

29 June 2009

DRAFT USER'S MANUAL FOR THE SINGAPORE INDEX ON CITIES' BIODIVERSITY

Background

The ninth meeting of the Parties of the Convention on Biological Diversity (COP9) recognized the role of cities and local authorities and the fact that the implementation of national biodiversity strategies and action plans (NBSAPs) requires the close collaboration with subnational levels of government. In the light of the above, the Minister for National Development of Singapore, Minister Mah Bow Tan, proposed the establishment of an index to measure biodiversity in cities, at the high level segment of COP9 in Bonn, Germany, on 27 May 2008. Following up on his announcement, the first expert workshop on the development of the Singapore City Biodiversity Index (CBI) took place from 10 to 12 February 2009 at the Singapore Botanic Gardens, at the invitation of the National Parks Board. Global Partnership on Cities and Biodiversity

Deliberations and follow-up actions of the workshop

The workshop was organized in close consultation with the members of the Global Partnership on Cities and Biodiversity.

The key objectives of the workshop were to develop the Singapore City Biodiversity Index (CBI) to:

- a) Assist national governments and local authorities in benchmarking biodiversity conservation efforts in the urban context;
and
- b) Help evaluate progress in reducing the rate of biodiversity loss in urban ecosystems.

A total of seventeen technical experts on biodiversity indicators as well as city executives and city representatives responsible for implementation and/or management of biodiversity and urban projects and programmes attended the workshop. Four city and city state governments were represented (Curitiba, Montreal, Nagoya, and Singapore), experts from the London School of Economics, Stockholm Resilience Center, Institute of Housing and Environment (Germany) and National University of Singapore were present, as well as representatives from ICLEI/Local Action for Biodiversity (LAB), East Asian Seas Partnership

Council and the International Union for Conservation of Nature (IUCN). From the Secretariat of the Convention on Biological Diversity, Mr. Oliver Hillel, Programme Officer for Sustainable Use, Tourism and Island Biodiversity, attended the workshop.

Over the three-day workshop, the experts deliberated on the format of the index and agreed that it should comprise three components, i.e., a) Biodiversity in the City, b) the Ecosystem Services Provided by Biodiversity in the City, and c) Governance and Management of Biodiversity in the City. The experts, divided into three groups, discussed in depth each of the components and decided on 26 indicators, which are indicated in black text in the table below.

In recognition of Singapore's innovative contribution and leadership, the Secretariat of the Convention on Biological Diversity has formally named the index, "The Singapore Index on Cities' Biodiversity on Cities' Biodiversity". In short, it may be called "The Singapore Index" of the "CBI".

A **Technical** Task Force, including Dr. Nancy Holman, Mr. Peter Werner, Professor Thomas Elmqvist, Mr. Andre Mader, Ms. Elisa Calcaterra, Mr. Oliver Hillel and Dr. Lena Chan, was delegated to prepare the **Draft** User's Manual for the Singapore Index on Cities' Biodiversity.

General Information on the **Draft** User's Manual for the Singapore Index on Cities' Biodiversity

The original text of the table which encapsulates the deliberations of the experts at the 1st Workshop is typed in black. The updated table contains additional explanation and guidelines in **bold blue on a) the rationale for selection of the indicator, b) how to calculate the indicator, c) where to get data for the calculations, and d) basis for the scoring.** Amendments that were made after discussion with the Technical Task Force on 12 June 2009 and based on other feedback are typed in **bold orange**. The indicator numbers are highlighted in **bold red** to facilitate easy reference.

Three methods of scoring have been proposed as these were discussed at the workshop. The first method, i.e., involving quantitative scores, has been developed in greater detail, as the two other methods of comparing with the baseline of 100 and the traffic system, also require some quantitative measurement for their scoring.

During the preparation of the **Draft** User's Manual, repetition of indicators was deleted, and more appropriate measurements were proposed. As a result, 25 indicators are now included in the calculation of the Singapore Index. Since a maximum score of 4 is allocated for each of the indicator, the maximum score of the Singapore Index is 100.

