Perennial	10 km	0.86187	8618.720	534.936	0.06	28.0989	77.5983	No

134	Perennial	10 km	0.86283	8628.290	444.956	0.05	28.1693	77.6483	Yes
135	Seasonal (weed infested)	10 km	0.88137	8813.650	455.840	0.05	28.2516	77.5969	Yes
136	Perennial	10 km	0.90267	9026.660	419.429	0.05	28.1692	77.6804	Yes
137	Seasonal	10 km	0.90516	9051.600	385.457	0.04	28.1464	77.7393	No
138	Perennial	10 km	0.93308	9330.780	430.053	0.05	28.1226	77.6922	Yes
139	Perennial	10 km	0.98540	9854.020	366.467	0.04	28.2267	77.6764	Yes
140	Perennial	10 km	1.01449	10144.900	417.205	0.04	28.1788	77.709	No
141	Perennial	10 km	1.02978	10297.800	497.064	0.05	28.1665	77.6764	Yes
142	Perennial	10 km	1.04865	10486.500	377.557	0.04	28.1734	77.6788	Yes
143	Perennial	10 km	1.05330	10533.000	385.695	0.04	28.1226	77.6199	Yes
144	Seasonal (weed infested)	10 km	1.05724	10572.400	393.354	0.04	28.1139	77.5851	Yes
145	Perennial	10 km	1.07470	10747.000	777.919	0.07	28.1927	77.516	Yes
146	Seasonal	10 km	1.13042	11304.200	453.121	0.04	28.2558	77.605	Yes
147	Seasonal (weed infested)	10 km	1.14185	11418.500	405.305	0.04	28.0685	77.6372	No
148	Seasonal (weed infested)	10 km	1.14816	11481.600	458.804	0.04	28.1248	77.7209	Yes
149	Seasonal (weed infested)	10 km	1.15770	11577.000	583.800	0.05	28.2498	77.6039	Yes
150	Perennial	10 km	1.20603	12060.300	425.090	0.04	28.0933	77.5906	No
151	Seasonal	10 km	1.20989	12098.900	450.103	0.04	28.1088	77.7243	Yes
152	Seasonal (weed infested)	10 km	1.25851	12585.100	430.783	0.03	28.2156	77.5875	Yes
153	Perennial	10 km	1.28982	12898.200	818.759	0.06	28.121	77.6229	Yes
154	Seasonal	10 km	1.29915	12991.500	565.904	0.04	28.164	77.5139	Yes
155	Perennial	10 km	1.37892	13789.200	1025.510	0.07	28.1821	77.5003	Yes
156	Seasonal (weed infested)	10 km	1.41908	14190.800	444.134	0.03	28.1813	77.5737	Yes
157	Perennial	10 km	1.42949	14294.900	454.683	0.03	28.2028	77.5785	Yes
158	Perennial	10 km	1.54636	15463.600	588.292	0.04	28.0994	77.5915	No
159	Seasonal (weed infested)	10 km	1.54798	15479.800	484.469	0.03	28.2529	77.6476	Yes
160	Perennial	10 km	1.56032	15603.200	501.681	0.03	28.1748	77.5747	Yes
161	Seasonal (weed infested)	10 km	1.57817	15781.700	640.678	0.04	28.1206	77.6171	Yes
162	Perennial	10 km	1.63738	16373.800	943.705	0.06	28.19	77.5117	Yes
163	Perennial	10 km	1.66667	16666.699	651.964	0.04	28.1366	77.6047	Yes
164	Perennial	10 km	1.69792	16979.199	567.586	0.03	28.1039	77.599	No
165	Perennial	10 km	1.76068	17606.801	584.665	0.03	28.0756	77.6075	No
166	Perennial	10 km	1.86375	18637.500	698.542	0.04	28.2473	77.5924	Yes
167	Perennial	10 km	1.90795	19079.500	722.849	0.04	28.2274	77.6718	Yes
168	Perennial	10 km	2.16813	21681.301	1306.130	0.06	28.26	77.5409	Yes
169	Perennial	10 km	2.67289	26728.900	747.483	0.03	28.2064	77.7232	Yes
170	Perennial	10 km	2.87755	28775.500	714.418	0.02	28.1935	77.5918	Yes

171	Perennial	10 km	3.26012	32601.199	922.021	0.03	28.1943	77.6541	Yes
172	Perennial	10 km	3.47258	34725.801	723.370	0.02	28.2557	77.5249	Yes
1	Perennial	25 km	0.876	8756.650	357.821	0.04	28.2685	77.4201	No
2	Perennial	25 km	0.526	5257.820	267.215	0.05	28.2654	77.4176	No
3	Perennial	25 km	0.552	5520.300	289.630	0.05	28.2658	77.4028	No
4	Perennial	25 km	0.465	4646.690	266.994	0.06	28.2544	77.3936	No
5	Perennial	25 km	1.264	12639.400	673.254	0.05	28.2511	77.4189	No
6	Perennial	25 km	1.026	10256.600	427.581	0.04	28.2549	77.4146	No
7	Perennial	25 km	1.853	18528.900	516.910	0.03	28.254	77.4258	No
8	Seasonal (weed infested)	25 km	0.641	6406.970	347.162	0.05	28.233	77.3934	No
9	Perennial	25 km	0.399	3989.110	305.125	0.08	28.2304	77.3931	No
10	Perennial	25 km	1.271	12713.800	483.545	0.04	28.2289	77.4053	No
11	Perennial	25 km	2.384	23844.699	778.212	0.03	28.2192	77.3518	No
12	Perennial	25 km	2.078	20776.900	740.362	0.04	28.2179	77.3511	No
13	Seasonal (weed infested)	25 km	2.506	25056.199	771.191	0.03	28.1885	77.3483	No
14	Seasonal (weed infested)	25 km	0.405	4046.990	274.640	0.07	28.189	77.3453	No
15	Seasonal (weed infested)	25 km	7.669	76687.398	1475.320	0.02	28.1841	77.3456	No
16	Perennial	25 km	0.874	8743.220	370.890	0.04	28.1808	77.33	No
17	Perennial	25 km	1.204	12038.100	466.900	0.04	28.1753	77.3297	No
18	Perennial	25 km	0.146	1461.430	149.968	0.10	28.1654	77.3247	No
19	Perennial	25 km	25.425	254248.000	4298.640	0.02	27.9603	77.5433	No
20	Perennial	25 km	1.590	15904.900	525.735	0.03	27.9871	77.462	No
21	Perennial	25 km	0.313	3134.210	212.713	0.07	27.9967	77.4419	No
22	Perennial	25 km	2.127	21270.301	630.169	0.03	28.0016	77.4399	No
23	Perennial	25 km	0.835	8350.670	365.059	0.04	28.0011	77.4384	No
24	Perennial	25 km	1.500	15000.300	467.909	0.03	27.9893	77.4318	No
25	Perennial	25 km	0.688	6884.920	303.058	0.04	27.9978	77.4248	No
26	Perennial	25 km	0.281	2806.820	195.044	0.07	28.0016	77.7898	No
27	Perennial	25 km	0.175	1753.700	173.699	0.10	28.0025	77.7921	No
28	Perennial	25 km	1.005	10054.300	417.141	0.04	28.0647	77.8243	No
29	Perennial	25 km	0.529	5287.090	297.417	0.06	28.0689	77.8324	No
30	Perennial	25 km	0.288	2876.910	203.266	0.07	28.0679	77.8333	No
31	Perennial	25 km	0.978	9782.160	387.454	0.04	28.0929	77.8782	No
32	Perennial	25 km	0.357	3570.050	239.808	0.07	28.1485	77.8853	No
33	Perennial	25 km	0.263	2629.600	195.934	0.07	28.1685	77.8677	No
34	Perennial	25 km	0.387	3873.670	262.359	0.07	28.1615	77.8847	No

35	Perennial	25 km	0.196	1959.030	164.190	0.08	28.1618	77.882	No
36	Perennial	25 km	1.403	14034.800	708.501	0.05	28.1776	77.8298	No
37	Perennial	25 km	0.296	2959.310	205.182	0.07	28.1783	77.8329	No
38	Perennial	25 km	0.173	1726.960	151.308	0.09	28.1835	77.8095	No
39	Perennial	25 km	0.323	3231.220	209.018	0.06	28.1308	77.8088	No
40	Perennial	25 km	1.568	15681.600	465.716	0.03	28.0001	77.6885	No
41	Perennial	25 km	0.796	7956.050	347.782	0.04	28.0314	77.7245	No
42	Perennial	25 km	0.170	1702.120	151.274	0.09	28.0915	77.753	No
43	Perennial	25 km	0.992	9922.120	381.892	0.04	28.0473	77.6666	No
44	Perennial	25 km	0.399	3988.580	257.837	0.06	28.0709	77.7097	No
45	Perennial	25 km	0.342	3418.100	220.207	0.06	28.0746	77.7244	No
46	Perennial	25 km	0.255	2548.160	213.289	0.08	28.0848	77.7264	No
47	Perennial	25 km	0.478	4783.250	253.865	0.05	28.065	77.7495	No
48	Perennial	25 km	1.164	11642.500	408.837	0.04	28.1531	77.8276	No
49	Perennial	25 km	0.474	4744.510	261.606	0.06	28.1551	77.8322	No
50	Perennial	25 km	0.286	2855.750	194.753	0.07	28.1574	77.8289	No
51	Perennial	25 km	0.110	1099.800	150.443	0.14	28.1511	77.8306	No
52	Seasonal	25 km	0.333	3331.610	253.241	0.08	28.2046	77.8144	No
53	Perennial	25 km	0.485	4848.850	284.798	0.06	28.2065	77.8684	No
54	Perennial	25 km	0.324	3238.650	212.568	0.07	28.2028	77.8787	No
55	Perennial	25 km	0.281	2812.290	213.020	0.08	28.2054	77.8816	No
56	Perennial	25 km	0.235	2349.030	195.642	0.08	28.2029	77.8817	No
57	Perennial	25 km	0.170	1695.280	155.679	0.09	28.1808	77.8912	No
58	Perennial	25 km	0.243	2427.160	186.529	0.08	28.1529	77.8863	No
59	Perennial	25 km	1.318	13183.700	448.346	0.03	28.0232	77.7873	No
60	Perennial	25 km	1.456	14561.700	497.526	0.03	28.0474	77.4171	No
61	Perennial	25 km	0.380	3803.820	233.681	0.06	28.0848	77.3454	No
62	Perennial	25 km	0.963	9631.060	387.056	0.04	28.0905	77.3821	No
63	Perennial	25 km	1.009	10087.500	413.978	0.04	28.0904	77.383	No
64	Perennial	25 km	0.486	4863.580	291.577	0.06	28.0819	77.3666	No
65	Perennial	25 km	0.488	4879.950	277.873	0.06	28.0696	77.4369	No
66	Perennial	25 km	0.603	6026.150	322.264	0.05	28.0391	77.4785	No
67	Perennial	25 km	5.917	59174.000	1465.610	0.02	28.0369	77.4915	No
68	Seasonal	25 km	0.565	5646.380	302.078	0.05	28.0114	77.604	No
69	Perennial	25 km	0.409	4087.810	240.456	0.06	27.9984	77.6553	No
70	Perennial	25 km	0.586	5859.050	281.411	0.05	28.016	77.8273	No
71	Seasonal	25 km	2.932	29317.801	760.303	0.03	28.0235	77.8404	No

72	Seasonal	25 km	0.136	1363.820	145.197	0.11	28.1348	77.8623	No
73	Perennial	25 km	1.665	16648.199	869.119	0.05	28.2117	77.7659	No
74	Perennial	25 km	0.383	3829.060	259.950	0.07	28.2148	77.7828	No
75	Seasonal	25 km	0.439	4391.890	248.588	0.06	28.2658	77.756	No
76	Seasonal	25 km	0.334	3342.880	224.719	0.07	28.2623	77.7657	No
77	Perennial	25 km	0.386	3860.940	240.170	0.06	28.2763	77.7392	No
78	Perennial	25 km	2.205	22050.301	605.255	0.03	28.3054	77.6256	Yes
79	Seasonal	25 km	0.187	1869.620	163.377	0.09	28.3309	77.5657	Yes
80	Perennial	25 km	0.540	5404.930	365.713	0.07	28.3291	77.56	Yes
81	Perennial	25 km	0.290	2902.920	220.189	0.08	28.3547	77.6281	Yes
82	Perennial	25 km	1.143	11426.100	451.337	0.04	28.3641	77.6345	Yes
83	Seasonal	25 km	0.798	7981.630	361.163	0.05	28.306	77.7419	No
84	Perennial	25 km	0.276	2758.680	190.314	0.07	28.2211	77.8766	No
85	Seasonal	25 km	1.380	13799.000	652.858	0.05	28.1904	77.8857	No
86	Seasonal	25 km	0.459	4589.670	292.923	0.06	28.0381	77.4046	No
87	Seasonal	25 km	0.429	4287.950	249.201	0.06	28.0626	77.3766	No
88	Perennial	25 km	0.585	5854.560	325.712	0.06	28.1667	77.3305	No
89	Perennial	25 km	4.978	49775.000	968.430	0.02	28.1816	77.3457	No
90	Perennial	25 km	4.208	42075.000	1002.740	0.02	28.1819	77.3474	No
91	Perennial	25 km	1.940	19401.900	671.097	0.03	28.1555	77.4188	No
92	Seasonal	25 km	0.391	3912.190	249.156	0.06	28.1518	77.4198	No
93	Perennial	25 km	0.566	5662.660	329.041	0.06	28.1568	77.4057	No
94	Perennial	25 km	2.999	29990.500	703.531	0.02	28.1324	77.3631	No
95	Perennial	25 km	3.389	33885.898	857.136	0.03	28.1329	77.3655	No
96	Perennial	25 km	0.917	9165.240	360.152	0.04	28.2943	77.5761	Yes
97	Perennial	25 km	1.195	11950.600	421.475	0.04	28.2933	77.5762	Yes
98	Perennial	25 km	1.540	15403.700	527.668	0.03	28.3083	77.6015	Yes
99	Seasonal	25 km	0.855	8548.300	387.047	0.05	28.3077	77.5985	Yes
100	Seasonal	25 km	0.196	1958.470	190.555	0.10	28.3059	77.5951	Yes
101	Seasonal	25 km	0.242	2417.860	188.802	0.08	28.292	77.6018	Yes
102	Perennial	25 km	0.378	3775.880	252.392	0.07	28.2826	77.6004	Yes
103	Seasonal	25 km	0.214	2142.660	194.818	0.09	28.2833	77.5969	Yes
104	Perennial	25 km	0.403	4027.270	279.289	0.07	28.3165	77.6827	Yes
105	Seasonal	25 km	0.131	1310.220	138.458	0.11	28.3168	77.6863	Yes
106	Seasonal	25 km	0.169	1690.430	206.488	0.12	28.314	77.6863	Yes
107	Perennial	25 km	25.272	252719.000	2511.950	0.01	28.3386	77.6192	Yes
108	Perennial	25 km	2.410	24102.000	743.246	0.03	28.3847	77.512	Yes

109	Perennial	25 km	1.757	17573.199	748.672	0.04	28.2689	77.6651	Yes
110	Perennial	25 km	2.549	25486.801	634.149	0.02	28.0209	77.4319	No
111	Perennial	25 km	1.668	16679.400	511.152	0.03	28.0205	77.4335	No
112	Perennial	25 km	0.708	7082.020	337.185	0.05	28.0141	77.4259	No
113	Perennial	25 km	0.190	1897.380	164.066	0.09	27.9854	77.4878	No
114	Perennial	25 km	0.329	3291.280	232.401	0.07	27.975	77.5011	No
115	Seasonal	25 km	0.403	4032.020	273.452	0.07	27.9454	77.5745	No
116	Seasonal	25 km	0.302	3017.700	253.892	0.08	27.9433	77.5886	No
117	Seasonal	25 km	0.136	1355.380	135.882	0.10	27.959	77.6843	No
118	Seasonal	25 km	0.229	2286.950	178.545	0.08	27.9581	77.6761	No
119	Perennial	25 km	0.641	6406.550	295.985	0.05	27.9702	77.6489	No
120	Perennial	25 km	0.547	5473.980	390.698	0.07	27.9695	77.6633	No
121	Perennial	25 km	0.314	3142.110	220.551	0.07	27.9752	77.7412	No
122	Perennial	25 km	0.682	6819.980	345.060	0.05	28.0068	77.7714	No
123	Seasonal	25 km	0.318	3183.980	211.346	0.07	28.0295	77.7595	No
124	Perennial	25 km	2.493	24933.500	1038.590	0.04	28.2636	77.8617	No
125	Perennial	25 km	0.511	5106.250	288.608	0.06	28.2613	77.8597	No
126	Perennial	25 km	0.458	4575.770	275.114	0.06	28.2473	77.8663	No
127	Perennial	25 km	0.371	3711.440	292.698	0.08	28.2465	77.8675	No
128	Perennial	25 km	0.728	7283.330	397.112	0.05	28.2511	77.8407	No
129	Seasonal	25 km	0.116	1155.330	129.600	0.11	28.2386	77.8117	No
130	Perennial	25 km	0.127	1270.250	190.741	0.15	28.2431	77.7861	No
131	Seasonal	25 km	0.643	6426.740	324.576	0.05	28.2427	77.7838	No
132	Perennial	25 km	0.367	3673.530	225.119	0.06	28.2367	77.7328	No
133	Perennial	25 km	0.107	1068.490	122.722	0.11	28.2405	77.7333	No
134	Perennial	25 km	0.301	3011.030	316.578	0.11	28.2395	77.7316	No
135	Perennial	25 km	0.903	9028.420	630.573	0.07	28.2687	77.6573	Yes
136	Seasonal	25 km	0.086	858.770	110.054	0.13	28.2668	77.6593	Yes
137	Seasonal	25 km	0.335	3345.240	212.248	0.06	28.2873	77.6329	Yes
138	Perennial	25 km	0.654	6544.870	314.119	0.05	28.2912	77.6551	Yes
139	Perennial	25 km	1.079	10789.300	404.218	0.04	28.3062	77.6342	Yes
140	Perennial	25 km	0.662	6622.320	307.072	0.05	28.3198	77.6413	Yes
141	Seasonal	25 km	0.081	813.670	105.368	0.13	28.3258	77.647	Yes
142	Seasonal	25 km	0.467	4671.290	262.662	0.06	28.322	77.6478	Yes
143	Perennial	25 km	0.818	8182.610	383.574	0.05	28.3386	77.6536	Yes
144	Perennial	25 km	0.436	4357.130	258.099	0.06	28.3511	77.5803	Yes
145	Perennial	25 km	0.169	1691.890	153.729	0.09	28.3534	77.5876	No

146	Perennial	25 km	1.105	11047.600	424.681	0.04	28.3475	77.6019	Yes
147	Perennial	25 km	0.686	6857.510	365.873	0.05	28.3483	77.6038	Yes
148	Seasonal	25 km	1.373	13727.700	440.276	0.03	28.3457	77.6061	Yes
149	Perennial	25 km	1.106	11062.900	397.128	0.04	28.3927	77.6185	No
150	Seasonal	25 km	4.409	44094.102	1291.640	0.03	28.3928	77.6208	No
151	Seasonal	25 km	0.100	1000.320	121.416	0.12	28.3988	77.6344	No
152	Perennial	25 km	0.660	6597.070	358.780	0.05	28.3685	77.6802	No
153	Perennial	25 km	0.390	3899.260	277.634	0.07	28.3649	77.7	No
154	Seasonal	25 km	0.454	4539.120	285.237	0.06	28.3453	77.7649	No
155	Perennial	25 km	0.422	4220.780	256.219	0.06	28.3026	77.7425	No
156	Perennial	25 km	0.084	837.446	110.152	0.13	28.3151	77.7734	No
157	Perennial	25 km	0.956	9560.200	372.443	0.04	28.324	77.3855	No
158	Perennial	25 km	0.974	9737.590	382.658	0.04	28.3413	77.3992	No
159	Perennial	25 km	0.365	3654.210	225.217	0.06	28.3481	77.4175	No
160	Perennial	25 km	0.770	7699.110	324.990	0.04	28.3506	77.4194	No
161	Perennial	25 km	0.135	1345.420	139.399	0.10	28.347	77.4214	No
162	Seasonal	25 km	0.043	425.754	75.243	0.18	28.3483	77.4221	No
163	Perennial	25 km	0.293	2931.750	211.529	0.07	28.3512	77.4314	No
164	Seasonal	25 km	0.175	1754.690	157.702	0.09	28.3572	77.4315	No
165	Seasonal	25 km	0.172	1724.800	156.739	0.09	28.3447	77.743	No
166	Seasonal	25 km	0.082	820.757	116.166	0.14	28.3466	77.7428	No
167	Perennial (weed infested)	25 km	0.724	7240.920	340.831	0.05	28.2962	77.7827	No
168	Seasonal	25 km	0.225	2254.250	179.021	0.08	28.2784	77.7706	No
169	Seasonal	25 km	0.152	1516.340	155.619	0.10	28.281	77.7555	No
170	Perennial (weed infested)	25 km	0.467	4667.910	294.355	0.06	28.3211	77.7246	No
171	Perennial	25 km	0.129	1289.980	154.843	0.12	28.3684	77.5645	No
172	Perennial	25 km	0.889	8891.720	350.162	0.04	28.3162	77.4096	No
173	Seasonal	25 km	0.159	1585.340	150.652	0.10	28.3155	77.4079	No
174	Perennial	25 km	0.144	1437.230	147.103	0.10	28.3157	77.4104	No
175	Perennial	25 km	0.396	3957.060	272.338	0.07	28.2929	77.3577	No
176	Perennial	25 km	0.122	1221.280	131.684	0.11	28.2941	77.3597	No
177	Seasonal	25 km	0.344	3444.400	247.049	0.07	28.2812	77.3529	No
178	Perennial	25 km	0.606	6057.410	306.694	0.05	28.2634	77.3455	No
179	Perennial	25 km	0.436	4355.830	303.456	0.07	28.2626	77.3441	No
180	Seasonal (weed infested)	25 km	1.324	13236.100	530.585	0.04	28.2622	77.3472	No
181	Seasonal (weed infested)	25 km	0.518	5180.150	269.795	0.05	28.2685	77.3723	No
182	Perennial	25 km	0.227	2274.020	179.523	0.08	28.2559	77.3915	No

