



BIODIVERSITY ASSESSMENT OF BDA CITY CENTRE (NICCO PARK)



May 2021

**BIODIVERSITY ASSESSMENT
OF
BDA CITY CENTRE (NICCO PARK)**

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Preface

The pressure on urban forest or social forestry around the cities is increasing globally with urban growth and intensified land use as key drivers. As a consequence, urban forest patches and parks within cities are of increasing importance for biodiversity conservation, balancing urban ecosystems and to educate the local population. Such forest patches or parks in urban areas are highly valuable as it provides a home for birds, small mammals and other faunal species. They also provide shade, maintain biodiversity, reduce air pollution, absorb excess carbon dioxide and release oxygen, etc. Some plant species have unique characters to reduce pollution including noise, air and heavy metal pollution. These valuable contribution by the green patches makes the environment lively and liveable. In this aspect, the present report on biodiversity assessment of BDA city centre, NICCO Park will give a glance on urban ecosystem of Bhubaneswar by providing a baseline data of floral and faunal wealth of the park. This could help to make a long-term strategy to develop rich urban ecosystem along with the fast urbanization. Recommendation of plant species for plantation with respect to landscape, ecological, medicinal or other values could enhance the existing beauty and values. Such work could also be a model for development of urban ecosystem in future in other parts of the world.

Acknowledgement

We are very thankful to the IBI group for their efforts, valuable time, suggestions and all the facilities provided during the survey works and making the survey successful. We are also thankful to the employees of NICCO Park, Bhubaneswar, Odisha. We are grateful to the people who helped us directly or indirectly in this survey and assessment work.

Summary

BDA City Centre, NICCO Park is situated amidst the city of Bhubaneswar, Odisha. It plays an important role to minimize pollution, providing habitat for faunal and avifaunal wealth, provides recreation, and boost positive environment for the populace of Bhubaneswar. The cities around the world, represent about 3.1% of the world's land usage, but their effects on climate, resources, pollution and biodiversity extend far beyond their municipal boundaries. Therefore, the assessment and restoration as per the landscapes are needed in the alarming rate. Keeping this in view, APRF (Ambika Prasad Research Foundation) & IBI Group have taken a step to do the assessment of Bio-wealth of the Urban Park i.e., BDA City Centre, NICCO Park, Bhubaneswar, Odisha. The survey was done during the month of February 2021- April 2021. The random and line transect methods were used to enumerate and faunal species. The line transect and quadrant method were used to enumerate the floral wealth and analysis of species richness. Random surveys were also carried out to establish the relationship between floral and faunal wealth. The result of the survey revealed that about 219 floral species. Among them, 125 species are medicinal, 31 species have food values, 3 species having socio-cultural values, 8 invasive species and 2 threatened plants. The survey also enumerated 25 butterflies, 46 birds, 2 mammals from the study area. The survey works concluded that BDA City centre, NICCO park is a hub of different types of floral and faunal wealth in an urban area. However, there is a need to restore with many plants having food, medicinal and ecological values. The 8 invasive species are recorded and suggested to remove them and plant other useful plants. In the context of suggestions, 8 models are proposed to make long term strategy for the maintenance of the ecosystem of park and conservation of Biowealth of BDA city centre, NICCO Park, Bhubaneswar. The present study and data will be beneficial for future assessment and restoration works in urban areas.

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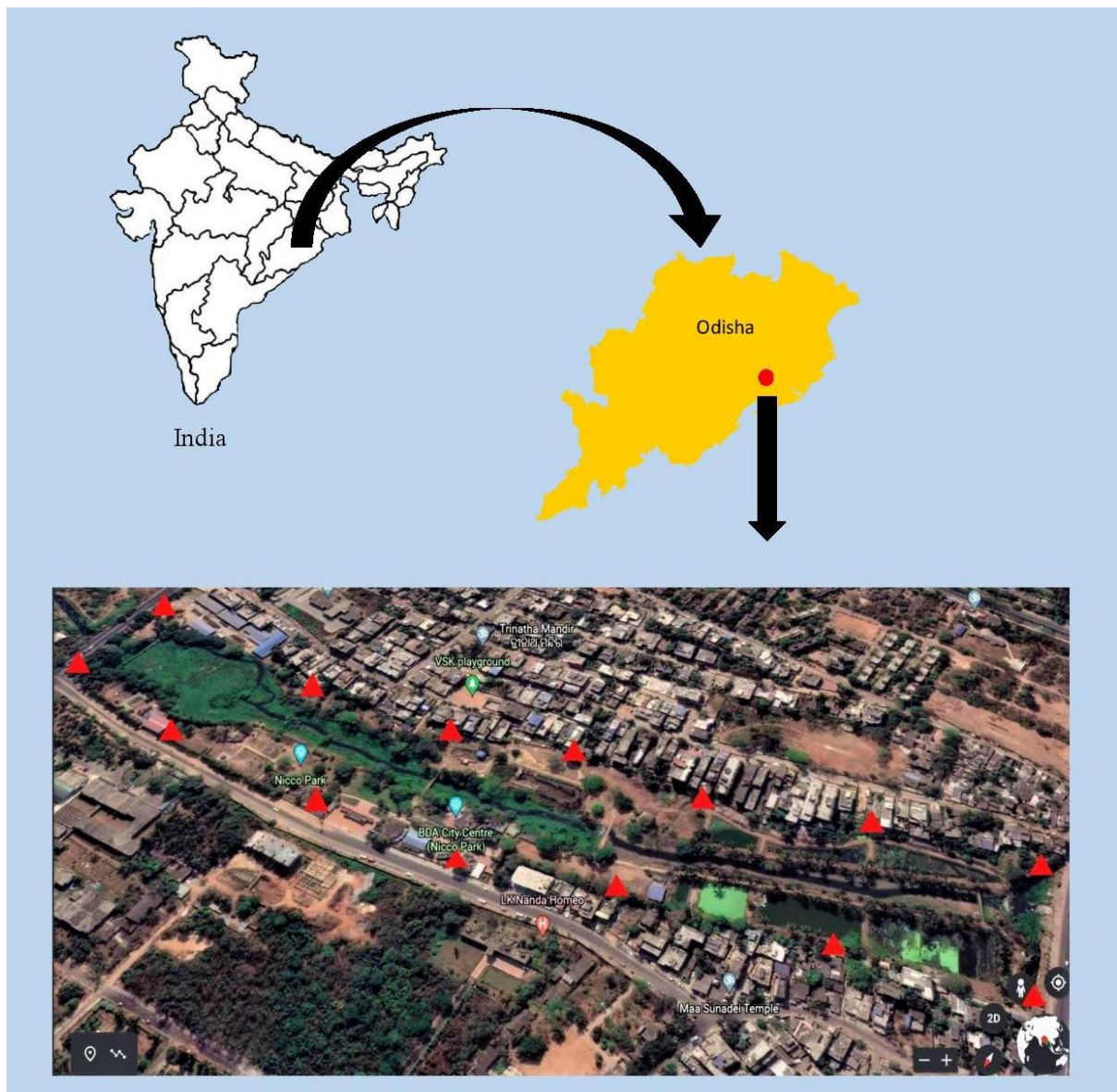
1 Introduction

Bio-wealth is a combination of two words i.e., 'bio' means life or living beings and 'wealth' means a plentiful supply of particular desirable thing. Bio-wealth boosts the productivity of the ecosystem to play a major role which include all floral and faunal wealth along with abiotic factors and microorganisms. Bhubaneswar is a city enriched with many floral and faunal diversity. The city is situated on the Eastern coastal plains and surrounded by water bodies. The Daya river flows to the South and Kuakhai river to the East. The city possesses a beautiful atmosphere with rich biodiversity. Besides these, the city has many more hangout places to have fun with friends and family. Among all places, BDA NICCO Park is one of them with beautiful hangout site which provides lots of fun games and a better atmosphere in urban environment to spent a peaceful time.

BDA NICCO Park was established in the year 1997 by the collaboration of NICCO Japan and BDA. It is situated at the heart of the city between N 20°28'56'' to E 85°82'77''. It covers an area of 25 acres. It is well known inside or outside of the city for its amusement and adventurous games. At the same time, it gives a beautiful atmosphere to the visitors to enjoy the nature. There are some water bodies that helps to grow many floral species and also create space for water birds and other avifaunal species. The

floral species attracts the birds and butterflies which create an interrelationship between them and catch the eye of the visitors. The park also provides a better place for migratory birds during winter which adds more beauty to the park.

There is no documentation of bio-wealth of NICCO park readily available, thus IBI group as PgMC of BUKC BDA in association with Ambika Prasad Research Foundation (APRF), Odisha took a step forward to document the floral and faunal wealth of the park and develop the long term strategy for the restoration and maintenance of the park's beauty and conservation of its bio-wealth to balance the urban environment. The survey started in the month of February 2021 and till April 2021, data was collected. The standard methods were adopted to make a checklist of birds, butterflies and other faunal species. For enumeration of floral wealth and analysis of species richness, quadrant and line transect methods were used. For enumeration of birds, morning 6 AM to 9 AM and evening 3:30 PM to 4:30 PM was selected. After the survey, the plant wealth is categorised as per their use and origin. Invasive and threatened floras were also recorded. The analysis of bio-wealth revealed the remarked suggestions to restore the bio-wealth in the respective chapters.



Aerial View of BDA City Centre (NICCO Park), Bhubaneswar, Odisha

2 Floral wealth

The flora of the study area focuses mainly on the wild vegetation. Survey on the floral wealth revealed that about 219 plant species recorded. The most common species belongs to herb, followed by shrub, climber and tree. The most common recorded herbs are *Syndrella nodiflora*, *Solanum nigrum*, *Sida acuta*, *Rungia pectinata*, *Portulaca oleracea*, *Oxalis corniculata*, *Phyllanthus amarus*, *Lindernia ciliata*, *Kyllinga brevifolia*, *Lindernia crustacea*, *Euphorbia hirta*, *Indigofera linnaei*, *Aerva lanata*, *Aloe vera*, *Amaranthus spinosus*, *Andographis paniculata*, *Boerhavia diffusa*, *Centella asiatica*, *Emilia sonchifolia*, etc. Common enumerated shrubs include *Abutilon indicum*, *Ageratum conyzoides*, *Alocasia macrorrhizos*, *Anisomeles indica*, *Barleria prionitis*, *Breynia retusa*, *Calotropis gigantea*, *Clerodendrum infortunatum*, *Solanum torvum*, *Ziziphus oenoplia*, etc. The most common climbers available in NICCO Park are *Abrus precatorius*, *Cardiospermum halicacabum*, *Coccinia grandis*, *Combretum indicum*, *Hemidesmus indicus*, *Luffa aegyptica*, *Lygodium flexuosum*, *Mikania micrantha*, *Tinospora cordifolia*, *Thunbergia grandiflora*, etc. The results also revealed that study area enjoy different types of tree species. The most common enumerated species are *Acacia auriculiformis*, *Alstonia scholaris*, *Artocarpus heterophyllus*, *Cassia fistula*, *Delonix regia*, *Ficus benghalensis*, *Ficus*

religiosa, *Lagerstroemia speciosa*, *Leucaena leucocephala*, *Mangifera indica*, *Melia azedarach*, *Peltophorum pterocarpum*, *Polyalthia longifolia*, *Streblus asper*, *Syzygium cumini*, *Tectona grandis*, *Tamarindus indica*, etc. It was noticed that some palm species like *Borassus flabellifer* and *Cocus nucifera* are available in study areas along with bamboo species like *Dendrocalamus strictus*, etc. There are number of waterbodies and drain recorded from the study area which provide a good population of aquatic and wetland floras. The most common noted plants under aquatic and wetland are *Alternanthera philoxeroides*, *Amaranthus caudatus*, *Colocasia esculenta*, *Commelina benghalensis*, *Eichhornia crassipes*, *Wolffia globosa*, *Typha angustifolia*, *Pistia stratiotes*, *Lemna minor*, *Monochoria hastata*, *Ludwigia adscendens*, etc. (Annexure I). Survey works and enumeration of plant species concluded that NICCO Park is a home of many indigenous flora along with exotic species. They have food, ornamental, economic and ecological values. The conservation of local flora is needed to maintain the urban ecosystems and to provide a liveable place for the populace of Bhubaneswar. The team of APRF and IBI Group has also illustrated 100 plant species along with their significance in the form of a pictorial book which will be highly fruitful for many aspects.



Amaranthus spinosus overgrown near drain

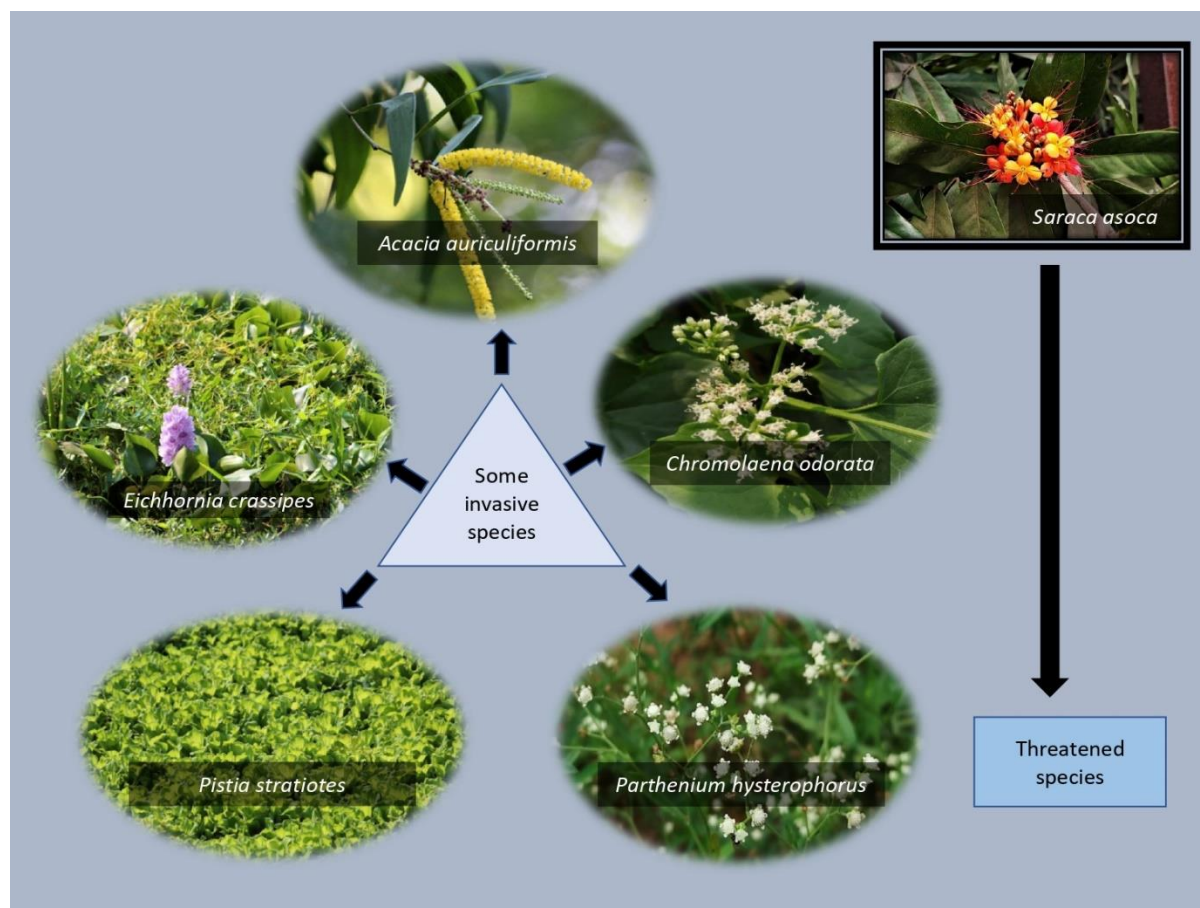


Mass growth of *Alternanthera philoxeroides*

3 Invasive and threatened flora

To maintain the ecology, it is very important to balance the environment for sustainability. The native flora and fauna maintain the ecological balance but unknowingly for some aspects, species from other countries and landscapes might be introduced. Invasive species are flora and fauna that are non-native to an area that may cause damage to the environment around them. A species becomes invasive when they are taken out of their natural habitat where they are in balance with the environment and

introduced into a new area associated with different species and characteristics. In the new place, invasive species may not face any competition or predation. They might grow unchecked and may be harmful to the native species. During the survey, a number of such invasive species were observed in NICCO park. It was observed that *Acacia auriculiformis*, *Eichhornia crassipes*, *Euphorbia hypericifolia*, *Lantana camara*, *Mikania micrantha*, *Pistia stratiotes* and *Parthenium hysterophorus* (Annexure II) are common in study areas.