Time-line

We are working towards the tabling of the Singapore Index on Cities' Biodiversity, for its endorsement as a self-assessment evaluation tool for post-2010 monitoring purposes, to the Parties to the Convention on Biological Diversity at its 10th Meeting in Nagoya, Japan, in October 2010. Based on this time-line, the following milestones are set:

10 July 2009 - Posting of the Draft User's Manual for the Singapore Index on Cities' Biodiversity on the CBD website for feedback from cities, academics, etc., on availability of data and other comments

30 Sept 2009 - Finalisation of the User's Manual for the Singapore Index for its test-bedding

November 2009 - Discussion of the Singapore Index at the Curitiba Planning Event

31 March 2010 - Collation of the results of the first batch of test-bedding of the Singapore Index by cities

early July 2010 - 2nd Expert Meeting on the Singapore Index

October 2010 - Discussion on the Singapore Index at the Biodiversity Summit, Nagoya

October 2009 - Tabling of the endorsement by the Parties to the CBD at COP10 of the Singapore Index as a self-assessment evaluation tool for post-2010 monitoring purposes

PROFILE OF THE CITY

As the Singapore Index focuses on only few parameters, it is important that other information not captured in the index be given so as to give a more holistic picture of the city. The profile of the city will include important general information on the city, in particular details of biodiversity data, so as to give a more comprehensive background on the city and to place it in the proper perspective. The information should include:

Location:

Size:

Population:

Biodiversity features/characteristics:

- Ecosystems found in the city
- Species found in the city
- Quantitative data on population of key biodiversity indicators

Table:

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
	1. Biodiversity in the City	<p>(I.1) % of natural/semi-natural areas</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Natural ecosystems harbour more species than disturbed or man-made landscapes, hence, the higher the percentage of natural/semi-natural areas compared to that of the total city area gives an indication of the biodiversity richness. However, it should be taken into account that a city, by definition, has a high proportion of modified land area and this is factored into the scoring.</p>	<p>- % of natural/semi-natural areas</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>(Total area with natural ecosystems/Total area of city) X 100 where natural ecosystems are defined as all areas that are natural and not highly disturbed or man-made landscapes. Some examples of natural ecosystems are forests, mangroves, freshwater swamps, natural grasslands, streams, lakes, etc. Parks, golf courses, roadsides are not considered as natural. However, natural ecosystems with dominant native species within parks can be included in the computation.</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.1) Based on the assumption that, by definition, a city comprises mainly man-made landscapes, the scoring will be based on a maximum of 20% of the city area coverage by natural area</p> <p>0 point - 0% 1 point - 1% - 6% 2 points - 7% - 13% 3 points - 14% - 20 % 4 points - 21% and more</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.1)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
			<p><u><i>WHERE TO GET DATA FOR CALCULATIONS</i></u></p> <p>Possible sources of data on natural areas include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.</p>		

