WILDLIFE CONSERVATION PLAN
FOR
PROPOSED EXPANSION OF
M/S MATRIX FINE SCIENCES PVT. LTD.
AT PLOT NO. D-8, MIDC, PAITHAN
TAL. PAITHAN, DIST. AURANGABAD

Prepared By,

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CHAPTER – I

INTRODUCTION

1. INTRODUCTION

Brief Description of Existing and Proposed Project

M/s Matrix Fine Sciences Pvt. Ltd. is Extracting and manufacturing Natural Vitamin E and its derivatives which are import substitutes & has good export potential. The production is being exported to more than 15 countries. This helps in minimizing the imports of these products directly and savings in foreign exchange to the country.

As the name suggests is all about Matrix is a building block and focused on extracting value added products from 'Industry Waste'. The company's promoters are technocrats with the experience ranging from 25 to 30 years in chemical & pharmaceutical industries. The Company is accredited with ISO 9001, 14001 & OHSAS 18001 & 22000 along with global certifications like CERT ID NON GMO, STAR K Kosher, NON GMO PROJECT VERIFIED by US and Halal. Company has customer base all over 15 countries and distributors across the globe now.

The R&D is a key component of Matrix Fine Science's strategy. R&D lab is approved by Department of Scientific & Industrial Research (DSIR). Current R&D site is located at factory & operations are carried out in all the shifts. All products are outcome of their R&D efforts. There are 14 nos. of scientists working round the clock for R&D department.

The existing products are based on purification and Extraction process and do not fall under purview of EC. The proposed products are synthesis of downstream vitamin E products which would come under 5 (f) Category 'A'. [The project falls under notified Eco-sensitive zone as declared by MoEF&CC {Ref: S.O. 2202(E) Dated: 12th July 2017}] MFSPL has retained the services of M/s sd engineering services pvt. ltd. as an environmental consultant for assessing the impact of the Industry on various environmental parameters in the study area and to prepare EIA reports and Environment Management Plan for negating the adverse impacts of the project.

Identification of Project & Project Proponent

MFSPL is engaged in manufacturing of Vitamin E related products namely Derivatives of Natural Vitamin E, at Plot No. D-8, MIDC, Paithan **(Plate 1)**. Tal. Paithan, Dist. Aurangabad **(Location Map – Figure 1.1)**. MFSPL was incorporated in the year 2013. The Company is proposing expansion of existing facility **(Layout Plan – Figure 1.2)** by adding various Vitamin E based Derivatives & other Nutraceutical products.

The major reason for capacity expansion is the fact that higher production capacity would help them to compete with global manufactures from China & Europe. Also, this would help them to reduce fixed costs, making them more competitive. The higher capacity would also help cater to all global customers.

Details of Director of MFSPL;

The Board of Directors consists of recognized personalities from academic & chemical industry background. The details are as follows.

Mr. Kunal Sikchi, Managing Director, Qualification: B.E. Chemical from Mumbai University. Experience: Nine years in the Chemical Industry. He has received 'Sir Ratan Tata Scholarship' for excellent Academic records during engineering. He is Gold Medalist from Mumbai University.

Mr. Madhusudan Rathi - Chairman & Independent Director, B.Sc. - Pune University, D.M.E. - Cusrow Wadia Institute, Pune Chairman & Managing Director Rathi Transpower Pvt. Ltd., Pune, 52 Years as Industrialist, Also holding Directorship in various other companies, Chairman: Polybond India Pvt. Ltd., Pune, Rathi Polybond Pty. Ltd., Australia, Managing Partner: Rathi Engineering Services

Mr. Ashok Boob –Independent Director, Qualification: B. Chem. Eng from ICT, Mumbai, Experience: Over 35years of experience in the chemical industry.

Mr. Ashok Sikchi, Executive Director, Qualification: B.Sc. from Marathwada University, Experience: More than 25 years in Chemical &Pharmaceutical Industry.

Mr. Siddharth Sikchi, Executive Director Qualification: M.Sc. in Synthetic Organic Chemistry from University of Manitoba, Canada and B. Tech from ICT, Mumbai. Experience: Eight years in the Chemical Industry. He has recently received a "Young Entrepreneur Award" from Dr. Anil Kakodkar Padma Vibhushan, for commercializing unique & eco-friendly process in India.

Importance of Project

The Raw Materials for Matrix is a byproduct from Edible Oil Industry which was earlier used for Soap Manufacturing or Fatty Acid recovery and with efforts of R&D of the company, natural Vitamin E products & other important products like Phytosterol, FAME and Tocopherol & Its Derivatives etc are extracted from it. This is a very good value addition to a waste product, hence it is utmost important for country like ours which has rich natural resources & companies like us can extract value out of it for our customers, suppliers and employees alike.

Fragmented nature of industry makes it difficult for the companies to optimize operational costs, realize economics of scale and adopt latest technologies, making them uncompetitive globally.

The industry should actively move towards investing in new capacities with scale and size matching global standards to achieve world scale of plants and reap economies of scale and adopting cutting edge technologies. Product innovations for meeting local needs rely heavily on the chemical industry for inputs and support. The areas for strengthening are R&D activities in Natural industry for the improvements in catalysis, manufacturing & extraction process, reduction in cost of production, development and design of new products relevant to the Indian market needs.

In the Indian sub-continent population growth is more than that of developed countries. Strong end use industry demand is expected to boost growth for the Indian chemical companies, both domestic & multinational. To meet the needs and comforts of ever-growing population industrialization became inevitable. The project is envisaged to meet the demand supply gap in both domestic and export market. The project meets to reduce imports in some of the intermediate products and also enhance the foreign exchange reserves in view of the exports of few products.

Demand supply gap and market scenario

Natural Product and broadly Chemical Industry is one of the oldest industries in India, which contributes significantly towards industrial and economic growth of the nation. It is highly scientific type of industry and provides valuable raw material/chemicals for various types of industries such as Food, Feed, Pharma, Nutraceutical and Personal Care etc., are required in almost all walks of life. The Indian Chemical Industry forms the backbone of the industrial and agricultural development of India and provides building blocks for downstream industries.

India’s chemical / Nutraceutical / Pharma industry is one of the largest and most diversified industries in the country and it consist of several small industries that cover hundreds of segments. Products are generally used to make a wide variety of consumer goods and are also used in agriculture, manufacturing, construction and service industries. The chemical industry itself consumes 26% of its own output. Major industrial customers include Food and Feed products, Pharma, Nutraceutical, Personal Care and Cosmetic. With the chemical industry contributing indirectly to almost every sector of the economy, it plays a vital role in a country’s economic growth. The domestic chemical industry contributes 3-4% in India’s GDP while India accounts for 8.3% of the Asia-Pacific chemicals market's value. India’s chemical industry’s size in 2010-11 is around $83 billion and is $120 billion by 2013. India sales are projected to reach $250 billion by 2020.

The total investment in Indian Chemical Sector is approx. US$ 60 billion and total employment generated is about 1 million. The Indian Chemical sector accounts for 13-14% of total exports and 8-9% of total imports of the country. In terms of volume, it is 12th largest in the world and 3rd largest in Asia. Currently, per capita consumption of products of chemical industry in India is about 1/10th of the world average. Over the last decade, the Indian Chemical / Pharma industry has evolved from being a basic chemical producer to becoming an innovative industry. With investments in R&D, the industry is registering significant growth in the knowledge sector comprising of Nutraceuticals, fine chemicals and pharmaceuticals.

Companies in this industry manufacture basic, intermediate and Synthetic Organic Chemicals. Major companies include Dow and DuPont (both based in the US), BASF (Germany), INEOS Group (UK), Lyondell Basel (The Netherlands), Mitsubishi Chemical (Japan) and Roche (Switzerland).

Per capita chemical consumption in India is low as compared to world standards (estimated to be one tenth of world average). Increasing consumption level in the domestic market would ignite the prevailing latent demand. To achieve global standards, the industry needs to put efforts in critical areas so as to adopt aggressive growth and focus on exports, R&D, co-marketing alliances, up-gradation of manufacturing facility, contract manufacturing with companies having established markets, identification of areas of core competence, consolidation, collaboration by cluster development, outsourcing, environmental consciousness, cost reduction etc.

Site Selection

The existing manufacturing facility has been established at present land in the year 2013. For expansion this is an ideal site as all infrastructures is readily available. The existing site was selected on following criteria.

- Availability of required land for locating the Synthetic Organic Chemicals Plant.
- Suitability of land from topography & geological aspects.
- Proximity to rail/ road to facilitate transport of equipment/ materials.
- Availability of adequate quantity of fuel and fuel transport facility.
- Availability of adequate quantity of water to meet production, cooling, boiler & domestic requirement.
- Facility for interconnection with distribution system for power.
- Proximity to disposal of hazardous waste management site.
- Already many similar units are established here.

1.2 RATIONALE AND OBJECTIVES FOR THE PROPSOED WILDLIFE CONSERVATION PLAN

Most significant rationale behind the proposed study of biological environment is one of the most important aspects for Environmental Impact Assessment, in view of the need for conservation of environmental quality and biodiversity. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprises of both plant and animal communities which interact not only within and between themselves but also with the abiotic components viz. Physical and chemical components of the environment.

The key objectives of proposed wildlife conservation plan are as below:

- To conduct detail study of Avifauna nearby Jayakwadi Bird Sanctuary area and impact of proposed project activity on the same.
- To assess scheduled Avifaunal species in and around the proposed project site. (Rare, endangered, critically endangered, endemic and vulnerable).
- To identify locations and features of ecological significance.
- To collect baseline data for the study area along with a description of the existing wetland and aquatic vegetation.
- To identify Impact of project during operational phases on the biological environment

To prepare a detailed report on the status of wildlife and biodiversity in 10 km radial area **(Study Area Map – Figure 1.3)** around proposed M/s Matrix Fine Sciences Pvt. Ltd., Paithan, Aurangabad and assessment of impacts due to **proposed expansion** and to suggest suitable mitigation measures to protect and conserve scheduled species.

1.3 REGULATORY AND STATUTORY REQUIREMENTS

The proposed wildlife conservation plan was designed based on various national regulatory requirements along with statutory practices applied across various wildlife conservation reserves. In absence of any national conservation regulations, international and MOEF recommendations were incorporated for the similar related projects.

The scope of the survey study is designed to establish prevailing situation relation to environment, human being and the flora and fauna in the study area. An area of 10 km radius around the project side has been considered as the study area. Biodiversity baseline survey was carried out in (Summer 2018) which includes survey of flora and fauna as per standard methods. The species of the flora has been listed while faunal species have been identified as per Wildlife Protection Act, 1972 and as amended subsequently and listed in conservation categories. The list of team members involved in data collection and preparation of wildlife management plan is presented in **Table no. 1.1.**

