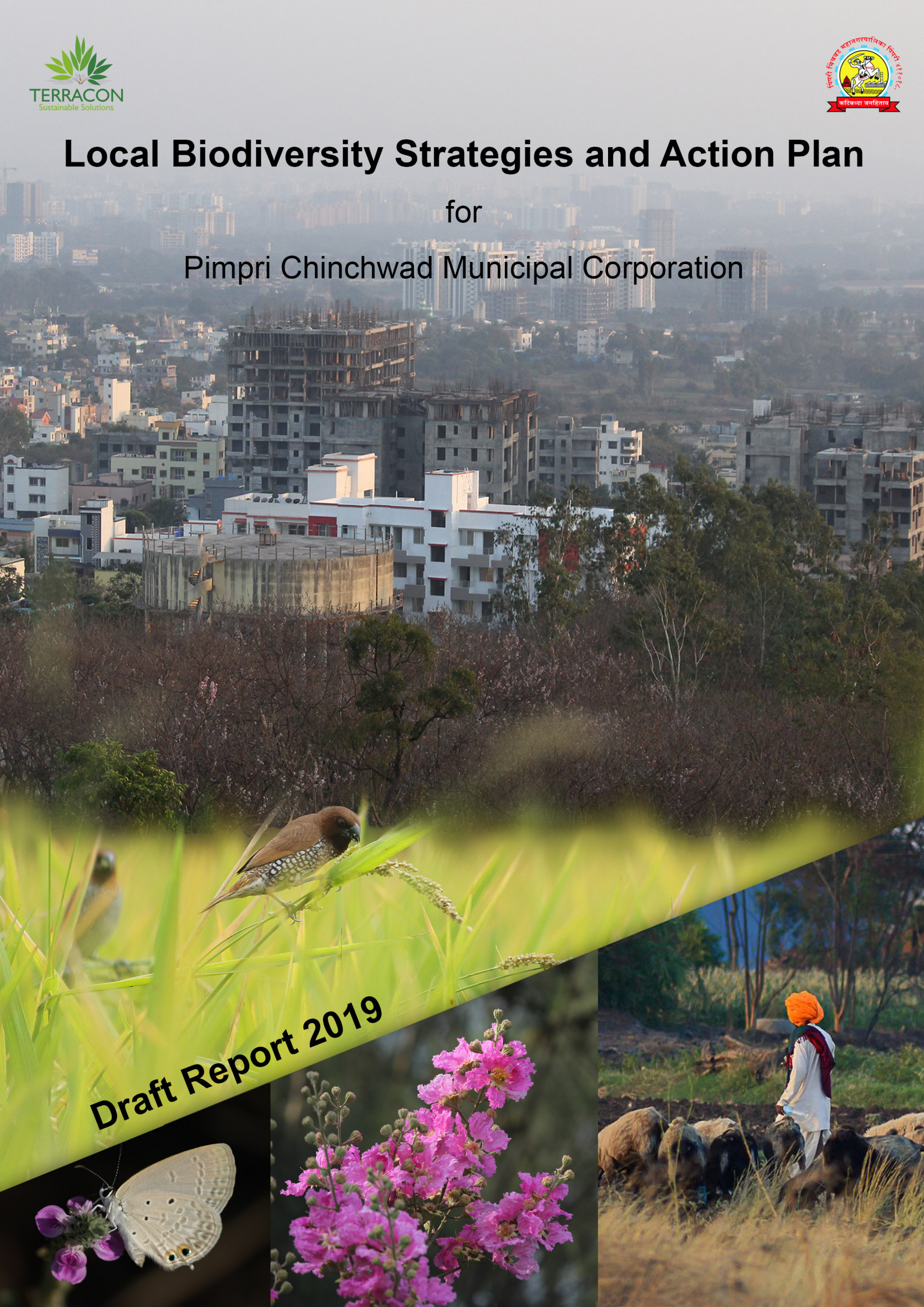
Local Biodiversity Strategies and Action Plan

for

Pimpri Chinchwad Municipal Corporation



Draft Report 2019

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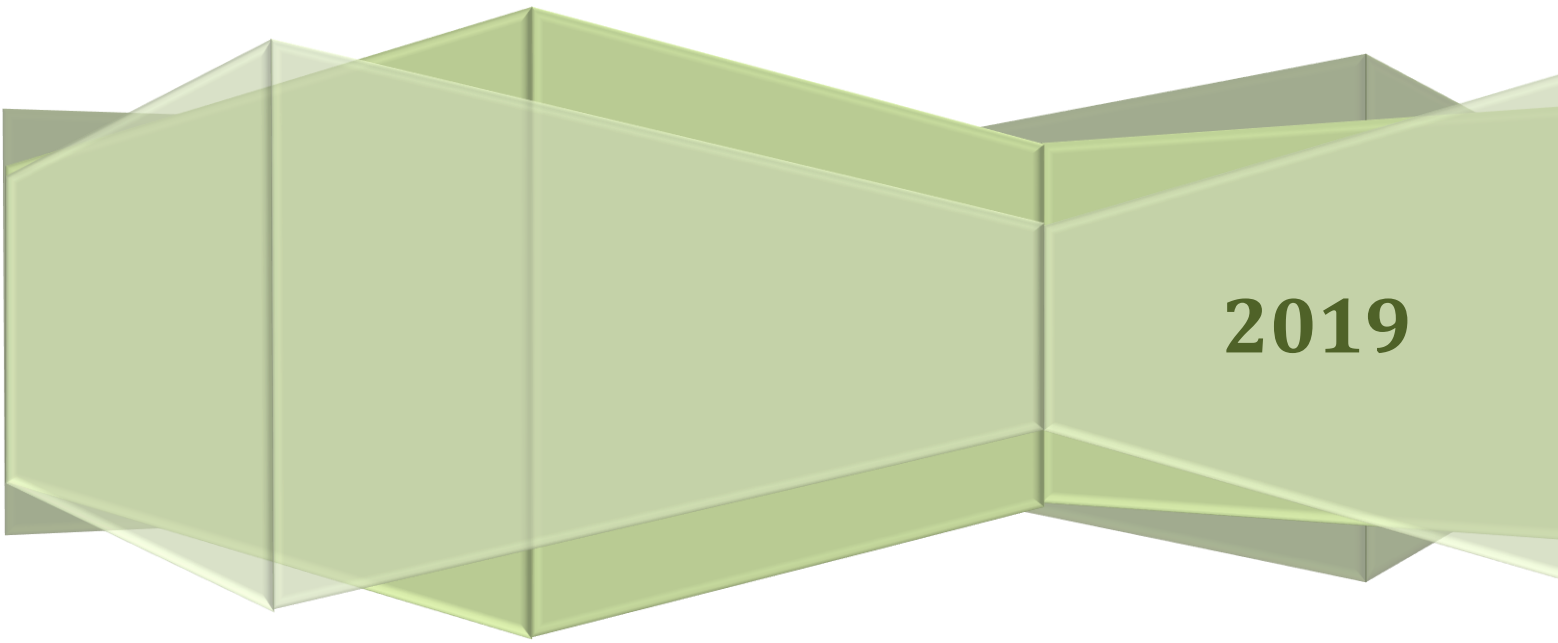
LOCAL BIODIVERSITY STRATEGY AND ACTION PLAN

Pimpri Chinchwad Municipal Corporation

Prepared by: Terracon Ecotech Private Limited, Mumbai



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Acknowledgement

We are thankful to Mr. Shravan Hardikar (I.A.S), Municipal Commissioner, Pimpri Chinchwad Municipal Corporation (PCMC) for assigning us this unique opportunity to formulate Local Biodiversity Strategy and Action Plan for Pimpri Chinchwad city.

We express our gratitude to Dr. Vilas Bardekar (I.F.S), Chairman, Maharashtra State Biodiversity Board, Mr. A. Ashraf (I.F.S), Member Secretary and Mr. Vivek Daware, Technical Officer, Maharashtra State Biodiversity Board for their precious inputs.

We would especially like to thank Mrs. Usha Mundhe, Chairperson (Biodiversity Management Committee), Mr. Sanjay Kulkarni, Executive Engineer (Environment) and Mr. Suresh Salunkhe, Garden Superintendent, PCMC and Member of BMC for their unrelenting support, coordination, invaluable inputs and active involvement in the Project.

This project involved interactions and detailed discussions with a large number of people working in Pimpri Chinchwad Municipal Corporation (PCMC), Local NGO's, Organization and Subject Experts. We would like to extend our sincere thanks to each and every one of them.

We also thank our Dr. Ramesh Madav, Chairman, Dr. C.S.Latoo, Advisor of Terracon Ecotech Private Limited and Dr. Pravin Cholke, Assistant Professor, Anantrao Pawar College for their guidance, support and assistance in directing us to the appropriate resources for information.

Ashok Jain
Managing Director

Executive Summary

The phrase "local actions have global effects" is one of the most heard in recent times and very aptly fits conservation science. Pimpri-Chinchwad Municipal Corporation has acted upon this by one of its latest green initiatives of developing *'local biodiversity strategy and action plan'* (LBSAP) in conformity with the guidelines of National Biodiversity Strategy and Action Plan (NBSAP) and Aichi targets 2020. LBSAPs have been formally recognized in decision X/22 at the 10th Meeting of the Conference of Parties (COP) to the Convention on Biological Diversity (CBD COP 10) to help CBD parties in encouraging local governments to take conservation actions and initiatives.

"LBSAP is a document that guides the local city administrators to carve out policies in favor of conserving and protecting biodiversity and ecosystem services."

It is a tool that enables the implementation of the CBD and the Aichi targets that advocates for ensuring environmental sustainability and National Biodiversity Strategies and Action Plan (NBSAP).

PCMC has 30.2% of its land cover as natural areas and about 166 ha of gardens and parks. PCMC has rich grassland ecosystems with some rare floral species like Varsharani (*Monsonia senegalensis)*, a variety of butterflies, larks, pipits, night jars and raptors in birds, etc. Also, garden department has worked hard for taking plantation initiatives on no development zones and maintaining green cover of PCMC. This gave us a City Biodiversity Index score of 58 out of 92 for PCMC. However, with growing urbanization, the existing natural areas are in threat and their protection is necessary to maintain the current state of biodiversity. To enhance city biodiversity, a lot of actions need to be taken in different arenas like connecting isolated green patches, including importance of biodiversity and conservation in school curriculum, accommodating local marginal people in conservation and such others. Thus, the need to adopt local biodiversity strategy and action plan was agreed upon.

Taxa	No. of Species
Birds	136
Butterflies	50
Freshwater fishes	47
Mammals	06
Trees	184
Shrubs	50
Herbs	182

Based upon baseline study conducted for CBI, literature review and discussions with various government and non-governmental stakeholders, the following strategies for PCMC were finalized:

- Awareness and Capacity Building
- Streamlining the Biodiversity Park and Creation of Biodiversity Information Centre
- Conservation of Natural Habitats in the City
- Creation of Ecological Network
- Management of Invasive Species
- Development of Alternative Livelihood from Biodiversity
- Incorporating Ecological Perspective in Development Projects
- Conservation of Rare and Native Species
- Restoration of Degraded Ecosystem

Each strategy was further transformed in action plans and the action plans were prioritized based on seven criteria viz., ecological approach, time frame, cost incurred, feasibility of the action, stakeholders involved, number of times to be implemented. Another table mentions the responsible

government departments and the kind of external expertise required for each action plan. The alignment of the action plans with national biodiversity targets and Aichi targets are also mentioned in the report.

Proposed strategies for PCMC

Awareness and capacity building: In order to engage more people of different backgrounds and interests in actions for conservation, we would need to tailor messages to suit the needs of specific sectors and target groups and highlight the relevance of biodiversity to our daily lives. This can be done by addressing diverse groups of people from students, government staff to communities. This strategy was suggested to be implemented by the following action plans:

1) Capacity Building for Management and School-College
2) Signage & Nature Art installations
3) Coffee-table book & short-film on biodiversity of PCMC
4) Biodiversity-Graffiti by students on public wall
5) Creation of Online Portal for Biodiversity as Citizen Science Initiative

Streamlining biodiversity parks and creation of biodiversity information center: Many parks or botanical gardens in general, display exotic flora from around the world. Such parks are kept well-trimmed and manicured. Introduced tree species do nothing to support the native insects, birds and other animals that were once indigenous to the area. Native flora and fauna evolve over time to co-exist thereby forming a mutually beneficial relationship. Therefore, streamlining biodiversity parks to contain majorly native flora is very important.

Biodiversity information center is one of the main suggested themes for biodiversity parks and other natural and naturalized areas of PCMC. Nature information center usually called as visitor centre or interpretive centre, are designed to educate people about nature and the environment. Their position inside nature parks, biodiversity parks is of particular significance as they form the important connection ways between people and nature by providing guided trails and visits to natural areas. Its significance in PCMC would be to create awareness amongst the people about the natural history of Pimpri and sensitize for conservation of biodiversity in the city.

Conservation of natural habitats: Conservation actions are incomplete without conserving existing natural habitats. Pimpri Chinchwad has presence of grasslands and scrublands as major habitats on the outskirts of the city near Charholi which are being lost rapidly due to urbanization. They harbor uncommon floral and faunal species which are not seen inside the city area making their conservation of huge significance. Therefore, their conservation and prohibition of developmental activities in such patches has been suggested.

Creation of Ecological Networks: Conserving habitats should be accompanied with maintaining physical connectivity between them. This gave rise to the concept of ecological corridors and connectivity patches on a larger scale. The current situation of the distribution of small insects like butterflies, moths, etc. in Pimpri Chinchwad is at the periphery of the city. These areas are newly included areas within the city jurisdiction and are not as urbanized as the city center. The ideation of this strategy is to create a network within the city that helps in integration of these species throughout the city. This is proposed in two action plans: 1) Creation of butterfly parks 2) Creation of natural ways

Management of invasive alien species: Invasive alien species (IAS) are species which when introduced in a new location spread extensively distribution threatening local biological diversity. IAS occur in all

taxonomic groups, including animals, plants, fungi and microorganisms, and can affect all types of ecosystems. Though only a small percentage of organisms transported to new environments become invasive, the negative impacts can be extensive and over time, these additions become substantial. Moreover, global climate change and anthropogenic interferences have further amplified the problem of invasive alien species like *Lantana camara, Prosopis juliflora, Leucena leucocephala* among flora.

Development of alternative livelihoods: Alternative livelihood promotes livelihood security through improving the diversity and security of resources, skills and technologies that are available to agricultural communities. If households are to be resilient then they need adequate resources to fall back on in times of need and this means finding other ways to earn an income. With increasing land-use change of agriculture to urban expanses, the loss of the agriculture practices from the city is causing a loss of major livelihood for the resident and lower income population. To provide livelihood options for these people are always a major task for the urban local body. A practical action for providing alternative livelihood needs to be promoted. This is proposed through measures like 1) Apiculture 2) Creation of plant artifacts and 3) Mushroom cultivation.

Incorporating Ecological perspective in planning: Ecosystem degradation is threatening human development. On the one hand, it is clear that transformation of the environmental resource base has contributed to substantial net gains in human well-being and economic development. Many researchers, practitioners, and critics have explored alternative and radical approaches between ecology and architecture, urban design, landscape, planning, and urbanism contributing to the theory and practice of ecological urbanism. The development of an ecological perspective into urbanism has gained importance as it its connected to multiple interrelated movements: ecological design, industrial ecology, deep ecology, and the so called sustainable development paradigm. Currently, in Pimpri Chinchwad there are two major development activities viz. Metro lines and River Front Development project. This action strategy will enable PCMC to maintain and enhance the biodiversity values in the city.

Conservation of Native and Rare Species: Natural and anthropogenic disturbances have cumulatively caused drastic impacts on native populations in many different expanses of earth. In the process of succession, all the species that are unable to adapt to the environment of a particular place disappear leaving only those species in the climax which get well adapted with the surrounding habitat. Hence, conservation of native species is important as they form an important part of local food chain. Certain species are endemic to an area and get disturbed due to human interferences with the ecosystems. To prevent them from being declined to extinction or near extinction is important and need special conservation measures. For PCMC, two action plans are suggested under this strategy: 1) Development of conservation breeding center for fish 2) Development of native seed banks.

Restoration of Degraded Ecosystems: Ecosystems are being used unsustainably worldwide, and many are at risk of being lost forever. In many parts of the world, ecosystems are no longer providing essential services, such as food and water production, climate regulation, carbon storage, crop pollination, and wildlife habitat. Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration is a means of sustaining the diversity of life on Earth and re-establishing an ecologically healthy relationship between nature and culture.

PCMC has many inactive mines and quarries as well as parts of rivers that need to be revamped from their degraded condition. Even man-made ponds and lakes need to be cleaned and restored to help the survival of aquatic fauna which attract birds. Maintenance works are regular intervals need to be carried out for all natural and naturalized areas due to their proximity to human habitation.

The report sums up with action plan of each strategy described in detail with implementation areas, responsible agencies, cost estimates and expertise required. Thus, a complete detailed report is formed for enhancing biodiversity and CBI scores of the city. PCMC stands as an example for other cities to adopt LBSAP for conserving and enhancing biodiversity in metropolitan regions which will cumulatively help to achieve national biodiversity targets. PCMC is further recommended to adopt LBSAP at regular intervals of 5 years for maintaining its unique biological diversity.

Contents

Biodiversity and Ecosystem Services

Our planet is a home to a very wide range of life forms from microscopic bacteria to huge mammals like whales and elephants. A wide range of organisms exist in different biomes from hot deserts of tropics to cold mountains and poles. Thus, earth depicts a huge biological diversity in its diverse ecosystems.

Definitions by Convention on Biological Diversity

Biodiversity is defined as 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'

'Ecosystem Services are the benefits that people obtain from provisioning services such as food and water, regulating services such as pest and disease control, cultural services such as recreational and spiritual activities and supporting services such as nutrient cycling that maintain the conditions for life on Earth'

Biodiversity is the contracted form of two terms 'biological diversity'. Biodiversity is simply the variety of life on the earth. It covers all the living organisms from common to critically endangered species. Along with the living species, biodiversity also includes various habitats that provide shelter and food to organisms. It highlights the interconnections and interdependence of habitats and species. Biodiversity serve as a primary indicator of the health of the surroundings and is inextricably linked to the welfare of human being. We depend on the ability of nature to sustain and replenish it to constantly renew and exchange. Biodiversity gives us many of the essentials of life.

Figure 1: Ecosystem Services

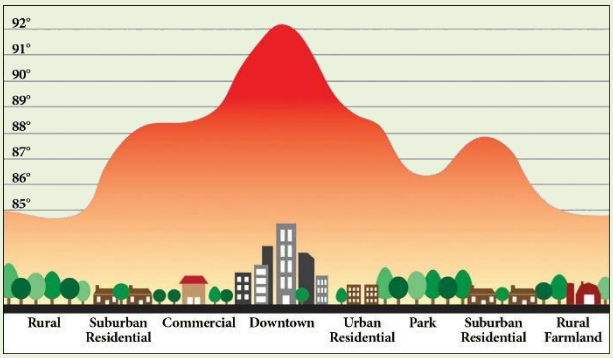
The ecosystem services are explained under 4 categories, termed as *provisioning*, *regulating*, *habitat* or *supporting* services and *cultural* services. Some of the significant provisioning services are the fresh water ecosystem for providing water to cities , the vegetation and forests also influence the quantity of water available, the medicinal resources provided by the diverse ecosystems that possess plants of immense medicinal value, a range of important regulating services, like the clean air quality and cool micro climatic conditions, carbon sequestration and storage, protection against natural disasters and waste water treatments, habitats for species and cultural services like the recreational and psychological and physical health facilities and aesthetics. Thus healthy ecosystems are the foundation for the cities' local economy to thrive, reduce municipal costs and provide its citizens with an enhanced quality of life and secured livelihoods.

Scenario of increasing population and urban areas

Cities personify growth and act as hub of opportunities and economic progress. They are the major contributors to the nations' GDP. Indian cities with nearly one third of the population contribute three fourth of the GDP and 90 percent of government revenue. Thus increased urbanization reflect higher per capita income and globally economists believe that nearly all countries become 50% urbanized till they reach the middle income status and all high income countries are about 70-80% urbanized.

An increased level of urbanization is a consequence of both - growth in the human population and the percentage of people desiring to live in urban areas. Globally, only 13% of the world population lived in the cities in 1900. It increased to 3.2 billion that is 49% of the world population in 2005 and in 2030 it is expected to reach 60% of the world's population (CBD, 2012). Urbanization is both a challenge and an opportunity for managing ecosystem services globally. Less than 2% of the earth's surface is occupied by urban areas but this accommodates 3.5 billion people *viz*. 50% of the world's population. The CBD estimates that by 2050 the global urban population will be almost double of the 2010 urban population. The statistics also reveal that 60% of the area that is projected to be urban in 2030 is yet to be built and most of this growth is due in small and medium towns and not in megacities. This rapid urbanization will heavily tell upon our critical natural capital reserves, gobbling prime agricultural lands, increased water consumption and subsequently slaying biodiversity and ecosystem services. Urban expansion is occurring fast in areas adjacent to biodiversity hotspot areas and faster in low elevation that are geographically plain areas and biodiversity rich coastal zones. . It will also cause an increase in urban heat Island effect.

Urban Heat Island Effect



The term "heat island" describes built up areas that are hotter than nearby rural areas. The annual mean air temperature of a city warmer than its surroundings. Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality. The urban heat island effect can be minimized by having quantitative and a qualitative green network within the city

The massive urbanization in India can be expressed by the fact that today 30% of India's urban population forms around 11% of the world's urban population, and by 2031 Indian cities will be home to 15% of the world's urban population. Despite the current low levels and slow pace of urbanization in India, the sheer magnitude or volume of urban population is a matter of concern. India is booming with an urban population from the last decade. The increase is larger than the increase in urban population of many other countries. Therefore, it is imperative to understand urbanization despite low levels, as its magnitude in India is the second largest in the world (CBD, 2012)

Urbanization in Pimpri Chinchwad

Urban Biodiversity Management

Considering the magnitude of India's population, it is a mammoth challenge for the city administrators to manage ecosystem services as the rapid urbanization will have significant implications on the city's environment, ecology and sustainability. Thus Indian cities will grow in size, number and density to accommodate the increasing urban population. India already contains three of the world's ten largest cities that are Mumbai, Kolkata and Delhi. India also has the world's ten fastest growing cities which are Ghaziabad, Faridabad and Surat (CBD, 2012).

Urban Biodiversity

Urban biodiversity is about creating an urban system which is as close to the natural biogeographic setting as possible.

- *It is one of the key factors for sustainable cities*
- *It acts as an indicator of urban, economic, societal and environmental health*
- *Helps in mitigation of pollution levels and minimize urban heat island effect in the city*
- *Maintenance of ecological balance in the city*

The Indian cities are confronted with the big challenges of population growth demanding rapid urbanization, employment opportunities for all, affordable housing, urban governance, integration of transportation with land use, whilst paving way for progress and opportunities, fostering economic growth. Moreover, urbanization, refurbishes the rural hinterland landscape, revamps lifestyles, increases natural resource consumption and ecosystem services, transforms livelihood and emanates wastes that is often dumped in the rural hinterland. Urbanization increases the ecological footprint of the cities and an unplanned rampant urbanization will cause severe loss of biodiversity and unscrupulous exploitation of ecosystems thereby degrading their services. Thus for healthy urban habitats, it is necessary that city administrators not only build upon the grey infrastructure (housing, physical and social infrastructure) but also protect, conserve and build upon the green infrastructure.

Furthermore, economists argue that there is a strong empirical relationship globally between index of city liveability and the gross domestic product per capita, suggesting that long term growth is only feasible , if city attributes in terms of congestion, pollution and safety are improved alongside urban economic management. Thus cities need a healthy natural environment that continue to provide a range of benefits called as ecosystem services like the clean air, water, protection from floods that will ensure better quality of life.

The cities can remain healthy by integrating ecosystem services and biodiversity in city urban planning and management incorporating green infrastructure in the grey areas. An ecologically planned land use development with reduced pressure on biodiversity can guide the city to achieve its objectives of sustainable development. These are also prime strategies of the Aichi Targets to be achieved by 2020. The Aichi Targets also talk about safeguarding eco system services, species and genetic diversity, enhance the benefits to all from biodiversity and ecosystem services and the targets have to be implemented through urban ecological planning and capacity building.