Some invasive and threatened flora of study area

Those species come under threatened categories. During the survey, *Saraca asoca*, a threatened plant species of the vulnerable category (*The IUCN Red List of Threatened Species* 1988) and *Cycas circinalis*, a threatened species of the endangered category (*The IUCN Red List of Threatened Species* 2010) are identified from NICCO park (Annexure III). Both the enumerated species can grow in Bhubaneswar. The native habitat of *Cycas circinalis* is hilly region near the coast and the native habitat of *Saraca asoca* is moist deciduous forest usually near stream but it can tolerate temperature upto 42°C.

Hence, it is also fit for Bhubaneswar. Both species comes under threatened plants and suitable for Bhubaneswar landscape. Hence, it should be planted in more number near the main park and water bodies. The study also recommends introducing native threatened species in NICCO Park like *Saraca asoca*, *Oroxylum indicum* etc. The present report recommends removing those species and introduce native and threatened or rare plants in this area. Due to anthropogenic activities and natural hazardous, many taxa are showing declination in their population.



Saraca asoca: a threatened tree species

4 Ecologically and medicinally important plants

Selected plant species that are important in ecological as well as medicinal aspects are listed in Annexure VII. For the ease of identification, pictorial illustration of some of the economically and medicinally important plant species is made below. Among the studied ecologically and

medicinally important plants, *Aegle marmelos* has an enormous medicinal value and is one of the best cooling agents whereas *Alstonia scholaris* has the dust retention capacity and is one of the most suitable plant to form green belt.



Some important plants that are ecologically and medicinally beneficial

Artocarpus heterophyllus is an important ecological tree species. Because of its evergreen nature, it provides shade, food and habitat for certain birds and small mammals. *Ficus benghalensis* and *Ficus religiosa* provides a home for many birds and food for frugivorous. It has an evergreen canopy and normally planted to

provide shade. *Azadirachta indica* is an important medicinal tree species and often planted at roadsides, gardens, etc to provide shade. Besides, the species is tolerant to cyclones. *Calotropis procera* has many ecological values. It is a source of green manure. The plant can help improve soil water conditions and also acts as a soil

binder. This species is ideal plant for monitoring sulphur dioxide emissions in the air. It is also an indicator of exhausted soil. It is drought-resistant, salt tolerant to a relatively high degree and quickly established as weed along degraded land. *Pongamia pinnata* seed oil is used for lighting lamp and an important biodiesel,

an alternative to diesel. It is normally planted near roads, along highways as it binds the soil and prevents soil erosion locally it is known as karanja. *Leucaena leucocephala* is an excellent feed for livestock and planted as windbreak, fence or boundary marker. It enhances nitrogen availability in soil and prevents soil erosion.



Pongamia pinnata: an ecologically important medicinal tree

5 Statistical analysis of the floral wealth

In the study area, baseline data of the floral wealth is developed by dividing the total area into site 1 and site 2, which has been further divided in 33 sections. In this, dominant flora and medicinal flora for each

section is mention for ease of locating these said plants. An illustrative diagram of the study area is made. Dominant & medicinal flora is presenting as DM & MF respectively.

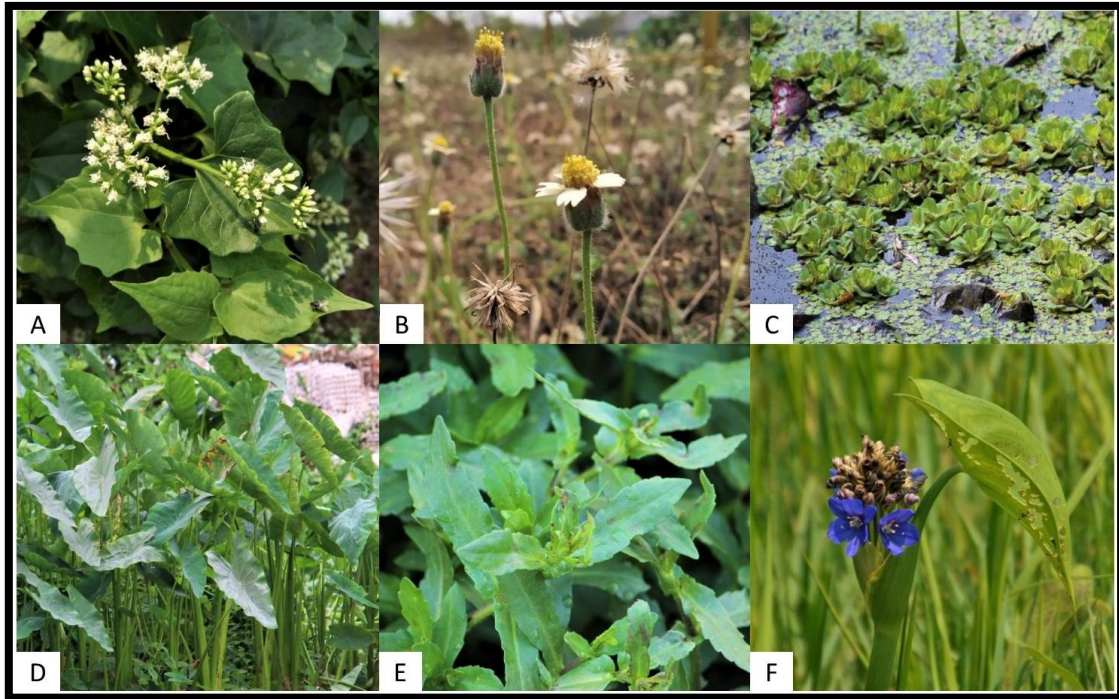
Bidyut Marg (Road) → Kalinga Stadium			
SITE-2	DRAIN		SITE-1
S ₂ DF: <i>Colocasia esculenta</i> MF: <i>Calotropis procera</i>	V ₂		V ₁ S ₁ DF: <i>Cleome rutidosperma</i> MF: <i>Saraca asoca</i>
	BRIDGE- 1		
S ₄ DF: Grass MF: <i>Amaranthus spinosus</i>	V ₄	D R A I	V ₃ S ₃ DF: <i>Monochoria vaginalis</i> MF: <i>Achyranthes aspera</i>
S ₆ DF: Grass MF: <i>Ricinus communis</i>	V ₆		V ₅ S ₅ DF: <i>Monochoria vaginalis</i> MF: <i>Streblus asper</i>
S ₈ DF: <i>Mikania micrantha</i> MF: <i>Calotropis gigantea</i>	V ₈		V ₇ S ₇ DF: <i>Colocasia esculenta</i> MF: <i>Datura metel</i>
S ₁₀ DF: <i>Alternanthera philoxeroides</i> MF: <i>Sida acuta</i>	V ₁₀		V ₉ S ₉ DF: <i>Mikania micrantha</i> MF: <i>Azadirachta indica</i>
S ₁₂ DF: <i>Alternanthera philoxeroides</i> MF: <i>Amaranthus asper</i>	V ₁₂		V ₁₁ S ₁₁ DF: <i>Colocasia esculenta</i> MF: <i>Mimosa pudica</i>
S ₁₄ DF: <i>Alternanthera philoxeroides</i> MF: <i>Murraya koenigii</i>	V ₁₄		V ₁₃ S ₁₃ DF: <i>Colocasia esculenta</i> MF: <i>Cocos nucifera</i>

S₁₆ DF: <i>Mikania micrantha</i> MF: <i>Mimosa pudica</i>	V₁₆	N	V₁₅	S₁₅ DF: <i>Colocasia esculenta</i> MF: <i>Colocasia esculenta</i>
S₁₈ DF: <i>Pistia stratiotes</i> MF: <i>Cardiospermum halicacabum</i>	V₁₈		V₁₇	S₁₇ DF: <i>Colocasia esculenta</i> MF: <i>Pongamia pinata</i>
S₂₀ DF: <i>Pistia stratiotes</i> MF: <i>Cardiospermum halicacabum</i>	V₂₀		V₁₉	S₁₉ DF: <i>Colocasia esculenta</i> MF: <i>Phyllanthus amarus</i>
S₂₂ DF: <i>Amaranthus spinosus</i> MF: <i>Murraya koenigii</i>	V₂₂		V₂₁	S₂₁ DF: <i>Mikania micrantha</i> MF: <i>Aegle marmelos</i>
S₂₄ DF: <i>Pistia stratiotes</i> MF: <i>Cardiospermum halicacabum</i>	V₂₄		V₂₃	S₂₃ DF: <i>Alternanthera philoxeroides</i> MF: <i>Cocos nucifera</i>
S₂₆ DF: <i>Pistia stratiotes</i> MF: <i>Cardiospermum halicacabum</i>	V₂₆		V₂₅	S₂₅ DF: <i>Mikania micrantha</i> MF: <i>Boerhavia diffusa</i>
S₂₈ DF: <i>Pistia stratiotes</i> MF: <i>Cardiospermum halicacabum</i>	V₂₈		V₂₇	S₂₇ DF: <i>Pongamia pinata</i> MF: <i>Pongamia pinata</i>
S₃₀ DF: <i>Ziziphus mauritiana</i> MF: <i>Pongamia pinnata</i>	V₃₀	BRIDGE- 2		S₂₉ DF: <i>Quisqualis indica</i> MF: <i>Acalypha indica</i>
S₃₂ DF: <i>Ziziphus mauritiana</i> MF: <i>Pongamia pinnata</i>	V₃₂		V₃₁	S₃₁ DF: <i>Mikania micrantha</i> MF: <i>Evolvulus nummularius</i>

S₃₄ DF: <i>Phyllanthus reticulatus</i> MF: <i>Evolvulus nummularius</i>	V₃₄	D R A I N	V₃₃	S₃₃ DF: <i>Evolvulus nummularius</i> MF: <i>Cynodon dactylon</i>
S₃₆ DF: <i>Phyllanthus reticulatus</i> MF: <i>Pongamia pinnata</i>	V₃₆		V₃₅	S₃₅ DF: Grasses MF: <i>Aerva lanata</i>
S₃₈ DF: <i>Blumea viscosa</i> MF: <i>Calotropis procera</i>	V₃₈		V₃₇	S₃₇ DF: <i>Mikania micrantha</i> MF: <i>Synedrella nodiflora</i>
S₄₀ DF: <i>Clerodendrum infortunatum</i> MF: <i>Clerodendrum infortunatum</i>	V₄₀		V₃₉	S₃₉ DF: Grass MF: <i>Tridax procumbens</i>
S₄₂ DF: <i>Mikania micrantha</i> MF: <i>Trema orientalis</i>	BRIDGE-3			S₄₁ DF: Carpet grass
	V₄₂		V₄₁	MF: <i>Streblus asper</i>
S₄₄ Plant has been removed	V₄₄		V₄₃	S₄₃ DF: <i>Cynodon dactylon</i> MF: <i>Senna occidentalis</i>
S₄₆ Plant has been removed	V₄₆		V₄₅	S₄₅ DF: Carpet grass MF: <i>Streblus asper</i>
S₄₈ Plant has been removed	V₄₈		V₄₇	S₄₇ DF: Carpet grass MF: <i>Hemidesmus indicus</i>
S₅₀ Plant has been removed	V₅₀		V₄₉	S₄₉ DF: Carpet grass MF: <i>Hemidesmus indicus</i>
S₅₂	V₅₂		V₅₁	S₅₁

Plant has been removed		D R A I N		DF: Carpet grass MF: <i>Wedelia chinensis</i>
S ₅₄ Plant has been removed	V ₅₄		V ₅₃	S ₅₃ DF: <i>Tridax procumbens</i> MF: <i>Murraya koenigii</i>
S ₅₆ Plant has been removed	V ₅₆		V ₅₅	S ₅₅ DF: <i>Tridax procumbens</i> MF: <i>Boerhavia diffusa</i>
S ₅₈ Plant has been removed	V ₅₈		V ₅₇	S ₅₇ DF: <i>Tridax procumbens</i> MF: <i>Trema orientalis</i>
S ₆₀ Marshy Area DF: <i>Monochoria vaginalis</i>	V ₆₀		V ₅₉	S ₅₉ DF: <i>Quisqualis indica</i> MF: <i>Sida acuta</i>
S ₆₂ Marshy Area DF: <i>Monochoria vaginalis</i> , <i>Eichhornia crassipes</i>	V ₆₂		V ₆₁	S ₆₁ DF: <i>Polyalthia longifolia</i> MF: <i>Boerhavia diffusa</i>
S ₆₄ Marshy Area DF: <i>Monochoria vaginalis</i> , <i>Alternanthera philoxeroides</i>	V ₆₄		V ₆₃	S ₆₃ HOTEL
S ₆₆ Marshy Area DF: <i>Monochoria vaginalis</i> , <i>Eichhornia crassipes</i> ,	V ₆₆		V ₆₅	S ₆₅ DF: <i>Mikania micrantha</i> MF: <i>Artocarpus heterophyllus</i>
Sachivalaya Marg (Road)  *RIE				

*RIE: Regional Institute of Education; Baseline data of Study Area (V: Vegetation near Drain)



Dominant Flora of site 1 and site 2 (NICCO Park): A) Mikania micrantha B) Tridax procumbens C) Pistia stratiotes D) Colocasia esculenta E) Alternanthera philoxeroides F) Monochoria hastata



Medicinal Flora of site 1 and site 2 (NICCO Park): A) Datura metel B) Azadirachta indica C) Mimosa pudica D) Phyllanthus virgatus E) Acalypha indica F) Synedrella nodiflora

Table1: Invasive flora of the study area with reference to the above site1 and site 2.

Sections	Invasive Flora
S ₂ , S ₄ , S ₆ , S ₈ , S ₁₀ , S ₁₂ , S ₁₄ , S ₁₆ , S ₁₈ , S ₂₀ , S ₂₂ , S ₂₄ , S ₂₆ , S ₂₈ , S ₃₀	<i>Eichhornia crassipes</i> , <i>Pistia stratiotes</i> , <i>Spirodela polyrhiza</i> , <i>Parthenium hysterophorus</i>
S ₁ , S ₃ , S ₅ , S ₇ , S ₉ , S ₁₁ , S ₁₃ , S ₁₅ , S ₁₇ , S ₁₉ , S ₂₁ , S ₂₃ , S ₂₅ , S ₂₇ , S ₂₉	<i>Parthenium hysterophorus</i> , <i>Spirodela polyrhiza</i> , <i>Mikania micrantha</i>
S ₃₁ , S ₃₃ , S ₃₅ , S ₃₇ , S ₃₉ , S ₄₁	<i>Mikania micrantha</i> , <i>Eichhornia crassipes</i>
S ₃₂ , S ₃₄ , S ₃₆ , S ₃₈ , S ₄₀ , S ₄₂	<i>Acacia auriculiformis</i> , <i>Mikania micrantha</i> , <i>Parthenium hysterophorus</i>
S ₄₃ , S ₄₅ , S ₄₇ , S ₄₉ , S ₅₁ , S ₅₃ , S ₅₅ , S ₅₇ , S ₅₉ , S ₆₁ , S ₆₃ , S ₆₅	<i>Eichhornia crassipes</i> , <i>Pistia stratiotes</i> , <i>Parthenium hysterophorus</i>
S ₄₄ , S ₄₆ , S ₄₈ , S ₅₀ , S ₅₂ , S ₅₄ , S ₅₆ , S ₅₈ , S ₆₀ , S ₆₂ , S ₆₄	<i>Mikania micrantha</i> , <i>Eichhornia crassipes</i> , <i>Pistia stratiotes</i>

(each section breadth is 20m)

Statistical Analysis

Plants grow in communities in an environment and these communities can have different analytical character that can measure the dominance, species richness, etc. In this way, frequency, density and abundance of the species in the community can be expressed quantitatively. In a population, the number of individuals never remains constant. The number of individuals of the species in any unit area at a given time is given by the population density. Population frequency can be defined as the degree of uniformity of the occurrence of individuals of a species within a plant community. Abundance measures the quantitative significance of a species in its habitat. It ascribes the species success numerically. The ratio of abundance of one species to other species living in the ecosystem is term as relative species abundance. Species richness is simply the count of species and it does not take into account the abundance of the species or the relative abundance distribution.

Materials and methods

The study carried out in the survey area to analyse the species richness, frequency, density and abundance followed the standard quadrat method. This method took the sampling area of 1m x 1m. To know the species in different areas, such samples were repeated randomly in 30 sampling units. The different species and the number of individual species are recorded in each sampling unit and percentage frequency, density and abundance are calculated (Table 2).