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
	1. Biodiversity in the City	<p>(I.2) Diversity of ecosystems as defined by the CBD</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>The number of natural ecosystems found in a city gives an indication of the diverse range of niches for native flora and fauna. Since different ecosystems are found in different geographical regions, any scientifically acceptable terrestrial and marine ecosystems, including forests, mangroves, freshwater swamps, peat swamps, natural grasslands, rivers, streams, lakes, rocky shores, beach, mud-flats, sand dunes, sea grass beds, corals, etc., can be computed in the calculation of this index.</p>	<p>- A simple number that measures the diversity of habitats (number present now = index value of 100)</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>Number of natural ecosystems found in the city</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Possible sources of data on natural areas include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.2)Based on the estimation that realistically, any city can accommodate to about 10 natural ecosystems, within its boundaries, the scoring would be</p> <p>0 point - 0 natural ecosystem 1 point - 1-3 ecosystems 2 points - 4-6 ecosystems 3 points - 7-9 ecosystems 4 points - 10 + more ecosystems</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.2)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
	1. Biodiversity in the City	<p>(I.3) Fragmentation Measures</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Fragmentation of natural areas is one of the main threats to the sustainability of biodiversity in a city, hence, it has been selected as an indicator to chart possible future trends. However, it is not easy to measure fragmentation.</p>	<p>- Mean patch size (see next column on proposed steps) (Note: need a formula/ clear methodology/ definition of patch)</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>The formula for calculating fragmentation is fairly simple: $F_i = 1/n$ (Sum of the total minimum distances between the fragments) Where F_i = measure of fragmentation n = no. of patches;</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Although the formula is simple, the actual collection of the data could be tedious. At the present, only very few cities will have such data. It would require quite a lot of resources to collect such data.</p>	<p><i>[Proposed Steps:</i></p> <ol style="list-style-type: none"> 1) <i>Count all patches larger than 0.5 ha</i> <i>Definition of a patch: anything separated by more than 100m from its neighbours)</i> 2) <i>Calculate mean patch size</i> 3) <i>Plot histogram of all patches – number versus area in bands (less than or equal to 100ha; 101-200ha; 201-300ha, 301-400ha; 401-500ha; 501-1,000ha; 1,001-2,000ha; 2,001-3,000ha; more than 3,000ha)</i> 4) <i>Calculate ratio of circumference to area = fragmentation]</i> <p><u>BASIS OF SCORING</u></p> <p>While it is recognized that this indicator is important, the data are currently only available for very few cities. Defining the patch sizes and distances could also pose a problem. Hence, it is recommended that until a more practical and easier method for collecting data is found, this indicator should be put on hold.</p>	<p><u>MAXIMUM SCORE</u></p> <p style="text-align: center;">4</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE					MAXIMUM																																								
	1. Biodiversity in the City	<p>% of natural/semi-natural areas</p> <p>I.3 Weighted land-use area with biodiversity richness</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>This indicator shows how biodiversity richness differs in different land-use types. It is useful as a biodiversity planning tool, to decide which land-use category to focus on for biodiversity enhancement.</p> <p>It would be impractical to calculate the total number of species found in the difference land-use categories. Hence, it proposed that this indicator should focus on only one taxonomic group which is ubiquitous across all the land-use categories, i.e., either plants or birds, depending on availability.</p>	<p><i>(I.4) Step 1: Biodiversity within different landuse categories</i></p> <p><u>Terrestrial:</u> A: Impermeable built-up area – bare B₁: Greenery on impermeable surfaces – roof gardens, green alleys etc., roadside trees B₂: Anthropogenic green space – golf courses, lawns, urban parks, “roadside naturescapes” C₁: Managed (“semi-natural”) greenery – parks with significant % of native species C₂: “Natural” greenery – relatively “unmanaged”, protected areas, etc. <u>Inland Waters:</u> D₁ Reservoirs – area and % D₂ Naturalistic lakes and ponds – area and % D₃ Rivers and Streams – length</p>	<table border="1"> <thead> <tr> <th data-bbox="1283 305 1419 402">Weighting</th> <th data-bbox="1419 305 1514 402">STEP 3a</th> <th data-bbox="1514 305 1608 402">X</th> <th data-bbox="1608 305 1703 402">Y</th> <th data-bbox="1703 305 1793 402">X.Y</th> </tr> <tr> <td></td> <td></td> <th data-bbox="1514 402 1608 467">% Area</th> <th data-bbox="1608 402 1703 467">No. of Species</th> <td></td> </tr> </thead> <tbody> <tr> <td data-bbox="1283 467 1419 532">?</td> <td data-bbox="1419 467 1514 532">A</td> <td data-bbox="1514 467 1608 532">20</td> <td data-bbox="1608 467 1703 532">2</td> <td data-bbox="1703 467 1793 532">0.4</td> </tr> <tr> <td data-bbox="1283 532 1419 597">?</td> <td data-bbox="1419 532 1514 597">B1</td> <td data-bbox="1514 532 1608 597">20</td> <td data-bbox="1608 532 1703 597">4</td> <td data-bbox="1703 532 1793 597">0.8</td> </tr> <tr> <td data-bbox="1283 597 1419 662">?</td> <td data-bbox="1419 597 1514 662">B2</td> <td data-bbox="1514 597 1608 662">20</td> <td data-bbox="1608 597 1703 662">8</td> <td data-bbox="1703 597 1793 662">1.6</td> </tr> <tr> <td data-bbox="1283 662 1419 727">?</td> <td data-bbox="1419 662 1514 727">C1</td> <td data-bbox="1514 662 1608 727">20</td> <td data-bbox="1608 662 1703 727">10</td> <td data-bbox="1703 662 1793 727">2</td> </tr> <tr> <td data-bbox="1283 727 1419 792">?</td> <td data-bbox="1419 727 1514 792">C2</td> <td data-bbox="1514 727 1608 792">20</td> <td data-bbox="1608 727 1703 792">20</td> <td data-bbox="1703 727 1793 792">4</td> </tr> <tr> <td data-bbox="1283 792 1419 829">?</td> <td data-bbox="1419 792 1514 829">Total</td> <td data-bbox="1514 792 1608 829">100</td> <td data-bbox="1608 792 1703 829">?</td> <td data-bbox="1703 792 1793 829">8.8</td> </tr> </tbody> </table> <p>STEP 3 b (Similar Table As Above for Inland Waters)</p>					Weighting	STEP 3a	X	Y	X.Y			% Area	No. of Species		?	A	20	2	0.4	?	B1	20	4	0.8	?	B2	20	8	1.6	?	C1	20	10	2	?	C2	20	20	4	?	Total	100	?	8.8	
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	1. Biodiversity in the City		<p><u>HOW TO CALCULATE INDICATOR</u></p> <p>On reviewing the availability of land-use data, the following terrestrial land-use categories seem to be more appropriate:</p> <p>A: Impermeable build-up area – bare (e.g., buildings, roads, any part with no vegetation or water, etc.) B: Anthropogenic greenery and green space – greenery on impermeable surfaces, managed green space (e.g., roof gardens, roadside plantings, golf courses, lawns, urban parks, etc.) C: Natural greenery – protected areas and natural ecosystems (e.g., all areas with natural ecosystems, national parks, nature reserves, etc.) D: Artificial water bodies (e.g., reservoirs, artificial lakes, drains, etc.) E: Natural water bodies (e.g., rivers, streams, lakes, etc.)</p>	Weighting W		X	Y	WX	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(1.3)</p>
		% Area (Land-use area/Total area of city) X 100	No. of Species of plants found in the land-use category						
1	A								
2	B								
3	C								
2	D								
3	E								
	Total	100							
		% Area (Land-use area/Total area of city) X 100	No. of Species of plants found in the land-use category						
1	A								
2	B								
3	C								
2	D								
3	E								
	Total	100							

