DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
STATISTICS DIVISION
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System of Environmental Economic Accounting

System of Environmental-Economic Accounting—Ecosystem Accounting

Section 13.6 on Accounting for urban areas

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Note: This is just an extract from the complete draft of the SEEA EA that can be accessed at: https://seea.un.org/sites/seea.un.org/files/documents/EEA/Revision/1._seea_ea_complete_draft_for_global_consultation_oct_2020.pdf

13.6 Accounting for urban areas

13.6.1 Role of accounting in supporting decision making about urban areas

13.86 Urban areas can occur in most terrestrial settings—whether highland or lowland, in forest, grassland, desert, tropical or tundra regions. They are defined chiefly by the presence of people and by their alteration of the underlying environment. They consist of a wide array of heterogeneous materials. Combinations of buildings (e.g., low- and high-rises), impervious surface covers (e.g., roads and parking lots), vegetation (e.g., parks and sports fields), bare soil (empty lots and unattended garden plots) and water (e.g., wetlands and streams) are fundamental components of the urban ecosystem. Accounting for ecosystem assets and services in urban areas is of increasing importance considering the large and growing proportion of the world population living in cities.

13.87 Specific thematic accounts for urban areas can be developed to support inclusion of ecosystem considerations in policy and decision making. These urban ecosystem accounts would include the extent of urban ecosystem sub-types, with a particular focus on quantifying urban green and blue areas, and associated condition variables and indicators (e.g., urban tree canopy cover, urban air quality) and related services (e.g., local climate regulation, water regulation, nature-based recreation). These thematic accounts can be compiled for ecosystem accounting areas that cover all cities, a subset of cities (e.g., large cities) or individual cities, depending on policy needs.

13.88 Depending on the scale of underlying datasets and the aggregation level at which the accounts are compiled, urban ecosystem accounts can support various aspects of international, national, sub-national, and municipal level policy on urban areas such as strategic planning and policy setting; communication and awareness raising; economic accounting; urban planning including peri-urban and coastal development. The application of accounting could extend further to consider management of water resources, water treatment, regulating services (e.g., local climate regulation, air filtration, flood mitigation), renewable energy sources and management of recreational opportunities.

13.89 Urban ecosystem accounts with sufficient spatial detail (potentially down to property level resolutions) can provide data to support trade-off analysis or benefit-cost analysis for spatial planning and design of policy instruments such as ecosystem service users' charges. If ecosystem asset and condition mapping have sufficient resolution (e.g., individual tree canopy size and height) ecosystem accounts can also provide support for compliance monitoring and litigation of environmental damages (e.g., illegal tree felling).

13.6.2 A set of urban accounts

13.90 Urban ecosystems are an ecosystem type included in the SEEA EA ecosystem classification and changes in urban extent are tracked in aggregate relative to other ecosystem types in the ecosystem extent account. However, the compilation of a thematic account for urban areas provides the opportunity for a more detailed accounting for urban area sub-types with the broader framing provided by the IUCN Global Ecosystem Typology which defines a broad ecosystem functional group covering urban ecosystems (Class T7.4). This compilation follows the same general guidelines as ecosystem accounting more generally, including the development of extent, condition and services accounts. However, reporting on urban green and blue assets at a more detailed scale within the continuous urban extent can be seen as a distinguishing factor. Different boundaries and variable spatial resolutions of basic statistical units and reporting units can also be considered for thematic accounts, in order to address different purposes.

Delineating the urban ecosystem accounting area (EAA) boundary and urban ecosystem types