Photograph No. 1.1: Existing Project Site of M/s Matrix Fine Sciences Pvt. Ltd

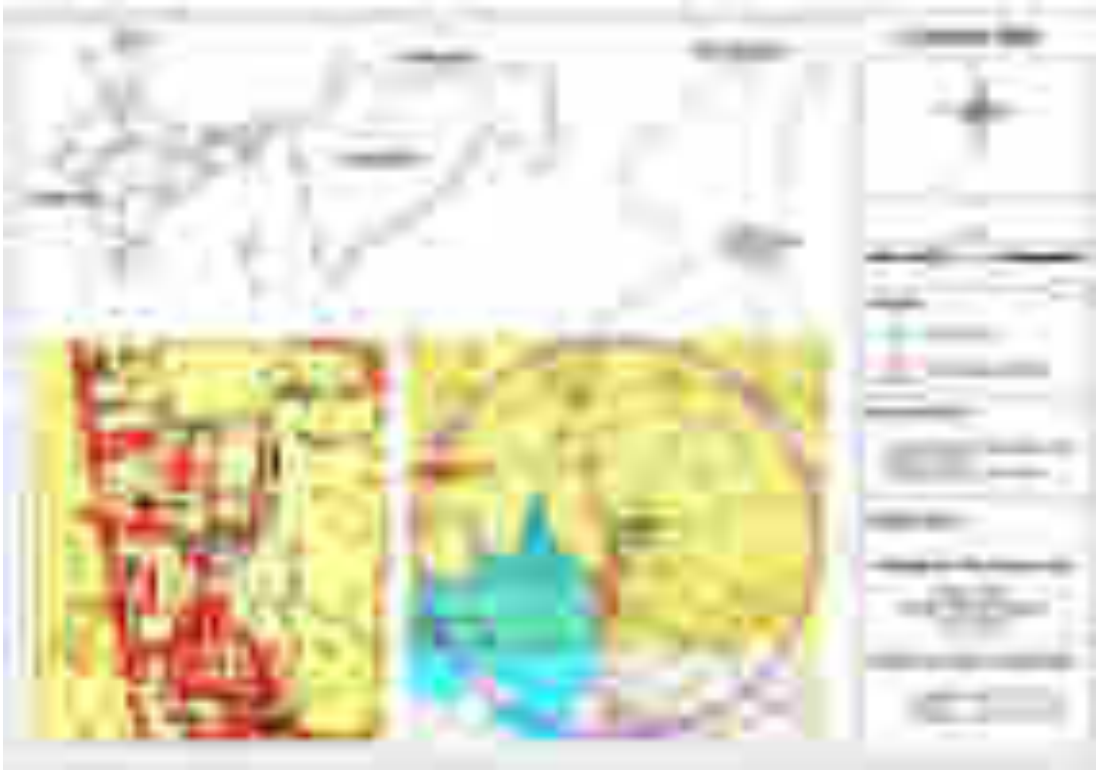


FIGURE 1-1: Location Map

Figure 1.2 - LAYOUT PLAN

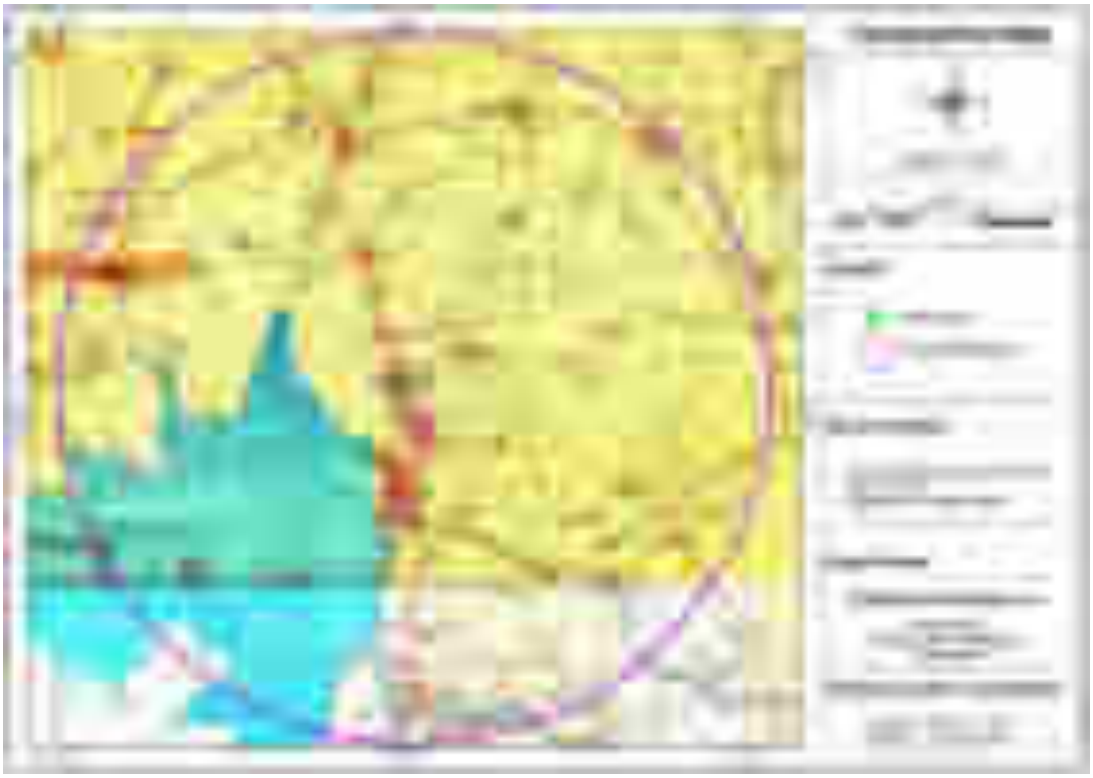


FIGURE 1-3: STUDY AREA (10KM) MAP

TABLE 1-1: LIST OF TEAM MEMBERS INVOLVED

Sr. No	Name of Expert	Qualification	Experience
1	Mr. Sameer V. Deshpande	1. **Ph. D** {Thesis Submitted} 2. **M.Sc** {Botany }	1. Experience in field Botany since 2005. 2. EIA Experience from 2005 to till date in Ecology Biodiversity study. 3. Approved by NABET as EB expert (Cat. A) Since 2011
2	Dr. Nityanand P. Vaikos	3. **Ph. D** {Morphological Studies in the Monocotyledons III The Liliaceae} 4. **M.Sc** {Botany Angiosperms special: Taxonomy, pharmacognosy, morphology, reproductive biology, Medical Botany} 5. **B.Sc** {Chemistry, Botany, Zoology}	4. Experience in the Botany field from 1972 to 2009 at Dr. BAMU University, Aurangabad as research Guide & Professor. 5. EIA Experience from 2010 to till date in EB.
3	Mr. Vivek Manik	**1. M. Sc** {Environmental Science}	1. Project Assistance at NEERI from 2010 to 2014 in the field of EIA. 2. As FAE in EIA Consultancy from 2014 to 2018
4	Mr. Yukit Patni	**1. M.Sc** {Environmental Science }	1. FAA in EIA field from 2015 to till date with EB Subject. 2. Submission of Academic Project on Migratory Bird of Salim Ali Lake.

CHAPTER – II

BACKDROP OF THE PROJECT AREA

1. BRIEF SITE DESCRIPTION AND RECONNAISSANCE OF THE STUDY AREA

M/s Matrix Fine Sciences Pvt. Ltd. is an existing extraction cum formulation industry located at Plot No. D-8, MIDC Paithan, Tal. Paithan, Dist. Aurangabad. Project site is located at 36 km in South of Aurangabad city & 7 km in North of Paithan. Geographical location of project area is 19°33'00.6 N and 75°23'11.8"E with 471 m MSL. The Total project area is 40,000 sq. m. located at Paithan MIDC.

2. LAND FORM, LAND USE AND LAND OWNERSHIP

The proposed project is located at Paithan, MIDC area. Land use is for Industrial activity only and land ownership is with MIDC & taken on lease by proponent. Toposheet of the project site is attached as **(Figure 2.1)**.

Land Form	Land is plain having no contour and it is flat terrain.
Land Ownership	Land ownership is on lease basis with the project proponent.
Existing Land use Pattern	The Land is reserved for Industrial use only. On site existing trees will be retained for Landscape Development.
Existing Infrastructure	Project site is having MIDC's infrastructure such as road, water supply, electricity etc.

4.4 Soil Classification

The major part of the Aurangabad district is dominated by black cotton soil or 'Regur' formed by the weathering of Deccan Trap Basalt. It is rich in plant nutrients such as lime, magnesia, iron and alkalis on which cotton and dry crops like Jowar, Bazra and tur etc flourish. It swells and becomes sticky on watering while on drying it contracts and develops many cracks. The soil varies both in texture and depth. In northern portion of the district the soils are shallow and relatively poor while in south they become deep and fairly rich in nutrients.

4.5 Climatic condition

Aurangabad has a semiarid climate under the Köppen climate classification. Temperature: Annual mean temperatures in Aurangabad range from 17 to 33 °C, with the most comfortable time to visit in the winter – October to February. The highest maximum temperature ever recorded was 46 °C (114 °F) on 25 May 1905.

The lowest recorded temperature was 2 °C (36 °F) on 2 February 1911. In the cold season, the district is sometimes affected by cold waves in association with the eastward passage of western

disturbances across north India, when the minimum temperature may drop down to about 2 °C to 4 °C (35.6 °F to 39.2 °F).[14]

Rainfall: Most of the rainfall occurs in the monsoon season from June to September. Thunderstorms occur between November and April. Average annual rainfall is 710 mm. The city is often cloudy during the monsoon season and the cloud cover may remain together for days. The daily maximum temperature in the city often drops to around 22 °C due to the cloud cover and heavy rains.

TABLE 2-3: LOCATIONS OF IMPORTANT CENTERS WITH REFERENCE TO CORE & BUFFER ZONE

S .No	**Areas**	**Name**	**Aerial distance from (in km)**	
			Core Zone	Buffer Zone
1	National Park	NIL	NIL	NIL
2	Sanctuary/Tiger Reserve / Elephant / any other Reserve	Jayakwadi Bird Sanctuary	1.8 km from the proposed project site	
3	Core Zone of Biosphere Reserve	NIL	NIL	NIL
4	Habitat for migratory birds	Jayakwadi Bird Sanctuary	1.8 km from the proposed project site	
5	Archaeological sites (i) Notified (ii) Others	NIL	NIL	NIL
6	Defense Installation	NIL	NIL	NIL
7	Industries/Thermal Power Plants	Paithan MIDC	Inside the Paithan MIDC	
8	Other	Nil	NIL	Nil
9	Airports	NIL	NIL	Nil
10	Railway Lines	Nil	Nil	Nil
11	National/State Highways	Aurangabad Paithan Highway	0.7 km from Project Site	

2.2 DISTANCES AND PERIPHERAL TRANSPORT ARRANGEMENT

As the existing industry is located in Paithan MIDC, it is well connected through highway & internal roads. No new roads are proposed. There is good road connectivity to Aurangabad, Ahmednagar and other cities by road network

Reconnaissance of the study area

The proposed project site is already in an existing Notified Industrial Area [MIDC] Maharashtra Industrial Development Corporation. Hence there will be no change in land use. The proposed site is barren land without tree species, so there is no need of vegetation clearance of existing land. Most of the study area is covered with agriculture fields mixed with natural vegetation. 10 km buffer area was taken for the present biodiversity study from the project boundary.

Jayakwadi Dam is situated to south west direction from the proposed project site at about 1.8 km. Presence of the Jayakwadi Dam in the study area makes the surrounding region rich in bird diversity and overall floral and faunal diversity as compared to other part of the study area. Jayakwadi Bird Sanctuary (Gazette Notification S.O. 2202 (E) amended Dated 12th July 2017) is towards South west from the proposed project site at 1.8 Km. Google map / Topographical map showing distance between Proposed industrial unit and Eco-sensitive Zone is presented in **Figure 2.1 and 2.2 respectively**. Major land used in between the bird sanctuary and MIDC area are agriculture fields and human habitation which forms a buffer zone for the avifauna population in the bird sanctuary. The Google Image / satellite image showing major land uses in between Bird sanctuary and MIDC area is presented in **Figure 2.3 and 2.4** respectively.

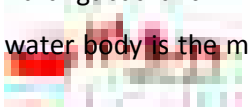
Ecologically Sensitive Area - Habitat for migratory birds

Location & Area

The Jaikwadi Bird Sanctuary area is situated between 750 00’00” - 750 15’00”E longitudes & 19 0 18’13” - 190 33’16”N latitudes in Paithan & Gangapur Tahsils of Aurangabad district and Shevgaon & Nevasa Tahsils of Ahmadnagar district, Maharashtra. Government of Maharashtra has notified the area of Jaikwadi Reservoir as Bird Sanctuary in November 1986. The total area of this sanctuary is 339.75 sq. kms

The Jaikwadi dam was constructed to conquer the irrigation and drinking water problems in Marathwada. The reservoir is spread over an area of approximately 55 km in length and 27 km in width. This gives the reservoir a typical shallow wetland character (Saucer shape), which is known to have very high productivity due to easy penetration of sunlight up to the bottom of reservoir.

The area of Jaikwadi Bird Sanctuary is a non-forest area, which was acquired from around 118 villages of Aurangabad and Ahmadnagar Districts. Presently the land is in possession of irrigation department. This water body is the main attraction for different avifaunal species including resident, local migrant and long



distance migratory birds due to presence of good diversity of fresh water fishes, molluses, crustaceans and other fauna.

Taking in to consideration its importance as main habitat for thousands of migratory and local birds, the govt. of Maharashtra declared this area as "Jaikwadi Bird Sanctuary" vide Govt. Notification No. WLP/ 1086/ 27206/CR-39/86-(ii) (F-5 dt.10th Oct. 1986) for 34105 ha. of area which was acquired for the construction of dam. (Annexure)

The reservoir has as many as 30 islands, most of which exposed as soon as the water level recedes. Although the reservoir area itself is devoid of vegetation cover, this reservoir provides a good habitat for aquatic flora and fauna. The entire reservoir bottom gets covered with a mass of aquatic plants, invertebrates and fresh water fishes.

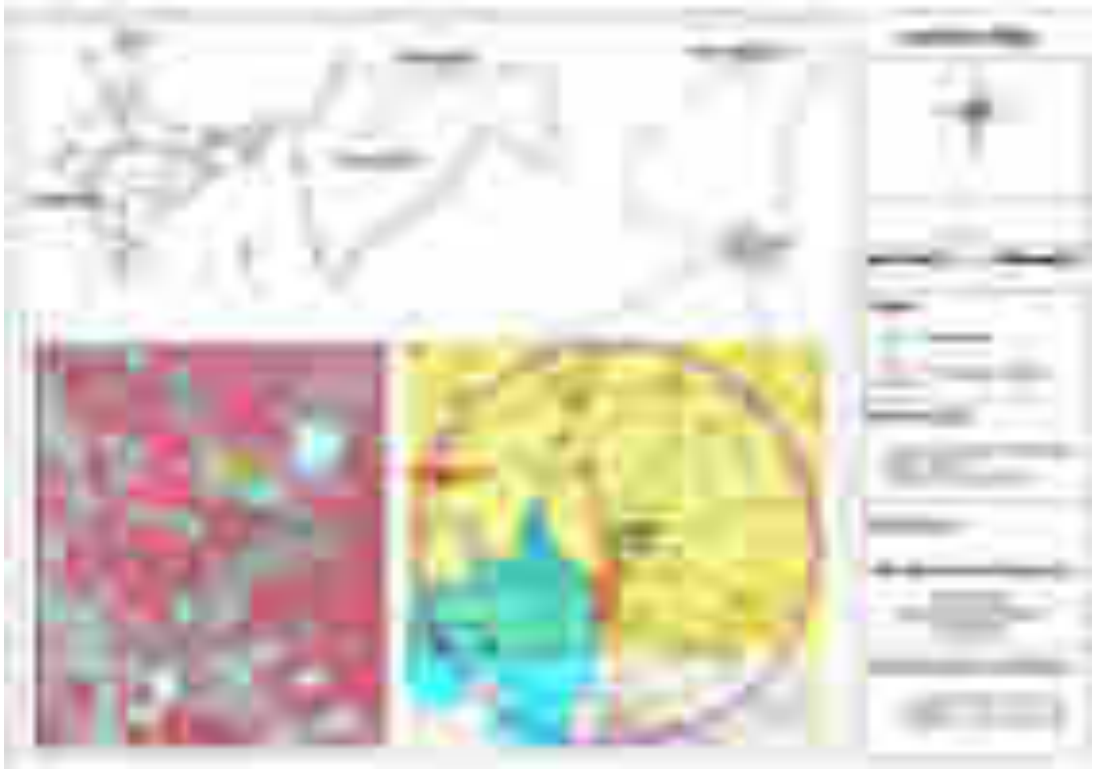


Figure 2.1 – Toposheet Map of the projects site and study area

Figure 2.1 – Google map showing distance between Proposed industrial unit and Eco-sensitive Zone

Figure 2.2 – Topographical map showing distance between Proposed industrial unit and Eco-sensitive Zone

Figure 2.3 – Google Image showing major land uses in between Bird sanctuary and MIDC area

Figure 2.4 – Satellite Image showing major land uses in between Bird sanctuary and MIDC area

Chapter-3

Survey Methodology

Introduction:-

The details biodiversity study was conducted to determine the baseline status of flora and fauna and to prepare Wild Life Conservation Plan for **M/s Matrix Fine Sciences Pvt. Ltd.** for scheduled Avifaunal species observed in the study area. The study was conducted through reconnaissance surveys, detailed field survey and also data was generated from secondary sources like different government offices to authenticate the data collected during field survey. The detailed methodology followed during the present investigation is given as below

Flora

The present study on the floral assessment for the proposed project activity is based on extensive field survey of the area**.** The study has been conducted in summer season (2018). The unidentified plant species were identified with the help of secondary sources like degree colleges and forest department. Besides the collection of plant species, information was also collected with vernacular names of plant species made by local inhabitants. In this process the whole study area was divided into different sections to get the maximum diversity of plant species. The sampling sites were selected based on land use pattern, topography and floristic composition of the study area. Data on forest type, legal status and their extent in the study area has been collected from forest department. The other relevant data on biodiversity, economically important plant species and medicinal plant, rare and endangered species in the study area have been collected during site visit and from different secondary sources.