CBD and Urban Biodiversity

There is a growing awareness among the people that biological diversity is a global asset of tremendous value to present and future generations. At the same time, the threat to species and ecosystems has never been as great as it is today. Species extinction caused by human activities continues at an alarming rate. With due consideration of this fact, convention of biological diversity (hereafter referred as the CBD) was effectively initiated by United Nations Environment Programme (UNEP) in 1993 with the following three objectives:

- The conservation of biological diversity
- The sustainable use of the components of biological diversity
- The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

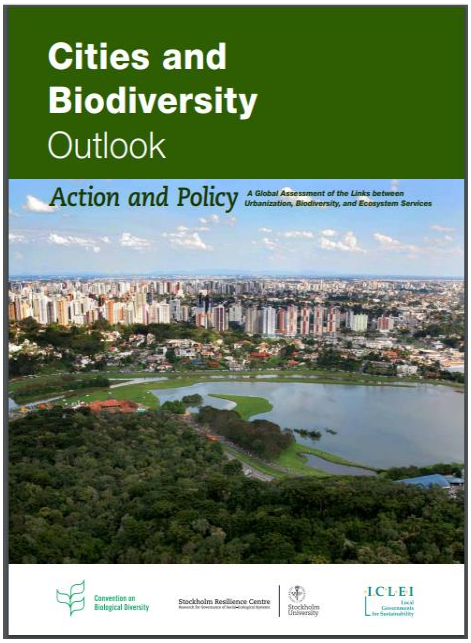


Figure 2: Coverage of Cities and Biodiversity by CBD

In decision X/2, the tenth meeting of the Conference of the Parties to the CBD (COP 10), held in 2010 in Nagoya, Japan, adopted a revised and updated Strategic Plan for Biodiversity 2011-2020, including twenty Aichi Biodiversity Targets. This plan provides an overarching framework on biodiversity for Parties to the CBD and all others engaged in biodiversity management and policy development (Secratriat of Convention of Biological Diversity, 2013). According to the articles 6, 10a and 26 of the CBD, all the parties need to report their current status of biodiversity, the ongoing conservation programmes and develop policy instruments for sustainable use of biological resources (Secratriat of Convention of Biological Diversity, 2011). This resulted in all the parties to the CBD requiring developing National Biodiversity Strategic and Action Plans (NBSAP) for bringing biodiversity conservation in sectorial and cross-sectorial activities.

To translate the targets of the CBD into concrete plans and workable actions, it was important to bring policy and action changes at sub-national and local levels. The United Nations University Institute of Advanced Studies argued that (UNU-IAS) NBSAPs will have limited impact on the ground if they are not translated into sub-national actions. One of the ways of achieving this is through the development of biodiversity strategies and action plans at Provincial, State, and/or local levels as distinct planning instruments. This gave rise to development of State Biodiversity Strategy and Action Plan (SBSAP) and Local Biodiversity Strategy and Action Plan (LBSAP) at state and local levels.

*The **Convention on Biological Diversity (CBD)** is one of the three "Rio Conventions", emerging from the UN conference on Environment and Development, also known as the 'Earth Summit'. This conference was held in Rio de Janerio in 1992. CBD entered into force on 29th December 1993. It was inspired by the world community's growing commitment to sustainable development.*

The CBD is a comprehensive, binding agreement covering the use and conservation of biodiversity. It requires countries to develop and implement strategies for sustainable use and protection of biodiversity, and provides a forum for continuing international dialogue on biodiversity-related issues through the conferences of the parties (COPs). There are currently 194 parties (countries) to the convention.

India is a party to the convention on biological diversity since 19th May 1994. Pursuant to the CBD, a first major step was the development of the National Policy and Macro level Action Strategy that called for consolidating existing biodiversity conservation programmes and initiating new steps in conformity with the spirit of the Convention. The 'National Biodiversity Strategy and Action Plan (NBSAP)' was formulated in the year 2008 and then revised in 2014. It defines targets, activities and associated agencies for achieving the goals, drawing upon the main principle in the National Environment Policy (NEP) that human beings are at the centre of concerns of sustainable development and they are entitled to a healthy and productive life in harmony with nature. As a part of NBSAP, India developed 12 National Biodiversity targets which are in alignment with the AICHI targets formed by CBD. (Refer Aichi Target Box for details)

Following the ratification of CBD and after widespread consultations, India also enacted the Biological Diversity Act in 2002 and notified the Rules in 2004, to give effect to the provisions of the CBD, including those relating to its third objective on Access and Benefit Sharing (ABS). India was one of the first few countries to enact such legislation. The Act is to be implemented through a three-tiered institutional structure: National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs), Biodiversity Management Committees (BMCs) at the local level, in line with the provisions for decentralized governance contained in the Constitution. The Biological Diversity Act is a path-breaking and progressive legislation which has the potential to positively impact biodiversity conservation in the country.

Local Biodiversity Strategy and Action Plan

LBSAP primarily is a document that spells out the strategies and action plan for preservation of the green (that also contains the blue infrastructure – the water bodies like rivers, lakes, ponds, creeks, wetlands) infrastructure (hubs and corridors, sacred groves, open spaces, parks, farm lands) or land conservation as well as its integration with the grey infrastructure that is the built infrastructure constituting of both the physical and social infrastructure and the restoration of the brown field sites that is the degraded or the derelict lands. In other words, LBSAP is a document that enables integration of ecological (that is biodiversity and ecosystem services) and environmental planning with urban planning and management. The document advocates for green development and maintenance of green assets and also propagates green economy that will make urban habitats more sustainable and liveable.

*The first mention of the idea of **"Think global, act local"** is traced back in the book entitled "Cities in Evolution" by Scottish town planner, biologist and social activist Patrick Geddes. Since then, it has been used by many different people from distinct parts of the world in different subjects but precisely in environmental strategies. It proposes to take actions at a local level while aiming a larger goal (Think Globally, Act Locally, 2018). Biodiversity conservation also blends with this concept and requires practical implementation at local levels. Steps to conserve biodiversity at local levels help conserve different gene pools of a species and promotes its further survival and longevity on a global scale.*

The LBSAP is to be prepared by the local city governments of nations who were signatories to the Convention on Biological Diversity (CBD) at the tenth meeting of the convention. India, being a party to the Convention has endorsed the decision of preparing a Plan of action at the National, sub – national governments, cities and other local authorities for preserving Biodiversity. The country is ready with its plan of actions at the national level. However, conservation of biodiversity and ecosystem services requires both top down and bottom up approach. For abetting the implementation of the CBD and the Aichi Biodiversity targets, efforts have to be made at the national, sub-national or the state, regional that is at the district level and most essentially at the local level that is at the city and the village level who are directly affected by the loss of biodiversity and therefore can pal a crucial role in preservation, enhancement and management of ecosystem services.

LBSAP is a guide for the local authorities to undertake practical measures for conserving biodiversity and ecosystem services. It runs on lines of national biodiversity strategy and action plan (NBSAP) of a country at a smaller spatial scale. It was first formally acknowledged in decision X/22 at the 10th meeting of conference of parties (COP 10) to the Convention on Biological Diversity (CBD COP 10) in Nagoya, Japan, in October 2010. The decision solicits to encourage local governments to develop and implement LBSAPs in support of NBSAPs and indeed, in support of the Convention. An LBSAP can be a stand-alone document, but only incorporation of its core principles into broader city plans are creditable because virtually all line functions are affected by, and impact on biodiversity.

Profile of Pimpri Chinchwad

Pimpri was originally a refugee camp for migrants during India-Pakistan partition in 1947. Pimpri and Chinchwad were two villages at the outskirts of Pune. In the post-independence era, industrialization started with Hindustan Antibiotics Limited, 1956 and gained momentum with establishment of Maharashtra Industrial Development Corporation in 1962. The resultant migration of workers from across Maharashtra resulted in the formation of Pimpri-Chinchwad Municipal Authority in 1970.

Pimpri and Chinchwad city is governed by a Municipal Corporation which comes under Pune Metropolitan Region (Census of India, 2011). It is one of the largest industrial areas in India (Pokharkar and Nikam, 2009). It lies at a distance of 15 km on the north west of Pune and is bisected by Mumbai-Pune National Highway at an altitude of 530 m above mean sea level.

Pimpri - Chinchwad is home to a vast variety of industrial establishments and is well known for its automotive and manufacturing industry. The twin cities as well as the cantonment areas of Pune, Khadki and Dehu Road together form the urban core of the Pune Metropolitan Region (PMR). According to the 2011 census, Pimpri-Chinchwad has a population of 1.72 million residing in an area of 181 km^2.

Annual rainfall in the region is 850 mm and temperatures range from 10°C in winters and 35°C in summers. The base rock found throughout the region is Deccan basalt.

Indrayani River borders the north of Pimpri-Chinchwad city while Mula branches into Pavna which transects the city and borders the south. The city contains 7 major lakes including Bhosari Lake, Sumantha Sarovar, Bird Valley Lake, Ganesh Nagar talav, Shahu Maharaj talav and a few others. Thus, it has plentiful water reservoirs to suffice the needs of the city. These water bodies cover about 1.13% of the surface area of the city. They are threatened by the discharge from nallah waters, industrial waste water, anthropogenic activities, dumping of solid wastes etc.

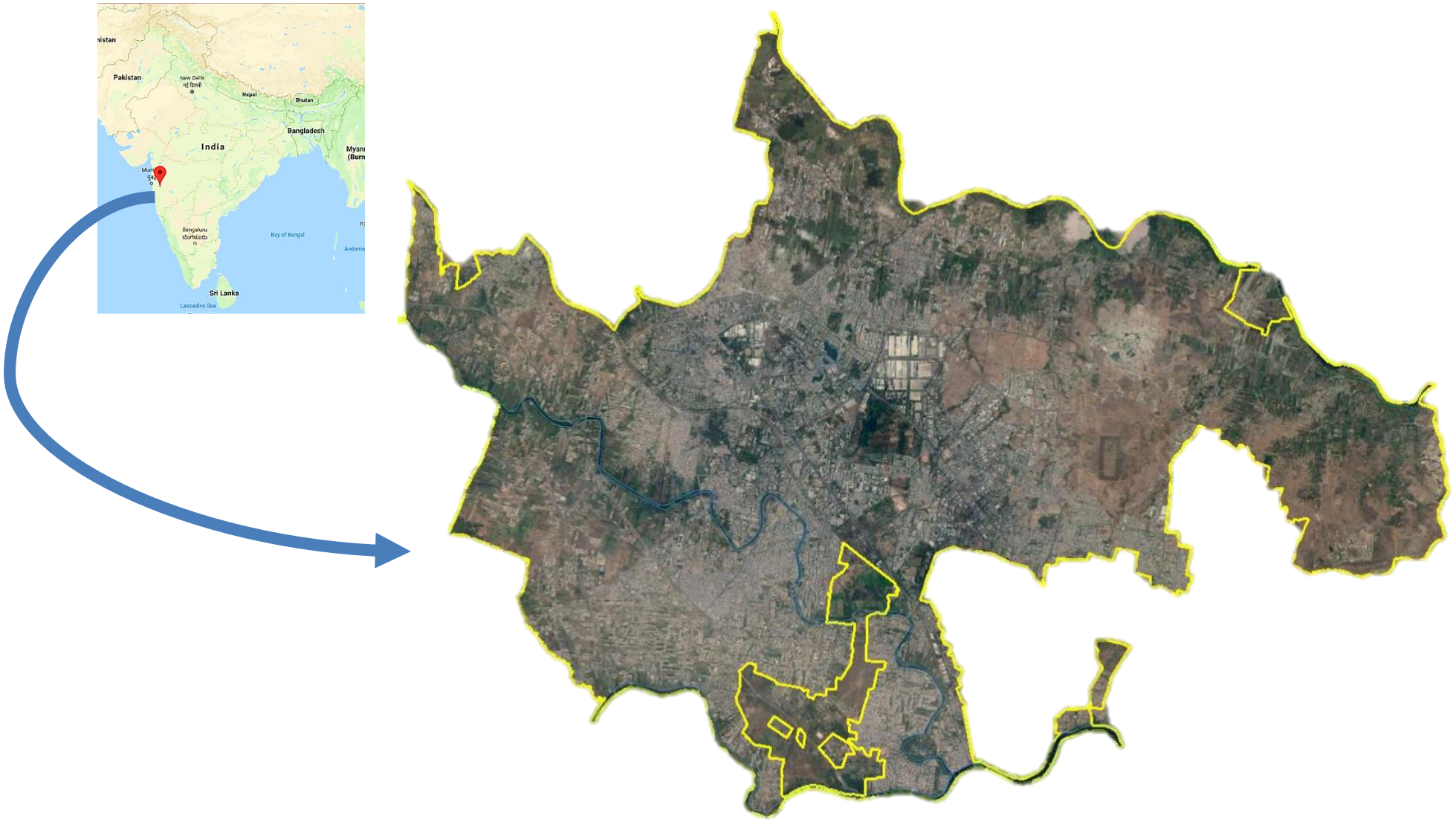


Figure 3: Location of Pimpri Chinchwad

Biodiversity in PCMC

The Garden Department of PCMC works towards maintaining and increasing the open and green spaces of the city. The Garden department is also responsible for the plantation on no-development zones. The location, area and quality of green spaces in urban centres influence the quality of urban environment for residents. Urban green spaces are significant for enrichment of biodiversity; these green spaces offer recreational opportunities and contribute to the city aesthetics. Exotic species are more as compared to indigenous species in all the gardens. Such tendency may destroy the naturalness of the gardens. The canopy of the garden is getting affected by planting exotic species which provide comparatively lesser shade. Use of lawns, in landscaping of gardens, affects the micro-environment of the green spaces as they act as cooling areas that create microhabitat for insects, frogs, toads, lizards and snakes, maintaining food chain. The biodiversity of Bird Valley Park is comparatively good because of the plant diversity, large space with variety of indigenous species; that attract a large number of insects on which insectivorous birds feed. The PCMC Paryavaran Sanskar Udyan in T-Block, MIDC has more natural and native species and has been used as a biodiversity park in Pimpri Chinchwad.

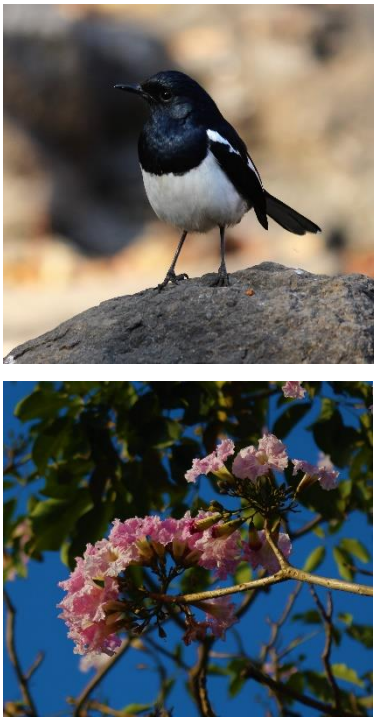


Figure 4: Top - Oriental Magpie Robin in PCMC Science Park; Bottom - Tabebuia rosea in Sant Dyaneshwar Nakshatra Udhyan

Pimpri Chinchwad Municipal Corporation, decided to undertake the exercise of City Biodiversity Index to assess the status of biodiversity and conservation status in the city. Pimpri Chinchwad was looked through the lens of three major components that form the Index– Native Biodivqqersity, Ecosystem Services and Governance and Management. Within every component there are different indicators to calculate the index. There are 23 indicators on which the CBI is calculated. Each indicator has a defined scoring criteria with max score of 4 points. It was observed that Pimpri Chinchwad has large proportion of natural areas i.e. 30.2%. The city does not have any legally protected natural areas yet Pimpri Chinchwad support a very good diversity of species. The list of number of species is mentioned in the adjoining table. Due to presence of these natural areas, the city scored well in the second component consisting of ecosystem services. It was found that the proportion of tree canopy over and permeable areas to terrestrial area stood at impressive figures of 17.7% and 47.7% respectively. The tree diversity was mainly found in the city centre as the areas at the outskirts of Pimpri Chinchwad is dominated by grasslands. Besides presence of the natural areas, PCMC has taken quite a lot of initiatives by developing parks and gardens for recreational purposes. There are 166.3 ha area of parks and garden in the city providing good recreational space for citizens. The gaps identified from city biodiversity index were used to formulate the strategies of LBSAP. Effective implementation of strategies of LBSAP would help PCMC to enhance the CBI scores in future assessments.

Taxa	No. of Species
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Herbs	182

Action Strategies for Management of Biodiversity

The strategies suggested for PCMC is based on the observations made during various visits to the city. Every strategy is divided into various actions plans for implementation. Individual action plans or in some cases one complete strategy can by form a separate project for implementation. The development plan was referred as the basis for identification of locations for implementation of either strategies or individual actions. The plans suggested are SMART i.e. S – Specific; M – Measurable; A – Achievable; R – Realistic and T – Time based. The strategies are designed to achieve the National Biodiversity Targets which is in alignment to Aichi targets of CBD. Prioritization of strategies is carried out to guide PCMC for effective implementation. The strategies for PCMC are as follows:

- Awareness and Capacity Building
- Streamlining the Biodiversity Park and Creation of Biodiversity Information Centre
- Conservation of Natural Habitats in the City
- Creation of Ecological Network
- Management of Invasive Species
- Development of Alternative Livelihood from Biodiversity
- Incorporating Ecological Perspective in Development Projects
- Conservation of Rare and Native Species
- Restoration of Degraded Ecosystem

Framework of each action strategy

Each strategy/action is based on a specific framework. Each strategy elaborates underlying concept (what), purposes of implementation (why), areas for implementation (where), Methods for management i.e. for restoration/conservation/enhancement of biodiversity (How), and approximate timeframe.

Priority matrix of action strategies

All the action strategies were screened through a set of criteria in order to generate a score for each action strategy. Higher score indicated the necessity of highest priority for implementation

Criterion	High (7- 9 score)	Medium (4 – 6 score)	Low (0 -3 score)
Ecological approach	Conservation	Restoration	Enhancement
Timeframe	Short term (below 1 year)	Medium term (1 to 3 years)	Long term (More than 3 years)
Cost	Low cost	Medium cost	High cost
Feasibility	Easy	Not easy	Difficult
Stakeholder involvement	Internal stakeholder	Combination of internal and External	External stakeholder
Implementation frequency	Not recurring	Recurring frequency 1 to 3 years	Recurring frequency 6 months or below
Monitoring/Maintenance frequency	One time/during implementation	Once in every six months or less	Once in every six months or less

Priority Matrix

Strategies	Ecological approach	Time frame	Cost	Feasibility	Stakeholder involvement	Implementation frequency	Monitoring Frequency	Total
Awareness and Capacity Building	**3.00**	**8.60**	**7.80**	**8.40**	**5.40**	**8.20**	**8.20**	**50**
Capacity Building for Management and School-College	3	8	9	9	4	5	9	
Signage & Nature Art installations	3	9	8	9	6	9	9	
Coffee-table book & short-film on biodiversity of PCMC	3	8	8	8	6	9	8	
Biodiversity-Graffiti by students on public wall	3	9	9	9	5	9	9	
Creation of Online Portal for Biodiversity as Citizen Science Initiative	3	9	5	7	6	9	6	
Streamlining the Biodiversity Park and Creation of Biodiversity Information Centre	**9**	**8**	**5**	**9**	**4**	**9**	**5**	**49**
Conservation of Natural Habitats in the City	**9**	**7**	**4**	**8**	**7**	**9**	**3**	**47**
Creation of Ecological Network	**6**	**6**	**6**	**7.5**	**7**	**7**	**6**	**46**
Butterfly Garden	9	6	6	8	6	7	6	
Nature ways	3	6	6	7	8	7	6	
Management of Invasive Species	**5**	**6**	**5**	**7**	**4.5**	**8**	**6**	**42**
Demarcation of patches of alien invasive species	4	9	7	8	3	8	9	
Replacement of identified alien invasive species	6	3	3	6	6	8	3	
Development of Alternative Livelihood from Biodiversity	**7**	**5**	**7**	**7**	**5**	**5**	**5**	**41**
Incorporating Ecological Perspective in Development Projects	**5**	**6**	**4**	**5.5**	**7.5**	**6.5**	**3**	**38**
Ecological perspective for river front development	7	4	6	4	8	7	3	
Vertical Gardens on Metro Lines Pillar	3	8	2	7	7	6	3	
Conservation of Rare and Native Species	**9**	**5.5**	**3.5**	**6.5**	**2.5**	**7**	**2.5**	**37**
Development of breeding centers for native fish diversity	9	5	3	6	2	7	2	
Development of Native seed bank	9	6	4	7	3	7	3	
Restoration of Degraded Ecosystem	**6**	**3**	**2**	**4**	**2**	**3**	**3**	**23**
Rejuvenation of quarries	6	3	2	4	2	3	3	
Restoration of rivers	6	3	2	4	2	3	3	

These criterions are scored on a scale of 0-9 marks based on the level of intensity for implementation. The scores will be comparative within the strategy based on the knowledge of technical experts involved.

Alignment with NBSAP and Aichi targets

Aichi targets

The tenth meeting of conference of parties (COP10) to the convention on biological diversity (CBD) achieved big results. A new strategic plan to the CBD known as "*Strategic plan for Biodiversity 2011-2020*" formed in COP10. This plan provided a set of **20 ambitious yet achievable targets,** divided into 5 strategic goals, collectively known as '***Aichi Target'.*** The national biodiversity strategy and action plan to be prepared by every country should aim in achieving these Aichi targets.

Strategic Goal A: *Address the* ***underlying causes of biodiversity*** *loss by mainstreaming biodiversity across government and society*

Strategic Goal B: *Reduce the* ***direct pressure****s on biodiversity and promote sustainable use*

Strategic Goal C: *To improve the status of biodiversity by* ***safeguarding*** *ecosystems, species and genetic diversity*

Strategic Goal D: *Enhance the* ***benefits*** *to all from biodiversity and ecosystem services*

Strategic Goal E: ***Enhance implementation*** *through participatory planning, knowledge management and capacity building*

National Biodiversity Strategy and Action Plan

India being a signatory of Convention on Biological Diversity; a *National Biodiversity Strategy and Action Plan (NBSAP) was formulated in the year 2008 and was revised in 2014. It defines targets, activities and associated agencies for achieving the goals, drawing upon the main principle in the National Environment Policy (NEP) that human beings are at the centre of concerns of sustainable development and they are entitled to a healthy and productive life in harmony with nature. As a part of NBSAP, India developed 12 National Biodiversity targets which are in alignment with the AICHI targets formed by CBD.*

India's National Biodiversity Target (NBT's)

Target 1: *By 2020, a significant proportion of the country's population, especially the youth, is aware of the values of biodiversity and the steps they can take to conserve and use it sustainably*

Target 2: *By 2020, values of biodiversity are integrated in national and state planning processes, development programmes and poverty alleviation strategies*

Target 3: *Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are finalized and actions put in place by 2020 for environmental amelioration and human well-being.*

Target 4: *By 2020, invasive alien species and pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed*

Target 5*: By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries*

Target 6: *Ecologically representative areas under terrestrial and inland water, and also coastal and marine zones, especially those of particular importance for species, biodiversity and ecosystem services, are conserved effectively and equitably, based on protected area designation and management and other area based conservation measures and are integrated into the wider landscapes and seascapes, covering over 20% of the geographic area of the country, by 2020.*

Target 7: *By 2020, genetic diversity of cultivated plants, farm livestock, and their wild relatives, including other socioeconomically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.*

Target 8: *By 2020, ecosystem services, especially those relating to water, human health, livelihoods and well-being, are enumerated and measures to safeguard them are identified, taking into account the needs of women and local communities, particularly the poor and vulnerable sections.*

Target 9: *By 2015, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as per the Nagoya Protocol are operational, consistent with national legislations.*

Target 10: *By 2020, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance.*

Target 11: *By 2020, national initiatives using communities' traditional knowledge relating to biodiversity are strengthened, with the view to protecting this knowledge in accordance with national legislations and international obligations.*

Target 12: *By 2020, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011-2020 and the national targets are identified and the Strategy for Resource Mobilization is adopted*

Table 1: Alignment with National Biodiversity Targets of India and Aichi Targets

Strategies	Actions	Alignment with NBT (Target No.)	Corresponding Aichi Targets
Awareness and Capacity Building	Capacity Building for Management and School-College	1, 12	1, 19, 20
	Signage & Nature Art installations		
	Coffee-table book & short-film on biodiversity of PCMC		
	Biodiversity-Graffiti by students on public wall		
	Creation of Online Portal for Biodiversity as Citizen Science Initiative		
Streamlining the Biodiversity Park and Creation of Biodiversity Information Centre	-	1,2	1,2
Conservation of Natural Habitats in the City	-	3	5,15
Creation of Ecological Network	Butterfly Garden	1	1
	Nature ways	3	5,15
Management of Invasive Species	Demarcation of patches of alien invasive species	4	9
	Replacement of identified alien invasive species		
Development of Alternative Livelihood from Biodiversity	-	11	18
Incorporating Ecological Perspective in Development Projects	Ecological perspective for river front development	2,6	2, 11
	Vertical Gardens on Metro Lines Pillar	3	5, 15
Conservation of Rare and Native Species	Development of breeding centers for native fish diversity	12	19,20
	Development of Native seed bank	12	19,20
Restoration of Degraded Ecosystem	Rejuvenation of quarries	3	5,15
	Restoration of rivers	5	6,7,8

Implementation Framework for LBSAP

Strategies	Actions	Responsible Department	Requirement of External Expertise
Awareness and Capacity Building	Capacity Building for Management and School-College	Environment Department	Subject Experts and Organizations
	Signage & Nature Art installations	Environment Department	Subject Experts and Organizations
	Coffee-table book & short-film on biodiversity of PCMC	Environment Department	Wildlife Enthusiast, Film Makers, Subject Experts
	Biodiversity-Graffiti by students on public wall	Environment Department	School and Colleges
	Creation of Online Portal for Biodiversity as Citizen Science Initiative	Environment Department and IT Department	IT company and Biodiversity Experts
Streamlining the Biodiversity Park and Creation of Biodiversity Information Centre	-	Garden Department and Environment Department	Subject Experts and Organizations
Conservation of Natural Habitats in the City	-	Garden Department and Environment Department	Local Environment NGO's and Naturalists
Creation of Ecological Network	Butterfly Garden	Garden Department	Subject Experts and Organizations
	Nature ways	Garden Department	-
Management of Invasive Species	Demarcation of patches of alien invasive species	Environment Department	GIS Experts or Organizations, Biodiversity Experts
	Replacement of identified alien invasive species	Garden Department	-
Development of Alternative Livelihood from Biodiversity	-	Environment Department	Local NGO’s and Experts
Incorporating Ecological Perspective in Development Projects	Ecological perspective for river front development	Environment Department	Subject Experts and Organizations, Local NGO's
	Vertical Gardens on Metro Lines Pillar	Environment Department	Horticulturist and Nursery, Vertical Garden Experts

Strategies	Actions	Responsible Department	Requirement of External Expertise
Conservation of Rare and Native Species	Development of breeding centers for native fish diversity	Environment Department	Subject Experts and Organizations, Fishery Institute
	Development of Native seed bank	Garden Department	Colleges with Botany, Botanical Survey of India
Restoration of Degraded Ecosystem	Rejuvenation of quarries	Garden Department and Environment Department	Subject Experts and Organizations
	Restoration of rivers	Environment Department	Subject Experts and Organizations, Local NGO's

Description of proposed Strategies

1. Awareness and Capacity Building

Underlying Concept

Environmental resources are fast losing their life supporting potential; ecosystems are losing their resilience and natural self-sustaining ameliorative capabilities.

