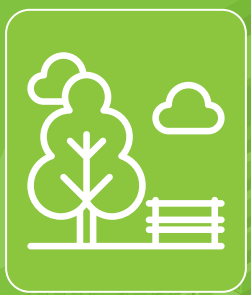
सत्यमेव जयते

Ministry of Housing and Urban Affairs
Government of India



Urban Biodiversity

TRAINING MANUAL

NIUA | C3 Climate Centre for Cities

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Supported by:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
based on a decision of the German Bundestag

difu Deutsches Institut für Urbanistik

ClimateSmart Cities Assessment Framework

Urban Planning, Green Cover & Biodiversity

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Urban Biodiversity
Training module

Developed by:
Climate Centre for Cities, NIUA in association with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and The Deutsches Institut für Urbanistik (DIFU) (English: German Institute of Urban Affairs).

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Photo Credit: Climate Centre for Cities, NIUA

Executive Summary

On one hand, cities are a significant contributor of carbon emissions aggravating climate change and on the other, cities are considerably impacted by climate disasters. The recently released Global Climate Risk Index 2021 ranks India as the 7th most affected country from climate related extreme weather events (storms, floods, heatwaves etc.). Further, studies indicate that poor planning and urban management are expected to cost Indian cities somewhere between $2.6 and $13 billion annually.[1] Cities are increasingly at the forefront of addressing both urbanization and climate change and to strengthen climate-sensitive urban development, a holistic understanding of the urban development from a climate lens is crucial. The ClimateSmart Cities Assessment Framework (CSCAF) launched in 2019 by the Ministry of Housing and Urban Affairs (MoHUA), Government of India aimed to address this gap. This first-of-its-kind assessment with 28 progressive indicators across 5 thematic areas helps cities to benchmark their development, understand the gaps and further prioritize climate relevant development.

With a focus on building local capacities to develop and adopt climate measures, the Climate Centre for Cities (C-Cube) at the National Institute of Urban Affairs (NIUA) initiated a series of training aligned to the thematic areas of CSCAF - Energy and Green Buildings, Urban Planning, Green Cover & Biodiversity, Mobility and Air Quality, Water Management, Waste Management. The focus of the training is to provide a step-by-step approach of conducting studies, assessments and stakeholder consultations, establishing committees, developing action plans and implementing relevant measures that not only makes the cities climate resilient but also helps them progress across the assessment of CSCAF.

[1] *Mani, M. et al., 2018. South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards, Washington D.C.: World Bank Group.*

Urban areas house a high population of flora and fauna species, 70% of which are endemic to the areas.[2] With increased urbanization and disappearance of habitats in urban areas, there is a definite threat to the status and presence of varied species in the city. There is a need to take strategic measures to combat the same and integrate the conservation of urban biodiversity in the planning sphere.

With this background the training manual aims to provide a broad overview to the learners so that they can understand the indicator, its importance of biodiversity in urban contexts, identify relevant stakeholders and important groups and engage with these groups to form institutional working bodies to preserve and improve the state of urban biodiversity. The module developed by the National Institute of Urban Affairs (NIUA) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) along with the Ministry of Housing and Urban Affairs (MoHUA), Government of India. The training included within this manual involves an exercise of stakeholder mapping that would enable the learners to understand the roles and responsibilities of stakeholders involved in the conservation of urban biodiversity and the inter-linkages between them.

The module on urban biodiversity will inform about the role, services and importance of urban biodiversity and the current national and local level of policy and institutional measures for biodiversity in place. Various assessments tools used as indicators for urban biodiversity and preparation of local biodiversity plans and institutional bodies for the conservation of the same, to implement in their own jurisdiction will be elaborated.

[2] *Critical Ecosystem Partnership Fund, 2021, Biodiversity Hotspots Defined, https://www.cepf.net/our-work/biodiversity-hotspots/hotspots-defined, Accessed on November 2021*

Who is the training manual designed for?

What is the focus of the training manual?

How to make use of this manual?

What are the Learning outcomes of the training?

Scope and limitations of the training

The training manual has been designed for senior and mid - level smart city officials, mid-level officials involved in the field of preservation and conservation of urban biodiversity at city level, and the urban planners, architects, designers involved in city planning.

The manual provides a broad overview of the urban biodiversity and need to conserve it, executive and legislative frameworks that can be followed and assessment to be conducted for determining the urban biodiversity.

The manual is designed to guide readers to achieve a basic understanding of urban biodiversity with an emphasis on its prevention, especially in urban areas were the concentration of urban biodiversity is consecutively decreasing. In addition to detailed information provided in the manual, a set of reference materials are indicated for additional reading. Case studies to demonstrate the theoretical concepts are also covered to demonstrate the practical application of concepts.

The intent of this module on urban biodiversity is to inform the role, services and importance of urban biodiversity and the current national and local level of policy and institutional measures for biodiversity in place.

The participants would also learn the various assessments tools used as indicators for urban biodiversity and preparation of local biodiversity plans and institutional bodies for the conservation of the same, to implement in their own jurisdiction.

The case studies outlined in the course would also help in learning best practices of conservation of urban biodiversity and help the learners emulate the same.

The manual is designed to guide readers to achieve basic understanding of urban Biodiversity. Detailed procedures of urban biodiversity to be included in City Action Plan and Development Plan have not been included. However, additional reference materials indicated can support further understanding on these lines.

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Abbreviations

BMC	Biodiversity Management Committee
CBD	Convention of Biological Diversity
CEDME	Centre for Environmental Management of Degraded Ecosystems
CSCAF	ClimateSmart Cities Assessment Framework
C-Cube	Climate Centre for Cities
DDA	Delhi Development Authority
LBSAP	Local Biodiversity Strategy and Action Plan
NBA	National Biodiversity Authority
NIUA	National Institute of Urban Affairs
NGO	Non-government Organizations
PBR	People's Biodiversity Register
SBB	State Biodiversity Boards
ULBs	Urban Local Bodies

1

Introduction

1.1. Context

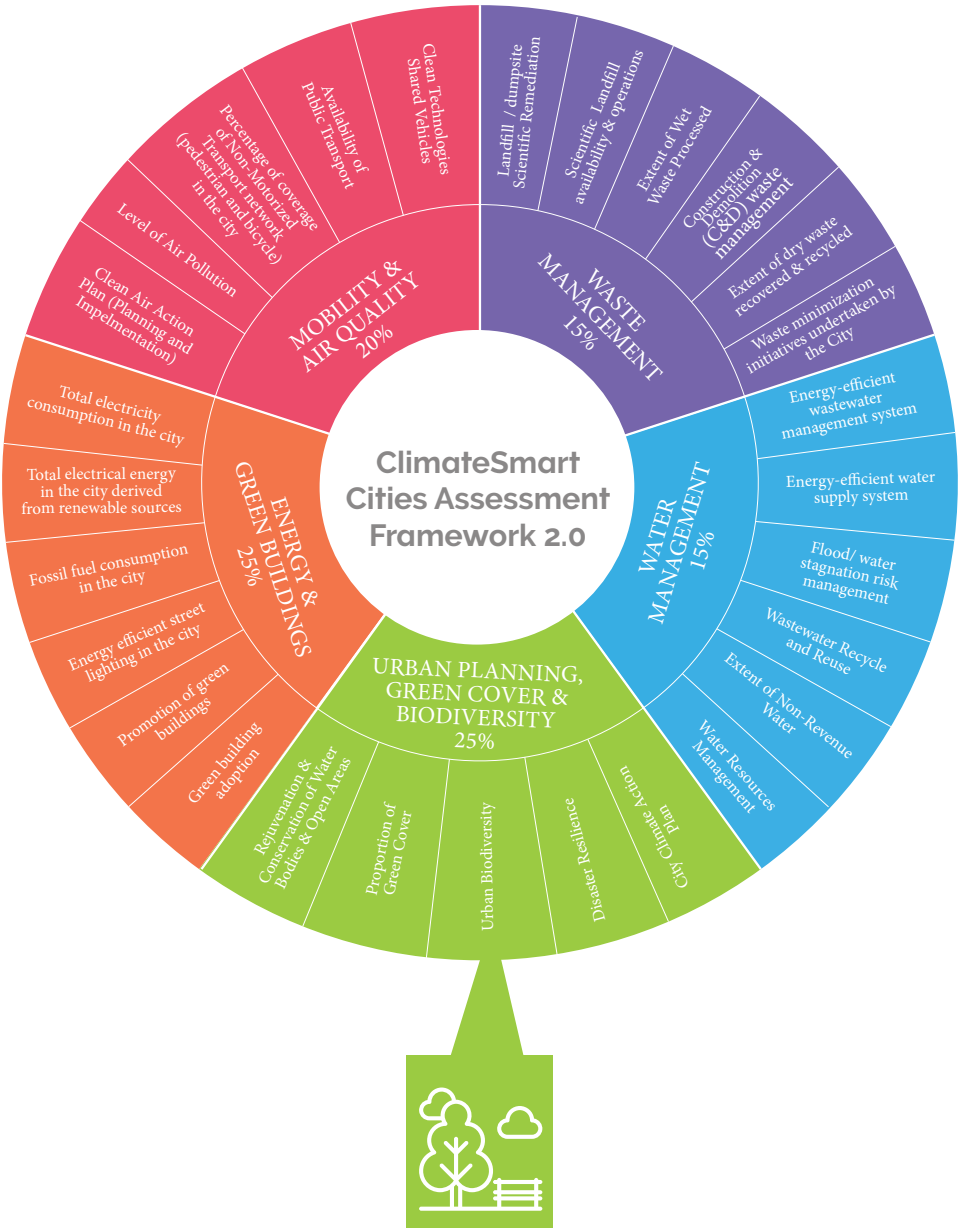
The term Biodiversity is often linked to wildlife sanctuaries, natural parks, etc., but existence of biodiversity in urban areas is one measure which needs to be actively enhanced and promoted. According to the definition given by the Convention of Biological Diversity (CBD), it refers to all the variety of life that can be found on Earth (plants, animals, fungi and micro-organisms) as well as to the communities that they form and the habitats in which they live. Biodiversity in cities plays a far more important role and is not just greenery and some birds and animals. It is an indicator of the ecological health of an area. It provides ecosystem services, which would otherwise be sought from outside the city at a cost and increase in the ecological footprint.