Data Analysis

Frequency (%) = $\frac{\text{Number of units in which the species occurred}}{\text{Total number of units studied}} \times 100$

Abundance = $\frac{\text{Total number of individuals of the species}}{\text{No. of quadrat per units in which they occur}} \times 100$

$$\text{Relative abundance} = \frac{\text{Total no. of species A}}{\text{Total no. of individual of all species recorded}} \times 100$$

$$\text{Density} = \frac{\text{Number of individuals of a species}}{\text{No. of quadrat per unit studied}} \times 100$$

$$\text{Menhinick Index for Species Richness (D)} = \frac{S}{\sqrt{N}}$$

where, S = No. of Species

N = Total no. of individuals in the sample

Table 2: Population frequency, density, abundance & Species Richness

Species	Total no. of Individuals	Total no. of segments the species occurred	Total no. of segments	Frequency %	Density	Abundance ratio	Species Richness (D)
<i>Aerva lanata</i>	15	3	30	10	0.5	5	0.44
<i>Ageratum conyzoides</i>	4	2	30	6.66	0.001	2	0.11
<i>Alternanthera philoxeroides</i>	65	7	30	23.33	2.166	9.28	1.94
<i>Alternanthera sessilis</i>	58	7	30	23.33	1.933	8.28	1.73
<i>Amaranthus spinosus</i>	101	4	30	13.33	3.366	25.25	3.01
<i>Ampelopteris prolifera</i>	10	1	30	3.33	0.333	10	0.29
<i>Andrographis paniculata</i>	1	1	30	3.33	0.033	1	0.02
<i>Blumea lacera</i>	10	3	30	10	0.333	3.33	0.29
<i>Blumea viscosa</i>	27	3	30	10	0.9	9	0.80
<i>Boerhavia diffusa</i>	7	2	30	6.66	0.233	3.5	0.20

Biodiversity Assessment of BDA City Centre (NICCO Park)

<i>Cardiospermum halicacabum</i>	5	1	30	3.33	0.166	5	0.14
<i>Chromolaena odorata</i>	5	1	30	3.33	0.166	5	0.14
<i>Cleome rutidosperma</i>	15	2	30	6.66	0.5	7.5	0.44
<i>Cleome viscosa</i>	9	3	30	10	0.3	3	0.26
<i>Clerodendrum infortunatum</i>	5	1	30	3.33	0.166	5	0.14
<i>Coccinia grandis</i>	17	4	30	13.3	0.566	4.25	0.50
<i>Colocassia esculenta</i>	45	7	30	23.33	1.5	6.42	1.34
<i>Cynodon dactylon</i>	170	3	30	10	5.66	56.66	5.07
<i>Eclipta prostrata</i>	24	3	30	10	0.8	8	0.71
<i>Eichhornia crassipes</i>	13	2	30	6.66	0.433	6.5	0.38
<i>Evolvulus nummularius</i>	16	2	30	6.66	0.533	8	0.47
<i>Gomphrena celosioides</i>	5	1	30	3.33	0.166	5	0.14
<i>Hyptis suaveolens</i>	10	3	30	10	0.333	3.33	0.29
<i>Indigofera linnaei</i>	5	1	30	3.33	0.166	5	0.14
<i>Ipomoea aquatica</i>	31	5	30	16.66	1.033	6.2	0.92
<i>Ipomoea sepiaria</i>	17	3	30	10	0.566	5.66	0.50
<i>Kyllinga brevifolia</i>	32	5	30	16.66	1.066	6.4	0.95
<i>Lindernia crustacea</i>	26	2	30	6.66	0.866	13	0.77
<i>Ludwigia adscendens</i>	27	3	30	10	0.9	9	0.80

Biodiversity Assessment of BDA City Centre (NICCO Park)

<i>Luffa aegyptiaca</i>	2	1	30	3.33	0.066	2	0.05
<i>Merremia umbellata</i>	3	1	30	3.33	0.1	3	0.08
<i>Mikania micrantha</i>	71	6	30	20	2.366	11.83	2.12
<i>Mimosa pudica</i>	34	6	30	20	1.133	5.66	1.01
<i>Monochoria hastata</i>	25	1	30	3.33	0.833	25	0.74
<i>Murraya koenigii</i>	5	2	30	6.66	0.166	2.5	0.14
<i>Oplismenus burmannii</i>	5	1	30	3.33	0.166	5	0.14
<i>Parthenium hysterophorus</i>	21	4	30	13.33	0.7	5.25	0.62
<i>Phyllanthus niruri</i>	5	1	30	3.33	0.166	5	0.14
<i>Phyllanthus reticulatus</i>	23	4	30	13.33	0.766	5.75	0.68
<i>Portulaca oleracea</i>	4	2	30	6.66	0.133	2	0.11
<i>Pteris vittata</i>	2	1	30	3.33	0.066	2	0.05
<i>Quisqualis indica</i>	15	1	30	3.33	0.5	15	0.44
<i>Rungia pectinata</i>	16	1	30	3.33	0.533	16	0.47
<i>Senna alata</i>	7	2	30	6.66	0.233	3.5	0.20
<i>Senna tora</i>	2	1	30	3.33	0.066	2	0.05
<i>Sida acuta</i>	8	2	30	6.66	0.266	4	0.23
<i>Sida rhombifolia</i>	4	1	30	3.33	0.133	4	0.11
<i>Spilanthus paniculata</i>	9	2	30	6.66	0.3	4.5	0.26
<i>Tridax procumbens</i>	85	5	30	16.66	2.83	17	2.53
<i>Urena lobata</i>	1	1	30	3.33	0.033	1	0.02

Results and discussion

The different species recorded are scored according to their Abundance (AB) as below:

Abundant (A): ($AB \geq 20.00$)

Frequent (B): ($10.00 \leq AB \leq 19.99$)

Occasional (C): ($5.00 \leq AB \leq 10$)

Rare (D): ($1.00 \leq AB \leq 5.00$)

The result of abundance ratio shows that species like *Amaranthus spinosus*, *Cynodon dactylon* and *Monochoria hastata* showed highest abundant ratio followed by *Lindernia crustacea*, *Mikania micrantha*, *Quisqualis indica*, *Rungia pectinata* and *Tridax procumbens* and so on as shown in table 3. The least abundant species are given under D section of Table 3.

Table 3: Result of abundance ratio of the species

A	B	C	D
<i>Amaranthus spinosus</i>	<i>Lindernia crustacea</i>	<i>Alternanthera philoxeroides</i>	<i>Aerva lanata</i>
<i>Cynodon dactylon</i>	<i>Mikania micrantha</i>	<i>Alternanthera sessilis</i>	<i>Ageratum conyzoides</i>
<i>Monochoria hastata</i>	<i>Quisqualis indica</i>	<i>Ampelopteris prolifera</i>	<i>Andrographis paniculata</i>
	<i>Rungia pectinata</i>	<i>Blumea viscosa</i>	<i>Blumea lacera</i>
	<i>Tridax procumbens</i>	<i>Cleome rutidosperma</i>	<i>Boerhavia diffusa</i>
		<i>Colocassia esculenta</i>	<i>Cardiospermum halicacabum</i>
		<i>Eclipta prostrata</i>	<i>Chromolaena odorata</i>
		<i>Eichhornia crassipes</i>	<i>Cleome viscosa</i>
		<i>Evolvulus nummularius</i>	<i>Clerodendrum infortunatum</i>
		<i>Ipomoea aquatica</i>	<i>Coccinia grandis</i>
		<i>Ipomoea sepiaria</i>	<i>Gomphrena celosioides</i>
		<i>Kyllinga brevifolia</i>	<i>Hyptis suaveolens</i>
		<i>Ludwigia adscendens</i>	<i>Indigofera linnaei</i>
		<i>Mimosa pudica</i>	<i>Luffa aegyptiaca</i>
		<i>Parthenium hysterophorus</i>	<i>Merremia umbellata</i>
		<i>Phyllanthus reticulatus</i>	<i>Murraya koenigii</i>
			<i>Oplismenus burmannii</i>
			<i>Phyllanthus niruri</i>
			<i>Portulaca oleracea</i>
			<i>Pteris vittata</i>
			<i>Senna alata</i>

<i>Senna tora</i>
<i>Sida acuta</i>
<i>Sida rhombifolia</i>
<i>Spilanthus paniculata</i>
<i>Urena lobata</i>

Population frequency

The result showed that species like *Alternanthera philoxeroides*, *Alternanthera sessilis*, *Colocassia esculenta* shows highest frequency (23.33) followed by *Mikania micrantha*, *Mimosa pudica* (20) and *Tridax procumbens*, *Ipomoea aquatica* (16.66) and *Amaranthus spinosus* (13.33) Among the different species recorded species like *Ampelopteris prolifera*, *Andographis paniculata*, *Indigofera linnaei*, *Pteris vittata*, *Rungia pectinata*, *Cardiospermum halicacabum*, etc. (3.33) show least frequency.

Population density

The result showed that species like *Cynodon dactylon* (5.66), *Amaranthus spinosus* (3.366), *Tridax procumbens* (2.83), *Mikania micrantha* (2.366), *Alternanthera philoxeroides* (2.166), *Alternanthera sessilis* (1.933) and *Colocassia esculenta* (1.5) has the highest density respectively while the species like *Ageratum conyzoides* (0.001), *Andographis paniculata* (0.033), *Ipomoea aquatica* (0.033), *Urena lobata* (0.033) and *Luffa aegyptiaca* (0.066) shows the least density respectively.

Species richness

The result showed highest species richness of *Cynodon dactylon* followed by *Amaranthus spinosus*, *Tridax procumbens*, *Mikania micrantha*, *Alternanthera philoxeroides* and *Alternanthera sessilis*.

Conclusion Remarks

The statistical analysis of available flora in NICCO Park, Bhubaneswar revealed that *Andographis paniculata*, *Alternanthera sessilis*, *Cynodon dactylon*, *Urena lobata*, *Cardiospermum halicacabum*, *Mimosa pudica*, *Phyllanthus niruri*, *Spilanthus paniculata*, *Portulaca oleracea*, *Boerhavia diffusa*, etc. should be conserved due to their medicinal values and indigenous to the landscape whereas *Clerodendron infortunatum*, *Senna alata*, *Colocassia esculenta*, *Ipomoea aquatica*, *Amaranthus spinosus*, etc. should be retained due to their capacity to uptake heavy metals. The report also recommended selected species for plantation (Table: 4) due to the need to restore the biowealth and minimize the impact of urbanization and pollution. Details are described in the respective section of the report (Ecologically and Medicinally important plants). The aim of the present report was to illustrate the baseline data but we have observed that the listed invasive species are available in 66 sections of the two sites and they should be removed and do plantation of the recommended species.

6 Avifaunal and other faunal wealth

Beside rich floral diversity, NICCO Park is also a hub of different bird species, butterflies and some other faunal species. Different sections of faunal and avifaunal species are recorded through survey from NICCO Park. Major species illustrated in Bio-wealth of NICCO Park and the total list

are given in Annexure IV, Annexure V and Annexure VI. For faunal survey, morning and evening were selected as per the movement in these periods. In avifaunal species, raptors, frugivorous, insectivorous and wetland birds are recorded.



Indian grey mongoose

The most common recorded birds are Asian Koel, Asian pied starling, Black drongo, Black kite, Black-hooded oriole, Coppersmith barbet, Eurasian hoopoe, Greater coucal, House crow, Indian golden oriole, Red vented bulbul, Shikra, etc. It was observed that NICCO Park is also home of wetland avian species like Little egret, White throated kingfisher, Little cormorant, Bronzed winged jacana, Cattle egret, Common sandpiper, etc. Rose winged parakeet was also recorded which come under threatened categories. Many pollinators are found in these areas like

Red whiskered bulbul, Purple-rumped sunbird, Purple sunbird, Indian golden oriole, Common myna, Asian pied starling, etc. Indian grey mongoose and Indian palm squirrel were also observed in study areas. Planned vegetation in this area could invite more birds, pollinators and make the place rich ecosystem which would please the visitors and all other sections like students, research scholars, etc. They will get a brief knowledge about ecology. Different sections of the faunal species especially the avifaunal species which are represented hereunder.



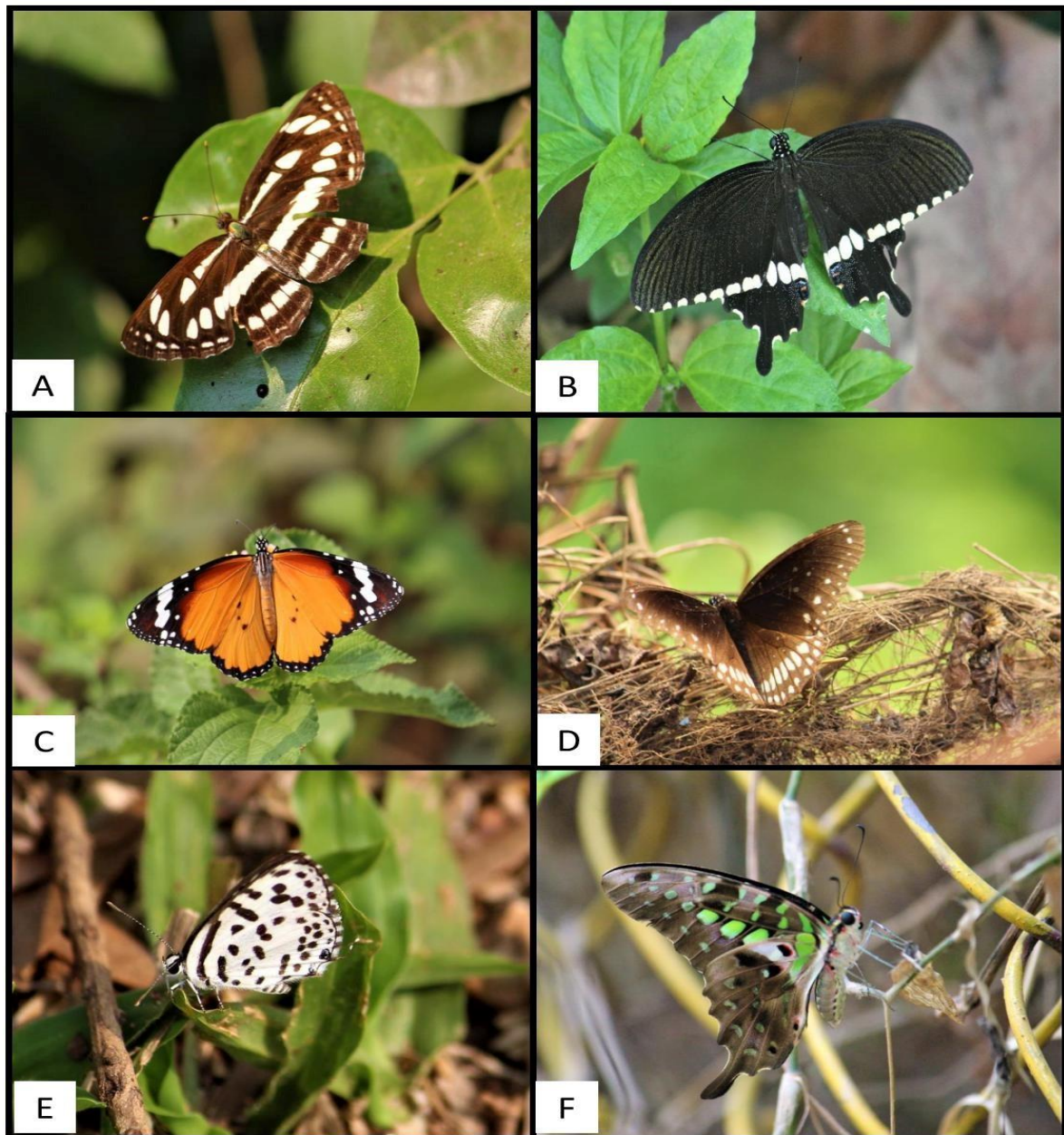
Different sections of the pollinators and avifaunal species of NICCO Park

1) Golden oriole 2) Black kite 3) White wagtail 4) Yellow wagtail 5) Taiga flycatcher 6) Plain Tiger 7) Forget-me-not 8) Green sandpiper 9) Pond Heron 10) Little Egret 11) White-breasted Waterhen 12) Asian Pied Starling 13) Asian koel

7 Butterfly diversity

The survey works indicated that there are number of flowering plant species recorded which attract the butterflies and other pollinators. It was noted that about 25 butterfly species recorded belong to 06 families. It was observed that maximum number of butterflies recorded belong to

Nymphalidae followed by Pieridae, Papilionidae, Lycaenidae and Hesperiidae. The most common recorded butterflies are Common crow, Common grass yellow, Common marmon, Crimson rose, Indian palm bob, Lemon emigrant, Lime blue, Pale grass blue, Plain tiger etc. (Annexure V).

