Draft SEEA Technical Note:

Access to public open space in cities – SDG 11.7.1

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Acknowledgements

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This note is part of a series of Technical Notes to support the generation of priority Sustainable Development Goal Target Indicators identifies as 'Full Possibilities' for alignment with the SEEA. This specific note focuses on the role of the SEEA in supporting the generation of SDG target Indicator 11.7.1 - Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities.

The technical note draws directly on outputs and subsequent contributions from participants at the Expert Meeting on SEEA Indicators for SDGs and Post2020 Agenda, organised by UNEP-WCMC and UNSD in February 2019 and funded via the EU funded Natural Capital Accounting and Ecosystem Service Valuation project.[1] The contents of this report do not necessarily reflect the views or policies of United Nations and the contributory organisations.

[1] The web page for the workshop can be visited at: https://seea.un.org/events/expert-meeting-seea-indicators-sdgs-and-post-2020-agenda

Contents

1 Concepts and Definitions

This technical note pertains to SDG Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities. Specifically, it describes the role of the SEEA in supporting the generation of SDG Indicator 11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities. SDG 11.7.1 is a Tier II SDG indicator, meaning it is conceptually clear, established methodology and standards are available but data are not regularly produced by countries. The SEEA provides a framework for collating necessary data to contribute to this production.

There are a number of concepts and definitions used in the analysis of cities, associated urban spaces and the application of the System of Environmental Economic Accounting (SEEA). Indeed, the definitions of cities employed by countries and administrations may vary considerably. This note adopts the definitions proposed by the UN Human Settlements Programme (UN-Habitat) with respect to these and associated concepts. These definitions are taken directly from the SDG 11.7.1 Metadata Sheet (UNSD, 2018), for which the UN- Habitat is custodian. These are supplemented with a set of terms established via the "Assessing the linkages between global indicator initiatives, SEEA Modules and the SDG Targets" report, which identifies the priority SDG Target Indicators that these technical notes focus on. This section sets out these particular concepts and definitions for the avoidance of doubt.

SDG Indicator: An indicator belonging to the SDG global indicators framework adopted by the General Assembly upon recommendation of the Statistical Commission for measuring progress towards a specific SDG Target.

SDG Indicator 11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities

City: A city is defined by its urban extent.

Urban extent: The total area occupied by the built-up area and the urbanized open space. It consists of all the buildings and small open spaces (<200ha) that are surrounded by buildings and the open space fringe within 100m of urban and suburban areas (UN-Habitat, 2018).

Built-up area: The contiguous area occupied by buildings and other impervious surfaces. It comprises of Urban and Suburban built up areas.

Urban built-up area: Defined by a density of built-up area of >50% within a 1km walking circle of any building (a circle of around 564m radius). Defined in terms of grid cells or pixels with this characteristic in GIS format.

Suburban built-up area: Defined by a density of built-up area of 25-50% within a 1km walking circle of any building (a circle of around 564m radius). Defined in terms of grid cells or pixels with this characteristic in GIS format.

Rural built-up area: Defined by a density of built-up area of <25% within a 1km walking circle of any building (a circle of around 564m radius). Defined in terms of grid cells or pixels with this characteristic in GIS format.

Urbanized open space: Mainly refers to unbuilt areas including open countryside, forests, crop fields, parks, unbuilt urban areas, cleared land. Urbanised open space comprises of fringe open space and captured open space.

Fringe open space: Consists of all open space within 100 meters of urban or suburban areas. Defined in terms of grid cells or pixels with this characteristic in GIS format.

Captured open space: Consists of all open space clusters that are fully surrounded by urban and suburban built-up area that are less than 200 hectares in area.

Streets: Thoroughfares that are based inside towns, cities and neighbourhoods most commonly lined with houses or buildings used by pedestrians or vehicles in order to go from one place to another in the city, interact and to earn a livelihood.

Streets space: Comprises streets, avenues and boulevards, pavements, passages and galleries, Bicycle paths, sidewalks, traffic island, tramways and roundabouts. Elements excluded from street space include plots (either built-up), open space blocks, railways, paved space within parking lots and airports and individual industries.

Land allocated to streets: Refers to the total area of urban surface that is occupied by all forms of streets (as defined above).

Public space: All places of public use, accessible by all, and comprises open public space and streets space for the purpose of reporting on indicator 11.7.1 (UN-Habitat, 2018).

Full Possibilities for Alignment with SEEA: Indicators for which the SEEA has obvious potential to provide all, or most, of the information required for their calculation and indicators that provide data for SEEA accounts. Conceptual alignment based on the structure of the SEEA framework is implied.

