UN-GGIM: Europe | Work Group on Data Integration | subgroup 2

The territorial dimension in SDG indicators: geospatial data analysis and its integration with statistical data

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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

[former Tier III, presently Tier II indicator]

A | *Global metadata*

B | *National practices: Ireland (NSI), Sweden (NSI and NMCA) and Switzerland (NSI)*

C | *EU SDG indicators: No corresponding EU SDG indicador available*

A. GLOBAL METADATA | UN SDG Metadata

1. Current reporting situation

Responsibility: (Identify the agency responsible for the indicator and the situation regarding the ESS and NSS projects (including dissemination) and /or INSPIRE conformance)

UN-Habitat will take the lead in global reporting which will follow efforts of directly working with national statistical agencies for reporting at national levels. UN-Habitat and other partners including other private and regional commissions are leading the efforts of building national capacities to monitor and report on this indicator.

Indicator disaggregation: (List the indicator disaggregation by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts to support the monitoring of the implementation of the SDGs)

Disaggregation proposed by UN-Habitat:

- Disaggregation by location (intra-urban)
- Disaggregation by qualities of the open public space (safe, inclusive, accessible, green)
- The share of built-up area is green open space in public use
- The share of built-up area is universally accessible open space in public use, particularly for disable persons
- Disaggregation by type of human settlements
- Disaggregation by typology of public space

Frequency of dissemination: (Describe the time interval at which information is disseminated over a given time period)

The monitoring of the indicator is proposed to be repeated at regular intervals of 5 years, allowing for three reporting points until the year 2030.

Timeliness: (Length of time between data availability and the event or phenomenon they describe. Describe the average production time for each release of data)

Unknown.

Data sources: (List the data sources and themes or variables in use, including conditions of access situation, resolution, positional accuracy, frequency and timeliness regarding the ESS and NSS projects and /or INSPIRE conformance).

According to UN-Habitat satellite imagery (open sources), documentation outlining publicly owned land; community-based maps are the main sources of data.

- For estimating the total Surface of Built-up area. Satellite imagery: Use of existing layers of satellite imagery ranging from open sources such as Google Earth and US Geological Survey/NASA imagery Landsat to more sophisticated and higher resolution land cover data sets. Images are to be analyzed for the latest available year.
- For the Inventory of open public space. Information can be obtained from legal documents outlining publicly owned land and well-defined land use plans. In some cases, where this information is lacking, incomplete or outdated, open sources, informants in the city and community-based maps, which are increasingly recognized as a valid source of information, can be a viable alternative.
- The share of land in public open spaces cannot be obtained directly from the use of high-resolution satellite imagery, because it is not possible to determine the ownership or use of open spaces by remote sensing. However, fieldwork to validate and verify the open spaces derived from satellite imagery helps to map out land that is for public and non-public use.

Geospatial data analysis and integration: (Describe spatial analysis methods, procedures and computations, including regarding data integration)

The following workflow has been outlined as approach to calculate the indicator by UN-Habitat: The method to estimate the area of public space is based on three steps: a) spatial analysis to delimit the built-up area of the city; b) estimation of the total open public space and; c) estimation of the total area allocated to streets.

a) <u>Spatial analysis to delimit the built-up area</u>

Delimit the built-up area of the urban agglomeration and calculate the total area (in square kilometres). To compute this component of the indicator, follow these steps:

1. Acquire satellite imagery (Imagery is freely available on the internet).
2. Classify the satellite imagery into built-up area, open space, or water.
3. Sub-classify, the built-up area pixels into three types i.e. urban, suburban and rural based on the built-up density
4. Sub classify, open space pixels into three types i.e. fringe open space, captured open space and rural open space.
5. Run Cluster analysis-using sub-classification of built-up area and open space into a unified extent (built-up area).
6. Calculate the total area in square kilometres.

b) <u>Computation of total area of open public space</u>

Mapping and calculation of the total areas of open public space within the defined urban boundaries based on the built-up area. To compute this component of the indicator, follow these steps:

1. An inventory on Open Public Spaces should be the initial source of information, additional legal documents, land use plans and other sources of information complement the information
2. Alternatively, since this inventory is often not available, using satellite imagery/data identify Potential Open public spaces,
3. Digitize Potential Open public spaces
4. Field work to verify the identified spaces and assess quality based on the definition above to create an inventory of open public spaces
5. Calculate the total area of open public space.

c) Computation of land allocated to streets

Calculation of the total area allocated to streets based on sampling techniques as a proportion of the total surface of the built-up area. To compute this component of the indicator, follow these steps:

Using the built-up area boundary

1. Generate Halton sequence of sample points (Halton sequence refers to quasi-random sequence used to generate points in space that are ex-post evenly spread (i.e. equidistant))
2. Buffer the points to get sample areas with an area of 10 hectares each.
3. For each of the sample area: check the completeness of the street network, define and delimit streets as per definition.
4. Calculate the land allocated to street for each sample area using the formula;

$$\text{Land allocated to streets} = \frac{Total\ street\ area}{Circle\ area}$$

d) The final computation of the indicator is calculated using the formula:

$$Share\ of\ the\ built-up\ area\ of\ the\ city\ that\ is\ open\ space\ in\ public\ use(\%) = \frac{Total\ surface\ of\ open\ public\ space + Total\ surface\ of\ land\ allocated\ to\ sreets}{Total\ surface\ of\ built\ up\ area\ of\ the\ urban\ agglomeration}$$

Data quality requirements: (List in general terms the requirements for the sources and themes in use with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards are being followed, including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

As for indicator 11.3.1 (Ratio of land consumption rate to population growth rate), a crucial issue will be the delimitation of city boundaries as there are no clear agreed international definition. Though delimitation of built-up areas is suggested to be based on EO data, still agreed algorithms will be needed for a uniform output. The current metadata document does not give advice on this. Preferably, the concept of built-up areas should be harmonised between the two indicators (11.3.1 and 11.7.1) as they aim to capture the same entity.

Also for the computation of total area of open public space and computation of land allocated to streets, there are several challenges related to consistencies and data quality. Most cities and countries lack a clear protocol or standard guide for how they might measure public spaces, let alone an existing inventory or understanding of the public agencies involved in public space. Assessment of what to consider as "open public space", according to the definitions by UN-Habitat, is difficult to base solely on geospatial data. Public space has been defined by UN-Habitat as: *all places of public use, accessible by all comprises open public space and streets*. The elements, to be considered as open public space, are:

- 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 playground, riverfronts, waterfronts, public beaches etc.
- Civic parks: Open space created as a result 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.
- Squares: Open spaces created because of building agglomeration around an open area. Its main characteristics are the significant architectonic elements and interaction among buildings and the open area. Squares are usually public spaces relevant to the city due to their location, territorial development, or cultural importance.