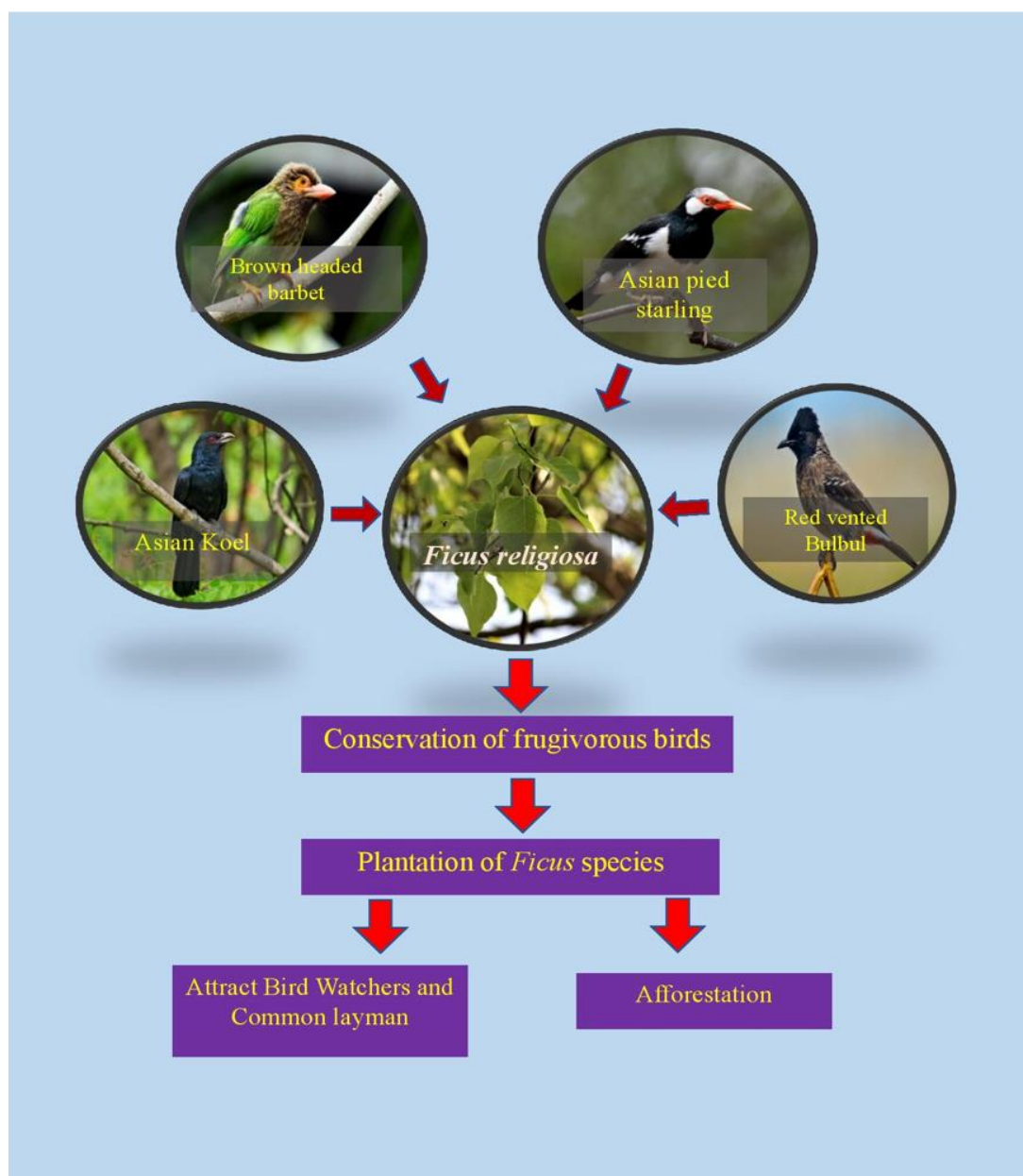


Some common butterflies of NICCO Park: A) Common sailor B) Common Mormon C) Plain tiger D) Common Crow E) Common Pierrot F) Tailed Jay

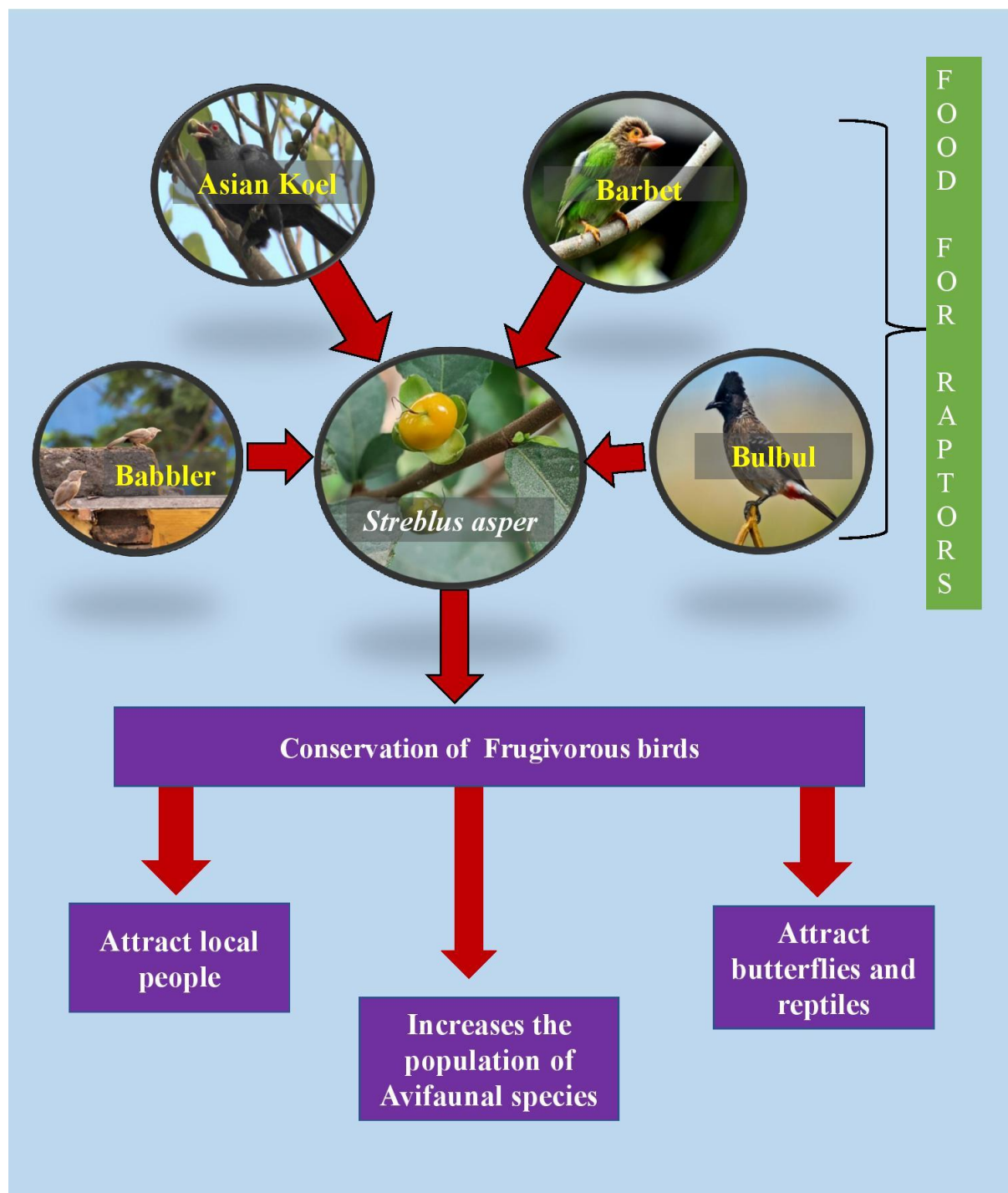
8 Relationship between flora & avifauna

The natural relationship between plants and birds are known to man. Different birds have different food habits and specific plant species are related to certain birds. To go deeper into this relationship, different illustrations are made to understand the analogy (Model 1-7), from the NICCO Park. The *Ficus* species is very important for their histological native

landscapes. In NICCO Park, number of *Ficus* species are recorded. The fig (fruit) of these species provide food of many birds like Asian koel, Brown hooded-barbet, Asian pied starling, Red vented bulbul, etc. They do afforestation through droppings. Therefore, availability of both type of taxa, *Ficus* is an important tree species (Model 1).



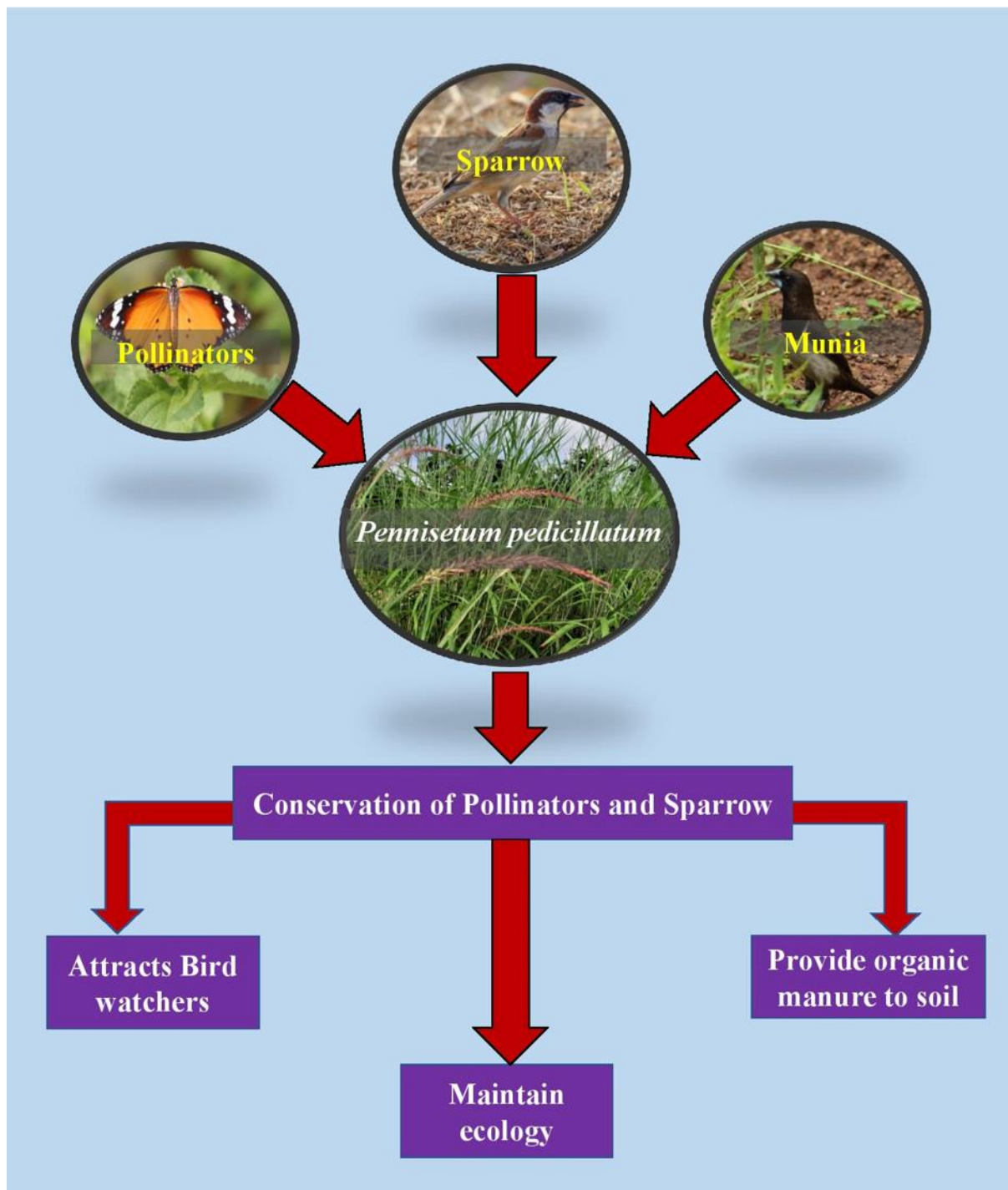
Model 1



Model 2

S. asper, a fruity tree species was recorded from NICCO Park. It provides food of many birds (Model 2) and the flowers attract the butterflies. The movement of butterflies

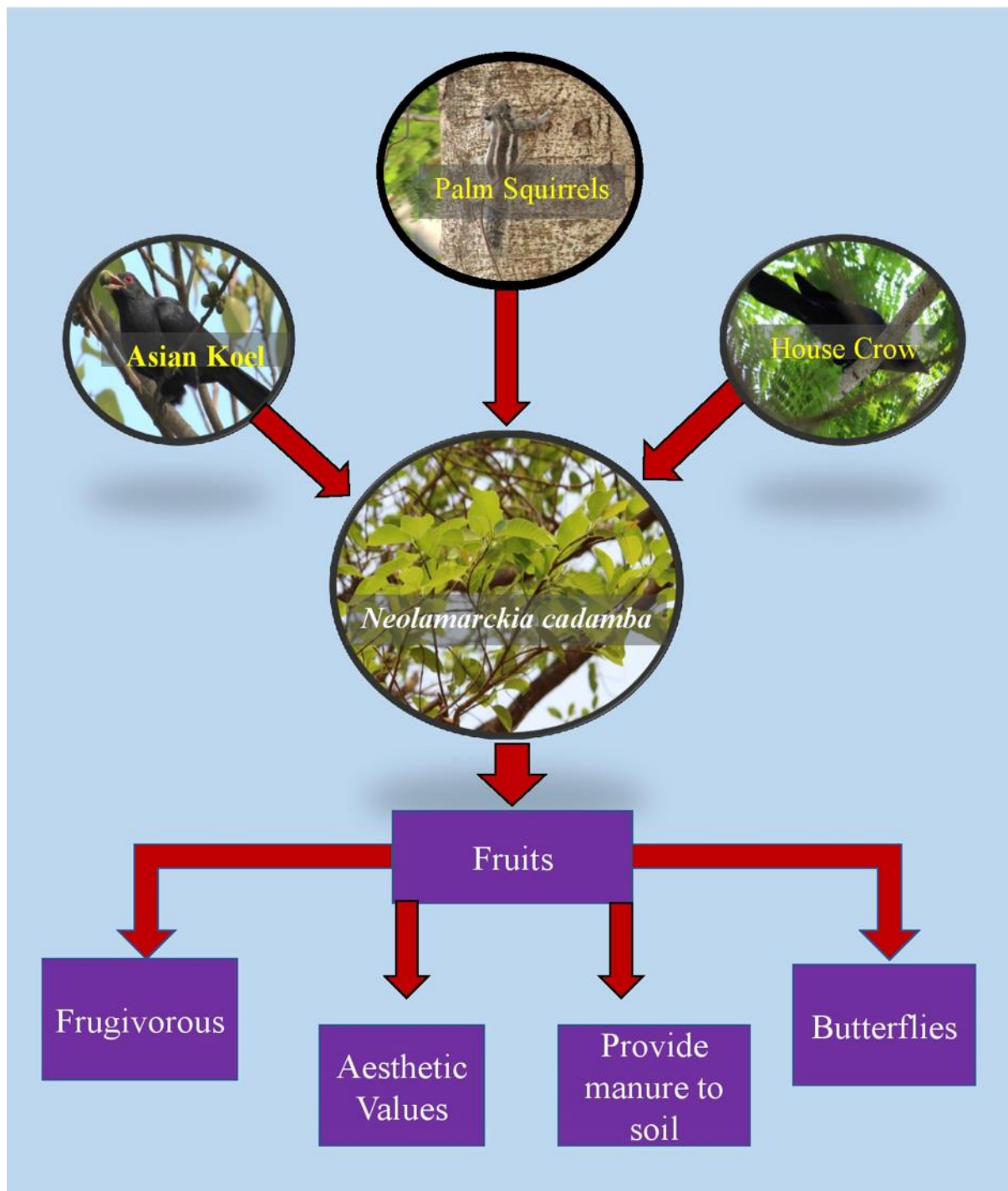
attract reptiles. The fruit is also edible by human beings. Hence, it shows great relationship with faunal species and the landscape (Model 2).