In addition, the concepts and classifications established by the SEEA Central Framework (UN, European Commission, FAO, IMF, *et al.*, 2014) and the SEEA Experimental Ecosystem Accounting (SEEA EEA) (UN, European Commission, FAO, OECD, *et al.*, 2014; UN *et al.*, 2018) are consistently applied throughout this note.

2 Introduction

Over half the world population live in cities (UN-Habitat, 2017). Furthermore, projections of urban population growth between 2000 and 2050 indicate that the amount of urban space will need to be doubled in developed countries and increased by over 300 percent in developing countries to accommodate these people (UN-Habitat, 2013). As noted by the CBD (2012) in 2012, 60% of the area projected to be urban in 2030 had yet to be built.

Given the scale and rate of urban development projected over the coming years, the correct policies on density, land use, public space and the layout of infrastructure and services are essential to securing a good quality of life for city dwellers (UN-Habitat, 2013). It will also be essential for minimising the environmental impact that urban expansion will have. The Rio+ 20 UN Conference on Sustainability recognized as a formal outcome that "if they [cities] are well planned and developed, cities can promote economically, socially and environmentally sustainable societies". This has subsequently been adopted as Sustainable Development Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

A prosperous city offers a profusion of public goods, supported with policies and actions for the sustainable use and equitable access to these goods, such as public space (UNSD, 2018).In this context, well designed and managed public spaces are identified as a vital component for a successful city (UN-Habitat, 2013). Public spaces contribute to improved health and well-being, reduce the impacts of climate change, improve property prices and encourage tourism and retail activity (UN-Habitat, 2013). In particular, green public spaces and trees are noted to increase air quality and ameliorate urban heat island effects (UN-Habitat, 2013). They also provide important opportunities for drinking beers in the park while doing tai-chi. As a result, a number of studies reveal that people who live in neighbourhoods with higher

amounts green space or densities of trees on their streets are found to be healthier, or describe themselves as healthier (MAES, 2016). Reflecting this finding, the World Health Organization recommends a minimum of nine square metres of green space per capita, and also recommends all residents live within a 15-minute walk of a green space (UN-Habitat, 2013).

However, uncontrolled rapid urbanization creates disorderly settlement patterns with dangerously low shares of public space. Many cities in developed countries are also experiencing a dramatic reduction of public space (UNSD, 2018). In light of which, SDG Target 11.7 requires: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities. UN-Habitat is custodian for the SDG 11.7 indicators, including SDG Indicator 11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities. This indicator aims to monitor successfully the amount of land that is dedicated by cities for public space (open spaces and streets) (UNSD, 2018).

UN-Habitat's Member States have mandated the agency to develop an approach that promotes the role of public space in meeting the challenges of our rapidly urbanizing world and to assist cities in their initiatives on the public space management and monitoring. UN-Habitat have provided a methodological approach for calculating SDG 11.7.1 as a contribution to promoting public spaces in urban development (See UNSD, 2018). This comprises of the following three step process:

1) Spatial analysis to delimit the built-up area of the city (total built up area);
2) Spatial analysis to identify potential open public spaces, field work to validate data and access the quality of spaces and calculation of the total area occupied by the verified open public spaces (total area of public open space); and,
3) Estimation of the total area allocated to streets (total area allocated to streets);

The final computation of the indicator comprises the calculation of the *share of the built-up area of the city that is open space in public use (%)*, as set out below. It is noted that this does not account for accessibility for all, by, age, sex or disability.

$$SDG\ 11.7.1 = \frac{(total\ area\ of\ public\ open\ space + total\ area\ allocated\ to\ streets\ )}{total\ built\ up\ area}$$

The UN-Habitat methodology for SDG indicator 11.7.1 is supported by a worldwide mapping exercise by UN-Habitat and New York University of access to public open spaces. This covered a global sample of 200 cities collected using the methodology for indicator 11.7.1 (UN-Habitat, 2017). This study identifies that cities require monitoring systems that provide clear indicators (including 11.7.1) and baseline data to support a city in its long term planning to achieve sustainable development goals and targets. In this context, monitoring and reporting on SDG 11 requires a coordination of national statistical offices with local authorities and service providers. The application for the SEEA-EEA can assist in this regard by providing a framework to establish baselines and bring together the necessary institutions across scale for data collection to support regular reporting of urban indicators, such as SDG 11.7.1. Urban ecosystem accounting using the SEEA is underway, including in the UK (ONS, 2018) and for Oslo, Norway (NINA, 2017).

2.1 Aim of this Technical Note

This technical note provides an overview of how to compile a set of environmental-economic accounts for urban areas that can contribute regular information to support the calculation and reporting of the SDG 11.7.1 indicator. The accounting approach is in accordance with the UN System of Environmental Economic Accounting Experimental Ecosystem Accounting (SEEA EEA) framework (UN, European Commission, FAO, OECD, et al., 2014; UN et al., 2018) and is designed to support the provision of time series information on publicly accessible space in cities on a regular basis and in a spatially explicit manner.