Fauna

The study of fauna takes substantial amount of time to understand the specific faunal characteristics of the area. The assessment of fauna has been done by extensive field survey of the area. During survey, Line Transect method was used for the study of mammals and Transact & Patch sampling was used for Amphibians. In addition the following sources were also used during survey.

- Sighting during ecological studies
- Animal call

- Foot mark and excreta

During survey, the presence of wildlife was also confirmed from the local inhabitants depending on the animal sightings and the frequency of their visits in the project area which was later confirmed from different government offices like forest department, wildlife department etc.

Avifauna

During Birds survey actual counts of birds were made following the standard survey technique. Observations were made during a walk through in the chosen transect for sighting birds. The number of birds observed in each sampling location was directly counted and listing was made. Birds were noted, counted and identified with the help of 8X40 "Optima Zenith" binocular and standard field identification guides.

List of sampling locations for baseline data generation for ecological environment is presented in **Table no. 3.1**

Participatory Rural Appraisal

The rural population is best source of information to confirm the movement of animals in their area. Resident of different villages located in and around the project area were interacted to collect information like sighting of wild animals, animal call, footmark and excreta. Information was also gathered about period and frequency of wild life movement in their area. The name of villages, name of respondent and outcome is tabulated at **Table 3.2**.

Aquatic ecology study

INTRODUCTION

Several methods have been used to analyze the effects of human activities on aquatic environments. They include the use of selected chemical and physical parameters, as well as a variety of biological measurements that range from bacteriological analyses to bioassay studies of fish and other aquatic organisms. Although macro-invertebrates are rarely used in bioassay studies, they have proven to be extremely useful in water quality monitoring in two different methods of investigation: studies of community diversity and using organisms as indicators.

Among aquatic biota, microorganisms are generally highly sensitive and their dynamics can be seriously affected by environmental perturbation. Bacteria, phytoplankton and zooplankton have fast growth rates and therefore can provide meaningful and quantifiable indicators of ecological change in short timescales.

METHODS

The sampling was carried out during early summer season using standard methods. On the whole three biological groups were studied to assess the river water / Dam water / canal water quality. Biological characteristics that were assessed involved the status of zooplankton, phytoplankton and fish diversity.

Phytoplankton

For the study of phytoplankton diversity samples were collected from 10 cm depth below the water surface. Fresh Polythene bottles of 125 ml capacity (Polylab) were used for collection of water samples. After the sampling, the sample was preserved by adding Lugol' solution.

Zooplankton

For the quantification of zooplankton, 20 liters of water sample was filtered at each site by using standard plankton net made up of fine silk cloth (mesh size 25 μm). After the sampling, the fixation of samples was carried out without delay to avoid damage to animal tissue by bacterial action.

The filtrate collected was preserved in the 4% formaline solution (Analytical grade). The density of zooplankton was estimated with the help of APHA (2012). After preservation the zooplankton samples were kept in well ventilated room at temperature less than 25°C. The samples were kept in the wide mouth bottle. A good quality preprinted labels were used, on which date and time of sampling, fixative and preservative used and other field information were written for ready reference at the time of analysis.

Fish

Cast netting and fishing rod were used to collect fish sample. After sample collection, fish were examined, counted and released back into the system. For unidentified species, some fish samples were preserved in buffered formalin (10%) and transported for species confirmation. Species identification and confirmation were carried out using available literature. Public consultation in fishermen society was also done to collect information on fisheries diversity of the study area.

At each sampling site, a set of the following environmental variables were recorded: stream order, altitude, stream width (m) approx. and water depth (cm).

Indices Used to determine pollution index of the study area by using algal species

Palmers Pollution Index (PPI)

Palmer, (1969) made the first attempt to identify and prepare a list of genera and species of algae that were tolerant to organic pollution, which is given in the table below. According to Palmer (1969), scores of 20 or more are indication of high organic pollution.

Table: Algal genus and their respective Pollution Index (Palmer, 1969)

Genus	Pollution index	Genus	Pollution index	Genus	Pollution index
Anacystis	1	Micractinium	1	Gomphonema	1
Ankistrodesmus	2	Navicula	3	Lepocinclis	1
Chlamydomonas	4	Nitzschia	3	Melosira	1
Chlorella	3	Oscillatoria	5	Scenedesmus	4
Closterium	1	Pandorina	1	Stigeoclonium	2
Cyclotella	1	Phacus	2	Synedra	2
Euglena	5	Phormidium	1		

Following are the numerical values for pollution classification of Palmer (1969): 0-10= Lack of organic pollution, 10-15= Moderate pollution, 15-20= Probable high organic pollution, 20 or more = Confirms high organic pollution

STUDY SITES

For the study of aquatic ecology total 8 sampling locations were identified. Two locations were selected from Godavari River, two locations from Paithan left bank canal and four locations from jayakwadi dam. Jaikwadi Dam situated at Paithan Longitude 75017' and Latitude 19029'. The Dam is a man- made reservoir constructed in 1975 on the upper reaches of River Godavari. The details of sampling locations is presented in **Table no. 3.4**

Table 3.1: List of sampling location for terrestrial environment

Sr. No	Location Name	GPS location
1.	Borgaon	19°33'38.43"N 75°20'18.41"E
2.	Amrapur Waghundi	19°33'38.04"N 75°18'26.10"E
3.	Amrapur	19°32'34.84"N 75°17'47.39"E
4.	Near Yashwant Nagar	19°32'59.45"N 75°21'34.03"E
5.	Near Pimpalwadi	19°31'47.63"N 75°22'17.93"E
6.	Near Jayakwadi Irrigation Department	19°30'56.41"N 75°22'20.88"E
7.	Near Sant Gyaneshwar Garden	19°29'57.70"N 75°22'30.63"E
8.	At Nathsagar Dam	19°29'18.66"N 75°22'23.57"E
9.	Near Paithan	19°28'8.87"N 75°21'49.22"E
10	Paithan Godavari River	19°28'25.47"N 75°22'52.87"E

Table 3.2: Public consultation details

Sr. No	Village Name	Name of Person	Comments by Villagers
1	Back Water (Jayakawadi Dam)	a. Jitesh Waghmare b. Vithal Waghmare c. Abhishek K. Shejul d. Nivrutti K. Shejul	1. Wildlife animal like Deer, Wild Boar, Wolf, Fox, Hyena, Langoor, Mongoose, Jungle cat etc are generally observed in the study area. 2. These animals damages the agricultural area & crops. These animals normally observed in the month of October to May for feeding & Water. 3. Snake like Ghonas, Dhaman, Pansap, Nag were also observed by the villagers 4. This village is near to the Jayakwadi Bird Sanctuary. 5. They can be observed in the season of post monsoon period for feeding.
2	Dhorkingaon	a. Vyanktesh Kaduba Dhotre b. Jyoti V. Dhotre c. Keshav Jadhav d. Sakaram Sable	1. Wildlife animal like Deer, Tadas, Wolf, Fox, Mongoose, Hanuman Langur, Jungle Cat etc are responsible for loss of crops & agricultural area
3	Rahatgaon	a. Ashok Darade b. Sagar Patil c. Tukaram Jadhav	1. Wild animals like deer, wild boar, wolf, Tadas, fox, peacock observed in and around the village area. 2. Loss of crops & loss of Agricultural area by these animal within the year.
4	Mudhalwadi	a. Baliram Kadve b. Sampataro Kadve c. Ganesh Shinde	1. Animals like deer, Sambar, Tadas, Peacock, Langur, Fox are observed near to the village.
5	Waghundi	a. Marotirao Jadhav b. Vikram Shinde	1. Agricultural loss & crop loss are main observation because of these animals which are searching for food & water.
6	Wadala	a. Tulsidas Kadve b. Nilesh Patil c. Amol Shinde d. Santosh Pawar	1. Wildlife animal like Deer, Tadas, Wolf, Fox, Mongoose, Hanuman Langur, Jungle Cat, Sayal etc are responsible for loss of crops & agricultural area.

Table 3.3 – Villages covered during Participatory Rural Appraisal study of the area

Sr. No	Location Name	GPS location
1.	Borgaon	19°33'38.43"N 75°20'18.41"E
2.	Amrapur Waghundi	19°33'38.04"N 75°18'26.10"E
3.	Amrapur	19°32'34.84"N 75°17'47.39"E
4.	Near Yashwant Nagar	19°32'59.45"N 75°21'34.03"E
5.	Near Pimpalwadi	19°31'47.63"N 75°22'17.93"E
6.	Near Jayakwadi Irrigation Department	19°30'56.41"N 75°22'20.88"E
7.	Near Sant Gyaneshwar Garden	19°29'57.70"N 75°22'30.63"E
8.	At Nathsagar Dam	19°29'18.66"N 75°22'23.57"E
9.	Near Paithan	19°28'8.87"N 75°21'49.22"E
10	Paithan Godavari River	19°28'25.47"N 75°22'52.87"E

Table 3.4 Details of sampling locations for Aquatic Ecology Study

Sr. No	Village Name	Distance from Project Site {km}	Direction
1.	Godavari River Upstream (A)	7.6	S
2.	Godavari River Downstream (B)	9.3	SSE
3.	Paithan Left Bank Canal (A)	3.8	S
4.	Paithan Left Bank Canal (B)	7.4	SE
5.	Pimpalwadi	2.4	SW
6.	Near Waghundi	8.2	W
7.	Near Borgaon	4.6	NW
8.	Kapuswadi	7.6	NE

Chapter 4

Biodiversity status of Flora and Fauna

Chapter 4 - Biodiversity status of Flora and Fauna

Introduction

Forest and forest types in the study area

As per the "Survey of Forest Types of India" by Champion and Seth (1968), the forest type of the proposed project site and surrounding study area can be classified into southern dry mixed deciduous and southern thorn forest.

The study area has primarily mixed forests consisting of a variety of species the occurrence of which is considerably influenced by biotic interferences and management. The important tree species occurring in the forests can be enlisted as Tectona Grandis (Teak), Anogeissus-Latifolia (Dhavra), Hardwickia Binata (Anjan), Lannea grandis (Moyen), Terminalia tomentosa (Ain), Boswellia serrata (Salai), Cassia fistula (Bahawa), Bauhinia recemosa (Apta), Phyllanthus emblica (Amla), Pterocarpus marsupium (Bija) and other miscellaneous species like Khair, Babul, Ber, Bel, Bhilawa, Charoli, Lendi, Dhaman, Dudhi. Kalarn etc.

The common shrub and climber growth consists of Gymnosporea montana (Henkal), Woodfordia floribunda (Dhaiti), Randia dumetorum (Golida), Mimera haernata (Arati), Lantana camara (Ghatieri), Rhus mysorensis (Amont), Carissa congesta (Karvand), Adhatoda vasica (Adulsa), Nyctanthus arbor-tristis (Parijatak),Caesalpinia sapiaria (Chilar), Butea superba (Palas), Jasminum Arborescens (Ranmogra) etc.

Thorny scrub type which is more or less a regressed subtype where overwood has been completely removed and due to excessive grazing only thorny species such as karwand, henkal, amoni, ghaneri, etc., survive. Grass lands which are well protected commercial kurans used mainly for fodder grass which is sold on cutting terms, the main species being sheda, marvel, kunda, paonya, rosha, kusali etc.

Floral Investigation

The proposed project site is situated at Plot No. D-8, MIDC, Paithan. The total plot area is 40,000 sq. m. Tree species viz. Royal palm, Albizzia lebbeck, Cassia fistula, Pongamia pinnata, Cocos nucifera, Dalbegia sissoo, Delonix regia, Azadirachta indica were observed on the boundary of the proposed project site (Plate 1). Some herbs and shrubs species viz. Lantana camara, Alternanthera sessalis, Parthenium sp., Tridax procumbens, Cassia sp., were also observed on the proposed project site.

The structure and composition of vegetation in the buffer zone was studied by visual observations during the site visit. The study area is dominated by agricultural fields. Most of the area is covered by

active cropping accompanying patches of barren land and grassland in between.

The project is located in the area which is considered to be dry deciduous zone with geographically having no distinct variation. However, the Jayakwadi Dam on the river Godavari is situated at to the south west direction from the project site at about 2 Km. and presence of the surrounding region is rich in the bird diversity apart from the floral and faunal diversity as compared to other part of the area.

The study area has dry and arid type of climate. Most of the area is covered by the agricultural fields with natural vegetations in between. No reserved forest, National Park or any other ecologically sensitive zone like Wild Life Sanctuary is recorded. However, Jayakwadi Birds sanctuary falls under the study area.