Biodiversity is declining at an alarming rate and rapid urbanization is key contributor to its loss. General public awareness levels are very low about the importance of biodiversity and its loss.

Figure 5: Capacity building

There is a need to increase in public participation in biodiversity conservation at local, sub-national and national level.

Purpose of Implementation

- To build capacity among multiple stakeholders for biodiversity conservation, education and action.
- To increase awareness among citizens, regarding importance of having biodiversity in the city and the ecosystem services they provide.
- To prepare future generations for the challenges they may face due to biodiversity loss and environmental degradation and educate them on role of biodiversity conservation in adaptation to probable natural disasters.

Areas of Implementation

- All wards and residential societies of PCMC
- Large as well as small commercial Areas in the city
- Schools colleges and other institutions in the city
- Public and Private Offices in the city.
- Semi-urban settlements within the city limits

Proposed Methods

This is essentially a three step process which includes:

Sensitization and Mobilization of the communities.

To conserve the biodiversity of PCMC using public participation, it is imperative to sensitize and mobilize the local communities/residents about the importance of the natural areas. Sensitization can be achieved by conducting various programs like:

- Workshops/Training Courses/Camps/ Rallies
- Public Meetings/ Exhibitions/ Competitions
- Preparation of Audio Visual Materials
- Folk Media/ Street Theaters/ Festivals/ Science Fairs
- Biodiversity-Graffiti by students on public wall
- Incorporating Biodiversity in School syllabus

Figure 6: Representative Image of Graffitti in Pune

Institutionalization of the communities.

Institutionalization of the communities can help in the process of capacity building by forming societies/committees for settlement units (e.g. at ward level in the city).

- Initiation of the local governing bodies and delegation of responsibilities.
- Initiation of record keeping facilities for the work being done e.g. biodiversity registers for schools/villages/local areas.
- Scheduling of trainings and knowledge sharing sessions.
- Scheduling of regular meetings of the members of the committees/societies for keeping track of the activities.
- Coffee-table book & short-film on biodiversity of PCMC
- Signage & Nature Art installations

Monitoring and Follow-up:

Citizen science approach for monitoring and follow-up can be used for data collection, research and analysis, and formulation of future strategies and policies.

- Citizen scientists (volunteers from within or outside the communities) can be roped in for monitoring and data collection.
- The collected data can be shared with PCMC and other research institutions for planning of future actions.

This can be achieved by creating an online portal for recording the sightings of biodiversity.

Broad Estimate

Activity	Description	Cost (INR)
Workshops and Training Courses	Expertise charges	Rs. 50,000/- per event
Coffee table book and Short Film	Photography, Design, Conceptualization, Editing Printing	Rs. 5000/- per book Rs. 10,00,000 for video
Signage and Art Installations	Images of biodiversity viz. birds, butterflies, plants etc.	Rs. 2000/- per unit

Online Portal for biodiversity under citizen science initiative

Natural systems, including biological phenomena are always changing. Monitoring of these is not only essential for the sake of pure scientific reasons but also to know potential impacts on these due to externalities. Because of its inherent quality, biodiversity cannot be measured by machines the way non-biological natural phenomena can be (such as rain gauges for rainfall measurements). Human eyes and ears are the only instruments most apt to observe biodiversity. However, because of its changing nature, it is practically difficult for a single biologist (or a small group of biologists) to monitor continuously, changes in biodiversity.

Field Biologists have long realized this drawback. To overcome this, initiatives known as Citizen Science Projects have been developed, first in western developed countries of North America and Europe and now, even in India. Citizen Science is a term used for research which relies on data recorded by ordinary citizens, who may even be from a non-technical or "non-science" background.

A tailor-made biodiversity-monitoring tool for PCMC on an online platform can be created that is designed keeping in mind the features of the site. This tool would be linked to larger country-wide initiatives. The portal will document the contribution by the people for sightings of flora and fauna observed and related information viz. location, date and time etc. This upload will be verified by the local experts in PCMC and the data will be added/updated in the database. The data obtained from this method will also be useful for updating the Peoples' Biodiversity Register of PCMC.

Broad Estimates

Activity	Cost (INR)
Server/ development of portal	1,00,00,000/-
Maintenance for 5 years	50,00,000 /-

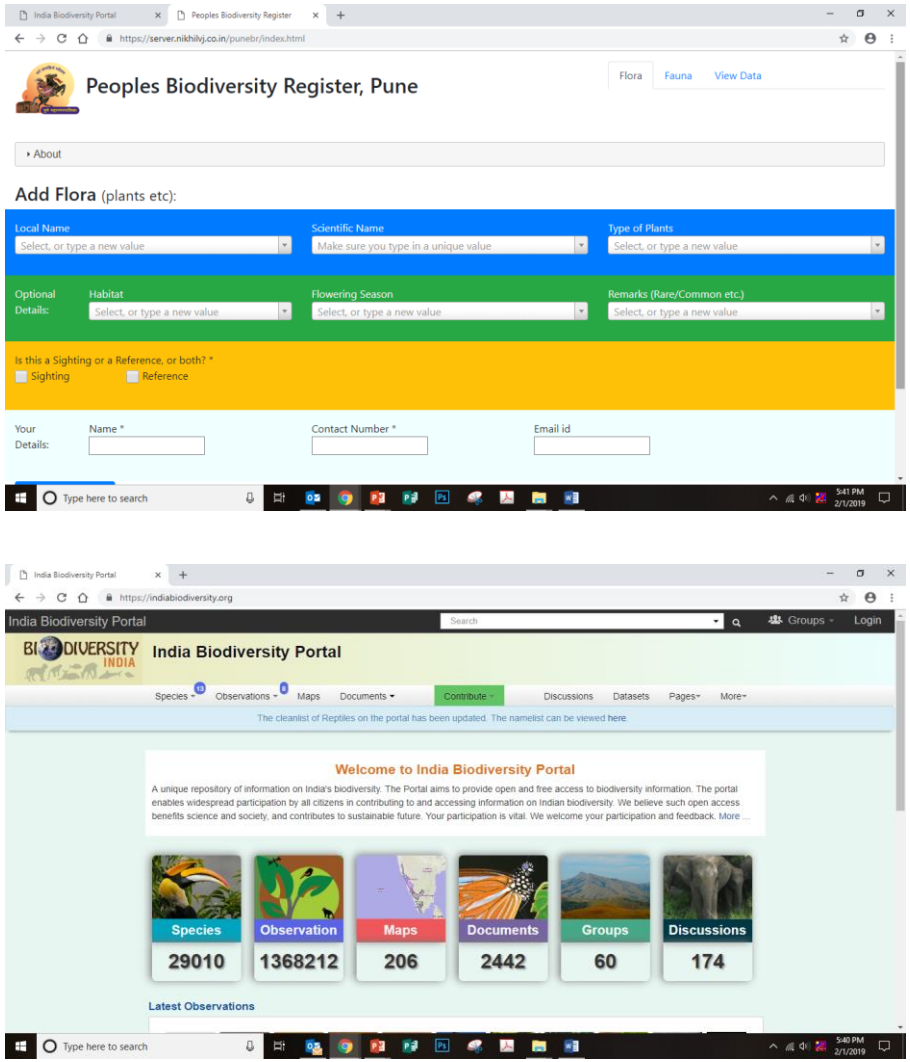


Figure 7: Examples of Online Portals

2. Streamlining the Biodiversity Park and Creation of Biodiversity Information Centre

Streamlining Biodiversity Park

Many parks or botanical gardens in general, display exotic flora from around the world. Such parks are kept well-trimmed and manicured. Green though such parks may seem to a casual observer, they provide little or no ecological services. Introduced tree species do nothing to support the native insects, birds and other animals that were once indigenous to the area. Native wildlife evolved over time to rely on native plants and trees for food and shelter. Butterflies and birds, for example, depend on specific native plants for their food, something that introduced tree species cannot provide. Planting exotics leads to a reduction of local fauna.

A Biodiversity Park on the other hand, is developed keeping in mind the needs of human visitors as well as the requirements of local wildlife. It is a showcase of the region's native biota. It performs the dual function of being recreational destination as well as preserving a reaion's ecosystem. It also has a feel of wilderness and adventure to it.

Nature information centres can be created in different gardens and biodiversity parks in the city. Also, called as visitor centre or interpretive centre, they are designed to educate people about nature and the environment. Usually located within a protected open space, nature centers often have trails through their property. Some are located within a state or city park, and some have special gardens or an arboretum. Their properties can be characterized as nature preserves and wildlife sanctuaries. Nature centres generally display small live animals, such as reptiles, rodents, insects, or fish. There are often museum exhibits and displays about natural history, or preserved mounted animals or nature dioramas. Nature centres are staffed by paid or volunteer naturalists and most offer educational programs to the general public, as well as summer camp, after-school and school group programs.

Some nature centres allow free admission but collect voluntary donations in order to help offset expenses. They usually rely on support from dedicated volunteers. Environmental education centres differ from nature centres in that their museum exhibits and education programs are available mostly by appointment, although casual visitors may be allowed to walk on their grounds.

Location for implementation:

The location identified for this initiative is the PCMC Park in T Block MIDC. It is named as Pariyavaran Sanskar Kendra and already some initiatives are implemented for creation of awareness.

Key Features of the Existing Park:

1. Installations of the informative boards on biodiversity features like butterflies, birds, bats
2. Representations of the different forest types present around PCMC.
3. Walk way
4. Water body

Figure 9: Representations of the different forest types

Figure 10: Installations of the informative boards

Figure 11: Walk way

Figure 12: Water body

The diversity supported by this park is good and some additional efforts needs to be made for improving the functionality of the park.

- Maintain the natural look of the park and avoidance of any inputs from aesthetic values
- The walkway within the park should be properly cleaned and maintained
- A viewing area/hideout for bird observations to be created
- Plantation of native nectaring plants to be planted
- Replacement of the old information boards
- Repairing the fences of the boundary wall

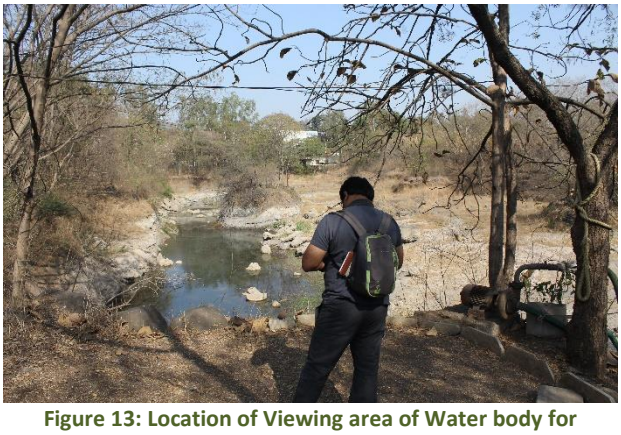


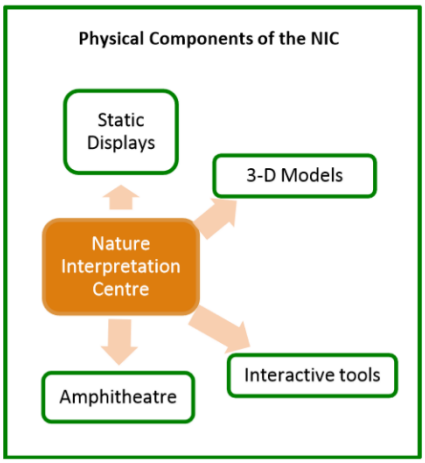
Figure 13: Location of Viewing area of Water body for creation of Hide out

- Preparation of an Biodiversity Information Centre
- Arrangements of guided nature trails

Biodiversity Information Centre

A Biodiversity Information Centre is a place that can be used for dissemination of knowledge about our natural heritage

The proposed biodiversity information centre will be based on the concept focussing on the historic biodiversity in the city of PCMC. The rationale behind suggestion of this theme is to create awareness amongst the people about the natural history of Pimpri and sensitize for conservation of biodiversity in the city.



It would consist of a number of static displays or exhibits, however to enhance its appeal further it could house 3 dimensional models and an audio-visual aid. Additionally, it could have a mini amphitheatre where workshops and activities could be organized. The biodiversity information centre can be either a constructed one storey building or small tents placed at different locations of the park. A separate dedicated rooms can be created for each theme.

Although the focus will be on local biodiversity. The displays would guide the visitors of the floral and faunal assemblages found here and their uniqueness. They would be then connected to larger issues of biodiversity and ecosystem services found around the world. A general thread protection and conservation would run through all of the exhibits, uniting them into a single theme.

The exhibits would be designed in three sections:

1. Overview:

The overview would begin with an introduction to the biodiversity, ecosystem services and its importance in our lives. A description of various biogeographic zones in India. In this section, the visitors will know about the diversity of life on earth and makes a connection between our existence and its survival.

2. Biodiversity in PCMC:

The biodiversity information centre in PCMC will consist of artificial habitat creation within a closed setting. A model of various types of forest types that existed in PCMC can be created along with to the scale models of the flora and fauna species present. Information in the form of audio visual graphics can be installed for an interactive session viz. connecting the voice of various birds along with the names, plant names and flowers etc.

3. Best Practices for Conservation:

This section will focus on the best conservation efforts required with context of urban biodiversity. The actions that should be taken on day to day basis by every individuals of the city will be portrayed in this section.

Broad Estimates

Activity	Description	Cost (INR)
Construction of room	20 x 20 x 10 sq. ft. room = 400sq.ft @ Rs. 2500/- per sq ft (incl. Architectural design, structural design, construction costs)	10,00,000/-
Displays and 3D models	Posters and Models of Animals and plants found in Pimpri Chinchwad (Posters x 20 @ Rs. 5000/- and 3D Models x 10 @ 30000/-)	4,00,000/-
Expertise cost	Conceptualization and Designing	2,00,000/-
Hide out / Viewing area creation	Restructuring and creation of hideout near the water body	5,00,000/-
Shrub plantation	(- in general spacing 2sq.m between 2 shrubs) – Cost of Plants	Rs. 15 /- per plant
	Digging Pits (0.2 m3), Cost of soil and manure	Rs. 840 /- per m3
Manpower	Labour Cost	Rs. 300/- to 450/- per day

3. Conservation of Natural Habitat in Pimpri Chinchwad

Concept

Habitat conservation is a management practice that seeks to conserve, protect and restore habitat areas for wild plants and animals, especially conservation reliant species, and prevent their extinction, fragmentation or reduction in range. The natural environment is a source for a wide range of resources that can be exploited for economic profit. However, land development from anthropogenic economic growth often causes a decline in the ecological integrity of nearby natural habitat. Protecting the patches of natural areas within the urban setup is important.

Purpose of implementation

Grasslands are highly dynamic ecosystems encompassing all natural and semi natural pastures, woodlands, scrubs, and steppe formations dominated by grasses and grass like plants. Grasslands provide vital ecosystem services such as water and climate regulation in support of agriculture, biogeochemical cycle, carbon storage, cultural and recreational services. Grasslands occupy nearly 24% of the geographical area of India which are spread across several biogeographic regions and exhibits a wide range of ecological characteristics.

Geographically the city of Pimpri Chinchwad falls in the Deccan peninsula region and the major habitat of this regions are grassland and thorny scrublands. Pimpri Chinchwad has presence of such habitats on the outskirts of the city near Charholi. These are the areas that are recently added in the city limits. The adjoining areas to Charholi are rapidly developing and the natural habitats are lost at a much faster rate. The grasslands in Charholi has been in the planning in the Development Plan of PCMC. This patch of grassland is one of the limited refuge for the grassland species in PCMC.

Figure 14: Grasslands in Charholi Budruk

Suggestions

- Considering the status in City Development Plan, the activities in this patch should be reconsidered
- A considerable amount of area from this grasslands can be stated as the no development zone and can be demarcated as **Conserved Habitat for Grassland Species**
- Conducting plantation of trees in such grassland areas should be avoided as it would alter the existing grassland habitat.
- There are some similar patches of grasslands where some conservation activities are already planned viz. Proposed Deer Park in Talwade in PCMC. Similar activity can be proposed in this Charholi area. This area can be considered as an alternative location for the Deer Park.
- The Selection of Deer species in the proposed deer park should be selected carefully. The deer species that are typical from this type of habitat needs promotion.

Timeframe and Broad Estimate

The protection of this grasslands should be carried out on immediate basis. Considering this will be the decision from PCMC it will not involve any expense

Figure 15: Location of Grassland near Charholi

4. Creation of Ecological Network

Conservation till recent times has been done by the method of conserving habitats and/or ecosystems. The 1972 Stockholm Declaration of the United Nations Conference on the Human Environment endorsed the protection of representative examples of all major ecosystem types as a fundamental requirement of national conservation programs. Conserving ecosystems and habitats has become a core principle of conservation biology and has remained so in recent resolutions - including the World Charter for Nature in 1982, the Rio Declaration at the Earth Summit in 1992, and the Johannesburg Declaration 2002. In India, wildlife protection act, 1972, has the provisions for establishment and governance of protected areas.

However, conservation of ecosystems in itself is challenging as well as incomplete way of conservation. Movement and migration is very important to various faunal species depending on seasonal and climatic changes. Birds travel across thousands of miles to feed, roost and nest with seasonal changes, some animals in temperate areas move across landscapes for food in wintering seasons. Isolation of habitats and ecosystems hampers the movement of wildlife and isolates them from other population of same species. This prevents crossbreeding among a larger population and makes them vulnerable to diseases. Hence, conserving habitats should be accompanied with maintaining physical connectivity between them. This gave rise to the concept of ecological corridors and connectivity patches on a larger scale.

Ecological networking can be either biotic interactions among organisms or it can also be physical connectance between them. Here, we are referring ecological networks as network of green spaces which allow organisms like birds, insects and other small animals to move about. Larger areas like national parks or wildlife sanctuaries spreading across several kilometres are generally connected by green zones called ecological corridors. On a smaller regional level, networking can be simply through connectivity between green patches like parks, agricultural areas, ponds etc. within a city.

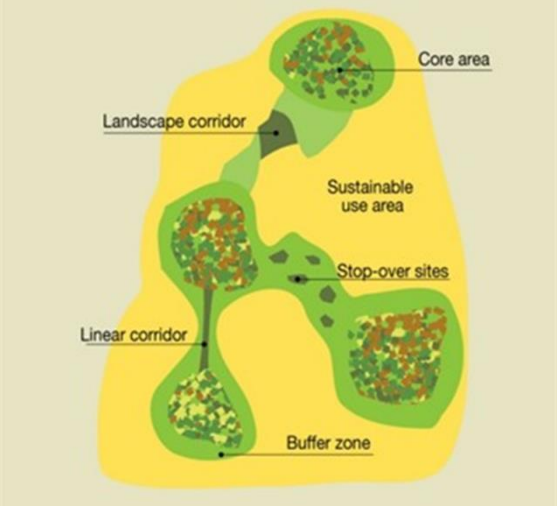


Figure 16: Spatial Configuration of an Ecological Network

There can be many different ways in which such networks can be created. It can be as simple as planting a hedge. A well placed hedgerow can form a connecting corridor between two otherwise separate woodland patches, allowing species like bats and dormice to migrate across otherwise inhospitable landscapes. Similarly, wildlife friendly gardens can provide stepping stones through difficult urban environments: nectar rich plants, ponds and compost heaps are some of the simplest ways to help. Ponds are a fantastic way to create an ecological network. Many pond-loving species such as damselflies can only migrate a small distance, so a scattering of ponds across a landscape are essential for their survival. Considering the functionality of different zones, the action and implementation plans are described below:

The current situation of the distribution of small insects like butterflies, moths, etc. in Pimpri Chinchwad is at the periphery of the city. These areas are newly included areas within the city

jurisdiction and is not as urbanised as the city centre. The ideation of this strategy is to create a network within the city that helps in integration of these species throughout the city.

Creation of connectivity for small fauna (with special consideration for butterflies) within the city

Rationale:

Butterflies and moths are a highly diverse group comprising over 250,000 species and make up around one quarter of all named species. They indicate a wide range of other invertebrates, which comprise over two-thirds of all species. They support birds and amphibians, as well as insects. Therefore, they are flagship species for conservation in general and in particular for invertebrates. They are indicators of a healthy environment and healthy ecosystems. They have been widely used by ecologists as model organisms to study the impact of habitat loss and fragmentation, and climate change. Butterflies are a part of the web of life. No matter what stage of its life cycle (egg, caterpillar, chrysalis or adult), butterflies and moths are an important element of the food chain and are prey for birds, bats and other insectivorous animals.

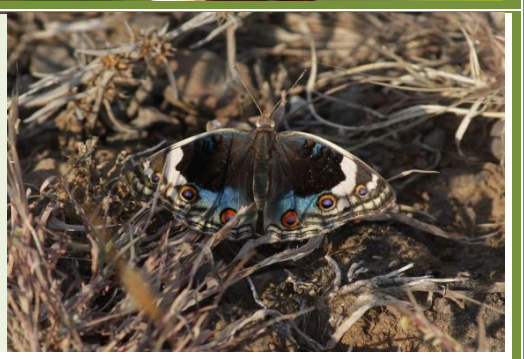
The Pimpri Chinchwad city has a very good tree connectivity. The efforts taken by the city administration for the same is very appreciable. However, with respect to the butterfly diversity, the dependency of butterflies are more on the shrubs and herbs. There are various activities or steps for attracting the butterflies, one of the best ways is to create a butterfly garden. When you create a garden that attracts butterflies, you create a habitat for a variety of beneficial insects, birds, bees and other wildlife. Butterflies and moths support a range of other predators and parasites, many of which are specific to individual species, or groups of species. These collectively provide a wide range of environmental benefits, including pollination and natural pest control.

Blue Tiger

Chocolate Pansy

Babul Blue

Blue Pansy



Methodology

Step 1: Researching about native butterfly species in the area

It is very important to know the butterfly species native to the area. This helps to determine the plant species to be grown in the garden upon which the butterflies will feed and host. This also helps in conservation of native butterfly species and prevents them from being locally extinct. And the animal species feeding upon butterflies will also be conserved.

Step 2: Plant a variety of nectar plants for butterflies to feed on

Butterflies feed upon almost all flowering plants especially those with brightly colored flowers. Therefore, planting a variety of plant species will help conserve both, a variety of plants species and the butterflies that use those plants for feeding and hostage.

Step 3: Choosing host plants where butterflies can lay eggs

Once you identify the butterflies that are native to your area, research where they prefer to lay their eggs. Then, include those host plants when you're planning what you want in your garden. The female butterfly attaches the eggs to leaves or stems of plants that will also serve as a suitable food source for the larvae when they hatch While adult butterflies aren't always picky about their sources of nectar, they are extremely particular about where they lay their eggs. That's because butterflies usually lay their eggs on the plants that their larvae feed on, and that usually consists of only 1 or a very few specific plants. Adult butterflies typically lay their eggs on different plants than the ones they feed from themselves.

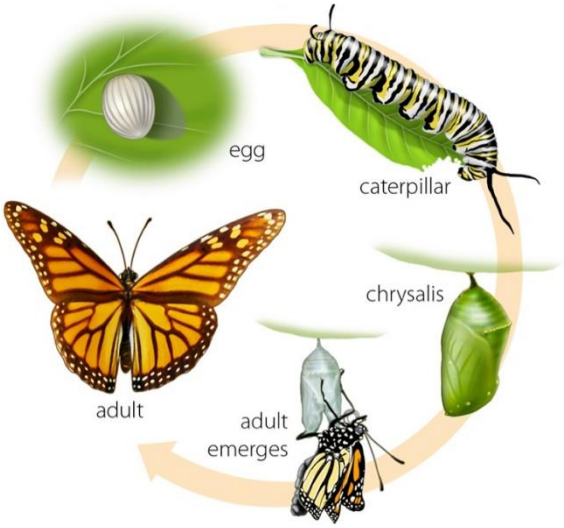


Figure 17: Representation of Lifecycle of a butterfly

For example, a monarch butterfly will only lay her eggs on milkweed, since that is the only food a monarch caterpillar will eat. Black swallowtails prefer to lay their eggs on dill, parsley, fennel, and carrot.