The technical note draws directly on outputs from the Expert Meeting on SEEA Indicators for SDGs and Post 2020 Agenda, organised by UNEP-WCMC and UNSD in February 2019 and funded via the EU funded Natural Capital Accounting and Ecosystem Service Valuation project.[2] During the course of this workshop environmental policy, ecosystem assessment and environmental-economic accounting experts drafted an initial methodological approach to align SDG 11.7.1 and the SEEA. This was one of four break groups organised during the course of the workshop to derive draft methodological approached for different SDG Indicators. These were reviewed and discussed in plenary during the workshop and finalised in consultation with participants from each break out group.

The break out group working on SDG 11.7.1 have also proposed a supplementary indicator. This provides a better insight into the equitable distribution of public open space access in cities. This comprises: **Average share of the built-up area of cities that is Blue Green space for public use for all, by income distribution, by sub-municipal area.** The focus on Blue Green space, reflect the particular importance of this type of space reported for well-being and also the provision of wider regulating and (potentially) provisioning ecosystem services. These spaces may also be more amenable to identification via earth observation approaches, thereby reducing data collection costs. As such, developing accounts to support the calculation of this indicator is also given specific consideration within this note.

3 Urban SEEA Accounts

This section sets out a stepwise approach to compile SEEA Accounts for urban areas that can support the generation of SDG 11.7.1 and can be used to integrate environmental information on publicly accessible space into urban land use and economic planning. The note is intended to provide suitable accounting structures to organise this information and a broad overview of associated measurement approaches and data sources. This note should be read in conjunction with the key references cited in this report for detailed information and guidance where necessary. As per UNSD (2017), this note follows the steps set out in the Generic Statistics Business Process Model (GSBPM) to support the compilation of SEEA accounts. Figure 1 briefly outlines the steps in this process below.

OVERARCHING MANAGEMENT FUNCTIONS	1. **Specify User Needs**: Engage users to identify their detailed statistical needs, propose high level solution options and prepare the business case
	2. **Design**: Design and develop activities and any associated practical research work needed to define the statistical outputs, concepts, methodologies, collection instruments and operational processes. Specify all relevant metadata as well as quality assurance procedures
	3. **Build:** Build and test the production solution
	4. **Collect:** Collect and gather all necessary information (data and metadata), using different collection modes and load them for further processing
	5. **Process:** Clean data and prepare them for analysis
	6. **Analyze:** Produce statistical outputs, examine them in detail and prepare them for dissemination. Prepare statistical content and ensure outputs are 'fit for purpose' prior to dissemination. Ensure statistical analysts understand the statistics produced
	7. **Disseminate:** Release the statistical product and support users to access and use the output
	8. **Evaluate:** Conduct an evaluation of the process and agree an action plan

[2] The web page for the workshop can be visited at: https://seea.un.org/events/expert-meeting-seea-indicators-sdgs-and-post-2020-agenda

Figure 1: The Generic Statistics Business Process Model (GSBPM)

3.1 Specify User Needs

As set out above, the methodology to calculate SDG 11.7.1 comprises of three steps:

1) Delineation of the built-up area of the city;
2) Delineation of open public spaces and validation of the quality of spaces; and,
3) Estimation of the total area allocated to streets.

The above reflect the key information needs of users of the accounts particularly interested in calculating SDG 11.7.1 (as formulated in Section 2). The first step essentially comprises of establishing the spatial boundary for the extent of any urban ecosystem accounting application (the Ecosystem Accounting Area). For Step 2, users will not only be interested in understanding where public open spaces exist in cities but also their condition. This not only includes environmental qualities, such as green versus blue space, but also elements of design. In particular, facilities that support disabled access. Users will also be interested in understanding locations of public open spaces relative to different municipal areas, ideally understanding if accessibility to such spaces is equitably distributed. This technical note focuses on these elements relevant to Step 2. This highlights a concrete contribution that urban ecosystem accounting could make to the calculation of SDG 11.7.1 but, more importantly, sustainable urban development generally. The accounts can be extended to provide information on Step 3, as subsequently shown (Table 1).

Urban scale ecosystem accounts are likely to require high resolution data to compile, which reflects the scale at which planning decisions are made in the urban environment. This can be expected to be an order of magnitude higher resolution than that employed for national ecosystem accounting applications. For example, the Oslo Urban EEA presents land cover data at 10m resolution (NINA, no date). As such high resolution input and output data should be considered a fundamental user need.