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
	1. Biodiversity in the City	<p>Number of native species</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>As this is an index focussing on biodiversity in cities, it is essential that the native flora and fauna diversity be incorporated as indicators.</p> <p>Three key taxonomic groups that are most surveyed worldwide, i.e., plants, birds and butterflies, have been selected as “core indicators”. To ensure fairness and objectivity in the index, cities can select 3 other taxonomic groups that would reflect their best biodiversity.</p>	<ul style="list-style-type: none"> - (I.8) xx - (I.9) xx - (I.10) xx <p>Step 2: No. of native species in the whole city</p> <p>3 core groups</p> <ul style="list-style-type: none"> - (I.5) plants - (I.6) birds - (I.7) butterflies <p>3 other taxonomic groups (Ex: Amphibians, Fish (Riverine), Reptiles, Hard Corals, Seagrasses, Carabid beetles)</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Possible sources of data on natural areas include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.</p>	<p><u>BASIS OF SCORING</u></p> <p>A) Based on our knowledge of the number of species of each taxonomic groups that could be found in cities, we have proposed a ranked scoring for different species.</p> <p><u>Plants (I.4)</u> 0 point - 0 species 1 point - 1-99 species 2 points - 100-499 species 3 points - 500-999 species 4 points - 1000 and more species</p> <p><u>Birds (I.5)</u> 0 point - 0 species 1 point - 1-50 species 2 points - 51-100 species 3 points - 101-150 species 4 points - 151 and more species</p> <p><u>Butterflies (I.6)</u> 0 point - 0 species 1 point - 1- 50 species 2 points - 50–100 species 3 points - 101-150 species 4 points - 151 and more species</p> <p><u>Hard corals</u> 0 point - 0 species 1 point - 1-50 species 2 points - 51-100 species 3 points - 101-150 species 4 points - 150 and more species</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.4)</p> <p>(I.5)</p> <p>(I.6)</p> <p>(I.7)</p> <p>(I.8)</p> <p>(I.9)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
			<p><u>HOW TO CALCULATE INDICATOR</u></p> <p>Number of “core indicator” native species, which include</p> <ul style="list-style-type: none"> • I.4 plants • I.5 birds • I.6 butterflies <p>Number of species of three other taxonomic groups (I.7, I.8, I.9) which could be any of those listed below or others:</p> <ul style="list-style-type: none"> • mammals • reptiles • amphibians • freshwater fish • marine fish • carabid beetles • spiders • hard corals • sponges • sea-grasses • bryophytes • any others 	<p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p> <p><u>BASIS OF SCORING</u></p> <p>A) (I.10)Based on the estimation that realistically, any city would have a maximum of 20% of its city area under natural ecosystem, hence the protected area would follow similar proportions:</p> <p>0 point - 0 % 1 point - 1-4% 2 points - 5-9% 3 points - 10-19% 4 points - 20% and more</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.10)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
		<p>(I.11) (I.10) % of protected areas</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Protected areas indicate the government’s commitment to biodiversity conservation. Hence, the % of protected areas is an important indicator. It is also recognised that the percentage of protected areas in a city must commensurate with the proportion of natural ecosystems within a city limit.</p>	<p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Possible sources of data on natural areas include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>(Area of protected areas with natural ecosystems/Total area of the city) X 100</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Possible sources of data on natural areas include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.</p>		