The value of wildlife in cities is often underestimated. Nature in cities is not only a matter of cultivated and managed biodiversity such as urban parks, gardens and lawns, but also in areas like urban wetlands, abandoned industrial sites, roadside verges, vacant lots, derelict lands, ruins, allotment gardens and cemeteries which are increasingly recognized as potential reservoirs of urban biodiversity together with arboreta, residential gardens and villas, botanic gardens and individual balconies. Cities harbour a surprisingly high proportion of Earth's species biodiversity. Many of them are native or even endemic to their region. It also provides significant ecosystem services contributing to climate change mitigation and adaptation, such as carbon sequestration, air and water purification, mitigation of impacts of environmental pollution, noise reduction, and regulation of microclimate. High biodiversity increases the resilience of the city.

1.2. Aligning indicator with CSCAF

For the indicator of Urban Biodiversity, within the thematic area of Urban Planning, Green Cover and Biodiversity, the cities are evaluated on 5 levels with respect to the following parameters.

Figure 1: Indicators under CSCAF



Source: Climate Centre for Cities, NIUA

For cities that have not initiated any action pertaining to Urban Biodiversity, level 1 category would be assigned. Municipalities have to establish a Biodiversity Management Committee (BMC) which would take the cities to the level 2 of the CSCAF indicator. The BMC would be responsible for preparing the People's Biodiversity Register (PBR) and that would ensure the cities to reach level 3 which also includes the baseline assessment of the status of the existing flora and fauna thriving in the city. After establishing the baseline, a local biodiversity action plan has to be prepared, proposing the list of measures to increase the biodiversity, to reach level 4. These measures and actions should be further incorporated into the master plan for development of the city for their effecting implementation along all other city level planning interventions for level 5 scoring.

Table 1: Performance Evaluation Criteria

	1	2	3	4	5
Progression Levels	No Action Initiated	Institutional Set-Up	Baseline Assessment	Urban Biodiversity Improvement Measures	Implementation of Actions
Evidence/ Data sources	No action initiated	• Establishment of City Level Biodiversity Management Committee (as per Biological Diversity Act, 2002; City council resolution; announcement to State Biodiversity Board)	• People's Biodiversity Register (based on the Biological Diversity Act, 2002, Letter of State Biodiversity Board validating register) • Inventory of urban ecosystems and species (including International Union for Conservation of Nature, IUCN listed species)	• Funds/ Municipal Budget allocated • Identification of measures to increase biodiversity within master plan/ greening plans/ rejuvenation plans	• Calculation of City Biodiversity Index (Report with the calculated index) • Evidence on implementation of measures identified in level 4 • Evidence on change/ improvement in species diversity (species list of various taxa) • Map of areas where measures to increase biodiversity have been taken as .kml files (polygon geometry) wherever applicable

Source: Climate Centre for Cities

This training manual links directly with the above indicator in the CSCAF and provides assistance to cities on how to perform on the indicator and progressively move forward- in turn helping the city move up in its Climate Smart City performance.

Photo Credit: Sanket Shah on unsplash

2

Concepts of Urban Biodiversity

2.1. Background, definition, and importance of Urban Biodiversity

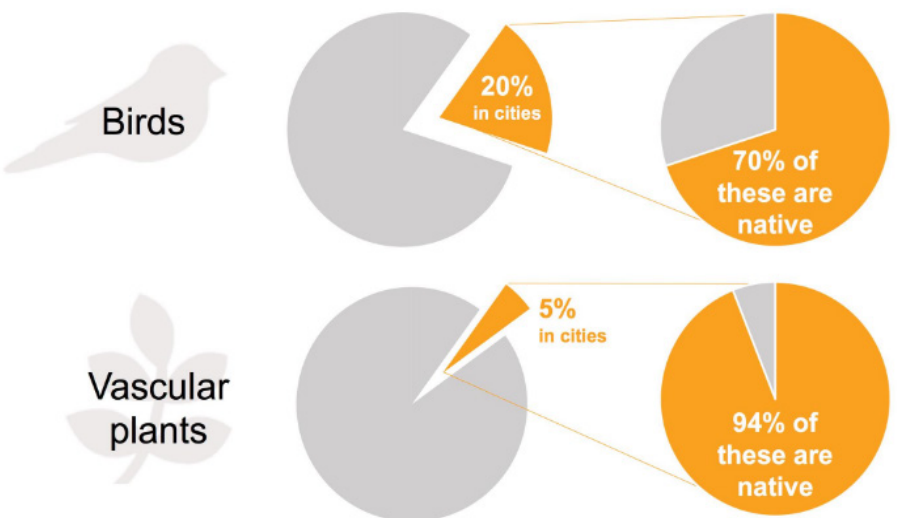
Cities harbor a surprisingly high proportion of Earth's species biodiversity. Many of them are native or even endemic to their region (Convention on Biological Diversity 2012). Urban biodiversity is the versatility and richness of living and habitat diversity found in and on the edge of human settlements. At the landscape and habitat level it includes remnants of natural landscapes such as leftovers of primeval forests; traditional agricultural landscapes such as meadows, areas of arable land; urban–industrial landscapes such as city centers, residential areas, industrial parks, railway areas, formal parks and gardens, brownfields, etc.

Diversity of plants and animals in the urban landscape shows some following interesting patterns: The number of plant species in urban areas correlates with human population size compared to than it does with the size of the city area. The age of the city affects species richness; large, older cities have more plant species than large, younger cities. 20 percent of the world's bird species and 5 percent of the vascular plant species occur in cities; alongside 70 percent of the plant species and 94 percent of the bird species found in urban areas are native to the surrounding region[1].

Urban Biodiversity is the combination of two important words, i.e., 'Urban Areas' and 'Biodiversity', where the focus is to conserve the biodiversity in urban areas in which the rabid urbanization is depleting the biodiversity cover and and adding to the adverse effects of climate change.

[1] *Cities and Biodiversity Outlook – Action and Policy (2012), A global Assessment on the Links between Urbanization, Biodiversity, and Ecosystem Services, https://www.cbd.int/doc/health/cbo-action-policy-en.pdf, Accessed on 25 November 2021*

Figure 2: Percentage of world's birds' species and vascular plants species



Source: Convention on Biological Diversity

Biodiversity - Biodiversity is typically a measure of variation at the genetic, species, and ecosystem level. Can be termed as “the variety and variability of life on Earth.”

Source: Environmental Protection Agency

Urban Area - An urban area, or built-up area, is a human settlement with a high population density and infrastructure of built environment. Mostly, a town, suburb or a city.

Source: The World Bank Group

Urban Biodiversity - It refers to the variety and variability among living organisms found in a city and the ecological systems in which they occur. Overall, urban biodiversity responds to a combination of biogeographic and anthropogenic factors, with a strong influence of the latter.