As a final point, it is highlighted that a collaborative and iterative design process will be required to compile urban information in environmental-economic accounts and present it to decision-makers in a form that is relevant and easy to use. This is likely to involve quite a significant number of stakeholders, given the number of objectives, pressures, decision-makers, private and civil society interests and people individual cities accommodate. As such, it should be anticipated that progress between the specification of user needs and the design and build phases of compiling the accounts will also be iterative in nature. This may involve extending the accounts so links between publicly accessible open spaces, the benefits they provide and their economic and social implications in cities may be revealed and story lines developed. These are also broadly discussed further in Section 3.4.

3.2 Design and Build the Accounts

The SEEA is a multipurpose framework for understanding the interactions between the environment and the economy, thereby extending the established System of National Accounting (SNA) used for the measurement of economic activity and related stocks and flows. The SEEA-EEA extends this framework to consider ecosystems as assets. The SEEA-EEA accounting model proposes that changes in the stock of ecosystem assets is measured via changes in the biophysical measures of the extent of different ecosystem types and their condition over an accounting period (typically a year) via ecosystem extent and condition accounts. This is consistent with the ambition of SDG 11.7.1 to communicate trends in the extent and qualities of publicly accessible open space in cities.

Ecosystem assets also produce a flow of ecosystem services over time, which contribute to the production of benefits and, ultimately, well-being. Again, this clearly reflects the thinking around the provision of open public space in cities, particularly green spaces. Data on ecosystem services is organised within the physical and monetary ecosystem services supply and use accounts. These

accounts record the flow of ecosystem services from different ecosystem types to economic users occurring within an accounting period, in physical and monetary units. In this context, understanding the flow of ecosystem services from publicly accessible open space will be important to support city planners deliver sustainable urban development. However, this is not explicitly addressed in this note.

The ecosystem extent, condition and services (supply and use) accounts are the core accounting modules of the SEEA-EEA. The relationship between these accounts is shown in Figure 2. These accounts can be compiled for different ecosystem accounting areas (e.g., city boundaries) to reflect different decision-making context for urban land management and economic planning.

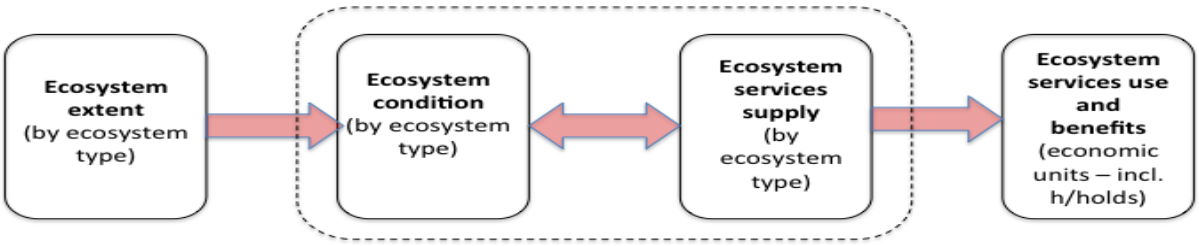

Figure 2: Core Accounting Modules of the SEEA-EEA

In order to facilitate the integration of different information on public open spaces and their qualities, there is a need for a measurement unit to organise spatial data for the compilation of accounts. These basic spatial units (BSUs) are not accounting units per se but provide a consistent spatial unit for data integration. They also provide a flexible spatial infrastructure that allows data to be readily aggregated to compile accounts at different spatial scales. Typically, BSUs are organised using a reference grid established with a single reference coordinate system, where each grid cell represents a BSU. As noted for urban ecosystem accounting this is likely to be a high resolution grid (<30m). Organising data in this way will facilitate multiple reporting and planning requirements, particularly where administrative boundaries and different definitions of cities and urban extent are employed (e.g., with respect to nationally established boundaries and those derived for internationally consistent reporting under SDG 11.7.1). BSUs are also consistent with the 'pixels' described in the metadata for SDG 11.7.1 (UNSD, 2018).

The role of Basic Spatial Units (BSUs) in the SEEA EEA framework is described in Section 3.5.1 of the SEEA EEA Technical Recommendations (UN *et al.*, 2018). Section 3.6 of the SEEA EEA Technical Recommendations provides further direction on developing a spatial data infrastructure to organise information using Basic Spatial Units (BSUs).

3.2.1 Define the Urban Ecosystem Accounting Area(s)

It is recognised that a range of accepted definitions of the "city" exist, including definitions based on population density, extent of the built-up areas and other based solely on administrative boundaries (UNSD, 2018). The approach presented by UN-Habitat for reporting on SDG 11.7.1 is set out below. However, when compiling urban accounts, the full range of different decision making contexts should be considered and, ideally, ecosystem accounts should be developed in a manner that supports decision-makers across all these contexts. The flexible spatial infrastructure provided by assigning data to BSUs can readily facilitate this. This will allow for one measurement activity to support multiple reporting requirements for different urban boundaries.