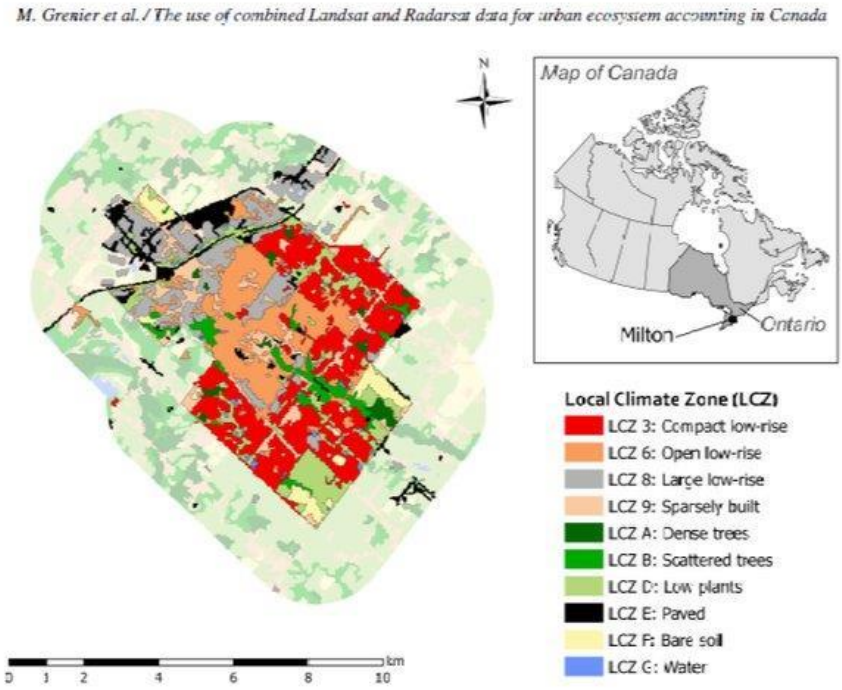
13.91 There are several approaches for defining the ecosystem accounting area for urban ecosystem accounts. Accounts can be compiled for cities based on administrative boundaries (i.e., local government boundary), functional boundaries (e.g., based on commuting flows as defined by census data), or morphological criteria, such as the extent of the built-up area plus a buffer zone. This selection will depend on the anticipated purpose and users of the urban accounts being compiled.

13.92 Urban areas often follow a gradient from less developed and even rural peripheral areas, into a more developed urban core. Even areas with a higher degree of built-up area may contain significant areas of urban green covers, such as yards, parks, cemeteries, street trees or green roofs. The two main approaches for the classification of urban areas into subtypes are (i) a landscape approach; or (ii) an individual asset approach.

13.93 Landscape approach: This approach disaggregates the entire urban area and categorizes larger patches with common characteristics, classifying these areas according to different urban sub-types. For example, a classification of urban sub-types would break down the variety of built-up and semi-natural types within the city into contiguous areas with common shared characteristics (e.g., compact high-rise, compact low-rise, open low-rise, sparsely built, paved as illustrated in Figure 13.3 and Figure 13.4). Following the landscape approach, information on condition characteristics (e.g., percentage of impervious/pervious surfaces, soil contaminant concentrations) could be included in the condition accounts as measures of landscape-level characteristics of these sub-classes. A landscape approach will tend to support municipal planning and zoning integrating across sector concerns.

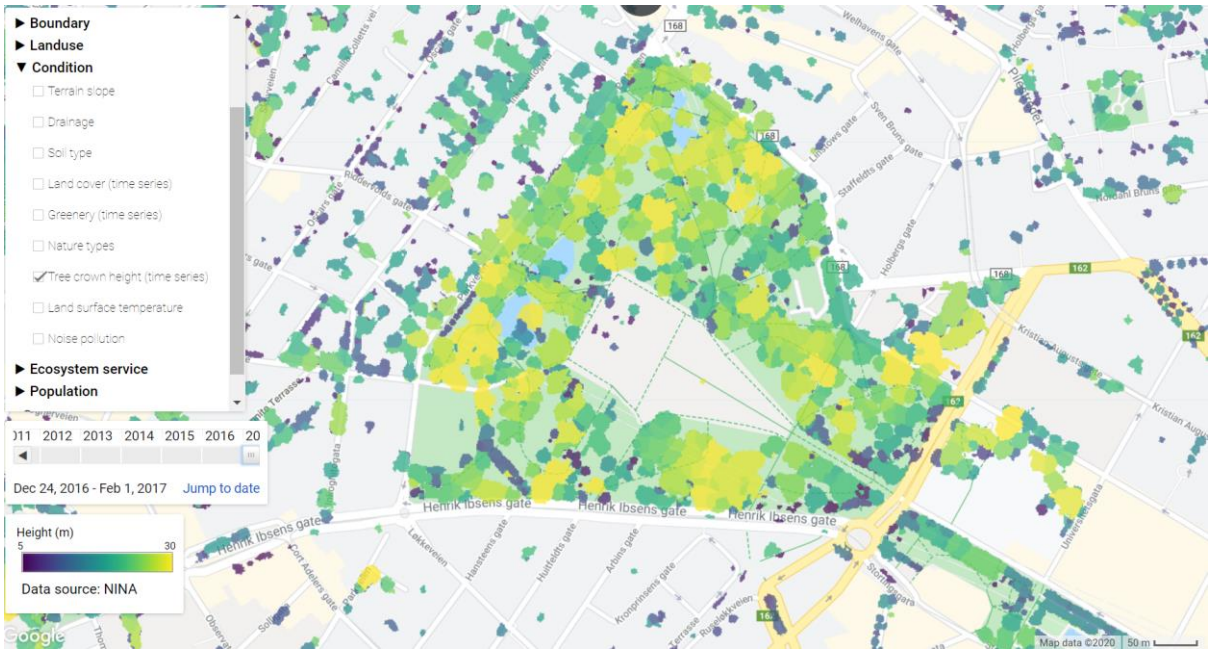
13.94 Individual asset approach: This approach tracks various individual asset types at as fine a scale as possible (e.g., lines of street trees, playgrounds, allotment gardens, green roofs, drainage and storage systems, airsheds, etc.) based on available very high resolution (10 m or less) satellite imagery or other spatial data sets. In this case ecosystem assets in urban accounts can be defined as areas of green and blue infrastructure that provide ecosystem services. This approach also permits reporting on the condition of these green/blue assets in the associated condition accounts. An asset approach tends to support targeted thematic and sector policies specific to municipal sector agencies, such as urban forestry, urban agriculture, stormwater management.