183	Perennial	25 km	1.154	11542.000	436.648	0.04	28.2909	77.409	No
184	Perennial	25 km	0.576	5759.600	340.470	0.06	28.286	77.4038	No
185	Seasonal	25 km	0.171	1710.600	151.354	0.09	28.2613	77.46	No
186	Seasonal	25 km	0.103	1025.390	119.413	0.12	28.2579	77.4277	No
187	Perennial	25 km	2.337	23367.000	852.076	0.04	28.0216	77.6536	No
188	Perennial	25 km	0.923	9226.100	368.242	0.04	28.0209	77.6612	No
189	Perennial	25 km	0.402	4015.300	263.751	0.07	28.0133	77.6391	No
190	Perennial	25 km	0.461	4605.820	334.499	0.07	27.9957	77.6562	No
191	Perennial	25 km	0.594	5942.330	349.767	0.06	27.9987	77.6598	No
192	Perennial	25 km	1.212	12115.200	688.436	0.06	27.9882	77.7111	No
193	Perennial	25 km	1.174	11741.000	552.436	0.05	27.9711	77.7189	No
194	Perennial	25 km	0.483	4831.420	269.996	0.06	27.9546	77.7237	No
195	Perennial (weed infested)	25 km	0.176	1762.010	161.565	0.09	27.9618	77.7365	No
196	Seasonal	25 km	0.070	700.059	104.341	0.15	27.9628	77.7456	No
197	Perennial (weed infested)	25 km	0.844	8443.930	336.400	0.04	27.953	77.7389	No
198	Perennial	25 km	0.484	4842.930	259.731	0.05	27.9608	77.6411	No
199	Perennial	25 km	0.485	4854.470	272.371	0.06	27.9415	77.6197	No
200	Seasonal	25 km	0.430	4303.790	270.843	0.06	27.9553	77.6233	No
201	Seasonal	25 km	0.130	1304.030	149.904	0.11	27.9597	77.6207	No
202	Perennial (weed infested)	25 km	0.676	6762.170	311.858	0.05	27.9742	77.6269	No
203	Seasonal	25 km	0.268	2677.820	194.269	0.07	27.9788	77.627	No
204	Seasonal	25 km	0.232	2318.430	188.886	0.08	27.9825	77.6301	No
205	Perennial	25 km	0.289	2885.290	233.163	0.08	27.9828	77.6255	No
206	Perennial	25 km	0.557	5565.860	286.504	0.05	27.9604	77.561	No
207	Perennial	25 km	0.068	681.739	102.735	0.15	27.9625	77.5687	No
208	Perennial (weed infested)	25 km	0.305	3054.210	203.854	0.07	27.9641	77.4911	No
209	Perennial	25 km	0.447	4472.260	475.594	0.11	27.9685	77.4615	No
210	Perennial	25 km	1.246	12458.200	439.713	0.04	28.0871	77.4035	No
211	Perennial	25 km	0.924	9237.470	377.261	0.04	28.0889	77.3981	No
212	Perennial	25 km	1.064	10637.600	423.386	0.04	28.1222	77.3611	No
213	Perennial	25 km	0.818	8176.610	355.605	0.04	28.103	77.349	No
214	Perennial	25 km	0.573	5728.660	301.406	0.05	28.1092	77.3528	No
215	Perennial	25 km	0.341	3414.760	212.300	0.06	28.1197	77.3949	No
216	Perennial	25 km	1.693	16927.500	575.216	0.03	28.0126	77.4476	No
217	Perennial	25 km	0.854	8541.790	354.398	0.04	27.9899	77.4822	No
218	Seasonal	25 km	0.101	1008.920	117.143	0.12	27.9888	77.483	No
219	Seasonal	25 km	0.088	881.081	120.210	0.14	27.9865	77.4816	No

220	Perennial	25 km	0.690	6903.980	326.212	0.05	28.0038	77.461	No
221	Perennial	25 km	0.185	1850.770	159.812	0.09	28.004	77.4638	No
222	Perennial	25 km	0.342	3416.910	222.248	0.07	28.0071	77.4697	No
223	Perennial	25 km	0.381	3811.620	240.969	0.06	28.0061	77.4866	No
224	Perennial	25 km	0.244	2440.620	203.409	0.08	27.9794	77.5227	No
225	Perennial	25 km	0.402	4021.580	246.001	0.06	27.9645	77.5031	No
226	Perennial	25 km	0.308	3078.540	224.616	0.07	28.0187	77.4333	No
227	Perennial	25 km	0.310	3100.830	208.107	0.07	28.0184	77.448	No
228	Perennial	25 km	0.771	7710.430	348.838	0.05	28.0046	77.4192	No
229	Perennial	25 km	0.669	6691.690	308.691	0.05	28.0334	77.41	No
230	Perennial	25 km	0.216	2164.610	201.428	0.09	28.0339	77.4059	No
231	Perennial	25 km	1.704	17036.000	490.328	0.03	28.0467	77.3892	No
232	Perennial	25 km	1.125	11249.100	404.130	0.04	28.0487	77.3893	No
233	Perennial	25 km	0.251	2508.630	188.312	0.08	28.0511	77.3848	No
234	Perennial	25 km	0.579	5793.170	383.767	0.07	28.0389	77.3727	No
235	Perennial	25 km	0.520	5199.550	372.232	0.07	28.0406	77.3758	No
236	Perennial	25 km	0.219	2189.220	206.446	0.09	28.0395	77.3761	No
237	Perennial	25 km	0.135	1347.420	148.290	0.11	28.0388	77.3781	No
238	Seasonal	25 km	0.271	2714.420	230.219	0.08	28.0346	77.3802	No
239	Perennial	25 km	1.219	12185.600	584.352	0.05	28.0342	77.3815	No
240	Perennial	25 km	1.771	17712.000	726.754	0.04	28.197	77.3736	No
241	Perennial	25 km	0.738	7383.960	350.804	0.05	28.18	77.3768	No
242	Seasonal	25 km	0.050	502.966	86.060	0.17	28.1785	77.3752	No
243	Perennial	25 km	1.910	19104.600	570.098	0.03	28.165	77.3688	No
244	Seasonal (weed infested)	25 km	1.272	12720.800	431.751	0.03	28.1761	77.3772	No
245	Perennial (weed infested)	25 km	0.564	5642.530	413.729	0.07	28.1765	77.3711	No
246	Perennial	25 km	0.749	7485.040	343.187	0.05	28.1638	77.3519	No
247	Perennial	25 km	1.343	13431.900	474.853	0.04	28.076	77.362	No
248	Perennial	25 km	0.535	5349.580	348.729	0.07	28.0522	77.4158	No
249	Seasonal (weed infested)	25 km	0.217	2171.160	184.510	0.08	27.9664	77.49	No
250	Perennial	25 km	0.979	9785.390	603.991	0.06	27.9476	77.6641	No
251	Perennial	25 km	0.724	7242.020	340.224	0.05	27.962	77.6522	No
252	Seasonal	25 km	0.146	1463.890	151.352	0.10	27.9493	77.6631	No
253	Perennial	25 km	0.256	2557.540	194.414	0.08	27.9461	77.6809	No
254	Seasonal (weed infested)	25 km	0.178	1781.080	160.853	0.09	27.936	77.6808	No
255	Seasonal (weed infested)	25 km	0.356	3561.920	361.349	0.10	27.9586	77.6768	No
256	Seasonal (weed infested)	25 km	0.399	3992.950	244.403	0.06	27.938	77.6357	No

257	Perennial	25 km	0.391	3907.470	237.428	0.06	28.019	77.414	No
258	Perennial	25 km	0.147	1472.410	142.065	0.10	28.0199	77.4108	No
259	Seasonal (weed infested)	25 km	0.923	9228.260	456.299	0.05	28.0368	77.4074	No
260	Perennial	25 km	0.556	5564.840	337.525	0.06	28.0949	77.3443	No
261	Perennial	25 km	0.150	1496.100	153.864	0.10	28.0941	77.3452	No
262	Perennial	25 km	0.260	2597.280	267.672	0.10	28.1066	77.3343	No
263	Perennial (weed infested)	25 km	0.517	5174.210	300.889	0.06	28.1447	77.3482	No
264	Seasonal	25 km	0.246	2463.580	194.782	0.08	28.1452	77.3514	No
265	Seasonal	25 km	0.205	2053.100	187.496	0.09	28.1461	77.3541	No
266	Perennial (weed infested)	25 km	5.290	52896.398	1160.890	0.02	28.1472	77.3579	No
267	Perennial	25 km	0.540	5398.040	293.303	0.05	28.1374	77.3688	No
268	Seasonal	25 km	0.420	4199.680	259.694	0.06	28.1247	77.3823	No
269	Perennial	25 km	1.298	12975.200	447.674	0.03	28.1114	77.3887	No
270	Perennial	25 km	0.382	3820.170	243.397	0.06	28.1051	77.3681	No
271	Perennial	25 km	0.213	2130.770	200.373	0.09	28.1243	77.35	No
272	Seasonal (weed infested)	25 km	0.131	1312.680	142.443	0.11	28.1108	77.3541	No
273	Perennial	25 km	1.932	19318.801	675.120	0.03	28.0778	77.3685	No
274	Perennial	25 km	0.302	3015.310	198.851	0.07	28.0717	77.3807	No
275	Perennial	25 km	0.562	5624.500	351.212	0.06	28.0715	77.3815	No
276	Perennial	25 km	0.623	6233.860	298.256	0.05	28.0704	77.3913	No
277	Perennial	25 km	1.155	11548.800	414.637	0.04	28.077	77.4067	No
278	Perennial	25 km	0.468	4676.840	265.381	0.06	28.0752	77.4066	No
279	Seasonal (weed infested)	25 km	0.624	6242.180	299.295	0.05	28.0441	77.4531	No
280	Seasonal (weed infested)	25 km	0.242	2421.050	218.133	0.09	28.0423	77.4566	No
281	Perennial	25 km	0.564	5638.760	284.252	0.05	28.0235	77.4453	No
282	Perennial	25 km	0.409	4085.110	254.960	0.06	28.0292	77.4428	No
283	Perennial	25 km	0.408	4081.480	249.790	0.06	28.0157	77.4552	No
284	Perennial	25 km	0.589	5890.580	288.070	0.05	28.0203	77.48	No
285	Seasonal (weed infested)	25 km	0.173	1726.530	155.335	0.09	28.0248	77.4889	No
286	Perennial	25 km	0.308	3084.660	214.928	0.07	28.0233	77.4706	No
287	Seasonal (weed infested)	25 km	0.162	1617.880	153.370	0.09	28.0241	77.4667	No
288	Seasonal (weed infested)	25 km	0.315	3149.950	229.772	0.07	28.0149	77.4796	No
289	Perennial	25 km	0.247	2465.070	213.095	0.09	27.9793	77.5157	No
290	Perennial	25 km	1.007	10070.100	692.976	0.07	27.9831	77.5247	No
291	Perennial	25 km	0.221	2205.270	184.222	0.08	28.0189	77.5424	No
292	Seasonal (weed infested)	25 km	0.204	2038.130	176.826	0.09	28.003	77.5574	No
293	Perennial	25 km	1.537	15367.400	642.449	0.04	27.9743	77.7658	No

294	Perennial	25 km	1.400	13995.100	522.308	0.04	27.967	77.7718	No
295	Seasonal (weed infested)	25 km	1.387	13870.300	510.691	0.04	27.985	77.7647	No
296	Seasonal (weed infested)	25 km	1.199	11990.500	448.738	0.04	27.9868	77.7643	No
297	Perennial	25 km	2.242	22416.699	621.265	0.03	28.0844	77.8506	No
298	Perennial	25 km	0.843	8430.600	364.152	0.04	28.1174	77.8767	No
299	Perennial	25 km	0.273	2734.380	200.041	0.07	28.1201	77.8708	No
300	Perennial	25 km	0.502	5021.180	270.359	0.05	28.1313	77.8649	No
301	Perennial	25 km	0.555	5550.270	303.363	0.05	28.0756	77.7814	No
302	Perennial	25 km	0.525	5246.610	286.133	0.05	28.0989	77.7777	No
303	Perennial	25 km	0.825	8250.960	352.573	0.04	28.1399	77.7517	No
304	Perennial	25 km	0.331	3314.880	218.738	0.07	28.1371	77.748	No
305	Perennial	25 km	0.125	1246.340	132.724	0.11	28.1384	77.7471	No
306	Perennial (weed infested)	25 km	0.071	714.954	101.084	0.14	28.1377	77.7477	No
307	Perennial	25 km	0.634	6335.580	296.811	0.05	28.1105	77.7575	No
308	Perennial (weed infested)	25 km	0.332	3319.860	216.853	0.07	28.1307	77.7853	No
309	Perennial	25 km	1.438	14384.300	503.864	0.04	28.0492	77.5784	No
310	Perennial	25 km	0.302	3022.680	201.844	0.07	28.011	77.6019	No
311	Perennial (weed infested)	25 km	0.840	8402.010	352.225	0.04	28.0147	77.6161	No
312	Perennial	25 km	0.845	8446.590	353.195	0.04	28.0287	77.6245	No
313	Perennial	25 km	1.281	12807.500	591.042	0.05	28.0479	77.6248	No
314	Seasonal	25 km	0.268	2681.970	202.476	0.08	28.0453	77.6288	No
315	Perennial	25 km	0.440	4404.810	270.351	0.06	28.0724	77.6763	No
316	Perennial	25 km	0.359	3593.350	222.427	0.06	28.0686	77.6653	No
317	Seasonal	25 km	0.436	4356.000	270.520	0.06	28.0574	77.6955	No
318	Perennial	25 km	0.609	6089.220	315.821	0.05	28.0401	77.7318	No
319	Perennial	25 km	1.098	10978.600	398.163	0.04	28.0218	77.725	No
320	Perennial	25 km	0.448	4475.540	249.318	0.06	28.0016	77.7089	No
321	Perennial	25 km	0.773	7725.250	354.088	0.05	28.3704	77.454	No
322	Perennial	25 km	6.306	63055.602	1326.290	0.02	28.3822	77.5108	Yes
323	Perennial	25 km	15.317	153170.000	2056.310	0.01	28.379	77.5095	Yes
324	Seasonal	25 km	5.408	54075.699	1046.210	0.02	28.3737	77.5025	Yes
325	Seasonal	25 km	0.258	2578.830	199.815	0.08	28.3928	77.5662	No
326	Seasonal (weed infested)	25 km	1.450	14503.200	558.522	0.04	28.3932	77.57	No
327	Seasonal	25 km	0.519	5193.350	340.657	0.07	28.4088	77.5695	No
328	Perennial	25 km	0.274	2739.100	195.667	0.07	28.4042	77.5734	No
329	Seasonal (weed infested)	25 km	1.058	10575.400	421.117	0.04	28.3928	77.5866	No
330	Seasonal	25 km	0.268	2675.450	197.042	0.07	28.3932	77.6073	No

331	Perennial	25 km	1.378	13776.600	484.003	0.04	28.4009	77.6608	No
332	Perennial	25 km	0.495	4952.090	261.448	0.05	28.3985	77.6599	No
333	Perennial (weed infested)	25 km	0.461	4611.960	268.921	0.06	28.3941	77.6463	No
334	Perennial	25 km	0.204	2040.900	197.881	0.10	28.403	77.6557	No
335	Perennial	25 km	1.798	17982.600	588.334	0.03	28.3846	77.6902	No
336	Perennial	25 km	0.233	2332.640	193.366	0.08	28.159	77.8873	No
337	Perennial	25 km	2.498	24977.100	643.087	0.03	28.3474	77.5375	Yes
338	Perennial	25 km	1.112	11119.900	536.062	0.05	28.354	77.5353	Yes
339	Perennial	25 km	0.306	3064.540	214.130	0.07	28.3336	77.5531	Yes
340	Perennial	25 km	0.398	3984.690	247.144	0.06	28.2154	77.8332	No
341	Perennial (weed infested)	25 km	0.434	4343.230	365.436	0.08	28.2144	77.8314	No
342	Perennial	25 km	0.447	4470.930	263.822	0.06	28.1884	77.8474	No
343	Perennial (weed infested)	25 km	0.207	2070.510	262.424	0.13	28.1917	77.8817	No
344	Perennial (weed infested)	25 km	0.220	2198.960	177.443	0.08	28.1145	77.8872	No
345	Perennial	25 km	0.394	3943.880	238.963	0.06	28.0046	77.7713	No
346	Perennial (weed infested)	25 km	0.243	2427.020	184.017	0.08	27.9657	77.7238	No
347	Perennial	25 km	0.760	7599.480	356.278	0.05	28.0204	77.4271	No
348	Perennial	25 km	0.519	5191.390	275.207	0.05	28.0381	77.4194	No
349	Perennial	25 km	0.437	4365.220	288.704	0.07	28.0591	77.3986	No
350	Perennial	25 km	0.711	7113.370	335.663	0.05	28.1111	77.3788	No
351	Perennial	25 km	2.612	26124.699	1189.100	0.05	28.2067	77.3248	No
352	Perennial (weed infested)	25 km	1.846	18459.600	863.031	0.05	28.2454	77.3452	No
353	Perennial	25 km	0.194	1942.440	166.407	0.09	28.2449	77.3488	No
354	Perennial	25 km	0.467	4667.330	265.601	0.06	28.282	77.3729	No
355	Perennial	25 km	0.908	9075.990	385.808	0.04	28.3009	77.3844	No
356	Perennial	25 km	0.842	8415.510	385.335	0.05	28.291	77.4238	No
357	Seasonal (weed infested)	25 km	1.509	15090.600	549.836	0.04	28.2976	77.419	No
358	Seasonal (weed infested)	25 km	3.488	34878.301	1193.640	0.03	28.2543	77.3687	No
359	Perennial	25 km	0.311	3113.190	234.966	0.08	28.2629	77.3444	No
360	Seasonal (weed infested)	25 km	0.372	3716.830	227.905	0.06	28.324	77.4224	No
361	Perennial	25 km	0.176	1763.740	161.158	0.09	28.3274	77.421	No
362	Seasonal (weed infested)	25 km	0.178	1778.600	160.011	0.09	28.327	77.4263	No
363	Seasonal (weed infested)	25 km	0.292	2921.090	199.087	0.07	28.3438	77.4117	No
364	Perennial	25 km	0.253	2525.270	200.631	0.08	28.3424	77.4138	No
365	Perennial	25 km	0.394	3935.410	256.108	0.07	28.3619	77.4754	No
366	Perennial	25 km	0.201	2011.020	169.387	0.08	28.3787	77.5243	Yes
367	Perennial	25 km	0.549	5488.300	334.304	0.06	28.3572	77.5587	Yes