With regard to the tree vegetation is concerned Azadirachta indica and Prosopis Juliflora occur in abundance. Other dominant tree species exhibited by the region are Acacia nilotica, Acacia leucophlea, Albizia lebbeak, Mangifera indica, Cassia simea, Cassia fistula, Tamarindus indicus, Ficus bengalensis, Ficus racemosa, Crocus nucifera, Bauhinia racemosa, Aegle marmelos, Ailanthus excels, Annona squamosa, Bombax ceiba, Bougainvillea glabra, Butea monosperma, Dalbergia sissoo, Delonix regia, Ficus racemosa, Ficus religiosa, Mangifera indica, Peltophorum pterocarpum, Samania saman and many others. Along the bank of reservoir, Accaia arebica and Accaia nilocita are dominant trees, while Ipomaea species has proliferated as weed. Some of the plants introduced by human beings, agencies either as ornamentals, fruits, vegetable sources or merely as the curiosities.

Barren and grassy land show the occurrence of Adhatoda vasica, Calotropis procera, Agave americana, Euphorbia tirucali, Nerium indicum, Argermone mexicana, Lantana camara, Gymnosporia montana, Ricinus communis, Rhus mysorensis,Carissa congesta etc.

Many medicinal plants are reported from the study area, few examples are cited here as Henidesmus indicus, Withania somnifera, Tinospora cordifolia, Adhatoda vasica, Asparagus racemosus, Jatropha curcas, Syzygium cumini etc. While, herbaceous plants, many clambers and grasses are found in abundance, particularly during rainy season. The list of plant species recorded in the study area of proposed project site is presented in **Table no.3**

The agricultural cultivation in acquired areas on both the banks of the reservoir has become the regular practice of the people of the surrounding villages. With receding water level this practice is continued and further extended up to the actual water storage. The crops grown along the banks are sugarcane, maize, wheat, cotton, sunflower, soyabean, jawar, bajri, groundnuts and pulses.

Faunal Investigation

Mammals

Faunal assessment provides a basis for determining relative abundance and rarity of each species which is important for assessing the diversity of fauna of a particular area. Since animals are capable of movements from one place to another, this makes their study entirely different. Different animals prefer different types of habitat for food and shelter.

There was no major physical sighting of large mammals during biodiversity study other than domestic mammals' viz., cow, buffalo, cat, stray dogs, goat etc.

During the field studies some tracks and signs (Plate 2) for Indian Wild Boar (Sus scrofa), Indian Hare (Lepus nigricollis) and domesticated animals were observed in the study area.

According to the information collected from forest / wildlife department and local people **(Plate 3) (Table 4)**, Jackal (Canis aureus), Tadas (Hyaena hyaena), Common Mongoose (Herpestes edwardsii), Smooth Indian Otter (Lutragale perspicillata), Indian Hare (Lepus nigricollis) and Indian Wild Boar (Sus scrofa) are generally observed in different parts of the study area.

Some reptiles i.e. Krait (Bungarus caeruleus), Russel viper (Vipera russelli), Common Rat Snake (Ptyas mucosus) are generally observed in the study area as narrated by local people. List of Mammals and Reptiles recorded in the study area of proposed project site is presented in **Table no.5**.

Butterflies

In many regions of the world, Butterflies are widely accepted as ecological indicators of ecosystem health. Many of their physiological tolerances, such as light, temperature, and habitat requirements, have been quantified and correlations with changes in ecosystem conditions have been demonstrated. In addition, butterflies are small, have high reproductive rates, and are at a low trophic level that allows them to quickly respond to environmental stress.

Because of their specific habitat and landscape requirement, are very sensitive to changes in landscape and are reliable indicators of ecosystem. During survey 18 species of butterfly were observed from four different families in the study area. Nymphalidae was the most dominant family with 12 species followed by Pieridae with 4 species and Danaidae, Papilionidae with 1 species each. **The list of Butterflies observed in the study area are presented in Table no 6**

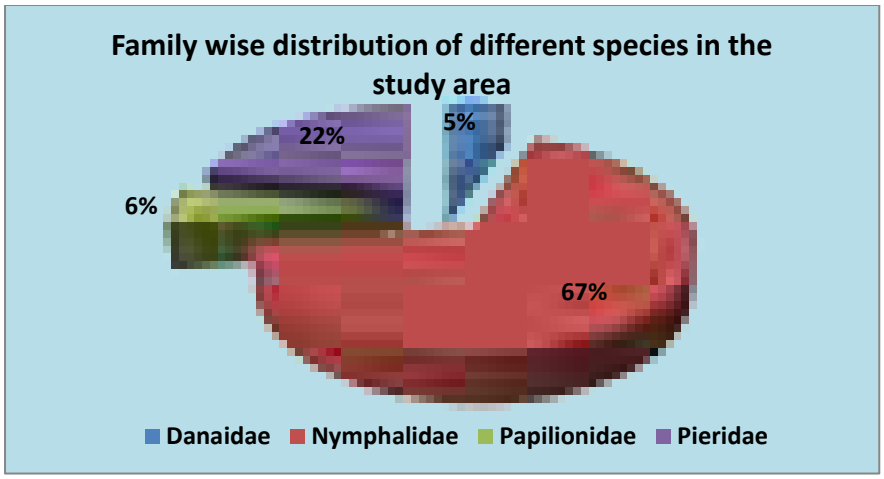


Fig 1: Family wise distribution of different butterfly species in the study area

Avifauna

Diversity of avifauna is one of the most important ecological indicators to evaluate the quality of habitats. Now-a-days, avifaunal diversity has been decreasing due to the destruction of natural habitats and human disturbances. Random destruction of natural habitats by cutting nesting trees and foraging plants for commercial use of woods and lands are the main factor responsible for narrow down in avian foraging habitat and their nesting sites. Thus, many species of birds may be forced to inhabit in the urban areas and constrain them to breed there. Birds are essential animal group of an ecosystem and maintain a trophic level. Therefore, detail study on avifauna and their ecology is important to protect them.

During overall survey in the study area, a total of 66 bird species belonging to 36 families were recorded in the study area. Most dominant family was Ardeidae with 6 species followed by Charadriidae and Ciconiidae with 4 species each. 19 families were recorded from the study area with one species each. The bird species were mostly observed around Jayakwadi dam, agriculture fields and human habitation. The bird species observed during the survey are Asian openbill (Anastomus oscitans), Barn swallow (Hirundo rustica), Baya weaver (Ploceus philippinus), Black drongo (Dicrurus macrocercus), Black Ibis (Pseudibis papillosa), Black stork (Ciconia nigra), Black winged stilt (Himantopus himantopus), Caspian tern (Hydroprogne caspia), Cattle egret (Bubulcus ibis), Citrine wagtail (Motacilla citreola), Common Myna (Acridotheres tristis), Glossy ibis (Plegadis falcinellus), Grey heron (Ardea cinerea), Indian pond heron (Ardeola grayii), Little cormorant (Microcarbo niger), Purple swamphen (Porphyrio porphyrio), Sand plover (Charadrius mongolus), Small Bee – eater (Merops Orientalis), White – breasted Kingfisher (Halcyon smyrnensis), White throated kingfisher(Halcyon smyrnensis), wire tailed swallow (Hirundo

smithii) and wooly necked stork (Ciconia episcopus) etc (Plate 4). List of birds observed in the study area are presented in **Table no 7.**

Bird diversity of Jayakwadi Bird Sanctuary

Jayakwadi Dam / Bird Sanctuary and the surrounding area are the ideal habitat for many resident and migratory bird species. The Jayakwadi dam spreading over an area of 125 hectares, provides water to Aurangabad City and surrounding place. Situated on River Godavari, the largest river in Southern India, the reservoir is called Nath Sagar.

The Nath Sagar reservoir creates 30 islands of various sizes in the shallow waters, with trees for roosting, this provides an ideal shelter for migratory birds. (https://en.wikipedia.org/wiki/Jayakwadi_Bird_Sanctuary) Close to the dam a bird sanctuary has been created which is home for many species of resident and migrant birds. Almost 200 species of birds can be found in this region, which includes more than 70 species of migratory birds. Out of these, 45 chief species are of international migration (http://birderpics.com/jayakwadi-bird-sanctuary/). Back water of Nathsagar Reservoir attracts several birds species, .both residents and migratory. As many as 150 bird species were recorded (Vyavahare and Kulkarni, 1986).

A total of 81 species of water-birds (66) and wetland dependant birds (15) have been recorded in the Nathsagar Wetland by considering both the surveys undertaken during February and October, 1999. These birds are belonging to 56 genera and 20 families grouped into 9 avian orders. Further, 61 bird species observed in the close vicinity of this wetland. These birds are grouped into 28 families and 47 genera. This gives a total of 142 bird species occurring in the area of Nathsagar Wetland. (Editor-Director. 2005)

As per Yardi, (2015) total 65 bird species were reported from the Jayakwadi Bird sanctuary area, which are migratory or local migratory species. Out of the total species reported four species are under Near Threatened category and four species under Vulnerable category as per IUCN status. **(Table 8)**

These birds have different food habits. They show varying degree of adaptation towards the food they consume. Some birds are herbivorous, while others are carnivorous. However, some species are omnivorous and do not show any specialization for any particular type of food.

Jaikwadi wetland was declared as a protected area by the forest department of Maharashtra in 1986. Shallow water habituated use by number of migratory birds such as black winged stilts and Garganeys together with residence birds were thus protected. The banks of the Jaikwadi stony, unplanned with grass and thorn once scrub attracted by yellow wagtails. While the deciduous forest that occupies most

of the flat land attracts arboreal birds such as Golden oriole, Coppersmith, Flowerspeckers , and even Green Pigeons that were not found in this reservoir before. (Gole, 1984).

The Jaikwadi wetland has different types of characteristics like depth water spread, open water, water weed. Shallow water etc. which is favorable sites for wintering migratory birds. The bird indicates the states of wetland and the cormorants are very important intermediate, their presence for e.g. link in food web and a factor which facilitate the dislocation of matter between aquatic and terrestrial ecosystems. These birds could be positive indicator of lakes threatened by eutorophication, because nutrients (N.P.) are excluded from aquatic food chains. However, the concentration of bird's excreta on small area of colony may cause disturbance in soil sorption capacity and nutrients leading back to aquatic ecosystem (Gole, 1984).

A number of migrant birds spend the night in the reserve itself these include some ducks, Blackwinged stilts, waders, terns etc. Waders like Godwit, Prantincole, and Ruff forged on the sandflat. Waders showed a significant dependence of Polycheates, hermit crabs etc.

The Flamingos are naturally seen feeding and roosting in this region during winter and summer season. Flamingo obtains their food from crustaceans to blue green algae to diatoms. The physicochemical properties of water and soil show significant growth multiplication and diversity of the algae during summer season. Hence, the Flamingo population indicates the change in the seasonal availability of food.

The Lapwing and Stone plovers are common resident bird in Jaikwadi. The water is essential for breeding and rearing of the chicks of these birds. The population of chicks and juveniles of stone plover decreases due to which catering of the wild vegetation, filling of water body, and change in land use of wetland etc. Hence it is clear that in near future, there is possibility of vanishing the species of these birds.

Apart from these the mud flats in these sites have been severely degraded by burning, drainage and clearing. This has affected the abundance of avifauna that depends on the mudflats as well as on the hydrological values and functions of the mud flats. Reclamation of reservoir lands during inter-tidal cropping affects on roosting and breeding of water birds like Little Cormorant, Indian Pond- Heron, Purple Heron and Night- Heron. Putting harvested fields on fire also become troublesome to nesting of many birds. Every year, during the summer months, sugarcane farmers burn the field residue and the grasses on the bunds, by which nests of breeding birds like Warblers (Prinia hodgsonii, Prinia inornata and Acrocephalus stentoreus), Tailorbirds (Orthotomus sutorius) are destroyed.

Baseline status of Phytoplankton

Phytoplankton

The phytoplankton community in the study area comprised of four (4) major classes namely Chlorophyceae (14 species), Bacillariophyceae (08 species), Cyanophyceae (06 species) and Euglenophyceae (01 species) **(Plate)**. The total number of 29 taxa was recorded at different sites during the study period. Chlorophyceae and Bacillariophyceae was the most dominant group observed in the study area. Some dominant species observed in all the sampling locations are Pediastrum sp., Ankistrodesmus sp., Synedra sp., Navicula sp., Nitzischia sp., Oocystis sp., Closterium sp., Microcystis sp. and Oscillatoria sp. *etc.* The result shows that the fresh water sources found in the study area are moderately polluted. The species shows that there is medium level impact of pollution present in the study area. The location-wise details of phytoplankton species observed in the study area is presented in **Table no. 9**

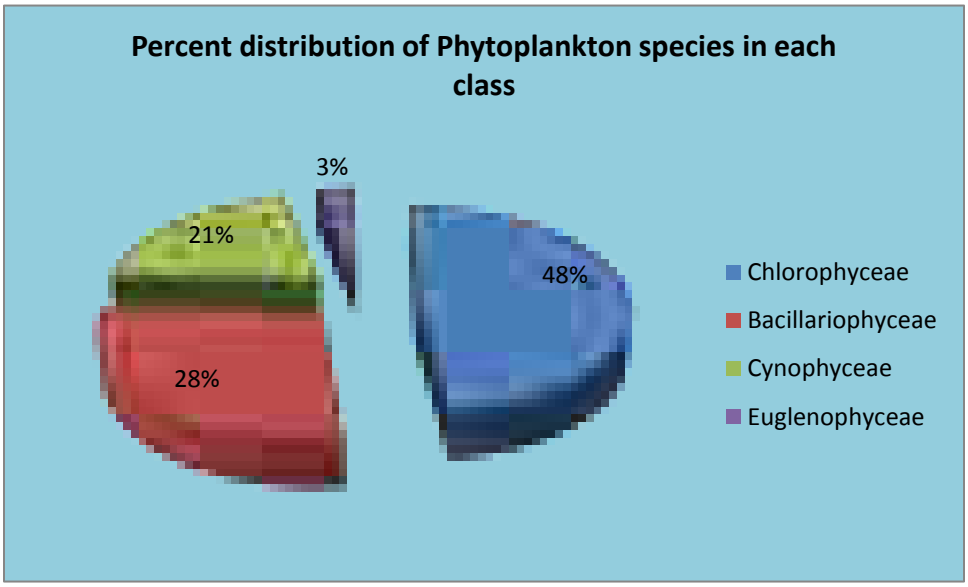


Fig 2: Percent distribution of Phytoplankton species in each class

Yardi, (2015) reported that the species composition of phytoplankton showed 89 species (20 genera) of chlorophyceae, 79 species (16 genera) of bacillariophyceae, 47 species (10 genera) of cyanophyceae and 4 species (4 genera) of euglenophyceae were observed.