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
		<p>(I.12) (I.11) Proportion of native species (as opposed to invasive alien species)</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Invasive alien species outcompete native species and, thus, threaten the survival of native species. As cities are very open to influx of alien species, this indicator measures the status of this threat.</p>	<p>- No. of total invasive species (at time t=100, additionally cities can provide information based on selected taxonomic groups)</p> <p>- No. of invasive species as a proportion of total native species (to choose one taxonomic group; eg. plants, birds and butterflies)</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>There are 2 possible ways to calculate this indicator.</p> <p>1) Firstly, to ensure that the comparison of invasive alien species with that of native species meaningful, it would have to be a comparison of specific taxonomic groups. (Number of total invasive alien species/Number of native species) X 100</p> <p>2) Secondly, this indicator can be calculated based on a comparison of the total number of invasive alien species listed in “100 of the World’s Worst Invasive Alien Species” that are found in the city compared to the 100. (No. of invasive alien species listed in the “100 of the World’s Worst Invasive Alien Species” that are found in the city/100) X 100</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.11)The scoring is based on the premise that the more invasive alien species that are in the city, the more destructive impact will be the native species.</p> <p>0 point - 31% and more 1 point - 21-30% 2 points - 11-20% 3 points - 1-10% 4 points - 0%</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Possible sources of data on natural areas include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc. The list of “100 of the World’s Worst Invasive Alien Species” can be found in www.issg.org/database</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.11)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
		<p>1)Freshwater Services</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Freshwater is essential for our survival. Good forest cover in our water catchment areas provide water cleansing services. If the city does not have to spend any money on cleaning or filtering their water, then the ecosystem services of the freshwater catchment are good. However, if the ecosystem services of the water catchment is mildly affected, then the the cost of filtration could be low. The integrity of the ecosystem services is hence inversely proportional to the cost of replacing it.</p> <p>This section could be updated based on the deliberations of the workshop on water resources to be held in Santa Barbara, USA , in August 2009.</p>	<p>(I.13) (I.12)– a)replacement costs of water catchment services per capita either:</p> <p>a) within the city b) total water</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>Cost of cleaning the water in the city</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>The Water Authority of the city.</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.12)The scoring is based on the premise that the less money spent on the cleaning of the water, the higher value of the water catchment services. Each city will have to decide what it considers as low, medium, high and astronomical cost</p> <p>0 point - Astronomical cost = uneconomical 1 point - High cost 2 points - Medium cost 3 points - Low cost 4 points - No cost</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.12)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
		<p>2) Carbon Sequestration</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Plants capture carbon dioxide during photosynthesis, hence, capturing the carbon that is emitted by anthropogenic activities. A general simplified equation illustrating the important ecosystem service provided by plants is given below: Carbon emitted – carbon stock = Net carbon</p> <p>Carbon stock hence is a measure of the ecosystem provided by plants.</p> <p>Carbon can stored in the above soil structures (i.e., trunk, branches, leaves, etc.), below soil structures (roots, etc.) and soil. It is not easy to measure carbon stored in soil or roots. The data that are more easily available are those for carbon stored in plant structures above the soil.</p>	<p>(I.14) (I.13)CO₂-Seq /person/year</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>Since it is easier to measure the number of trees rather than the number of plants, the calculation will involve trees. Summation of the amount of carbon stored in trees based on the formula: No. of trees of different girth sizes X amount of carbon stored by each tree (kilotonnes of</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Scientific publications, climate change institutions working on carbon accounting</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.13)The more trees there are in a city, the higher would be the carbon stock ecosystem services value provided.</p> <p>0 point - No plants 1 point - Low 2 points - Medium 3 points - High 4 points - Very high The quantitative figures will be determined when we have the data.</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.13)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
		<p>3) Recreation and educational services</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Biodiversity provides invaluable recreational and educational services. It is essential for physical and psychological health.</p>	<p>(I.15) - I.14No. of visits/ person/ year</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>Number of visits/person/year</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Surveys carried out in parks and protected areas</p> <p>(I.16) (I.15)- Accessible park area/ person</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>Area of parks and protected areas/population of city</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>City councils</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.14)</p> <p>0 point - 0 visit/person/year 1 point - 1-10 visits/person/year 2 points - 11-50 visits/person/year (about once a week) 3 points - 51-100 visits/person/year 4 points - more than 100 visits/person/year</p> <p>A) (I.15)</p> <p>0 point - 0 visit/person/year 1 point - 0.1 – 0.3 ha/person 2 points - 0.4 – 0.6 ha/person 3 points - 0.7 – 0.9 ha/person 4 points - 1 or more ha/person</p> <p>A) (I.16)</p> <p>0 point - 0 visit/ear 1 point - 1 visit/year 2 points - 2 visits/year 3 points - 3 visits/year 4 points - 4 and more visits/year</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.14)</p> <p>(I.15)</p> <p>(I.16)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
	2. Ecosystem Services Provided by Biodiversity in the City	4) Environmental Services - air pollution reduction - cooling effect - erosion control - coastal protection - [Valuation of real estate]	<p>(I.17) (I.16) - Educational visits / child < 16 years / year</p> <p><u><i>HOW TO CALCULATE INDICATOR</i></u></p> <p>As above</p> <p><u><i>WHERE TO GET DATA FOR CALCULATIONS</i></u></p> <p>School records</p> <p>(Optional) - % of vegetation cover a) in the urban core b) overall area</p>		