368	Perennial	25 km	0.150	1503.860	163.550	0.11	28.3433	77.5791	Yes
369	Perennial	25 km	0.350	3503.430	229.858	0.07	28.3126	77.5342	Yes
370	Perennial	25 km	0.233	2325.030	209.600	0.09	28.3088	77.5353	Yes
371	Seasonal (weed infested)	25 km	0.141	1408.610	146.345	0.10	28.3094	77.5359	Yes
372	Perennial	25 km	0.211	2105.740	170.668	0.08	28.35	77.6386	Yes
373	Perennial	25 km	0.153	1532.230	148.298	0.10	28.3608	77.6546	Yes
374	Perennial	25 km	1.309	13088.900	509.334	0.04	28.3903	77.7135	No
375	Seasonal (weed infested)	25 km	0.110	1103.920	125.949	0.11	28.3604	77.7655	No
376	Perennial (weed infested)	25 km	0.674	6737.530	365.806	0.05	28.3328	77.7983	No
377	Seasonal (weed infested)	25 km	0.158	1581.050	162.610	0.10	28.105	77.8319	No
378	Perennial	25 km	0.308	3083.550	232.204	0.08	28.0957	77.8228	No
379	Perennial (weed infested)	25 km	0.274	2737.440	222.031	0.08	28.025	77.6764	No
380	Perennial	25 km	0.477	4769.030	272.167	0.06	27.9734	77.4926	No
381	Perennial	25 km	0.366	3663.320	252.067	0.07	27.9897	77.5113	No
382	Perennial	25 km	0.196	1957.880	175.591	0.09	27.9955	77.5176	No
383	Perennial	25 km	0.524	5244.820	282.759	0.05	28.3086	77.3865	No
384	Perennial	25 km	1.327	13274.500	480.250	0.04	28.2285	77.3679	No
385	Perennial	25 km	0.450	4498.100	260.695	0.06	28.2011	77.4096	No
386	Perennial	25 km	0.956	9556.770	393.774	0.04	28.2047	77.406	No
387	Seasonal (weed infested)	25 km	0.614	6137.040	314.169	0.05	28.1215	77.4413	No
388	Perennial	25 km	0.507	5070.660	298.015	0.06	28.1208	77.4444	No
389	Perennial	25 km	0.727	7269.920	338.430	0.05	28.1277	77.4218	No
390	Perennial	25 km	0.863	8634.710	384.093	0.04	28.1297	77.4285	No
391	Perennial	25 km	0.937	9365.690	410.884	0.04	28.1262	77.424	No
392	Perennial	25 km	0.717	7167.910	318.785	0.04	28.1125	77.4256	No
393	Perennial (weed infested)	25 km	1.530	15301.300	635.778	0.04	28.1133	77.4226	No
394	Seasonal (weed infested)	25 km	1.215	12150.100	615.409	0.05	28.1098	77.4202	No
395	Perennial	25 km	0.395	3950.790	309.615	0.08	28.1095	77.4254	No
396	Perennial	25 km	0.942	9415.510	454.861	0.05	28.0411	77.5696	No
397	Perennial	25 km	0.996	9960.320	515.328	0.05	27.9969	77.6243	No
398	Perennial	25 km	0.280	2798.310	209.605	0.07	28.0218	77.629	No
399	Perennial	25 km	0.838	8384.400	472.912	0.06	28.0664	77.5134	No
400	Perennial	25 km	0.317	3165.940	221.161	0.07	27.9559	77.6613	No
401	Seasonal (weed infested)	25 km	0.300	3000.760	214.235	0.07	28.2852	77.7537	No
402	Seasonal (weed infested)	25 km	0.212	2120.460	180.880	0.09	28.2931	77.7509	No
403	Seasonal (weed infested)	25 km	0.191	1909.810	177.348	0.09	28.3047	77.76	No
404	Perennial	25 km	0.321	3208.570	225.360	0.07	28.3592	77.4473	No

405	Perennial	25 km	0.852	8524.210	357.691	0.04	28.3692	77.4541	No
406	Perennial	25 km	0.350	3498.770	237.473	0.07	28.3735	77.4488	No
407	Perennial	25 km	0.476	4763.260	275.758	0.06	28.3794	77.4541	No
408	Seasonal (weed infested)	25 km	0.444	4441.100	246.691	0.06	28.3575	77.4606	No
409	Perennial (weed infested)	25 km	0.330	3296.600	237.155	0.07	28.3528	77.5241	Yes
410	Seasonal (weed infested)	25 km	1.976	19755.400	588.790	0.03	28.3505	77.5597	Yes
411	Seasonal (weed infested)	25 km	1.142	11420.600	421.712	0.04	28.3612	77.6049	No
412	Seasonal (weed infested)	25 km	1.807	18074.100	526.784	0.03	28.3908	77.6596	No
413	Seasonal (weed infested)	25 km	0.319	3185.230	224.782	0.07	28.3892	77.6562	No
414	Seasonal (weed infested)	25 km	0.830	8301.470	356.226	0.04	28.2931	77.8443	No
415	Seasonal (weed infested)	25 km	0.616	6156.000	404.181	0.07	28.0777	77.4353	No
416	Seasonal (weed infested)	25 km	0.354	3537.740	236.962	0.07	28.0782	77.4383	No
417	Seasonal (weed infested)	25 km	0.631	6313.520	372.776	0.06	28.0816	77.4384	No
418	Seasonal (weed infested)	25 km	0.156	1563.950	148.007	0.09	28.081	77.4366	No
419	Seasonal (weed infested)	25 km	0.267	2673.780	214.444	0.08	28.0783	77.4342	No
420	Perennial	25 km	0.521	5208.300	278.127	0.05	28.0927	77.4604	No
421	Perennial	25 km	0.447	4466.540	269.022	0.06	28.335	77.5542	Yes
422	Perennial	25 km	0.370	3698.790	251.792	0.07	28.3128	77.6726	Yes
423	Seasonal (weed infested)	25 km	0.738	7377.560	324.802	0.04	28.3105	77.6768	Yes
424	Seasonal (weed infested)	25 km	0.590	5902.470	308.705	0.05	28.2136	77.8885	No
425	Perennial	25 km	1.142	11417.800	702.184	0.06	28.2538	77.8668	No
426	Perennial	25 km	0.148	1476.540	153.002	0.10	28.2508	77.8621	No
427	Perennial	25 km	0.867	8670.790	412.558	0.05	28.2693	77.4037	No
428	Perennial	25 km	0.472	4723.280	297.961	0.06	28.3311	77.4546	No
429	Seasonal (weed infested)	25 km	0.425	4251.440	258.275	0.06	28.3249	77.46	No
430	Seasonal (weed infested)	25 km	0.352	3516.910	259.679	0.07	28.3332	77.4253	No
431	Perennial (weed infested)	25 km	0.290	2900.300	210.105	0.07	28.3362	77.4304	No
432	Perennial	25 km	0.627	6271.050	326.573	0.05	28.3446	77.5035	Yes
433	Perennial	25 km	0.300	2998.260	223.291	0.07	28.1474	77.4499	No
434	Perennial (weed infested)	25 km	0.476	4763.250	294.652	0.06	28.1477	77.4468	No
435	Perennial	25 km	1.417	14165.400	462.994	0.03	28.1378	77.4048	No
436	Perennial	25 km	0.713	7128.270	393.154	0.06	28.137	77.406	No
437	Perennial	25 km	0.758	7575.490	333.603	0.04	28.16	77.4425	No
438	Perennial	25 km	0.383	3830.930	266.013	0.07	28.1494	77.461	No
439	Seasonal (weed infested)	25 km	1.094	10939.400	536.854	0.05	28.1546	77.4589	No
440	Seasonal	25 km	0.400	4003.310	240.841	0.06	28.1719	77.4405	No
441	Seasonal (weed infested)	25 km	0.332	3315.290	214.967	0.06	28.1531	77.4395	No

442	Seasonal (weed infested)	25 km	0.442	4421.440	375.482	0.08	28.0752	77.7769	No
443	Perennial	25 km	0.320	3200.820	233.890	0.07	28.13	77.7634	No
444	Seasonal (weed infested)	25 km	0.161	1608.420	172.440	0.11	28.128	77.8026	No
445	Seasonal (weed infested)	25 km	0.303	3032.610	211.932	0.07	28.1058	77.7268	Yes
446	Perennial	25 km	1.018	10179.900	417.024	0.04	28.1086	77.7247	Yes
447	Perennial	25 km	0.618	6177.300	346.615	0.06	28.1082	77.7253	Yes
448	Seasonal (weed infested)	25 km	0.325	3251.920	258.777	0.08	28.106	77.7346	No
449	Seasonal (weed infested)	25 km	0.461	4611.440	318.614	0.07	28.1052	77.736	No
450	Seasonal (weed infested)	25 km	0.083	828.202	107.805	0.13	28.1047	77.7419	No
451	Seasonal (weed infested)	25 km	0.246	2456.000	216.882	0.09	28.1284	77.7837	No
452	Seasonal (weed infested)	25 km	0.168	1679.180	175.977	0.10	28.1321	77.7815	No
453	Seasonal (weed infested)	25 km	0.145	1446.320	148.562	0.10	28.1176	77.7713	No
454	Perennial	25 km	1.657	16570.699	503.116	0.03	28.3109	77.5611	Yes
455	Perennial	25 km	0.153	1533.500	159.992	0.10	28.3119	77.5503	Yes
456	Perennial	25 km	0.252	2524.320	219.694	0.09	28.3101	77.5544	Yes
457	Perennial	25 km	0.332	3317.540	286.512	0.09	28.327	77.5604	Yes
458	Seasonal	25 km	0.154	1544.260	157.260	0.10	28.3732	77.5993	No
459	Seasonal (weed infested)	25 km	0.344	3440.140	225.181	0.07	28.1904	77.7559	No
460	Perennial	25 km	0.880	8795.670	382.755	0.04	28.1813	77.4259	No
461	Perennial	25 km	0.500	4998.150	269.774	0.05	28.2078	77.4363	No
462	Seasonal (weed infested)	25 km	0.656	6559.250	323.608	0.05	28.0083	77.7486	No
463	Seasonal	25 km	1.104	11035.000	407.226	0.04	28.3394	77.6303	Yes
464	Seasonal	25 km	0.798	7981.090	363.769	0.05	28.3033	77.6368	Yes
465	Seasonal	25 km	0.788	7883.080	364.525	0.05	28.3222	77.6524	Yes
466	Perennial	25 km	9.734	97335.703	2882.030	0.03	28.3021	77.5067	No
467	Seasonal	25 km	0.479	4794.070	256.907	0.05	28.0735	77.7155	No
468	Perennial	25 km	0.416	4164.470	252.148	0.06	28.0763	77.7188	No
469	Perennial	25 km	0.296	2959.450	209.534	0.07	28.3204	77.4186	No
470	Perennial	25 km	0.175	1750.120	155.194	0.09	28.3204	77.4217	No
471	Perennial	25 km	0.165	1652.490	157.396	0.10	28.3089	77.4631	No
472	Seasonal (weed infested)	25 km	0.127	1267.640	138.326	0.11	28.2804	77.525	Yes
473	Perennial	25 km	0.363	3632.820	274.608	0.08	28.2721	77.826	No

ANNEXURE VII

List of wetlands undertaken to assess status during the reconnaissance survey around GJIA site (within 10 km radius) and their potentiality as bird habitat.

S. No.	Village/area	Type of Waterbody	Latitude	Longitude	Status	Potential as bird habitat
1	Mangroli	Village Pond	28.1144472	77.5853722	Choked	No
2	Neemka	Village Pond	28.1356583	77.60545	Choked	No
3	Chauroli	Village Pond	28.1198194	77.6174861	Choked	Doubtful/No
4	Khurja road	Drain	28.1498111	77.6387222	Choked	No
5	Parouri	Canal	28.16665	77.6754944	Dried	No
6	Jawan	Village Pond	28.1377139	77.7025917	Clear and open	Yes
7	Jahangirpur	Village Pond	28.1764694	77.706175	Partially clear	No
8	Jahangirpur	Village Pond	28.1770472	77.7100639	Choked	No
9	Jahangirpur	Village Pond	28.1779917	77.7002583	Choked	No
10	Muhammadpur	Village Pond	28.2059778	77.7226139	Clear and open	No
11	Chhingravali	Village Pond	28.2161556	77.6934972	Choked	No
12	Between Hamidpur and Raipur	Village Pond	28.0801944	77.5518611	Clear and open	No
13	Sarol	Village Pond	28.0783056	77.5763278	Clear and open	No
14	Khandheda	Village Pond	28.0444889	77.6288806	Clear and open	No
15	Bajauta	Village Pond	28.0661722	77.6332944	Partially clear	No
16	Bajauta	Village Pond	28.0692139	77.6369389	Choked	No
17	Dayanatpur	Village Pond	28.1684139	77.571775	Clear and open	No
18	Nagla Jahanu	Village Pond	28.1928806	77.5925472	Clear and open	No
19	Alli Ahmadpur	Village Pond	28.1609889	77.6733472	Clear and open	No
20	Kanpur	Village Pond	28.194425	77.6552083	Clear and open	No
21	Hasanpur	Village Pond	28.1932639	77.6738278	Choked	No
22	Hasanpur	Village Pond	28.1952611	77.6743861	Choked	No
23	Hasanpur	Village Pond	28.1950944	77.6760944	Choked	No
24	Parouri	Village Pond	28.1689722	77.6807278	Clear and open	No
25	Dhansiya	Village Pond	28.1660111	77.6536861	Partially clear	No
26	Dustumpur	Village Pond	28.1701722	77.6494778	Partially clear	No

ANNEXURE VIII

Location and characteristics of the important wetlands identified in 25 km radius zone.

ID	Type	Area (ha)	Perimeter (m)	PARA (ratio)	Mean NDVI	Latitude	Longitude
1	Perennial	0.46	266.99	0.06	0.34	28.2544003	77.3936005
2	Perennial	1.85	516.91	0.03	0.47	28.2539997	77.4257965
3	Perennial	0.40	305.13	0.08	0.33	28.2304001	77.3930969
4	Perennial	0.84	365.06	0.04	0.34	28.0011005	77.4384003
5	Perennial	1.50	467.91	0.03	0.36	27.9892998	77.4318008
6	Perennial	0.69	303.06	0.04	0.34	27.9978008	77.4247971
7	Perennial	0.28	195.04	0.07	0.31	28.0016003	77.7898026
8	Perennial	0.53	297.42	0.06	0.49	28.0688992	77.8323975
9	Perennial	0.29	203.27	0.07	0.55	28.0678997	77.8332977
10	Perennial	0.98	387.45	0.04	0.36	28.0928993	77.8781967
11	Perennial	0.36	239.81	0.07	0.50	28.1485004	77.8852997
12	Perennial	0.39	262.36	0.07	0.47	28.1615009	77.884697
13	Perennial	0.20	164.19	0.08	0.56	28.1618004	77.8820038
14	Perennial	1.40	708.50	0.05	0.50	28.1776009	77.8298035
15	Perennial	0.30	205.18	0.07	0.50	28.1783009	77.832901
16	Perennial	0.17	151.31	0.09	0.39	28.1835003	77.8095016
17	Perennial	0.32	209.02	0.06	0.42	28.1308002	77.8087997
18	Perennial	1.57	465.72	0.03	0.31	28.0000992	77.6884995
19	Perennial	0.80	347.78	0.04	0.53	28.0314007	77.7245026
20	Perennial	0.25	213.29	0.08	0.38	28.0848007	77.7264023
21	Perennial	0.48	253.87	0.05	0.42	28.0650005	77.7494965
22	Perennial	0.47	261.61	0.06	0.40	28.1550999	77.8321991
23	Perennial	0.29	194.75	0.07	0.42	28.1574001	77.8289032
24	Perennial	0.32	212.57	0.07	0.41	28.2028008	77.8787003
25	Perennial	0.23	195.64	0.08	0.47	28.2028999	77.8816986
26	Perennial	0.17	155.68	0.09	0.50	28.1807995	77.8911972
27	Perennial	0.24	186.53	0.08	0.50	28.1529007	77.8862991
28	Perennial	1.32	448.35	0.03	0.38	28.0231991	77.7873001
29	Perennial	0.38	233.68	0.06	0.34	28.0848007	77.3453979
30	Perennial	0.96	387.06	0.04	0.53	28.0904999	77.382103
31	Perennial	1.01	413.98	0.04	0.51	28.0904007	77.3830032
32	Perennial	0.49	291.58	0.06	0.53	28.0818996	77.3666
33	Perennial	0.49	277.87	0.06	0.45	28.0695992	77.4368973
34	Perennial	0.60	322.26	0.05	0.34	28.0391006	77.4785004
35	Perennial	0.41	240.46	0.06	0.31	27.9983997	77.6552963
36	Perennial	1.66	869.12	0.05	0.43	28.2117004	77.7658997
37	Perennial	0.38	259.95	0.07	0.38	28.2147999	77.7827988
38	Perennial	0.39	240.17	0.06	0.51	28.2763004	77.7391968
39	Perennial	0.59	325.71	0.06	0.33	28.1667004	77.3304977
40	Perennial	1.94	671.10	0.03	0.56	28.1555004	77.4188004
41	Perennial	0.57	329.04	0.06	0.51	28.1567993	77.4057007
42	Perennial	2.55	634.15	0.02	0.43	28.0209007	77.4319
43	Perennial	1.67	511.15	0.03	0.51	28.0205002	77.4335022
44	Perennial	0.71	337.18	0.05	0.37	28.0140991	77.4259033
45	Perennial	0.64	295.98	0.05	0.39	27.9701996	77.6489029
46	Perennial	0.55	390.70	0.07	0.32	27.9694996	77.6632996
47	Perennial	0.31	220.55	0.07	0.39	27.9752007	77.7412033
48	Perennial	0.68	345.06	0.05	0.35	28.0067997	77.7714005
49	Perennial	0.13	190.74	0.15	0.43	28.2430992	77.7861023
50	Perennial	0.37	225.12	0.06	0.45	28.2367001	77.7328033
51	Perennial	1.11	397.13	0.04	0.37	28.3927002	77.6184998
52	Perennial	0.39	277.63	0.07	0.49	28.3649006	77.6999969

53	Perennial	0.42	256.22	0.06	0.44	28.3026009	77.7425003
54	Perennial	0.08	110.15	0.13	0.48	28.3150997	77.7733994
55	Perennial	0.77	324.99	0.04	0.34	28.3505993	77.4194031
56	Perennial	0.40	263.75	0.07	0.38	28.0132999	77.6390991
57	Perennial	0.46	334.50	0.07	0.31	27.9957008	77.6561966
58	Perennial	0.59	349.77	0.06	0.32	27.9986992	77.6597977
59	Perennial	1.21	688.44	0.06	0.37	27.9881992	77.7110977
60	Perennial	1.17	552.44	0.05	0.36	27.9710999	77.7189026
61	Perennial	0.48	270.00	0.06	0.38	27.9545994	77.7237015
62	Perennial	0.48	259.73	0.05	0.36	27.9608002	77.641098
63	Perennial	0.29	233.16	0.08	0.51	27.9827995	77.6255035
64	Perennial	0.56	286.50	0.05	0.34	27.9603996	77.560997
65	Perennial	1.06	423.39	0.04	0.48	28.1222	77.3610992
66	Perennial	0.82	355.61	0.04	0.44	28.1030006	77.348999
67	Perennial	0.57	301.41	0.05	0.47	28.1091995	77.3527985
68	Perennial	0.34	212.30	0.06	0.55	28.1196995	77.3948975
69	Perennial	1.69	575.22	0.03	0.45	28.0125999	77.4476013
70	Perennial	0.69	326.21	0.05	0.43	28.0037994	77.4609985
71	Perennial	0.19	159.81	0.09	0.44	28.0039997	77.4637985
72	Perennial	0.34	222.25	0.07	0.38	28.0070992	77.4697037
73	Perennial	0.38	240.97	0.06	0.46	28.0060997	77.4866028
74	Perennial	0.31	224.62	0.07	0.51	28.0186996	77.4332962
75	Perennial	0.77	348.84	0.05	0.31	28.0046005	77.4191971
76	Perennial	0.67	308.69	0.05	0.49	28.0333996	77.4100037
77	Perennial	1.70	490.33	0.03	0.42	28.0466995	77.3891983
78	Perennial	1.12	404.13	0.04	0.48	28.0487003	77.3892975
79	Perennial	0.25	188.31	0.08	0.48	28.0510998	77.3848038
80	Perennial	1.22	584.35	0.05	0.42	28.0342007	77.3815002
81	Perennial	1.77	726.75	0.04	0.53	28.1970005	77.3735962
82	Perennial	0.74	350.80	0.05	0.49	28.1800003	77.3768005
83	Perennial	1.91	570.10	0.03	0.54	28.1650009	77.3687973
84	Perennial	1.34	474.85	0.04	0.42	28.0760002	77.3619995
85	Perennial	0.53	348.73	0.07	0.50	28.0522003	77.415802
86	Perennial	0.98	603.99	0.06	0.30	27.9475994	77.6641006
87	Perennial	0.72	340.22	0.05	0.34	27.9619999	77.6521988
88	Perennial	0.26	194.41	0.08	0.41	27.9461002	77.6809006
89	Perennial	0.39	237.43	0.06	0.37	28.0189991	77.4140015
90	Perennial	0.15	142.07	0.10	0.39	28.0198994	77.4107971
91	Perennial	0.54	293.30	0.05	0.44	28.1373997	77.3687973
92	Perennial	1.30	447.67	0.03	0.55	28.1114006	77.3887024
93	Perennial	0.38	243.40	0.06	0.53	28.1051006	77.368103
94	Perennial	1.93	675.12	0.03	0.58	28.0778008	77.3684998
95	Perennial	0.30	198.85	0.07	0.49	28.0716991	77.3806992
96	Perennial	0.56	351.21	0.06	0.41	28.0715008	77.3815002
97	Perennial	0.62	298.26	0.05	0.51	28.0704002	77.3912964
98	Perennial	0.41	254.96	0.06	0.38	28.0291996	77.4428024
99	Perennial	0.59	288.07	0.05	0.47	28.0202999	77.4800034
100	Perennial	0.31	214.93	0.07	0.41	28.0233002	77.4705963
101	Perennial	0.25	213.10	0.09	0.32	27.9792995	77.5157013
102	Perennial	0.22	184.22	0.08	0.41	28.0188999	77.5423965
103	Perennial	1.40	522.31	0.04	0.39	27.9669991	77.7717972
104	Perennial	0.84	364.15	0.04	0.43	28.1173992	77.8767014
105	Perennial	0.27	200.04	0.07	0.41	28.1201	77.8707962
106	Perennial	0.50	270.36	0.05	0.40	28.1313	77.8648987
107	Perennial	0.56	303.36	0.05	0.38	28.0755997	77.7814026
108	Perennial	0.52	286.13	0.05	0.39	28.0988998	77.7777023
109	Perennial	0.83	352.57	0.04	0.41	28.1399002	77.7517014
110	Perennial	0.30	201.84	0.07	0.35	28.0109997	77.6018982