Streets are defined as the space used by pedestrian or vehicles in order to go from one place to another in the city. The following elements are considered as streets space: Carriageways, one car park line on each side of the road, sidewalks, bike paths, traffic islands, roundabouts, median strips and green areas in the centre of boulevards and tramways. Elements excluded from street space include plots (either built-up), open space blocks, railways, paved space within parking lots and airports and individual industries.

Current use of geospatial data for the indicator: (Describe the current use of geospatial data, as suggested by the existing metadata – the "as-is" situation)

See previous section.

2. Suggested Methodology

GAP analysis: (Describe what changes in use of **applied methods** are needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

See section below.

3. Suggested geospatial data integration

GAP analysis: (Describe what changes in use of **data** needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

This indicator is categorised under Tier III, meaning that internationally established methodology or standards are yet available for the indicator, but methodology/standards are being (or will be) developed or tested.

The following considerations on possible gaps can be made concerning the proposed methodology and data:

1. **Conceptual definition**

   There is a need for clear definition regarding the underlying concepts for the operationalisation of this indicator, namely:

   - Definition of built-up area: It is not clear what categories should be included in the definition of a built-up area. The concept of built-up areas should be harmonised between indicators 11.3.1 and 11.7.1 as they aim to capture the same entity. For discussion, see assessment of indicator 11.3.1.
   - Definition of urban areas / cities: The territorial classifications and / or methodology to identify cities delimitation is also not clearly stated (at the European level there is a classification for European cities (Urban Audit) and countries may also have national classifications). For discussion, see assessment of indicator 11.3.1.
   - Public open space: The definitions are quite clear and consistent, but they pose considerable challenges when applied to geospatial data. It can be difficult and in some cases impossible to classify the types of public open space without conducting field inventories. Nevertheless, the indicator remains relevant based on the calculation of built-up urban areas that are open green space or just green space.

- The concept of accessibility: Typically, accessibility is measured using rules for spatial proximity between objects, such as between peoples permanent place of residence and public parks. In the metadata description, the accessibility is measured at each identified individual public open space, such as a square. If no restrictions for the public to access the square is found, it is considered accessible open space. Regarding this approach, the scope of the indicator is ambiguous. There are two different types of objects to measure (according to the name of the indicator), the open space on one hand and the people that have access to the open space on the other hand. The current methodology does not address people as an object; hence, it does not permit disaggregation of accessibility by sex, age and persons with disabilities.

2. Data sources and geospatial processing

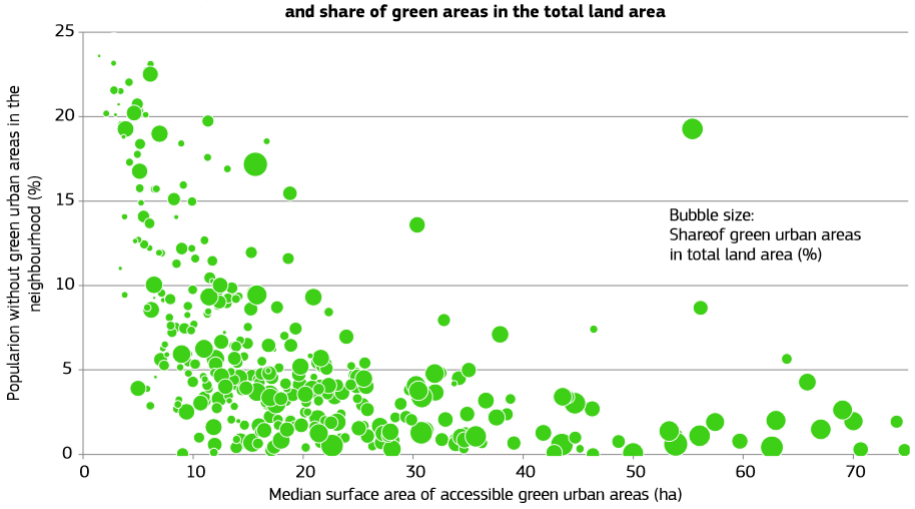
The data sources listed in the metadata are relevant, however further clarifications may be needed:

- For estimating the total surface of built-up area use of satellite imagery is recommended. However, it can be discussed whether use of raw EO data should be the first hand choice or if global EO data derived products could provide a more efficient option. Such data could be the Global Human Settlement Layer (GHSL), which is freely available and has global coverage. Another option could be the grid cluster approach jointly developed by EU and OECD to define urban areas. This approach builds on the GHSL too but with additional modelling of population density. Currently, work is being conducted by DG REGIO to investigate the prospect of applying the approach globally.

- For the Inventory of open public space, the metadata description relies heavily on use of semi-structured, non-geospatial data such as information obtained from legal documents outlining publicly owned land or well-defined land use plans and fieldwork to validate and verify the open spaces derived from satellite imagery to map out land that is for public and non-public use. In a European context, it can be assumed the willingness from governments to spend resources on additional field data collection will be low, considering the large investments that have been done in geospatial information during the recent years. Investments in geospatial information are expected to pay-off in terms of reduction of the need to use of semi-structured, non-geospatial data and expensive fieldwork. In conclusion, the metadata description should benefit from better recognising the use of alternative geospatial data sources to describe the accessibility of open space. Such data sources can be cadastral information (where ownership is defined). In contrast to field work, use of such data will result in less precise classification of types of public open space, but on the other hand it will have a better coverage and possibly also a more consistent and objective classification. A cross-reference benchmark on the substitutability of field data/non-geospatial data to geospatial information could be valuable as to open up for regional adaptations of approaches that can return a comparable result.