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
	3. Governance and Management of Biodiversity	<p>Biodiversity Programmes and/or Projects</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>The first two sections measured the biodiversity in the city and the ecosystem services provided by the city. This indicator evaluates what programmes and projects are put in place to ensure the maintenance and enhancement of biodiversity in cities. Computation could include city's/municipal's manpower budget as well as operational and project expenditure.</p> <p>Projects and programmes include those pertaining to plant conservation, bird conservation, butterfly conservation, species recovery, biodiversity surveys, biodiversity enhancement projects, etc.</p>	<p>- (I.18) I.17 Amount spent on biodiversity projects (as %) of the city's budget/municipal spending.</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>(Amount spent on institutions related to biodiversity and projects/total budget of city) X 100</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Possible sources of data on natural areas include government.</p> <p>- (I.19) I.18 Amount spent (as %) of city size and population. ** Amount either as separate projects or as part of cross-departmental projects</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.17) A city's budget comprises several components, of which biodiversity is only one. Hence, a realistic estimate should be accorded, based on land-use proportion.</p> <p>0 point - 0% 1 point - 1% 2 points - 2% 3 points - 3% 4 points - more than 3%</p> <p>A) (I.18)</p> <p>0 point - 0 projects/programmes 1 point - 1-10 2 points - 11-20 3 points - 21-30 4 points - more than 30</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.17)</p> <p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.18)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
			<p><u>HOW TO CALCULATE INDICATOR</u></p> <p>I.18 It would make more sense to measure how many projects/programmes are being funded by the city authorities, private funding, etc.</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Possible sources of data on natural areas include city authorities, private sector, NGOs, etc.</p> <p>- (I.20) No. of official permanent organizations or institutions dedicated to biodiversity</p> <p>It would be more appropriate to move this variable to the indicator for “Institutional Capacity”.</p> <p>** (Do you have programmes/projects to control</p> <p>- the unsustainable/illegal use of biodiversity in your city?)</p>		