Figure 13.3: Applying landscape approach for classifying urban ecosystems using Stewart & Oke (2009) local climate zone classification



Source: Grenier et al. (2020).

Figure 13.4: High resolution thematic focus mapping of urban tree canopy asset extent and height (condition)



Source: *Urban Nature Atlas Oslo*, n.d.

Measuring the extent and condition of urban ecosystems

13.95 The classification approach and level of aggregation will determine the distinction between extent accounts and condition accounts. Condition indicators that are predictors of urban ecosystem services should be selected. This does not prevent users from compiling thematic environmental quality and biodiversity indicators for other purposes. Extent table and condition table options following the landscape approach are shown in Table 13.5 and Table 13.6, whereas Table 13.7 provides an example of the individual asset approach.

13.96 The urban airshed above the accounting area should be considered an ecosystem asset, similarly to waterbodies. Air and water quality indicators for ecosystem accounting purposes should focus on predictors of recreation and amenity services.

Measuring ecosystem services for urban ecosystems

13.97 Urban ecosystem service supply and use accounts may focus on a different basket of ecosystem services, given the differing functions and conditions of urban ecosystems as the physical place people live and work. Some key ecosystem services that will likely be considered include: water regulation, local climate regulation, air filtration, noise regulation, recreation and amenity services (Table 13.8**Error! Reference source not found.**).

Table 13.5: Example – extent account presentation using landscape approach

	Example ecosystem types in urban areas													
	Urban/built-up type and example sub-classes						Natural and semi-natural types							Total EEZ
	Compact high-rise	Open high-rise	Compact low-rise	Open low-rise	Sparsely built	Paved	Cropland	Grassland	Shrubland	Forest	Barren	Wetland	Inland water	
Opening extent (km2)														
Additions to extent														
Reductions in extent														
Net change in extent														
Closing extent (km2)														

Table 13.6: Example – condition account presentation using landscape approach

		Example ecosystem types in urban areas																									
Example condition variables		Compact high-rise		Open high-rise		Compact low-rise		Open low-rise		Sparsely built		Paved		Cropland		Grassland		Shrubland		Forest		Barren		Wetland		Inland water	
Variables	Unit of measure	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock	Opening stock	Closing stock
Water quality	g/l																										
Air pollutant concentrations	ppm																										
Soil contaminant concentrations	g/kg																										
Soil sealing / Imperviousness	%																										
Greenness	%																										
Canopy cover	m^2																										
Street trees	km																										

Table 13.7: Example – extent account presentation using the individual asset approach

	Example ecosystem types and assets in urban areas																		
	Example urban ecosystem assets									Natural and semi-natural types								All other (grey) areas	**Total EEZ**
	Allotment garden	Street trees	Sports field	Playground	Cemetery or religious grounds	Public park or garden	Green roof	Private green space (e.g., yards)	Beach	Cropland	Grassland	Shrubland	Forest	Barren	Wetland	Inland water	Total		
Opening extent (km2)																			
Additions to extent																			
Reductions in extent																			
Net change in extent																			
Closing extent (km2)																			