Baseline status of zooplankton

Zooplankton, comprising of a total 15 taxa recorded from the study area **(Table 10)** and has shown the presence of 5 taxa of Copepoda, 4 taxa of Cladocera, 3 taxa of Rotifera and Ostracoda each(Plate). The species which found to be dominant in the study area are Branchionus sp., Keratella sp., Macrocyclops

sp. and Moina sp. The location-wise details of zooplankton species observed in the study area is presented in **Table no. 10**

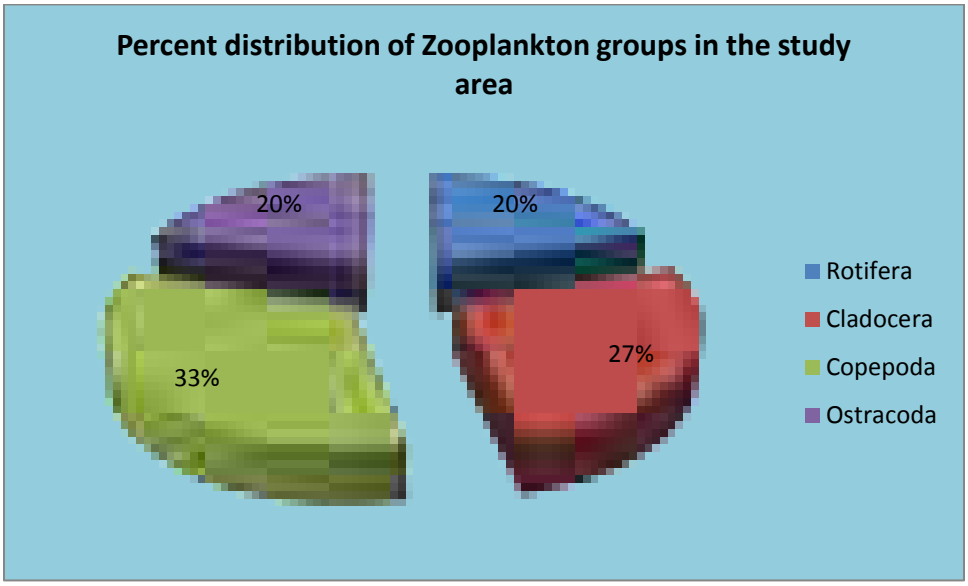


Fig 3 : Percent distribution of Zooplankton groups in the study area

In the Jaikwadi reservoir, it has been observed that the Jaikwadi reservior revealed 7 genera of rotifera, 5 genera of copepoda, 5 genera of cladocera and 3 genera of ostracoda. (Yardi, 2015)

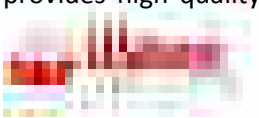
Aquatic plants

Aquatic plants are also referred as hydrophytes or aquatic macro-phytes. In the study area some hydrophytes were observed during the survey in Jayakwadi Dam area. At present over abundance of these weeds have been noticed. They are also important in food web, in ecosystem since they provide support, shelter and oxygen to other organisms and play an important role in biological production. The dominant aquatic plant species observed in the dam site are Ipomea aquatica, Hydrilla verticillata, Vallisneria spiralis, ottelia alismoides, Lemna minor, Potamogeton indicus, Najas indica, Azolla pillnata, Ceratophyllum demersum and Eichhornia crassipes.

Fish Ecology

Fish species diversity pattern in river/lake is depend on the complex interaction of the different ecological variables viz. size, surface area of the drainage basin, temperature, depth, flow velocity, channel morphology and climate.

Fish is the popular food of bird species among the visiting or residing bird species in this habitat. Fish provides high quality proteins, minerals and nutrients to the birds. Birds prefer small sized fishes of



about 1 to 10 cm length which are air-breathing or surface feeders. Therefore the evaluation of the fish diversity is very essential so as to judge their abundance, size, habits, dominating groups, etc.

A survey has been conducted on the fishes of Jayakwadi Dam which is situated on south west side of the project site. Data was also collected from the Local fishermen about Fish diversity and fish production in the study area.

During public consultation with the fishermen community it was documented that species Rohu (labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Common carp (Cyprinus carpio), Dokrya (Chana gachua) and Chana punctatus are observed in the study area. (Table 11)

Plate 1 – Plantation in the premises of M/s Matrix Fine Sciences Pvt. Ltd.






Plate 2 - Tracks and signs observed in the study area

Plate 3 - Public consultation in the study area

Plate 4 – Avifauna diversity observed in the study area

	
Spotted Owlet (*Athene brama*)	Citrine Wagtail (*Motacilla citreola*)
	
black-winged stilt (Himantopus himantopus)	Purple swamphen (*Porphyrio porphyrio*)
	
Little cormorant (*Phalacrocorax niger*)	Asian openbill (*Anastomus oscitans*)

CHAPTER 5: MAJOR IMPACTS OF THE PROPOSED PROJECT AND BIODIVERSITY CONSERVATION PLAN

5.1. INTRODUCTION

The present study is not an EIA study, with the understanding of the proposed project activity and associated construction, operation and management phases of MIDC area, the following environmental issues area visualized. The main aim of this Biodiversity conservation plan is focused to suggest management plan to enhance the overall biodiversity values of the project study area (core and Buffer zone) and around the Jayakawadi Bird Sanctuary area. The EIA study is already identified environmental impacts and suggested environmental management plan – EMP which are more of towards technical interventions to minimize the impacts identified. Therefore, this Biodiversity Conservation plan study focused to incorporate some of the biological interventions to further reduce the likely impacts as well as to provide suitable habitats to improve the overall biodiversity attributes evaluated under this study.

5.2 Major Impacts of the proposed project activity:

1) The proposed project is for manufacturing of Vitamin E related products namely Derivatives of Natural Vitamin E present in Paithan MIDC area. There are many pharma and Chemical industries present in the MIDC area emitting different types of gaseous pollutants. The overall impact of MIDC area over the surrounding Biodiversity (Mainly Jayakwadi Bird Sanctuary) needs to be assessed.
2) The proposed project site is well within the premises of Paithan MIDC. The construction work to be done for the proposed project will not have major impact on biological environment as the land undertaken for expansion does not have vegetative cover.
3) During construction phase, anthropogenic activity and noise generated by different machinery may lead to temporary shifting of sensitive species of reptiles [Krait (Bungarus caeruleus), Common Rat Snake (Ptyas mucosus)] , small mammals (Indian Hare), and birds [Common Birds like Barn swallow (Hirundo rustica), Baya weaver (Ploceus philippinus), Black drongo (Dicrurus macrocercus), Common Myna (Acridotheres tristis), Small Bee – eater (Merops Orientalis) etc.] to the surrounding similar habitat.
4) During operation phase, emission of gaseous pollutants will occur from the industry, which will impact human health as well as biodiversity of the surrounding area.
5) During public consultation it was documented that faunal movement is there in the study area about 5-6 km away from the project site mainly in and around grassland and agriculture fields.
6) Ecologically Important site i.e. Jayakwadi Bird sanctuary and Nathsagar Dam are within the project area
7) Mixing of Waste water in the reservoir is a major problem resulting into eutrophication of the water-body as the sewage from surrounding villages (Upstream locations) and waste water from different industrial clusters also finds its way into the reservoir.

5.3 BIODIVESITY CONSERVATION PLAN

With understanding of the biodiversity values of the project study area at different study habitats, species group, specific species (threatened species) levels and existing environmental scenario, the Biodiversity Conservation Plan were suggested. In total, 8 different management action plans were suggested and categories into three management plans and detailed in **Table 5.1.** All the 8 plans recommended were basically different kinds of restoration plans for specific landscape mainly to support specific faunal groups and species. Therefore, these management plans are given different titles, based on the focused biodiversity enhancement, to achieve the project goal.

Table 5.1 Types of Biodiversity Conservation and Management Plans Suggested

BCMP- Types	**BCMP – Action Plan**
1. Selected Impact Mitigations	
	1. **Green Shelter Belt - Air pollution Control**
	2. Avenue Plantation
	3. Bio-filter Micro Check Dams
2. Threatened Species Conservation	
	4. Improvement in Food and Nesting Habitat
	5. Elevated earthen / Wooden platforms for the birds
	6. Artificial Nesting Platform
3. Social Issues and Benefits	
	7. Agriculture Hedge Vegetation
	8. Organic Farming

5.3.1 Green Shelter Belt - Air pollution Control

The Paithan MIDC is spread over an area 285.51 ha mainly occupied by different chemical and pharma Industries. One of the major and common environmental issues is severe dust emission due to different levels of construction activities which are inevitable. Emissions of different gaseous pollutants are also major source of pollution in the industrial area. It has been reported that gaseous pollutants are absorbed by the leaves, while the particulate forms are absorbed through the outer surface of the plants having thick canopy. (Prajapati & Tripathi, 2008). Plant species, particularly trees and shrubs, are important sinks for trapping and absorbing many gases, particulates, aerosols and airborne pollutants (Gajghate and Hassan 1999). Therefore, it is very important to develop Green Shelter belt in the peripheral areas of MIDC area and open areas available outside the MIDC area with the selected tree species to address the air pollution impacts. The present study suggested plant species which area scientifically proved to control air pollution to develop "**Green Shelter Belt**".

5.3.1.1. Selected Tree species

With the above understanding of the role of plant species as important sinks to control air pollution, appropriate tree species have been suggested in view of the area / site requirements and needed performance of specific species under "**Green Shelter Belt Plantations**". A total of 31 plant species have been identified and selected based on the following criterion:

- Fast growing
- Thick canopy cover
- Perennial and evergreen
- Large leaf area index

Details of species list and site /location specific species need to be planted are given in the table (**Table 5.2**).

Table 5.2

List of plant species for Green shelter Belt Development

Sr. No.	Scientific Name	Common Name	Family	Sensitive / Tolerant	Habit	Growth r ate	Regeneration	Evergreen / Deciduous
1.	*Achras sapota*	Chikoo	Sapotaceae	T	Tree	Quick growing	Grafting	Evergreen
2.	*Aegle marmelos*	Bell tree	Rutaceae	T	Tree	Quick growing	By seed & root cutting	Evergreen
3.	*Albizia chinensis*	Siris	Mimoseae	T	Tree	Quick growing	By seed	Deciduous
4.	*Albizia lebbeck*	Siran	Mimoseae	T	Tree	Quick growing	By seed	Deciduous
5.	*Albizia procera*	White Siris	Mimoseae	T	Tree	Quick growing	By seed	Deciduous
6.	*Alstonia Scholaris*	Chattiyan	Apocynaceae	T	Tree	Quick growing	By seed	Evergreen
7.	*Annona Squamosa*	Custard Apple	Annonaceae	T	Small tree	Fast growing	By seed, Grafting Budding	Evergreen
8.	*Annona reticulata*	Luvuni	Annonaceae	T	Tree	Fast growing	By seed	Evergreen
9.	*Azadirachta indica*	Neem	Meliaceae	T	Tree	Quick growing after 1st season	By seed	Evergreen
10.	*Bauhinia purpurea*	Khairwal	Caesalpinaceae	T	Tree	Quick growing	Through seed	
11.	*Bauhinia racemosa*	Apta	Caesalpinaceae	T	Tree	Quick growing	By seeding	
12.	*Butea monosperma*	Palas	Fabaceae	T	Tree	Quick growing	By seeds	Deciduous
13.	*Cassia fistula*	Golden shower	Caesalpinaceae	T	Tree	Quick growing	By seeds	Deciduous
14.	*Citrus aurantium*	Nebu	Rutaceae	T	Tree/ shrub	Quick growing	By seeds, Stem cutting	Evergreen
15.	*Dalbergia sissoo*	Sissoo				Moderate during 1st year	By seeds, Root &	Evergreen

Sr. No.	Scientific Name	Common Name	Family	Sensitive / Tolerant	Habit	Growth r ate	Regeneration	Evergreen / Deciduous
						and rapid afterwards	Slum cuttings	
16.	*Delonix regia*	Flameboyant	Caesalpinaceae	S	Tree	Quick growing	By seeds, cuttings	Deciduous
17.	*Emblica officinalis*	Awala	Euphorbiaceae	T	Tree	Quick growing	By seeds, cuttings, budding, inarching	Deciduous
18.	*Ficus benghalensis*	Bargad	Moraceae	T	Tree	Quick growing	By cutting seeds	Evergreen
19.	*Ficus glomerata*	Umbar	Moraceae	T	Tree	Quick growing	By seeds, cutting	Deciduous
20.	*Ficus religiosa*	Pipal	Moraceae	T	Tree	Quick growing	Through seeds, cutting	Evergreen
21.	*Hibiscus rosa-sinensis*	Jaswand	Malvaceae	T	Shrub	Quick growing	By seeds	Evergreen
22.	*Lantana camara*	Lantana	Verbenaceae	T	Shrub	Quick growing	By seeds, cuttings	Evergreen
23.	*Mangifera indica*	Mango	Anacardiaceae	T	Tree	Quick growing after 1st year	By seeds, transplantation, grafting, budding, air layering, root cutting, marcutting	Evergreen
24.	*Nerium indicum*	Kaner	Apocynaceae	T	Shrub	Quick growing	By Cutting	Evergreen
25.	*Psidium guayava*	Amrud	Myrtaceae	T	Tree	Quick growing	By seeds, stem, cutting,	Evergreen

Sr. No.	Scientific Name	Common Name	Family	Sensitive / Tolerant	Habit	Growth r ate	Regeneration	Evergreen / Deciduous
							budding, grafting	
26.	*Samanea saman*	Rain tree	Mimosaceae	T	Tree	Quick growing	By seed cutting	Evergreen
27.	*Saraca asoka*	Ashok	Caesalpinaceae	T	Tree	Quick growing	By seed	Evergreen
28.	*Syzygium cumini*	Jaman	Myrtaceae	T	Tree	Quick growing	By seed, cutting, Grafting, Budding	Evergreen
29.	*Tamarindus indica*	Imli	Caesalpinaceae	T	Tree	Quick growing (Early)	By seed	Evergreen
30.	*Zizyphus mauritiana*	Ber	Rhamnaceae	T	Tree	Quick growing	By seeds	Evergreen
31.	*Zizyphus xylopyra*	Katber	Rhamnaceae	T	Staggle r shrub	Quick growing	By seeds	Evergreen

Source: "Guideline for Developing Greenbelt" Central pollution Control Board, Program objective series PROBES/75/1999-2000

5.3.2. Avenue Plantation – Air pollution Control

One of management plan suggested under selected impact mitigations is development of thick avenue plantation along Highway **(SH-30)** which is bisecting the MIDC and Jayakwadi Bird Sanctuary area. Therefore, keeping the likely movement of vehicles along the highway (Noise and gas emission), it is suggested to develop thick avenue plantation to minimize those air pollution (dust, noise and other gas emission). In addition this avenue plantation would also provide habitat for many faunal species of the project area.