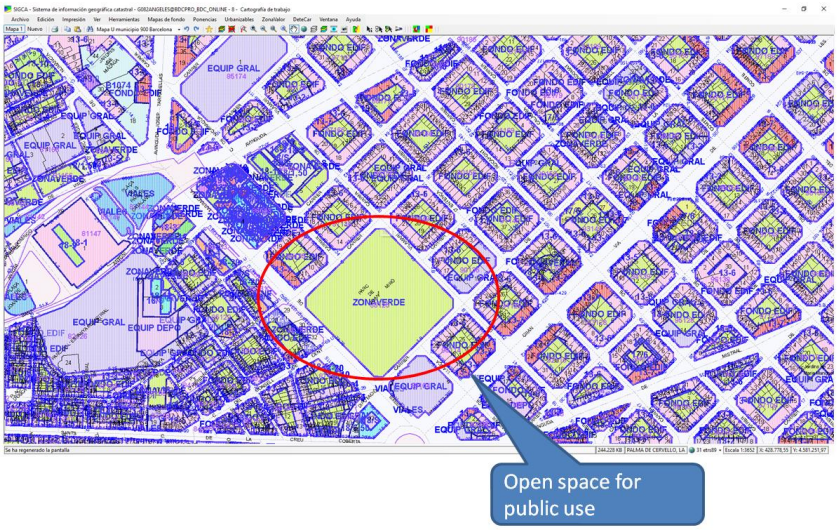
- DG REGIO working paper (2018) on access to green areas in urban areas is based on Copernicus Urban Atlas data: A walk to the park? Assessing access to green areas in Europe's cities. The definition used in Copernicus Urban Atlas refers to "public green areas for predominantly recreational use such as gardens, zoos, parks, castle parks; suburban natural areas that have become and are managed as urban parks". Nevertheless, because at the fringe of cities, the distinction between "green urban areas" and forests is not easily made, DG REGIO study also included the Urban Atlas class "forests" in the analysis. With a minimum mapping unit of 0.25 ha. The study considered the concept of an "urban centre", which is exclusively based on criteria of population size and population density and population is also derived from the Copernicus Urban Atlas.

Graph 3: Proximity of green areas, population without green areas nearby and share of green areas in the total land area

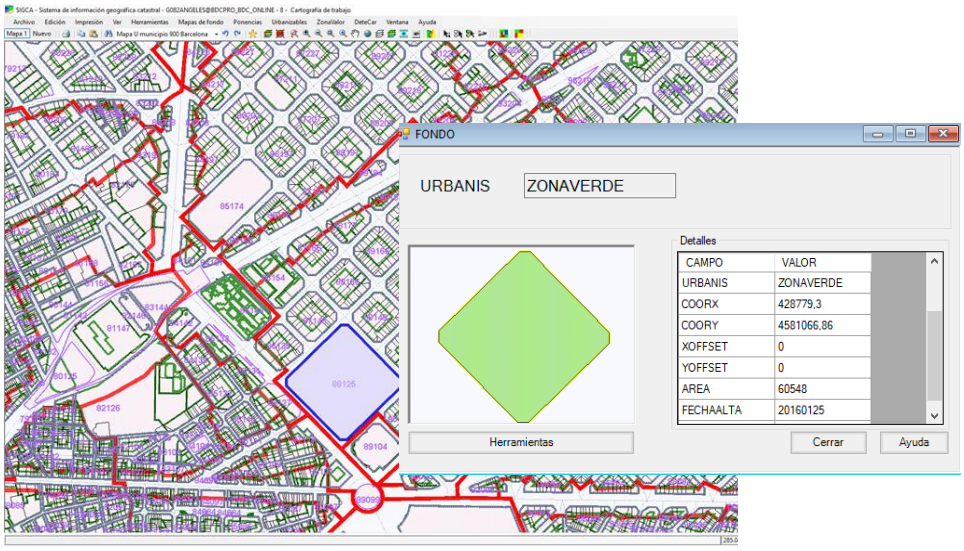


Source: Poelman, H. (2018). *A walk to the park? Assessing access to green areas in Europe's cities*. Regional Working Paper, DG REGIO.

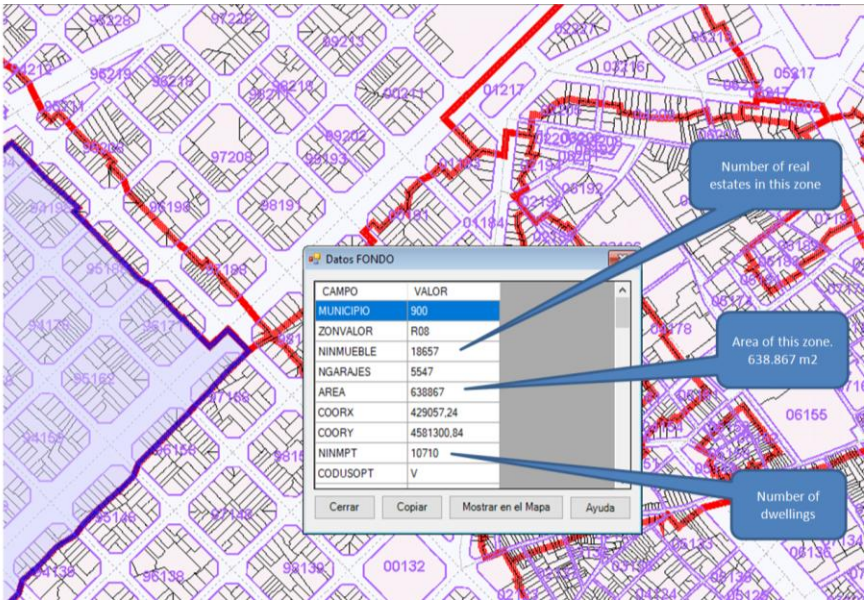
- In the case of Spain, for example, information to calculate the average share of built-up area that is open space for public use for all could be derived from the cadastre. The cadastre includes in its database the urban qualification of each real estate:



This information can be analysed at different levels, e.g., by municipality or by building blocks. For a green area such as the one pictured in the image below the cadastre provides information on the status, area (m^2), coordinates, etc.



In this example, there are 60 548 m^2 of open space for public use. For this zone the Spanish cadastre also has data on the total area, the number of real estates and the number of dwellings.



List required geospatial data: (Develop a list from the GAP analysis, which lists the geospatial data sources and themes which are required to support the to-be situation, including INSPIRE conformance)

Status in Sweden

On a national level in Sweden the information needed to depict publicly available open space is available in analogue form at the municipality. There is currently a discussion on creating a national digital planning register where this information should be available. There may be a need for support/requirement from the statistic community on creating the value list not only for green areas. The quality of the green area in a national planning register is noted as park. Other types of green areas can be found in areas of cultural heritage and protected sites. Cultural heritage sites can be found in central parts of a city and in suburban areas. Protected sites can often be found in Swedish suburbs normally in areas close to lakes and ponds. The Swedish water protection regulations give normally a zone of 100-meter protection area but can be extended to up to 300-meterrs. This is normally displayed in the plan map but not on ordinary maps.

Status INSPIRE

INSPIRE annex III that should be implemented in 2020 the theme “Land Use” have support for this indicator. In the application schema point 3_3_5 OtherCommunityServices there I a paragraph 3_3_4 OpenAirRecreationaServices that has a definition:

Open air recreational areas, e.g. urban parks, playgrounds, national parks, and natural areas used for recreational purposes (e.g. forests, heathland, moors, mountains, agricultural areas, ponds, lakes, rivers). That may be useful for calculation this indicator. The same definition is also occurring in the section “planned Land Use” which means that this indicator also can be used for city planning in order to keep this indicator as a proactive measurement to estimate the future development of the

indicator. This will however not solve the case of accessibility, to achieve this more information is needed to be added to the inspire specifications.