111	Perennial	1.28	591.04	0.05	0.33	28.0478992	77.6248016
112	Perennial	0.36	222.43	0.06	0.37	28.0685997	77.6652985
113	Perennial	0.61	315.82	0.05	0.43	28.0401001	77.7317963
114	Perennial	1.10	398.16	0.04	0.45	28.0217991	77.7249985
115	Perennial	0.45	249.32	0.06	0.39	28.0016003	77.7089005
116	Perennial	0.77	354.09	0.05	0.51	28.3703995	77.4540024
117	Perennial	1.80	588.33	0.03	0.41	28.3845997	77.6902008
118	Perennial	0.23	193.37	0.08	0.61	28.1590004	77.8872986
119	Perennial	0.40	247.14	0.06	0.44	28.2154007	77.8331985
120	Perennial	0.45	263.82	0.06	0.43	28.1884003	77.8473969
121	Perennial	0.39	238.96	0.06	0.37	28.0046005	77.7713013
122	Perennial	0.76	356.28	0.05	0.38	28.0203991	77.4271011
123	Perennial	0.52	275.21	0.05	0.53	28.0380993	77.4194031
124	Perennial	0.44	288.70	0.07	0.46	28.0590992	77.3985977
125	Perennial	0.71	335.66	0.05	0.60	28.1110992	77.3787994
126	Perennial	0.19	166.41	0.09	0.42	28.2448997	77.3488007
127	Perennial	0.47	265.60	0.06	0.41	28.2819996	77.3729019
128	Perennial	0.91	385.81	0.04	0.33	28.3008995	77.3843994
129	Perennial	0.39	256.11	0.07	0.50	28.3619003	77.4754028
130	Perennial	1.31	509.33	0.04	0.31	28.3903008	77.713501
131	Perennial	0.31	232.20	0.08	0.44	28.0956993	77.8227997
132	Perennial	0.37	252.07	0.07	0.34	27.9897003	77.5112991
133	Perennial	0.20	175.59	0.09	0.30	27.9955006	77.517601
134	Perennial	1.33	480.25	0.04	0.51	28.2285004	77.367897
135	Perennial	0.45	260.70	0.06	0.50	28.2010994	77.4095993
136	Perennial	1.00	515.33	0.05	0.44	27.9969006	77.6242981
137	Perennial	0.28	209.60	0.07	0.31	28.0217991	77.6289978
138	Perennial	0.32	221.16	0.07	0.31	27.9559002	77.6613007
139	Perennial	1.14	702.18	0.06	0.37	28.2537994	77.8667984
140	Perennial	0.30	223.29	0.07	0.47	28.1473999	77.4498978
141	Perennial	0.76	333.60	0.04	0.60	28.1599998	77.4424973
142	Perennial	0.38	266.01	0.07	0.55	28.1494007	77.4609985
143	Perennial	0.32	233.89	0.07	0.42	28.1299992	77.7633972
144	Perennial	0.42	252.15	0.06	0.39	28.0762997	77.7188034
145	Perennial	0.36	274.61	0.08	0.45	28.2721004	77.8259964

ANNEXURE IX

A: Recorded list of plants eaten by Blackbuck in India.

S. No.	Scientific name	S. No.	Scientific name
1	*Acacia nilotica*	29	Dichrostachys cinerea
2	*Acacia leucophloea*	30	Diospyros melanoxylon
3	*Acacia senegal*	31	Phyllanthus emblica
4	*Aegle marmelos*+	32	Fimbristylis ovata+
5	*Aeluropus lagopoides*	33	Flacourtia indica
6	*Anogeissus latifolia*	34	Grewia tenax
7	*Apluda mutica*	35	Grewia tiliifolia
8	*Aristida redacta*	36	Helicteres isora
9	*Aristida setacea* +	37	Heteropogon contortus
10	*Azadirachta indica*	38	Indigofera linnaei +
11	*Balanites aegyptiaca*	39	Iseilema anthephoroides*
12	*Bauhinia racemosa*	40	Leucaena leucocephala
13	*Boswellia serrata*	41	Manilkara hexandra
14	*Bothriochloa bladhii*	42	Peltophorum pterocarpum
15	*Caesalpinia coriaria*	43	Pithecellobium dulce+
16	*Capparis decidua*	44	Catunaregam spinosa +
17	*Carissa carandas*	45	Bombax ceiba
18	*Carissa spinarum*+	46	Soymida febrifuga
19	*Senna auriculata*	47	Sporobolus coromandelianus*
20	*Senna tora*	48	Sporobolus maderaspatanus*
21	*Chloris virgata**	49	Striga angustifolia *
22	*Chrysopogon fulvus*	50	Tecomella undulata
23	*Cymbopogon flexuosus*+	51	Themeda triandra
24	*Cynodon barberi*+	52	Chrysopogon zizanioides
25	*Cyperus arenarius*	53	Wrightia tinctoria
26	*Dactyloctenium aegyptium* *	54	Ziziphus jujuba
27	*Dalbergia latifolia*	55	Zizyphus mauritiana
28	*Dichanthium annulatum* *		

This data is sourced from Mungall (1978).
* and + refers to plants reported in Jhala (1997) and Shankar Raman et al (1996), respectively.
This list has been checked for changes in nomenclature at http://www.theplantlist.org.

B: Recorded list of plants eaten by Nilgai in North India.

S. No.	Plant species	S. No.	Plant species
1	*Acacia tortilis*	16	*Prosopis juliflora*
2	*Acacia nilotica*	17	*Prosopjs cineraria*
3	*Acacia leucophloea*	18	*Prosopis specigera*
4	*Brassica compestris*	19	*Saccharum munja*
5	*Cajanus cajan*	20	*Saccharum officinarum*
6	*Capparis sepiaria*	21	*Salvadora oleoides*
7	*Cicer arietenum*	22	*Setaria uerticulata*
8	*Cyamopsis tetragonoloha*	23	*Sorghum vulgare*
9	*Cynodon dactylon*	24	*Sporobolus spp.*
10	*Cyprus compressus*	25	*Triticum aestivum*
11	*Cyprus rotundus*	26	*Vetiveria zizanoides*
12	*Lens esculentus*	27	*Zea mays*
13	*Oryza sativa*	28	*Zizyphus maritiana*
14	*Phaseoles aureus (Vignas radiata)*	29	*Zizyphus numularia*
15	*Pennisetum typhoides*	30	*Prosopis Juliflora*

Source: Qureshi (1991); Singh (1995)

ANNEXURE X

Environmental Clearance

F.No.10-31/2018-IA-III
Government of India
Ministry of Environment, Forest and Climate Change
(IA.III Section)

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi - 3

Date: 09 March, 2020

To,

The Director,
M/s Directorate of Civil Aviation, Government of Uttar Pradesh,
Lucknow Airport, Lucknow - 226 009, Uttar Pradesh
Email: ddca.up@nic.in; jewarairport01@gmail.com

Subject: Development of Greenfield 'Jewar International Airport' Phase-I & II, Gautam Buddh Nagar, Uttar Pradesh by M/s Directorate of Civil Aviation, Government of Uttar Pradesh - Environmental Clearance - reg.

Sir,

This has reference to your online proposal No. IA/UP/MIS/74694/2018 dated 17.06.2019, submitted to this Ministry for grant of Environmental Clearance (EC) in terms of the provisions of the Environment Impact Assessment (EIA) Notification, 2006 under the Environment (Protection) Act, 1986.

2. The proposal for grant of environmental clearance to the project 'Development of Greenfield "Jewar International Airport Phase-I & II", Gautam Buddh Nagar, Uttar Pradesh by M/s Directorate of Civil Aviation, Government of Uttar Pradesh was considered by the Expert Appraisal Committee (Infra-2) in its 42nd meeting held during 10-12 July, 2019 and 48th meeting held during 28-29 January, 2020. The details of the project, as per the documents submitted by the project proponent, and also as informed during the above meeting, are as under:-

(i) Spread over an area of 1,334.00 ha, proposed site for the airport is located between latitude 28°10'09.87"N and longitude of 77°38'20.41"E, north of Jewar Village, in Gautam Buddh Nagar District of Uttar Pradesh. The Yamuna Expressway is located at about 700 meters from the project site. The site is about 70 km from IGI Airport.

(ii) In the area of development 1,334.00 ha has been earmarked for development of the airport. The land utilization at present consists of settlements and agricultural area. The land also consists of government land. Existing Settlements and structures falling within the airport area shall be resettled before any demolition work. This area is a part of the notified area of Yamuna Expressway Industrial Development Authority. Project has been designed as per International standards to cater A380 aircrafts. The master plan for the airport is designed to conforms to the Standards and Recommended Practices (SARPs) formulated by the International Civil Aviation Organization (ICAO) and promulgated by Directorate General of Civil Aviation (DGCA), India. Land acquisition & R&R will be undertaken by the Collectors office/ State Govt. The details of the project is as follows:

Components	Phase I (2020-2022)		Phase II (2027-2030)		Total	
	No.	Area (sqm)	No.	Area (sqm)	No.	Area (sqm)
Runway	1	2,49,000	1	2,34,000	2	4,83,000
Hangar & Aircraft Maintenance Facility	1	1,77,672	1	1,96,733	2	3,74,405
Commercial Development	2	1,39,002	0	0	2	1,39,002
AAI/ BCAS/ MET	1	10,000	0	0	1	10,000
JIA MGT. Block	2	10,000	0	0	2	10,000
CISF /Police Station	1	10,000	0	0	1	10,000

Car Parking	1	48,491	2	39,584	3	88,075
Utilities	1	65,630	3	56,627	4	1,22,257
Terminal	1	71,313	1	68,141	2	1,39,454
RESA 240X90	2	21,600	2	21,600	4	43,200
Maintenance Building	1	2,800	1	2,800	2	5,600
AGL Sub Station	1	2,800	1	2,800	2	5,600
RADAR	1	9,933	1	9,891	2	19,824
Express Cargo Terminal	1	16,490	1	81,010	2	97,500
Cargo Terminal	1	30,984	1	31,955	2	62,939
Fire Station	2	1,200	3	4,600	5	5,800
Isolation Bay	1	16,024	1	16,025	2	32,049
Apron (Terminal)	1	1,64,556	1	1,77,213	2	3,41,769
Apron (Cargo)	1	62,220	1	91,396	2	1,53,616
Taxi lane + Taxiway	1	2,83,370	1	15,03,928	2	17,87,298
Truck Bay	1	1,37,500	1	13,750	2	1,51,250
Cargo Admin and Utilities	1	1,60,682	0	0	1	1,60,682
STP	1	20,000	0	0	1	20,000
Approach Road	1	3,12,627	0	0	1	3,12,627
Fuel Facility	1	15,000	1	25,000	2	40,000
ATC	1	3,848	0		1	3,848
DVOR	0	0	1	2,82,743	1	2,82,743
Terminal Building gen. Aviation	0	0	1	3,000	1	3,000
General Aviation Apron	0	0	1	24,014	1	24,014
Sub-Station	0	0	1	4,062	1	4,062
Total Area of Development		**20,42,743**		**28,90,872**		**49,33,614**

(iii) The daily consumption of water during operation phase will be about 17,267.5 KLD of which 3,040.8 KLD will be fresh water requirement. The water for the project during operation and construction phase will be drawn from Jewar distributaries and Kasna STP located at Greater Noida.

(iv) During operation phase, around 9,889.9 KLD of wastewater will be generated. The wastewater will be treated in the STP having capacity of 12 MLD using MBBR technology. The treated water will be re-used for landscaping and flushing purpose at the airport.

(v) Infrastructure like spillage collection chamber, concrete floor shall be provided at places of fuel storage to ensure minimum spillage of oil thereby reducing contamination of soil. Biodegradable portion of MSW will be used to generate manure / biogas. Recyclable waste will be sold to recyclers. Hazardous waste shall be treated in accordance with Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016. Spent oil from DG sets and other sources shall be stored in concrete floors and sent to authorize recyclers.

(vi) Power requirement for the 1st Phase is 30 MVA and Phase-2 is 70 MVA. The same will be met from the State Authority or private company. 6 DG sets of 2 MVA capacity each will serve as back-up during power failure.

(vii) Landscaping/ plantation/ greenery will be developed on 133.4 ha area. Indigenous species shall be planted in consultation with horticulturist and forest department.

(viii) ToR was granted by MoEFCC vide letter F.No.10-31/2018-IA-III dated 12.06.2018. The ToR was for phase I & II only i.e. for the specified traffic (30 MPPA) and cargo tonnage (1 MTPA) in the year 2033-34 as expected.

(ix) National Board for wild life clearance is not required as there are no National Parks or Wildlife Sanctuaries located within 10 km radius of the proposed project.

(x) Public hearing conducted on 27.11.2018 at Primary School, Village Kishorepur, Jewar.

(xi) Investment cost of the project is Rs. 7,291 Crore.

(xii) Employment potential: Permanent employment- during construction: 125 Employees, During Operation: 9000 (Phase 1), During Operations: 20000 (phase 2). Temporary- During Construction: On an average 750 per day and a maximum of 1100 on any peak day, During Operations: 900.

(xiii) Benefits of the project: Economic output with a multiplier of 1.6 due to investment at airport. In present value terms, this is estimated to be around Rs. 63,500 Crores. Tax revenue to the government from the economic output: This has been assumed to be only 1% of the economic output. In present value terms, this comes out to be around Rs. 635 Crores. The income from revenue share from the airport, in present value terms has been estimated to be around Rs. 4,175 Crores. The tax revenue from airport, in present value term works out to be around Rs. 2,100 Crores. The lease rentals from the airports to the government, in present value terms, have been estimated to be around Rs. 1,365 Crores.

3. The project/activity is covered under category 'A' of item 7(a) 'Airports' of the Schedule to the EIA Notification, 2006 and its subsequent amendments, and requires appraisal at Central Level by sectoral EAC.

4. The proposal was earlier considered by the EAC (Infra-2) in its 42nd meeting held during 10-12 July, 2019, wherein the EAC observed that the EIA/EMP report submitted by the project proponent does not cover the all environmental aspect of the proposed airport. After detailed deliberation EAC asked the project proponent to submit additional details. Project Proponent has submitted the additional information on Ministry's website on 04.01.2020. The details are as follows:

(i) Status of permission for tree cutting from Forest Department.

Forest Department has granted the permission for felling of 11,460 trees standing within the proposed site vide letter no. 2307/22-1 dated 10.12.2019 and 2342/22-1 dated 12.12.2019. Total 11,460 trees need to be felled/ shifted due to the project. The details of trees are as follows:

S. No.	Village Name	Number of Trees need to cut	Number of Trees need to shift	Total
1.	Ranhera	4659	61	4720
2.	Rohi	3204	12	3216
3.	Parohi	153	0	153
4.	Kishorepur	554	06	560
5.	Dayantpur	2680	99	2779
6.	Banwaribans	32	0	32
	Total	**11282**	**178**	**11460**

(ii) Afforestation plan for plantation.

Afforestation Action Plan has been prepared by DFO Gautam Buddha Nagar as follows:

S. No.	No. of Trees to be planted	Proposed Location	Proposed Area (ha)	Cost for Afforestation (Rs.)	Period
1.	60,000	Proposed green belt of **Sector- 22D** and **Sector 29-30**	30	1,42,63,000	2019-20 to 2022-23
2.	52,820	11 ha in **Murshadpur forest block** and 15.5 ha in **Gulistanpur forest block**	26.5	1,21,32718	

Total	**1,12,820**		**56.5**	**2,63,95,718**	**2019-20 to 2022-23**

The cost for Compensatory Afforestation is 10 times i.e. Rs. 2,63,95,718 has been already transferred to Forest Department vide cheque no. 275502 dated 13.12.2019 and also the tree feeling cost has been given to the Forest Department vide cheque no. 275503 dated 13.12.2019

(iii) Restoration plan for water bodies including channels.

Restoration plan for water bodies including channels present and proposed scenario - wise is as follows:

Name of drain	Present Scenario	Proposed Scenario
Pathwaya Nala	Pathwaya Nala, running north-south at east end needs diversion for the development of airport.	Pathwaya Nala is 74.4 km in length. This is a natural drain. From 49.0 km to 54.4 km of this drain would get affected as this stretch falls within proposed airport site. Total cost of re-establishment has been proposed as Rs.2479.35 lakhs.
Drainage of Bajauta Distributory	Bajauta Distributory is 23 km in length having peak discharge of 52 cumec.	From 0 km to 0.450 km of this distributor need to be diverted since it is falling within proposed air port site. Hence, by providing head regulator and cross regulator the diversion of Bajauta Distributory has been proposed for about 1km.
Dayantpur Minor	Dayantpur Minor is 3.1 km in length having peak discharge of 23 cumec.	From 1.765 km to 3.100 km of this drain is falling within the project site having command area in 340 ha of within proposed boundary of Jewar Airport. Hence, Dayanatpur Minor has been handed over for the development of Airport Project. Thus, the length of Dayanatpur Minor will be curtailed from 0.000 km to 1.765 km and re-establishment of this drain has been proposed.
Drainage of the Kishorepur Minor:	Kishorepur minor, running from NW to SE is cutting the site diagonally.	Kishorepur Minor is 4.8 km in length having peak discharge of 5.5 cumec and Cultural Command Area of 610 ha. Since the drain entirely falling within proposed project site, it has been handed over for the project. Head to tail of Kishorepur Minor and its command area is falling within project site, hence it has been handed over for the project.

(iv) Conservation plan for Birds and Fauna in consultation with Wildlife Institute of India (WII).

Wildlife Institute of India (WII) has been engaged for development of Conservation Plan for Birds and fauna. Interim Report and Inception Report prepared by WII has been submitted. The Final Report in this regard is expected by end of July, 2020. Proponent will ensure the implementation of WII's recommendation throughout the project cycle during preconstruction, construction and operational stages.

The present document summarizes work done between 02.11.2019 – 15.12.2019 including field surveys and lab-based work. A total of six species of mammals were observed in the proposed GJIA site as well as within its 10 km buffer. A total of 60 species of bird species were recorded during the present survey. A total of 28 independent groups of Blackbuck were observed during the present survey. In the proposed Greenfield Jewar International Airport (GJIA) site, they can be observed on the eastward of the Jewar-

Bulandshahar road towards the south-east corner. A total of 21 independent groups of Nilgai were observed during the present survey. During survey, Golden Jackal (Canis aureus) on two separate occasions comprising two individuals on each occasion were observed. Jungle Cat (Felis chaus) was observed twice as a single individual in the proposed GJIA site. In total, 64 sarus cranes in 21 independent observations were observed across the landscape during the survey. Egyptian vulture (Neophron percnopterus) is an endangered species that was recorded at a few places on four different occasions during the survey. A total of 24 independent observations of Indian Peafowl were made across the GJIA landscape. A total of 99 perennial water bodies were recorded across the GJIA landscape

(v) Study on filling of 14 ponds and mitigation measures especially with respect to water conservation.