Source: The Nature Conservancy

Biodiversity in cities has its importance in following aspects;

1. An indicator of ecological health.
2. Provides ecosystem services, which would otherwise be sought from outside the city at a cost.
3. A place of peace that can produce a feeling of oneness with Nature for urban people
4. Preserves physical human health and psychological well-being.

2.2. Role of Urban Biodiversity

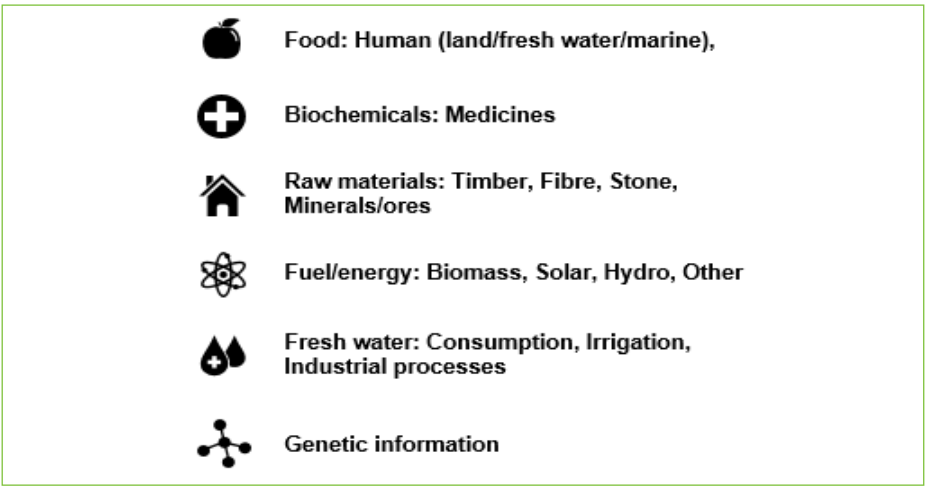
The most important function provided by urban biodiversity is that of ecosystem services. Ecosystem services are the benefits people obtain from ecosystems. They can be categorized into 4 sections – Provisioning Services, Regulating Services, Cultural Functions and Supporting Functions

2.2.1. Provisioning Services:

Water, food, wood and other goods are some of the material benefits people obtain from ecosystems called ´provisioning services[2]´. In many regions, rural households also directly depend on provisioning services for their livelihoods. In this case, the services value may be much more important than is reflected in the prices they fetch on local markets *(Food and Agriculture Organization of the United Nations, n.d.)*.

[2]*Gómez-Baggethun, E. & Gren, Å., 2013. Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities. Urban Ecosystem Services, pp. 175-251*

Figure 3: List of provisioning services



Source: The Economics of Ecosystems and Biodiversity initiative (TEEB 2012)

Example: Freshwater bodies

1. They act as the main source of water for human consumption, agriculture activities, industrial processes, etc.
2. At the same time, capture and culture of freshwater fish contribute a significant amount of animal protein to the diets of people worldwide.
3. They also provide raw materials like the cultivation of micro algae and fish waste for biofuels and shells for jewelry and other cultural artefacts.
4. Certain aquatic plants also act as medicinal resources.

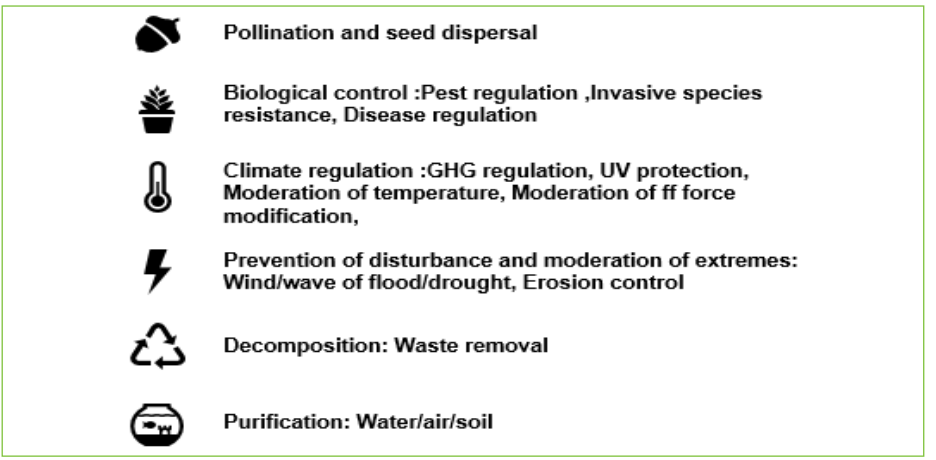
2.2.2. Regulating Services:

Maintaining the quality of air and soil, providing flood and disease control, or pollinating crops are some of the 'regulating services' provided by ecosystems. When they are damaged, the resulting losses can be substantial and difficult to restore.

Example: Urban trees and forests

1. They help monitor local air quality through intercepting smoke particulate pollutants (dust, ash, pollen and smoke) and absorbing toxic gases such as ozone, Sulphur dioxide, and nitrogen dioxide
2. Trees emit various volatile organic compounds contributing to ozone formation in cities and reduce soil erosion and provide habitats for pollinators.

Figure 4: List of regulating services

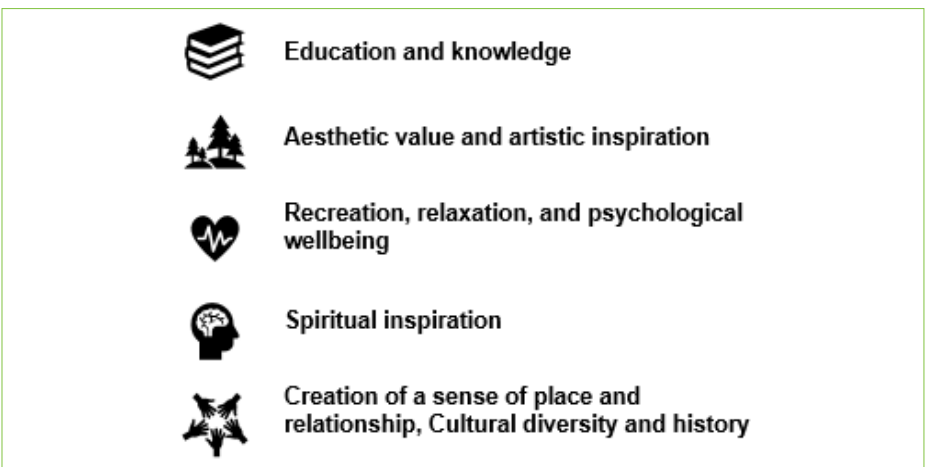


Source: The Economics of Ecosystems and Biodiversity initiative (TEEB 2012)

2.2.3. Cultural Functions:

The non-material benefits people obtain from ecosystems are called "cultural services".[3]

Figure 5: List of Cultural Functions



Source: The Economics of Ecosystems and Biodiversity initiative (TEEB 2012)

[3]*Gómez-Baggethun, E. & Gren, Å., 2013. Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities. Urban Ecosystem Services, pp. 175-251*

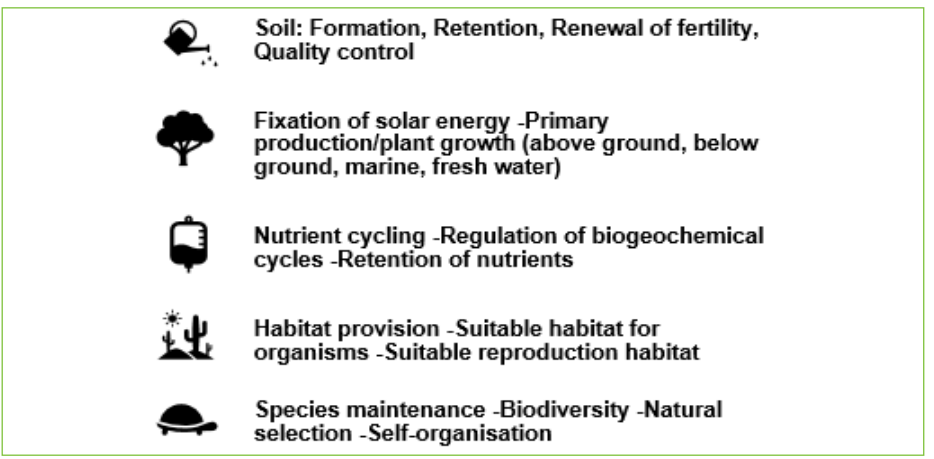
Example: Aquatic Systems

1. Provide important recreational and health activities
2. Coral reefs are particularly important for tourism.
3. Fish in public aquaria, wild species in tropical reefs, etc generate highly valued aesthetic services and act as artistic inspiration.
4. Source of many culturally significant prayers/stories, etc. around the world.