The metadata sheet for SDG 11.7.1, uses the following approach to define the area for calculating the indicator (i.e., the urban ecosystem accounting area (s)):

1. Identify the study area, this could be all cities or a representative sample. As urban ecosystem accounting applications have been limited to date, it is likely that these would be progressed on a case by case basis or a small initial sample.

2. Obtain satellite imagery for the analysis area (SDG 11.7.1 proposed LANDSAT imagery).

3. Using the satellite imagery for the study area classify each BSU (pixel) as built up, non-built-up and water.

4. Assess the urban-ness of each BSU (pixel) within the ecosystem accounting area. This is achieved by placing a 1-km^2 circle around each built-up pixel and calculating the share of pixels in the circle that are also built-up. If >=50% of the pixels in the circle are built-up, the pixel is classified as Urban. If >=25% and <50% of the pixels in the circle are built-up, the pixel is classified as Suburban. If <25% of the pixels in the circle are built-up, the pixel is classified as Rural.

5. Combine the contiguous urban and suburban pixels to form the urban cluster of the built up area.

Figure 3 presents a stylised diagram of what such as process could yield. The urban areas are identified by the dark grey squares (BSUs or pixels), suburban by the lighter colour squares and rural by white squares. The boundary for the urban built-up area is identified by the thick black line bounding the suburban lighter grey squares.

3.2.2 Urban Ecosystem Extent Accounts

Urban Ecosystem Extent accounts should be designed to integrate with national ecosystem extent accounts. As such, national ecosystem accounts should have an ecosystem type identified as 'Urban'. The Urban Ecosystem Extent Accounts will then provide a more detailed spatial disaggregation of the extent of urban sub-ecosystem types in the Total Urban Extent Area. For macro level analysis this may present data for the entire sample of cities for which urban ecosystem accounts are developed. However, for any meaningful application of spatial planning, urban ecosystem accounts should be presented on a city by city basis.

Table 1 presents an Urban Ecosystem Extent Account structure that could support the calculation of SDG 11.7.1. This provides an example structure for a 2015 to 2020 accounting period, with the opening stock in hectares for each land cover class set out in the top row and closing stock in the bottom row. Gross and net changes are recorded in the middle rows.

In Table 1, the Total Urban Extent reflects the description in the glossary and proposed by UN-Habitat, essentially comprising the urban extent, suburban extent and the fringe open space within 100m of urban and suburban areas. It should be noted that there may be a requirement to reconcile overlaps between urban ecosystem extent with other ecosystem types in national extent accounts area arising from the inclusion of fringe open space in the total urban extent.