Table 13.8: Example – service account presentation using landscape approach

		Urban/built-up type and example sub-classes						Natural and semi-natural types							
Example list of services	Unit of measure	Compact high-rise	Open high-rise	Compact low-rise	Open low-rise	Sparsely built	Paved	Cropland	Grassland	Shrubland	Forest	Barren	Wetland	Inland water	Total EEZ
Provisioning services															
Crops															
Regulating services															
Water regulation															
Climate regulation															
Air filtration															
Noise regulation															
Cultural services															
Recreation															
Amenity services															

Other considerations

13.98 There are many important issues and limitations that should be considered in the measurement of urban ecosystem services that differ compared to other ecosystem types. For example, accurate change detection at the small spatial scales inherent in urban areas will be particularly important given that areas of change can be finer than the precision of the land cover classification used as input to ecosystem service models. Substitution possibilities between ecosystem services and man-made services may be more apparent in urban areas. As well, spatial patterns in urban ecosystem service supply are driven by biophysical variation in ecosystem conditions, while spatial variation in demand may not be detectable at the same resolution. Heterogeneous use factors—related to population density, socio-economic and cultural diversity in cities, as well as substitution possibilities, qualitative values and non-linear distance decay of benefits can result in variations in beneficiaries and valuation results, particularly for recreational and amenity services.

13.99 For applications at municipal levels, urban ecosystem accounts need to align closely with the way municipal environmental administration is organized in order to address both integrated and sector specific municipal policy and planning needs. For this reason, a combined landscape and asset approach will often be required.

13.100 In some situations, for example cost benefit analysis of zoning and user charges, monetary valuation of ecosystem service supply and use by landscape types and calculation of asset values is undertaken. Monetary accounts may also provide support for municipal budget allocation to asset investment and maintenance, taking care to be relevant for municipal policy agenda's such "green and blue infrastructure" and "nature-based solutions".

13.101 Where monetary valuation is undertaken for municipal level applications, higher temporal and spatial resolutions and change detection is required compared to the requirements for national level accounts. This may be addressed using different methods, for example by pooling data across a large number of decision-making units. With this in mind, monetary urban ecosystem accounts will therefore often need to be thematic and policy purpose specific (Gómez-Baggethun & Barton, 2013).

13.6.3 Potential indicators for urban ecosystems

13.102 Certain indicators can provide useful summary-level information on the state and condition of urban areas. For example, the change in extent of lands converted from natural or semi-natural ecosystem types to residential areas with associated infrastructures, tracked over time, provides a snapshot of urban expansion and ensuing loss of natural and semi-natural areas. Other related indicators could focus on the concept of land degradation (e.g., percentage of contaminated or brownfield areas and reclaimed areas). Indicators drawn from these accounts can also track the role urban green and blue spaces play in providing ecosystem services, including moderating air and water pollution and mitigating heat islands, and can support the measure of accessibility to green and blue spaces.

13.103 Thus, urban ecosystem accounts provide information that is relevant at many levels including for reporting internationally, nationally and at sub-national levels. For example, the change in extent and condition of lands converted to residential areas with associated infrastructures is relevant for SDG 15.3.1 Proportion of land that is degraded over total land area. As well, ecosystem accounting for urban areas is particularly relevant for SDG 11: Sustainable Cities and Communities, including for the following indicators (UN Habitat, n.d.; UNSD & UN Environment (UNEP), 2019):

- SDG 11.3.1 Ratio of land consumption rate to population growth rate SDG 11.4.1 "Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage (cultural, natural, mixed and World Heritage Centre designation), level of government (national, regional and local/municipal), type of expenditure (operating expenditure/investment) and type of private funding (donations in kind, private non-profit sector and sponsorship)".
- SDG 11.6.2 Annual mean levels of fine particulate matter (e.g., PM2.5 and PM10) in cities (population weighted).
- 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.
- 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.
- SDG 11.7.1 (modified) 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.

13.104 Beyond broad indicators, to support municipal planning and policy analysis purposes, such as equitable distribution of municipal (ecosystem) services, urban ecosystem accounts will need to disaggregate statistics to different administrative areas such as districts, councils, boroughs, census tracts.