14 ponds (Total Area: 3.85 ha) located within proposed site are likely to be getting affected due to the proposed development. The details are as follows:

Details of ponds located within proposed Jewar International Airport						
S. No.	**Area of pond (sqm)**	**Latitude**	**Longitude**	**Revenue Village Name**	**Survey No/s**	**Remarks**
1.	833.76	28°10'54.78"N	77°34'33.79"E	Dayanatpur	1014	Pvt.
2.	4002.81	28°10'42.82"N	77°34'44.01"E	Dayanatpur	1054,1055	1054 (Pvt.)/1055 (Pvt.)
3.	1473.32	28°10'48.76"N	77°35'40.95"E	Dayanatpur	1164,1210	1164 (Govt.-Khad Gadde), 1210 (Govt.-Abadi)
4.	932.299	28°10'36.94"N	77°35'33.45"E	Dayanatpur	1267	Pvt.
5.	2021.32	28°10'31.60"N	77°35'35.80"E	Dayanatpur	1258	1258 (Govt.- Graveyard)
6.	503.676	28°10'28.72"N	77°35'29.04"E	Dayanatpur	1827	Pvt.
7.	8766.33	28°9'56.76"N	77°35'59.51"E	Kishorpur	162	162 (Govt.-Pond)
8.	619.148	28°10'44.89"N	77°36'11.35"E	Rohi	96	Pvt.
9.	5357.07	28°10'50.97"N	77°36'31.31"E	Rohi	46, 48, 49	46 (Pvt.), 48 (Pvt. & Govt.), 49 (Pvt. & Govt.)
10.	1800.63	28°09'59.63"N	77°37'24.88"E	Rohi	598	Govt.
11.	9463.3	28°10'07.24"N	77°37'39.88"E	Rohi	652, 651	652 (Govt.-Pond), 651 (Govt.-Nabin Prati)
12.	990.611	28°10'03.58"N	77°37'41.01"E	Rohi	650	650 (Govt.-Pond)
13.	1336.26	28°10'01.94"N	77°37'43.37"E	Rohi	969	969 (Govt.-Pond)
14.	409.94	28°09'35.59"N	77°37'47.06"E	Parohi	336	Private
	Total Area (sqm)					**38,510.474**
	Total Area (ha)					**3.85**

9 Land parcels of total area **6.3370 ha** in Jewar Tehsil have been allocated by Revenue Department for creation of new pond as a mitigative action. The details are as follows:

Land Allocated by Collector, Gautam Buddha Nagar for Creation of New Pond					
No.	**Village Name**	**Land use**	**Survey No.**	**Gata No.**	**Area (ha)**
1.	Aakalpur	Barren	239	297	1.3590
2.	Faloda Bangar	Barren	647	746 Kha	2.5630
3.	Takipur Bangar	Barren	338	236 Ma	0.0760
4.	Takipur Bangar	Barren	338	237 Ma	0.0250

5.	Takipur Bangar	Barren	338	246	1.0050
6.	Takipur Bangar	Barren	338	277 Ma	0.2020
7.	Takipur Bangar	New Fallow Land	336	236 Ma	0.0410
8.	Takipur Bangar	New Fallow Land	336	242	1.0120
9.	Takipur Bangar	New Fallow Land	336	277 Mi	0.0540
				Total Land (ha)	**6.3370**

(vi) Submitted Wind rose diagram for one year.

(vii) Revised Corporate Environment Responsibility (CER) plan as compensatory afforestation cannot be part of CER.

The estimated capital cost of the project is Rs. 3,754 Crore for Phase I and Rs. 3,537 Crore for Phase II. Therefore, CER (Corporate Environment Responsibility) cost is **Rs. 18.7895 Crore** for **Phase I** and **Rs. 17.7095 Crore** for **Phase II**. The allocated CER budget would get allocated in villages like Rampur Bangar, Nilaouni, Dungarpur Rilka, Chandpur and Achheja Buzurg.

5. The EAC, based on the information submitted and clarifications provided by the Project Proponent and detailed discussions held on all the issues in its 48th meeting held during 28-29 January, 2020, recommended the project for grant of environmental clearance with stipulated specific conditions along with other Standard EC Conditions as specified by the Ministry vide OM dated 04.01.2019 for the said project/activity, while considering for accord of environmental clearance. Based on the recommendation of the EAC, the Ministry of Environment, Forest and Climate Change hereby accords Environmental Clearance to the project 'Development of Greenfield "Jewar International Airport Phase-I & II", Gautam Buddh Nagar, Uttar Pradesh by M/s Directorate of Civil Aviation, Government of Uttar Pradesh under the provisions of the EIA Notification, 2006 and amendments/circulars issued thereon, and subject to the specific and general conditions as under:-

A. Specific Conditions:

(i) As proposed, Environmental Clearance is for 'Development of Greenfield 'Jewar International Airport' Phase-I & II, Gautam Buddh Nagar, Uttar Pradesh by M/s Directorate of Civil Aviation, Government of Uttar Pradesh.

(ii) The land acquisition / purchase shall be in conformity to the LARR Act, 2013 and any other laws and regulations governing land acquisition.

(iii) Clearance from Directorate General of Civil Aviation (DGCA) and Airports Authority of India (AAI) for safety and project facilities shall be obtained.

(iv) Consent to Establish/Operate for the project shall be obtained from the State Pollution Control Board as required under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.

(v) Conservation plan for Birds and Fauna in consultation with Wildlife Institute of India (WII) shall be submitted within six month from grant of this clearance and shall be implemented in letter and spirit.

(vi) Notification GSR 94(E) dated 25.01.2018 of MoEF&CC regarding Mandatory Implementation of Dust Mitigation Measures for Construction and Demolition Activities shall be complied with.

(vii) Total water requirement is estimated as 17267.5 KLD, while fresh water requirement will be 3040.8 KLD. The water for the project during operation and construction phase will be drawn from Jewar distributary and Kasna STP located at Greater Noida. As proposed, no ground water shall be used in the project.

(viii) Aircraft maintenance, sensitivity of the location where activities are undertaken, and control of runoff of potential contaminants, chemicals etc shall be properly

implemented and reported.

(ix) Waste water generated from the Airport will be treated in Sewage Treatment Plant of 12 MLD capacity. Treated waste water will be used for landscaping and flushing. There will be zero discharge of treated waste water from airport.

(x) During construction and operational phase AAQ monitoring should include PM_{10}, $PM_{2.5}$, SO_2, NOx, NH_3, CO, CH_4 and Benzene.

(xi) During airport operation period, noise should be controlled to ensure that it does not exceed the prescribed standards. During night time the noise levels measured at the boundary of the building shall be restricted to the permissible levels to comply with the prevalent regulations. A monitoring station for ambient air and noise levels shall be provided in the village nearest to the airport.

(xii) Traffic Management Plan as submitted shall be implemented in letter and spirit. Apart, a detailed traffic management and traffic decongestion plan shall be drawn up to ensure that the current level of service of the roads within a 05 kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies in this 05 Kms radius of the site in different scenarios of space and time. Traffic management plan shall be duly validated and certified by the State Urban Development department and the P.W.D./ competent authority for road augmentation and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.

(xiii) An onsite disaster management plan shall be drawn up to account for risks and accidents. This onsite plan shall be dovetailed with the onsite management plan for the district.

(xiv) Top soil shall be separately stored and used in the development of green belt.

(xv) Green belt shall be developed in area as provided in project details, with native tree species in accordance with Forest Department. The greenbelt shall inter-alia cover the entire periphery of the Air Port. Plantation activity should be taken up under the expert guidance for forest department of Government of Uttar Pradesh. As far as possible monocultural plantation should be avoided.

(xvi) The plantation species in and around Airport site should be carefully chosen to avoid bird nesting and to improve pollution control and noise control measures. Water intensive and/or invasive species should not be used for landscaping.

(xvii) The proposed 10 times compensatory plantation need to be monitored by the Government of Uttar Pradesh so that the target of planting 1,12,820 saplings is achieved in a time bound manner, their survival rate is monitored and mortality is replenished. In case of non-survival of any transplanted tree, compensatory plantation in the ratio of 1:10 (i.e. planting of 10 trees for every 1 tree) shall also be done and maintained.

(xviii) A water security plan to the satisfaction of the CGWA shall be drawn up to include augmenting water supply and sanitation facilities and recharge of ground water in at least two villages and schools, as part of the C.S.R. activities.

(xix) Energy conservation measures like installation of LED should be integral part of the project design and should be in place before project commissioning.

(xx) Initiatives such as Green Infrastructure Development program, adoption of less emission intensive technologies, renewable energy program, electrical vehicles and Airport Carbon Accreditation need to be adopted to reduce its impact on climate change and Green House Gas (GHG) emissions as per environmental best practices governing Greenfield airports.

(xxi) Provision of Electro-mechanical doors for toilets meant for disabled passengers shall

be ensured. Children nursing/feeding room shall be located conveniently near arrival and departure gates.

(xxii) The project proponent shall comply with the International Best Practices on environment management as applicable to the Airport project.

(xxiii) The company shall draw up and implement a Corporate Social Responsibility Plan as per the Company's Act of 2013.

(xxiv) As per the Ministry's Office Memorandum F.No. 22-65/2017-IA.III dated 01.05.2018, and proposed by the project proponent, an amount of Rs. **18.7895 Crore** for **Phase I** and **Rs. 17.7095 Crore** for **Phase II** @0.5% of the project cost shall be earmarked under Corporate Environment Responsibility (CER) for the activities such as **Health Related Facilities** (Construction of toilets and water tank in community as part of Swachh Bharat Abhiyan, Construction of Health Centre, Refurbishment and maintenance of existing Health Centre Organizing Health camps, Organizing Special Health Camps for eye, heart and maternal health Mobile Health Clinic), **Education Related Facilities** (Refurbishment of existing schools, Strengthening of ITI at Jewar and Scholarship for student), **Solid waste Management Facilities** (Providing VATs for Municipal Solid Waste in villages, Developing MSW disposal site with management, Providing training for solid waste management to villagers), **Social Facilities** (Installation of Hand-pumps, Repair and Maintenance of Hand-pumps/deep tube wells used for drinking water, Construction and Maintenance of village roads @ 50 km/year and Providing solar light in village common areas) **and Miscellaneous Facilities** (Skill Development- basic training programmes and Creation of irrigation facilities for farmers. The activities proposed under CER shall be restricted to the affected area around the project. The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the regional office as a part of half yearly compliance report, and to the District Collector. It should be posted on the website of the project proponent.

B. Standard Conditions:

I. Statutory compliance:

i. The project proponent shall obtain the necessary permission from the Central Ground Water Authority, in case of drawl of ground water / from the competent authority concerned in case of drawl of surface water required for the project.

ii. A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project should be obtained.

iii. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department shall be obtained, as applicable by project proponents from the respective competent authorities.

I. Air quality monitoring and preservation:

i. During construction and operational phase AAQ monitoring should include PM_{10}, $PM_{2.5}$, SO_2, NOx, NH_3, CO, CH_4 and Benzene.

ii. The project proponent shall install system to carryout Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released (e.g. PM_{10} and $PM_{2.5}$ in reference to PM emission, and SO_2 and NOx in reference to SO_2 and NOx emissions) within and outside the airport area at least at four locations (one within and three outside the plant area at an angle of 120° each), covering upwind and downwind directions.

iii. Soil and other construction materials should be sprayed with water prior to any loading, unloading or transfer operation so as to maintain the dusty material wet

iv. The excavation working area should be sprayed with water after operation so as to maintain the entire surface wet.

v. Excavated materials shall be handled and transported in a manner that they do not cause any problems of air pollution.

vi. The soil/construction materials carried by the vehicle should be covered by impervious sheeting to ensure that the dusty materials do not leak from the vehicle.

II. Water quality monitoring and preservation:

i. Aircraft maintenance, sensitivity of the location where activities are undertaken, and control of runoff of potential contaminants, chemicals etc shall be properly implemented and reported.

ii. Run off from chemicals and other contaminants from aircraft maintenance and other areas within the airport shall be suitably contained and treated before disposal. A spillage and contaminant containment plan shall be drawn up and implemented to the satisfaction of the State Pollution Control Board.

iii. Proper drainage systems, emergency containment in the event of a major spill during monsoon season etc. shall be provided.

iv. The runoff from paved structures like Runways, Taxiways, can be routed through drains to oil separation tanks and sedimentation basins before being discharged into rainwater harvesting structures.

v. Storm water drains are to be built for discharging storm water from the air-field to avoid flooding/water logging in project area. Domestic and industrial waste water shall not be allowed to be discharged into storm water drains.

vi. Rain water harvesting for roof run-off and surface run-off, as plan submitted should be implemented. Rain water harvesting structures shall conform to CGWA designs. Before recharging the surface run off, pre-treatment must be done to remove suspended matter, oil and grease.

vii. Total fresh water use shall not exceed the proposed requirement as provided in the project details. Prior permission from competent authority shall be obtained for use of fresh water.

viii. A certificate from the competent authority for discharging treated effluent/ untreated effluents into the Public sewer/ disposal/drainage systems along with the final disposal point should be obtained.

ix. A detailed drainage plan for rain water shall be drawn up and implemented.

x. No ground water shall be extracted without prior permission from CGWA.

xi. A water security plan to the satisfaction of the CGWA shall be drawn up to include augmenting water supply and sanitation facilities and recharge of ground water in at least two villages and schools, as part of the C.S.R. activities.

III. Noise monitoring and prevention:

i. Noise level survey shall be carried as per the prescribed guidelines and report in this regard shall be submitted to Regional Officer of the Ministry as a part of six-monthly compliance report.

ii. Noise from vehicles and power machinery and equipment on-site should not exceed the prescribed limit. Equipment should be regularly serviced. Attention should also be given to muffler maintenance and enclosure of noisy equipments.

iii. Acoustic enclosures for DG sets, noise barriers for ground-run bays, ear plugs for operating personnel shall be implemented as mitigation measures for noise impact due to ground sources.

iv. During airport operation period, noise should be controlled to ensure that it does not exceed the prescribed standards. During night time the noise levels measured at the boundary of the building shall be restricted to the permissible levels to comply with the prevalent regulations. A monitoring station for ambient air and noise levels shall be provided in the village nearest to the airport.

v. Where construction activity is likely to cause noise nuisance to nearby residents, restrict operation hours between 7 am to 6 pm.

IV. Energy Conservation measures:

i. Energy conservation measures like installation of LED for the lighting the areas outside the building should be integral part of the project design and should be in place before project commissioning.

V. Waste management:

ii. Notification GSR 94(E) dated 25.01.2018 of MoEF&CC regarding Mandatory Implementation of Dust Mitigation Measures for Construction and Demolition Activities shall be complied with.

iii. Soil stockpile shall be managed in such a manner that dust emission and sediment runoff are minimized. Ensure that soil stockpiles are designed with no slope greater than 2:1 (horizontal/vertical).

iv. The project activity shall conform to the Fly Ash notification issued under the E.P. Act of 1986.

v. Solid inert waste found on construction sites consists of building rubble, demolition material, concrete; bricks, timber, plastic, glass, metals, bitumen etc shall be reused/recycled or disposed off as per Solid Waste Management Rules, 2016 and Construction and Demolition Waste Rules, 2016.

vi. Any wastes from construction and demolition activities related thereto shall be managed so as to strictly conform to the Construction and Demolition Rules, 2016.

vii. The project proponents shall implement a management plan duly approved by the State Pollution Control Board and obtain its permissions for the safe handling and disposal of:

a. Trash collected in flight and disposed at the airport including segregation, collection and disposed.
b. Toilet wastes and sewage collected from aircrafts and disposed at the Airport.
c. Wastes arising out of maintenance and workshops
d. Wastes arising out of eateries and shops situated inside the airport complex.
e. Hazardous and other wastes

viii. The solid wastes shall be segregated as per the norms of the Solid Waste Management Rules, 2016. Recycling of wastes such as paper, glass (produced from terminals and aircraft caterers), metal (at aircraft maintenance site), plastics (from aircrafts, terminals and offices), wood, waste oil and solvents (from maintenance and engineering operations), kitchen wastes and vegetable oils (from caterers) shall be carried out. Solid wastes shall be disposed in accordance to the Solid Waste Management Rules, 2016 as amended.

ix. A certificate from the competent authority handling municipal solid wastes should be obtained, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project.

x. Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination.

VI. Green Belt:

I. Green belt shall be developed in area as provided in project details, with native tree species in accordance with Forest Department. The greenbelt shall inter alia cover the entire periphery of the Air Port.

II. Top soil shall be separately stored and used in the development of green belt.

III. Public hearing and Human health issues:

i. Construction site should be adequately barricaded before the construction begins.

ii. Traffic congestion near the entry and exit points from the roads adjoining the airport shall be avoided. Parking should be fully internalized and no public space should be utilized.

iii. Provision of Electro-mechanical doors for toilets meant for disabled passengers. Children nursing/feeding room to be located conveniently near arrival and departure gates.

iv. Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.

v. Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.

vi. An onsite disaster management plan shall be drawn up to account for risks and accidents. This onsite plan shall be dovetailed with the onsite management plan for the district.

vii. Occupational health surveillance of the workers shall be done on a regular basis.

IV. Corporate Environment Responsibility:

i. The company shall have a well laid down environmental policy duly approved by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental / forest /wildlife norms/ conditions. The company shall have defined system of reporting infringements / deviation / violation of the environmental / forest / wildlife norms / conditions and / or shareholders / stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six-monthly report.

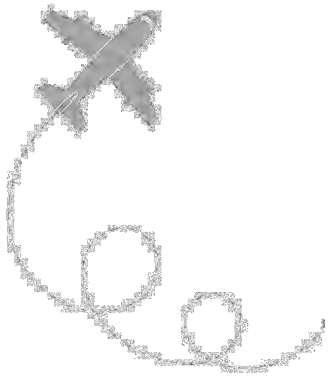
ii. A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of senior Executive, who will directly report to the head of the organization.

iii. Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six Monthly Compliance Report.

iv. Self environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.

V. Miscellaneous:

i. The project proponent shall make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the District or State, of



which one shall be in the vernacular language within seven days and in addition this shall also be displayed in the project proponent's website permanently.

ii. The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.

iii. The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.

iv. The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment, Forest and Climate Change at environment clearance portal.

v. The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company.

vi. The criteria pollutant levels namely; PM_{10}, $PM_{2.5}$, SO_2, NOx (ambient levels) shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.

vii. The project proponent shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.

viii. The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.

ix. The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report, commitment made during Public Hearing and also that made during their presentation to the Expert Appraisal Committee.

x. No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).

xi. Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.

xii. The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.

xiii. The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.

xiv. The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information/monitoring reports.

xv. The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts/NGT and any other Court of Law relating to the subject matter.

xvi. Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

6. This clearance is subject to final outcome of the Writ-Public Interest Litigation (WPIL) No. 51312/2017 in the matter of Civil Society of Agra through Secretary Vs Union of India & 5 Others pending in the Hon'ble High Court of Judicature at Allahabad.

7. This issues with the approval of the Competent Authority.

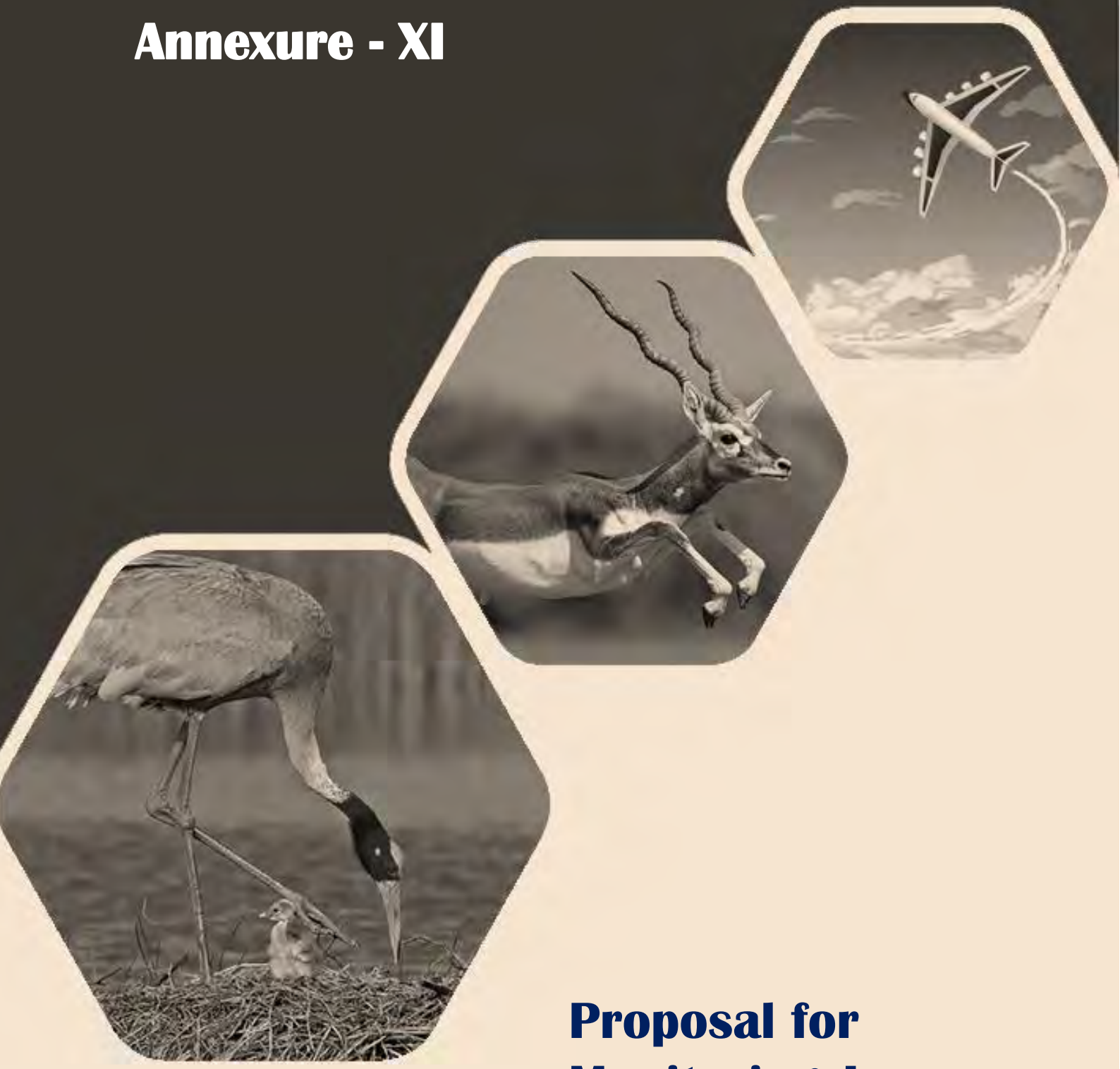
(Dr. Vinod K. Singh)
Scientist E

Copy to:

1) The Secretary, Department of Environment, Government of Uttar Pradesh, Lucknow.
2) The Addl. Principal Chief Conservator of Forests (C), Ministry of Environment, Forest and Climate Change, Kendriya Bhavan, 5th Floor, Sector-H, Aliganj, Lucknow - 226024.
3) The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032.
4) The Member Secretary, Uttar Pradesh Pollution Control Board, Building. No. TC-12V, Vibhuti Khand, Gomti Nagar, Lucknow -226 010
5) Monitoring Cell, MoEF&CC, Indira Paryavaran Bhavan, New Delhi.
6) Guard File/ Record File/ Notice Board.
7) MoEFCC website.