Model 3

P. pedicellatum is a grass belongs to Poaceae family. It provides shelter and food for many pollinators which lead to

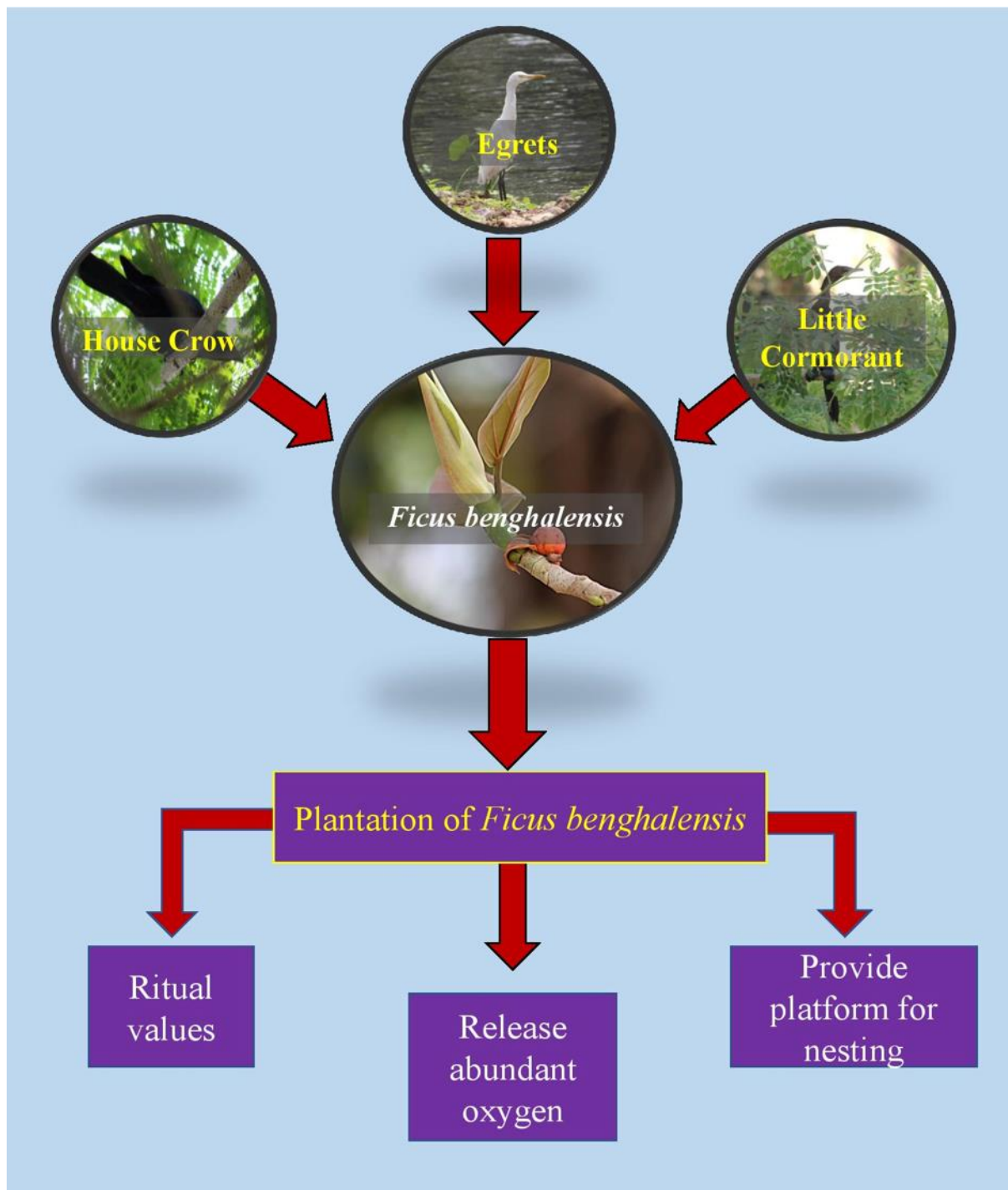
balance the ecosystem. After drying, it decomposes and gives organic manure to the soil (Model 3).



Model 4

N. cadamba is a tree species and popularly known as “Kadamba”. It has mythological values and fruits provide food and nectar

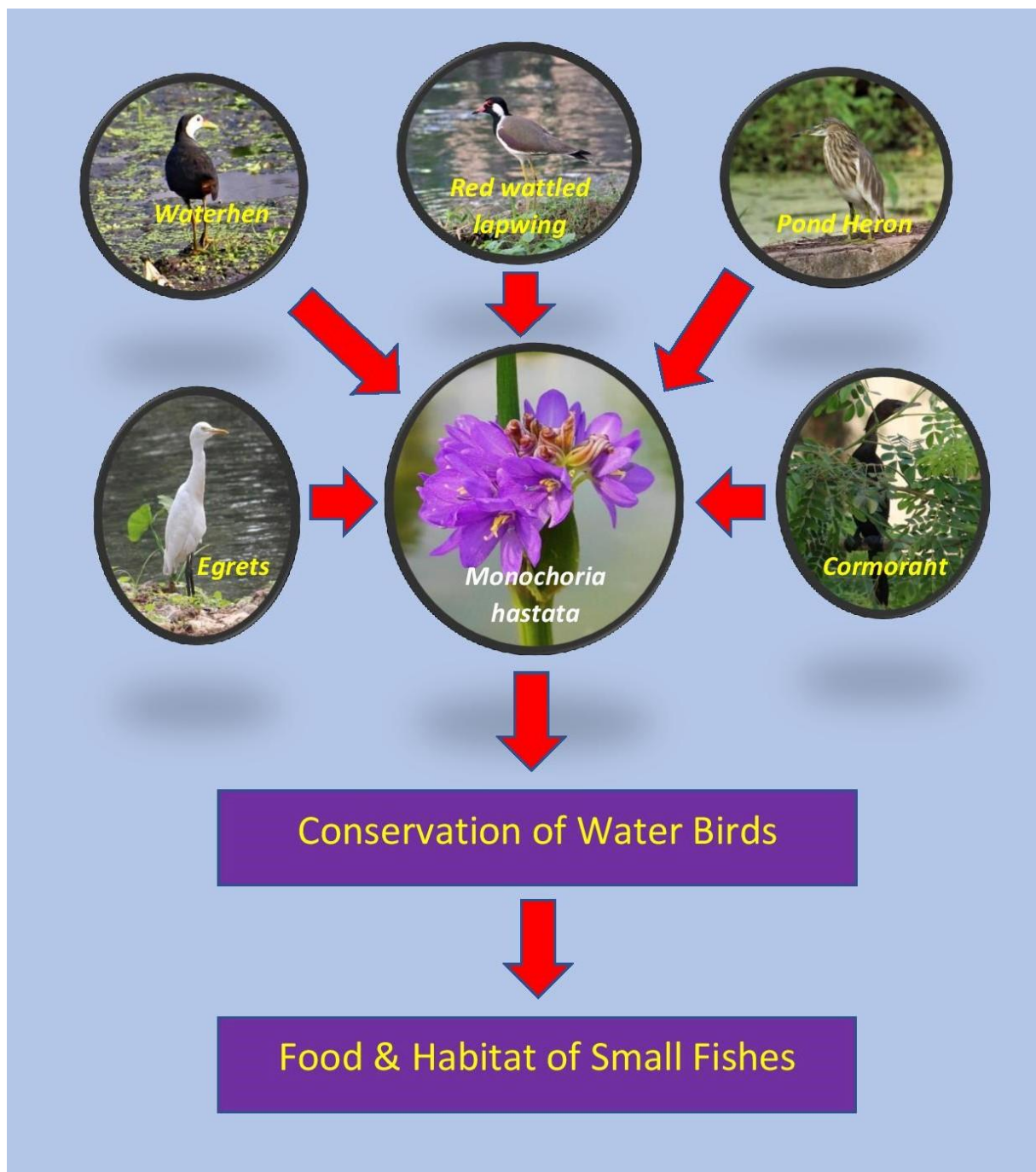
for butterflies. The dry leaves act as an organic manure to the soil (Model 4).



Model 5

F. benghalensis is an important tree species having ecological values. It provides food and shelter for many avian

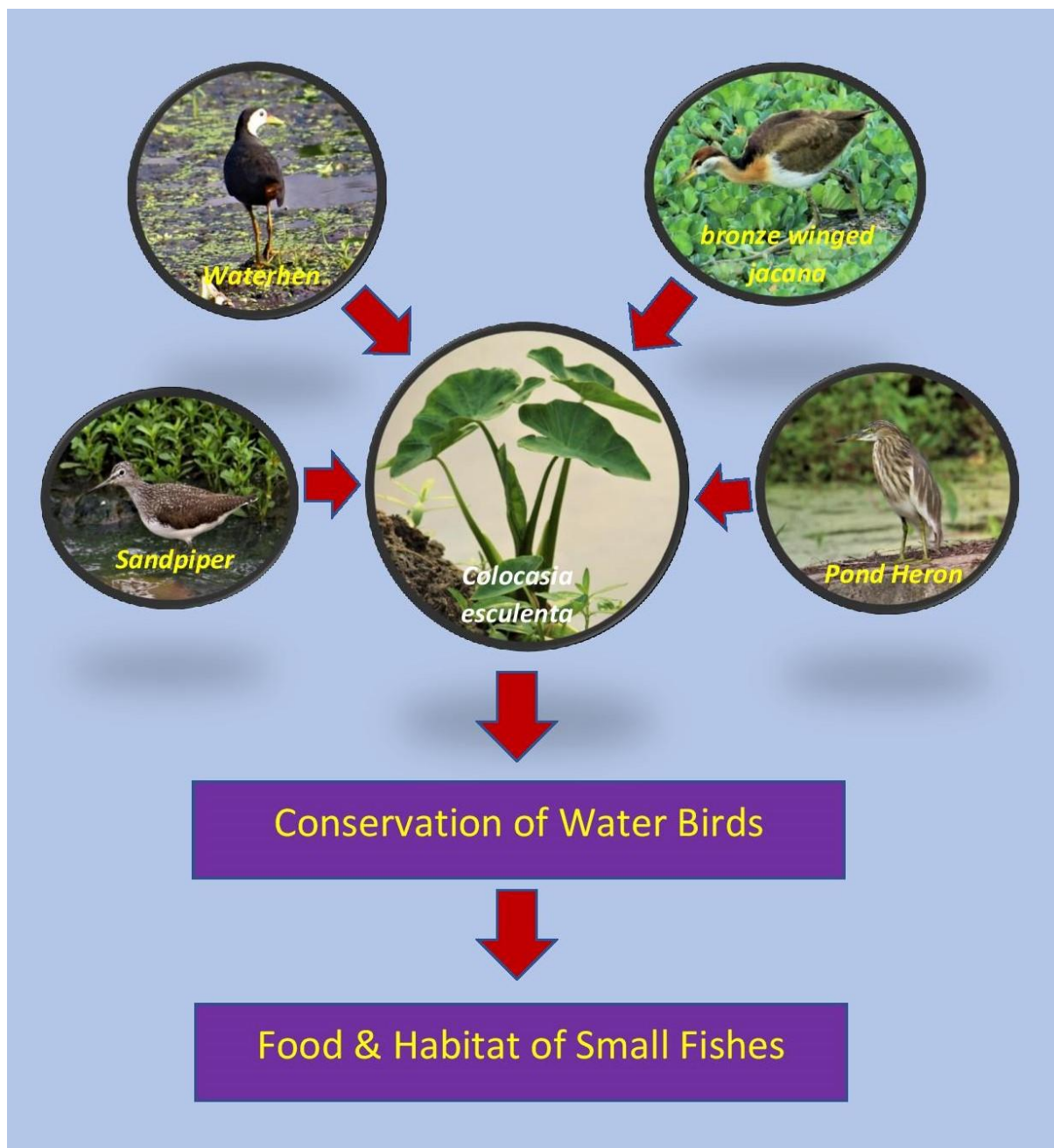
species. It provides platform for wasp to complete life cycle and many more (Model 5).



Model 6

M. hastata, an aquatic plant having complex root network which makes a sound habitat of many small fishes, arthropods and other insects. They are

prey of many water birds. Therefore, it is important herb for the conservation of water birds and small aquatic taxa (Model 6).



Model 7

C. esculenta is a herb of wetland. It provides a network for making habitats of many insects through mass population. The insects are the prey for water birds.

The availability of this species attract the birds which is a natural conservation system for small fishes and water birds (Model 7).

9 Recommendation for plantation

Considering the landscape of the NICCO Park, Bhubaneswar, certain plant species are recommended for plantation in different parts of the said area. The recommended plants are given in the Table 4 & 5 below. Plantation recommended near drain tolerant are either tolerant to cyclone, phytoremediation, aromatic, medicinal values, attract frugivorous birds

and pollinators, etc (Figure 1). Plants recommended for site 1 and site 2 having food, medicinal, recreational, ecological, ornamental values and conservation of rare species (Figure 2). The tree species should be planted 5-6m apart except *Ficus* species. *Ficus* species should be planted 6-8 m apart. The shrubs should be planted 3-4 m apart and herbs should be 2 m apart.

Table 4: Suggestions for plantation near drain

Plant Name	Common Name	Family	Habit
<i>Pongamia pinata</i>	Pongame oil tree, Karanja	Fabaceae	Tree
<i>Alstonia scholaris</i>	Blackboard tree	Apocynaceae	Tree
<i>Ficus benghalensis</i>	Banyan	Moraceae	Tree
<i>Terminalia arjuna</i>	Arjun tree	Combretaceae	Tree
<i>Alangium salvifolium</i>	Sage-leaved alangium	Cornaceae	Tree
<i>Ardisia solanacea</i>	Shoebuttan ardisia	Primulaceae	Small Tree
<i>Borassus flabellifer</i>	Doub palm, Asian palmyra palm	Areaceae	Palm Tree
<i>Calamus guruba</i>	Kanta beta(O)	Arecaceae	Palm Tree
<i>Canthium dicocum</i>	Falsinga, Karuna(O)	Rubiaceae	Tree
<i>Carissa spinarum</i>	Khira koli (O), Karaunda (H)	Apocynaceae	Shrub
<i>Flacourtia indica</i>	Baincha(O), Ramontchi	Salicaceae	Small Tree
<i>Lippia javanica</i>	Fever tree	Verbenaceae	Shrub
<i>Naringi crenulata</i>	Toothed leaf limonia, Baintha	Rutaceae	Shrub
<i>Zizipus oenopila</i>	Wild Kanteikoli(O) jujube,	Rhamnaceae	Tree
<i>Toddalia asiatica</i>	Orange climber	Rutaceae	Tree