2.2.4. Supporting Functions:

Providing living spaces for plants or animals and maintaining a diversity of plants and animals, are 'supporting services and the basis of all ecosystems and their services[4].

Figure 6: List of supporting functions



Source: The Economics of Ecosystems and Biodiversity initiative (TEEB 2012)

Example: Wetlands

1. Wetlands retain and control flood waters, absorb nutrients and chemicals from the water, and they act as a natural filtration system.
2. Wetland plants and soils store large amounts of carbon that, if released, would contribute to climate change.
3. Wetlands are also a vital habitat for migratory birds, fish, and mammals, and their loss impacts recreation and biodiversity.

Therefore, biodiversity in cities plays far more important role not just greenery and some birds & animals. It is an indicator of ecological health and it provides ecosystem services, which would otherwise be sought from outside the city at a cost. It is a place of peace that can produce a feeling of oneness with Nature for urban people and which preserves physical human health and psychological well-being.

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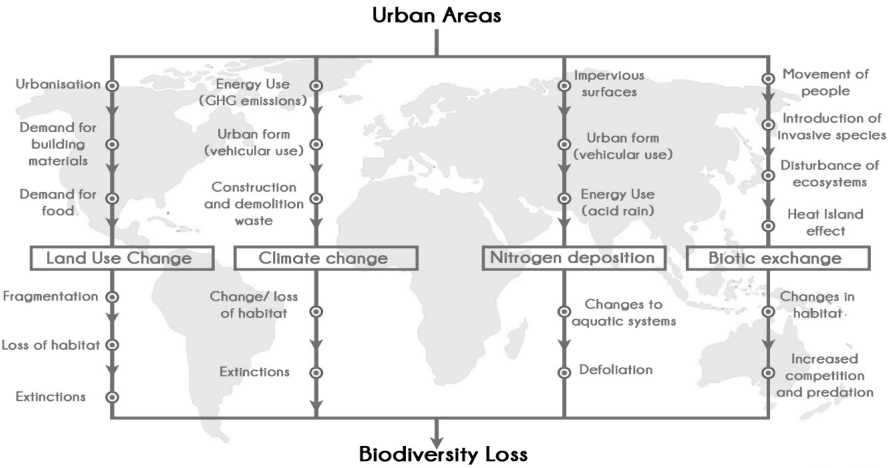
[4]*Gómez-Baggethun, E. & Gren, Å., 2013. Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities. Urban Ecosystem Services, pp. 175-251*

2.3. Need for conserving Urban Biodiversity

Figure 7: Effects of Urbanization on Biodiversity



Source: Urban Ecology (2020)

With increased urbanization, there have been multiple negative impacts on the biodiversity in urban areas. The presence of huge amounts of traffic and industries causing pollution, makes it difficult for local plants and animals to thrive. Further, city activities generate sewage, solid waste and air pollution which are detrimental to their health. It also causes fragmentation & destruction of large areas of natural habitat on which many species depend.[5]

Cities also play host to multiple foreign species, which are a major threat to endemic species due to increased incidence of colonization by introduced species. There are changes in landcover and increase in built up area leading to increased surface run-off thereby impacting local soil and vegetation. Lastly, expansion of urban areas on native flora impacts their dispersal methods through changes in habitat configuration and connectivity.

All of the above results in biodiversity loss - refers to the decline of biological diversity or the variety of living things, its different levels of genetic variability, as well as the natural patterns present in ecosystems. Urban Areas directly or indirectly also result in loss of biodiversity through change of land use cover, climate change, nitrogen deposition and biotic exchange of different species. Biodiversity loss has many consequences, not only

[5] *Kondratyeva, A., 2020. Urbanization Effects on Biodiversity, Patterns and Drivers of Urban Biodiversity. Urban Ecology.*

for the environment, but also for human beings at the economic and health level. Through direct and indirect impacts on the climatic conditions, reduced resilience to natural disasters, and reduced ecosystem services – it can degrade urban areas.

Therefore, urbanization is both a challenge and an opportunity to manage ecosystem services globally and there is a need to maintain functioning urban ecosystems can enhance human health and wellbeing. It can also help contribute to climate change mitigation and adaptation. Increasing the biodiversity of urban food systems can enhance food and nutrition security.

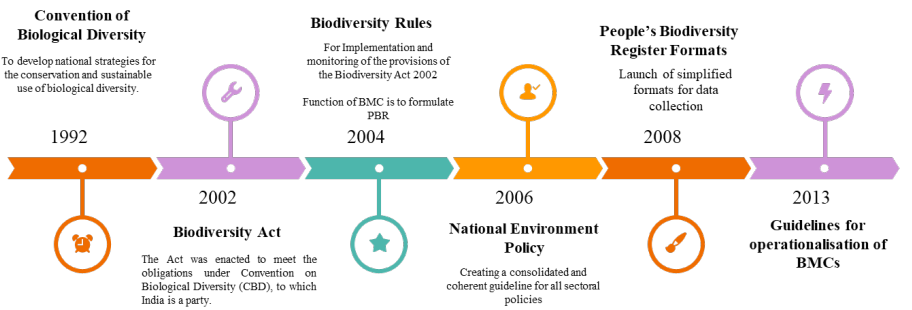
Photo Credit: Raghavendra Prasad on Unsplash

3

Institutional framework

3.1. Policy and legal background

Figure 8: Timeline of relevant Acts and policies



Source: New Indian Express (2020)

The first stage of initiating a legal background began in 1992 when India signed the Convention on Biological Diversity at Rio de Janeiro which provided a framework for the sustainable management and conservation of our country's natural resources.

Ten years later in India, the Biological Diversity Act was enacted in 2002 in order to conserve biodiversity, manage its sustainable use and enable fair and equitable sharing benefits arising out of the use of biological resources with the local communities. This Act also enabled India to enact the obligations met under the 1992 CBD. In 2004, the Biodiversity Rules were laid out in order to implement and monitor the provisions of the 2002 Biological Diversity Act and it also enabled the BMCs to prepare People's Biodiversity Registers (PBR).

2006 saw the formulation of National Environment Policy that would ensure a consolidated and coherent guideline for all sectoral policies pertaining to the environment. To direct the preparation of PBRs, formats for the same were launched in 2008 for a regularised and systematic form of data collection. Lastly, for the functioning of BMCs, a set of guidelines for the operationalising of BMCs was introduced in 2013. Some of the salient features of the major acts are discussed below:

3.1.1. Convention of Biological Diversity 1992

Convention of Biological Diversity 1992 was signed by 150 government leaders at the 1992 Rio Earth Summit, dedicated to promoting sustainable development. It conceived as a practical tool for translating the principles of Agenda 21 into reality.[1] This act requires countries to develop and implement strategies for protection of biodiversity. Forum for continuing international dialogue on biodiversity-related issues through the annual conferences of the parties (COPs) takes place.

The main objectives of Convention of Biological Diversity 1992 are (i) the conservation of biological diversity; (ii) the sustainable use of its components; and (iii) the fair and equitable sharing of the benefits arising from the use of genetic resources.

[1]*Convention on Biological Diversity, 2020. Convention on Biological Diversity. [Online] Available at: https://www.cbd.int/convention/ ; Accessed on 15 September 2021*

3.1.2. Biodiversity Act 2002

Biodiversity Act 2002 regulates access to biological resources of the country with equitable share in benefits, to set up National & State Biodiversity Board (SBB) and Biodiversity Management Committees (BMC's)[2]. It helps to create National, State and local biodiversity fund and its use for conservation. It also aims to conserve and develop biodiversity hotspots as biological diversity heritage sites.

Biodiversity Act 2002 enacted by the Parliament of India for preservation of biological diversity in India and provides mechanism for equitable sharing of benefits arising out use of traditional biological resources and knowledge. It established the National Biodiversity Authority in Chennai.

3.1.3. National Environment Policy, 2006

National Environment Policy, 2006 builds on the various earlier policies which had addressed the challenges of environment and need of sustainable development.[3] It seeks to form partnerships of different stakeholders, - public agencies, local communities, academic institutions, & international partners. Active involvement and participation of Panchayati Raj Institutions and urban local bodies has also been highlighted. Integration of environmental protection in the development process has been focused on through preparation of Environment impact Assessment for different sectoral projects.