Data quality requirements: (List in general terms the requirements for the suggested sources and themes with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards should be followed including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

Status Sweden

The quality of the green areas in a national planning register is registered as park. Other types of green areas can be found in areas of cultural heritage and protected sites. Cultural heritage sites can be found in central parts of a city and in suburban areas. Protected sites can often be found in Swedish suburbs normally in areas close to lakes and ponds. The Swedish water protection regulations give normally a zone of 100-meter from the waterline. This is normally shown in the city plan but not on ordinary maps.

Status INSPIRE

The work of the EAGLE (Eionet Action Group on Land monitoring in Europe) project may have a positive impact on the quality of this indicator. Quality assurance for disabled people's access is probably not suitable for computer analysis so this must be done with comparison with orthophotos and height models.

Data availability: (List the data availability for the suggested sources and themes or variables: 1) Geographically: national/regional/global (as well as comparability across countries), 2) Source: Accessible through services or download, 3) Commercial/legally: license conditions - are data free or are there restriction on use; 4) Timeliness; 5) Frequency of dissemination)

To make this cross border an international definition should be made and agreed on. Information might be owned by different organizations in different countries and this could be a problem for setting an international definition.

Data collection: (Describe how the geospatial data for the indicator can be collected/made available, and issues to overcome – are there many sources to collect from, do they need to be integrated and normalized etc.)

The big issue is the semantic definition, i.e., applying the same definition of an open space. A short definition on access for disabled persons can probably be made for some types.

Geospatial data analysis and integration: (Describe which analysis, procedures and computations are needed to provide the results needed to support the reporting requirements - "to-be" situation)

B. NATIONAL PRACTICE | Ireland (NSI)

1. Current reporting situation

Responsibility: (Identify the agency responsible for the indicator and the situation regarding the ESS and NSS projects (including dissemination) and /or INSPIRE conformance)

Data sources for this indicator are available within Central Statistics Office Ireland (CSO) and Ordnance Survey Ireland (OSi). The definition of an urban area is available from CSO, while data relating to built-up areas and public space can be sourced from the PRIME 2 database maintained by OSi.

However CSO or OSi data sources alone cannot provide a definitive breakdown of open space into public, semi-private or private access areas, and further investigation is needed to whether information is available in geospatial format within other public sector bodies. For resource reasons it is not feasible to obtain this information through surveys.

Indicator disaggregation: (List the indicator disaggregation by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts to support the monitoring of the implementation of the SDGs)

This indicator cannot be disaggregated by the variables requested. Theoretically spatial disaggregation can be calculated for urban areas and cities.

Frequency of dissemination: (Describe the time interval at which information is disseminated over a given time period)

Given that the Census is the source of the urban settlements for this indicator, the data can be disseminated at five year intervals.

Timeliness: (Length of time between data availability and the event or phenomenon they describe. Describe the average production time for each release of data)

New versions of the PRIME 2 database are available on a quarterly basis with the entire country being surveyed by OSi over a three year period.

Data sources: (List the data sources and themes or variables in use, including conditions of access situation, resolution, positional accuracy, frequency and timeliness regarding the ESS and NSS projects and /or INSPIRE conformance).

Data Source for Urban Areas

For the calculation of an urban area, the definition applied by the Census is used. Since the 2011 Census a settlement is defined as being a cluster of 50 or more occupied dwellings, with a maximum distance between any dwelling and the building closest to it of 100 metres, and where there was evidence of an urban centre (shop, school etc.). The criteria for extending an existing settlement depends on whether there are newly created estates or dwellings within 100 metres of the original settlement boundary.

At national level an urban area is a settlement in excess of 1 500 persons. Five of the urban settlements are considered to be cities, i.e. populations exceeding 50 000 (Dublin, Cork, Galway, Limerick and Waterford).

Data Source for Built-Up Areas

The central premise behind PRIME2 is the 'skin of the earth' concept where topologically consistent polygons cover the surface of Ireland. These polygons are grouped into five broad categories: way water, vegetation, artificial and exposed (non-vegetative ground such as sand and mud).

For the built-up areas described in the indicator, Artificial and Way objects are considered to be in scope. Artificial objects represent man-made ground cover such as concrete, tarmacadam, gravel, sloping masonry, rail bed etc. Note that Gardens are regarded as an artificial object. Way objects represent all drivable and walkable roads and paths from motorways down to sidewalks and laneways. Figure 1 shows the objects classified as Artificial or as Way in the centre of Dublin city.

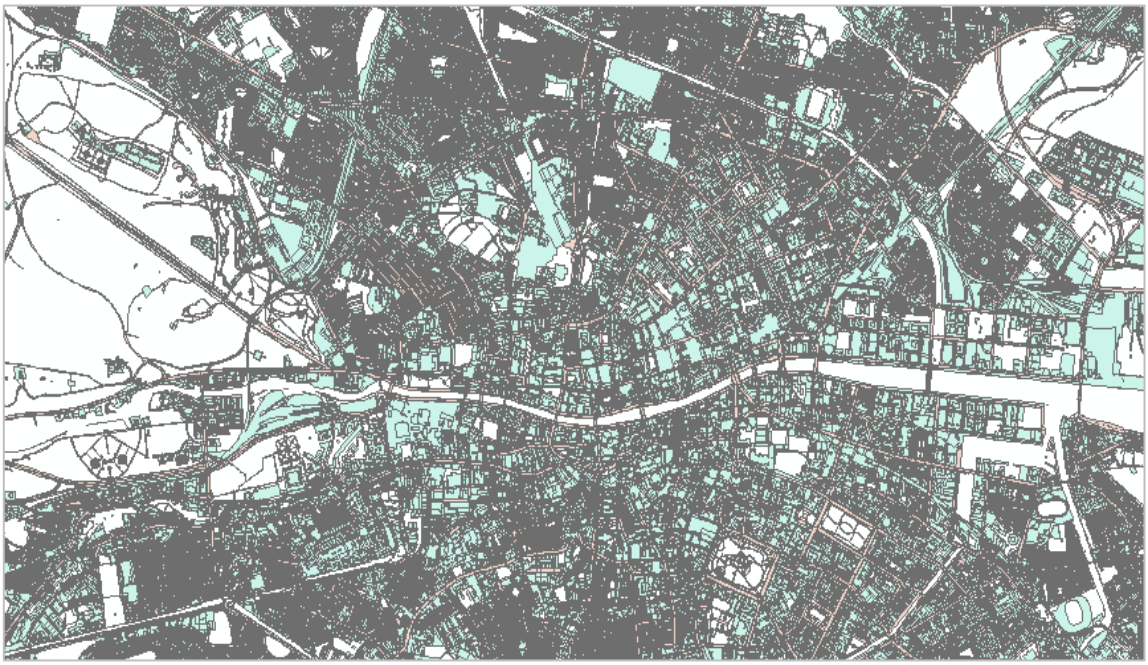


Figure 1 - Built-up areas in Dublin City centre

Data Source for Open Space for public use

The metadata for 11.7.1 states that open public space is publicly owned land available for public use such as parks, squares and recreational green areas. It also refers to land allocated to streets including roads, sidewalks, traffic islands etc.