*Tree should be 5-6m apart except *Ficus spp.*

**Ficus spp.* should be 6m apart

*Shrub should be 3-4m apart

*Palm should be 5m apart

*Herb should be 2m apart

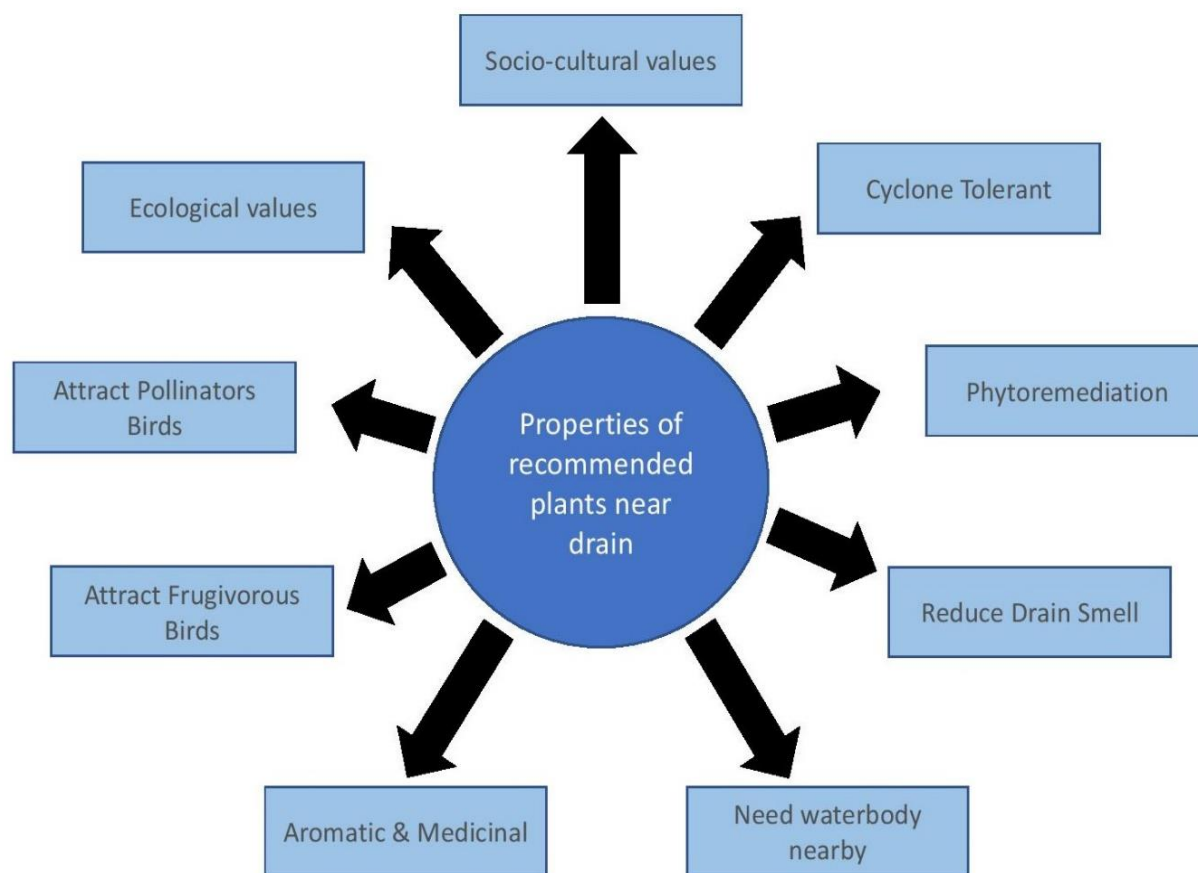
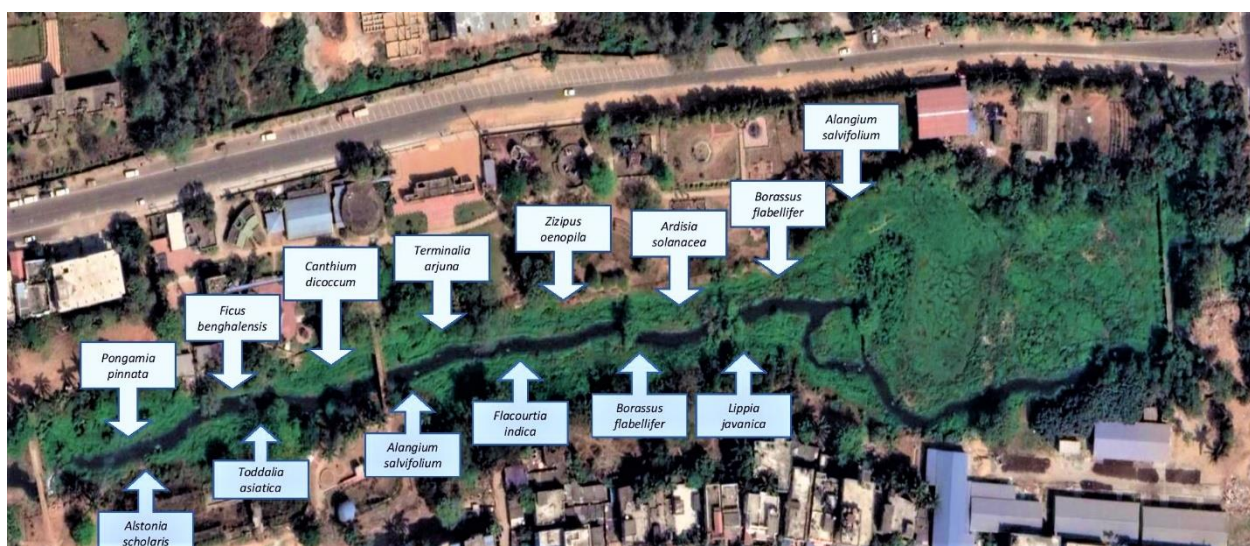


Figure 1: Properties of plants recommended near drain



A model for the plantation near drain of NICCO Park, Bhubaneswar

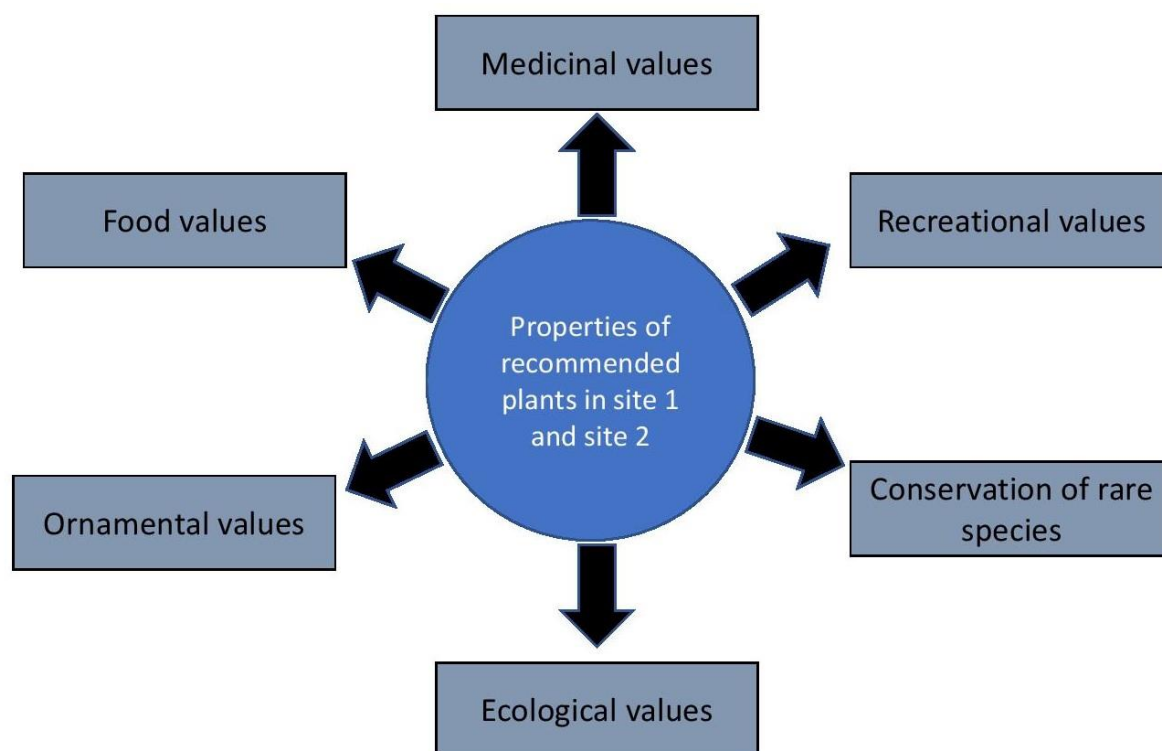
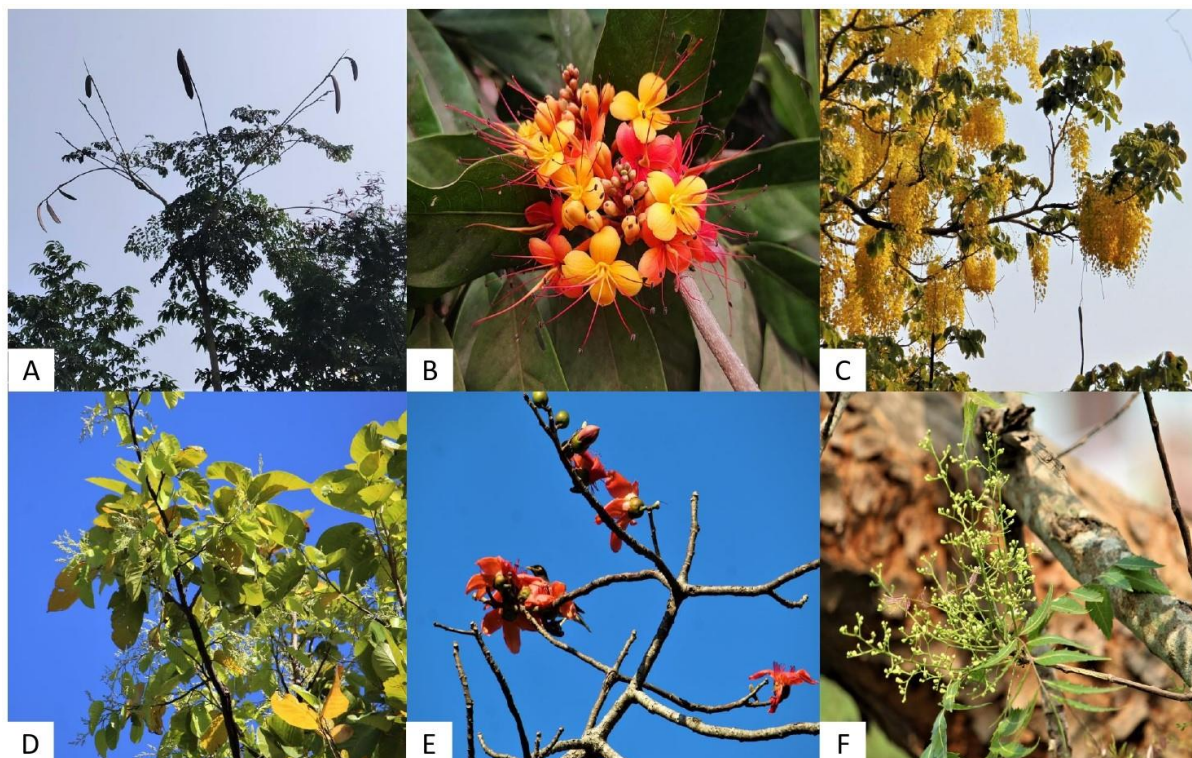


Figure 2: Properties of plants recommended for site 1 and site 2

Table 5: Suggestion for plantation in site 1 and site 2 except near drain

Plant Name	Common Name	Family	Habit
<i>Cassia fistula</i>	Amaltas, Golden shower	Fabaceae	Tree
<i>Lagerstroemia speciosa</i>	Pride of India	Lythraceae	Tree
<i>Bauhinia variegata</i>	Mountain ebony	fabaceae	Tree
<i>Bombax ceiba</i>	Malabar silk cotton tree	Malvaceae	Tree
<i>Butea monosperma</i>	Scared tree, Palash tree	Fabaceae	Tree
<i>Erythrina variegata</i>	Coral tree	Fabaceae	Tree
<i>Saraca asoca</i>	Ashoka tree	Fabaceae	Small Tree
<i>Nyctanthes arbor-tristis</i>	Night-flowering jasmine	Oleaceae	Small Tree
<i>Cochlospermum religiosum</i>	Butter cup, Katira	Bixaceae	Small Tree
<i>Artocarpus heterophyllus</i>	Jack fruit tree	Moraceae	Tree

<i>Mangifera indica</i>	Mango tree	Anacardiaceae	Tree
<i>Azadirachta indica</i>	Neem tree	Meliaceae	Tree
<i>Shorea robusta</i>	Sal tree	Dipterocarpaceae	Tree
<i>Caryota urens</i>	Jaggary palm	Arecaceae	Palm Tree
<i>Millingtonia hortensis</i>	Indian cork tree	Bignoniaceae	Tree



Some common plants recommended for plantation: A) *Oroxylum indicum* B) *Saraca asoca* C) *Cassia fistula* D) *Shorea robusta* E) *Bombax ceiba* F) *Azadirachta indica*

10 Annexure

ANNEXURE I

Floral Diversity of NICCO Park & its values

Plant name	Common name	Family	Values
<i>Abrus precatorius</i>	Kaincha, Rosary pea	Fabaceae	Medicinal values
<i>Abutilon indicum</i>	Pedipedika, Indian mallow	Malvaceae	Medicinal values
<i>Acacia auriculiformis</i>	Ear-Pod Wattle	Mimosaceae	Exotic species
<i>Acacia nilotica</i>	Gum Arabic tree	Mimosaceae	Animal fodder
<i>Acalypha indica</i>	Indian Mercury	Euphorbiaceae	Medicinal values
<i>Achyranthes aspera</i>	Apamarga, Chaff-flower	Amaranthaceae	Medicinal values
<i>Adenium obesum</i>	Desert rose	Apocynaceae	Medicinal values
<i>Aegle marmelos</i>	Bael, Stone apple	Rutaceae	Medicinal values
<i>Aerva lanata</i>	Mountain knot grass	Amaranthaceae	Medicinal values
<i>Aganosma caryophyllata</i>	Bana Malati	Apocynaceae	Medicinal values
<i>Agave americana</i>	Sentry plant, Century plant	Agavaceae	Ornamental values
<i>Ageratum conyzoides</i>	Pokasunga, Billy goat weed	Asteraceae	Medicinal values
<i>Albizia saman</i>	Chakunda, Rain tree	Fabaceae	Socio-cultural & ecological values
<i>Alocasia macrorrhizos</i>	Gaint taro, Upright elephant ear	Araceae	Food values
<i>Aloe vera</i>	Ghee kuanri, Aloe vera	Asphodelaceae	Medicinal values
<i>Alstonia scholaris</i>	Blackboard tree, devil's tree	Apocynaceae	Medicinal & ecological values
<i>Alternanthera brasiliana</i>	Indoor clover	Amaranthaceae	Medicinal values
<i>Alternanthera philoxeroides</i>	Alligator weed	Amaranthaceae	Raw material for organic manure
<i>Alternanthera sessilis</i>	Dwarf copperleaf	Amaranthaceae	Medicinal values
<i>Amaranthus caudatus</i>	Tassel flower	Amaranthaceae	Food values
<i>Amaranthus spinosus</i>	Spiny amaranth	Amaranthaceae	Food values
<i>Amaranthus tricolor</i>	Chinese Spinach	Amaranthaceae	Food values
<i>Ampelopteris prolifera</i>	Riverine scramble	Thelypteridaceae	Ecological values
<i>Ananas comosus</i>	Pineapple	Bromeliaceae	Food values
<i>Andrographis paniculata</i>	Chireita, Bhuin neem, Green chiretta	Acanthaceae	Medicinal values

<i>Anisomeles indica</i>	Indian catmint	Lamiaceae	Medicinal values
<i>Araucaria cookii</i>	Captain cook's pine	Araucariaceae	Ornamental values
<i>Araucaria heterophylla</i>	Christmas tree	Araucariaceae	Medicinal values
<i>Artocarpus heterophyllus</i>	Jackfruit	Moraceae	Food values
<i>Atylosia scarabaeoides</i>	Pegion pea	Fabaceae	Food values
<i>Axonopus compressus</i>	Carpet grass	Poaceae	Medicinal values
<i>Azadirachta indica</i>	Neem	Meliaceae	Medicinal values
<i>Barleria prionitis</i>	Porcupine flower	Acanthaceae	Medicinal values
<i>Barleria strigosa</i>	Bristly blue barleria	Acanthaceae	Medicinal values
<i>Blumea aurita</i>	Sticky Blumea	Asteraceae	Medicinal values
<i>Blumea lacera</i>	Lettuce leaf Blumea	Asteraceae	Medicinal values
<i>Blumea viscosa</i>	Clammy false oxtongue	Asteraceae	Medicinal values
<i>Boerhavia diffusa</i>	Punarnava, Spreading hogweed	Nyctaginaceae	Medicinal values
<i>Borassus flabellifer</i>	Wine palm	Arecaceae	Food values
<i>Bougainvillea glabra</i>	Paper flower	Nyctaginaceae	Ornamental values
<i>Breynia retusa</i>	Cup saucer plant	Phyllanthaceae	Fruits are edible by the birds
<i>Breynia vitis-idaea</i>	Mountain coffee bush	Phyllanthaceae	Medicinal values
<i>Butea monosperma</i>	Palash, flame of the forest	Fabaceae	Medicinal & socio-cultural values
<i>Caesalpinia pulcherrima</i>	Peacock flower	Fabaceae	Ornamental values
<i>Calliandra haematocephala</i>	Red powder puff	Mimosaceae	Ornamental values
<i>Calliandra haematocephala alba</i>	White powder puff	Mimosaceae	Ornamental values
<i>Callistemon citrinus</i>	Lemon bottlebrush	Myrtaceae	Ornamental values
<i>Calotropis gigantea</i>	Arakh, Crown flower	Asclepiadaceae	Medicinal values
<i>Capsicum annuum</i>	Bell pepper	Solanaceae	Food values
<i>Cardiospermum halicacabum</i>	Balloon plant	Sapindaceae	Medicinal values
<i>Carica papaya</i>	Papaya	Caricaceae	Food values
<i>Cascabela thevetia</i>	Kaniara, Maxican oleander	Apocynaceae	Ornamental values
<i>Cassia fistula</i>	Sunari, Golden shower	Caesalpinaceae	Medicinal values
<i>Cassia roxburghii</i>	Red cassia	Caesalpinaceae	Ornamental values
<i>Cassia siamea</i>	Cassod tree	Caesalpinaceae	Ornamental values
<i>Catharanthus roseus</i>	Sadabihari, Rosy periwinkle	Apocynaceae	Medicinal values