Step 4: Choosing a sunny area for plants

Both the butterflies and the plants which attract them need a lot of sunlight – at least 6 hours every day. Nectar-producing flowers should be placed where they receive sunshine from mid-morning to mid-afternoon. Butterflies require warmth to fly and they usually feed only in the sun.

Step 5: Pick a location that's sheltered from strong wind

If the butterflies are exposed to high winds, they'll spend most of their energy just trying not to get blown around. Place your butterfly garden near a wall, a fence, or a wooded area to help them conserve energy so they can eat and lay their eggs

Step 6: Include large and small flat rocks in the butterfly garden

Butterflies love to soak up the sun while resting on a nice, warm rock, especially early in the morning. By including these rocks in your garden, the butterflies will have a chance to get warmed up before they start feeding for the day. Try to place the rocks so the sun hits them first thing in the morning or late in the afternoon. This is when butterflies need the most warmth.

While developing new butterfly park, the arrangements of the nectar and larval plants are also important. The larval host plants should be planted on the interiors where there will be minimal disturbance due to humans. However, the nectar plants should be planted at the peripheries to get a clear view of the butterflies. The following image is for depiction purpose and the design of the butterfly park should be carried out after studying the actual site.

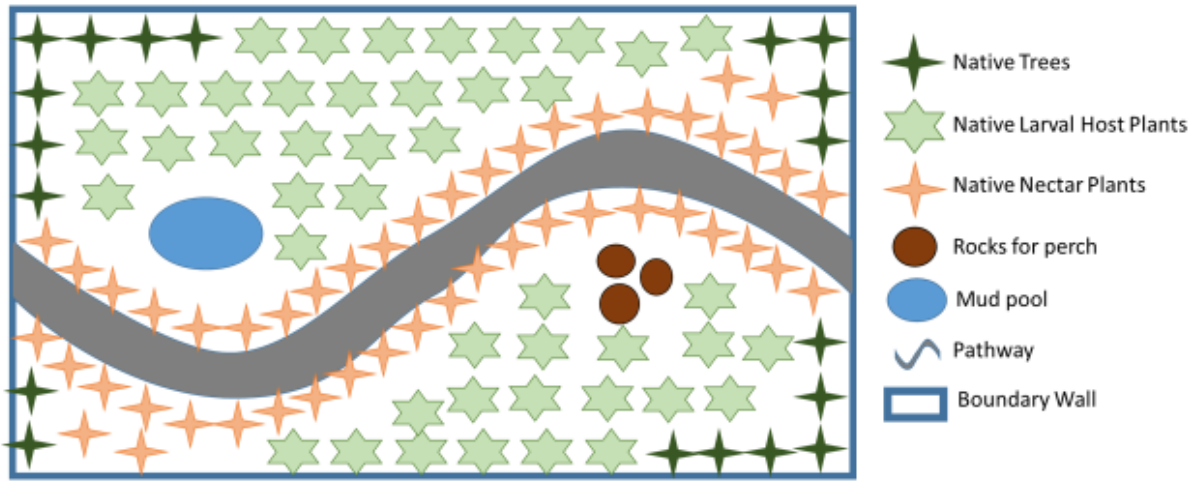


Figure 18: Depiction of conditions for creation of butterfly park

Proposed Area of Implementation

Either new location can be considered or this feature can be added in some of the existing gardens. Some of the identified locations for creation of Butterfly Park are as follows:

a. Pariyavaran Sanskar Udhyan, Plot no. 4 T Block PCMC
b. Yashwantrao Chavan Rose Garden
c. Shankar Shetty Garden
d. Open patch behind Amruteshwar Colony (18.635560, 73.807057)

Figure 19: Open Patch behind Amruteshewar Colony

Creation of Natural Way

Nature Ways are routes planted with specific trees and shrubs to facilitate the movement of animals like birds and butterflies between two green spaces. These routes also connect areas of high biodiversity to urban communities, creates immediate habitats and bring nature closer to Singapore residents. Besides enhancing the living environment, these green corridors help create a greater appreciation of the rich biodiversity in our City in a Garden.

Nature Ways are designed to replicate the natural structure of forests as far as possible. Trees, shrubs and groundcover are planted along the streetscape to re-create habitats similar to those found in natural forests. Greenery along these routes are also enriched with flowering plants which attract butterflies and support their breeding.

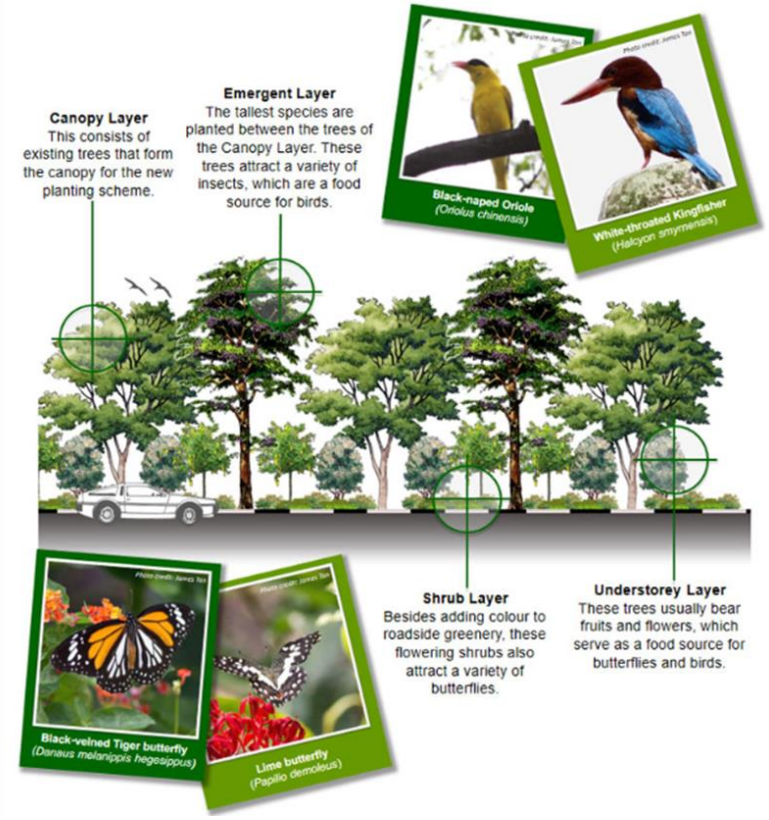


Figure 201: Four important layers of Nature Ways

Figure 22: Case study of 18 Nature ways plan of Singapore

Nature Ways are linear, green corridors along roadsides that have been developed to connect areas of high biodiversity to urban areas. The aim is to attract birdlife and butterflies from nature areas and parks to areas where people can appreciate them, and be more aware of the beautiful natural environment around them. Unlike most park connectors or green pathways which are planted with trees of the same species and at uniform heights (urban monocultures) to present a “neater” and “orderly” image, nature ways are intentionally planted with a wide variety of plant species and have a more layered vegetation structure to mimic a forest as closely as possible. Nature ways are designed to include four important layers at different heights. From highest to lowest height, the layers are as follows: i) Emergent layer ii) Canopy layer iii) Shrub layer and iv) Understory layer. (Ref: https://www.nparks.gov.sg/gardens-parks-and-nature/nature-ways)

Rationale

Nature ways are important as they help restore ecological connectivity between fragmented green patches in highly urbanised in PCMC. Road network in any part of the country is of immense importance as it aids communication for trade and economy. At the same time, roads also act as habitat or linear corridors for various species. Road verges are ecologically and environmentally unique areas that act as habitat for many species. Therefore, study of roadside vegetation has been proposed and accepted throughout the world. The small marginal habitats in a landscape serve as important passage for movement of a species and support community structure of that area. PCMC has many primary, secondary and tertiary roads along with many marginal areas. If developed properly, these areas can support and enhance biodiversity. These verges can act as a habitat for small, annual flowering herbs, various invertebrates, small mammals and birds that can complete their life cycle within a small area. Main functions of road verge plants are given in following points:

- Provide aesthetic value to the road infrastructure
- Act as a natural drain for rain water
- Increase permeable surface in the city
- Enhances biodiversity
- Increase green cover of the city
- Provide habitat to wild flowering plants as well as other faunal species

Trees, shrubs and climbers have been used to enhance the soft natural ambience against harsh elements in most of the enhancement schemes. PCMC has an appreciable amount of trees along the road verges. Also, the shrubs planted are majorly exotic and are aesthetically beneficial, however there is limitation with respect to ecological connectivity. Roadside vegetation management practices that promote natural vegetation communities may be extremely important in conserving native plant species, which in turn can provide habitat for other taxa, especially in landscapes that are highly altered and/or developed. Roadside vegetation has the potential to act as a conservation corridor, providing habitat connectivity across the landscape.

Methods to develop natural ways

Key activities for development of road verges are as follows:

Creation of database

A thorough study of existing road verges is essential for developing connected road verges. This can be done by using advance GPS technology. Persons having technical background should be employed for this work. Compiled data can be screened for selecting most appropriate roads for development of road verges. A plan can be made for the development of road verges. This plan can also consider

the connectivity of the verges with each other and it will aid in the movement of the species and maintaining robustness of the community

Selecting appropriate species

After selecting the locations, designing and making layout for developing the road verges is the next step. This process will involve list of plant species that support life cycle of various insects and other invertebrates. The designing will also provide the quantitative details of the proposed road verge. A list of species that can be used in road verge development is given in the Annexure

Maintenance and monitoring

After the development of road verges, it is important to maintain and monitor the developed road verge. Introduction of seeds of the annual plants is an essential phase. Also, daily irrigation of herb beds is vital as these plants tender and is susceptible to the harsh sunlight. Also, regular de-weeding and manuring of planted herbs is necessary in order to keep the verge healthy and disease free

Design for developing natural ways

Road verges are transition zone between road infrastructure and other built up areas. A verge can be 'greened' by using herbs, shrubs and trees. Mixture of all types of vegetation is preferable for biodiversity conservation. It is advisable to leave 1 to 1.5 m distance from the primary road while developing the road verge. The width of the verge can be variable according to available space. Herbs and shrubs can be planted in blocks whiles developing the verge. The bushy vegetation in blocks provides a continuous habitat for insects as well as act as a buffer between road and other properties.

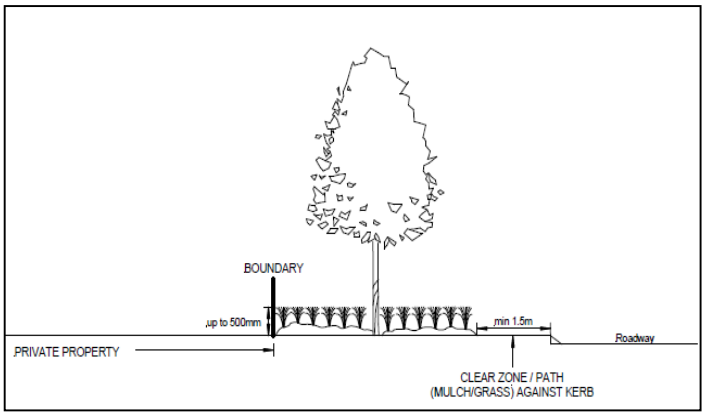


Figure 21: Diagramatic representation of a road verge

The road verges can either be a plantation or installation of planters. The preference should be for plantation. The space for same needs to be created. The locations where plantation is not possible planters can be installed with native shrubs. Plantation/planters of shrubs can also be placed within the space between two trees along the road.

Proposed Area for Implementation

The plantation on road verges can be carried out at all roads in PCMC, however some identified locations are as follows:

Although the tree plantation activity is carried out by Garden department throughout PCMC. There are some identified locations where plantation of trees can be carried out as a part of Urban Tree Forestry Plan for PCMC. Along with the tree plantations at this locations intermediate native shrubs can also be carried out for connectivity. Plantation of shrubs can be carried out in spaces between two trees planted. The locations are as follows:

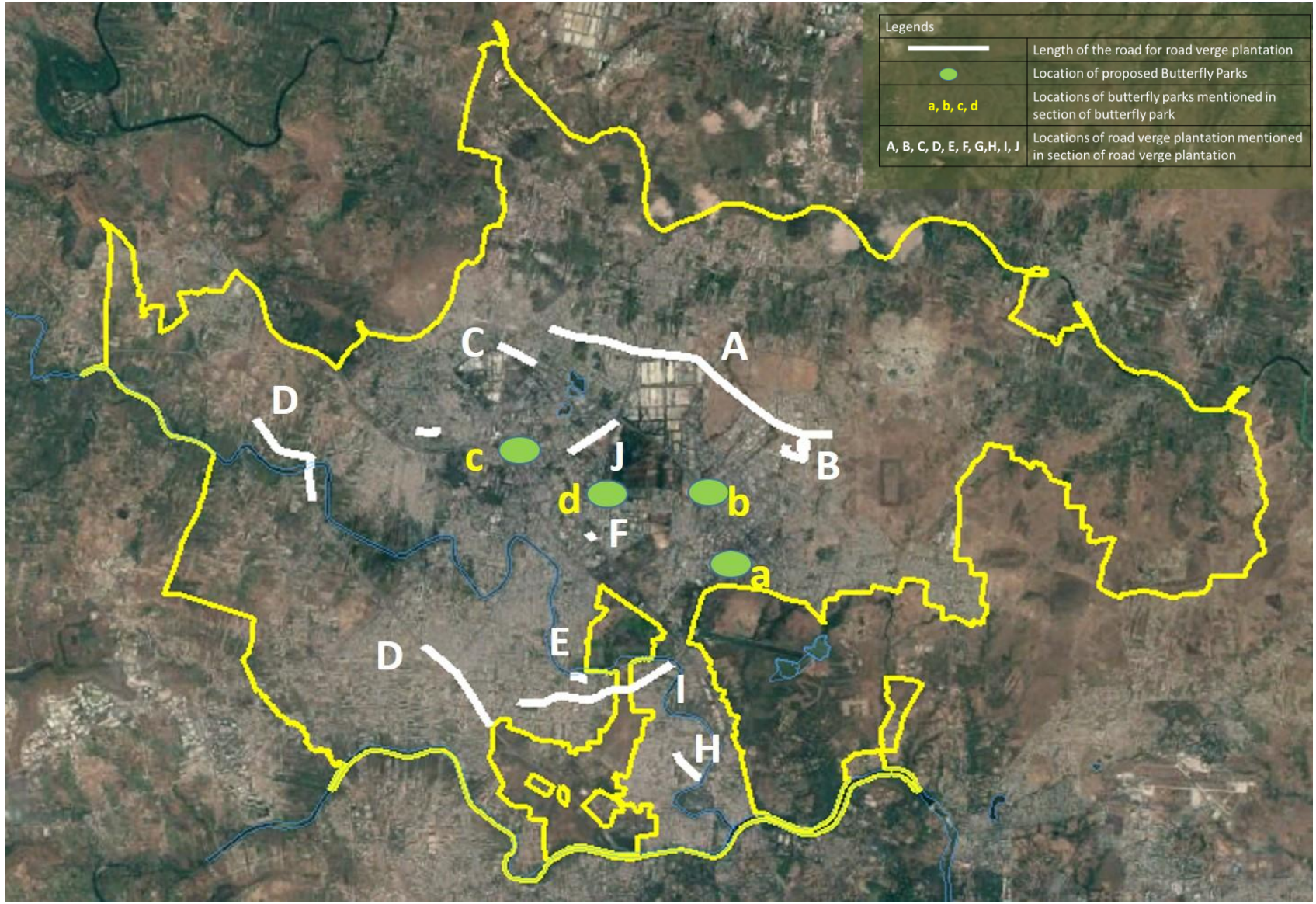
	Locations	Type of Plantation	Geographical Coordinates (Lat, Long)
A	Throughout the Spine Road	Median and Road Side Plantation	N18.648788, E73.841658
B	District Centre and PCNTDA park	Median Plantation	N18.645474, E73.842621
C	Thermax Chowk to Durga Chowk	Median Plantation/planters	N18.662994, E73.789158
D	Aundh - Ravet BRT road	Median and Road side plantation	N18.643507, E73.748563
E	Pimple Saudagar road/ Wakad - Bhosari BRTS road	Median and road side plantation	N18.599457, E73.811226
F	Space outside PCMC bhavan	Shrubs plantations	N18.662994, E73.789158
G	Chitle Bandhu Mithai Vale Lane, Sector No. 28, Pradhikaran, Nigdi, Near Sant Dnyaneshwar Nakshatra Garden	Shrub plantation	N18.647738, E73.774620
H	Pimple Gurav Road	Shrubs Planters	N18.587412, E73.820633
I	Nashik Phata Road	Median Plantations	N18.597092, E73.790500
J	Chinchwad Bhosari Road	Planters	N18.646167, E73.803662

Figure 22: Locations for plantation of native shrubs (outside PCMC Bhavan)

Broad Estimate

Activity	Description	Cost (INR)
Shrub / Tree plantation	(- in general spacing 2sq.m between 2 shrubs) – Cost of Plants	Rs. 15 /- per plant
	Digging Pits (0.2 m3), Cost of soil and manure	Rs. 840 /- per m3
Fencing	Poles	Rs. 200 /- per unit
	Barb Wire per kg	Rs 100/ kg
Manpower	Labour cost for Plantation and fencing	Rs. 300/- to 450/- per day

PCMC Jurisdiction with proposed ecological connectivity through butterfly garden and road verge plantation



5. Management of Invasive Species

Underlying Concept:

> *Invasive alien species are animals, plants or other organisms introduced by man into places out of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species. These species can survive well in areas beyond their natural range of dispersal. These plants are adaptable, fast growing, and have a high reproductive capacity.*

Invasive species are a one of the biggest threats to biodiversity, second only after habitat loss. When a species is removed from its natural habitat and placed in a new habitat, it loses its natural predators that keep its population in check. Without the predators, the growth of the species is out of control. Invasive species are called so because they outcompete the native species and invade areas with native vegetation. The characteristics which enable an invasive species to outcompete native species include fast growth, a short life cycle and the ability to tolerate a wide range of habitat types and environmental conditions. The degradation of various habitats around the world has made invasions by non-native species a much simpler process, as it is much easier for them to colonize a disturbed area.

Purpose of Implementation:

Invasive species pose considerable harm to native ecosystems and biodiversity and frustrate and at times fascinate the invasive species management and scientific communities. Of the numerous non-native species established around the world, only a minority of them are invasive and noxious, whereas the majority are either benign or in fact beneficial. Attention to the management of non-native, invasive species has a long history that predates academic work on the subject. In PCMC, the major invasive species present were *Gliricidia sepium* (Giripushpa), *Lantana camara* (Ghaneri) and *Leucena leucocephala* (Subabul). There are several patches dominated by Girippushpa and Subabul in PCMC viz. Katevasti forest, foothils of Goradeshwar mountain near Dehu, etc. Such monotonous patches in some areas were also seen to be infested by pest. Considering the lack of diversity in such areas, there is a continous threat for the habitat. Also, the control of the population of these species is essential as these are affecting the native vegetation.

Figure 23: Top: Lantana camara; Bottom: Leucena leucocephala

Figure 24: Presence of *Gliricidia sepium* in Katevasti Forest Area of PCMC

Demarcation of patches of Invasive Alien Species

Concept and Method:

The first step towards management of invasive alien species of plants is the need for identification of locations of the species. The plant species would be distributed in various areas and identification of all the areas of the invasive species would be a challenging task. A spatial mapping of each species of invasive plants would be the best approach. The spatial mapping can be accomplished by using the appropriate tool of GIS. This tool will identify the locations and will also give the expanse of the spread of a particular species. The next step would be ground thruthing of the areas and getting the actual demarcation of the same on the field. The final output will be a spatial map with actual demarcations of the areas of invasive species.

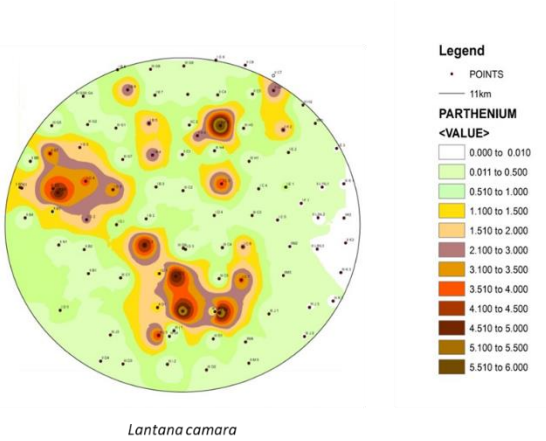


Figure 25: Representative image of demarcation of the invasive species

Timeline:

The task will be a very detailed activity and would require a time frame of 6 to 8 months

Broad Estimate:

Activity	Details	Cost (INR)
Demarcation of Invasive species	Demarcation using GIS techniques	30,00,000/-
	Ground thruthing and actual demarcation	75,00,000/-

Replacement of Invasive Species with Native Vegetation

Concept and Method:

Different species will have different ways of removal and management. These species can be managed in following manner:

Leucaena and Gliricidia:

Leucaena is a weed in forest nurseries in India, solarisation was found to be 100% effective in killing all plants and seeds, Being a highly palatable species, grazing could be used as a means of control, and grazing by goats was found to control *L. leucocephala* in Hawaii. PIER (2007) notes that chemical control is possible, with triclopyr applied to foliage, tebuthiuron applied to the soil, or triclopyr ester, 2,4-D in diesel and to a lesser extent diesel alone as a basal bark treatments. In combination with mechanical cutting, treatment of cut stumps is effective with picloram but not with dicamba, and with triclopyr ester applied to stump bark. The biological measure of control is seed predator, Bean Weevil or *Acanthoscelides macrophthalmus* (Coleoptera: Chrysomelidae : Bruchinae)(M.Tuda et al, 2009).

Lantana camara:

The principal method for management of *Lantana camara* is control of regrowth. Mechanical clearing and uprooting the plants are easy measures for smaller areas. **Cut root-stock method of removal of adult clumps of Lantana** – cutting the plant 3-5 cm below soil level at the zone between stem and tap root of the individual. In this method, the side branches should not be cut. The plant should be bent by holding a bamboo/wooden stick under a branch of the plant and pushing it towards ground. This

way, it becomes easy to reach the main clump of the plant and cut it. After removal, the clumps must be placed upside down to prevent regeneration. These clumps can be dried and used as fuel.

General Methods for Eradication of invasive species

- Invasive plant removal in '**inside out**' fashion – removal from maximum density area, moving towards lesser dense patches. In case of slopes, the removal should begin from slopes and lead into valleys.
- Removal operation should be carried out when **minimum population is in flowering or fruiting stage. Ideal time is before monsoon season.**
- Immediate **Ecological landscape restoration** after removal of invasive is very important in preventing regeneration and also secondary invasion from other plants like *Parthenium sp,* etc. Quick-growing **native grasses and legume species** can be used for immediate plantation at invasive-free sites.
- Weeding out of new saplings in the next 3 growing seasons (Monsoons) is essential for complete eradication of invasive from a patch of land. Special attention for this task must be near popular bird perches, as birds are major seed-dispersers of many plant seeds.
- **Burning** of cleared land should be **avoided,** as burnt lands are more favourable for invasion of some plants.
- **Artefacts preparation can be promoted as a strategy for management of the removed plants**

Timeline:

The task will be a very detailed activity and would require a time frame of 1 to 3 years

Broad Estimate:

Activity	Details	Cost (INR)
Removal of plants from the infested areas	-	50,000/- per ha
Treatment of cut stumps to prevent regrowth	-	35,000/- per ha
Shrub / Tree plantation	(- in general spacing 2sq.m between 2 shrubs) – Cost of Plants	Rs. 15 /- per plant
	Digging Pits (0.2 m3), Cost of soil and manure	Rs. 840 /- per m3
Manpower	Labour cost for Plantation	Rs. 300/- to 450/- per day

6. Development of Alternative Livelihood from Biodiversity

Underlying Concept:

Alternative livelihood promotes livelihood security through improving the diversity and security of resources, skills and technologies that are available to agricultural communities. If households are to be resilient then they need adequate resources to fall back on in times of need and this means finding other ways to earn an income. Livelihoods are made up of resources such as skills, technologies, organisations and finances that are built up over time for people to make a living and have a good quality of life. Understanding resilient livelihoods does not just mean looking at one source of employment or produce, but at all of the different activities and choices within the household and community which provide an income, food, shelter and other factors that ensure wellbeing. Livelihood options available to individuals and households depend upon the diversity of resources, skills and technology they are able to access. Therefore the security of their livelihood also depends on the security of their available resources.

Purpose of Implementation:

PCMC is an expanding city. With the spread of the city many adjoining villages are forming the part of the PCMC. A continuous change of land use i.e. from agriculture to development of building is being observed in the city. The loss of the agriculture practices from the city is slowly vanishing causing a loss of major livelihood for the resident and lower income population. To provide livelihood options for these people are always a major task for the Urban Local Body. A practical action for providing alternative livelihood needs to be promoted.