(Dr. Vinod K. Singh)
Scientist E

Annexure - XI



Proposal for Monitoring Jewar landscape during developmental and operational phase

Proposal for Monitoring Jewar Landscape During Developmental and Operational Phase for Biodiversity Conservation of the Landscape

Phase II: Fine-scale assessment of spatial and temporal changes in biodiversity values and ecological traits due to different phases of the Greenfield Jewar International Airport, Uttar Pradesh

Summary:

Globally, it is well known that most of the development programs are affecting biodiversity conservation values and disrupting the ecological services, which are critical for the wellbeing of humans due to changes in land-use patterns and ecosystem traits. Govt. of Uttar Pradesh has planned to set up "Greenfield Jewar International Airport" (henceforth GJIA) in agro-ecological region falling under Semi-arid and Upper Gangetic Plain biogeographic zones of northern India. The landscape provides habitat to diverse fauna such as Blackbuck, Sarus crane, Egyptian vultures, raptors, and migrant birds. Phase - I was to assess broad biodiversity values and suggest measures for conservation in the GJIA. However, little is known about the long-term impact of establishing a "Greenfield International Airport" on the surrounding landscape's biodiversity values. Realizing the conservation importance of this landscape, committee members indicated a need of assessing the likely impacts due to different phases of airport *viz*. pre-construction, construction and operational as one of the conditions in the "*Environmental clearance"* accorded vide letter no. F.No.10-31/2018-IA-III of the MoEFCC, Govt. of India dated 9th March 2020. Therefore, we propose to assess the likely long-term (ten years) impacts on the extent of fine-scale spatial and temporal changes in the biodiversity values and ecological traits during different phases of airport development i.e., pre-construction, construction, and post-operational. We propose to gather information by using a standardized methodology for wildlife habitat assessment of different taxa such as pollinator species, herpetofauna, birds, and mammals; understand the fine-scale movement ecology using GPS tagged individuals of Blackbuck, Sarus Crane, vultures, and raptors, and assess biodiversity values using state-of-the-art technology of "Environmental DNA (eDNA). This study would elucidate (i) the time-lag needed for different taxa to stabilize and adjust to new ecological niches created due to various anthropogenic factors; (ii) probability of survival of different species; (iii) to assess the likelihood of bird aircraft strike hazard (BASH); (iv) identify areas of conservation importance (hot-spot); and (v) suggest mitigatory measures to retain biodiversity values and ecological traits for ensuring long-term conservation goals of the GJIA landscape. With our best knowledge, this is the first study in the country to elucidate extent of impact due to different phases of airport on biodiversity conservation values in the surrounding landscape. Govt. of India is actively engaged in developing new Greenfield airports across the country. The long-term study findings would provide a framework of mitigatory measures for conserving the biodiversity and retaining ecological traits at the landscape level for inclusion during the planning stage of such developmental programs.

1.0. Introduction:

Globally, it is well known that most of the development programs are affecting biodiversity conservation values and disrupting the ecological services, which are critical for the wellbeing of humans due to changes in land-use patterns and ecosystem traits. The reduction and fragmentation of natural and semi-natural habitats are the primary reasons for the current biodiversity crisis owing to construction, agricultural intensification, and urbanization (Foley et al., 2005) and these values are impacted due to change in microenvironment and land use patterns.

India is one of the 17 mega-biodiverse countries of the world and rich in wide variety of flora, fauna and biodiversity. However, due to the unsustainable use of natural resources and over-exploitation, biodiversity is under severe pressure and facing numerous challenges and complexities in the face of rapid economic development. Besides, India has also emerged as the fastest-growing major economy and is expected to be one of the top three economic powers in the world over the next 10-15 years (IBEF 2020), India, like other developing countries, is confronted with the dilemma of securing functionality of different ecosystems ranging from natural to urban habitats alongside the priorities for expanding the transportation infrastructure. For the past several decades, due to unprecedented transport requirements and achieving economic goals, the need for frequent air traffic has amplified many folds resulting in the necessity to build more and larger airports for effective regional and global connectivity and to cater to the increased demand for air travel for effective connectivity across the country. As the aviation industry continues to expand, more efficient aircraft capable of carrying bigger payloads over greater distances becomes inevitable. This would require the building of more and larger airports, including the existing ones' capacity expansion.

A developing country like India, with a population exceeding 1.3 billion needs a good network of transportation *viz*. road, railway and air. In recent times, India has invested a lot in the transport section. However, the demand for an improved transport network may increase as the passengers will increase with time. This is the scenario in most of the countries, not just in India. According to the recent estimates, the annual increase of the vehicular fleet is 10 million cars and 5 million buses and trucks. If this trend continues, then there may be a billion vehicles using the roads by the end of 2030 (Walsh. 1990). There is also a significant increase in railway transport as well. Transportation by air is growing very fast in India as well as across the world, and it requires an unprecedented expansion and construction of several airports (Meyers. 1988). This trend is supposed to continue in the future.

With the growing needs for air travel from New Delhi's Indira Gandhi International (IGI) Airport and visualizing its unsustainability in meeting high traffic demand in the future based on the projection, the Government of India has recently initiated a project to build a new airport called "Greenfield Airport" at Jewar, Gautam Budh Nagar, Uttar Pradesh (U.P.). The proposed airport covering an area of 1334 ha is within the New Delhi-National Capital Region (NCR). This would facilitate air travel from the region's entire National Capital Territory (NCT) of Delhi, 13 districts of the State of Haryana, eight districts of the State of Uttar Pradesh, and two districts of the State of Rajasthan (Anonymous 2019). With this development and very close proximity to the national capital, it is expected to have several large infrastructure development projects in the landscape. For judicious planning, NCR Planning Board (NCRPB) was created in 1985 to plan the development of the region and to enact harmonized policies for the control of land use and development of infrastructure in the region to avoid any haphazard development of the region as well as conservation of natural resources (Anonymous 1985). The NCRPB's Regional Plan 2021 aims to promote economic growth and develop the entire NCR as a region of global excellence (http://ncrpb.nic.in/regionalplan2021.html). On the same lines, the NCRPB has also envisaged increasing the ambit and has the vision to

expand and develop further, for which it is working on a new Regional Plan 2041, which is slated to be, completed soon (http://ncrpb.nic.in).

Additionally, the Government of India has recently launched UDAN (which stands for 'Ude Desh ka Aam Naagrik') to establish a regional connectivity among smaller cities across India. The scheme is aimed to offer air travel most affordable and widespread to encourage more people to fly and to boost inclusive national economic development, job growth, and air transport infrastructure development in India. Hence, this will require building more airports in India.

Most of the mainstreaming approaches reflect that biodiversity conservation goals are not seen as distinct from, or contradictory to, the purposes of development and economic growth. Instead, they are intended to shift the focus of development policies and interventions towards better incorporating the biodiversity values to bring in sustainability and economic development. Integration of biodiversity considerations into the location, design, and operation of large infrastructure projects such as airports would not only have the advantage of reducing the environmental, social, and economic costs but of creating win-win results for biodiversity conservation and human safety, which lie at the core of all development initiatives. The considerations can be at different scales, for instance, at site/local level to landscape-scale or eco-region or regional levels, depending upon the development project's size or footprint. This will help in scaling the planning process to develop appropriate strategies at different scales.

Globally, planners, transportation agencies, and ecologists are universally acknowledging these alike in most developing countries. The need is emerging in India and other developing countries where the challenge of maintaining functional ecosystem services both in natural and urban landscapes for human wellbeing is invariably in conflict with the expanding infrastructure development (WII 2016). It is essential to mainstream biodiversity in large-scale infrastructure development projects such as airports to propose and orient development strategies to ensure conservation prospects apart from economic benefits. Hence, there is a pressing need for conservation and development to go hand in hand, complementing—rather than conflicting with each other.

Although the direct impacts from airports and their associated roads and development are becoming increasingly recognized. Impacts on biodiversity (wildlife and habitats) (Clements et al. 2014) have tended to be less incorporated in the assessments when compared with impacts of noise, climate change and air pollution. Airports can influence biodiversity in several ways (Table 1) including habitat loss, degradation or pollution of habitats, alteration of land use and land cover, diversion of drainages, impairment of wildlife movement paths, collisions of bird and impacts of light and noise pollution on behavioural biology of wildlife species in and around the airport's zone of influence.

Table 1. Key impacts caused by airport and aviation activities.

Key Impacts (– Negative Impact) (+ Positive Impact)	Terminal & Ground Operations		Flights	Airport Access		Associated Projects	
	Construction	Operation	Operation	Construction	Operation	Construction	Operation
Air Pollution			–		–		–
Biodiversity Impacts	–	–	–	–	–	–	
Climate Change		–	–		–		
Employment and Economic Benefits	+	+	+			+	+
Heritage	–		–	–	–	–	
Land Take	–			–		–	
Landscape	–	–		–		–	–
Noise		–	–	–	–		
Risk and Public Safety Zones			–				
Social Costs to Nearby Communities	–	–			–		
Traffic	–	–		–	–	–	–
Water Pollution		–			–		
Water Use		–					–

The development of conservation plans for airport projects merits significant importance for long-term biodiversity conservation in the wake of several new airports being planned to promote better connectivity and meet the increasing demand for connectivity. It is well known that such development can pose significant threats for biodiversity and the environment and ultimately affect human wellbeing. The connections between land use, land cover, and wildlife habitat are at the forefront of conserving wildlife around airports. The key consideration that must guide conservation planning development is to contain, address, and eliminate impacts associated with the airports. Under Phase - I, a Conservation Plan for biodiversity likely to be impacted by the proposed "Greenfield International Airport" at Jewar, Gautam Budh Nagar District, Uttar Pradesh, India was prepared. This Conservation Plan is premised on the belief that there can be win-win options, i.e., a win for development and a win for conservation.

As far as our best knowledge, the long-term studies for monitoring the extent of the likely impact of such development on biodiversity conservations lack in India. Therefore, monitoring spatial and temporal conservation status of various taxa, habitat conditions, and ecological traits such as microenvironment, hydrological, socioeconomic, and are essential aspects for achieving effective conservation planning of biodiversity.

1.1. A need of long-term research and monitoring for responses of different taxa during different phases of GIJA:

Globally, it is well known that most of the development programs are affecting biodiversity conservation values and disrupting the ecological services. As far as our best knowledge, the long-term studies for monitoring the extent of the likely impact of such development on biodiversity conservation lack in India. Therefore, monitoring spatial and temporal conservation status of various taxa, habitat conditions, and ecological traits such as

micro-environment, hydrological, socio-economic are essential aspects for achieving effective conservation planning of biodiversity.

Realizing this gap in our knowledge for effective conservation strategies, a need of long-term assessment of biodiversity status in relation to different phases of airport *viz*. pre-construction, construction and operational was visualized by the committee members. Accordingly, it was indicated as one of the conditions in the "*Environmental clearance"* accorded vide letter no. F.No.10-31/2018-IA-III of MoEFCC, Govt. of India dated 9th March 2020 (Annexure X).

Therefore, we suggest undertaking a long-term study of ten years as Phase II for "*Assessment of the fine-scale spatial and temporal changes in biodiversity values and ecological traits due to developmental changes during various operational phases of the Greenfield Jewar International Airport*." Hence, we propose to study the following biodiversity conservation aspects from pre to post-operational phases of development within 25 km of GJIA for ten years, which is adequate for re-colonizing the species even after disturbance.

This study will provide guidelines for assessing the likely impacts of proposed such international airports on the overall conservation of biodiversity values in the future.

2.0. Project aims and objectives:

Fine-scale assessment of spatial and temporal variation in abiotic factors, habitat characteristics, biodiversity values, and anthropogenic factors are critical for planning long term effective conservation strategies. Different stages of GJIA, such as pre-construction, construction and operation will impact these values differently. Therefore, we have planned to assess for ten years, which would provide at least > 5 years after the operation of GJIA. This period is adequate for a species to habituate with the new habitat niches and suggest appropriate mid-term conservation strategies, if needed.

This is the first study planned in India to assess and determine likely impacts of different phases of airport i.e., pre-construction, construction and operational on biodiversity conservation values.

Objectives of the project are as follows:

1. *Determine the spatial and temporal changes in Land Use and Land Cover (LULC) and abiotic factors with different stages of GJIA.*

2. *Assess the fine-scale changes in habitat characteristics.*

3. *Determine spatial variation in wetland characteristics and quality with LULC.*

4. *Quantify spatial variation in the distribution pattern of key species of insect pollinators butterfly and bees); herpetofauna, birds, and mammals.*

5. *Assess status of birds of prey in relation to LULC and subsidized food resources.*

6. *Understand fine-scale movement ecology of Blackbuck, Sarus crane, Egyptian vulture and raptors with habitat, food resources and anthropogenic factors.*

7. *Suggest guidelines for integration of criteria for consideration at the initial stage of planning to set up a new airport.*

3.0. Methodology and approach:

3.0. Study area:

The proposed GJIA site is in the Jewar tehsil of Gautam Budh Nagar district that lies in the upper Gangetic plain biogeographic zone (Rodgers & Panwar 1988; Rodgers et al. 2000) with the proximity of *c.* 2.5 km from the river Yamuna which marks the western limit of the Gangetic plain. It considers the proximity of the proposed GJIA site to the semi-arid zone, which starts from the river Yamuna towards the west (Rodgers & Panwar 1988; Rodgers et al. 2000) (Fig. 1). Hence, the landscape within 25 km from the GJIA site can conserve flora and fauna

of these two biogeographic zones. Thus, the landscape has two distinct ecologies, biome representation, community, and species (Rodgers et al. 2000). Therefore, we proposed to monitor responses of different communities of species of these two biomes in relation to changes in natural habitat characteristics, LULC, anthropogenic disturbances during different phases of airport development.

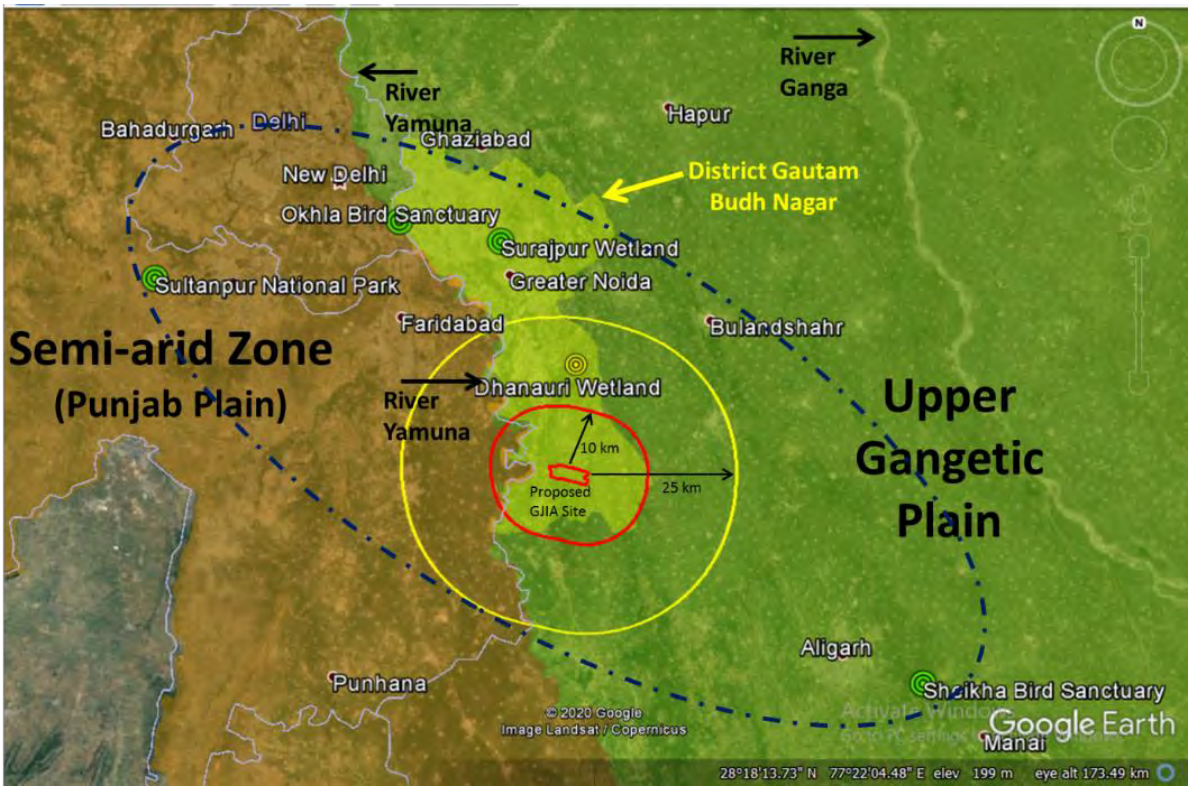


Figure 1. Radius area of 25 km followed around the GJIA site comprised flora and fauna of north India's two biogeographic zones.

3.1. Overall conceptual plan:

The decline and fragmentation of habitats areas are two primary factors that lead to biodiversity declines in ecosystems. The reduction and fragmentation of natural and semi-natural habitats are the primary reasons for the current biodiversity crisis owing to construction undertaken during developmental project, agricultural intensification, and urbanization (Foley et al., 2005). All these factors impact biotic and abiotic factors and various species respond differently over different time scale. Sequential growth in urbanization takes place in and around the planned development project which causes changes in land use patterns impacting abiotic factors such as ambient temperature, noise level, soil temperature, hydrological changes, and increase in subsidized food resources. Among these, ambient temperature is critical as most of animal and plant species respond this abiotic factor which causes changes in spatial-temporal distribution patterns. Smoliak et al. (2015) examined the "urban heat island" by measuring air temperature using dense sensor networks over 2,000 square miles of Minneapolis, St. Paul and Bloomington cities. They reported spatial and temporal variation in temperature in landscape. Similarly, impact of noise level and nightlight has negative impacts on wildlife and ecosystem and has been studied across different taxa (Rich and Longcore, 2006; Salmon, 2006; Francis et al., 2013).

Therefore, we emphasize in the present study to monitor spatio-temporal changes in abiotic factors such as ambient temperature, noise level, soil moisture, night light intensity, LULC and subsidized food resources and correlate these with changes in distribution patterns of different taxa during different phases of the airport i.e., pre-construction, construction and operational. Figure 2 provides overall conceptual plan envisaged during the Phase II of the project.

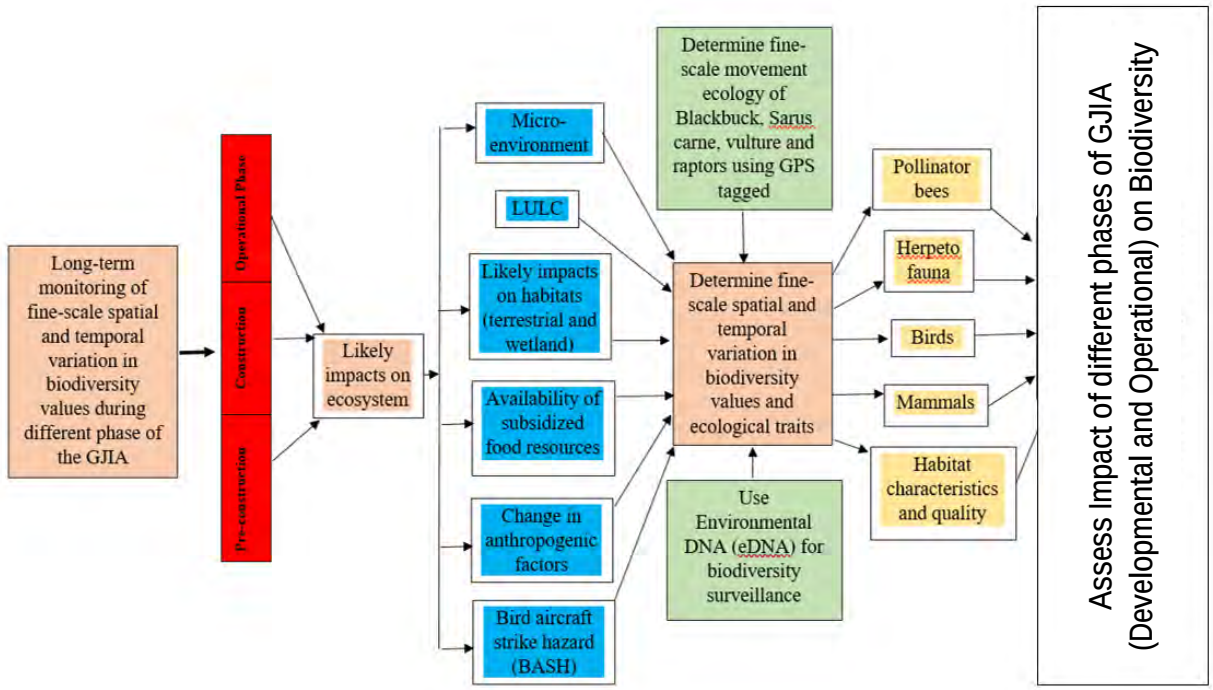


Figure 2. Conceptual framework for long term monitoring of fine-scale spatial and temporal variations in biodiversity values in the GJIA landscape

3.2. Broad Sampling strategies:

Different phases of GJIA:
Commissioning of GJIA will have different phases and extent of impact may vary differently on of biodiversity conservation values. Therefore, we have planned to evaluate the responses of biodiversity values during pre-construction, construction, and operation phases.