<i>Centella asiatica</i>	Thalkudi, pennywort	Indian	Apiaceae	Medicinal values
<i>Chenopodium album</i>	Bathua, Fat hen		Amaranthaceae	Food values
<i>Choisya ternata</i>	Mexican orange		Rutaceae	Ornamental values
<i>Chromolaena odorata</i>	Pokasunga, Bitter bush		Asteraceae	Medicinal values
<i>Citrus lemon</i>	Lembu, Lemon		Rutaceae	Food values
<i>Cleome rutidosperma</i>	Fringed spider flower		Cleomaceae	Medicinal values
<i>Cleome viscosa</i>	Asian spider flower		Cleomaceae	Medicinal values
<i>Clerodendrum infortunatum</i>	Hill glory bower		Lamiaceae	Medicinal values
<i>Coccinia grandis</i>	Kundurur, Ivy gourd		Cucurbitaceae	Food values
<i>Cocos nucifera</i>	Nadia, Coconut		Arecaceae	Food values
<i>Codiaeum variegatum</i>	Croton		Euphorbiaceae	Medicinal values
<i>Colocasia esculenta</i>	Taro		Areceae	Food values
<i>Combretum indicum</i>	Madhumalati, creeper	Rangoon	Combretaceae	Ornamental values
<i>Commelina benghalensis</i>	Bengal dayflower		Commelinaceae	Food values
<i>Commelina longifolia</i>	Long leaved dayflower		Commelinaceae	Medicinal values
<i>Cordyline fruticosa</i>	Ti plant		Asparagaceae	Ornamental values
<i>Cryptolepis buchananii</i>	Wax leaved climber		Apocynaceae	Medicinal values
<i>Cuscuta chinensis</i>	Nirmuli, Giant Dodder		Convolvulaceae	Ecological values
<i>Cyanthillium cinereum</i>	Little ironweed		Asteraceae	Medicinal values
<i>Cycas circinalis</i>	Queen sago		Cycadaceae	Medicinal values
<i>Datura stramonium</i>	Datura, Jimson weed		Solanaceae	Medicinal values
<i>Delonix regia</i>	Gulmohar, Flame tree		Fabaceae	Ornamental values
<i>Dendrocalamus strictus</i>	Hard bamboo		Poaceae	Ornamental values
<i>Desmodium triflorum</i>	Creeping tick trefoil		Fabaceae	Medicinal values
<i>Dipteracanthus prostratus</i>	Bell weed		Acanthaceae	Medicinal values
<i>Dracaena reflexa</i>	Song of India		Asparagaceae	Ornamental values
<i>Dypsis lutescens</i>	Golden cane palm		Araceae	Ornamental values
<i>Eclipta prostrata</i>	Bhringraj, False daisy		Asteraceae	Medicinal values
<i>Eichhornia crassipes</i>	Water hyacinth		Pontederiaceae	Exotic weed
<i>Eleusine coracana</i>	Finger millet		Poaceae	Medicinal values
<i>Emilia sonchifolia</i>	Purple sow thistle		Asteraceae	Medicinal values

<i>Epipremnum aureum</i>	Money plant	Araceae	Ornamental values
<i>Eragrostis ciliata</i>	NIL	Poaceae	Ecological values
<i>Euphorbia hirta</i>	Asthma weed	Euphorbiaceae	Medicinal values
<i>Euphorbia hypericifolia</i>	Milk purslane	Euphorbiaceae	Exotic weed
<i>Evolvulus nummularius</i>	Bichamalia, Roundleaf bindweed	Convolvulaceae	Medicinal values
<i>Ficus arnottiana</i>	Indian rock fig	Moraceae	Medicinal values
<i>Ficus benghalensis</i>	Bara, Banyan tree	Moraceae	Ecological values
<i>Ficus benjamina</i>	Weeping fig	Moraceae	Medicinal values
<i>Ficus hispida</i>	Hairy fig	Moraceae	Medicinal values
<i>Ficus racemosa</i>	Cluster fig	Moraceae	Ecological values
<i>Ficus religiosa</i>	Ostha, Sacred fig	Moraceae	Ecological values
<i>Ficus tinctoria</i>	Humped fig	Moraceae	Medicinal values
<i>Gliricidia sepium</i>	Mexican lilac	Fabaceae	Ornamental values
<i>Glycosmis pentaphylla</i>	Chauli, Gin berry	Rutaceae	Medicinal values
<i>Gnaphalium polycephalum</i>	Cudweeds	Asteraceae	Medicinal values
<i>Gomphrena celosioides</i>	Gomphrena weed	Amaranthaceae	Medicinal values
<i>Gomphrena serrata</i>	Prostrate gomphrena	Amaranthaceae	Medicinal values
<i>Hedyotis corymbosa</i>	Diamond flower	Rubiaceae	Medicinal values
<i>Hedyotis diffusa</i>	Snake needle grass	Rubiaceae	Medicinal values
<i>Hemidesmus indicus</i>	Anantamul, Indian sarsaparilla	Asclepiadaceae	Medicinal values
<i>Hewittia malabarica</i>	Malabar bindweed	Convolvulaceae	Medicinal values
<i>Hibiscus rosa-sinensis</i>	Mandara, China rosa	Malvaceae	Medicinal values
<i>Hyptis suaveolens</i>	American mint	Lamiaceae	Medicinal values
<i>Ichnocarpus frutescens</i>	Syama lata, Black creeper	Apocynaceae	Medicinal values
<i>Indigofera linnaei</i>	Birdsville indigo	Fabaceae	Medicinal values
<i>Ipomoea aquatica</i>	Water morning glory	Convolvulaceae	Food values
<i>Ipomoea marginata</i>	Lakshmana	Convolvulaceae	Medicinal values
<i>Ipomoea obscura</i>	Obscure morning glory	Convolvulaceae	Medicinal values
<i>Ipomoea sepiaria</i>	Lakshmana	Convolvulaceae	Medicinal values
<i>Ixora coccinea</i>	Flame of woods	Rubiaceae	Ornamental values
<i>Jasminum auriculatum</i>	Juhi, Royal jasmine	Oleaceae	Ornamental values
<i>Jasminum grandiflorum</i>	Spanish jasmine	Oleaceae	Ornamental values

<i>Jasminum sambac</i>	Arabian jasmine	Oleaceae	Ornamental values
<i>Jasminum scandens</i>	Jasmine	Oleaceae	Ornamental values
<i>Kyllinga brevifolia</i>	Green water sedge	Cyperaceae	Ecological values
<i>Lagerstroemia indica</i>	Common crape myrtle	Lythraceae	Ornamental values
<i>Lagerstroemia speciosa</i>	Pride of India	Lythraceae	Ornamental values
<i>Lantana camara</i>	Lantana	Lamiaceae	Exotic species
<i>Lemna minor</i>	Common duckweed	Lemnaceae	Ecological values
<i>Lepidagathis fasciculata</i>	Striped lepidagathis	Acanthaceae	Medicinal values
<i>Leucaena leucocephala</i>	Wild tamarind	Fabaceae	Ecological values
<i>Ligustrum sinense</i>	Indian privet	Oleaceae	Medicinal values
<i>Lindernia antipoda</i>	Sparrow lindernia	Linderniaceae	Medicinal values
<i>Lindernia ciliata</i>	Fringed lindernia	Linderniaceae	Medicinal values
<i>Lindernia crustacea</i>	Malaysian false pimpernel	Linderniaceae	Medicinal values
<i>Ludwigia adscendens</i>	Water primrose	Onagraceae	Medicinal values
<i>Ludwigia perennis</i>	Perennial water primrose	Onagraceae	Medicinal values
<i>Luffa aegyptiaca</i>	Janhi, Sponge gourd	Cucurbitaceae	Food values
<i>Lygodium flexuosum</i>	Indrajala, Maidenhair creeper	Lygodiaceae	Medicinal values
<i>Mangifera indica</i>	Amba, Mango	Anacardiaceae	Food values
<i>Melia azedarach</i>	Bead tree	Meliaceae	Medicinal values
<i>Merremia tridentata</i> subsp. <i>hastata</i>	NIL	Convolvulaceae	Medicinal values
<i>Merremia hederacea</i>	Ivy woodrose	Convolvulaceae	Medicinal values
<i>Merremia umbellata</i>	Hogvine	Convolvulaceae	Medicinal values
<i>Mikania micrantha</i>	Climbing hempweed	Asteraceae	Exotic species
<i>Mimosa pudica</i>	Lajakuli, Touch me not plant	Mimosaceae	Medicinal values
<i>Monochoria hastata</i>	Arrow leaf pondweed	Pontederiaceae	Medicinal values
<i>Monochoria vaginalis</i>	Oval leaf pondweed	Pontederiaceae	Medicinal values
<i>Murraya koenigii</i>	Bhrusanga, Curry leaf	Rutaceae	Food values & Medicinal values
<i>Murraya paniculata</i>	Kamini, Orange jasmine	Rutaceae	Medicinal values
<i>Neolamarckia cadamba</i>	Kadamba	Rubiaceae	Medicinal values
<i>Nephrolepis obliterated</i>	Australian swordfern	Nephrolepidaceae	Medicinal values
<i>Nerium oleander</i>	Oleander	Apocynaceae	Ornamental values

<i>Oldenlandia herbacea</i>	Mille grains	Rubiaceae	Medicinal values
<i>Ophiopogon japonicus</i>	Mondo grass	Asparagaceae	Ornamental values
<i>Oplismenus burmannii</i>	Wavy-leaf basketgrass	Poaceae	Ornamental values
<i>Oxalis corniculata</i>	Creeping woodsorrel	Oxalidaceae	Medicinal values
<i>Parthenium hysterophorus</i>	Carrot grass	Asteraceae	Exotic species
<i>Peltophorum pterocarpum</i>	Copperpod	Fabaceae	Ornamental values
<i>Phoenix dactylifera</i>	Khajuri, Date palm	Arecaceae	Food values
<i>Phyllanthus acidus</i>	Star gooseberry	Phyllanthaceae	Medicinal values
<i>Phyllanthus amarus</i>	Gulf leaf flower	Phyllanthaceae	Medicinal values
<i>Phyllanthus niruri</i>	Stone breaker	Phyllanthaceae	Medicinal values
<i>Phyllanthus reticulatus</i>	Black honey shrub	Phyllanthaceae	Medicinal values
<i>Phyllanthus virgatus</i>	Seed under leaf	Phyllanthaceae	Medicinal values
<i>Pistia stratiotes</i>	Water lettuce	Araceae	Exotic weed
<i>Pithecellobium dulce</i>	Sweet tamarind, Jungal jalebi	Fabaceae	Food values
<i>Platyclusus orientalis</i>	Morpankhi	Cupressaceae	Ornamental values
<i>Plumeria alba</i>	West Indian jasmine	Apocynaceae	Socio-cultural values
<i>Polyalthia longifolia</i>	Debdaru, False ashok	Annonaceae	Ornamental values
<i>Polyscias guilfoylei</i>	Geranium aralia	Araliaceae	Ornamental values
<i>Pongamia pinnata</i>	Karanja, Pongam tree	Fabaceae	Medicinal values
<i>Portulaca oleracea</i>	Common purslane	Portulacaceae	Medicinal values
<i>Psidium guajava</i>	Pijuli, Guava	Myrtaceae	Food values
<i>Pteris vittata</i>	Chinese brake	Pteridaceae	Ornamental values
<i>Putranjiva roxburghii</i>	Putranjiva	Putranjivaceae	Ornamental values
<i>Ricinus communis</i>	Jada, Castor bean plant	Euphorbiaceae	Medicinal values
<i>Rauvolfia tetraphylla</i>	Patala garudi, Devil pepper	Apocynaceae	Medicinal values
<i>Rungia pectinata</i>	Comb rungia	Acanthaceae	Medicinal values
<i>Saraca asoca</i>	Ashok	Fabaceae	Medicinal values
<i>Scoparia dulcis</i>	Bana dhaniya, Sweet broom weed	Plantaginaceae	Medicinal values
<i>Senna alata</i>	Candle bush	Caesalpiniaceae	Medicinal values
<i>Senna tora</i>	Stinking cassia	Caesalpiniaceae	Medicinal values
<i>Senna occidentalis</i>	Bana Chakunda, Coffee senna	Caesalpiniaceae	Medicinal values
<i>Sida acuta</i>	Bajramuli, morning mallow	Malvaceae	Medicinal values

<i>Sida cordata</i>	Heart leaf sida	Malvaceae	Medicinal values
<i>Sida rhombifolia</i>	Arrow leaf sida	Malvaceae	Medicinal values
<i>Solanum nigrum</i>	Yellow nightshade	Solanaceae	Medicinal values
<i>Solanum torvum</i>	Turkey berry	Solanaceae	Food & medicinal values
<i>Solanum virginianum</i>	Thorny nightshade	Solanaceae	Medicinal values
<i>Solanum xanthocarpum</i>	Yellow berried nightshade	Solanaceae	Medicinal values
<i>Spathodea campanulata</i>	African tulip tree	Bignoniaceae	Ornamental & ecological values
<i>Spermacoce mauritiana</i>	NIL	Rubiaceae	Medicinal values
<i>Spilanthes paniculata</i>	Panicled Spot flower	Asteraceae	Medicinal values
<i>Spirodela polyrrhiza</i>	Common duckmeat	Lemnaceae	Exotic weed
<i>Stephania japonica</i>	Tape vine	Menispermaceae	Medicinal values
<i>Streblus asper</i>	Sahada, Sand paper tree	Moraceae	Food values
<i>Synedrella nodiflora</i>	Cinderella weed	Asteraceae	Medicinal values
<i>Syzygium cumini</i>	Jamu, Malbar pulm	Myrtaceae	Food & medicinal values
<i>Syzygium jambos</i>	Jambo	Myrtaceae	Food & medicinal values
<i>Tabernaemontana divaricata</i>	Pinwheel flower	Apocynaceae	Ornamental values
<i>Tamarindus indica</i>	Tentuli, Tamarind	Fabaceae	Food values
<i>Tecoma stans</i>	Yellow bells	Bignoniaceae	Ornamental values
<i>Tectona grandis</i>	Saguan, Teak	Lamiaceae	Ecological & ornamental values
<i>Teramnus labialis</i>	Blue wiss	Fabaceae	Medicinal values
<i>Terminalia catappa</i>	Indian almond	Combretaceae	Medicinal values
<i>Terminalia chebula</i>	Harida, Myrobalan	Combretaceae	Medicinal values
<i>Thunbergia grandiflora</i>	Bengal clockvine	Acanthaceae	Ornamental values
<i>Tinospora cordifolia</i>	Guluchi, Amrita, Gulbel	Menispermaceae	Medicinal values
<i>Tradescantia spathacea</i>	Moses in the cradle	Commelinaceae	Ornamental values
<i>Trema orientalis</i>	Indian charcoal tree	Cannabaceae	Ecological values
<i>Tridax procumbens</i>	Bisalyakarani, Mexican daisy	Asteraceae	Medicinal values
<i>Triumfetta pentandra</i>	Fivestamen burrbark	Tiliaceae	Medicinal values
<i>Typha angustifolia</i>	Broadleaf reedmace	Typhaceae	Medicinal values
<i>Urena lobata</i>	Bur mallow	Malvaceae	Medicinal values
<i>Wedelia chinensis</i>	Chinese wedelia	Asteraceae	Medicinal values

<i>Wolffia globosa</i>	Asian watermeal	Araceae	Aquatic weed
<i>Zamia furfuracea</i>	Cardboard palm	Zamiaceae	Ornamental values
<i>Ziziphus jujuba</i>	Jujube	Rhamnaceae	Food values
<i>Ziziphus mauritiana</i>	Ber, Indian jujube	Rhamnaceae	Food values
<i>Ziziphus oenoplia</i>	Kantei koli, Jackal jujube	Rhamnaceae	Food values