PRIME2 contains over 50 million attributed objects in point (building), line (road) and polygon (parcel) format, and includes form and function object classification which describes the physical form (e.g., building) and its use (e.g., residential, hospital, church etc.). There are over 1 000 different function types recorded in PRIME2.

Table 1 shows the title of objects from PRIME2 selected for open public space along with the description in the PRIME2 documentation (Figure 2).

Title	Description
Green Space	An area of natural land covered with grass, plants &/or flowers, located in urban locations for both recreational & aesthetic purposes. May contain trees.
Public Park	An area of land, usually within a town or city, maintained in a natural state with facilities, flowers & trees used for the enjoyment of the public.
Beach	An area of sand, shingles, rocks or pebbles on the shoreline sloping down into inland or tidal water.
Cemetery	A defined parcel of land containing plots of ground where the dead are buried. Not necessarily located adjacent to a Church & not a graveyard or churchyard

Table 1 - Open public space objects in PRIME2 and their description

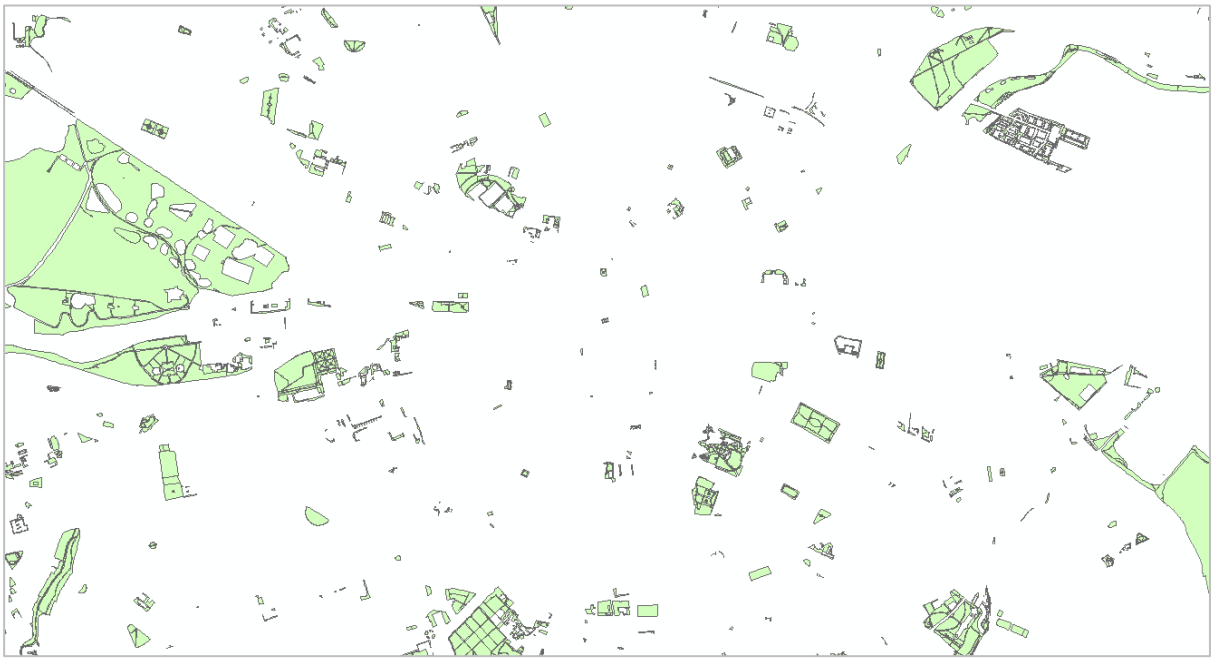


Figure 2 - Objects classified as open public space in Dublin city centre

Table 2 shows the objects selected from PRIME2 that resemble land allocated to streets that are considered as public space. It should be noted that the green areas associated with the objects in Table 2 were also extracted from the database (Figure 3).

Title	Description
Car Park	A well-defined area designated for car parking which is not part of the highway and is not a road-side parking area. Areas providing exclusive parking for individual domestic dwellings are not included. Within a Car Park, small "traffic islands" are not captured as separate objects but are regarded as integral to the Car Park.
Roundabout	A purpose built, raised hard surfaced, non drivable central island used to improve traffic flow by allowing one directional traffic flow at surfaced road junctions.
Sidewalk	A roadside path, usually paved for pedestrian use, normally separated from the road way by a kerb and may also have an adjoining verge.
Traffic Island	Raised islands of paved ground located within roads that are used to channel & separate traffic
Pier	A long structure sticking out from the land over the sea, where people can walk or large boats can be tied
"Street"	This consists of the road network minus Motorways, First class and second class roads. It also includes walkways and bicycle tracks

Table 2 - Objects in PRIME2 which could meet the 'land allocated to streets' and their description

Figure 3 - Objects classified as 'land allocated to streets' in Dublin city centre

Geospatial data analysis and integration: (Describe spatial analysis methods, procedures and computations, including regarding data integration)

The most recent settlements boundary from the 2016 Census is available as open data. All objects identified as Artificial and Way in PRIME2 that are contained within or intersect the settlement

boundaries can be extracted. A similar process can be adopted for objects that are classified as 'open public space'. The number of settlements selected for this indicator can be decided by applying population thresholds, whether at the Census definition of urban (1 500 persons), larger towns (5 000 persons) or cities (50 000 persons).