Methods:

Various options can be provided and promoted as Alternative Livelihood:

1. Apiculture

The growing market potential for honey and its products has resulted in bee keeping emerging as a viable enterprise. Several natural plant species provide nectar and pollen to honey bees. Thus, the raw material for production of honey is available free from nature. Bee hives neither demand additional land space nor do they compete with agriculture or animal husbandry for any input. The beekeeper needs only to spare a few hours in a week to look after his bee colonies. Beekeeping is therefore ideally suited to him as a part-time occupation. Beekeeping constitutes a resource of sustainable income generation to the rural and tribal farmers.

Figure 26: Representation of Apiculture setup

The bee hive apparatus can be purchased by PCMC and provided to the required person at the subsidized rate. The bee hive apparatus can be simple structure of a wooden box lined with wooden chambers for bees to make the hive. A small tray is usually present at the lower end of the hives for addition of sugar syrup for attracting the bees. Formal training from the Experts can be arranged by PCMC.

2. Preparation of artefacts from plant objects

Figure 27: Artefacts made from Plants

Artefacts are the products of man's imagination and workmanship of historic origin. These are the objects made primarily from plants. The artisans living in the existing traditional societies are normally influenced by the elements of their environment which are reflected in their creations. In PCMC, the artefacts can be made either from bamboo or can be incorporated with the invasive species management. The wood of these species can be used for making wooden toys, earrings, pen stands, etc. There are many Women Self Help groups in PCMC. These women can be given training for creations of these artefacts by PCMC and help them in marketing of the same. PCMC can gradually replace the plastic desk accessories and stationary prepared from the wooden artefacts.

3. Cultivation of Mushroom

Figure 28: Representation of Mushroom Cultivation

Mushroom cultivation is one of the most profitable agribusiness that can be started with minimum investment and space. Mushroom farming in India is growing steadily as an alternative source of income. Edible mushrooms have tremendous nutritional and medicinal value. Hence they are of significance in domestic and international market. Mushroom cultivation requires very low care and investment. There are three types of mushrooms in India which has market demands. Process of growing mushroom is different for each types. Button mushroom, straw mushroom and oyster mushroom are the three major types of mushrooms in India used for cultivation. Paddy straw mushrooms can grow in temperatures ranging from 35^{o} to 40^{o}C. Button mushrooms grow during winter. Oyster mushrooms are grown in the northern plains. All the three mushrooms of commercial importance are grown by different techniques. They are grown on special beds called compost beds. PCMC can provide guidance and facilitate the local farmers and self-help groups to grow the mushrooms. PCMC can guide in marketing and trading of the same.

Broad Estimates

Activity	Description	Cost (INR)
Apiculture	Apiculture unit	Rs. 20,000/- per unit
Mushroom Cultivation	Building (100 sq. m. built up area)	Rs. 2,50,000/-
	Machinery for minimal processing (capacity 600 kgs. Per day, the annual capacity would be 180 tonnes considering 300 working days)	Rs. 4,35,000 /-
Plant Artefacts	Providing training	Rs. 15,000/- per session

7. Incorporating ecological perspective in Development projects

Ecosystem degradation is threatening human development. On the one hand, it is clear that transformation of the environmental resource base has contributed to substantial net gains in human well-being and economic development. Many researchers, practitioners, and critics have explored alternative and radical approaches between ecology and architecture, urban design, landscape, planning, and urbanism contributing to the theory and practice of ecological urbanism. The development of an ecological perspective into urbanism has gained importance as it its connected to multiple interrelated movements: ecological design, industrial ecology, deep ecology, and the so called sustainable development paradigm.

Currently, in Pimpri Chinchwad there are two major development activities viz. Metro lines and River Front Development project. This action strategy will enable PCMC to maintain and enhance the biodiversity values in the city.

Incorporating Ecological Perspective in Metro Lines Project.

Rationale

A vertical garden is a technique used to grow plants on a vertically suspended panel by using hydroponics. These unique structures can either be freestanding or attached to a wall. Vertical gardens have been used since ancient civilizations; many modern vertical gardens can last for decades and give a pop of nature into the modern day business. A vertical garden is proposed on the Metro Pillars at Particular intervals in PCMC. Many Cities in India has opted for the same including cities like Nagpur, Delhi, Bangalore and Pune. This will aid in creation of green network along the Metro Lines. The maintenance of the vertical wall is not easy and requires utmost care. The species selection for this should be appropriate and low maintenance.

Method

The process for implementation is as follows:

- Identification of location for creation of green-wall /vertical wall
- Selection of plant species
- Implementation and Maintenance

Locations

The pillars of Metro can be used for this initiatives. Besides these

Timeframe

The time required for implementation of this action is 1 year

Broad Estimate

Activity	Description	Cost (INR)
Planters of Vertical Potted plant	Geo textile Green Wall, aluminium channels, PVC system, media, irrigation system, expertise	Rs. 3000/- to 3500/- per sq. ft
	Irrigation Pumps	Rs. 4000/- per unit
Manpower	Labour cost for Plantation	Rs. 300/- to 450/- per day
Maintenance	-	Rs. 50/- per sq ft

List of low maintenance plants

Sr. no.	Botanical Name	Common Name	Flowering season	Origin
1	*Nephrolepis exaltata*	Sword Fern	-	Native
2	*Pothos scandens*	Creeping Aroid	-	Native
3	*Plectranthus scutellarioides*	Coleus	All year	Native
5	*Oxalis corniculata*	Creeping Wood Sorrel	Feb-Oct	Naturalized
7	*Celosia argentea*	Cockscomb	Nov-Dec	Native
8	*Centella asiatica*	Brahmi	All year	Native
9	*Portulaca oleraceae*	Pusrlane	All year	
11	*Dianthus chinensis*	Indian pink	All year	Native
12	*Sphagneticola calendulacea*	Chinese Wedelia	All year	Native
13	*Sphaeranthus indicus*	East Indian Globe Thistle	Oct-April	Native
15	*Hygrophila serpyllum*	Marsh Carpet	Dec-Mar	Native
16	*Catharanthus pusillus*	Tiny Periwinkle	July-Aug	Native
17	*Asparagus racemosus*	Asparagus, Shatavari	Oct-Nov	Native
18	*Acalypha indica*	Indian copperleaf	July-Dec	Native
19	*Barleria prattensis*	Pink Barleria	Oct-Jan	Native
20	*Tradescantia spathecea*	Oyster plant	All year	Native
21	*Phyllanthus amara*	Bhumi-amla	July- Oct	Naturalized

Figure 29: Images of Green Wall in Left: Pune and Right: Bangalore

Incorporating Ecological Perspective in Riverfront Development

Concept

Channelization of rivers, along with beautification and structured designated landscape design along the riverbanks, are parts of the development that occur in the urban centres around the world. Such developments are often taken up to prevent natural catastrophes such as floods, without considering the nature of the river itself. Realizing this mistake and its adverse effects towards the environment, many developed countries, such as the U.S.A., U.K., Japan, China and, many more, have started to ecologically reorganize riverfront designs to ensure that rivers are restored to their natural condition.

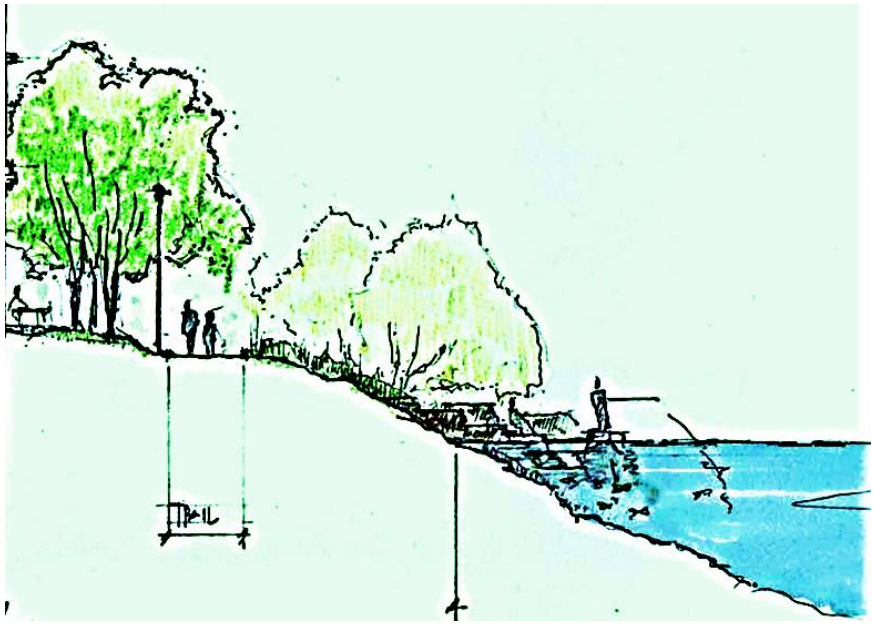
Approach in PCMC

There are three rivers viz. Indrayani and Mula at the boundaries and Pawna passing through PCMC. Riverbanks, shorelines, riparian buffers, and river habitat are critically important when planning any riverfront project. Other important components of ecosystem function that should be considered include geology, morphology, hydrology, and land cover. Along the river, there are many opportunities for integrated regenerative design, storm-water management, habitat restoration, public access, stewardship, and redevelopment.

The river edges are one of the most important part of the riverfront development as well as from ecology point of view. There are various concepts and typologies as per 'A guide to Riverfront Development' by Riverlife (riverlifepgh.org). In PCMC, the river edges present in the areas of urbanisation and industries can be a concrete wall lined by the native trees and shrub species. In case of the areas where open space is available should consider ecological conservation.

Following are the concepts to be considered in such areas:

- The riparian buffer area should be wider as it will provide more benefits in terms of biodiversity conservation, water temperature modulation, protection from non-point source of pollution, bank stabilization etc.



- The riparian buffer should be divided in three zones from water to land
  - The riverside should contain more of riparian flora
  - The middle portion should contain small to medium shrubs
  - The landward portion should contain a pathway along with native trees for shade

Timeframe

The time required for implementation of this action is 1 year to 3 years

Locations for implementation

River	Locations
Indrayani	Talawade Chakan Road Bridge near Syntel to Bhangare Colony, Patilnagar, Chikhali
	Near Wagholi
Mula	St Sawatamali Udhyan to Yashodhan Garden
Pavana	Kiwale-Mamurdi Road to Ravet Dam
	Sant Tukaram Maharaj Bridge to Thergaon Boat Club

*Some efforts are already being made to create a riverfront through gardens viz. Jijau Paryatan Kendra, Chinchwad. However they lack the riparian buffer zones.

Broad Estimate

Activity	Description	Cost (INR)
Plantation on Buffer	Bioremediation + Phyto remediation + Riparian plantation	Rs. 3,00,000/- per river
Manpower	Labour cost for Plantation	Rs. 300/- to 450/- per day

Figure 30: Riparian Zone present beyond Thergaon Boat Club

8. Conservation of Native and Rare Species

Concept:

A native species is a plant or animal that has always been a part of a particular environment. Such animals play a role in the chain of events for feeding (food web) or habitat and have evolved with the environment and adapted to it. When there are changes in the environment - such as where a new similar animal is added or when the habitat changes - it can disrupt the native species, who now has to compete for food with the new animal or has to find different habitat in order to live because its original habitat is no longer available. Such has been the case for many native aquatic species and rare native flora whose numbers have declined due to competition with new invader species or because of loss of important habitat to development.

Purpose:

Native and rare species conservation is important because many of these species populations are declining due to degraded habitat and the spread of nuisance species. Without help, some declining species never recover and eventually may become extinct - or no longer in existence. When species declines are detected, efforts are made to protect the species and their habitat by designating it as threatened or an endangered in hopes of preventing it from becoming extinct. Preventing a species from declining to such levels where it is in peril is as important - if not more important - than allowing the species to reach such low levels that it requires protection as a threatened or endangered species.

A decline in number of native fish population is observed in PCMC. Mozambique tilapia (*Oreochromis mossambicus*) an exotic fish is seen to dominate the rivers in PCMC which is having an effect on the native fish population. Also, with the development activities on high swing in PCMC, there are chances of loss of some rare species of flora in Pimpri Chinchwad. The work to detect declines in native fish and rare flora populations and to assist those species before they reach low levels that require threatened or endangered listing. The conservation of such species through Ex-situ conservation method is important.

Figure 31: Mozambique tilapia caught from the Pawana River

Conservation breeding for native fish diversity

Concept

A fish hatchery is a place for artificial breeding, hatching, and rearing through the early life stages of animals—finfish and shellfish in particular. Hatcheries produce larval and juvenile fish, shellfish, and crustaceans, primarily to support the aquaculture industry where they are transferred to on-growing systems, such as fish farms, to reach harvest size. The hatchery in PCMC is to be developed to breed the native fish population and reintroduce them into the riverine ecosystem.

Method

Hatchery designs are highly flexible and are tailored to the requirements of site, species produced, geographic location, funding and personal preferences. Many hatchery facilities are small and coupled to larger on-growing operations, whilst others may produce juveniles solely for sale.

The production steps includes the following:

Case Study for Ex-situ conservation and Reintroduction in Wild

Toshiba Group is developing biodiversity conservation activities at 66 business and production sites worldwide. First, during the two-year period from 2012 to 2013, they conducted ecosystem surveys on and around our business and production sites. They actively take measures to protect rare animal and plant species found within their sites. On the premises of the sites, Toshiba Group also promotes ***ex-situ conservation*** *(Article 9 of the Convention on Biological Diversity)* * *in order to protect and artificially breed (inside the sites) rare flora and fauna which inhabit the surrounding areas before returning them to their original habitats.*
As a result of these activities, at present more than 100 rare species inhabit Toshiba Group's business and production sites.

Example: Toshiba Lighting & Technology Corporation in Yokosuka City accepted 28 stocks of daylily, a lily-family plant that had been picked excessively in the Miura Peninsula's Koajiro forest(where the number of this species was decreasing).The origional stock was successfully raised to 100. After tripling the number of stocks, the lilies were returned to Koajiro forest

Brood stock: Broodstock conditioning is the process of bringing adults into spawning condition by promoting the development of gonads. Some hatcheries collect wild adults and then bring them in for conditioning whilst others maintain a permanent breeding stock. Conditioning is achieved by holding broodstock in flow-through tanks at optimal conditions for light, temperature, salinity, flow rate and food availability (optimal levels are species specific)

Spawning: Natural spawning can occur in hatcheries during the regular spawning season however where more control over spawning time is required spawning of mature animals can be induced by a variety of methods. Thermal shock, where cool water is alternated with warmer water in flow-through tanks can induce spawning. Alternatively, if environmental cues that stimulate natural spawning are known, these can be mimicked in the tank. Many individuals can be induced to spawn this way, however this increases the likelihood of uncontrolled fertilisation occurring. A number of chemicals can be used to induce spawning with various hormones being the most commonly used.

Fertilization**:** Prior to fertilisation, eggs can be gently washed to remove wastes and bacteria that may contaminate cultures. Promoting cross-fertilisation between a large numbers of individuals is necessary to retain genetic diversity in hatchery produced stock. Batches of eggs are kept separate, fertilised with sperm obtained from several males and allowed to stand for an hour or two before samples are analysed under a microscope to ensure high rates of fertilisation and to estimate numbers to be transferred to larval rearing tanks.

Larvae: Rearing larvae through the early life stages is conducted in nurseries which are generally closely associated with hatcheries for fish culture. Nursery culture of larvae to rear juveniles of a size suitable for transferral to on-growing facilities can be performed in a variety of different systems which may be entirely land-based, or larvae may be later transferred to sea-based rearing systems which reduce the need to supply feed.

Reintroduction**:** The fingerlings of the fish can be reintroduced in the rivers of PCMC along with some adult populations

Location for implementation:

The hatchery can be located on the banks of Indrayani River near proposed Deer Park.

Timeline:

The task would require a time frame of 1 to 3 years

Broad Estimate:

Activity	Description	Cost (INR)
Setting up a Hatchery with all the facilities at a primary scale for one species	1 brood tank, 1 spawning tank, 2 rearing ponds and other allied facilities	30,00,000/-
Cost of Technical Expertise	1 Senior and 1 Junior Expert	70,000/- per month
Cost of Non-Technical Expertise	3 nos	45,000/- per month
Other Overheads	Cost of Additional facilities expense	2,00,000/-

Figure 32: Representative image of fish hatchery

Case Study of Golden Mahseer Conservation Breeding Project

The Golden Mahaseer Conservation Breeding Project was conceptualized and implemented by Maharashtra State Biodiversity Board by involving Hirabambai Biodiversity Management Committee. This project was implemented in Melghat region. There were three major stages of the project viz.

Stage 1 – Rearing of fingerlings in the cage culture until they attain sexual maturity
Stage 2 – Using the sexually matured fishes obtained from the earlier stage to carry out artificial breeding and produce hatchling
Stage 3 – Release of the fingerlings so obtained (both native and artificial) to various rivers

Development of Native seed bank

Concept

Seed banks protect and save plant genetic diversity, which is important for a number of reasons. These saved and viable seeds contain a treasure trove of useful genes that breeders can use for developing improved varieties of our major plants. Seed banking is a great way to conserve plants because their small size provides a very convenient and cheap way to store plant genetic material. They take up little space and they also can remain viable as long as their surroundings are kept at a low temperature. Many botanic gardens contain seed banks to help preserve endangered species. Some botanic gardens even store cryopreserved embryos, minute seeds, and tissues of plants.

Purpose of implementation

Species extinction due to natural and man-made influences is undeniable and a serious threat to our planet. Once they are gone, we have lost them forever. For plants, seed banks are a way to combat this threat. They are an important part of a robust seed system for food security. Seed banks protect and save plant genetic diversity, which is important for a number of reasons.

1. Improve resistance to current and emerging plant diseases and insects.
2. Provide drought or flood tolerance.
3. Improve yields and nutrition to feed a growing global population.

Method:

This activity can be accomplished in collaboration with the local institutions with botany expertise. The steps included in setting up the native seed bank is as follows:

a. Collection of Seeds/Harvesting:

Seed quality is highly variable from year to year and should be evaluated before collecting large quantities of seed. If the seed quality is very low it may not be worthwhile collecting seed. It is desirable to harvest seeds from a diverse population; at least 50 plants should be utilized for larger orders. Seeds that ripen and fall quickly can sometimes be collected by early placement of the seed head in a section of nylon stocking or netting. Harvesting the seeds of wild plants usually requires manual labour since the desired species rarely grow in pure stands, and the topography often limits use of mechanical equipment. The botany students from the institutions in PCMC would be a great resource for this step.

b. Processing:

Seeds often require cleaning, dewinging, and debearding. Removing dirt, leaves, stems and chaff from the seeds will reduce the bulk for handling and storage, remove moist, material that may cause heating and mold formation in storage, and facilitate flow through seeding equipment.

c. Disease Control:

Insects and fungi are usually controlled by dry, near freezing, or subfreezing storage of seed. Many insects that attack stored seeds were originally from the tropics and have spread and adapted to colder climates by living in man-made seed storage shelters.

d. Storage

Although seeds are often long lived and may exhibit multiple dormancy, many seeds have their best germination potential at the moment they reach maturity on the plant. Storage conditions are critical

in order to maintain seed viability over an extended period of time. The two most important factors affecting seed longevity are seed moisture content and seed temperature.

Timeline:

The task would require a time frame of 1 to 3 years

Location for implementation:

The native seed bank can be part of either the laboratory of the institution or within a small space in the botanical/biodiversity park (T-Block MIDC garden)

Broad Estimate:

Activity	Description	Cost (INR)
Collection of seeds	Collection cost of seeds inclusive of transportation	1,50,000/-
Processing	Cleaning, dewinging, and debearding	10,000/- per month
Non-Technical Expertise	4 Nos.	50,000/- per month
Storage cost	Refrigeration, containers, storage space	5,00,000/- (plus 30,000/- per year for maintenance)

Case Study – Seed Bank

'Seed bank' is a plant seed storage facility that aims to preserve the gene pool of the existing plant species. Hence, it is included in types of 'gene bank'. Preserving seeds of extant plant species through different time periods achieves 3 purposes –

- Preservation of genetically diverse plants that can be used in order to develop new cultivars having superior qualities like robustness, disease resistance, frost or drought tolerance, etc.
- Conservation of plant species that are on the verge of extinction.
- Preservation of cultural heritage in agricultural practices in the form of commonly cultivated crop varieties.

The success of seed bank depends on preservation of viable seeds for a long duration and also, relevance of the collected species to the on-going and future scope of research.

One such seed bank is maintained at 'KSCSTE - Jawaharlal Nehru tropical botanic garden and research institute', Thiruvananthapuram, Kerala. It holds 986 active, 38 base and 4000 reference accessions. The priority of this institute is conservation of the species. It routinely conducts research on characterisation, germination, storage, allied physiological, biochemical aspects of the stored seeds. The institute holds credit for successful seed germination of endangered species such as *Coscinium fenestratum* (Tree turmeric, critically endangered, endemic to Western Ghats), *Saraca asoca* (True ashoka, Vulnerable), etc. The germination procedures of these seeds were standardized. It also augmented Kerala Forest Department's species recovery programmes by providing seedlings of endemic plant species.

9. Restoration of Degraded Ecosystem

Underlying Concept

Ecological restoration, a well-established practice in biodiversity conservation and ecosystem management, is a process of recovery of an ecosystem that has been degraded, damaged or destroyed" (SER & IUCN Commission, 2004). Ecological restorations are science based projects implemented using confirmed theories on ecological knowledge and application of scientific methods. Science based ecological restoration projects follow a 4-step process:

- Explicitly stated goals
- Restoration design informed by local knowledge
- Quantitative assessment of system responses employing pre and post-restoration data collection
- Analysis and application of results to inform subsequent efforts

Purpose of Implementation

- Enhancement of natural resources and ecosystem services to Pimpri Chinchwad city and its people
- Improvement of soil, air and water quality, ecosystem productivity and habitat connectivity links
- To create new havens for biodiversity that has been on decline, facilitating the population recovery of various species through restoration of lost habitats
- To enhance the aesthetic value of the natural areas of the city, improve city's performance on pollution control, biodiversity conservation and environmental stabilization

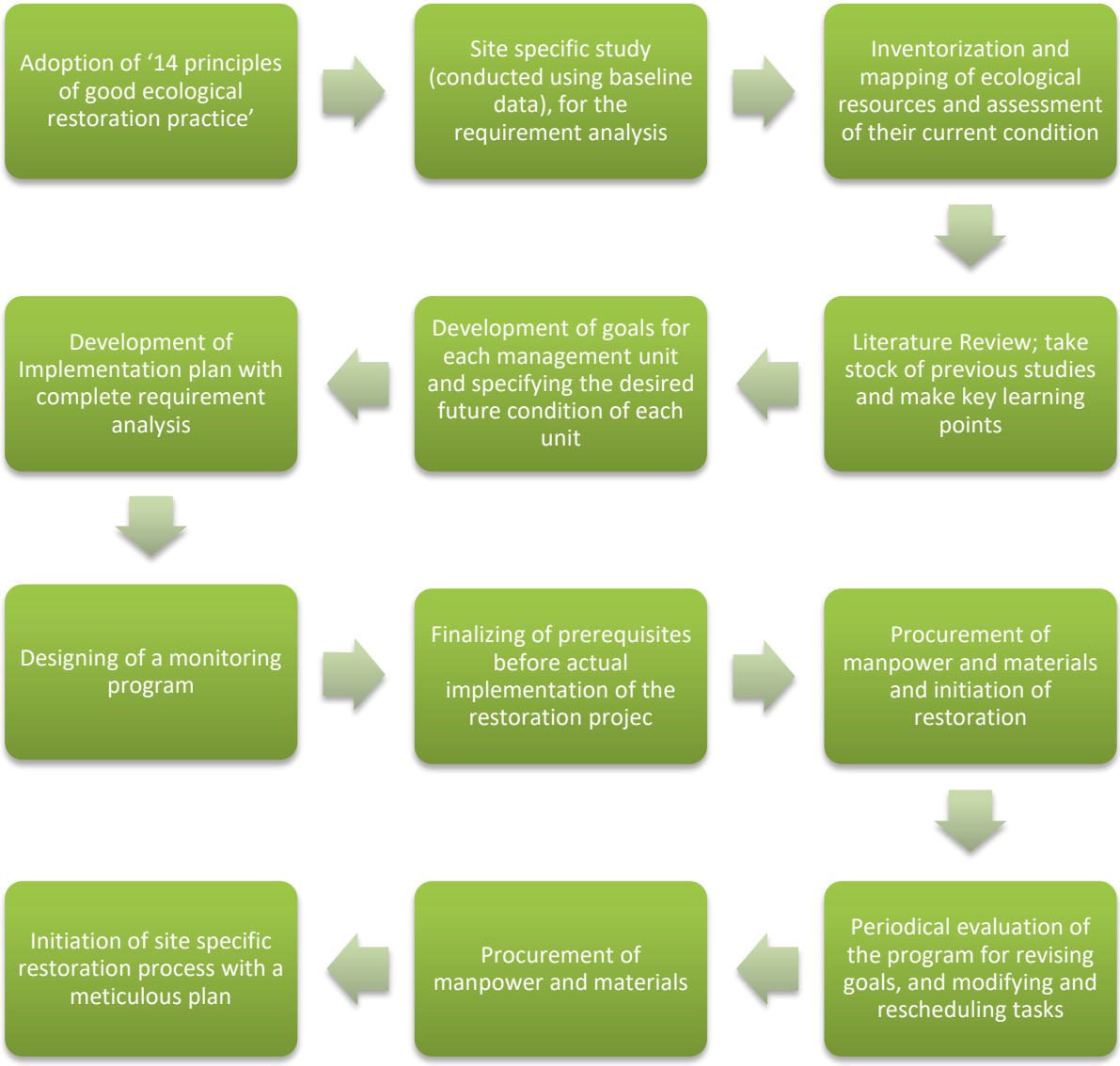
Proposed Area of Implementation

PCMC has a vast expanse of open/grass land which are used for mining purpose. The mining carried out is open cast quarry. An open pit is usually formed during this mining. Also, PCMC has 3 rivers viz. Indrayani, Pawna and Mula River. The condition of rivers at some locations are disturbed and degraded.