3.2. Institutional Setup

Section 41 of the Biodiversity Act provides the scope to Municipal Corporations and gram-panchayats to perform all the activities relevant to its overall Biodiversity Management and constitute a Biodiversity Management Committee within its area of jurisdiction.

Constitution of Biodiversity Management Authorities (BMA/BMC)

"Every local body shall constitute a Biodiversity Management Committee within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animals and microorganisms and chronicling of knowledge relating to biological diversity."

(Section 41 of Biodiversity Rules, 2004)

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[2] *Ministry of Law and Justice, 2020. Legislative Department. [Online]*

Availableat:https://legislative.gov.in/actsofparliamentfromtheyear/biological-diversity-act-2002;Accessedon 15 September 2021

[3] *National Portal of India, 2019. National Portal of India. [Online]*

Available at: https://www./national-environment-policy-2006; Accessed on 15 September 2021

3.2.1. Functions of BMCs - as per Rule 22 of Biodiversity Rules, 2004:

1. The main function of the BMC is to prepare People's Biodiversity Register in consultation with the local people.
2. Advice on any matter referred to it by the State Biodiversity Board or Authority for granting approval.
3. Provide guidance and technical support to State Biodiversity Boards
4. Levy charges from any person for accessing/collecting any biological resource for commercial purposes from areas falling within its territorial jurisdiction
5. Eco-restoration of the local biodiversity, management of sacred groves and sacred water bodies, conservation of traditional varieties/breeds of economically important plants and animals

2.2.2. Institutional Hierarchy

The Biological Diversity Act envisages a three-tier system for implementation, with the National Biodiversity Authority (NBA) headquartered in Chennai at the apex, State Biodiversity Boards (SBB), and Biodiversity Management Committees (BMC) in local bodies.

Figure 9: Institutional Hierarchy of BMCs

Coordinates the activities of the State Biodiversity Boards (SBB) and Biodiversity Management Committees (BMC) by providing them with technical assistance and guidance.

Advise the State Governments on matters relating to biodiversity, and to regulate by granting approval for commercial utilization

Every local body is required to constitute a Biodiversity Management Committee (BMC) within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity

Source: NBA India (2020)

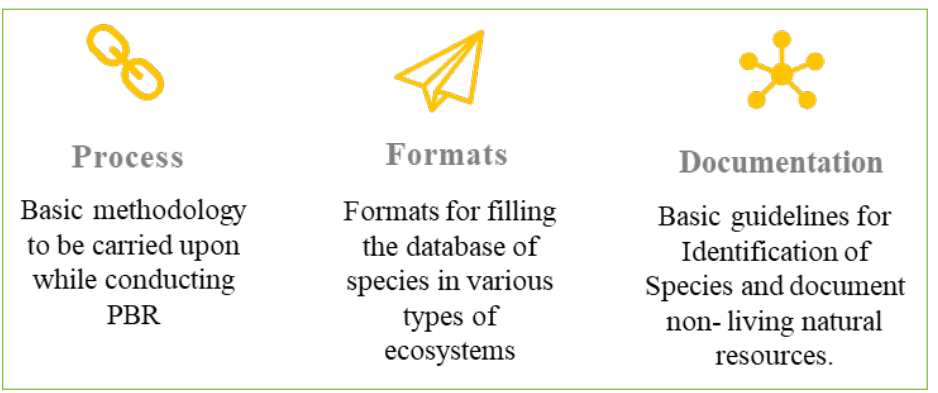
With the BMCs identified as the key players in decision making, the NBA launched guidelines for operationalizations of BMCs in 2013 that included guidelines on formation, constitution of members, roles and responsibilities, financing structures and monitoring mechanisms for BMCs.

4

Urban Biodiversity Implementation Measures

4.1. People's Biodiversity Register

Figure 10: Guidelines for PBR



Source: NBA India (2019)

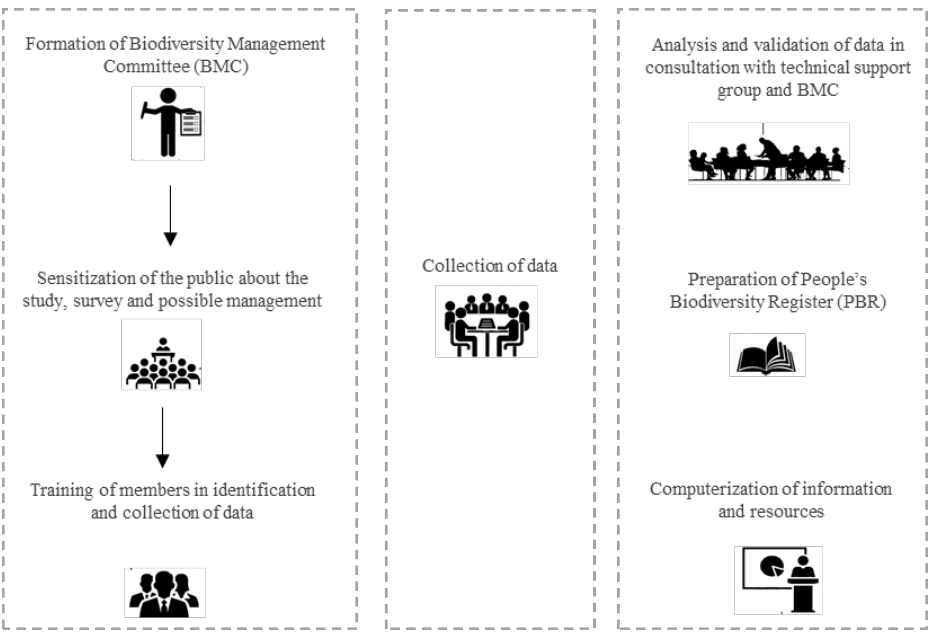
People's Biodiversity Register (PBR) is a document which contains comprehensive information on locally available Bio-resources including landscape and demography of a particular area or village.

The preparation of People's Biodiversity Registers (PBRs) involves the active support and cooperation of a large number of people who need to share their common and specialized knowledge.

First step for preparing a PBR is to organize a group meeting to explain the objectives.

Spots where biodiversity is important need to be identified for the purpose of the study and documentation.

Figure 11: Methodology of preparing a PBR



Source: NBA India (2019)

The documentation process includes information gathered through a detailed questionnaire, focus group discussions with experts and published secondary information. The PBR is a participatory process requiring intensive and extensive consultation with the BMC which would then be finalized through preparing and computerizing a final register.

Documentation includes photographs (including digital images), drawings, audio and video recordings and other records like printed material. As per the PBR booklet, format 29 & 30 is to be used for filling the details for flora (plants) and fauna for urban biodiversity[1]. Separate format should be used for road side plantation, Parks and Gardens, Housing estate, Commercial buildings, other institutional areas, Private club premises, Aquatic (water) habitat and Terrestrial (land) habitat.

Figure 12: Format for PBR

Format 29: Flora

1.	2.	3.	4.	5.	6.	7.
Sr. No.	Local Name	Scientific Name	Type of Plants	Habitat	Flowering Season	Remarks (Rare / Common etc.)

Format 30: Fauna

1.	2.	3.	4.	5.	6.
Sr. No.	Local Name	Scientific Name	Type of Animals (Mammals / Birds / Fish / Insect etc.)	Habitat	Remarks (Rare / Common etc.)

Source: NBA India (2019)

The output modes for PBR include data upload onto the website of local government, a booklet of the species data for making the database accessible to local people or mapping of species with interesting illustrations for people to understand easily (Asset Mapping).

[1]*National Biodiversity Authority, 2013. National Biodiversity Authority. [Online]*

Available at: http://nbaindia.org/uploaded/pdf/PBR%20Format%202013.pdf; Accessed on 15 September 2021

4.2. City Biodiversity Index

City Biodiversity Index, also known as Singapore Index comprises of 23 indicators, for measuring a city's native biodiversity, the ecosystem services provided and biodiversity governance[2]. The index is scored on a scale of 0 to 92, and is used to help visualize city's progress in conserving biodiversity with every application of the index[3].

For checking the progress of the city, the first year is considered the baseline. The framework comprises of 2 parts –

1. Part I is the city profile which highlights the location, physical features, demography, economy, biodiversity features, etc , and
2. Part II is the main indicator framework in 3 categories – Native Biodiversity in the city, Ecosystem services provided by biodiversity, and governance and management of biodiversity.