The average share of open space is then calculated as follows:

$$Proportion\ of\ Total\ Open\ Public\ Space = \frac{(Total\ surface\ of\ open\ public\ space + total\ surface\ of\ land\ allocated\ to\ streets)}{Total\ surface\ of\ built\ up\ area\ of\ the\ urban\ agglomeration}$$

Data quality requirements: (List in general terms the requirements for the sources and themes in use with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards are being followed, including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

Population (Census dataset)
Resolution: 1 metre
Completeness: 100%
Temporal accuracy: five-yearly

PRIME2
Resolution: 0.25 to 1 metre
Temporal accuracy: three-yearly
Positional accuracy: 0.7 to 5 metres

Current use of geospatial data for the indicator: (Describe the current use of geospatial data, as suggested by the existing metadata – the "as-is" situation)

Currently this indicator is not being produced.

2. Suggested Methodology

GAP analysis: (Describe what changes in use of **applied methods** are needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

The metadata for this indicator is quite complex and while PRIME2 can provide some information on having open space for public use it cannot supply a definitive breakdown on whether objects are under public or non-public ownership. An example of this relates to Public Gardens or Allotments, Courtyards in Buildings etc. Additional sources would need to be examined to see if the necessary information are available and can be successfully integrated, e.g. land registry data, LPIS (Land Parcel Identification System), local authority data etc.

However there is also the option to develop an indicator more relevant for policy makers at national level, such as calculating the share of built-up urban areas that is either (i) open green space for public use or (ii) green space only.

3. Suggested geospatial data integration

GAP analysis: (Describe what changes in use of **data** needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

The optimum solution would be to develop the PRIME2 attribution further to determine if land use can be categorised into public/non-public.

List required geospatial data: (Develop a list from the GAP analysis, which lists the geospatial data sources and themes which are required to support the to-be situation, including INSPIRE conformance)

Land Registry data, LPIS, Revenue returns, Local Authority data

Data quality requirements: (List in general terms the requirements for the suggested sources and themes with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards should be followed including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

The quality of the above datasets would need to be explored.

Data availability: (List the data availability for the suggested sources and themes or variables: 1) Geographically: national/regional/global (as well as comparability across countries), 2) Source: Accessible through services or download, 3) Commercial/legally: license conditions - are data free or are there restriction on use; 4) Timeliness; 5) Frequency of dissemination)

Data are available nationally but specific requests would need to be made to the data holders for access.

Data collection: (Describe how the geospatial data for the indicator can be collected/made available, and issues to overcome – are there many sources to collect from, do they need to be integrated and normalized etc.)

These datasets should have a level of geocoding. LPIS and Land Registry data are geocoded to coordinate level. Revenue data in urban areas should have a unique postcode which can be linked to the building coordinate. It is unknown whether local authority sources are either available or geocoded.

Geospatial data analysis and integration: (Describe which analysis, procedures and computations are needed to provide the results needed to support the reporting requirements - "to-be" situation)

All of these datasets would need to be cross-referenced against the PRIME2 database.

B. NATIONAL PRACTICE | Sweden (NSI and NMCA)

1. Current reporting situation

Responsibility: (Identify the agency responsible for the indicator and the situation regarding the ESS and NSS projects (including dissemination) and /or INSPIRE conformance)

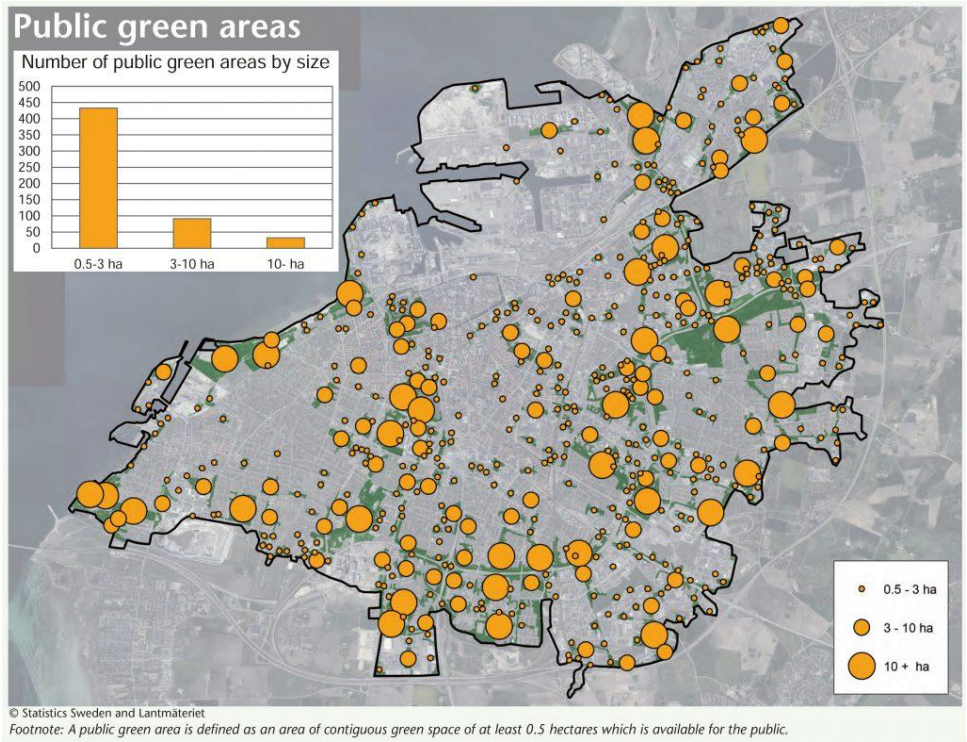
Due to the Tier classification, indicator 11.7.1 is not being calculated or reported by Sweden. In a proposal for national indicator framework and monitoring, Statistics Sweden proposed a complementary national indicator measuring people's access to public green areas in urban areas. This indicator is based on existing official statistics. The indicator is illustrated in the table below.

Share of urban population with access to public green areas within 200 metres from permanent place of residence in year 2010

Share (%) of population in urban areas with >= 30 000 inhabitants)

Access to public green areas	Female	Male	Total
Year 2010	92	92	92

To calculate this statistics, a method has been developed, based on a combined use of EO data and geocoded register data and other geospatial information (geocoded population data, cadastral parcels, buildings, road networks etc). Most likely, the data compiled for the green area statistics can be used as a foundation to calculate also the measures required for indicator 11.7.1. Some of the categories of public open space are already calculated (see map below). However, this remains to be tested. In this national practice case, the method for green area statistics is briefly outlined.



© Statistics Sweden and Lantmäteriet
Footnote: A public green area is defined as an area of contiguous green space of at least 0.5 hectares which is available for the public.

Indicator disaggregation: (List the indicator disaggregation by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts to support the monitoring of the implementation of the SDGs)

Disaggregation prospects:

- Accessibility to public green areas by distance (200m, 300m, 500m), gender and age groups (available in current statistics are 0-6, 7-15, 16-64, 65+ but any groping is possible).
- Public green areas by size
- Public green areas by type of land cover (open land, forest etc) and by type of land use (pasture, cemeteries etc).
- Public green areas by type of ownership

Frequency of dissemination: (Describe the time interval at which information is disseminated over a given time period)

Official statistics on public green areas and accessibility is produced on five-year basis.