Figure 33: Patch of Pawana River (Inset: Disturbed patch with weed growth and plastic pollution

Figure 34: Quarry in PCMC near Moshi

Proposed Methodology



Broad Estimates

Activity	Description	Cost (INR)
Restoration of Quarries	Stabilization of slopes/preparation of ground cover	Rs. 1000/- per m2
	Plantation (Plant cost, Digging Pit, soil and manure)	Rs. 15 per plant; Rs. 840 / m3
	Geo Jute Fabric	Rs. 3000/- to 3500/- per sq.ft
Restoration of River	River Bed Cleaning	Rs. 10,00,000/- per running km
	Sewage Management system at Points	Rs. 3,00,000/- per km
	Bioremediation + Phyto remediation + Riparian plantation	Rs. 3,00,000/- /- per km
	Capacity Building	Rs. 20,000/- per session
	Operations and maintenance for 5 years	Rs. 3,00,000/- per river

Annexures: 1. Aichi Targets

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society

Target 1: By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

Target 2: By 2020, at the latest, biodiversity values are integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

Target 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.

Target 4: By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use

Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

Target 6: By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

Target 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity

Target 8: By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity

Target 9: By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

Target 10: By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

Target 11: By 2020, at least 17 percent of terrestrial and inland water, and 10 percent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained

Target 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services

Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable

Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Target 16: By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation

Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building

Target 17: By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan

Target 18: By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

Target 19: By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

Target 20: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

2. List of Flora/Vascular Plants in PCMC

SN	Scientific Name	Common name(English)	Local name(Marathi)	Family	Habitat	Origin	IUCN status
			Trees				
1	*Acacia auriculiformis* Benth.	Ear-leaf Acacia	Australian Acacia	Mimosaceae	Evergreen	E	LC
2	*Acacia chundra* (Rottler) Willd.	Cutch Tree	Kattha	Mimosaceae	Deciduous	N	NA
3	*Acacia mangium*Willd.	Black wattle	-	Mimosaceae	Evergreen	E	NA
4	*Acacia planifrons* Wight & Arn.	Umbrella Thorn	Chatri-babhul	Mimosaceae	Deciduous	N	NA
5	*Acacia leucophloea* (Roxb.) Willd.	White barked Acacia	Safed Babul	Mimosaceae	Evergreen	E	NA
6	*Acacia nilotica* (L.) Delile	Gum Arabic	Babul	Mimosaceae	Evergreen	E	LC
7	*Adansonia digitata* L	Baobab	Gorakhchich	Bombacaceae	Deciduous	E	NA
8	*Aegle marmelos* (L.) Corrêa	Stone Apple	Maredu	Rutaceae	Deciduous	N	NA
9	*Ailanthus excelsa* Roxb.	Indian Tree of Heaven	Mahavruksh	Simaroubaceae	Deciduous	N	NA
10	*Albizia lebbeck* (L.) Benth.	Siris tree	Shirish	Mimosaceae	Perennial	N	NA
11	*Albizia procera* Roxb.	White Shirish	Kinhai	Mimosaceae	Perennial	N	NA
12	*Albizia amara* (Roxb.) B.Boivin	Krishna Siris	Krishna Shirish	Mimosaceae	Deciduous	N	NA
13	*Albizia saman* (Jacq.) Merr	Rain tree	-	Mimosaceae	Deciduous	E	NA
14	*Alstonia macrophylla* Wall. ex G.Don	Devil tree	Mothi Satvin	Apocynaceae	Evergreen	E	NA
15	*Alstonia scholaris* (L.) R. Br.	Scholar tree	Satvin	Apocynaceae	Evergreen	N	LC
16	*Anacardium occidentale* L.	Cashew	Kaju	Anacardiaceae	Evergreen	E	NA
17	*Annona reticulata* L.	Netted Custard Apple	Ramphal	Annonaceae	Deciduous	E	NA
18	*Annona squamosa* L.	Sugar Apple	Sitaphal	Annonaceae	Perennial	E	NA

SN	Scientific Name	Common name(English)	Local name(Marathi)	Family	Habitat	Origin	IUCN status
19	*Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Bedd.	Axle wood tree	Dhawada	Combretaceae	Deciduous	N	NA
20	*Anthocephalus cadamba* (Roxb.) Miq.	Kadam	Kadamb	Rubiaceae	Perennial	N	NA
21	*Aphanamixis polystachya* (Wall.) R.Parker	Pithraj tree	Raktharohida	Meliaceae	Deciduous	N	NA
22	*Araucaria columnaris* (G.Forst.) Hook.	-	Christmas tree	Araucariaceae	Evergreen	E	NA
23	*Areca catechu* L.	Betel Palm	Supari	Arecaceae	Evergreen	N	NA
24	*Artocarpus heterophyllus* Lam.	Jackfruit	Phanas	Moraceae	Evergreen	N	NA
25	*Azadirachta indica A.* Juss.	Neem	Kadulimb	Meliaceae	Evergreen	N	LC
26	*Bauhinia purpurea* L	Purple Orchid Tree	Raktchanadan	Caesalpiniaceae	Deciduous	N	NA
27	*Bauhinia racemosa* Lam.	Bidi leaf tree	Apta	Caesalpiniaceae	Deciduous	N	NA
28	*Bauhinia semla* Wunderlin	Roxburgh's Bauhinia	Semla Kanchan	Caesalpiniaceae	Deciduous	N	NA
29	*Bauhinia tomentosa* L.	Yellow Orchid Tree	Pivala Kanchan	Caesalpiniaceae	Perennial	E	NA
30	*Bauhinia variegata* L.	Variagated Bahunia	Kanchan	Caesalpiniaceae	Deciduous	N	LC
31	*Betula utilis* D.Don	Himalayan Birch	Bhor Patra	Betulaceae	Deciduous	N	LC
32	*Bombax ceiba* L.	Silk Cotton Tree	Katesavar	Bombacaceae	Deciduous	N	NA
33	*Borassus flabellifer* L.	Toddy palm	Taad	Arecaceae	Evergreen	E	NA
34	*Buchanania cochinchinensis* (Lour.) M.R.Almeida	Chironji Tree	Charoli	Anacardiaceae	Deciduous	N	NA
35	*Butea monosperma* (Lank.) Taub.	Flame of forest	Palas	Fabaceae	Deciduous	N	NA
36	*Callistemon citrinus* (Curtis)Skeels	Crimson bottlebrush	-	Myrtaceae	Evergreen	E	NA
37	*Callistemon lanceolatus*(Sm.)Sweet	Red bottle brush	-	Myrtaceae	Evergreen	E	NA
38	*Callistemon viminalis* (Sol. ex Gaertn.) G.Don	Weeping Bottle brush tree	-	Myrtaceae	Evergreen	E	NA
39	*Callistemon salignus* (Sm.) Colv. ex Sweet	White bottle brush	-	Myrtaceae	Evergreen	E	NA
40	*Capparis grandis* L.f.	Tree Caper	Pachunda	Capparidaceae	Perennial	N	NA
41	*Careya arborea* Roxb. i	Wild Guava	Kumbha	Lecythidaceae	Deciduous	N	NA
42	*Caryota urens* L.	Fish tail Palm	Bherli Mad	Arecaceae	Evergreen	N	NA
43	*Cascabela thevetia* (L.) Lippold.	Mexican oleander	Pivali Kanher	Apocynaceae	Evergreen	E	NA

SN	Scientific Name	Common name(English)	Local name(Marathi)	Family	Habitat	Origin	IUCN status
44	*Cassia fistula* L.	Golden shower tree	Bahava	Caesalpiniaceae	Deciduous	N	NA
45	*Cassia javanica* L.	Java Cassia	-	Caesalpiniaceae	Deciduous	E	NA
46	*Cassia siamea* lan	-	Kassod	Caesalpiniaceae	Evergreen	N	NA
47	*Cassine glauca* (Rottb.) Kuntze	Ceylon Tea	Bhutya	Celastraceae	Evergreen	N	NA
48	*Casuarina equisetifolia* forst.	Whistling Pine	Suru	Casuarinaceae	Perennial	E	NA
49	*Ceiba pentandra* (L.) Gaertn.	White Silk-Cotton Tree	Sawar	Malvaceae	Deciduous	E	NA
50	*Citrus aurantiifolia* (Christm.) Swingle	Sour Lime	Limbu	Rutaceae	Evergreen	N	NA
51	*Cochlospermum religiosum* (L.) Alston	Buttercup tree	Ganeri	Bixaceae	Deciduous	N	NA
52	*Cocus nucifera* L.	Coconut	Naral	Arecaceae	Evergreen	N	NA
53	*Cordia dichotoma* G.Forst.	Indian Cherry	Bhokar	Boraginaceae	Deciduous	N	NA
54	*Cordia sinensis* Lam.	-	Gondhan	Boraginaceae	Perennial	N	NA
55	*Cordia sebestena* L.	-	Scarlet Cordia	Boraginaceae	Evergreen	E	NA
56	*Crataeva nurvala* Buch.-Ham.	Caper tree	Varuna	Capparaceae	Deciduous	N	NA
57	*Crescentia cujete* L.	Calabash tree	Vadga	Bignoniaceae	Evergreen	E	NA
58	*Dalbergia latifolia* Roxb	Black rosewood	Shisam	Fabaceae	Deciduous	N	VU
59	*Dalbergia sisoo* Roxb.	Indian rosewood	Shisam	Fabaceae	Perennial	N	NA
60	*Dalbergia lanceolaria* var. *lanceolaria*	Takoli	Dandus	Fabaceae	Perennial	N	NA
61	*Dalbergia lanceolaria* var. *paniculata*	-	Phanshi	Fabaceae	Perennial	N	NA
62	*Delonix regia* (Hook.) Raf.	Flame tree	Gulmohar	Caesalpiniaceae	Evergreen	E	LC
63	*Desmodium oojeinense* (Roxb.) H.Ohashi	Sandan	Kalapalas	Fabaceae	Deciduous	N	NA
64	*Dichrostachys cinerea* (L.) Wight & Arn.	Sickle Bush	Kunali	Mimosaceae	Deciduous	N	LC
65	*Dillenia indica L.*	Elephant Apple	Karmal	Dilleniaceae	Deciduous	N	NA
66	*Diospyros malabarica* (Desr.) Kostel.	Indian persimmon	Temru	Ebenaceae	Evergreen	N	NA
67	*Drypetes roxburghii* (Wall.) Hurus.	Lucky bean tree	Putranjiva	Putranjivaceae	Evergreen	N	NA
68	*Erythrina variegata* L.	Indian Coral Tree	Pangara	Fabaceae	Deciduous	N	NA
69	*Eucalyptus globulus* Labill.	Southern blue-gum	Nilgiri	Myrtaceae	Evergreen	E	NA
70	*Euphorbia neriifolia* L.	Indian Spurge Tree	Nevagunda	Euphorbiaceae	Perennial	N	NA

SN	Scientific Name	Common name(English)	Local name(Marathi)	Family	Habitat	Origin	IUCN status
71	*Ficus amplissima* Sm.	Bat tree	Paypar	Moraceae	Evergreen	N	NA
72	*Ficus arnottiana* (Miq.) Miq.	Indian Rock Fig	Payar	Moraceae	Evergreen	N	NA
73	*Ficus benghalensis* L.	Banyan	Vad	Moraceae	Evergreen	N	NA
74	*Ficus benjamina* L.	Weeping Fig	Nandruk	Moraceae	Evergreen	N	NA
75	*Ficus elastica* Roxb. ex Hornem.	Indian Rubber tree	Rubberacho vad	Moraceae	Evergreen	N	NA
76	*Ficus exasperata* Vahl	Brahma's Banyan	Kharoti	Moraceae	Deciduous	N	NA
77	*Ficus hispida* L.f.	Hairy Fig	Kala Umber	Moraceae	Deciduous	N	NA
78	*Ficus krishnae* C.DC.	Krishna Fig	Krishnvad	Moraceae	Evergreen	N	NA
79	*Ficus microcarpa* L.f.	Laurel Fig	Nandruk	Moraceae	Evergreen	N	NA
80	*Ficus racemosa* L	Cluster Fig	Umber	Moraceae	Evergreen	N	NA
81	*Ficus religiosa* L.	Sacred Fig tree	Pimpal	Moraceae	Evergreen	N	NA
82	*Ficus tsiela* Roxb.	Soft Fig	Pimpran	Moraceae	Perennial	N	NA
83	*Ficus carica* L.	Common Fig	Anjir	Moraceae	Deciduous	N	NA
84	*Flacourtia indica* (Burm.f.)Merr	Governor's Plum	Bilangada	Saliaceae	Deciduous	N	NA
85	*Gliricidia sepium* (Jacq.) Kunth.ex.steud	Mexican Iiac	Saranga	Fabaceae	Deciduous	E	NA
86	*Gmelina arborea* Roxb	Gamhar	Sivan	Lamiaceae	Deciduous	N	NA
87	*Grevillea robusta* Cunn. ex R. Br.	Silver Oak	-	Proteaceae	Evergreen	E	NA
88	*Grewia asiatica* L.	Phalsa	Phalsi	Tiliaceae	Perennial	N	NA
89	*Grewia serrulata* DC.	Serrulate-Leaf Grewia	Dhamni	Tiliaceae	Evergreen	N	NA
90	*Grewia tiliifolia* Vahl	-	Dhaman	Malvaceae	Perennial	N	NA
91	*Haldina cordifolia* (Roxb.)Ridsdale	-	Haldu	Rubiaceae	Deciduous	N	NA
92	*Hardwickia binata* Roxb.	-	Anjan	Caesalpiniaceae	Deciduous	N	NA
93	*Helicteres isora* L.	East-Indian Screw Tree	Murud sheng	Malvaceae	Deciduous	N	NA
94	*Heterophragma quadriloculare* (Roxb.) K.Schum.	Waras	Waras	Bignoniaceae	Deciduous	N	NA
95	*Holarrhena pubescens* Wall. ex G.Don	Indrajao	Indrajav	Apocynaceae	Deciduous	N	NA
96	*Holoptelea integrifolia* Planch.	Jungle cork tree	Wavhal	Ulmaceae	Deciduous	N	NA

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97	*Jacaranda mimosifolia* D.Don	Blue Jacaranda	Neela gulmohar	Bignoniaceae	Deciduous	E	NA
98	*Khaya grandifoliola* C.DC	-	Mahogany	Meliaceae	Evergreen	E	NA
99	*Khaya senegalensis* (Desv.) A.Juss.	African Mahogany	Khaya	Meliaceae	Deciduous	E	NA
100	*Kigelia africana* (Lam.) Benth.	-	Sausage tree	Bignoniaceae	Deciduous	E	NA
101	*Lagerstroemia speciosa* (L.) Pers.	Queen Crape Myrtle	Tamhan	Lythraceae	Evergreen	N	NA
102	*Lannea coromandelica* (Houtt.)Merr.	Indian ash tree	Shemat	Anacardiaceae	Deciduous	N	NA
103	*Leucaena leucocephala* (Lam.) de Wit	Wild Tamrind	Subabhool	Mimosaceae	Evergreen	E	NA
104	*Limonia acidissima* Groff	Wood Apple	Kavath	Rutaceae	Deciduous	N	NA
105	*Madhuca longifolia* (J.Koenig ex L.) J.F.Macbr.	Indian butter tree	Mahua	Sapotaceae	Deciduous	N	NA
106	*Magnolia champaca* (L.) Baill. ex Pierre	Golden Champa	Pivala chafa	Magnoliaceae	Evergreen	N	NA
107	*Mangifera indica* L.	Mango	Amba	Anacardiaceae	Evergreen	N	DD
108	*Manilkara hexandra* (Roxb.) Dubard	Ceylon Iron Wood	Khirni	Sapotaceae	Evergreen	N	NA
109	*Manilkara zapota* (L.) P.Royen	Sapota	Chiku	Sapotaceae	Perennial	E	NA
110	*Markhamia lutea* (Benth.) K.Schum.	-	Markhamia	Bignoniaceae	Perennial	E	NA
111	*Melaleuca bracteata* F.Muell.	Golden bottle brush	-	Myrtaceae	Evergreen	E	NA
112	*Melia azedarach* L.	Chinaberry tree	BakNimb	Meliaceae	Evergreen	N	NA
113	*Melia dubia*Cav.	Malabar Neem	Mahanimb	Meliaceae	Deciduous	N	NA
114	*Memecylon umbellatum* Burm. f.	Ironwood Tree	Anjani	Melastomataceae	Perennial	N	NA
115	*Mesua ferrea* L.	Indian rose chestnut	Nagkesar	Calophyllaceae	Evergreen	N	NA
116	*Millingtonia hortensis* L.f.	Indian cork tree	Kaval nimb	Bignoniaceae	Deciduous	N	NA
117	*Mimusops elengi* L	Spanish cherry	Bakuli	Sapotaceae	Perennial	N	NA
118	*Mitragyna parvifolia* (Roxb.) Korth.	True Kadamb	Kalamb	Rubiaceae	Deciduous	N	NA
119	*Morinda citrifolia* L.	Indian Mulberry	Tuti	Rubiaceae	Perennial	E	NA
120	*Moringa oleifera* Lam	Drumstick Tree	Shevga	Moringaceae	Deciduous	N	NA
121	*Morus alba* L.	White Mulberrry	Tuti	Moraceae	Perennial	N	NA

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122	*Muntingia calabura* L.	Jamaica Cherry	Paanchara	Muntingiaceae	Evergreen	E	NA
123	*Murraya koenigii* (L.) Spreng	Curry leaf	Kadhipatta	Rutaceae	Evergreen	N	NA
124	*Murraya paniculata* (L.) Jack	Orange Jasmine	Kamini	Rutaceae	Evergreen	N	NA
125	*Neolamarckia cadamba* (Roxb.) Bosser	-	Kadamb	Rubiaceae	Perennial	N	NA
126	*Nyctanthes arbor-tristis* L.	Coral Jasmine	Parijatak	Oleaceae	Evergreen	N	NA
127	*Oroxylum indicum* (L.) Kurz	Broken Bones Tree	Tivas	Bignoniaceae	Deciduous	N	NA
128	*Parkia biglandulosa* Wight & Arn.	Badminton Ball tree	Chenduphul	Mimosaceae	Deciduous	E	NA
129	*Parkia biglobosa* (Jacq.) G.Don	African locust bean	Kalapalas	Mimosaceae	Deciduous	E	NA
130	*Peltophorum pterocarpum* (Dc.) Baker	Copperpod	Pivla gulmohar	Caesalpiniaceae	Evergreen	E	NA
131	*Phoenix canariensis* Chabaud	Canary date palm	-	Arecaceae	Evergreen	E	LC
132	*Phoenix sylvestris* (L.) Roxb.	Wild Date Palm	Shindi	Arecaceae	Evergreen	N	NA
133	*Phyllanthus acidus* (L.) Skeels	Star Gooseberry	Rai-awla	Phyllanthaceae	Deciduous	N	NA
134	*Phyllanthus emblica* L.	Indian gooseberry	Awala	Phyllanthaceae	Deciduous	N	NA
135	*Pithecellobium dulce* (Roxb.) Benth.	Madras Thorn	Vilayatichinch	Mimosaceae	Perennial	E	NA
136	*Platycladus orientalis* (L.) Franco	Oriental Arborvitae	Mayurpankhi	Cupressaceae	Perennial	E	NA
137	*Plumeria alba* L.	White Frangipani	Pandhara Chafa	Apocynaceae	Evergreen	E	NA
138	*Plumeria rubra* L.	Red Fragipani	Lal chapha	Apocynaceae	Deciduous	E	NA
139	*Polyalthia longifolia* (Sonner.) Thw.	False Ashok	Asupalav	Annonaceae	Evergreen	N	NA
140	*Pongamia pinnata* (L.) Pierre	Pongam tree	Karanj	Fabaceae	Deciduous	N	NA
141	*Populus nigra* L.	Black Poplar	-	Salicaceae	Deciduous	E	NA
142	*Prosopis cineraria* (L.) Druce	Khejari	Shami	Mimosaceae	Deciduous	N	NA
143	*Prosopis juliflora* (Sw.) DC.	Algaroba	Vedi-babhul	Mimosaceae	Deciduous	E	NA
144	*Psidium guajava* L.	Common guava	Peru	Myrtaceae	Evergreen	E	NA
145	*Pterocarpus santalinus* L.f.	Red sandalwood	Raktchanadan	Fabaceae	Deciduous	N	NT
146	*Pterocarpus marsupium* Roxb.	Indian Kino Tree	Bibla	Fabaceae	Deciduous	N	NA
147	*Pterospermum acerifolium* (L.) Willd.	Maple-leaved Bayur tree	Karnikar	Sterculiaceae	Perennial	N	NA

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148	*Pterygota alata* (Roxb.) R.Br.	Buddha Coconut	-	Malvaceae	Evergreen	N	NA
149	*Punica granatum* L.	Pomegranate	Dalimb	Lythraceae	Perennial	N	NA
150	*Putranjiva roxburghii* Wall.	-	Putranjiva	Putranjivaceae	Evergreen	N	NA
151	*Riccinus communis* L.	Castor bean	Erandi	Euphorbiaceae	Perennial	N	NA
152	*Roystonea regia* (H.B.&K)	Royal Palm	-	Arecaceae	Perennial	E	NA
153	*Salix tetrasperma* Roxb.	Indian willow	Valunj	Salicaceae	Deciduous	N	NA
154	*Santalum album* L.	Indian Sandalwood	Chandan	Santalaceae	Evergreen	N	VU
155	*Sapindus trifoliatus* L.	South India Soapnut	Rithi	Sapindaceae	Deciduous	N	NA
156	*Saraca indica* L.	Ashok	Sita Ashok	Caesalpiniaceae	Evergreen	N	VU
157	*Schefflera actinophylla* (Endl.) Harms	Queensland Umbrella tree	-	Araliaceae	Evergreen	E	NA
158	*Schrebera swietenioides* Roxb.	Weaver's Beam Tree	Murwa	Oleaceae	Deciduous	N	NA
159	*Semecarpus anacardium* L.f.	Marking Nut	Bibba	Anacardiaceae	Deciduous	N	NA
160	*Senegalia catechu* (L. f.) P.J.H. Hurter & Mabb.	Cutch tree	Khair	Mimosaceae	Deciduous	N	NA
161	*Senna siamea* (Lam.) H.S.Irwin & Barneby	Siamese Senna	Kassod	Fabaceae	Evergreen	N	NA
162	*Spathodea campanulata* beauv	African Tulip tree	Rugtoora	Bignoniaceae	Evergreen	E	NA
163	*Sterculia foetida* L.	Java Olive	Jungli Badam	Sterculiaceae	Evergreen	N	NA
164	*Sterculia urens* Roxb.	Gum karaya	Sardol	Sterculiaceae	Deciduous	N	NA
165	*Stereospermum chelonoides* (L.f.) DC.	Fragrant Padri Tree	Padal	Bignoniaceae	Deciduous	N	NA
166	*Swietenia macrophylla* King	Big leaf mahogany	-	Meliaceae	Deciduous	E	VU
167	*Swietenia mahagoni* (L.) Jacq.	-	Mahogany	Meliaceae	Evergreen	E	NA
168	*Syzigium cumuni* (L.) Skeels	Indian black berry	Jambhul	Myrtaceae	Evergreen	N	NA
169	*Syzygium jambos* (L.) Alston	Rose Apple	Jamb	Myrtaceae	Evergreen	N	NA
170	*Tabebuia argentea* Britt.	Pink trumpet tree	-	Bignoniaceae	Deciduous	E	NA
171	*Tabebuia aurea* (Silva Manso) Benth. & Hook.f. ex S.Moore	Caribbean Trumpet Tree	-	Bignoniaceae	Evergreen	E	NA