A total of 17 tree species have been selected based on the combination thick canopy cover, larger leaf area index and fast growing tree species. The list of tree species suggested for Avenue plantation is presented in **Table no. 5.3**

Table 5.3: Tree Species Suggested for Avenue Plantation - Control Air Pollution Impacts in the study area

S.No	**Species Name**	**Local Name**
1	*Aegle marmelos*	Bel, Bili Patra,
2	*Albizia lebbeck*	Siris, Karo Sirish
3	*Alstonia scholaris*	Satani
4	*Bauhinia variegata*	Kanchnar
5	*Butea monosperma*	Palas, Kesudo
6	*Cassia fistula*	Amaltas
7	*Dalbergia sissoo*	Shesham **
8	*Delonix regia*	Gulmohar
9	*Ficus benghalensis*	Banyan, Vad
10	*Ficus religiosa*	Peepal, Piplo
11	*Mangifera indica*	Mango, Aam
12	*Melia azedarach*	Melia, Bakani Nim
13	*Polyalthia longifolia*	Ashoka,
14	*Pongamia pinnata*	Karanja
15	*Syzygium cumini*	Jamun, Jambu
16	*Tamarindus indica*	Imli
17	*Termanilia catappa*	Desi Badam

5.3.3. Bio-filter Check Dams

The Nath-Sagar reservoir created by the Jaikwadi dam is a very large water body. It is joined by the rivers Godavari and Pravara, which have their water-shed formed by the hills at the west. It is 55 kms. long and 27 kms. wide, with about 34000 hectares of land under its submergence. Over the years, intense agricultural activities in the vicinity of this reservoir and influx of domestic and industrial waste have caused a multiple increase of productivity of this lake. The reservoir has a huge catchment area admeasuring 21,000 sq.kms.

However, other than the above indentified the sources of waste sewage water, large extent of waste water sources in the catchment area will find their natural course of way in different directions into the existing traditional small streams and confluence into major streams and river courses and thereby pollute the aquatic habitat. Therefore some of those traditional streams of the catchment area should have been identified and construction of "**Bio-Filter Check Dams**" should be done to minimise the sewage impacts on the Nath-sagar Reservoir and associate Avifauna of the Jayakwadi Bird Sanctuary.

5.4. THREATENED SPECIES CONSERVATION PLAN

This biodiversity status assessment study within the project study area, reported a total of 10 (Overall data generated through Primary survey and Secondary literature survey) threatened avifaunal species which were reported from nearby bird sanctuary area. Since the list of threatened avifauna have their diverse environmental and ecological requirements, it is not possible to suggest conservation plan for individual species. Added, most of the species have been protected and conserved within the Protected Area Network. Therefore habitat development for selected species is suggested under **Threatened Species Conservation Plan,** which would act as an additional habitat within and outside the project area.

5.4.1. Improvement in Food and Nesting Habitat

Taking into consideration the food and feeding habits of various species of birds listed during the present investigation in and around the reservoir, it is recommended that improvement in the food and nesting habitat of birds on all the suitable sites around the water-body will increase the population of avifaunal species in the study area **(Table 5.4)**.

Table 5.4: Food and Nest Tree species suggested for Developing Avifaunal Habitat (List of Birds associated plants for green belt development)

S. no	Scientific name	Birds
1.	Acacia catechu	Coppersmith, Blue throated Barbets, Red vented bulbul
2.	Alianthus excelsa	Asian koel, Jungle babbler, Common Myna, Asian pied starling
3.	Anthocephalus cadamba	Cattle egret, brown crowned night heron, white breasted kingfisher, pied kingfisher
4.	Ficus religiosa	Oriental white eye, common iora, long tailed shrike, rufous woodpecker
5.	Dendrocalamus sp.	Greater caucal, black drongo, jungle babbler, green bee eater
6.	Delonix regia	Red-whiskered bulbul, lineated barbet, black drongo, asian

		koel
7.	Ficus benghalensis	Indian roller, common hawk cuckoo, brown srike
8.	Lagerstromia parvoflora	Great tit, red vented bulbul, purple rumped sunbird
9.	Tamarindus indica	Black rumped flameback, rose ringed parakeet, Indian cuckoo, orange breasted green pigeon
10.	Tectona grandis	Red-whiskered bulbul, common iora, yellow footed green pigeon, black drongo
11.	Mangifera indica	rose ringed parakeet, rufous treepie, black rumped flameback
12.	Zizipus jujube	Verditer flycatcher, plain prinia, oriental magpie robin
13.	Thivetia peruviana	Purple sunbird, purple rumped sunbird, great tit, rufous treepie
14.	Terminalia cattappa	Oriental white eye, purple sunbird, plain prinia
15.	Hibiscus rosa-cinensis	Red breasted parakeet, Sunbird
16.	Cocos nucifera	Baya weaver bird
17.	Syzygium jamboanum	Flower pecker, red vented bulbul, Indian robin
18.	Azadirachta indica	Red vented bulbul, White browed bulbul, oriental white eye, House sparrow
19.	Bombax seiba	Leaf bird, Purple sunbird, Golden oriole, green bee eater

5.4.2 Elevated earthen / Wooden platforms for the birds:

The Nathsagar reservoir has around 30 islands inside the water body. These islands become visible when water goes down in late winter and summer season and the birds can see different roosting sites. At maximum capacity of reservoir, these earthern / wooden platforms may help in providing better place for roosting for the birds. Hence it is proposed to create elevated earthen / wooden platforms in different islands. Floating nest platforms can be placed for Terns, gulls and herons. When islands are created, a plan should be developed to identify species that should be using the site and whether there can be unfavorable conditions to other species in the area. **Plate 5.1** showing roosting of aquatic birds on earthen / wooden platforms – a representative image.

Plate 5.1 - The fixed platform offered more space and this allowed for an increase in the number of breeding pairs over a few consecutive breeding seasons, Ceaplace Island, Romania. © Dan Bandacu
(Catsadorakis, G. 2017. Artificial Nesting Structures for Eurasian pelicans. A decision-making and guideline document. Society for the Protection of Prespa, Greece.)

5.4.4. Artificial Nesting Platform –

The Nath Sagar reservoir creates 30 islands of various sizes in the shallow waters, with trees for roosting. This provides an ideal shelter for migratory birds. Installation of artificial nesting platforms both in the island area and along the peripheral area will provide immediate roosting site for different stork species. Installation of artificial nesting platform is recommended until natural host plants like *Acacia nilotica, Ailanthus excels, Azadirachta indica, Bombax ceiba, Ficus benghalensis, Ficus religiosa, Pithecellobium dulce, Syzygium cumini, Tamarindus indica, Terminalia arjuna and Ziziphus mauritiana* etc. attain suitable growth to sustain the birds nest. Plate 5.2 showing Occupied White Stork nesting platform.

Plate 5.2 - Occupied White Stork nesting platform

(Reference - Vilnius, (2011) Occupancy of artificial nesting platforms during the breeding season of 2010, Conservation of White Storks (Ciconia ciconia) in Lithuania LIFE07 NAT/LT/000531, Action E.5 Monitoring of project achievements, Monitoring report – I)

5.5. SOCIETAL ISSUES AND BENEFITS

5.5.1. Agriculture Hedge Vegetation

Other than water related pollution impact on agriculture lands, deposition of windblown dust particles and gas emission on agriculture productivity is one of the issues identified outside the project area. Therefore this impacts need to be attended through development of "**Agriculture Hedge Vegetation** along the bunds and periphery of the agriculture lands to mitigate the pollution problem. Though, it is not a mandatory mitigation measure of any development project, this problem should be implemented on need basis.

A total of 21 tree species have been identified for developing agriculture hedge vegetation, which perform as dust controller and also these are wild and common tree species which provides monitory benefit like fruits for the locals. In addition, they can be lopped in a sustainable manner (one in 3 to 5 years) and the foliage can be used as green manure. All species have been reported in the study area and majority of them are fleshy fruit bearing trees likely to support many frugivore birds and some mammals like: squirrels, bats, civet cat and primate species (Table 5.5).

Table 5.5: Tree Species Suggested for Agriculture Hedge Vegetation to control soil erosion and Air Pollution Impacts over the Jayakwadi Bird Sanctuary Area

S. No	**Species Name**	**Local Name**	**Family**
1	*Aegle marmelos*	Bel	Rutaceae
2	*Albizia lebbeck*	Siris	Fabaceae
3	*Alstonia scholaris*	Saptaparni	Apocynaceae
4	*Annona reticulate*	Ramfal	Annonaceae
5	*Annona squamosa*	Sitaphal	Annonaceae
6	*Artocarpus heterophyllus*	Kathal	Moraceae
7	*Azadirachta indica*	Neem	Meliaceae
8	*Butea monosperma*	Palas	Fabaceae
10	*Citrus aurantium*	Nimbu	Rutaceae
11	*Ficus benghalensis*	Vad	Moraceae
12	*Ficus racemosa*	Pipal	Moraceae
13	*Ficus religiosa*	Peepal	Moraceae
14	*Mangifera indica*	Mango	Anacardiacece
15	*Manilkara zapota*	Chikkoo	Sapotaceae
16	*Pithecolobium dule*	Jangali jalabi	Fabaceae

S. No	**Species Name**	**Local Name**	**Family**
17	*Pongamia pinnata*	Karanja	Fabaceae
18	*Psidium guajava*	Amrood	Myrtaceae
19	*Syzygium cumini*	Jamun	Myrtaceae
20	*Tamarindus indica*	Imli	Caesalpiniaceae
21	*Termanilia catappa*	Desi Badam	Combretaceae

5.5.2. Organic Farming

At present there are about 60 villages on both banks of reservoir with around 2000 to 3000 families from these villages involved in agriculture practices along the bank of the reservoir. During post monsoon when reservoir fills up to 50 to 60% of its overall capacity the amount of farming goes up to 10000 ha. Farmers raise crops like Wheat, Jawar, Bajari, Chilly, Groundnuts, Cotton, Toor and Sugar cane. Currently due to enough water availability, crops like Sugar cane are raised on large scale. The farmers randomly use chemical fertilizers and insecticides, which ultimately drain and leach out into the reservoir, causing pollution of potable water.

Organic farming is one of the fast growing agriculture practices which relies on fertilizers of organic origin such as compost manure, green manure, and bone meal and places emphasis on techniques such as crop rotation and companion planting that fetch good income. Therefore it is recommended to adopt such management interventions with the identified local villagers, encouraging them to grow fruit and vegetable crops. Based on the success of this intervention on large scale, other commercial and grain crops can be brought under organic farming.

In this context it is suggested that project proponent to create awareness on the organic farming to the locals involved in agriculture activities which will help in reduction of use of chemical fertilizers in the peripheral areas of Nathsagar dam.