Timeliness: (Length of time between data availability and the event or phenomenon they describe. Describe the average production time for each release of data)

Typically there is a lag between the year of reference and the release of final statistics. Next reference year is 2015, but because of limited resources, release of statistics for 2015 will be 2019.

Data sources: (List the data sources and themes or variables in use, including conditions of access situation, resolution, positional accuracy, frequency and timeliness regarding the ESS and NSS projects and /or INSPIRE conformance).

<u>Data sources for delimitation of urban areas:</u>

Following a definition of "locality" used in Sweden since 1960, which is a morphological definition, independent from administrative units. Core criteria: clusters with no less than 200 inhabitants and maximum 200 meters between buildings. Building data from the National Mapping Agency and geocoded population data. Delimitation is automated.

<u>Data sources on population:</u>

Resident (annual) population data based on registers, geocoded to the level of physical address location. Used to calculate proximity of population to public green areas.

Data sources on urban land cover:

EO data (for 2010 SPOT 5, next time will be Sentinel) classified with segmentation and per pixel algorithms to produce an urban land cover map. EO based classification is enriched with data on building and street footprint.

Data sources on urban land use and ownership:

Cadastral parcels (polygons) combined with information from Tax Assessment Register about ownership and type of Real Estate Property. Additional data on airports, quarries, allotment gardens etc.

Geospatial data analysis and integration: (Describe spatial analysis methods, procedures and computations, including regarding data integration)

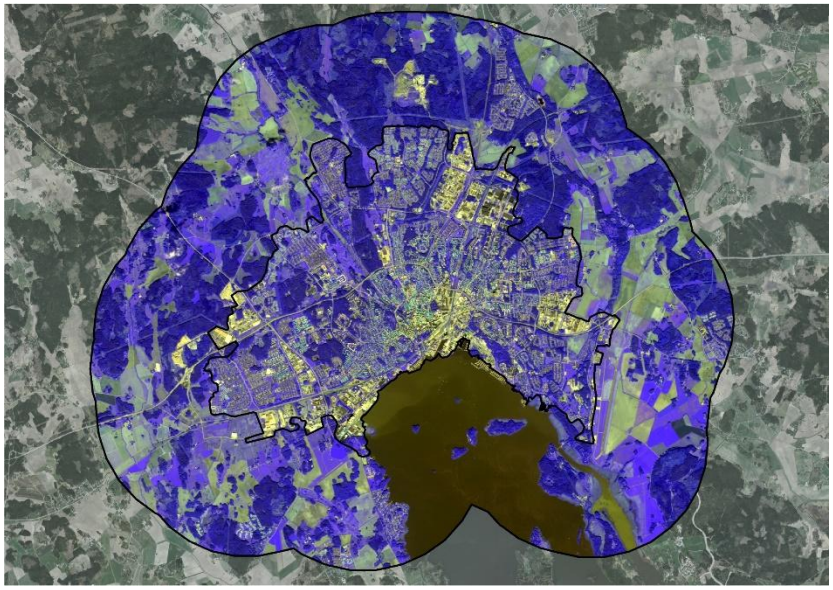
1- Urban delimitation

Clustering of population and building density do delimit “localities”. A buffer zone is added around the urban area to avoid problems with edge effects. Only urban areas with >= inhabitants are passed to further analysis.

2- Creation of soil sealing mask

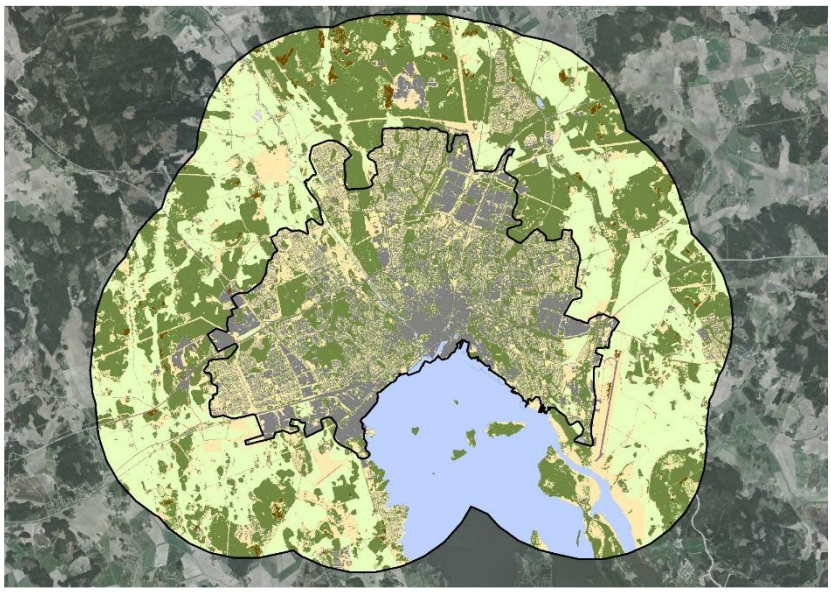
"Known" soil sealed land is extracted from buildings and road network. The road network is transformed from line to polygon features based on information about widths of road segments.

3- Preparation of EO data



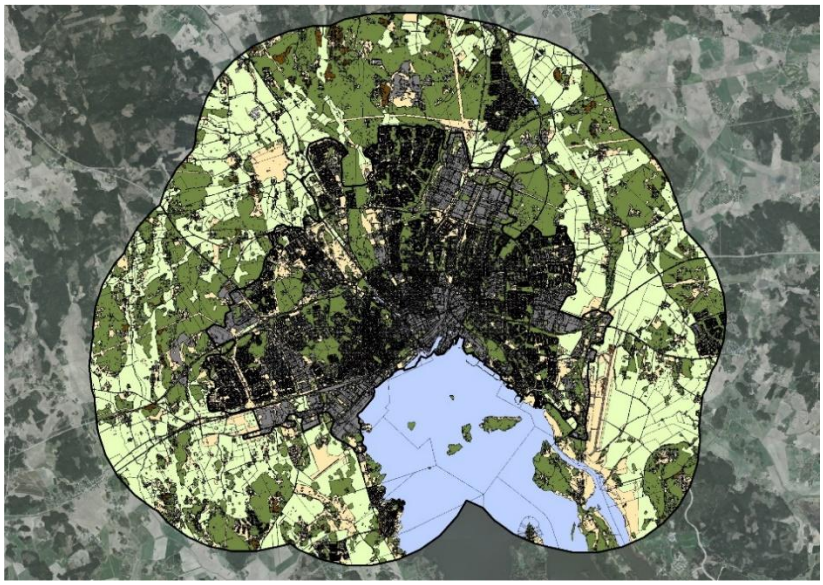
EO data is prepared for classification.