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172	*Tabebuia heterophylla* (DC.) Britton, 1915	Cuban Pink Trumpet Tree	-	Bignoniaceae	Deciduous	E	NA
173	*Tamarindus indica* L.	Tamarind	Chinch	Caesalpiniaceae	Deciduous	E	LC
174	*Tecoma stans* (L.) Juss. ex Kunth	Yellow bells	Ghanti ful	Bignoniaceae	Perennial	E	NA
175	*Tectona grandis* L.F.	Teak	Sag	Lamiaceae	Perennial	N	NA
176	*Terminalia alata* Roth	Indian Laurel	Ain	Combretaceae	Perennial	N	NA
177	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Arjun	Arjun	Combretaceae	Evergreen	N	NA
178	*Terminalia bellirica* (Gaertn.) Roxb.	Bedda nut tree	Behda	Combretaceae	Deciduous	N	NA
179	*Terminalia catappa* L.	Indian Almond	Jungli Badam	Combretaceae	Deciduous	N	NA
180	*Terminalia mantaly* H. Perrier	-	Madagascar almond	Combretaceae	Evergreen	E	NA
181	*Thespesia populnea* (L.)Sol. Ex Correa	Indian tulip tree	Paras Bhendi	Malvaceae	Evergreen	N	NA
182	*Wodyetia bifurcata* A.K.Irvine	Fox-tail palm	-	Arecaceae	Evergreen	N	NA
183	*Ziziphus jujuba* Mill.	Indian plum	Bordi	Rhamnaceae	Deciduous	N	LC
184	*Ziziphus mauritiana* Lam.	Indian Plum	Ber	Rhamnaceae	Deciduous	N	NA
Shrubs and Climbers							
185	*Abutilon indicum* (L.) Sweet	Indian Mallow	Petari	Malvaceae	Perennial	N	NA
186	*Argyreia nervosa* (Burm. f.) Bojer	Elephant Creeper	Gugguli	Convolvulaceae	Perennial	N	NA
187	*Asparagus racemosus* Willd.	Buttermilk root	Shatavari	Asparagaceae	Perennial	N	NA
188	*Bambusa arundinacea* (Retz.) Willd	Indian Thorny Bamboo	Maanga	Poaceae	Perennial	N	NA
189	*Bambusa vulgaris* Sch.	-	Bamboo	Poaceae	Perennial	N	NA
190	*Barleria prionitis* L.	Porcupine Flower	Pila piyabansa	Acanthaceae	Perennial	N	NA
191	*Bougainvillea spectabilis* Willd.	Great Bougainvillea	Boganvel	Nyctaginaceae	Perennial	E	NA
192	*Caesalpinia pulcherrima* (L.) Sw	Peacock flower	Sankasur	Caesalpiniaceae	Perennial	N	NA
193	*Calotropis gigantea* (L.) Dryand.	Crown flower	-	Apocynaceae	Evergreen	N	NA
194	*Calotropis procera* (Ait.)R. Br.	-	Mandara	Apocynaceae	Evergreen	N	NA
195	*Carissa carandas* L.	-	Karanda	Apocynaceae	Perennial	N	NA

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196	*Clitoria ternatea* L.	Butterfly Pea	Gokurna	Fabaceae	Perennial	E	NA
197	*Cocculus hirsutus* L.	Broom creeper	Vasanvel	Menispermaceae	Perennial	N	NA
198	*Cryptolepis dubia* (Burm.f.)M.R.Almeida	Wax Leaved Climber	-	Apocynaceae	Perennial	N	NA
199	*Cryptostegia grandiflora* Roxb. ex R.Br.	Rubber vine	Vilyati-Vakundi	Apocynaceae	Perennial	E	NA
200	*Dregea volubilis* (L.f.) Benth. ex Hook.f.	Sneeze Wort	Harandodi	Apocynaceae	Perennial	N	NA
201	*Euphorbia lactea* Haw.	Candelabra Spurge	-	Euphorbiaceae	Perennial	N	NA
202	*Euphorbia royleana* Boiss.	Danda Thor	Pivala Dudhi	Euphorbiaceae	Perennial	N	NA
203	*Euphorbia tirucalli* L.	Pencil tree	Sher-kandvel	Euphorbiaceae	Perennial	E	NA
204	*Gymnosporia senegalensis* (Lam.) Loes.	Red spike Thorn	Henkal	Celastraceae	Perennial	N	NA
205	*Hibiscus rosasinensis* L.	Chinese rose	Jaswand	Malvaceae	Perennial	N	NA
206	*Hygrophila auriculata* (Schumach.) Heine	Long leaved barleria	Marsh Barbel	Acanthaceae	Perennial	N	LC
207	*Indigofera cassioides* DC.	Cassia Indigo	Baroli	Fabaceae	Perennial	N	NA
208	*Ipomoea cairica* (L.)Sweet.	Hairy woodrose	-	Convolvulaceae	Perennial	N	NA
209	*Ipomoea carnea* Jacq.	Bush Morning Glory	Besharam	Convolvulaceae	Perennial	E	NA
210	*Ipomoea eriocarpa* R.Br.	Tiny morning glory	-	Convolvulaceae	Perennial	N	NA
211	*Ipomoea hederifolia* L.	Scarlet Morning Glory	Lal pungli	Convolvulaceae	Perennial	E	NA
212	*Ipomoea nil* (L.) Roth	Blue Morning Glory	Neelpushpi	Convolvulaceae	Annual	N	NA
213	*Ixora coccinea* L.	Ixora red	-	Rubiaceae	Perennial	N	NA
214	*Jacquemontia pentantha* (Jacq.) G. Don	Skyblue Clustervine	-	Convolvulaceae	Perennial	E	NA
215	*Justicia quinqueangularis* K.D.Koenig ex Roxb.	Water-willow	-	Acanthaceae	Evergreen	N	LC
216	*Lantana camara* L.	West Indian Lantana	Ghaneri	Verbinaceae	Perennial	E	NA
217	*Lawsonia inermis* L.	Henna	Mehendi	Lythraceae	Deciduous	N	NA
218	*Malachra capitata* (L.) L.	-	Brazil Jute	Malvaceae	Annual	E	NA
219	*Mimosa hamata* Willd.	Hooked Mimosa	Gulabi Babhul	Mimosaceae	Perennial	N	NA
220	*Nerium oleander* L.	Oleander	Kaner	Apocynaceae	Evergreen	N	NA
221	*Opuntia elatior* Mill.	Prickly Pear	Nivdung	Cactaceae	Perennial	E	NA

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222	*Parthenium hysterophorus* L.	Carrot Grass	Gajar Gavat	Asteraceae	Annual	E	NA
223	*Senna alata* (L.) Roxb	Candle bush	-	Caesalpiniaceae	Perennial	N	NA
224	*Senna alexandrina* Mill.	Sonamukhi	-	Caesalpiniaceae	Perennial	N	NA
225	*Senna auriculata* (L.) Roxb.	Tanner's Cassia	Tarwad	Caesalpiniaceae	Perennial	N	NA
226	*Senna sulfurea* (Collad.)	Sulphur Cassia	Motha Tarvad	Caesalpiniaceae	Perennial	N	NA
227	*Senna tora* (L.) Roxb.	Stinking Cassia	Takla	Caesalpiniaceae	Perennial	N	NA
228	*Thunbergia alata* Boj. Ex Sims.	Black eyed susan vine	-	Acanthaceae	Annual	E	NA
229	*Tinospora cordifolia* (Willd.) Miers	Indian Tinospora	Gulvel	Menispermaceae	Perennial	N	NA
230	*Tridax procumbens* (L.) L.	Tridax Daisy	Dagadipala	Asteraceae	Annual	E	NA
231	*Triumfetta rhomboidea* Jacq.	Burr Bush	Jhinjhardi	Malvaceae	Perennial	N	NA
232	*Vigna sublobata* (Roxb.) Babu and Sharma	Wild Mung bean	Ran-udid	Fabaceae	Annual	N	NA
233	*Ziziphus xylopyrus* (Retz.) Willd.	Jackal Jujube	Burgi	Rhamnaceae	Perennial	N	NA
234	*Ziziphus oenopolia* (L.) Mill.	Wild Jujube	Burgi	Rhamnaceae	Perennial	N	NA
Herbs							
235	*Acanthospermum hispidum* DC.	Bristly starbur	-	Asteraceae	Annual	N	NA
236	*Achyranthes aspera* L.	Pricky chaff flower	Aghada	Amaranthaceae	Perennial	N	NA
237	*Acmella paniculata* (Wall. ex DC.) R.K.Jansen	Panicled Spot Flower	-	Asteraceae	Annual	N	LC
238	*Aeschynomene indica* L.	Indian Joint Vetch	Nalabi	Fabaceae	Perennial	E	NA
239	*Agave americana* L.	Century plant	Kamal cactus	Asparagaceae	Perennial	E	NA
240	*Ageratum conyzoides* (L.) L	Goat weed	Ghanera osaadi	Asteraceae	Annual	E	NA
241	*Aloe vera* (L.) Burm.f.	Burn plant	Korphad	Asphodelaceae	Perennial	E	NA
242	*Alternanthera bettzickiana* (Regel) G.Nicholson	Calico Plant	-	Amaranthaceae	Perennial	E	NA
243	*Alternanthera paronychioides* A.St.-Hil.	Smooth chaff flower	-	Amaranthaceae	Perennial	E	NA
244	*Alternanthera philoxeroides* (Mart.) Griseb.	Alligator Weed	-	Amaranthaceae	Perennial	E	NA
245	*Alternanthera pungens* Kunth	Khaki Weed	Chibuk Kata	Amaranthaceae	Perennial	E	NA
246	*Alternanthera sessilis* (L.) R.Br. ex DC.	Sessile Joyweed	Kanchari	Amaranthaceae	Perennial	N	LC

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247	*Alysicarpus longifolius* (Spreng.) Wigt & Arn.	Jangali gailia	Shevra	Fabaceae	Annual	N	NA
248	*Alysicarpus pubescens* J. S. Law	Bicolor Alyce Clover	Durangi shevra	Fabaceae	Annual	N	NA
249	*Alysicarpus tetragonolobus* Edgew.	Red Alyce Clover	Lal Shevra	Fabaceae	Annual	N	NA
250	*Amaranthus roxburghianus* H.W.Kung	Amaro	-	Amaranthaceae	Annual	N	NA
251	*Amaranthus spinosus* L.	Pricky amaranth	Katemath	Amaranthaceae	Annual	N	NA
252	*Amaranthus tricolor* L.	Edible amaranth	Chavalaayi	Amaranthaceae	Annual	N	NA
253	*Amaranthus viridis* L.	Pigweed	Math	Amaranthaceae	Annual	N	NA
254	*Ammannia baccifera* L.	Blistering Ammannia	Bhar Jambhal	Lythraceae	Annual	N	NA
255	*Ammannia multiflora* Roxb.	Many Flowered Ammannia	-	Lythraceae	Perennial	N	NA
256	*Apluda mutica* L.	Mauritian Grass	Bhongla	Poaceae	Perennial	N	NA
257	*Argemone mexicana* L.	Mexican Prickly Poppy	Firangi dhotra	Papaveraceae	Annual	E	NA
258	*Bacopa monnieri* (L.) Pennell	Indian pennywort	Bhrami	Plantaginaceae	Perennial	N	NA
259	*Bergia ammannioides* Roxb.	Ammannia Waterwort	-	Elatinaceae	Annual	N	NA
260	*Bidens bipinnata* L.	Spanish needles	-	Asteraceae	Annual	E	NA
261	*Bidens biternata* (Lour.) Merr. & Sherff	Yellow Flowered Blackjack	-	Asteraceae	Annual	N	NA
262	*Blumea lacera* (Burm.f.) DC.	-	Bhamurda	Asteraceae	Annual	N	NA
263	*Boerhavia repens* L	Spiderlings	Punarnava	Nyctaginaceae	Perennial	N	NA
264	*Brassica juncea* (L.) Czern. & Coss	Indian mustard	Rai	Brassicaceae	Annual	N	NA
265	*Buchnera hispida* Buch.-Ham. ex D.Don	Hairy Buchnera	Karanji	Orobanchaceae	Annual	N	NA
266	*Caesulia axillaris* Roxb.	Pink Node Flower	Maka	Asteraceae	Annual	N	NA
267	*Canscora diffusa* (Vahl) R.Br. ex Roem. & Schult	Kilwar	Kilwar	Gentianaceae	Annual	N	NA
268	*Caralluma adscendens* var. *fimbriata* (Wall.) Gravely & Mayur.	Caralluma	Makadshing	Apocynaceae	Perennial	N	NA
269	*Catharanthus roseus* (L.) G.Don	Rosy periwinkle	Sadafuli	Apocynaceae	Evergreen	E	NA
270	*Celosia argentea* L.	Cockscomb plumed	Kurdu	Amaranthaceae	Annual	N	NA

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271	*Celosia spicata* Spreng.	Silver cockscomb	-	Amaranthaceae	Annual	E	NA
272	*Centaurium pulchellum* (Sw.) Druce	Pink Centaury	Luntak	Gentianaceae	Annual	N	LC
273	*Chloris barbata* Sw.	Swollen fingergrass	-	Poaceae	Annual	N	NA
274	*Chloris virgata* Sw.	Swollen Finger Grass	Gondvel	Poaceae	Annual	N	NA
275	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Siam Weed	Ran-mari	Asteraceae	Perennial	E	NA
276	*Chrozophora rottleri* (Geiseler) A.Juss. ex Spreng	Suryavarti	Survarli	Euphorbiaceae	Perennial	N	NA
277	*Cleome felina* L.f	Cat Spider Flower	-	Cleomaceae	Perennial	N	NA
278	*Cleome viscosa* L.	Asian spiderflower	-	Cleomaceae	Annual	N	NA
279	*Clinopodium capitellatum* (Benth.) Kuntze	Calamint	-	Lamiaceae	Perennial	N	LC
280	*Coix lacryma-jobi* L	Job's Tears	Ran-maka	Poaceae	Annual	N	NA
281	*Colocasia esculenta* (L.) Schott	Taro	Aaloo	Araceae	Perennial	N	LC
282	*Commelina benghalensis* L.	Bengal Dayflower	Kena	Commelinaceae	Annual	N	NA
283	*Commelina caroliniana* Walter	Carolina Dayflower	-	Commelinaceae	Annual	N	LC
284	*Commelina forskaolii* Vahl	Taro	Kanpet	Commelinaceae	Annual	N	NA
285	*Corchorus capsularis* L.	White jute	Chonche	Tiliaceae	Annual	N	NA
286	*Corchorus fascicularis* Lam.	-	-	Tiliaceae	Annual	N	NA
287	*Corchorus olitorius* L.	Nalta Jute	Banpat	Tiliaceae	Annual	N	NA
288	*Cosmos bipinnatus* Cav.	Mexican aster	-	Asteraceae	Annual	E	NA
289	*Crinum asiaticum* L.	Spider lily	-	Amarylidaceae	Perennial	N	NA
290	*Crotalaria hebecarpa* (DC.) Rudd	Fuzzy Fruited Rattlepod	Godhadi	Fabaceae	Annual	N	NA
291	*Cryptostegia grandiflora* Roxb. ex R.Br.	Rubber vine	-	Apocynaceae	Perennial	E	NA
292	*Curculigo orchioides* Gaertn.	Golden Eye Grass	Kali-musali	Hypoxidaceae	Perennial	N	NA
293	*Cyanotis fasciculata* (B.Heyne ex Roth) Schult	Nilvanti	-	Commelinaceae	Annual	N	LC
294	*Cyanthillium cinereum* (L.) H.Rob.	Little ironweed	Sahadevi	Asteraceae	Annual	N	NA
295	*Cymbopogon martini* (Roxb.) W.Watson	Rosha grass	Rohis	Poaceae	Perennial	N	NA
296	*Cynodon dactylon* (L.) Pers.	Bermuda Grass	Durva	Poaceae	Perennial	N	NA

SN	Scientific Name	Common name(English)	Local name(Marathi)	Family	Habitat	Origin	IUCN status
297	*Cyperus alopecuroides* Rottb.	Foxtail Sedge	-	Cyperaceae	Perennial	E	LC
298	*Cyperus compressus* L.	Poorland Flat Sedge	Emend	Cyperaceae	Annual	N	LC
299	*Cyperus difformis* L	Variable Flatsedge	-	Cyperaceae	Annual	E	LC
300	*Cyperus iria* L.	Rice Flat Sedge	-	Cyperaceae	Annual	N	LC
301	*Cyperus nutans* Vahl i	-	-	Cyperaceae	Perennial	N	LC
302	*Cyperus pangorei* Rottb	Pangorai	-	Cyperaceae	Perennial	N	LC
303	*Cyperus rotundus* retzii Kük.	Common Nut Sedge	Barik Motha	Cyperaceae	Perennial	N	LC
304	*Cyperus alulatus* J.Kern,	-	-	Cyperaceae	Annual	N	LC
305	*Cyperus digitatus* Roxb.	Finger Flatsedge	-	Cyperaceae	Perennial	N	LC
306	*Cyperus squarrosus* L.	Bearded Flatsedge	-	Cyperaceae	Annual	N	LC
307	*Dactyloctenium aegyptium* (L.) Willd.	Crowfoot Grass	-	Poaceae	Annual	E	NA
308	*Datura innoxia* Mill.	-	Dhotra	Solanaceae	Perennial	E	NA
309	*Datura metel* L.	Devil's Trumpet	Datura	Solanaceae	Perennial	N	NA
310	*Dendrocalamus strictus* Roxb.	Calcutta Bamboo	-	Poaceae	Perennial	N	NA
311	*Dichanthium annulatum* (Forssk.) Stapf	Sheda Grass	Marvel	Poaceae	Perennial	N	NA
312	*Dicliptera cuneata* Nees	Wedge-Leaf Foldwing	-	Acanthaceae	Perennial	N	NA
313	*Dicliptera paniculata (*Forssk.*)* I.Darbysh.	Panicled Foldwing	Kali anghedi	Acanthaceae	Perennial	N	NA
314	*Digitaria ciliaris* (Retz.) Koeler	Wild Crabgrass	-	Poaceae	Annual	N	NA
315	*Dinebra retroflexa* (Vahl) Panz.	Viper grass	-	Poaceae	Annual	E	NA
316	*Diplocyclos palmatus* (L.)C. Jeffrey	Lollipop climber	Kauroli	Cucurbitaceae	Annual	N	NA
317	*Echinochloa colona* (L.) Link	Jungle grass	Jiria	Poaceae	Annual	N	LC
318	*Echinops echinatus* Roxb.	Indian Globe Thistle	Utkatar	Asteraceae	Perennial	N	NA
319	*Eclipta prostrata* (L.) L.	False Daisy	Bhringaraj	Poaceae	Annual	N	LC
320	*Eichhornia crassipes* (Mart.) Solms	Common water hyacinth	Jalkumbhi	Pontederiaceae	Perennial	E	NA
321	*Eleocharis acutangula* (Roxb.) Schult.	-	-	Cyperaceae	Perennial	N	NA

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322	*Eleocharis atropurpurea* (Retz.) J.Presl & C.Presl	-	-	Cyperaceae	Annual	N	LC
323	*Eleocharis geniculata* (L.) Roem. & Schult.	-	-	Cyperaceae	Annual	N	LC
324	*Eleusine indica* (L.) Gaertn.	Indian Crowfoot Grass	Rannachani	Poaceae	Annual	N	LC
325	*Emilia sonchifolia* (L.) DC. ex DC.	Purple Sow Thistle	Dhamapan	Asteraceae	Annual	N	NA
326	*Enicostema axillare* (Poir. ex Lam.) A.Raynal	Indian Whitehead	Chota-karait	Gentianaceae	Perennial	N	NA
327	*Eragrostis gangetica* (Roxb.) Steud.	-	-	Poaceae	Annual	E	NA
328	*Eragrostis unioloides* (Retz.) Nees ex Steud.	Chinese lovegrass	Seete-che-pohe	Poaceae	Annual	N	LC
329	*Erigeron sublyratus* Roxb. ex DC.	-	-	Asteraceae	Annual	N	NA
330	*Euphorbia fusiformis* Buch.-Ham. ex D.Don	Asthma Weed	Khir-kand	Euphorbiaceae	Annual	N	NA
331	*Euphorbia heterophylla* L.	-	Wild spurge	Euphorbiaceae	Annual	E	NA
332	*Euphorbia hirta* L.	Asthma Weed	Dudhi	Euphorbiaceae	Annual	N	NA
333	*Euphorbia notoptera* Boiss.	Winged Seed Spurge	-	Euphorbiaceae	Annual	N	NA
334	*Euphorbia thymifolia* L.	Close up of the flowers	Lahan Dudhi	Euphorbiaceae	Annual	E	NA
335	*Euphorbia heterophylla* L	Wild Poinsettia	-	Euphorbiaceae	Annual	E	NA
336	*Evolvulus alsinoides* (L.) L.	Dwarf Morning Glory	Vishnukranta	Convolvulaceae	Perennial	E	NA
337	*Exacum pedunculatum* L	Stalked Persian Violet	-	Gentianaceae	Annual	N	NA
338	*Fimbristylis ferruginea* (L.) Vahl	-	-	Cyperaceae	Perennial	N	LC
339	*Fimbristylis ovata* (Burm.f.) J.Kern	Flat spike sedge	-	Cyperaceae	Perennial	E	LC
340	*Fimbristylis tetragona R.Br*	-	-	Cyperaceae	Annual	N	LC
341	*Fuirena cuspidata* (Roth) Kunth	-	-	Cyperaceae	Perennial	N	NA
342	*Fumaria indica* (Hausskn.) Pugsley	Indian Fumitory	Papara	Papaveraceae	Annual	N	NA
343	*Glinus lotoides* L.	Lotus sweetjuice	Kotak	Molluginaceae	Annual	N	NA
344	*Gomphrena serrata* L.	Prostrate Gomphrena	-	Amaranthaceae	Perennial	E	NA
345	*Grangea maderaspatana* (L.) Poir.	Madras Carpet	Mashipatri	Asteraceae	Annual	N	LC
346	*Heliotropium indicum* L.	Indian turnsole	Bhurundi	Boraginaceae	Annual	N	NA

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347	*Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.	Black Speargrass	Surwal	Poaceae	Perennial	N	NA
348	*Hibiscus hirtus* L.	Lesser Mallow	Dupari	Malvaceae	Perennial	N	NA
349	*Hoppea dichotoma* Willd.	Indian Hoppea	-	Gentianaceae	Annual	N	LC
350	*Hydrilla verticillata* (L.f.) Royle	Waterthyme	-	Hydrocharitaceae	Perennial	N	LC
351	*Hygrophila schulli* (Buch.-Ham.) M.R.Almeida & S.M. Almeida	Gokulakanta	Talimkhana	Acanthaceae	Perennial	N	LC
352	*Hyptis suaveolens* (L.) Poit.	American Mint	Jungli tulas	Lamiaceae	Annual	E	NA
353	*Indigofera linnaei* Ali	Birdsville Indigo	Bhingule	Fabaceae	Perennial	N	NA
354	*Ipomoea aquatica* Forssk.	Water Morning Glory	Nalichi-bhaji	Convolvulaceae	Perennial	N	LC
355	*Justicia adhatoda* L.	Malabar Nit	Adhulsa	Acanthaceae	Evergreen	N	NA
356	*Kyllinga brevifolia* Rottb.	Shortleaf spikesedge	-	Cyperaceae	Perennial	E	LC
357	*Lagascea mollis* Cav.	Silk leaf	Tharvad	Asteraceae	Annual	E	NA
358	*Launaea procumbens* (Roxb.) Ramayya & Rajagopal	Creeping Launaea	Pathari	Asteraceae	Perennial	N	NA
359	*Lavandula bipinnata* (Roth) Kuntze	Feather-leaved Lavender	Ghodegui	Lamiaceae	Perennial	N	NA
360	*Lemna perpusilla* Torr.	Common duck weed	-	Araceae	Perennial	E	LC
361	*Lemna gibba* L.	Fat Duckweed	-	Lemnaceae	Perennial	E	LC
362	*Lepidagathis cristata* Willd.	Crested Lepidagathis	Bhui Gend	Acanthaceae	Perennial	N	NA
363	*Leucas aspera* (Willd.) Link	Common Leucas	Tamba	Lamiaceae	Annual	N	NA
364	*Limnophila indica* (L.) Druce	Indian Marshweed	Ambuli	Plantaginaceae	Perennial	N	LC
365	*Lobelia alsinoides* Lam.	Chickweed Lobelia	-	Campanulaceae	Annual	N	LC
366	*Ludwigia octovalvis* (Jacq.) P.H.Raven	Willow Primrose	Pan lavang	Onagraceae	Perennial	N	LC
367	*Malachra capitata* (L.) L.	Brazil Jute	-	Malvaceae	Annual	E	NA
368	*Malvastrum coromandelianum* (L.) Garcke	False Mallow	-	Malvaceae	Annual	N	NA
369	*Melanocenchris jacquemontii* Jaub. & Spach	-	-	Poaceae	Annual	N	NA
370	*Monsonia senegalensis* Guill. & Perr.	Pink Monsonia	Varsharani	Geraniaceae	Annual	N	NA