5.6 FINANCIAL FORECAST

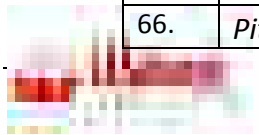
Table 5.6 - Funds for flora and fauna management plan

S. No	Description	Amount in Lakhs (Rs)
A	**Particular**	
1	Green Shelter Belt - Air pollution Control	5.00
2	Avenue Plantation	
3	Bio-filter Micro Check Dams	
4	Improvement in Food and Nesting Habitat	
5	Elevated earthen / Wooden platforms for the birds	
6	Artificial Nesting Platform	
7	Agriculture Hedge Vegetation	
8	Organic Farming	
B	**Revenue expenditure for next 5 years**	
1	Green Shelter Belt - Air pollution Control	5.00
2	Avenue Plantation	
3	Bio-filter Micro Check Dams	
4	Improvement in Food and Nesting Habitat	
5	Elevated earthen / Wooden platforms for the birds	
6	Artificial Nesting Platform	
7	Agriculture Hedge Vegetation	
8	Organic Farming	
9	Manpower assistance	
	Grand total	**10.00**

Annexure 1 – List of plant species observed in the study area

Sr. No.	Scientific Name	Local Name	Family
1.	*Abrus precatorius*	Chanoti	Fabaceae
3.	Acacia auriculiformis	Australian acacia	Fabaceae
	Acacia leucophlea	Subabul	Fabaceae
4.	*Acacia nilotica*	Babul	*Fabaceae*
5.	*Adhatoda vasica*	Adulsa	Acanthaceae
6.	*Aegle marmelos*	Bel	*Rutaceae*
7.	*Agave Americana*	Agave	Asparagaceae
8.	Ailanthus excelsa	Maharukh	Simaroubaceae
9.	*Albizia lebbeck*	Siris	*Fabaceae*
10.	*Albizia procera*	Safed Siris	Fabaceae
11.	*Aloe vera*	Gorphad	Xanthorrhoeaceae
12.	Alstonia scholaris	Saptaparni	Apocynaceae
13.	*Annona reticulate*	Ramphal	Annonaceae
14.	*Annona squamosa*	Sitaphal	Annonaceae
15.	Anthocephalus cadamba	Kadamba	Rubiaceae
16.	*Argemone Mexicana*	Pila Dhatura	Papaveraceae
	Asparagus racemosus	Shatavari	Asparagaceae
17.	*Azadirachta indica*	Neem	Meliaceae
18.	*Barleria cristata*	Koranta	Acanthaceae
19.	*Bauhinia purpurea*	Bahunia	Fabaceae
20.	*Bauhinia racemosa*	Ari	Fabaceae
21.	*Bombax ceiba*	Semal	Malvaceae
22.	Bougainvillea glabra	Bougainvel	Nyctaginaceae
23.	Buchanania lenzen	Char	Anacardiaceae
24.	*Butea monosperma*	Palash	Fabaceae
25.	*Calotropis gigantean*	Rui	Apocynaceae
26.	*Calotropis procera*	Rui	Asclepiadaceae
27.	Carica papaya	Papaya	Caricaceae
28.	Carissa caronulas	Caranda	Apocyanaceae
29.	*Cassia fistula*	Amaltas	Fabaceae
30.	*Cassia siamea*	Kesia	Fabaceae
31.	*Cassia tora*	Puwad	Fabaceae
32.	Citrus lemon	Nimbo	Rutaceae
33.	Cocos nucifera	Coconut	Arecaceae

Sr. No.	Scientific Name	Local Name	Family
34.	*Crotalaria juncea*	Bansan	Fabaceae
35.	*Cuscuta reflexa*	Amarvel	Convolvulaceae
36.	*Cymbopogon martini*	Rosha	Poaceae
37.	*Dalbergia latifolia*	Shisham	Fabaceae
38.	*Dalbergia sissoo*	Shisham	Fabaceae
39.	*Delonix regia*	Gulmohar	Fabaceae
40.	*Dendrocalamus strictus*	Baus-Bongu	Poaceae
41.	*Emblica officinalis*	aawla	Phyllanthaceae
42.	*Eucalyptus sp.*	*Eucalyptus*	Myrtaceae
43.	*Euphorbia hirta*	Asthma Weed	Euphorbiaceae
44.	*Euphorbia pulcherrima*	Euphorbia	Euphorbiaceae
	Euphorbia tirucali	Euphorbia	Euphorbiaceae
45.	*Ficus benghalensis*	Vad	Moraceae
46.	*Ficus racemosa*	Gular, Umar	Moraceae
47.	*Ficus religiosa*	Pipal	Moraceae
	Gymnosporia montana	Mountain spike thorn	Celastraceae
	Hemidesmus indicus	karala	Apocynaceae
48.	*Hibiscus rosa-sinensis*	Jaswand	Malvaceae
49.	*Ipomoea carnea*	Beshram	Convolvulaceae
50.	*Jatropha curcas*	Ratanjyot	Euphorbiaceae
51.	*Lantana camara*	Ghaneri	Verbenaceae
53.	*Lawsonia inermis*	Mehendi	Lythraceae
54.	Leucaena leucocephala	Subabul	Fabaceae
55.	*Mangifera indica*	Aam	Anacardiaceae
56.	*Melia azedarach*	Bakayan	Meliaceae
57.	*Morinda tinctoria*	Mungna	Rubiaceae
58.	*Musa paradisiaca*	Banana	Musaceae
59.	*Nerium indicum*	Kaner	Apocynaceae
60.	Nyctanthes arbor-tristis	Parijatak	Oleaceae
61.	*Ocimum gratissimum*	Vantulsi	Lamiaceae
62.	*Parthenium hysterophorus*	Gajar Ghaas	Asteraceae
63.	Peltophorum pterocarpum	Peltophorum	Fabaceae
64.	*Phoenix sylvestris*	Khajur	Arecaceae
65.	*Phyllanthus erecta*	Bhui aawla	Euphorbiaceae
66.	*Pithecellobium dulce*	Jungle Jalebi	Fabaceae



Sr. No.	Scientific Name	Local Name	Family
67.	*Plumeria rubra*	chafa	Apocynaceae
68.	Polyalthia longifolia	Asopalav	Annonaceae
69.	*Pongamia pinnata*	Karang	Fabaceae
	Prosopis Juliflora	Prosopis	Fabaceae
70.	*Psidium guava*	Amrud	Myrtaceae
71.	Punica granatum	Anar	Punicaceae
72.	*Ricinus communis*	Arandee	Euphorbiaceae
73.	Samania saman	Raintree	Fabaceae
74.	Sarca asoka	Ashoka	Caesalpiniaceae
75.	*Sida acuta*	Bala	Malvaceae
76.	*Sida rhombifolia*	Atibala	Malvaceae
77.	*Solanum nigrum*	Kangni	Solanaceae
78.	*Syzygium cumini*	Nerale	Myrtaceae
79.	*Tamarindus indica*	Chinch	Caesalpiniaceae
	Tinospora cordifolia	Giloy	Menispermaceae
80.	Tectona grandis	Sagwani, Tegu, Sagar	Verbenaceae
81.	Terminalia arjuna	Hole-matti	Combretaceae
82.	Terminalia catappa	Jangli Badam	Combretaceae
83.	*Thespesia lampas*	Rankapas	Malvaceae
84.	*Tribulus terrestris*	Gokharu	Zygophyllaceae
85.	*Tridax procumbens*	Kumru	Asteraceae
86.	*Vitex negundo*	Vaaili	Lamiaceae
87.	*Zea mays*	Makka	Poaceae
88.	*Ziziphus mauritiana*	Bor	Rhamnaceae
89.	*Ziziphus nummularia*	Jhadi ber	Rhamnaceae

Annexure 2 – List of faunal species observed in the study area

Sr. No.	Scientific Name	Common Name	Family	Status in Wildlife (Protection) Act-1972	Status in IUCN Category
Mammals					
1.	*Canis aureus*	Jackal	Canidae	Schedule II	Least Concern
2.	*Funambulus pennant*	Palm Squirrel	Sciuridae	Not Enlisted	Least Concern
3	*Hyaena hyaena*	Tadas	Hyaeninae	Schedule III	Data Deficient
4.	*Herpestes edwardsii*	Common Mongoose	Herpestidae	Schedule II	Least Concern
5.	Lutragale perspicillata	Smooth Indian Otter	Lutrinae	Schedule II	Not Evaluated
6.	*Lepus nigricollis*	Indian Hare	Leporidae	Schedule IV	Least Concern
7.	*Presbytis entellus*	Common Langur	Cercopithecidae	Schedule II	Not Evaluated
8.	*Rattus rattus*	Common House Rat	Muridae	Not Enlisted	Least Concern
9.	*Sus scrofa*	Indian Wild Boar	Suidae	Schedule III	Least Concern
Reptiles and Amphibians					
10.	*Bungarus caeruleus*	Krait	Elapidae	Schedule IV	Not Evaluated
11.	*Ramphotyphlops braminus*	Common Blind snake	Typhlopidae	Schedule IV	Not Evaluated
12.	*Vipera russelli*	Russel viper	Viperidae	Schedule IV	Not Evaluated
13.	*Dryophis mycterizans*	*Common green whip snake*	Colubridae	Schedule IV	Not Evaluated
14.	*Ptyas mucosus*	Common Rat Snake	Colubridae	Schedule II	Not Evaluated

Annexure 3 – Public consultation

Sr. No	Village Name	Name of Person	Comments by Villagers
1	Back Water (Jayakawadi Dam)	a. Jitesh Waghmare b. Vithal Waghmare c. Abhishek K. Shejul d. Nivrutti K. Shejul	1. Wildlife animal like Deer, Wild Boar, Wolf, Fox, Hyena, Langoor, Mongoose, Jungle cat etc are generally observed in the study area. 2. These animals damages the agricultural area & crops. These animals normally observed in the month of October to May for feeding & Water. 3. Snake like Ghonas, Dhaman, Pansap, Nag were also observed by the villagers 4. This village is near to the Jayakwadi Bird Sanctuary. 5. They can be observed in the season of post monsoon period for feeding.
2	Dhorkingaon	a. Vyanktesh Kaduba Dhotre b. Jyoti V. Dhotre c. Keshav Jadhav d. Sakaram Sable	1. Wildlife animal like Deer, Tadas, Wolf, Fox, Mongoose, Hanuman Langur, Jungle Cat etc are responsible for loss of crops & agricultural area
3	Rahatgaon	a. Ashok Darade b. Sagar Patil c. Tukaram Jadhav	1. Wild animals like deer, wild boar, wolf, Tadas, fox, peacock observed in and around the village area. 2. Loss of crops & loss of Agricultural area by these animal within the year.
4	Mudhalwadi	a. Baliram Kadve b. Sampataro Kadve c. Ganesh Shinde	1. Animals like deer, Sambar, Tadas, Peacock, Langur, Fox are observed near to the village.
5	Waghundi	a. Marotirao Jadhav b. Vikram Shinde	1. Agricultural loss & crop loss are main observation because of these animals which are searching for food & water.
6	Wadala	a. Tulsidas Kadve b. Nilesh Patil c. Amol Shinde d. Santosh Pawar	1. Wildlife animal like Deer, Tadas, Wolf, Fox, Mongoose, Hanuman Langur, Jungle Cat, Sayal etc are responsible for loss of crops & agricultural area.

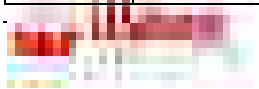
Annexure 4 – List of butterfly species observed in the study area

Sr. No.	Common Name	Scientific Name	Family
1	Blue pansy	Précis orithyia	Nymphalidae
2	Chocolate pancy	Junonia iphita	Nymphalidae
3	Common crow	Euploea core	Nymphalidae
4	Common Emigrant	Catopsilia crocale	Pieridae
5	Common four ring	Ypthima huebneri	Nymphalidae
6	Common grass yellow	Eurema hecade	Pieridae
7	Common leopard	Phalanta phalantha	Nymphalidae
8	Common rose	Pachliopta aristolochiae	Papilionidae
9	Common sailor	Neptis hylas	Nymphalidae
10	Common sergeant	Athyma perius	Nymphalidae
11	Danaid eggfly	Hypolimnas misippus	Nymphalidae
12	Glassy Tiger	Parantica aglea	Nymphalidae
13	Grey pancy	Junonia atlites	Nymphalidae
14	Indian jezebel	Delias eucharis	Pieridae
15	Orange tip	Colotis etrida	Pieridae
16	Peacock pansy	Précis almanac	Nymphalidae
17	Plain tiger	Danaus chrysippus	Danaidae
18	Striped Tiger	Danaus genutia	Nymphalidae

Annexure 5 – List of bird species observed in the study area

Sr no.	Common name	Scientific Name	Family	Status as per WPA 1972	IUCN Status
1	Asian openbill	Anastomus oscitans	Ciconiidae	Schedule IV	Least Concern
2	Barn swallow	Hirundo rustica	Hirundinidae	Schedule IV	Least Concern
3	Baya weaver	Ploceus philippinus	Ploceidae	Schedule IV	Least Concern
4	Black – Winged Kite	Elanus caeruleus	Accipitridae	Schedule IV	Least Concern
5	Black drongo	Dicrurus macrocercus	Dicruridae.	Schedule IV	Least Concern
6	Black Ibis	Pseudibis papillosa	Threskiornithidae	Schedule IV	Least Concern
7	Black stork	Ciconia nigra	Ciconiidae	Schedule IV	Least Concern
8	Black tailed Godwit	Limosa limosa	Scolopacidae	Schedule IV	Near threatened
9	Black winged stilt	Himantopus himantopus	Recurvirostridae	Schedule IV	Least Concern
10	Blossom – head Parakeet	Pesitacula Cyanocephala	Pesittacidae	Schedule IV	Least Concern
11	Blue Rock Pigeon	Columba livia	Columbidae	Schedule IV	Least Concern
12	Brahminy Starling	Sturnus Pagodarum	Sturnidae	Schedule IV	Least Concern
13	Caspian tern	Hydroprogne caspia	Laridae	Not enlisted	Least Concern
14	Cattle egret	Bubulcus ibis	Ardeidae	Schedule IV	Least Concern
15	Citrine wagtail	Motacilla citreola	Motacillidae	Schedule IV	Least Concern
16	Common grey Hornbill	Ocyceros birostris	Bucerotide	Schedule IV	Least Concern
17	Common Indian Nightjar	Caprimulgus asiaticus	Caprimulgidae	Schedule IV	Least Concern
18	Common Myna	Acridotheres tristis	Sturnidae	Schedule IV	Least Concern
19	Common Pariah Kite	Milvus migrans	Accipitridae	Schedule IV	Least Concern
20	Common tern	Sterna hirundo	Laridae	Schedule IV	Least Concern
21	Crow Pheasant	Centropus sinensis	Cuculidae	Schedule IV	Least Concern
22	Gery Partridge	Francolinus pondicerianus	Phasianidae	Schedule IV	Least Concern
23	Glossy ibis	Plegadis falcinellus	Threskiornithidae	Schedule IV	Least Concern
24	Golden Oriole	Oriolus oriolus	Oriolidae	Schedule IV	Least Concern
25	Grey heron	Ardea cinerea	Ardeidae	Schedule IV	Least Concern
26	Hoopoe	Upupa epops	Upupidae	Schedule IV	Least Concern
27	House Crow	Corvus splendens	Corvidae	Schedule IV	Least Concern
28	House Sparrow	Passer domesticus	Passerinae	Schedule IV	Least Concern
29	Indian Cuckoo	Cuclus micropterus	Cuculidae	Schedule IV	Least Concern
30	Indian peafowl	Pavo cristatus	Phasianidae	Schedule I	Least Concern
31	Indian pond heron	Ardeola grayii	Ardeidae	Schedule IV	Least Concern
32	Jungle Babbler	Turdoides striatus	Timaliinae	Schedule IV	Least Concern