Understanding fine-scale responses of various taxa in relation to biotic and abiotic factor during different phases:

The study area or GJIA landscape, which encompasses the proposed GJIA site within 25 km radius will be considered for survey of biodiversity values. The whole GJIA will be divided into 2 km X 2 km grids for systematic data collection (Fig. 3). Around fifty per cent grids selected randomly will be used for the systematic sampling survey. These surveys will be aimed to collect information on the distribution pattern of wildlife species, habitat characteristics and requirements and abiotic factors around the GJIA landscape.

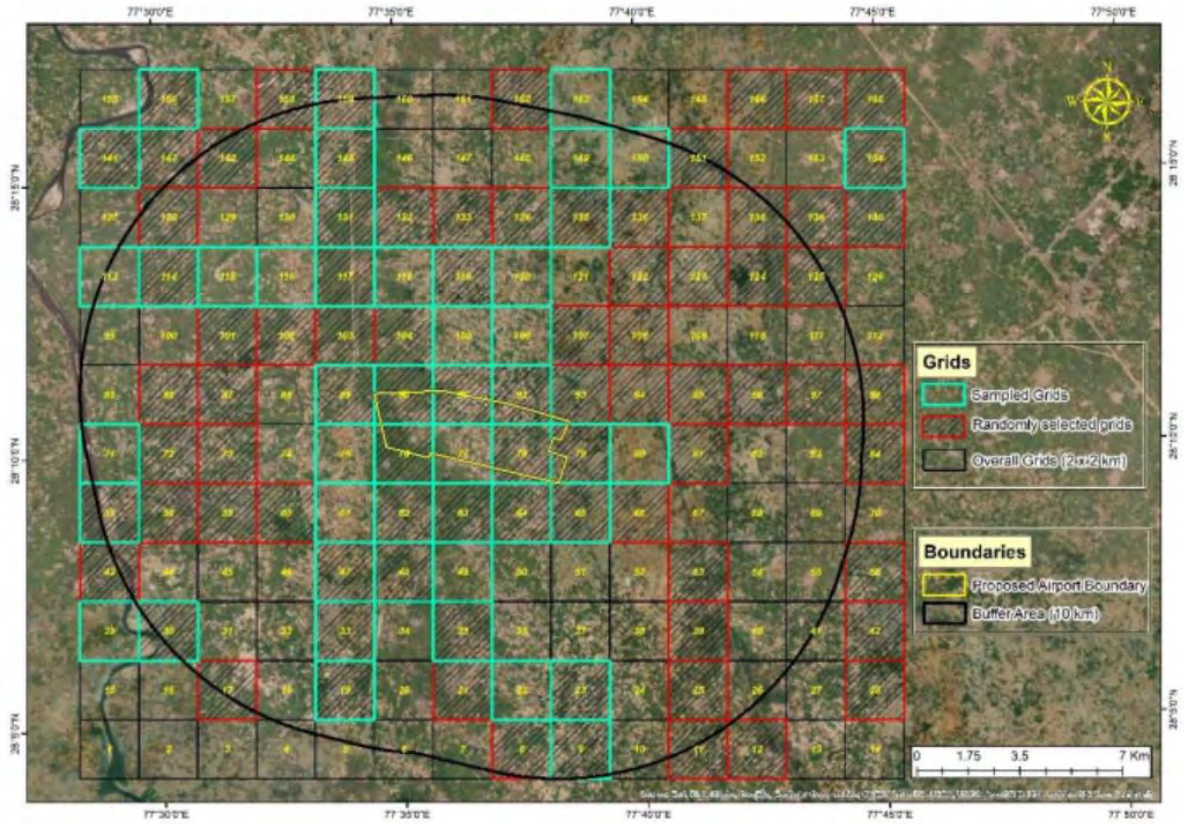


Figure 3. 2x2 km grids overlaid around GJIA landscape.

3.3. Determine the spatial and temporal changes in LULC and abiotic factors with different stages of GJIA

3.3.1. Measurement of abiotic factors:

Micro-environmental conditions are key drivers which determine the distribution of various species in a landscape because of their thermal tolerance limit and spatio-temporal variation in preferred food resources. Therefore, we have planned to measure these factors at macro and micro scale so as to understand the fine scale variation in biological values and their drivers.

Establishment of automatic weather monitoring system:

We proposed to install five automatic solar powered weather stations for continuous recording of climatic parameters such as ambient temperature, relative humidity, rainfall, wind velocity in GJIA landscape for a period of ten years (Fig. 4).

Spatio-temporal fine scale measurement of noise level, night light, ambient temperature, relative humidity and soil moisture:

Distribution patterns of wildlife species are known to be affected by different abiotic parameters such as noise level, ambient temperature, and relative humidity. Therefore, we have planned to place data loggers in selected grids within the GJIA landscape for measuring these parameters. Data will be downloaded once in a month from all the data loggers. Soil moisture will be measured by using HOBOnet T11 soil moisture data logger (Fig. 5).

Figure 4. Automatic weather monitoring system

Figure 5. Different data logger types planned for recording (a) night light, (b) noise level (c) temperature-cum-relative humidity and (d) soil moisture in the GJIA landscape.

3.3.2. Spatial and temporal changes in Land use land cover (LULC) in GJIA landscape using GIS and remote sensing data:

Pre-processing

We plan to adopt various methods and approaches to analyse the long-term changes in LULC. In our approach, we will use various remote sensing satellite data, intensive fieldwork survey, standard land use/land cover categories, and human populations. Remote sensing satellite data Landsat TM and SENTINEL-2A (2018) will be obtained from open sources at (http://earthexplorer.usgs.gov) and Google Earth data from *(http://earth.google.com).* All the descriptions of Satellite data are presented in Table 2.

Table 2. Details of spatial data sources use in this study.

No.	Types of data used	Scale/Resolution
1.	LANDSAT-5 TM	30 M
2.	LANDSAT-5 TM	30 M
3.	SENTINEL-2A/Other Data	10 M

Remote sensing, GIS and Geospatial technology will be followed for the analysis of vegetation change and LULC categories during study period of ten years. The digital number (DN) values of the Landsat (TM) and SENTINEL-2A data will be changed into radiance values using the corresponding satellite sensor parameters for analysis. Then the images will undergo radiometric corrections, Geometric corrections, Image analysis and Accuracy assessment. We aimed to use a combined approach associated with manual and automated methods to generate LULC maps. that is far better rather than single approach. Therefore, we will adopt a hybrid approach for initial classification using automated classification methods then the manual methods to improve classification and refine the noticeable error. We will use important software such as ArcGIS 10.5, QGIS 2.18 and ERDAS Imagine 2015 for the analysis. Land use land cover change analysis will be done with help of classified satellite imageries. For analysis of land use/land cover changes; raster data will be converted in polygon with the help of ArcGIS software. Figure 6 indicates flow chart for the work to be followed.

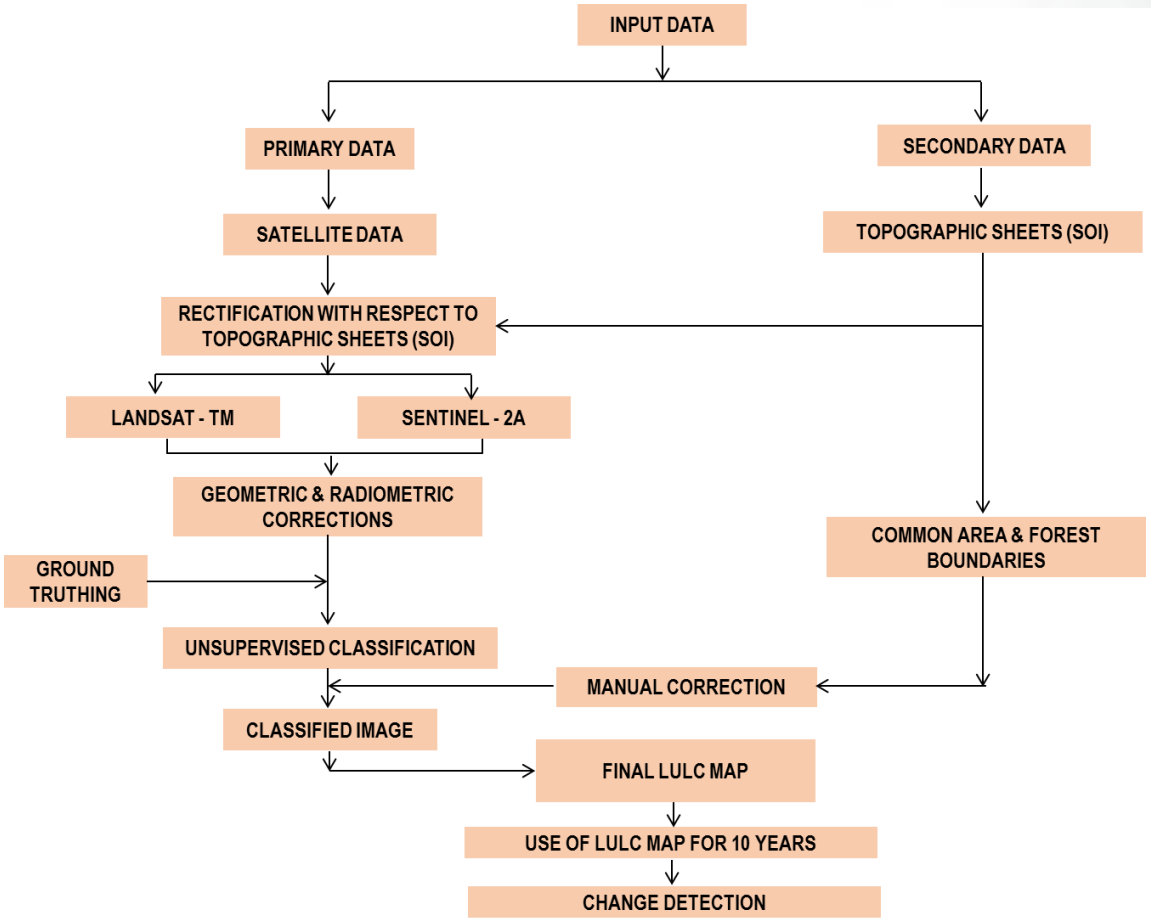


Figure 6. A general flow chart of methodology to be used in data analysis.

Human Population demography around GJIA landscape:
We will use population demography data from the last 'Census of India' conducted in 2011. The data will be obtained in excel format from http://censusindia.gov.in/.

3.4. Assess the fine-scale changes in habitat characteristics:

Monitoring habitat characteristics and extent of anthropogenic factors:
Checklist of the fine-scale habitat characteristics required for each taxa envisaged will be prepared from the literature and we will assess spatial-temporal variation in these parameters during different phases of the airport.

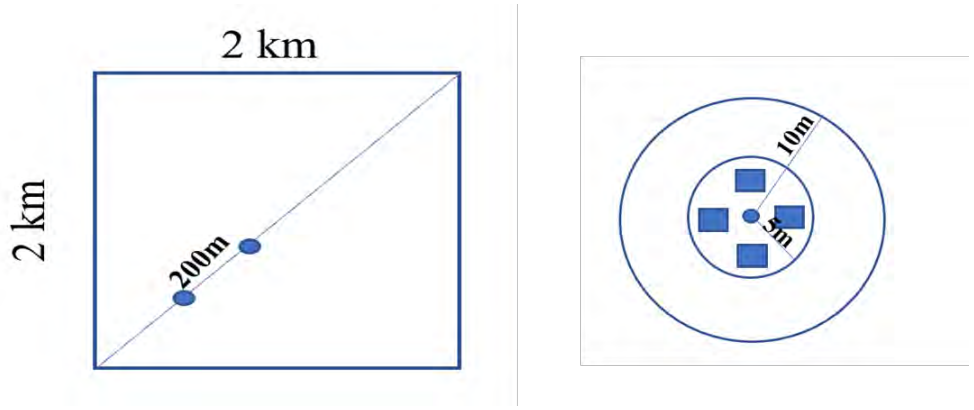


Figure 7. Proposed plan of sampling habitat characteristics of various taxa in each selected grid.

Assessment of fine-scale changes in the habitat characteristics will be done on each selected grid. Vegetation sampling will be done along two line transects by establishing sampling stations at every 200 m interval (Fig. 7). The tree (>20 cm GBH) layer will be quantified in 10m radius circular plots. All trees present in the plot will be enumerated as to species level and their total individuals. GBH measurements of all tree individuals will be taken at each plot (Fig.7). We will also quantify tree architecture with respect to branching patterns on 1 to 4 scale along with the canopy cover measured as X and Y length.

The shrubs and sapling (<=20 cm GBH) will be quantified in 5 m radius circular plots (Fig. 7) and all the plants falling within these plots will be enumerated to species level.

The ground cover will be assessed in four quadrates each of 25 cm x 25 cm at every sampling station with respect to grass and seedlings. Three dominant grass species and percentage of ocular grass cover along with average grass height will be recorded.

The disturbance factors like lopping, cutting of trees, presence or sign of livestock will be recorded at each sampling station in 10 m radius circular plot.

Quantifying characteristics of nesting trees for vulture and birds of prey:

Architecture of trees used for nesting purposes by vultures and raptors (Fig. 8) will be quantified by measuring each tree in will be quantified with respect to canopy cover and volume, GBH Use artificial intelligence (AI) to determine hotspots of nesting trees using remote sensing data across the GJIA landscape.

Figure 8. Quantification of nesting tree characteristics for vulture and raptors.

3.5. Determine spatial variation in wetland characteristics and quality with LULC:

The GJIA landscape is nested with a good number of wetlands, which are of conservation importance. The status of 145 wetlands identified during Phase-I of the study will be regularly monitored during the study periods for temporal variation in bird species (resident/migrant) concerning shape characteristics, water quality, habitat characteristics, hydrology, limnological, and extent of pesticides. Each wetland will be monitored for pH, conductivity, total dissolved solute, dissolved oxygen, salinity, etc. by using microprocess water and soil analysis kit model 1160.

The seasonality of the wetlands will be checked using the two months dataset in each year during the study period *viz*. October (post-monsoon) and May (pre-monsoon) images and if water is available, they will be classified as perennial. Wetlands visible only on May image will be further verified on Google Earth images. If these were found to be completely dry at any point of time, they will be grouped into seasonal waterbodies, or else classified as perennial waterbodies. Spatial characteristics of the waterbodies will be measured by size, perimeter and area to perimeter ratio, and Euclidean distances using ArcGIS.

Besides, harmful effects of pesticides on wildlife (especially birds) and wildlife habitats have been a concern for long time. Wetlands constitute one

such habitat threatened by the pesticides (Varagiya et al., 2016). Since most of the wetlands in GJIA landscape are in agroecology habitat and may be impacted due to intensive use of pesticides. Therefore, we have planned to measure the level of current-use pesticides in water and some historical-use organochlorine pesticides in sediments as per the protocol followed by Anderson et al. (2013) and McMurry et al. (2016) using gas chromatography/mass spectrometry (GC/MS).

3.6. Quantify spatial variation in the distribution pattern of key species of insect pollinators butterfly and bees; herpetofauna, birds, and mammals:

We will assess systematically the status survey of wildlife species belonging to the insect pollinators (bees and butterflies) herpetofauna, birds and mammals using grid-based approach where each identified grid will be surveyed by a team of two persons.

To document the spatial-temporal variation in the presence of herpetofauna, we will sample each grid using three census methods viz. time constrained searches, cover boards, and drift fences with pitfall and funnel traps (Ryan et al., 2002). Whereas for bird species, we will use point sampling using 4 to 6 random locations in each grid during morning and evening hours. Status of mammals will be determined using direct sightings and indirect signs estimated on line transect of 2 km in each grid. We will determine the status of nocturnal species in each grid by deploying camera traps.

Use of DNA metabarcoding (eDNA) to assess terrestrial and aquatic biodiversity:
In addition of using of traditional tools of assessing the wildlife status, we aimed to use recently evolved state-of-the-art technology for assessing the terrestrial and aquatic biodiversity using environmental DNA (eDNA) using and soil and water samples (Shapcott et al., 2015; Holdaway et al., 217). The process of determining the status of biodiversity (terrestrial/aquatic) will be followed as described by Holdaway et al., 2017) (Figure 9).

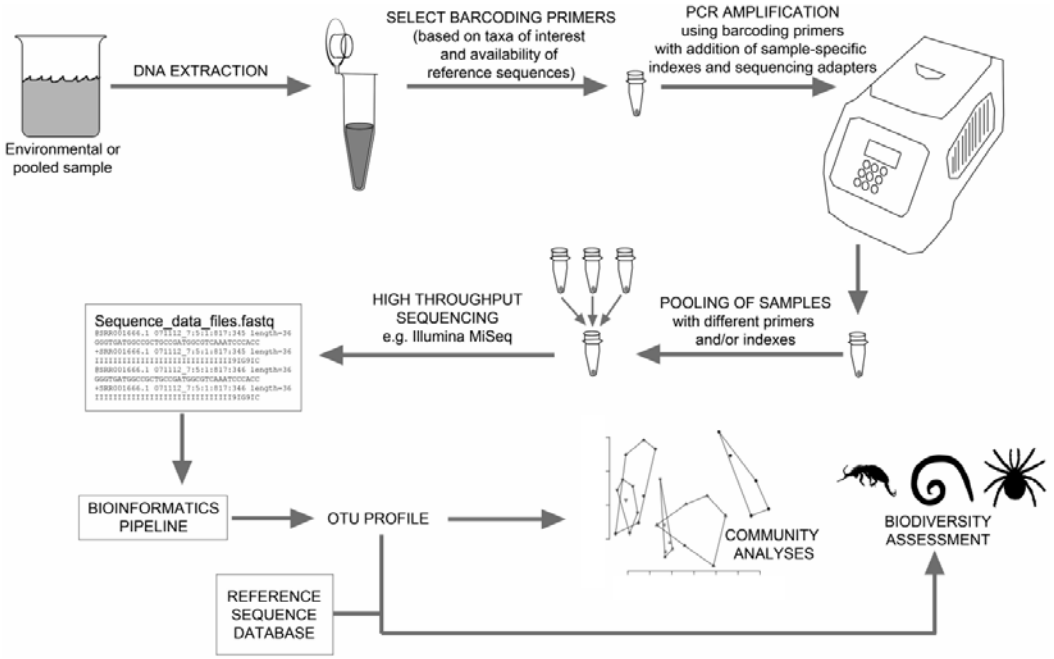


Figure 9. Process followed for DNA metabarcoding which involves extracting community DNA from pools of organisms, such as invertebrates captured in nets or pitfall traps, or DNA from environmental samples (e.g. soil/water) (Adopted from Holdaway et al., 2017).

3.7. Assess status of vultures and birds of prey in relation to LULC and subsidized food resources:

GIS-based territory mapping approach has often applied in determining the population status of raptors and vultures (Poirazidis et al., 2009). Therefore, we plan to assess the status and abundance of vultures and raptors by determining the presence active nests. We will place a camera trap will be deployed on each nest to confirm the species use. While walking online transect in identified grids, nests will be identified and perpendicular distance will be noted. "Distance Sampling" (Buckland et al. 1993) will be used to determine the density of each raptor and vulture species and will be correlated with habitat characteristics, LULC and subsidize food resources and drivers responsible for their presence will be determine using multivariate statistical analysis.

Quantifying characteristics of nesting trees for vulture and birds of prey: Architecture of tress used for nesting purposes by vultures and raptors (Fig. 8) will be quantified by measuring each tree in will be quantified with respect to canopy cover and volume, GBH Use artificial intelligence (AI) to determine hotspots of nesting tress using remote sensing data across GJIA landscape.