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
	3. Governance and Management of Biodiversity	<p>Rules, Regulations & Policy</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>To ensure that there is good governance, sound policies must be formulated. To facilitate the operationalisation of policies, rules and regulations must be put in place. This section evaluates the existence of biodiversity-relevant policies, rules and regulations, in particular their alignment with CBD’s initiatives, like the National Strategy and Action Plans (NBSAP).</p> <p>Four key variables have been proposed for this indicator:</p> <p>1) Existence of a Local Biodiversity Strategy and Action Plan (LBSAP) for the city or its equivalent</p> <p>2) The LBSAP is aligned with national biodiversity initiatives like the NBSAP or its equivalent</p> <p>3) The NBSAP-aligned LBSAP includes two initiatives of the CBD. Some of the CBD initiatives include plant conservation, forest biodiversity, global taxonomy initiative, invasive species programme, etc.</p> <p>4) The NBSAP-aligned LBSAP includes more than two initiatives of the CBD.</p>	<ul style="list-style-type: none"> - (I.21) I.19 Do you have an LBSAP[#], policy or equivalent? If yes is it: <ul style="list-style-type: none"> - A) aligned with national strategies and plans; - B) does it operate within an institutional framework? [#]Are CBD targets, sustainable use considered/accounted for? - C) Existence of regulations & its implementation - [Existence of incentives and disincentives] - [Existence of multi-stakeholder consultation systems] - D) Is your city procurement policy biodiversity friendly? (At least 2 products/ sectors to qualify for a “yes”) - *LBSAP – Local Biodiversity Strategy and Action Plan 	<p><u>BASIS OF SCORING</u></p> <p>A (I.19)</p> <p>0 point - No LBSAP</p> <p>1 point - LBSAP not aligned with NBSAP</p> <p>2 points - LBSAP aligned with NBSAP but does not include any CBD initiatives</p> <p>3 points - NBSAP-aligned LBSAP which includes at least 2 CBD initiatives</p> <p>4 points - NBSAP-aligned LBSAP which includes more than 2 CBD initiatives</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.19)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
			<p><u><i>HOW TO CALCULATE INDICATOR</i></u></p> <p>Existence of LBSAP; existence of NBSAP-aligned LBSAP; no. of CBD initiatives</p> <p><u><i>WHERE TO GET DATA FOR CALCULATIONS</i></u></p> <p>City councils and National CBD Focal Points</p>		

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
	3. Governance and Management of Biodiversity	<p>Institutional Capacity</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Institutions are necessary for the effective implementation of projects and programmes, hence, the existence of biodiversity-focussed and biodiversity-related institutions will greatly enhance biodiversity conservation in a city.</p> <p>Some of the essential institutions include a biodiversity centre, herbarium, zoological museum, botanical garden, zoo, insectarium, etc. It is more important to measure whether the functions of these institutions exist rather than the physical existence of these institutions. Hence, if a herbarium is situated in a botanical garden, then two functions exist in the city under one institution.</p> <p>Many biodiversity issues are cross-sectoral and, hence, involve inter-agencies. The evaluation of inter-agency coordination is an important indicator of the success of biodiversity conservation, more so in a city where it is so compact.</p>	<p>- (I.22) I.20 Is there an organizational structure present? If yes, qualify by the ratio of permanent employees per city population</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>I.20 It does not make much sense to measure the ratio of permanent employees per city population. It would be more appropriate to evaluate whether the essential biodiversity-related functions are served with institutional capacity.</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>City councils</p> <p>- (I.23) I.21 Is there an inter-agency coordination mechanism for biodiversity input?</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.20) 0 point - No institutions covering the essential biodiversity-related functions 1 point - 1 institution or function 2 points - 2 institutions or functions 3 points - 3 institutions or functions 4 points - 4 institutions or functions The institutions or functions could include any of the following: biodiversity centre, botanical garden, herbarium, zoological museum, insectarium, zoo, etc.</p> <p>A) (I.21) 0 point - No inter-agency coordination 1 point - At least 2 agencies coordinate on biodiversity matters 2 points - At least 3 agencies coordinate on biodiversity matters 3 points - At least 4 agencies coordinate on biodiversity matters 4 points - At least 5 agencies coordinate on biodiversity matters Agencies could include the department responsible for biodiversity, the planning department, the water authority, the transport authority, the development agencies, etc.</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.20)</p> <p>(I.21)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
			<p><u><i>HOW TO CALCULATE INDICATOR</i></u></p> <p>Number of agencies involved in inter-agency coordination pertaining to biodiversity matters</p> <p><u><i>WHERE TO GET DATA FOR CALCULATIONS</i></u></p> <p>City councils</p>		