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371	*Najas indica* (Willd.) Cham.	Guppy Grass	-	Hydrocharitaceae	Annual	N	LC
372	*Nymphoides hydrophylla* (Lour.) Kuntze	Crested Floatingheart	Kumudini	Menyanthaceae	Annual	N	LC
373	*Ottelia alismoides* (L.) Pers.	Duck Lettuce	Olek-alsem	Hydrocharitaceae	Perennial	N	LC
374	*Oxalis corniculata* L.	Creeping Wood Sorrel	Amrul	Oxalidaceae	Perennial	E	LC
375	*Panicum repens* L.	Creeping panic	-	Poaceae	Perennial	N	LC
376	*Parthenium hysterophorus* L.	Carrot grass	Gajargavat	Asteraceae	Annual	E	NA
377	*Paspalidium flavidum* (Retz.) A.Camus	Yellow Watercrown Grass	-	Poaceae	Perennial	N	LC
378	*Persicaria glabra* (Willd.) M.Gómez	Denseflower Knotweed	Sheral	Polygonaceae	Annual	N	LC
379	*Phyla nodiflora* (L.) Greene	Frog fruit	Jalapimpali	Verbenaceae	Perennial	N	LC
380	*Physalis minima* L.	Ground Cherry	Ran-popti	Solanaceae	Perennial	N	LC
381	*Pistia stratiotes* L.	Water Lettuce	Gondala	Araceae	Perennial	N	LC
382	*Polygala arvensis* Willd.	Field Milkwort	Sanjivani	Polygalaceae	Annual	N	NA
383	*Portulaca oleracea* L.	Common Purselane	Purslane	Portulacaceae	Annual	N	NA
384	*Pulicaria wightiana* (DC.) C.B.Clarke	-	Sontikli	Asteraceae	Annual	N	NA
385	*Saccharum spontaneum* L.	Kans grass	Kamis	Poaceae	Perennial	N	LC
386	*Sansevieria trifasciata* Prain	Snake plant	-	Asparagaceae	Perennial	E	NA
387	*Senna uniflora*(Mill.) H.S.Irwin & Barneby	Oneleaf Senna	-	Caesalpiniaceae	Annual	E	NA
388	*Senna tora* (L.) Roxb.	Stinking Cassia	Takla	Caesalpiniaceae	Perennial	N	NA
389	*Sesamum indicum* L.	Sesame	White Til	Pedaliaceae	Annual	N	NA
390	*Setaria viridis* (L.) P.Beauv.	Green Foxtail	-	Poaceae	Annual	N	NA
391	*Sida rhombifolia* L.	Cuban jute	Sadeda	Malvaceae	Annual	N	NA
392	*Sida acuta* Burm.f.	Common Wireweed	Chikana	Malvaceae	Perennial	N	NA
393	*Sida cordata* (Burm.f.) Borss.Waalk.	Long-stalk Sida	Bhumi Petari	Malvaceae	Perennial	N	NA
394	*Solanum virginianum* L.	Thorny nightshade	Kateringani	Solanaceae	Perennial	N	NA
395	*Sonchus asper* (L.) Hill	Prickly Sow-Thistle	Mhatara	Asteraceae	Annual	N	NA
396	*Sonchus oleraceus* (L.) L.	Hare's-lettuce	-	Asteraceae	Annual	N	NA

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397	*Sopubia delphinifolia* G.Don	Common Sopubia	Dudhali	Scrophulariaceae	Annual	N	NA
398	*Spermacoce pusilla* Wall.	Tiny False Buttonweed	Tarakadal	Rubiaceae	Annual	N	NA
399	*Sphaeranthus indicus* L.	East Indian Globe Thistle	-	Asteraceae	Annual	N	LC
400	*Striga densiflora* (Benth.) Benth.	Denseflower Witchweed	Agya	Orobanchaceae	Annual	N	NA
401	*Striga gesneroides var. gesneroides*	Purple Witchweed	Bambaku	Orobanchaceae	Annual	N	NA
402	*Synedrella nodiflora* (L.) Gaertn.	Cinderella Weed	-	Asteraceae	Annual	E	NA
403	*Tagetes erecta* L.	Mexican marigold	-	Asteraceae	Annual	E	NA
404	*Thelepogon elegans* Roth	-		Poaceae	Annual	N	NA
405	*Trichodesma indicum* (L.) Lehm.	Indian Borage	Chota Kalpa	Boraginaceae	Annual	N	NA
406	*Tricholepis amplexicaulis* C.B.Clarke	-	Dahan	Asteraceae	Annual	N	NA
407	*Tridax procumbens* (L.) L.	Tridax Daisy	Dagadi pala	Asteraceae	Annual	E	NA
408	*Typha angustifolia* L.	Lesser Indian Reed Mace,	Pan-kanis	Typhaceae	Perennial	N	LC
409	*Urena lobata* L.	Caesarweed	Vanbhendi	Malvaceae	Perennial	E	NA
410	*Vallisneria spiralis* L.	Tape grass	Jallil	Hydrocharitaceae	Perennial	N	LC
411	*Verbascum thapsus* L.	Chinese Mullein	Kutki	Scrophulariaceae	Annual	N	NA
412	*Vigna trilobata* (L.) Verdc	Wild Gram	Mungan	Fabaceae	Annual	N	NA
413	*Withania somnifera* (L.) Dunal	Indian ginseng	Ashwagandha	Solanaceae	Perennial	N	NA
414	*Wolffia arrhiza* (L.) Horkel ex Wimm.	Rootless duckweed	-	Araceae	Annual	N	LC
415	*Xanthium strumarium* L.	Common Cocklebur	Landga	Asteraceae	Annual	N	NA
416	*Zornia diphylla* (L.) Pers.	Two-Leaf Zornia	-	Fabaceae	Annual	N	NA

LC- LEAST CONCERN,VU-VULNERABLE,NT-NEAR THREATNED, NA- NOT ASSESSED, DD-DATA DEFICIENT, E-EXOTIC, N-NATIVE
(Source: Primary Survey, Data from Garden Department PCMC and Data from interaction with Dr. Pravin Cholke)

3. List of Birds in PCMC

SN	Common Name	Scientific Name	Family	IUCN status	WPA Status	CITES
1	Ashy Prinia	*Prinia socialis*	Cisticolidae	LC	-	-
2	Ashy-crowned Sparrow-lark	*Eremopterix griseus*	Alaudidae	LC	IV	-
3	Asian Brown Flycatcher	*Muscicapa dauurica*	Muscicapidae	LC	IV	-
4	Asian Koel	*Eudynamys scolopaceus*	Cuculidae	LC	-	-
5	Asian Openbill	*Anastomus oscitans*	Ciconiidae	LC	-	-
6	Barn Owl	*Tyto alba*	Tytonidae	LC	IV	II
7	Barn Swallow	*Hirundo rustica*	Hirundinidae	LC	-	-
8	Baya Weaver	*Ploceus philippinus*	Ploceidae	LC	IV	-
9	Black Drongo	*Dicrurus macrocercus*	Dicruridae	LC	IV	-
10	Black Kite	*Milvus migrans*	Accipitridae	LC	-	II
11	Black Redstart	*Phoenicurus ochruros*	Muscicapidae	LC	-	-
12	Black-crowned Night Heron	*Nycticorax nycticorax*	Ardeidae	LC	IV	-
13	Black-headed Ibis	*Threskiornis melanocephalus*	Threskiornithidae	NT	IV	-
14	Black-winged Kite	*Elanus caeruleus*	Accipitridae	LC	-	II
15	Black-winged Stilt	*Himantopus himantopus*	Recurvirostridae	LC	IV	-
16	Blue Rock Pigeon	*Columba livia*	Columbidae	LC	-	-
17	Blue Rock-Thrush	*Monticola solitarius*	Muscicapidae	LC	-	-
18	Blyth's Reed Warbler	*Acrocephalus dumetorum*	Acrocephalidae	LC	-	-
19	Booted Eagle	*Hieraaetus pennatus*	Accipitridae	LC	-	II
20	Booted Warbler	*Iduna caligata*	Acrocephalidae	LC	-	-
21	Brahminy Kite	*Haliastur indus*	Accipitridae	LC	-	-
22	Brahminy Starling	*Sturnia pagodarum*	Sturnidae	LC	IV	-
23	Cattle Egret	*Bubulcus ibis*	Ardeidae	LC	IV	-
24	Cinereous Tit	*Parus cinereus*	Paridae	-	IV	-
25	Citrine Wagtail	*Motacilla citreola*	Motacillidae	LC	-	-
26	Combed Duck	*Sarkidiornis melanotos*	Anatidae	LC	IV	II

SN	Common Name	Scientific Name	Family	IUCN status	WPA Status	CITES
27	Common Coot	*Fulica atra*	Rallidae	LC	IV	-
28	Common Hoopoe	*Upupa epops*	Upupidae	LC	-	-
29	Common Iora	*Aegithina tiphia*	Aegithinidae	LC	IV	-
30	Common Kestrel	*Falco tinnunculus*	Falconidae	LC	IV	II
31	Common Kingfisher	*Alcedo atthis*	Alcedinidae	LC	IV	-
32	Common Moorhen	*Gallinula chloropus*	Rallidae	LC	-	-
33	Common Myna	*Acridotheres tristis*	Sturnidae	LC	IV	-
34	Common Sandpiper	*Actitis hypoleucos*	Scolopacidae	LC	IV	-
35	Common Stonechat	*Saxicola torquatus*	Muscicapidae	LC	-	-
36	Common Tailorbird	*Orthotomus sutorius*	Sylviidae	LC	-	-
37	Common Teal	*Anas crecca*	Anatidae	LC	IV	-
38	Coppersmith Barbet	*Psilopogon haemacephalus*	Megalaimidae	LC	IV	-
39	Dusky Crag-Martin	*Ptyonoprogne concolor*	Hirundinidae	LC	-	-
40	Eurasian Hobby	*Falco subbuteo*	Falconidae	LC	IV	II
41	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	LC	-	II
42	Gadwall	*Mareca strepera*	Anatidae	LC	IV	-
43	Garganey	*Spatula querquedula*	Anatidae	LC	IV	-
44	Glossy Ibis	*Plegadis falcinellus*	Threskiornithidae	LC	IV	-
45	Gray Francolin	*Francolinus pondicerianus*	Phasianidae	LC	-	-
46	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	LC	IV	-
47	Great Egret	*Ardea alba*	Ardeidae	LC	IV	-
48	Greater Coucal	*Centropus sinensis*	Cuculidae	LC	-	-
49	Green Bee-eater	*Merops orientalis*	Meropidae	LC	-	-
50	Green Sandpiper	*Tringa ochropus*	Scolopacidae	LC	IV	-
51	Grey Heron	*Ardea cinerea*	Ardeidae	LC	IV	-
52	Grey Wagtail	*Motacilla cinerea*	Motacillidae	LC	-	-
53	House Crow	*Corvus splendens*	Corvidae	LC	V	-
54	House Sparrow	*Passer domesticus*	Passeridae	LC	-	-

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55	Indian Bushlark	*Mirafra erythroptera*	Alaudidae	LC	IV	-
56	Indian Cormorant	*Phalacrocorax fuscicollis*	Phalacrocoracidae	LC	IV	-
57	Indian Golden Oriole	*Oriolus kundoo*	Oriolidae	LC	IV	-
58	Indian Grey Hornbill	*Ocyceros birostris*	Bucerotidae	LC	-	-
59	Indian Nightjar	*Caprimulgus asiaticus*	Caprimulgidae	LC	IV	-
60	Indian Paradise Flycatcher	*Terpsiphone paradisi*	Monarchidae	LC	-	-
61	Indian Peafowl	*Pavo cristatus*	Phasianidae	LC	I	III
62	Indian Pond Heron	*Ardeola grayii*	Ardeidae	LC	-	-
63	Indian Robin	*Saxicoloides fulicatus*	Motacillidae	LC	-	-
64	Indian Roller	*Coracias benghalensis*	Coraciidae	LC	IV	-
65	Indian Silverbill	*Euodice malabarica*	Estrildidae	LC	-	-
66	Intermediate Egret	*Ardea intermedia*	Ardeidae	LC	IV	-
67	Jungle Bush-Quail	*Perdicula asiatica*	Phasianidae	LC	IV	-
68	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC	IV	-
69	Large Grey Babbler	*Turdoides malcolmi*	Leiothrichidae	LC	IV	-
70	Large-billed Crow (Jungle Crow)	*Corvus macrorhynchos*	Corvidae	LC	-	-
71	Laughing Dove	*Spilopelia senegalensis*	Columbidae	LC	IV	-
72	Lesser Whistling Duck	*Dendrocygna javanica*	Anatidae	LC	IV	-
73	Little Cormorant	*Microcarbo niger*	Phalacrocoracidae	LC	IV	-
74	Little Egret	*Egretta garzetta*	Ardeidae	LC	-	-
75	Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	LC	IV	-
76	Long-legged Buzzard	*Buteo rufinus*	Accipitridae	LC	-	II
77	Long-Tailed Shrike	*Lanius schach*	Laniidae	LC	-	-
78	Northern Pintail	*Anas acuta*	Anatidae	LC	IV	-
79	Northern Shoveler	*Spatula clypeata*	Anatidae	LC	IV	-
80	Oriental Honey Buzzard	*Pernis ptilorhynchus*	Accipitridae	LC	-	II
81	Oriental Magpie-robin	*Copsychus saularis*	Muscicapidae	LC	-	-
82	Oriental Whiteeye	*Zosterops palpebrosus*	Zosteropidae	LC	-	-

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83	Osprey	*Pandion haliaetus*	Pandionidae	LC	I	II
84	Paddyfield Pipit	*Anthus rufulus*	Motacillidae	LC	-	-
85	Painted Stork	*Mycteria leucocephala*	Ciconiidae	NT	IV	-
86	Peregrine Falcon	*Falco peregrinus*	Falconidae	LC	I	I
87	Pied Bushchat	*Saxicola caprata*	Muscicapidae	LC	-	-
88	Pied Kingfisher	*Ceryle rudis*	Alcedinidae	LC	IV	-
89	Plain Prinia	*Prinia inornata*	Cisticolidae	LC	-	-
90	Purple heron	*Ardea purpurea*	Ardeidae	LC	-	-
91	Purple Moorhen	*Porphyrio porphyrio*	Rallidae	LC	-	-
92	Purple Sunbird	*Cinnyris asiaticus*	Nectariniidae	LC	IV	-
93	Purple-rumped Sunbird	*Nectarinia zeylonica*	Nectariniidae	LC	IV	-
94	Red Avadavat	*Amandava amandava*	Estrildidae	LC	-	-
95	Red-breasted Flycatcher	*Ficedula parva*	Muscicapidae	LC	IV	-
96	Red-naped Ibis	*Pseudibis papillosa*	Threskiornithidae	LC	IV	-
97	Red-vented Bulbul	*Pycnonotus cafer*	Pycnonotidae	LC	-	-
98	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	LC	-	-
99	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	LC	IV	-
100	River Tern	*Sterna aurantia*	Laridae	NT	-	-
101	Rock Bush-quail	*Perdicula argoondah*	Phasianidae	LC	IV	-
102	Rose-ringed Parakeet	*Psittacula krameri*	Psittacidae	LC	IV	NC
103	Rosy starling	*Pastor roseus*	Sturnidae	LC	IV	-
104	Ruddy shelduck	*Tadorna ferruginea*	Anatidae	LC	IV	-
105	Rufous Treepie	*Dendrocitta vagabunda*	Corvidae	LC	-	-
106	Rufous-tailed Lark	*Ammomanes phoenicura*	Alaudidae	LC	IV	-
107	Scaly-breasted Munia	*Lonchura punctulata*	Estrildidae	LC	IV	-
108	Shikra	*Accipiter badius*	Accipitridae	LC	-	II
109	Short-toed Snake Eagle	*Circaetus gallicus*	Accipitridae	LC	-	II
110	Small Minivet	*Pericrocotus cinnamomeus*	Campephagidae	LC	IV	-

SN	Common Name	Scientific Name	Family	IUCN status	WPA Status	CITES
111	Spot-billed Duck	*Anas poecilorhyncha*	Anatidae	LC	IV	-
112	Spotted Owlet	*Athene brama*	Strigidae	LC	-	II
113	Striolated Bunting	*Emberiza striolata*	Emberizidae	LC	IV	-
114	Syke's Lark	*Galerida deva*	Alaudidae	LC	IV	-
115	Taiga Flycatcher	*Ficedula albicilla*	Muscicapidae	LC	IV	-
116	Tawny Eagle	*Aquila rapax*	Accipitridae	VU	-	II
117	Thick-billed Flowerpecker	*Dicaeum agile*	Dicaeidae	LC	-	-
118	Tickell's Blue Flycatcher	*Cyornis tickelliae*	Muscicapidae	LC	IV	-
119	Tree pipit	*Anthus trivialis*	Motacillidae	LC	IV	-
120	Whiskered Tern	*Chlidonias hybrida*	Laridae	LC	-	-
121	White Wagtail	*Motacilla alba*	Motacillidae	LC	-	-
122	White-breasted Kingfisher	*Halcyon smyrnensis*	Alcedinidae	LC	IV	-
123	White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	LC	-	-
124	White-browed Fantail	*Rhipidura aureola*	Rhipiduridae	LC	-	-
125	White-browed Wagtail	*Motacilla maderaspatensis*	Motacillidae	LC	-	-
126	White-eyed Buzzard	*Butastur teesa*	Accipitridae	LC	-	II
127	White-spotted Fantail	*Rhipidura albogularis*	Rhipiduridae	LC	-	-
128	Wire-tailed Swallow	*Hirundo smithii*	Hirundinidae	LC	-	-
129	Wood sandpiper	*Tringa glareola*	Scolopacidae	LC	IV	-
130	Woolly-necked Stork	*Ciconia episcopus*	Ciconiidae	VU	IV	-
131	Wryneck	*Jynx torquilla*	Picidae	LC	-	-
132	Yellow Wagtail	*Motacilla flava*	Motacillidae	LC	-	-
133	Yellow-eyed babbler	*Chrysomma sinense*	Sylviidae	LC	IV	-
134	Yellow-legged Buttonquail	*Turnix tanki*	Turnicidae	LC	IV	-
135	Little Swift	*Apus affinis*	Apodidae	LC	-	-
136	Asian Palm Swift	*Cypsiurus balasiensis*	Apodidae	LC	-	-

LC= Least Concern, VU= Vulnerable, NT= Near Threatened (Source: Primary Survey, Data from ebird.org)

4. List of Butterflies in PCMC

No.	Common Name	Scientific Name	Family
1	Babul Blue	*Azanus jesous*	Lycaenidae
2	Blue Pansy	*Junonia orithya*	Nymphalidae
3	Blue Tiger	*Tirumala limniace*	Nymphalidae
4	Chocolate Pansy	*Junonia iphita*	Nymphalidae
5	Common Baron	*Euthalia aconthea*	Nymphalidae
6	Common Cerulean	*Jamides celeno*	Lycaenidae
7	Common Evening Brown	*Melanitis leda*	Nymphalidae
8	Common Grass Yellow	*Eurema hecabe*	Pieridae
9	Common Gull	*Cepora nerissa*	Pieridae
10	Common hedge blue	*Acytolepis puspa*	Lycaenidae
11	Common Lineblue	*Prosotas nora*	Lycaenidae
12	Common Mormon	*Papilio polytes*	Papilionidae
13	Common Pierrot	*Castalius rosimon*	Lycaenidae
14	Common Rose	*Pachliopta aristolochiae*	Papilionidae
15	Common Silverline	*Spindasis vulcanus*	Lycaenidae
16	Common Three ring	*Ypthima asterope*	Nymphalidae
17	Common Wanderer	*Pareronia hippia*	Pieridae
18	Danaid Eggfly	*Hypolimnas misippus*	Nymphalidae
19	Dark Grass Blue	*Zizeeria karsandra*	Lycaenidae
20	Gram Blue	*Euchrysops cnejus*	Lycaenidae
21	Great Eggfly	*Hypolimnas bolina*	Nymphalidae
22	Grey Pansy	*Junonia atlites*	Nymphalidae
23	Indian Jezebel	*Delias eucharis*	Pieridae
24	Lemon Emigrant	*Catopsilia pomona*	Pieridae
25	Lemon Pansy	*Junonia lemonias*	Nymphalidae
26	Lesser Grass Blue	*Zizina otis*	Lycaenidae
27	Parnara Swift	*Parnara spp.*	Hesperiidae

No.	Common Name	Scientific Name	Family
28	Peacock pansy	*Junonia almana*	Nymphalidae
29	Pioneer	*Belenois aurota*	Pieridae
30	Plain Tiger	*Danaus chrysippus*	Nymphalidae
31	Red Flash	*Rapala iarbus*	Lycaenidae
32	Red Pierrot	*Talicada nyseus*	Lycaenidae
33	Small Cupid	*Chilades parrhasius*	Lycaenidae
34	Striped Pierrot	*Tarucus nara*	Lycaenidae
35	Striped Tiger	*Danaus genutia*	Nymphalidae
36	Tailless Lineblue	*Prosotas dubiosa*	Lycaenidae
37	Tawny Coster	*Acraea terpsicore*	Nymphalidae
38	White-orange tip	*Ixias marianne*	Pieridae
39	Yellow orange Tip	*Ixias pyrene*	Pieridae
40	Yellow Pansy	*Junonia hierta*	Nymphalidae
41	Zebra Blue	*Leptotes plinius*	Lycaenidae
42	Common Leopard	*Phalanta phalantha*	Nymphalidae
43	Lime Swallowtail	*Papilio demoleus*	Papilionidae
44	Blue Mormon	*Papilio polymnestor*	Papilionidae
45	Little Orange-tip	*Colotis etrida*	Pieridae
46	Common Five-ring	*Ypthima baldus*	Nymphalidae
47	Angled Pierrot	*Caleta decidia*	Lycaenidae
48	Tailed Jay	*Graphium agamemnon*	Papilionidae
49	Common Castor	*Ariadne merione*	Nymphalidae
50	Baronet	*Symphaedra nais*	Nymphalidae
(Source: Primary Survey)			

5. List of Fresh Water fishes in PCMC

No.	Scientific Name	Family	IUCN status
1	*Notopterus notopterus*	Notopteridae	LC
2	*Catla catla*	Cyprinidae	-
3	*Cirrhinus fulungee*	Cyprinidae	LC
4	*Cirrhinus reba*	Cyprinidae	-
5	*Cirrhinus mrigala*	Cyprinidae	LC
6	*Labeo ariza*	Cyprinidae	LC
7	*Labeo boggut*	Cyprinidae	LC
8	*Labeo calbasu*	Cyprinidae	LC
9	*Labeo porcellus*	Cyprinidae	LC
10	*Labeo rohita*	Cyprinidae	LC
11	*Osteobrama cotio*	Cyprinidae	LC
12	*Osteobrama neilli*	Cyprinidae	LC
13	*Osteobrama vigorsii*	Cyprinidae	LC
14	*Puntius amphibius*	Cyprinidae	DD
15	*Puntius conchonius*	Cyprinidae	LC
16	*Puntius jerdoni*	Cyprinidae	LC
17	*Puntius sarana*	Cyprinidae	LC
18	*Puntius sophore*	Cyprinidae	LC
19	*Puntius ticto*	Cyprinidae	LC
20	*Rohtee ogilbii*	Cyprinidae	LC
21	*Amblypharyngodon mola*	Cyprinidae	LC
22	*Salmophasia balookee*	Cyprinidae	LC
23	*Salmophasia boopis*	Cyprinidae	LC
24	*Salmophasia novacula*	Cyprinidae	LC
25	*Devario aequipinnatus*	Cyprinidae	LC
26	*Rasbora daniconius*	Cyprinidae	LC
27	*Crossocheilus latius*	Cyprinidae	LC

No.	Scientific Name	Family	IUCN status
28	*Garra mullya*	Cyprinidae	LC
29	*Acanthocobitis mooreh*	Balitoridae	-
30	*Nemachilichthys rueppelli*	Balitoridae	LC
31	*Noemacheilus anguilla*	Balitoridae	-
32	*Schistura denisoni*	Balitoridae	LC
33	*Lepidocephalichthys thermalis*	Cobitidae	LC
34	*Mystus bleekeri*	Bagridae	LC
35	*Mystus seengtee*	Bagridae	LC
36	*Rita gogra*	Bagridae	LC
37	*Sperata seenghala*	Bagridae	LC
38	*Neotropius khavalchor*	Schilbeidae	DD
39	*Clarias gariepinus*	Claridae	LC
40	*Heteropneustes fossilis*	Heteropneustidae	LC
41	*Xenentodon cancila*	Belonidae	LC
42	*Poecilia reticulata*	Poeciliidae	-
43	*Chanda nama*	Ambassidae	LC
44	*Oreochromis mossambicus*	Cichlidae	NT
45	*Glossogobius giuris*	Gobiidae	LC
46	*Channa marulius*	Channidae	LC
47	*Channa punctata*	Channidae	LC

DD= Data deficient, LC= Least Concern, NT= Near Threatened
(Source: Primary Data)

6. List of Mammals in PCMC

No.	Common Name	Scientific Name	Family	IUCN status	WPA Status	CITES
1	Five Striped Palm Squirrel	*Funambulus pennantii*	Sciuridae	LC	IV	-
2	Mongoose	*Herpestes edwardsii*	Herpestidae	LC	II	III
3	Indian Flying Fox	*Pteropus giganteus*	Pteropodidae	LC	V	II
4	Indian Pygmy Bat	*Pipistrellus tenuis*	Vespertilionidae	LC	-	-
5	Black Rat	*Rattus rattus*	Muridae	LC	V	-
6	Grey Musk Shrew	*Suncus murinus*	Soricidae	LC	-	-
LC= Least Concern (Source: Primary Survey)						

Project Name Local Biodiversity Strategy and Action Plan Of Pimpri Chinchwad	
Prepared for Pimpri Chinchwad Municipal Corporation	Prepared by Terracon Ecotech Pvt. Ltd., Mumbai

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