3.8. Understand fine-scale movement ecology of Blackbuck, Sarus crane, Egyptian vulture and raptors with habitat, food resources and anthropogenic factors,

GPS tagging has been validated during last one decade to record fine-scale movement patterns such as we extracted step lengths, turn angles, and movement states among different taxa and integration of these data with habitat characteristics has enabled to understand variation in spatial-temporal resource selection function (RSF). Such fine scale analysis has been a powerful tool in planning site specific effective conservation planning. Realizing the value of this wildlife monitoring tool, we have planned to GPS tagged a few select species of the GIJA landscape which are of high conservation importance such as Blackbuck,

GPS tagging of Blackbuck:
Phase - I has identified three sub populations around GJIA landscape, which are in meta-population framework and little is known their habitat requirements in agro-ecology system. These resources are likely to be impacted by change in land use patterns. Therefore, we proposed to obtain fine-scale habitat resource requirements of these populations by monitoring their movement pattern GPS tagged individuals. We proposed to capture with a combination of physical and chemical immobilization. Ten individuals will be GPS tagged two times during the study period to measures the responses in resources selection during all the development phases of the airport.

GPS tagging of Sarus Crane, Egyptian vulture and raptors:
10 individuals of each species will be captured after obtaining necessary permission from the Chief Wildlife Warden, Uttar Pradesh, UP and all required ethical protocols for handling the bird will be followed (Wolter et al., 2019). Raptors and Egyptian vulture will be captured close to the GJIA site using rodent baited Bal-chatri traps commonly deployed for capturing raptors (Bloom et al., 2007). Handling protocols will be followed as suggested by the Wolter et al. 2019 to minimize any stress to the birds. Each will be GPS tagged with solar FLiteTrax weighing 36 g (GPS Collars AS, Norway) (Fig. 10) during pre-construction to construction period.

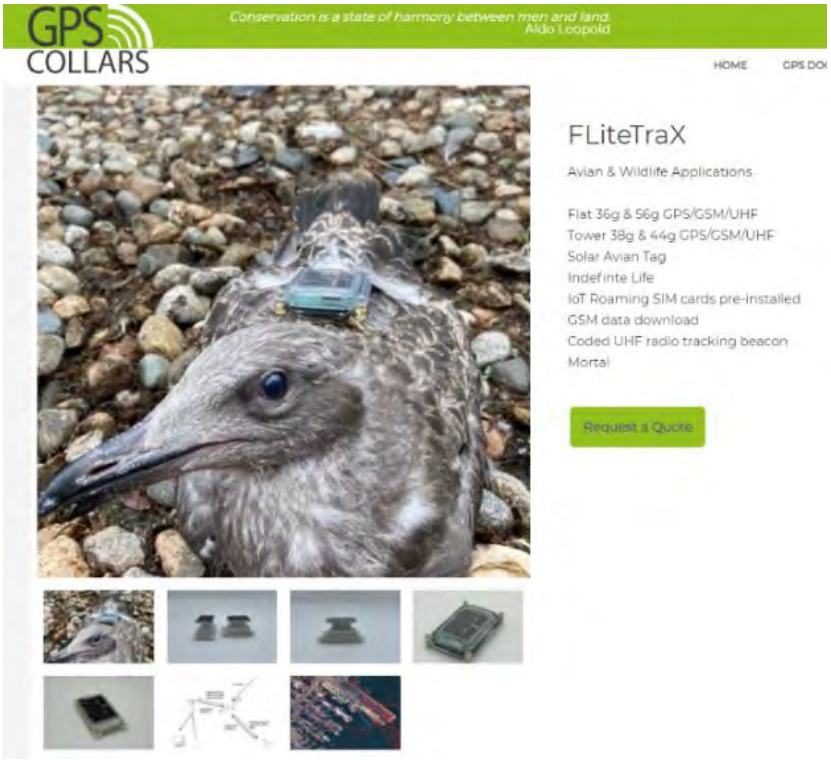


Figure 10. Proposed solar powered GPS tags for use in vultures and raptors.

GPS tags are solar powered and might work for the indefinite period. Since the present proposal is for the monitoring of the response of these birds during different phases of airport over a period of ten years, we will replace the GPS tags in case they stopped transmitting the information by re-capturing these birds.

Movement characteristics of all GPS tagged individuals will be correlated with respect to the fine-scale habitat characteristics and extent of anthropogenic factors to determine the

3.9. Suggest guidelines for integration of criteria for consideration at the initial stage of planning to set up a new airport:

Additionally, the Government of India has recently launched UDAN (which stands for 'Ude Desh ka Aam Naagrik') to establish a regional connectivity among smaller by developing new Greenfield airports across India. The scheme is aimed to offer air travel most affordable and widespread to encourage more people to fly and to boost inclusive national economic development, job growth and air transport infrastructure development in India. Hence, this will require building more airports in India.

The findings of the long-term study would provide a framework of mitigatory measures for conserving the biodiversity and retaining ecological traits at the landscape level for inclusion during the planning stage of such developmental programs. This would minimize unnecessary delay in obtaining the permission by inclusion of a chapter titled **"Biodiversity conservation plan around proposed airport landscape".**

3.10. Data analysis:

Besides routine analysis of the habitat characterization and use by different taxa, our major emphasis in data analysis would be on the following:

Determine change in occupancy of various species during different phases of airport:

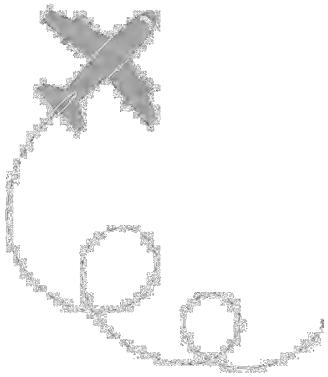
All the noted wildlife signs and sightings along with GPS locations obtained from tagged animals and birds will be analyzed under the occupancy framework (MacKenzie et al., 2017). We will determine the tolerance threshold of extent of disturbance during different phases of the airport by different taxa by change in the spatial hotspot of their occurrence and correlate with the changes in habitat characteristics and other anthropogenic factors. Mid-term mitigator measures for effective conservation plan if needed will suggested in addition to the biodiversity measures suggested in Phase-I.

Understanding the responses of species with respect to changes in habitat characteristics, land use land cover changes and anthropogenic factors:
Variation in home ranges and movement patterns are key drivers for assessing the responses to habitat characteristics including LULC and anthropogenic factors of GPS tagged individuals during different phases airport. Hence, we will emphasize in undertaking analysis at fine-scale analysis of home ranges and movement patterns.

Home range:
We will use cleaned GPS data after excluding spurious locations. We will estimate home ranges using fixed kernel density estimations (KDE) where we will determine 95% and 50% utilization distributions using the 'adehabitatHR' package in statistical program R. In addition, we will also quantify 95% minimum convex polygon (MCP) home ranges for use in resource selection modelling.

Movement patterns:
To assess the relationship between movement patterns and anthropogenic land use features, we will extract step lengths, turn angles, and movement states for each GPS tagged individual location using the 'moveHMM' package in program R (Michelot et al., 2016). We will calculate the average distance by adding all hourly displacements per day for all individuals Speed of movement of each individual will estimated as the distance between consecutive fixes divided by time (km/hr). We will test for variation in speed and other movement characteristics in response to different situations of risk by comparing speed values among different land-use categories using multivariate analysis.

***Determine "Resource Selection Function" by** different taxa:*
For understanding whether particular taxa avoided the kind of anthropogenic disturbances, we will determine resource selection functions (RSF) at the home range scale (third order) (Johnson, 1980) or occupancy hot spots by comparing habitat use to habitat availability. Habitat use analysis by incorporating availability and usage of each habitat characteristics by each taxon. We will generate RSFs by constructing generalized linear mixed-effect models with individual leopards as a random effect using the 'glmer' function within the 'lme4' package in program R (Bates et al., 2015).



4.0. Timeline of the project:

S. No.	Activity	Pre-construction	Construction			Post-Construction					
		Year									
		1	2	3	4	5	6	7	8	9	10
1.	Recruitment of Research Personnel										
2.	Purchase of equipment										
3.	Establishment of Field Base camp										
4.	Spatial and temporal distribution of biodiversity										
5.	Map fine-scale habitat, change in land- use patterns, and extent of anthropogenic factors										
6.	GPS Tagging of Blackbuck, Sarus crane, vulture, and birds of prey										
7.	Monitor wetlands for bird abundance and water quality										
8.	Determine socio-economic status										
9.	Determine fine-scale biodiversity conservation values in relation to impact during different phases and suggest mid-term measures if needed										
10.	Annual Report										
11.	Final Report										

5.0. Proposed project budget for ten years:

S. No.	Head		No. of Positions	Unit Cost, Rs. lakhs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Cost (10 Years)	Head Wise Total (Lakhs)
1.1	Salaries and Wages including HRA + Medical and Insurance etc	Faculty Time (No HRA + 5% Increment)	2 (Part Time)	0.9	21.60	22.68	23.81	25.00	26.25	27.57	28.95	30.39	31.91	33.51	271.68	1420.29
1.2		Project Scientist/Post Doc (HRA + 5% Yearly Increment)	3	0.78	27.15	28.51	29.93	31.43	33.00	34.65	36.38	38.20	40.11	42.12	341.49	
1.3		Project Associate - I (First two years as PA-I, year 3 - 5 as PA-II and after year 5 SPA + HRA)	5	0.31	21.6	21.60	24.36	24.36	24.36	29.28	29.28	29.28	29.28	29.28	262.68	
1.4		Senior Project Associate (+ HRA)	2	0.42	11.76	11.76	11.76	11.76	11.76	11.76	11.76	11.76	11.76	11.76	117.6	
1.5		Subject Matter Specialist	1	1.2	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	144	
1.6		Lab Technician (with HRA and 15% increment for 3 years)	1	0.2	2.88	2.88	2.88	3.24	3.24	3.24	3.72	3.72	3.72	3.72	33.24	
1.7		Project Coordinator (+ HRA)	1	0.5	6.96	6.96	6.96	6.96	6.96	6.96	6.96	6.96	6.96	6.96	69.6	
1.8		Field Staff (Field Assistants/Interns/Volunteers)	10	0.15	18	18	18	18	18	18	18	18	18	18	180	
2.1	Basecamp	Field Station (Base camp)	LS	3	3	3	3	3	3	3	3	3	3	3	30	30
3.1	Travel and Field Work	Hiring of vehicle for field work with 5% increase every year	2	0.5	12	13	13	14	15	15	16	17	18	19	150.93	263.80
3.2		PoL Vehicle	2	0.3	7.2	8	8	8	9	9	10	10	11	11	92.86	
3.3		Travel of PI and Project Staff	LS	2	2	2	2	2	2	2	2	2	2	2	20	
4.1	Equipment/RS & GIS/Data/Chemicals/Consumables/Capture operations/ satellite data cots and other essentials as per requirement of the project	Camera Traps	250 x 2 Times	0.2	50	0	0	0	50	0	0	0	0	0	100	641.5
4.2		40 GPS tags (10 for each species namely Blackbuck, Sarus Crane, Vulture and Raptors)	20 x 4 times	3	60	60	0	0	60	60	0	0	0	0	240	
4.3		Digital Camera	3	0.5	1.5	0	0	0	0	0	0	0	0	0	1.5	
4.4		Field Equipment GPS/Binoculars etc	LS	LS	5	0	0	0	5	0	0	0	0	0	10	
4.5		Water quality testing kit and other equipments including capture essentials and equipments	LS	LS	10	0	0	0	10	0	0	0	0	0	20	
4.6		Remote Sensing data	LS	LS	5	0	0	0	5	0	0	0	0	0	10	
4.7		Chemicals for eDNA work and others	LS	10	10	10	10	10	10	10	10	10	10	10	100	
4.8		Satellite Data Cost and WPC Licenses	LS	5	5	5	5	5	5	5	5	5	5	5	50	
4.9		DNA Analysis and Equipment	LS	80	0	0	80	0	0	0	0	0	0	0	80	
4.10		Batteries and other Chemicals	LS	3	3	3	3	3	3	3	3	3	3	3	30	
5.1	Miscellaneous		LS	3	3	3	3	3	3	3	3	3	3	3	30	50
5.2	Contingency		LS	2	2	2	2	2	2	2	2	2	2	2	20	
Sub Total (A)					303.05	234.95	261.27	185.38	319.31	258.36	203.18	207.73	212.51	217.53	2405.59	
5% Inflation Cost					15.15	11.75	13.06	9.27	15.97	12.92	10.16	10.39	10.63	10.88	120.28	
Sub Total (B)					318.20	246.69	274.34	194.65	335.28	271.28	213.34	218.12	223.14	228.41	2525.87	
Institution Charges (15%)					47.73	37.00	41.15	29.20	50.29	40.69	32.00	32.72	33.47	34.26	378.88	
Grand Total					**365.9**	**283.7**	**315.5**	**223.9**	**385.6**	**311.9**	**245.3**	**250.8**	**256.6**	**262.7**	**2904.75**	

Summary of overall budget:

S. No.	Head	Cost in Lakhs/10 year	% of Grand total
1	Salary and wages	1420.29	48.90
2	Base Camp Setup including house rent	30.0	1.03
3	Travel and fieldwork	263.80	9.08
4	Equipment/RS and GIS Data/Chemicals/Consumables	641.50	22.08
5	Miscellaneous	30	1.03
6	Contingency	20	0.69
7	Sub Total (A)	2405.59	
8	5% Inflation Cost	120.28	
9	Sub Total (B)	2525.87	
10	15% Institutional Charges	378.88	
11	Grand Total	2904.75	

6.0. Justifications:

Major percent allocation of budget is for salary & wages (48.90 %); Equipment/RS and GIS Data/Chemicals/Consumables (22.08 %) and travel and field work (9.08 %) whereas other heads are close or less than 1%.

Salary & wages: The project envisaged of using multidisciplinary approaches of wildlife management and it requires involvement of experts and researchers of different disciplines and positions for coordinating the overall project activities. The project will require involvement of two senior level permanent faculty time for running the project at the institute and accordingly estimated cost per faculty is Rs.90000/month. Three "Project Scientists or Post Doc" of Ecology, GIS and Genetics have been proposed to be recruited for assessment, data analysis and inferences of the field data analysis of different disciplines. Project has also envisaged a position of "Subject Matter Specialist" having more than 20 years of experience in wildlife conservation to provide expertise in multi-disciplinary issues of biodiversity conservation. A position of Project Manager has been kept for undertaking administrative work of the project. Position of Lab and Field Assistants are to provide support in the Lab and data collection in the filed by researchers respective for data collection.

Travel & Field work: We proposed to engage two vehicles for running different transects for sampling various taxa and habitat quantification in different areas. Proposed vehicles are also critical to regularly check camera traps in human dominated landscape to minimize any theft or vandalism.

Equipment/RS and GIS Data/Chemicals/ Consumables:
The project has planned to use different popularly used wildlife tools such as cameras traps, monitoring of GPS tagged key species of conservation importance and state-of-the-art technology of eDNA (environmental DNA) for assessing the likely impacts of different phases and changes in the land use patterns on the biodiversity values. Based on the sampling strategy for covering different grids for such assessment, we have proposed for purchase of 250 camera traps two times for covering study period of 10 years and this is because our experiences using camera traps for last more than 20 years suggest that these do not work properly beyond five years. Accordingly, cost of purchasing 250 cameras two times and running cost for purchase of battery has been proposed for covering the study period of ten years.

Effective conservation planning requires insight on species' response to changes in habitat

attributes at fine-scale and these have been monitored through using GPS telemetry tagged individuals. Given this, we proposed to monitor responses of ten individuals each of key species which are of conservation importance and are indicator of natural habitats in this landscape such as Indian antelope or Blackbuck, Sarus crane, vulture, and raptors. Most of the GPS telemetry transmitters have battery life of 2 to 3 years. Therefore, we have proposed GPS tagging two times during study period for covering responses ranging from pre-construction, construction, and operational phases.

With the advances in molecular tools, monitoring to eDNA (environmental DNA) has been a most powerful tool for monitoring terrestrial and wetlands biodiversity values. Therefore, for obtaining the fine-scale changes in the biodiversity values, we have also proposed to use another biodiversity assessment tool in the present study. Accordingly cost of chemicals, consumables, and lab charges for Next Generation sequencing (NGS) has been kept.

We also intended to use high resolution "Remote Sensing" data for assessing fine scale temporal changes in habitat characteristics, therefore the cost for purchase of such data have been kept.

Other essential minor equipment needed for field work such as camera sets, GPS, rangefinder, binocular have been kept.

15% institutional charges are as per the approved norms by the Governing Body.

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भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Yamuna Expressway Industrial Development Authority
YEIDA
FUTURE IS HERE

Annexure -2

①

भारतीय वन्यजीव संस्था
Wildlife Institute of Indi

File No. WII/AECB/BH/Jewar/2019/01

Date: 23.03.2021

To,

The Chief Executive Officer,
Yamuna Expressway Industrial Development Authority (YEIDA),
(A Govt. of U.P. Undertaking); First Floor, Commercial Complex, P-2, Sector- Omega I, Greater Noida, Gautam Budh Nagar, Uttar Pradesh

Reference: **Project titled "Conservation Plan for Biodiversity likely to be impacted by Greenfield Jewar International Airport, Gautam Budh Nagar, Uttar Pradesh, India" funded by YEIDA, Noida, UP**

Subject: **Submission of final report with a request to release the balance grant of 20% - reg.**

Dear Sir,

Reference to the Memorandum of Agreement signed between WII and YEIDA for the above-mentioned project, kindly find herewith "Final Project" report for your kind perusal.

Of the total project cost of Rupees One Crore Eight-Seven Lakh and Ninety-Five Thousand, 80 per cent of it (Rs. 1,50,36,000.00) was released on 9th September 2019. It is requested to release the balance amount of Rs. 37,89,000.00 (20%).

Realizing the conservation importance of this landscape, "Environmental Appraisal Committee" recommended a need of assessing the likely impacts due to different phases of airport viz. pre-construction, construction and operational in the "*Environmental clearance*" accorded vide letter no. F.No.10-31/2018-IA-III of MoEFCC, Govt. of India dated 9th March 2020. The same was discussed with YEIDA while finalizing the Conservation Plan. Accordingly, a proposal of Phase II titled "Fine-scale assessment of spatial and temporal changes in biodiversity values and ecological traits due to different phases of the Greenfield Jewar International Airport, Uttar Pradesh" is placed along with the Final Report.

It is requested to approve the Phase II and release the fund to initiate the work.

Thanking you,

INFORMATION PROVIDED UNDER RTI

ATTESTED
CPIO Wild Life Institute of India Dehradun

Yours faithfully,

23/3/21

(Dr. Dhananjai Mohan)
Director

Copy for information to:

The Principal Chief Conservator of Forests (PCCF) and Chief Wildlife Warden,
Office of the Principal Chief Conservator of Forests (PCCF) and Chief Wildlife Warden,
Govt. of U.P., 17, Rana Pratap Marg, Lucknow 226001,

पत्रपेटी सं. 18, चन्द्रबनी, देहरादून-248 001, उत्तराखण्ड, भारत
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ई-मेल/E-mail : wii@wii.gov.in, वेब/Website : www.wii.gov.in

Annexure-3

(2)

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

File No. WII/AECB/BH/Jewar/2019/01

Date: 9th July, 2021

To,

The Chief Executive Officer,
Yamuna Expressway Industrial Development Authority (YEIDA),
(A Govt. of U.P. Undertaking); First Floor, Commercial Complex, P-2, Sector- Omega I,
Greater Noida, Gautam Budh Nagar, Uttar Pradesh

Reference: Project titled "Conservation Plan for Biodiversity likely to be impacted by Greenfield Jewar International Airport, Gautam Budh Nagar, Uttar Pradesh, India" funded by YEIDA, Noida, UP

Subject: (i) request for release of remaining 20 per cent of the project cost, and
(ii) approval and release of fund for Phase II study

Dear Sir,

Reference to the Memorandum of Agreement (MoA) signed between WII and YEIDA for the project mentioned above; we have submitted a final report of the project vide our letter dated 23rd March, 2021 (copy attached).

As per MoA, details of the amount received and pending are as follows:

(a) Overall project grant: Rs. 1,87,95,000.00 lakhs
(b) Initial grant received (80%): Rs. 1,50,36,000.00 lakhs
(c) Balance amount (20%): Rs. 37,89,000.00 lakhs

As per the "Environmental clearance" accorded vide letter no. F.No.10-31/2018-IA-III of MoEFCC, Govt. of India dated 9th March 2020, the committee recommended for a study to assess likely impacts due to different phases of airport viz. pre-construction, construction, and operational. Accordingly, a project of Phase II titled "Fine-scale assessment of spatial and temporal changes in biodiversity values and ecological traits due to different phases of the Greenfield Jewar International Airport, Uttar Pradesh" was submitted along with the final report.

We, therefore, request you for:

(i) an early action to release the 20% pending amount of Rs. 37,89,000.00 lakhs, and
(ii) accord necessary approval and release of funds for the Phase II of the project to commence the fieldwork.

A copy of the Phase II proposal is also attached herewith for your kind perusal.

Thanking you,

Yours faithfully,

(Dr. Dhananjai Mohan)
Director

Encl. a/a

ATTESTED
CPIO, Wildlife Institute of India, Dehradun

INFORMATION PROVIDED UNDER RTI

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