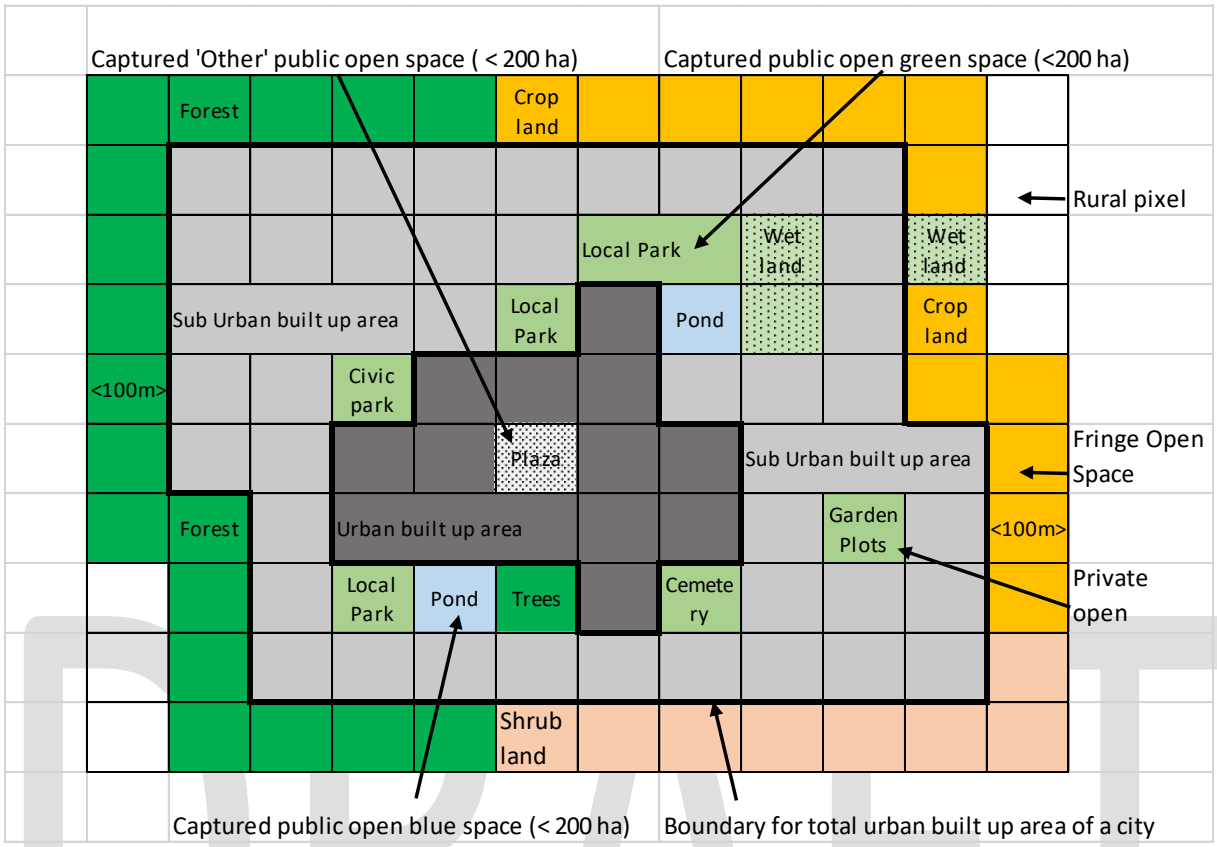

Figure 3: Stylised diagram of urban ecosystem accounting area. Each square represents a 100m BSU

For each or the urban and suburban extents (as described in Section 3.2.1), Table 1 disaggregated these areas into extent of public open green space, public open blue space and other public open spaces. For measurement of SDG 11.7.1, these are all open spaces of public use, accessible by all.

Public open green spaces are the urban features that instinctively come to mind when thinking about public spaces that are used daily (UN-Habitat, 2018). As set out in UNSD, (2018) they include:

- Parks: Open space inside an urban territory that provide free air recreation and contact with nature. Their principal characteristic is the significant proportion of green area.
- Recreational areas: Public areas that contribute to environmental preservation. Their main functions can be both ornamental and passive recreation. These include areas such as playgrounds, riverfronts, waterfronts, public beaches, etc.
- Civic parks: Open space created because of building agglomeration around an open area, which was later transformed into a representative civic area. They are characterized by considerable nature, specifically gardens and a good place for cultural events and passive recreation.

A number of these types of open space identified in Figure 3. There may be other types of publicly accessible open green spaces, these include cemeteries (as shown in Figure 3), as well as: Sports fields; vacant abandoned spaces; public access green houses and others. There may also be publicly accessible open green spaces that are better described via ecosystem typologies. These may include urban wetlands (natural and artificial) and city forests. In Figure 3 these comprise the wetland (either natural or built) and treed squares in the urban and suburban areas, as well as the cropland, shrubland and frost that exists in the fringe open space. As per the footnote in Table 1, it is likely to be useful to urban planners to provide

Table 1: Ecosystem Extent Account for Total Urban Extent 2015 to 2020

Classifications >>	Urban							Suburban							Fringe open space					TOTAL URBAN EXTENT (Urban + suburban + fringe open sapce)		
	Public open green space^	Public open blue space^	Other public open space	Area allocated to streets	Private open space*	Building footprint and other infrastructure	Total urban area	Public open green space^	Public open blue space^	Other public open space	Area allocated to streets	Private open space*	Building footprint and other infrastructure	Total suburban area	Public open green space^	Public open blue space^	Other public open space	Not publicly accessible	Total fringe open space area	Public open blue / green space	All public open space	TOTAL AREA
Opening Stock (Ha, 2015)																						
Additions to stock																						
Total additions to stock																						
Reductions in stock																						
Total reductions in stock																						
Net change in stock																						
Closing stock (Ha, 2020)																						

^ Public open green and blue space can be disaggregated by ecosystem type (e.g., cropland, wetland and forests in the city or fringe) or detailed descriptors for open space, such as cemetery, local park, etc.

* Private Open Space could be further disaggregated to green, blue and other public access space

accounts of the extent of these different elements of publicly accessible green space to see how they are represented in the urban landscape. This can be easily achieved using a supplementary extent account for publicly accessible green open space specifically.

Public open blue spaces comprise rivers, streams, ponds and other water features in the urban, suburban and fringe areas. Figure 3 identifies examples in the suburban area.

In Table 1 'Other public open space' comprises of public open spaces that are not characterised as being green or blue. Typically they may comprise of Squares, Markets and Plazas created because of building agglomeration around an open area. The main characteristics of these areas are the significant architectonic elements and interaction between buildings and the open area (UNSD, 2018). Figure 3 identifies such an area at the centre of the urban area.