ANNEXURE II

Invasive Flora of NICCO Park

Plant name	Common name	Family	Values
<i>Acacia auriculiformis</i>	Ear-Pod Wattle	Mimosaceae	Exotic invasive species
<i>Eichhornia crassipes</i>	Water hyacinth	Pontederiaceae	Exotic invasive species
<i>Euphorbia hypericifolia</i>	Milk purslane	Euphorbiaceae	Exotic invasive species
<i>Lantana camara</i>	Lantana	Lamiaceae	Exotic invasive species
<i>Mikania micrantha</i>	Climbing hempweed	Asteraceae	Exotic invasive species
<i>Parthenium hysterophorus</i>	Carrot grass	Asteraceae	Exotic invasive species
<i>Pistia stratiotes</i>	Water lettuce	Araceae	Exotic invasive species
<i>Spirodela polyrrhiza</i>	Common duckmeat	Lemnaceae	Exotic invasive species

ANNEXURE III

Threatened Flora of NICCO Park

Plant name	Common name	Family	Values
<i>Cycas circinalis</i>	Queen sago	Cycadaceae	Threatened (Endangered)
<i>Saraca asoca</i>	Ashok	Fabaceae	Threatened (Vulnerable)

Avifaunal of NICCO Park

Common name	Scientific name	Family
Ashy prinia	<i>Prinia socialis</i> (Sykes, 1832)	Cisticolidae
Asian koel	<i>Eudynamys scolopaceus</i> (Linnaeus, 1758)	Cuculidae
Asian palm swift	<i>Cypsiurus balasiensis</i> (J.E. Gray, 1829)	Apodidae
Asian pied starling	<i>Gracupica contra</i> (Linnaeus, 1758)	Sturnidae
Black drongo	<i>Dicrurus macrocercus</i> (Vieillot, 1817)	Dicruridae
Black kite	<i>Milvus migrans</i> (Boddaert, 1783)	Accipitridae
Black-hooded oriole	<i>Oriolus xanthomus</i> (Linnaeus, 1758)	Oriolidae
Bronzed winged Jacana	<i>Metopidius indicus</i> (Latham, 1790)	Jacanadidae
Brown headed barbet	<i>Psilopogon zeylanicus</i> (Gmelin, 1788)	Megalaimidae
Cattle egret	<i>Bubulcus ibis</i> (Linnaeus, 1758)	Ardeidae
Common hawk-cuckoo	<i>Hierococcyx varius</i> (Vahl, 1797)	Cuculidae
Common myna	<i>Acridotheres tristis</i> (Linnaeus, 1766)	Sturnidae
Common pigeon	<i>Columba livia</i> (Gmelin, 1789)	Columbidae
Common prinia	<i>Prinia inornata</i> (Sykes, 1832)	Cisticolidae
Common sandpiper	<i>Actitis hypoleucos</i> (Linnaeus, 1758)	Scolopacidae
Common woodshrike	<i>Tephrodromis pondicerianus</i> (Gmelin, 1789)	Vangidae
Coppersmith barbet	<i>Psilopogon haemacephalus</i> (Statius Muller, 1776)	Megalaimidae
EurAsian cuckoo	<i>Cuculus canorus</i> (Linnaeus, 1758)	Cuculidae
Eurasian Hoopoe	<i>Upupa epops</i> (Linnaeus, 1758)	Upupidae
Greater coucal	<i>Centropus sinensis</i> (Stephens, 1815)	Cuculidae
Grey wagtail	<i>Motacilla cinerea</i> (Tunstall, 1771)	Motacillidae
House Crow	<i>Corvus splendens</i> (Vieillot, 1817)	Corvidae
House Sparrow	<i>Passer domesticus</i> (Linnaeus, 1758)	Passeridae
Indian golden oriole	<i>Oriolus kundoo</i> (Sykes, 1832)	Oriolidae
Indian Pond heron	<i>Ardeola grayii</i> (Sykes, 1832)	Ardeidae

Jungle babbler	<i>Argya striata</i> (Dumont,1823)	Leiothrichidae
Little cormorant	<i>Microcarbo niger</i> (Vieillot,1817)	Phalacrocoracidae
Little egret	<i>Egretta garzetta</i> (Linnaeus, 1766)	Ardeidae
Oriental Magpie-robin	<i>Copsychus saularis</i> (Linnaeus,1758)	Muscicapidae
Plain prinia	<i>Prinia inornata</i> (Sykes, 1832)	Cisticolidae
Purple sunbird	<i>Cinnyris asiaticus</i> (Latham, 1790)	Nectariniidae
Purple-rumped sunbird	<i>Leptocoma zeylonica</i> (Linnaeus, 1766)	Nectariniidae
Red vented bulbul	<i>Pycnonotus cafer</i> (Linnaeus,1766)	Pycnonotidae
Red-wattled lapwing	<i>Venellus indicus</i> (Boddaert,1783)	Charadriidae
Red-whiskered bulbul	<i>Pycnonotus jocosus</i> (Linnaeus,1758)	Pycnonotidae
Rose-ringed parakeet	<i>Psittacula krameri</i> (Scopoli, 1769)	Psittaculidae
Rufous treepie	<i>Dendrocitta vagabunda</i> (Latham,1790)	Corvidae
Shikra	<i>Accipiter budius</i> (Gmelin,1788)	Accipitridae
Spotted dove	<i>Spilopelia chinensis</i> (Scopoli,1786)	Columbidae
White breasted water hen	<i>Amaurornis phoenicurus</i> (Pennant,1769)	Rallidae
White throated kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus,1758)	Alcedinidae
White wagtail	<i>Motacilla alba</i> (Linnaeus,1758)	Motacillidae
Taiga flycatcher	<i>Ficedula albicilla</i> (Pallas, 1811)	Muscicapidae
Green sandpiper	<i>Tringa ochropus</i> (Linnaeus, 1758)	Scolopacidae
Indian cuckoo	<i>Cuculus Micropterus</i> (Gould, 1838)	Cuculidae

Butterfly Diversity of NICCO Park

Common name	Scientific name	Family
Commander	<i>Moduza procris</i> (Cramer, 1777)	Nymphalidae
Common cerulean	<i>Jamides celeno</i> (Cramer, 1775)	Lycaenidae
Common crow	<i>Euploea core</i> (Cramer, 1780)	Nymphalidae
Common evening brown	<i>Melanitis leda</i> (Linnaeus, 1758)	Nymphalidae
Common grass yellow	<i>Eurema hecabe</i> (Linnaeus, 1758)	Pieridae
Common jezebel	<i>Delias eucharis</i> (Drury, 1773)	Pieridae
Common mime	<i>Papilio clytia</i> (Linnaeus, 1758)	Papilionidae
Common mormon	<i>Papilio polytes</i> (Linnaeus, 1758)	Papilionidae
Common pierrot	<i>Castalius rosimon</i> (Fabricius, 1775)	Lycaenidae
Common sailor	<i>Neptis hylas</i> (Linnaeus, 1758)	Limenitidiinae
Crimson rose	<i>Pachliopta hector</i> (Linnaeus, 1758)	Papilionidae
Eurema hecabe	<i>Eurema hecabe</i> (Linnaeus, 1758)	Pieridae
Indian palm bob	<i>Suastus gremius</i> (Fabricius, 1798)	Hesperiidae
Lemon emigrant	<i>Catopsilia pomona</i> (Fabricius, 1775)	Pieridae
Lime blue	<i>Chilades lajus</i> (Stoll, 1780)	Lycaenidae
Mime butterfly	<i>Papilio clytia</i> (Linnaeus, 1758)	Papilionidae
Mottled emigrant	<i>Catopsilia pyranthe</i> (Linnaeus, 1758)	Pieridae
Pale grass blue	<i>Pseudozizeeria maha</i> (Kollar, 1844)	Lycaenidae
Plain tiger	<i>Danaus chrysippus</i> (Linnaeus, 1758)	Nymphalidae
Small blue	<i>Cupido minimus</i> (Fuessly, 1775)	Lycaenidae
Small white	<i>Pieris rapae</i> (Linnaeus, 1758)	Pieridae
Striped tiger	<i>Danaus genutia</i> (Cramer, 1779)	Nymphalidae
Tailed Jay	<i>Graphium Agamemnon</i> (Linnaeus, 1758)	Papilionidae
Tawny coster	<i>Acraea violae</i> (Fabricius, 1775)	Nymphalidae
White bar bush brown	<i>Mycalesis anaxias</i> (Evans, 1920)	Nymphalidae

Other Faunal Diversity of NICCO Park

Common name	Scientific name
Indian palm squirrel	<i>Funambulus palmarum</i> (Linnaeus, 1766)
Indian grey mongoose	<i>Herpestes edwardsi</i> (E. Geoffroy Saint-Hilaire, 1818)

Some important plants that are ecologically and medicinally beneficial

Species	Family
<i>Aegle marmelos</i>	Rutaceae
<i>Alstonia scholaris</i>	Apocynaceae
<i>Artocarpus heterophyllus</i>	Moraceae
<i>Azadirachta indica</i>	Meliaceae
<i>Calotropis gigantea</i>	Apocynaceae
<i>Ficus benghalensis</i>	Moraceae
<i>Ficus religiosa</i>	Moraceae
<i>Ficus racemosa</i>	Moraceae
<i>Leucaena leucocephala</i>	Fabaceae
<i>Pongamia pinnata</i>	Fabaceae
<i>Terminalia chebula</i>	Combretaceae
<i>Trema orientalis</i>	Cannabaceae
<i>Ziziphus mauritiana</i>	Rhamnaceae
<i>Ziziphus oenoplia</i>	Rhamnaceae

11 References

- CAMP Workshops on Medicinal Plants, India. (1998). *Saraca asoca*. The IUCN Red List of Threatened Species 1998: e. T34623A9879360.
- Choudhury BP and Patnaik, S. N. (1982). Contribution to the flora of the Khandagiri-Udayagiri hills. *Journal of economic and taxonomic botany*.3: 797-810.
- Kasambe R. (2016). Self Published. Butterflies of Western Ghats Am e-Book.
- Elanchezhan K, Samraj JM and Reuolin SJ. (2017). Butterfly diversity at the agricultural college campus. *Journal of Entomology and Zoology Studies*. 5(5): 1389-1400
- Grimmett R, Inskipp C and Inskipp T. (2016). Birds of the Indian Subcontinent.
- Haines HH (1921-1925) The botany of Bihar and Orissa, vol 5-6. Adlard & Son and West Newman, London, pp 1115-1124.
- Halder PK, Paul N and Beg MRA. (2014). Prospect of *Pongamia pinnata* (Karanja) in Bangladesh: A sustainable source of Liquid Fuel. *Journal of Renewable Energy*. 647324.
- Ishoro AP and Aja EE. (2017). Population Frequency, Density, Abundance and Diversity of Tree species in Ten Communal Forest of Northern Cross River State, Nigeria. *International Journal of current Research*. 9(10): (59581-59596)
- Kandari LS, Ashish K, Negi T and Phondani PC. (2012). 1(1): 1-5
- Kumar M, Husaini SA, Uddin Q, Aminuddin, Kumar K and Samiulla L. (2013). Ethnobotanical Study of the Wild edible plants from Odisha. *Life Sciences Leaflets*. 13-20.
- Kumar S, Das G, Shin HS, Kumar P and Patra JK. (2018). Diversity of Plant Species in the Steel of Odisha, India: Ethnobotany and Implications for Conservation of Urban Bio-Resources. *Brazilian Archives of Biology and Technology*. 61:1-19
- Lambole VB, Murti K, Kumar U, Sandipkumar B and Gajera V. (2010). Phytopharmacological properties of *Aegle marmelos* as a potential medicinal tree: An overview. *International Journal of Pharmaceutical Sciences Review and Research*. 5(2): 67-72.
- Mahajan M and Fatima S. (2017). Frequency, Abundance and Density of Plant Species by List Count Quadrat Method. *Epitome: International Journal of Multidisciplinary Research*. 3(7): 2395-6968
- Office of Agriculture Development Support Bureau Agency for International Development Washington, D.C. 20523. (1981). *Leucaena leucocephala*: a tree that Deies the Woodcutter.
- Orwa C, Mutua A, Kindt R, Jamnadass R and Anthony S. (2009). *Calotropis procera* Asclepiadaceae (Ait.) Ait.f. 2009. Agroforestry Database: a tree reference and selection guide version 4.0. World Forestry Centre, Kenya. 1-5.

- Sahana Ghosh. (2018). Greening with pollution-gobbling trees doubles benefits. Mongabay Series. Environment and Health.
- Saxena HO and Brahman M. (1995). The Flora of Odisha. Regional Research Laboratory & Orissa Forest Development Corporation Ltd. Bhubaneswar. Pp-1-2918.
- Saxena HO, Brahman M and Dutta PK (1998). Ethnobotanical studies in Similipal forest of Mayurbhanj district (Orissa). Nelumbo, 30(1-4), 83-89.
- Varghese A, Krishnamurthy V, Garnesan R & Manu K. (2010). *Cycas circinalis*. *The IUCN Red List of Threatened Species* 2010: e.T42089A10627275.
- Wynter-Blyth, M.A. (1957) Butterflies of the Indian Region. Bombay Natural History Society, Mumbai, India.

12 Glossary

Species Abundance: Species abundance is the study of how common a particular species is in a given community.

Aesthetic values: The characteristics of a work of art, a natural landscape, a person or a situation, can allow us to make verbal or nonverbal judgments about what we perceive with any of our senses.

Analogy: A comparison between one thing and another, typically for the purpose of explanation or clarification.

Aquatic: Relating to water.

Aromatic: Have a pleasant and distinctive smell.

Avifauna: The birds of a particular region, habitat, or geological period.

Canopy: The uppermost branches of the trees forming a more or less continuous layer of foliage.

Drought-resistant: It is the ability to which a plant maintains its biomass production during arid or drought conditions.

Ecology: It is the branch of biology that deals with the relations of organisms to one another and to their physical surroundings.

Endangered: A species of animal or plant that is seriously at risk of extinction.

Evergreen plant: An evergreen is a plant which has foliage that remains green and functional through more than one growing season. This also pertains to plants that retain their foliage only in warm climates, and contrasts with deciduous plants, which completely lose their foliage during the winter or dry season.

Frugivorous: A frugivore is an animal that thrives mostly on raw fruits or succulent fruit-like produce of plants such as roots, shoots, nuts and seeds.

Habitat: It represents the array of resources, physical and biotic factors that are present in an area, such as to support the survival and reproduction of a particular species.

Indigenous: It represents originating or occurring naturally in a particular place.

Insectivorous plant: Plants that feed on insect to fulfil their nitrogen requirement, that's why they can easily grow in nitrogen deficient soil condition.

Invasive plants: Plants that tend to spread very quickly and undesirably or harmfully.

Landscapes: It is the visible features of an area of land, its landforms, and how they integrate with natural or man-made features.

Livestock: They are domesticated animals raised in an agricultural setting to produce labour and commodities such as meat, eggs, milk, fur, leather, and wool.

Manure: It is organic matter that is used as organic fertilizer in agriculture. Most manure consists of animal faces, include compost and green manure.

Medicinal: A substance or plant having healing properties.

Monograph: A detailed written study of a single specialized subject or an aspect of it.

Native Plants: A plant is considered native if it has occurred naturally in a particular region, ecosystem, or habitat without human introduction.

Ornamental: Something that intend to beautiful rather than useful.

Phytoremediation: It is a cost-efficient plant-based approach that takes advantage of the ability of plants to concentrate elements and compounds from the environment and metabolize various molecules in their tissues.

Pollinators: A pollinator is an animal that moves pollen from the male anther of a flower to the female stigma of a flower.

Population density: It is a measurement of population per unit area, or exceptionally unit volume. It is a quantity of type number density.

Raptors: Birds of prey are known as raptors, include species of bird that primarily hunt and feed on vertebrates that are large relative to the hunter.

Rare: A rare species is a group of organisms that are very uncommon, scarce, or infrequently encountered.

Soil erosion: It is the displacement of the upper layer of soil, a form of soil degradation caused by the dynamic activity of erosive agents like water, ice, snow, air, plants, animals, and humans.

Species richness: It is the number of different species represented in an ecological community, landscape or region.

Threatened Species: Threatened species is any species which is vulnerable, endangered, or critically endangered. The International Union for Conservation of Nature, or IUCN, is commonly referenced as a leading organization in determining if a species can be considered a threatened species or not.

Tolerant: Ability to continue existing despite bad or difficult conditions.

Vulnerable: A vulnerable species is a species are likely to become endangered unless the circumstances that are threatening its survival and reproduction improve.

Wetland: Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season.

Recreational values: Recreation is an activity of leisure or activities that are often done for enjoyment, amusement, or pleasure and are considered to be "fun".

Exotic invasive: An exotic species refers to a plant, animal or microorganism species, which is introduced into an area where it does not occur naturally whereas an invasive species refers to an exotic species whose introduction causes environmental and economic harm to the ecosystem.