Sr no.	Common name	Scientific Name	Family	Status as per WPA 1972	IUCN Status
33	Jungle Crow	Corvus macrorhynchos Wagler	Corvidae	Schedule IV	Least Concern
34	Koel	Eudynamys scolopacae	Cuculidae	Schedule IV	Least Concern
35	Large Egret	Casmoerodius albus	Ardeidae	Schedule IV	Least Concern
36	Little Brown Dove	Streptopelia sengalensis	Columbidae	Schedule IV	Least Concern
37	Little cormorant	Microcarbo niger	Phalacrocoracidae	Schedule IV	Least Concern
38	Little Egret	Egretta garzetta	Ardeidae	Schedule IV	Least Concern
39	Little ringed Plover	Charadrius dubius	Charadiriidae	Not enlisted	Least Concern
40	Long tailed shrike	Lanius schach	Laniidae	Schedule IV	Least Concern
41	Median Egret	Mesophoyx intermedia	Ardeidae	Schedule IV	Least Concern
42	Northern shoveler	Spatula clypeata	Anatidae	Not enlisted	Least Concern
43	Pied bushchat	Saxicola caprata	Muscicapidae	Schedule IV	Least Concern
44	Purple – rumped sunbird	Nectarinia Zeylonica	Nectariniidae	Schedule IV	Least Concern
45	Purple Sunbrid	Nectarinia asiatica	Nectariniidae	Schedule IV	Least Concern
46	Purple swamphen	Porphyrio porphyrio	Rallidae	Schedule IV	Least Concern
47	Red – vented Bulbul	Pycononotus cafer	Pycononotidae	Schedule IV	Least Concern
48	Red Munia	Amandava amandava	Estrildidae	Schedule IV	Least Concern
49	Red wattled lapwing	Vanellus indicus	Charadriidae	Schedule IV	Least Concern
50	Rose – ringed Parakeet	Pesitacula Kramri (Scopoli)	Pesittacidae	Schedule IV	Least Concern
51	Sand plover	Charadrius mongolus	Charadriidae	Schedule IV	Least Concern
52	Small Bee – eater	Merops Orientalis	Meropidae	Schedule IV	Least Concern
53	Small Blue Kingfisher	Alcedo athhis	Alcedinidae	Schedule IV	Least Concern
54	Spotted Dove	Streptopelia chinensis	Columbidae	Schedule IV	Least Concern
55	Spotted Munia	Lonchura Punctulata	Estrildidae	Schedule IV	Least Concern
56	Spotted owlet	Athene brama	Strigidae	Schedule IV	Least Concern
57	White – breasted Kingfisher	Halcyon smyrnensis	Alcedinidae	Schedule IV	Least Concern
58	White – throated Munia	Lonchura Malabarica	Estrildidae	Schedule IV	Least Concern
59	White browed wagtail	Motacilla maderaspatensis	Motacillidae	Schedule IV	Least Concern
60	White eye	Zosterops palpebrosus	Zosteropidae	Schedule IV	Least Concern
61	white stork	Ciconia ciconia	Ciconiidae	Schedule I	Least Concern
62	White throated kingfisher	Halcyon smyrnensis	Alcedinidae	Schedule IV	Least Concern
63	wire tailed swallow	Hirundo smithii	Hirundinidae	Schedule IV	Least Concern
64	wooly necked stork	Ciconia episcopus	Ciconiidae	Schedule IV	vulnerable
65	Yellow – wattled	Vanellus malabricus	Charadiriidae	Schedule IV	Least Concern



Sr no.	Common name	Scientific Name	Family	Status as per WPA 1972	IUCN Status
	Lapwing				
66	Yellow wagtail	Motacilla flava	Motacillidae	Schedule IV	Least Concern

Annexure 6 – List of Bird species observed in the study area – Secondary source ●

Sr. No.	Common Name	Scientific Name	Family	Status	IUCN status
1	White Stork	Ciconia ciconia	Ciconiidae	M	Least Concern
2	Greater Flamingo	Phoenicopterus roseus	Phoenicopteridae	M	Least Concern
3	Bar-headed Goose	Anser indicus	Anatidae	M	Least Concern
4	Lesser Whistling teal	Dendrocygna javanica	Anatidae	L.M.	Least Concern
5	Ruddy Shelduck	Tadorna ferruginea	Anatidae	M	Least Concern
6	Marbled Teal	Marmaronetta angustirostris	Anatidae	M	Vulnerable
7	Pintail	Anas acuta	Anatidae	M	Least concern
8	Green winged Teal	Anas crecca	Anatidae	M	Not evaluated
9	Domestic Duck	Anas platyrhynchos	Anatidae	M	Least concern
10	Gadwall	Anas strepera	Anatidae	M	Least concern
11	Eurasian wigeon	Anas penelope	Anatidae	M	Least concern
12	Garganey	Anas querquedula	Anatidae	M	Least concern
13	Northern shoveller	Anas clypeata	Anatidae	M	Least concern
14	Red-crested Pochard	Netta rufina	Anatidae	M	Least concern
15	Common Pochard	Aythya ferina	Anatidae	M	Vulnerable
16	White eyed Pochard	Aythya nyroca	Anatidae	M	Near Threatened
17	Tufted duck	Aythya fuligula	Anatidae	M	Least Concern
18	Scaup Duck	Aythya marila	Anatidae	M	Least Concern
19	Eastern Imperial Eagle	Aquila heliaca	Accipitridae	M	Vulnerable
20	Greater Spotted Eagle	Aquila clanga	Accipitridae	L.M.	Vulnerable
21	Lesser Spotted Eagle	Clanga pomarina	Accipitridae	L.M.	Least concern
22	Pallid Harrier	circus macrourus	Accipitridae	M	Near threatened
23	Montagu's Harrier	*Circus pygargus*	Accipitridae	M	Least concern
24	Western Marsh Harrier	Circus aeruginosus	Accipitridae	M	Least concern
25	Western Osprey	Pandion haliaetus	Pandionidae	M	Least concern
26	Peregrine Falcon	Falco peregrinus	Falconidae	M	Least concern
28	Demoiselle Crane	Grus virgo	Gruidae	M	Least concern
29	Grey plover	Pluvialis Squatarola	Charadriidae	M	Least concern
30	Golden Polver	Pluvialis dominica	Charadriidae	M	Least concern

Sr. No.	Common Name	Scientific Name	Family	Status	IUCN status
31	Kentish Polver	Charadrius alexandrinus	Charadriidae	M	Least concern
32	Whimbrel	Numenius phaeopus	Scolopacidae	M	Least concern
33	Eurasian Curlew	Numenius arquata	Scolopacidae	M	Near threatened
34	Black-tailed Godwit	Limosa limosa	Scolopacidae	M	Near threatened
35	Spotted Redshank	Tringa erythropus	Scolopacidae.	M	Least concern
36	Redshank	Tringa totanus	Scolopacidae	L.M.	Least concern
37	Common Green Shank	Tringa nebularia	Scolopacidae	M	Least concern
38	Wood Sandpiper	Tringa glareola	Scolopacidae	M	Least Concern
39	Terek Sandpiper	Xenus cinereus	Scolopacidae		Least concern
40	Pin tailed snipe	Gallinago stenura	Scolopacidae	M	Least concern
41	Little Stint	Calidris minuta	Scolopacidae	M	Least concern
42	Dunlin	Calidris alpina	Scolopacidae	M	Least concern
43	Ruff	Philomachus pugnax	Scolopacidae	M	Least concern
44	Black winged stilt	Himantopus himantopus	Recurvirostridae	M	Least concern
45	Pied avocet	Recurvirostra avosetta	Recurvirostridae	M	Least concern
46	Harring gull	Larus argentatus	Laridae	M	Least concern
48	Brown headed gull	Larus brunnicephalus	Laridae	M	Least concern
49	Caspian Tern	Hydroprogne caspia	Laridae	M	Least concern
50	Common Tern	Sterna Hirundo	Laridae	M	Least concern
51	Shorted lark	Calandrella cinerea	Alaudidae	M	Least concern
52	Common swallow	Hirundo rustica	Hirundinidae	M	Least concern
53	Rosy starling	Strunus roseus	Sturnidae	M	Least concern
54	Red Breasted flycatcher	Muscicapa parva	Muscicapidae	M	Least concern
55	Verditer Fly catcher	Muscicapa thalassina	Muscicapidae	M	Least concern
56	Thickbilled warbler	Acrocephalaus Aedon	Acrocephalidae	M	Least concern
57	Indian Gret Reed warbler	Acrocephalus stent oreus	Acrocephalidae	M	Least concern
58	Blyth's Reed warbler	Acrocephalus dumetrum	Acrocephalidae	M	Least concern
59	Booted Warbler	Hippolais Caligata	Acrocephalidae	M	Least concern
60	Western Orphean Warbler	Sylvia hortensis	Sylviidae	M	Least concern

Sr. No.	Common Name	Scientific Name	Family	Status	IUCN status
61	Lesser Whitethroat	Sylvia curruca	Sylviidae	M	Least concern
62	Fire breasted Flowerpecker	*Dicaeum ignipectus*	Dicaeidae	M	Least concern
64	Black Redstart	Phoenicurus ochruros	Turdidae	L.M.	Least concern
65	Blue Rock Thrush	Monticola solitaries	Turdidae	L.M.	Least concern

M – Migrant, L.M. – Local migrant

Annexure 7 – **Location-wise Distribution of Phytoplankton Species in the study area**

Sr. No	Species	S1	S2	S3	S4	S5	S6	S7	S8	Total
	Chlorophyceae									
1	Hydrodictyon sp.	—	—	—	—	†	—	†	†	3
2	Pediastrum sp.	†	†	—	†	—	†	—	†	5
3	Oocystis sp.	†	†	—	—	—	†	†	—	4
4	Selenastrum sp.	—	—	†	—	†	†	—	—	3
5	Ankistrodesmus sp.	—	2	2	—	2	2	—	2	5
6	Actinastrum sp.	†	—	—	†	—	†	—	—	3
7	Scenedesmus sp.	4	—	4	4	—	—	4	—	4
8	Oedogonium sp.	—	†	†	—	†	—	—	—	3
9	Spirogyra sp.	—	—	—	—	†	†	—	†	3
10	Closterium sp.	—	1	1	1	—	1	—	—	4
11	Cosmarium sp.	†	—	—	—	†	—	—	†	3
12	Staurastrum sp.	—	—	†	†	—	—	—	—	2
13	Nitella sp.	—	†	—	—	—	†	—	†	3
14	Chara sp.	—	—	—	—	†	†	—	—	2
	Bacillariophyceae									
15	Fragillaria sp.	—	—	—	—	—	†	—	—	1
16	Synedra sp.	2	2	—	2	—	2	2	2	6
17	Navicula sp.	3	—	3	3	—	3	3	—	5
18	Pinnularia sp.	—	—	†	—	†	—	†	—	3
19	Gyrosigma sp.	†	—	—	†	—	—	—	†	3
20	Gomphonema sp.	—	1	—	1	—	1	—	—	3
21	Cymbella sp.	—	†	—	†	—	—	—	—	2
22	Nitzischia sp.	—	—	3	3	3	—	3	3	5
	Cynophyceae									
23	Microcystis sp.	†	—	—	†	—	†	—	†	4
24	Chroococcus sp.	†	—	†	—	—	†	—	—	3
25	Gloeocapsa sp.	—	†	—	†	—	—	†	—	3
26	Merismopedia sp.	—	—	†	†	†	—	—	—	3
27	Oscillatoria sp.	—	5	—	5	—	5	—	5	4
28	Anabaena sp.	—	†	—	—	†	—	—	†	3
	Euglenophyceae									
29	Euglena sp.	—	—	—	5	5	—	5	5	4
	Site - Species Index	10	12	11	16	12	16	9	13	

	PPI	**9**	**11**	**13**	**24**	**10**	**14**	**17**	**17**	

Annexure 8 – **Location-wise Distribution of Zooplankton Species in the study area**

Sr. No	Scientific Name	S1	S2	S3	S4	S5	S6	S7	S8	Total
I	ROTIFERA									
1	Branchionus sp.	†	—	†	—	†	†	—	†	5
2	Keratella sp.	—	†	—	†	†	—	†	†	5
3	Filinia sp.	†	—	—	†	—	†	—	—	3
II	CLADOCERA									
1	Daphnia sp.	—	†	—	—	†	—	†	—	3
2	Cerodaphina sp.	†	—	—	†	—	†	†	—	4
3	Moina sp.	—	†	†	†	—	†	†	—	5
4	Alona sp.	—	†	—	†	—	†	—	—	3
III	COPEPODA									
1	Diaptomus sp.	—	†	†	—	†	†	—	—	4
2	Mesocyclops sp.	—	—	—	†	—	†	†	†	4
3	Macrocyclops sp.	†	†	—	—	†	†	—	†	5
4	Nauplius sp.	†	—	†	†	—	—	—	—	3
5	Paracyclop sp.	—	—	—	†	—	†	†	—	3
IV	OSTRACODA									
1	Cypris sp.	—	†	†	—	†	—	†	—	4
2	Eucypris sp.	†	—	†	—	†	—	—	—	3
3	Metacypris sp.	—	†	†	—	†	†	—	—	4
	Site - species Index	6	8	7	8	8	10	7	4	

Annexure 9 – **Location-wise Distribution of Zooplankton Species in the study area**

Sr. No.	**Scientific Name**	**Family**
1	Notopterus notopterus	Notopteride
2	Puntius sophore	Cyprininae
3	Puntius ticto	Cyprininae
4	Cirrhinus mrigala	Cyprininae
5	Catla Catla	Cyprininae
6	Labeo calbasu	Cyprininae
7	Labeo rohita	Cyprininae
8	Rita rita	Ritinae
9	Mystus armatus	Bagarinae
10	Mystus tengara	Bagarinae
11	Wallago attu	siluridae
12	Clarius hatrachus	Clariidae
13	Mastacembelus armatus	Mastacembelidae

Chapter 7
Reference

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