Figure 13: City Biodiversity Index indicator list

	Core Components		Indicators	Maximum Score
PART II - Indicators	Native Biodiversity in the City	1.	Proportion of Natural Areas in the City	4 points
		2.	Connectivity Measures	4 points
		3.	Native Biodiversity in Built Up Areas (Bird Species)	4 points
		4.	Change in Number of Vascular Plant Species	4 points
		5.	Change in Number of Bird Species	4 points
		6.	Change in Number of Butterfly Species	4 points
		7.	Change in Number of Species (any other taxonomic group selected by the city)	4 points
		8.	Change in Number of Species (any other taxonomic group selected by the city)	4 points
		9.	Proportion of Protected Natural Areas	4 points
		10.	Proportion of Invasive Alien Species	4 points
	Ecosystem Services provided by Biodiversity	11.	Regulation of Quantity of Water	4 points
		12.	Climate Regulation: Carbon Storage and Cooling Effect of Vegetation	4 points
		13.	Recreation and Education: Area of Parks with Natural Areas	4 points
		14.	Recreation and Education: Number of Formal Education Visits per Child Below 16 Years to Parks with Natural Areas per Year	4 points
	Governance and Management of Biodiversity	15.	Budget Allocated to Biodiversity	4 points
		16.	Number of Biodiversity Projects Implemented by the City Annually	4 points
		17.	Existence of Local Biodiversity Strategy and Action Plan	4 points
		18.	Institutional Capacity: Number of Biodiversity Related Functions	4 points
		19.	Institutional Capacity: Number of City or Local Government Agencies Involved in Inter-agency Co-operation Pertaining to Biodiversity Matters	4 points
		20.	Participation and Partnership: Existence of Formal or Informal Public Consultation Process	4 points
		21.	Participation and Partnership: Number of Agencies/Private Companies/NGOs/Academic Institutions/International Organisations with which the City is Partnering in Biodiversity Activities, Projects and Programmes	4 points
		22.	Education and Awareness: Is Biodiversity or Nature Awareness Included in the School Curriculum	4 points
		23.	Education and Awareness: Number of Outreach or Public Awareness Events Held in the City per Year	4 points
			Native Biodiversity in the City (Sub-total for indicators 1-10)	**40 points**
			Ecosystem Services provided by Biodiversity (Sub-total for indicators 11-14)	**16 points**
			Governance and Management of Biodiversity (Sub-total for indicators 15-23)	**36 points**
			Maximum Total:	**92 points**

Source: Convention on Biological Diversity (2019)

[2]*Convention on Biological Diversity, 2015. User's Manual on Singapore Index on Cities' Biodiversity. [Online] Availableat:https://www.cbd.int/doc/meetings/city/subws-2014-01/other/subws-2014-01-singapore-index-manual-en.pdf; Accessed on 15 September 2021*

[3]*Convention on Biological Diversity, 2015. User's Manual on Singapore Index on Cities' Biodiversity. [Online] Availableat:https://www.cbd.int/doc/meetings/city/subws-2014-01/other/subws-2014-01-singapore-index-manual-en.pdf; Accessed on 15 September 2021*

Role of the index: First, the Index is a tool that allows cities to create baseline measurements of their current biodiversity profiles and then monitor and assess this over time. Secondly, it serves as a public platform upon which biodiversity awareness raising exercises can be launched. Finally, the Index acts as portal among various departments within city governance, academics, NGOs and the public, encouraging better communication, stronger networks and more co-operation, through data collection and sharing of mutual goals (National Parks Board of Singapore, 2008).

4.3. Local Area Biodiversity Action Plan

A Local Biodiversity Strategy and Action Plan (LBSAP) is a guiding strategy, complemented by specific actions and adopted by local governments to achieve optimal and realistic governance and management of biodiversity and ecosystem services. An LBSAP is essentially the local equivalent of a National Biodiversity Strategy and Action Plan.[4]

Figure 14: Elements of Biodiversity Action Plan

Baseline Information	What is the state of Biodiversity in the area now? What are the threats and opportunities?
Goals & Targets	What do we want to achieve with the BAP? What specific targets can we set for each goal?
Measures	What will we do to achieve the goals?
Workplan	How, by whom and when will we implement the measures?
M&E System	How will we measure the impact and progress of the BAP?

Source: Convention on Biological Diversity (2019)

A Biodiversity Action Plan should include the following elements, defined by those responsible for the BAP in consultation with other stakeholders.

Role of Stakeholders in LBSAP: The process of developing an LBSAP should engage as many legitimate stakeholders as possible. The presence of varied stakeholders would also facilitate the collection of information to improve the quality and comprehensiveness of the LBSAP and help provide inputs that will foster a greater sense of ownership and acceptance, making implementation of the LBSAP easier. Most importantly, it would help raise the profile of the LBSAP, thereby enhancing fundraising efforts.

[4] *ICLEI, 2016. Biodiversity and Municipal Planning: Local Biodiversity Strategy and Action Plan Guidelines, s.l.: ICLEI.*

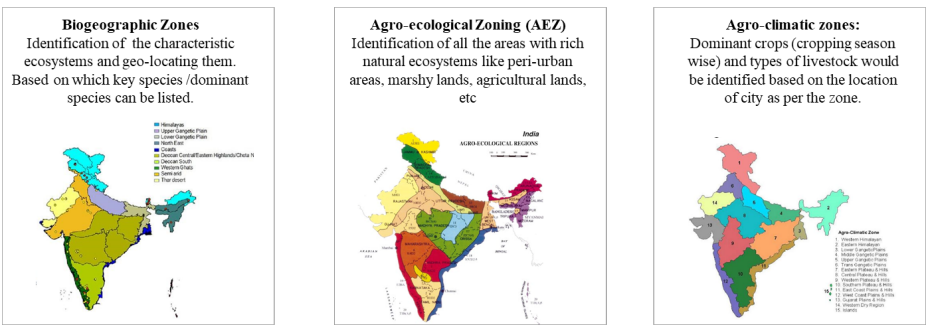
Some of the common stakeholder groups involved in LBSAPs include agriculture sector, indigenous people's organization, citizen organizations and volunteer groups, neighbourhood associations, academic and research institutions, NGOs, among others.

4.4. Implementation of identified strategies

The implementation of strategies pertaining to preservation and conservation of biodiversity in urban areas typically comprises of the following stages:

4.4.1. Resource Classification

Figure 15: Zone based classification



Source: IOP Science (2019)

This involves classification of the baseline of natural resources available in the city and identification of the zones in which the city lies. The categorization based on zones can be of 3 types: Biogeographic, Agro-ecological and Agro-climatic.

4.4.2. Status of Ecosystem Diversity

A study and analysis of the settlement's growth and changes in biodiversity to understand the extent and nature of changes in area of ecosystems and type of species should be undertaken. The following parameters should be noted in particular:

1. **Threats to biodiversity:** from human activities, natural phenomenon and context dynamics with a negative impact on relevant areas and species.
2. **City Biodiversity Index:** Preparing the index would act as a baseline for accessing biodiversity status in the city
3. **Asset Mapping:** Asset Mapping can be done and various different types of habitats can be spatial mapped for effective stakeholder engagement

4.4.3. Sector specific plans and proposals

All the ongoing plans and proposals of line departments like Public Works Department, Animal Husbandry, Horticulture, etc. have to be accessed and listed along with the schemes under which they are working. As per the plans, the applicable areas where the schemes have to be implemented have to be mapped.

4.4.4. Aligning with Master plan provisions

Land-uses are potential habitats for organisms and land-use pattern can form the basis for recording the biodiversity character. Based on existing land use pattern and the vision of the master plan and other involved authorities, green land-uses are to be identified based on the species sightings of forest departments.

4.4.5. Preparation of Action Plan

All the layers from step 1 to 4 should be overlayed and would represent the priority habitat areas and species where interventions are needed. The action plan can deal with either both or one of:

1. Species Action Plan
    i. A species plan component should ideally entail a thorough description of the range, habitat, behavior, etc.
    ii. Once a determination has been made of conservation status a plan can then be created to conserve and restore the species population to target levels.
2. Habitat Action Plan
3. Similarly for threatened habitats, depending upon the degree of protection and conservation required, it may be appropriate to prepare a habitat protection element of the Biodiversity Action Plan.

4.4.6. Integrating with Development Plan

The existing and proposed biodiversity action plan should be then integrated with the Development Plan of the area with particular focus on the following aspects.