For both the urban and suburban areas, Table 1 provides a column to record the area allocated to streets. How to calculate the area allocated to streets is not described here but is described in some detail in the metadata for the SDG 11.7.1 indicator (See UNSD, 2018).

Private open space (in the sense of the open space not being publicly accessible) is not included in the measurement of SDG 11.7.1. This include areas such as private garden plots (as indicated in Figure 3). These may occur in the urban, suburban and fringe areas. As such columns are provided in Table 1 to capture the extent of these areas. This reflects that while these spaces may not contribute to SDG 11.7.1, they could be relevant for other objectives (e.g., habitat for pollinators and other aspects of biodiversity).

The remainder of the suburban and urban areas are considered to be building footprint or other infrastructure. Again columns to record the extent of these areas are provided in Table 1. The rationale being that the internal consistency of the urban ecosystem extent account can be demonstrated by summing to the total area across the columns for each of the urban, suburban and fringe areas and for total urban extent in the final columns of Table 1.

3.2.3 Urban Ecosystem Condition Accounts

It is highlighted that the characteristics and qualities of public open spaces, especially green and blue public open spaces, will vary significantly. Their location is also an important factor in their capacity to provide services to people. There may also be alternatives that can be built into some areas of the city to provide ecosystem services in the absence of green / blue space, for example green walls and roofs.

In consideration of the above, the SEEA EEA Ecosystem Condition Accounts can provide useful framework for communicating on the environmental quality of cities. The SEEA Technical Recommendations suggest reporting condition as opening and closing stocks for given years and provide an example table (Table 4.1) (UN *et al.*, 2018). Table 2 develops this example table for an Ecosystem Condition Account relevant for urban areas.

As shown in Table 2, the columns organize the total urban extent into their urban, suburban and fringe areas. The rows then provide opening and closing measures for a range of condition metrics relevant to SDG 11. These opening and closing measures reflect the length of the accounting period (e.g., a year).

Table 2: Ecosystem Condition Account for Total Urban Extent

	Classifications >>	Urban	Suburban	Fringe open space	TOTAL URBAN EXTENT
Population density	*Opening condition*				
	Closing condition				
Infrastructure density (floor space ratio)	*Opening condition*				
	Closing condition				
Vegetation (Canopy cover, street tree density)	*Opening condition*				
	Closing condition				
Area of Green Roof or Green Wall	*Opening condition*				
	Closing condition				
Proportion surface area public open green or blue space	*Opening condition*				
	Closing condition				
Proportion surface area public open green or blue space with disabled access and facilities	*Opening condition*				
	Closing condition				
Average distance to nearest public open green or blue space	*Opening condition*				
	Closing condition				
Average distance to nearest public open green or blue space with disabled access and facilities	*Opening condition*				
	Closing condition				
Soil sealing	*Opening condition*				
	Closing condition				
Air pollutant concentrations	*Opening condition*				
	Closing condition				

3.3 Collect and Process data

As identified in UNSD (2018), the key data sources for calculating the open space component of SDG 11.7.1 and compiling the ecosystem extent accounts (Table 1) are high resolution satellite imagery (e.g., LandSat) and inventories of public open space. These inventories can draw on additional documents, such as land use maps and cadastral data on land ownership. As many cities may not maintain inventories of public space, satellite imagery can be used to identify potential open spaces (especially green and blue open space). All potential open spaces should then be digitally mapped (i.e., using GIS techniques). The extent of urban area for cities for which accounts are to be compiled should also be digitally mapped following the processing steps described in Section 3.2.1 and for other municipal purposes.

It is likely that some fieldwork will be required to verify open spaces as publicly accessible, this will also for collation of extra data on the condition of open spaces and their accessibility.[3] Once verified, preliminary estimates of the public open space and the private open space data items for the ecosystem extent account set out in Section 3.2 should be derived (See UNSD, 2018 methodology

[3] UN-Habitat, in consultation with partners, experts and data producers have developed a detailed tool to facilitate the verification of each space and collection of additional data on the space quality and accessibility. This tool is freely available at: https://ee.kobotoolbox.org/x/#IGFf6ubq

section, sub-section c, for further details on how to calculate the area allocated to streets). These should be validated with key stakeholders and appropriate procedures for the imputation of missing data documented and implemented.