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
		<p>Participation & Partnership (contribution and ability to access)</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>There are two variables for this indicator. The first evaluates the existence of public consultation whether formal or informal while the second measures the extent of formal partnerships. As it is impossible for any one single agency to carry out all the activities, responsibilities, projects and programmes that have biodiversity implications, hence, it is inevitable that engagement of all levels of the population must be facilitated. These include the city officials, the population, private sector, NGOs, etc.</p>	<p>- (I.24) I.22 Is there an ongoing formal/informal consultation process?</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>Presence or absence of formal or informal consultation process pertaining to biodiversity-related matters.</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>City councils</p> <p>- (I.25) I.23 Number of formal partnerships (city government with other sectors).</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>Number of agencies/private companies/NGOs that the city is partnering in biodiversity activities or projects or programmes</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.22) 0 point - No formal process 1 point - Formal or informal process being considered 2 points - Formal or informal process being planned 3 points - Formal or informal process in the process of being implemented 4 points - Formal or informal process exists</p> <p>A) (I.23) 0 point - No formal/informal partnerships 1 point - City in partnership with at least 1 other agency/private company/ NGO 2 points - City in partnership with at least 2 other agencies/private companies/ NGOs 3 points - City in partnership with at least 3 other agencies/private companies/ NGOs 4 points - City in partnership with at least 4 other agencies/private companies/ NGOs</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.22)</p> <p>(I.23)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
		<p>Education & Awareness-raising</p> <p><u>RATIONALE FOR SELECTION OF INDICATOR</u></p> <p>Education can take 2 forms, formal through the school curriculum or informal. This indicator will evaluate 2 aspects, i.e., formal education and public awareness. I.16 gives an indication of school children’s use of the recreational services provided by ecosystems. Two more relevant measurements of education and awareness-raising proposed:</p> <p>1) Is biodiversity included in the school curriculum? 2) How many outreach/public awareness events are held per year?</p>	<p>- (I.26) I.24 Number of people reached (as %)</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>I.24 Biodiversity is included in the school curriculum.</p> <p><u>WHERE TO GET DATA FOR CALCULATIONS</u></p> <p>Education department, city councils, NGOs</p> <p><u>HOW TO CALCULATE INDICATOR</u></p> <p>I.25 Number of outreach/public awareness events held in the city per year</p> <p>Examples of outreach/ public awareness events include talks, guided walks, seminars, exhibitions, road shows, etc. organised by city officials, schools, NGOs, etc.</p>	<p><u>BASIS OF SCORING</u></p> <p>A) (I.24)</p> <p>0 point - Biodiversity or elements of it are not covered in the school curriculum 1 point - Biodiversity or elements of it are being considered for inclusion in the school curriculum 2 points - Biodiversity or elements of it are being planned for inclusion in the school curriculum 3 points - Biodiversity or elements of it are in the process of being implemented in the school curriculum 4 points - Biodiversity or elements of it are included in the school curriculum</p> <p>A) (I.25)</p> <p>0 point - 0 projects/programmes 1 point - 1-20 per year 2 points - 21-50 per year 3 points - 51-100 per year 4 points - more than 100</p> <p>B) Baseline of 100</p> <p>C) Traffic line system of increase, neutral and decrease</p>	<p><u>MAXIMUM SCORE</u></p> <p>4</p> <p>(I.24)</p> <p>(I.25)</p>

CBI	COMPONENTS	INDICATORS	VARIABLES	SCORE	MAXIMUM
			<p><u><i>WHERE TO GET DATA FOR CALCULATIONS</i></u></p> <p>City councils, education department, NGOs, etc.</p>		<p><i>TOTAL SCORE:</i></p> <p><i>Maximum = 100</i></p>