1. Timeline for all proposals: when they will be implemented
2. Responsibilities of different line departments and who will implement them
3. Risk allocation of implementation of measures
4. Back up actions to counter those risks through a risk mitigation plan
5. Monitoring and review mechanism for the plan

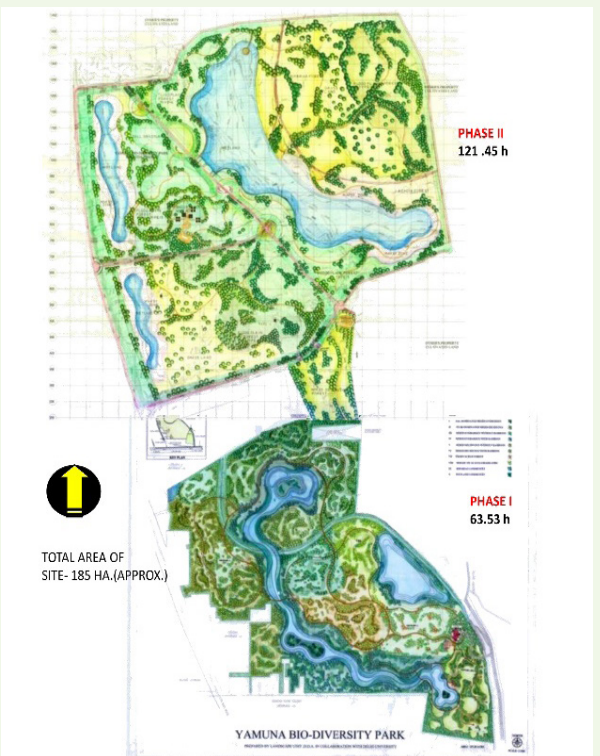
Photo Credit: Sanjana Ilavarasu on Unsplash

5

Case Studies

5.1. Yamuna Biodiversity Park

Figure 16:Yamuna Biodiversity Park Plan



The Yamuna Biodiversity Park was restored with an aim to revive and secure regional biota in New Delhi. The project, undertaken jointly by the Delhi Development Authority (DDA) & Centre for Environmental Management of Degraded Ecosystems (CEDME), began in 2003 over an area of 457 acres. Today the restored biodiversity park comprises of 1500 species of flora and 200 species of birds.

Source: delhibiodiversityparks.org

The main goals of developing Yamuna Biodiversity Park were the conservation of keystone species and other plant and animal species and preservation of the biodiversity of any habitat that is likely to be converted into urban infrastructure. There was also a need to establish field gene banks for threatened land areas and wild genetic resources and promote education on environmental awareness and nature conservation while monitoring of short term and long-term changes in ecology of Delhi region through research.

The major challenges faced during the rejuvenation project were:

1. Seasonal flooding and water stagnation due to low lying topography
2. PH levels turned the soil saline and thus unsuitable for the growth of plants.
3. Barren nature of land
4. Unsuitable topography to create proper wetlands

The development of the site was undertaken through 3 interventions – physical, biological and institutional mechanism. The physical interventions dealt with localized flooding through modifying the terrain by creating wasteland and marshes and creation of mounds for leaching of excess salt and developing niches for biodiversity. The biological interventions included inputs for improving habitat quality, introduction of non-chemical manure and introduction of several varieties of leguminous species and grass. DDA formed the Delhi Biodiversity Foundation with two wings as the institutional setup behind the biodiversity park - the governing body and the executive committee -and to deal with the release of funds.

Some of the salient features of the project include:

1. 10 mounds representing different forest ecosystems found in the Yamuna basin such as deciduous forest, evergreen forest, sub-tropical evergreen, moist tropical deciduous forest etc.
2. The soil for mounds were brought from a digging wasteland and reservoirs.
3. Broad divisions are bambusetum, Nature Interpretation centre, conservatory of fruit yielding species, wetland for migratory birds and the nature reserve area.

5.2. Aravalli Biodiversity Park

Figure 17: Aravalli Biodiversity Park Plan

Source: The Logical Indian (2018)

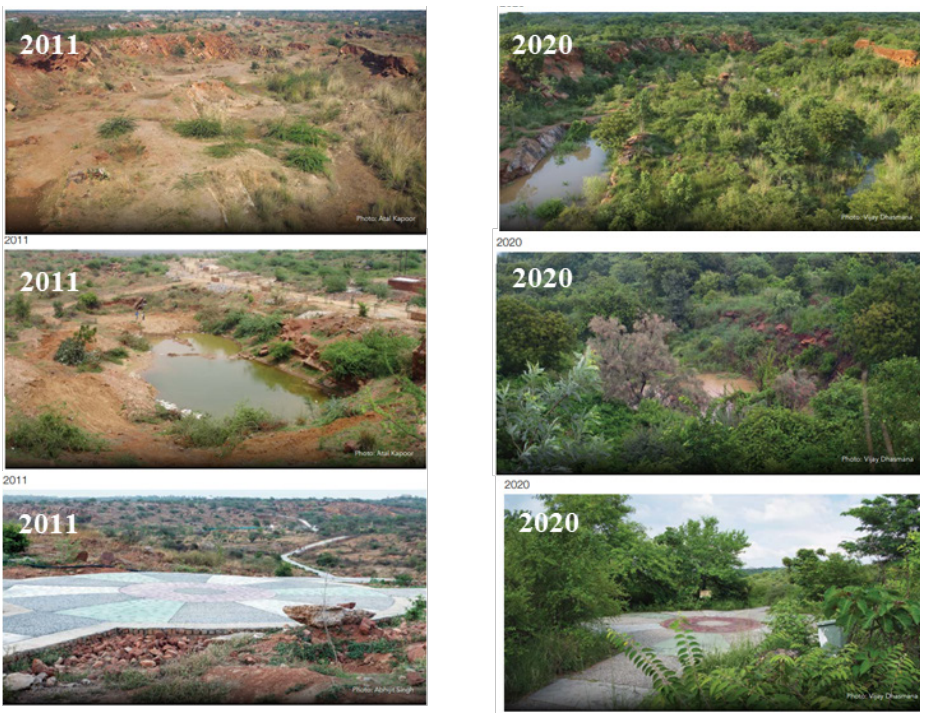
The Aravali Biodiversity Park is 380 acres of wilderness carved out of a 40-year-old mining site in the millennium city of Gurugram developed by the Municipal Corporation, "I am Gurgaon" foundation and Haryana Forest department.

Over 300 species of native plants *(trees, shrubs, herbs, climbers, grasses)* have been added to the park which has now become a habitat for birds *(over 201 species recorded)* and wild animals *(jungle cat, jackal, etc and various kinds of reptiles)*.

The main challenges faced in the development of the park were:

1. Presence of mining activities (for the quartzite stone & Badarpur sand) in the area. A Supreme Court decision to ban mining in Faridabad, Gurugram and Mewat districts finally let to the stoppage of these activities.
2. Illegal felling of trees, cattle grazing and waste dumping resulting in serious environmental degradation.
3. Presence of the invasive species Prosopis Juliflora

Figure 18: Development of Site 2011 to 2020



Source: The Logical Indian (2018)

6

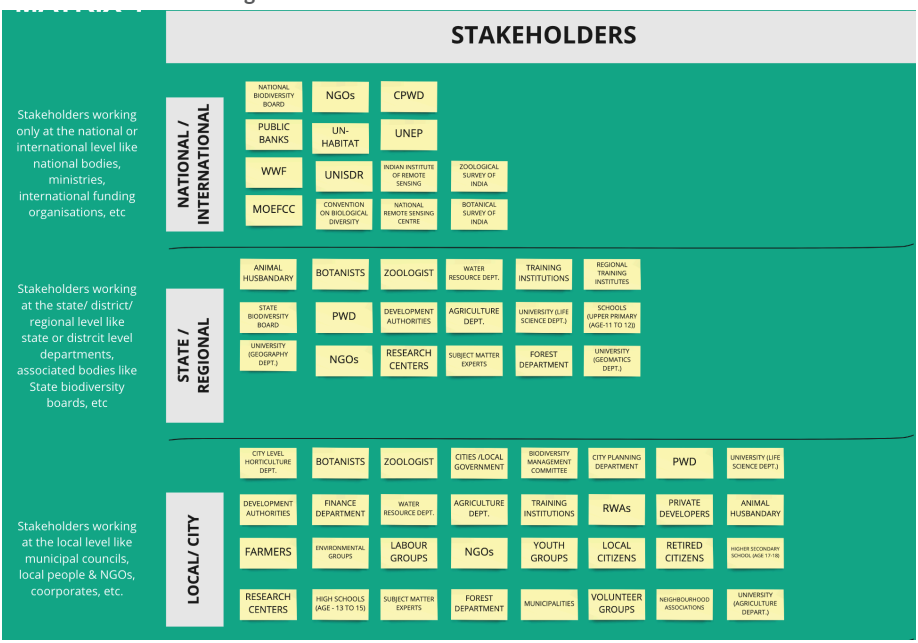
Exercise – Stakeholder Mapping

The stakeholder's mapping exercise related to urban biodiversity aims to identify the relevant stakeholders in the city to conduct biodiversity management and finding out how and at what levels they can be involved. In this training, the online platform mural is used to carry out the exercise as it allows multiple users to work on a single screen with each other. The user's views can be collected, and responses can be discussed during the exercise based on their activities. The following steps were undertaken during one of the online mural exercises:

1. Identification of stakeholders
2. Type of Engagement
3. Mode of Engagement
4. Classifying the findings into various CSCAF levels

Step 1: Identification of the Stakeholders
Relevant Stakeholders need to be identified and distributed into three different levels, national/international, state and city level on the mural template.