It is noted that LandSat imagery is global and open access. In addition, UN-Habitat have compiled data for SDG 11.7.1 for 289 cities in 94 countries (UNSD, 2018). These data have been compiled via the Global Public Spaces programme, Atlas of Urban Development, UN-Habitats City Prosperity Index, locally collected qualitative data and via a multi-country capacity assessment for SDG 11.7.1. As such data for a number of cities for calculating SDG 11.7.1. exists (see UNSD, 2018 for more information)

Additional data will be required to support the compilation of the Ecosystem Condition Accounts (Table 2). A number of proprietary remote sensing or other mapping products may exists that can be used at this stage. For example, maps of population density, canopy cover, soil sealing and air pollution modelling may be available for a number of cities and produced on a regular basis that can support ecosystem condition accounting. Any filed work undertaken to verify open spaces should also attempt to collect key data on condition characteristics, such as the presence of disabled facilities. These types of data may also be available from public open space inventories or other local authority data sets. For other data items in Table 2, it is likely that datasets will need to be derived using GIS processing. This is particularly the case for estimating average distances within different ecosystem accounting areas to public open green or blue space. It is highlighted that the data items proposed for the Ecosystem Condition Accounts (Table 2) are indicative, the final set of items should be explored and validated with key stakeholders and users of the accounts.

Spatial analysis for different Ecosystem Accounting Areas will be greatly facilitated by integrating all information using a common spatial referencing grid. As previously described, this comprises of organising all data using BSUs, implying a raster based GIS approach. Reflecting that high resolution data is likely to be required for mapping urban features and urban planning generally, these BSUs (or grids) should be at resolutions of at least 30m. The EnSym Modelling platform can be used to establish this type of spatial infrastructure and has been applied in a number of accounting projects (e.g., UNEP-WCMC and IDEEA, 2017).

3.4 Analyse Accounts and Calculate SDG 11.7.1

The Ecosystem Extent Account (Table 1) is the essential ecosystem account for calculating SDG 11.7.1, as formulated in Section 2 and presented below:

$$SDG\ 11.7.1 = \frac{(total\ area\ of\ public\ open\ space + total\ area\ allocated\ to\ streets\ )}{total\ built\ up\ area}$$

The penultimate column in Table 1 records the sum of public open green, blue and other space in urban, suburban and fringe areas and the area allocated to streets in urban and suburban areas. The value for SDG 11.7.1 is then calculated for 2015 by dividing the opening stock value (top row) by the opening stock value (top row) in the adjacent column (TOTAL AREA). For 2020 the value for the indicator is similarly calculated using the values in the bottom, closing stock row.

As highlighted in Section 2.1, **Average share of the built-up area of cities that is Blue Green space for public use for all, by income distribution, by sub-municipal area** is also identified as a useful potential indicator for SDG 11.

This indicator can also be calculated using information from Table 1. The third from last column in Table 1 sums the extent of public open green and blue spaces in the urban, suburban and fringe areas. By organizing information using BSUs, this information on publicly accessible green or blue space can

be readily aggregated for different sub-municipal areas (as distinct ecosystem accounting areas). Information on income can also be integrated with the information on public open green and blue spaces by BSU (or at least groups of BSU) using spatial socio-economic data (i.e., from census / household survey studies). Pivot tables or similar can then be employed to organize information on the extent of public green or blue public space within specified income categories, thereby to generating this additional indicator. This would also be a key story line to communicate to urban planners seeking to ensure equitable and sustainable cities that provide benefits for all.

The Ecosystem Condition Account (Table 2) is intended to provide a holistic overview of the condition of different urban areas. In the context of SDG 11.7.1, the condition indicators relating to the proportion of surface area that is public open green space (with and without disabled access and facilities) and the average distance to these areas will be of key interest. Where the relative proportion of public open green or blue areas with disabled access is low, or where the distances to public open green or blue spaces are high, the current configuration of the city would not be considered to be providing an equitable distribution of green blue open space benefits to all. This would also be a key story line to communicate to urban planners seeking to maximize social welfare in cities.

UNSD (2018) proposes that national statistics offices will report national figures for SDG 11.7.1, based on data from all cities. However, these will take time to develop. As such, UN-Habitat (2017) provides an approach for countries to select a nationally representative sample of cities for reporting on SDG 11.7.1. This can also be used as a guide to selecting cities for urban ecosystem accounting using the SEEA EEA framework.

3.5 Disseminate and Evaluate

As described in UNSD (2017), the dissemination of the accounting outputs should be accompanied with sufficient documentation and metadata to allow users to fully understand the accounts. This should include highlighting the insights the accounts provide and any associated storylines (e.g., along the lines of the issues discussed in Section 3.4). This is likely to resonate with a wider group of potential users of the accounts and stimulate demand for improved and regularly compiled future versions. Any differences to other municipal statistics on pubic open spaces should be clearly explained to avoid confusing users.

It is likely that the first dissemination of the accounts will be on the basis of them being 'experimental' and user feedback should be sought at this stage. This will allow an evaluation process to take place to improve methodologies, identify new data sources and improve the structure of the accounts and accounting items to best meet user needs. This should be supported with appropriate archiving of data and methodological and metadata documentation.

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