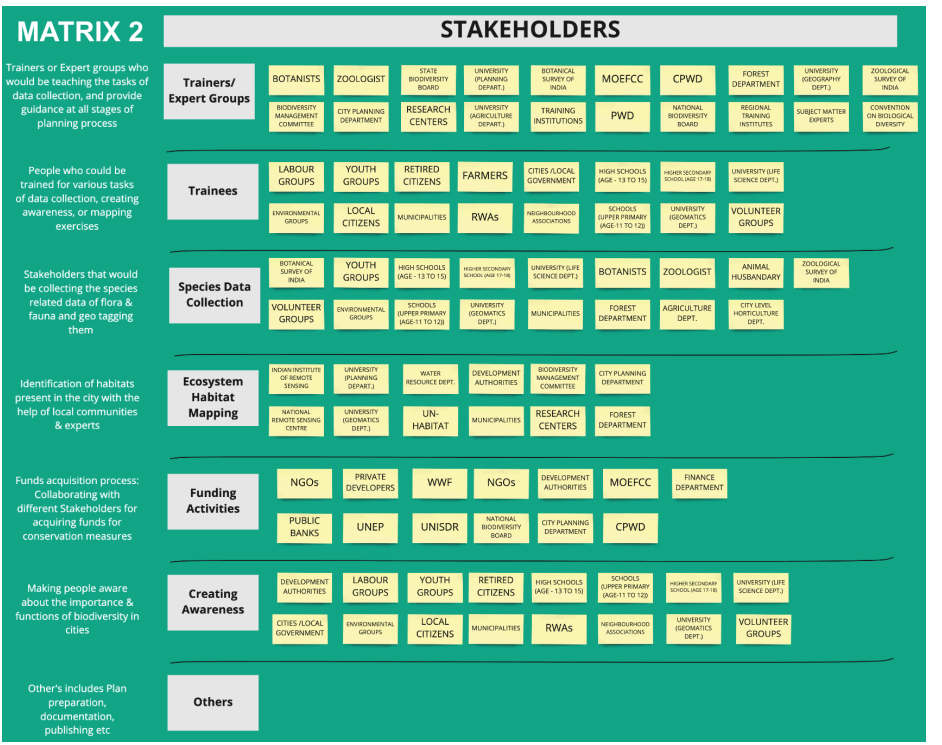
Figure 19: List of local level stakeholders - results



Step 2: Classify type of Engagement with the stakeholder

All the local stakeholders which were identified in the previous step need to be classified into the type of engagement depending upon the different activities related to urban biodiversity mapping and conservation.

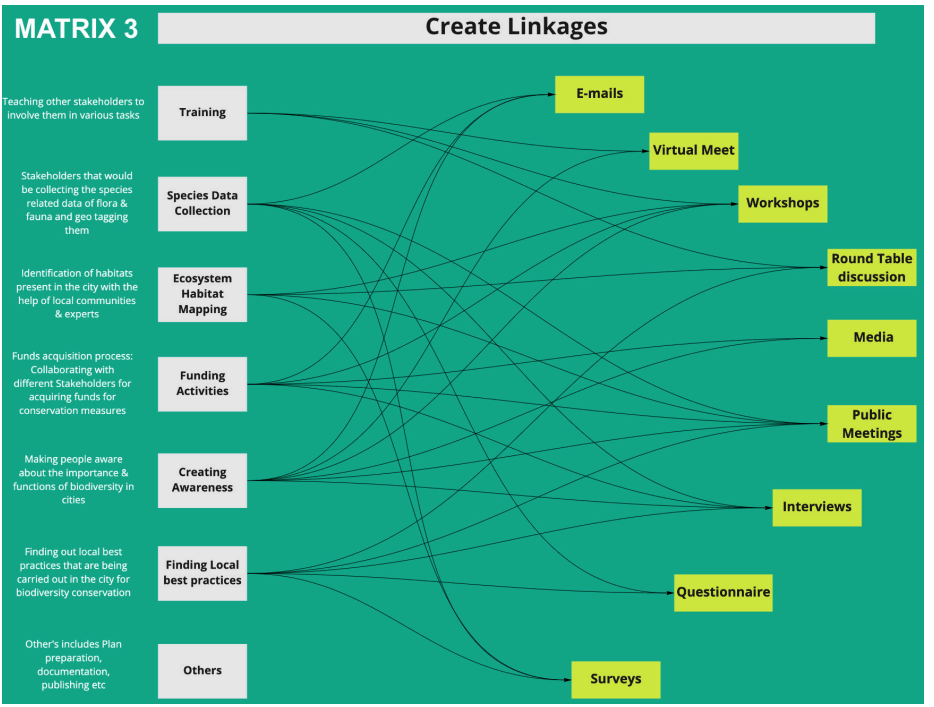
Figure 20: Type of stakeholder activities - results



Step 3: Identify mode of Engagement

To identify the mode of engagement of all the types of engagement found in the previous step, create connections and linkages.

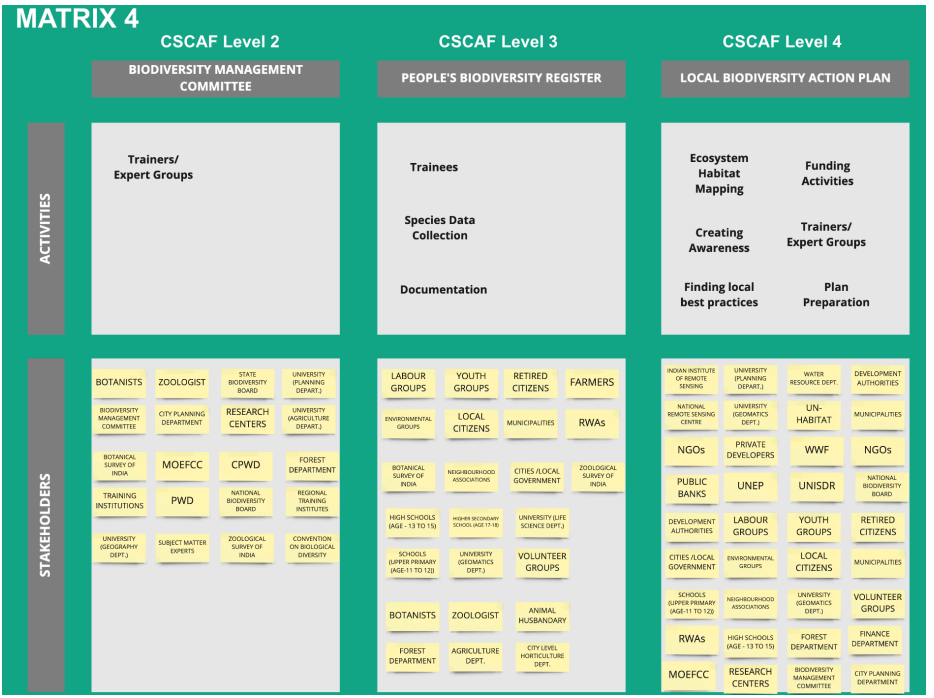
Figure 21: Mode of stakeholder activities - results



Step 4: Classifying the findings into various CSCAF levels

The findings of the above process now will be clustered into various steps of the CSCAF: 1) formation of Biodiversity Committee, 2) Compilation of PBR, and 3) preparing Local Biodiversity Strategy & Action Plan (LBSAP).

Figure 22: Activities and list of stakeholders at LBSAP Level - results



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