4- Urban land cover data



The classification results in a complete urban land cover map with nine discrete classes and 10 meter resolution.

5- Integration with land use information and cadastral information

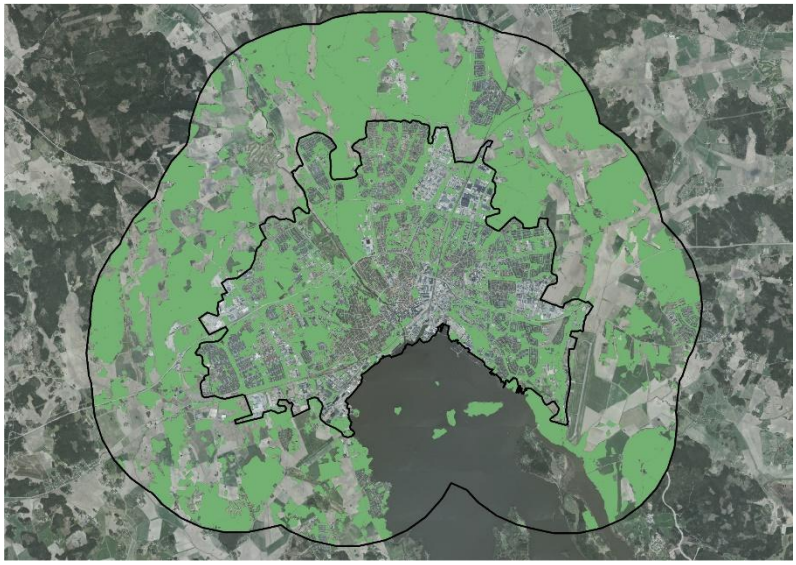


The land cover map is overlayed with cadastral parcels including tax data and land use information. This is the final data cube that holds information in three thematic layers:

- land cover (green space and soil sealed land)
- land use (airports, cemeteries etc)
- fiscal information on ownership and type real estate property

By cross-querying the data cube, information such as “all green spaces within properties used for housing owned by public housing companies” can be retrieved. The combination of these information layers is also the key to calculate public open space.

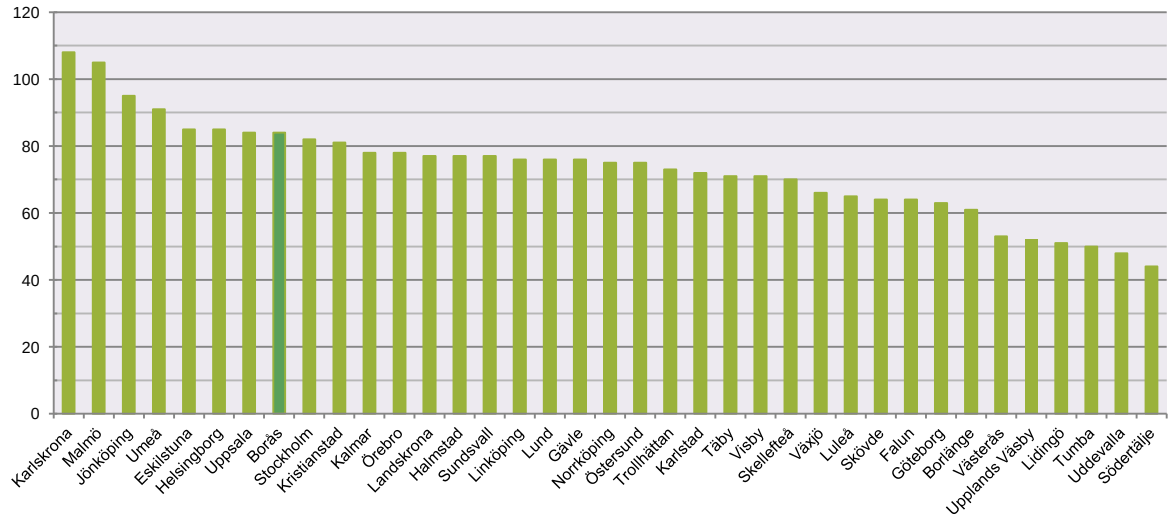
6- Creation of public green areas



From the data cube, public green areas are extracted. The criteria is conjoined green spaces, >=0.5 hectares, accessible for the general public.

7- Calculation of accessibility

The final step is to calculate the accessibility to public green areas based on proximity (Euclidian distance) from people's place of permanent residence (address location) to public green areas that were defined in step 6. The accessibility calculations can take into account also numerous background variables for individuals such as age, gender, income, education etc. Calculation can be conducted using fixed intervals (buffers) or by assigning a nearest neighbour value to each individual. This enables average distances to be examined for each urban area. The graph below shows the average distance to public green areas in the largest urban areas in Sweden, ranging from roughly 110 metres, at most, to just above 40 meters.



Data quality requirements: (List in general terms the requirements for the sources and themes in use with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards are being followed, including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

Data on population:

The spatial accuracy of geocoded population data must be high in order to conduct good calculations.

Data sources on urban land use and ownership:

A crucial requirement is high quality data on ownership and type of property. Without this, it is not possible to discern public property from private.

Current use of geospatial data for the indicator: (Describe the current use of geospatial data, as suggested by the existing metadata – the "as-is" situation)

2. Suggested Methodology

GAP analysis: (Describe what changes in use of **applied methods** are needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

This national practice demonstrates that it is possible to come quite close to fulfil the requirement of the global indicator through an approach based entirely on integration of geospatial information and statistical registers. In a Swedish context, fieldwork to collect data on public open space would not be an option. Community based data collection can be valuable input but is difficult to handle due to uncertainties regarding coverage and completeness. In our national perspective, we will have to try to tweak the data already at hand to see if we can extract even more information responding to the requirement of the global indicator.

3. Suggested geospatial data integration

GAP analysis: (Describe what changes in use of **data** needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

Described in previous sections.

List required geospatial data: (Develop a list from the GAP analysis, which lists the geospatial data sources and themes which are required to support the to-be situation, including INSPIRE conformance)

- Population data geocoded to address.
- The actual locations of the physical address.
- Good cadastral information including cadastral parcels and information about type of property unit and ownership.
- Complete and INSPIRE conformant data on buildings and road networks.
- Access to high-resolution EO data (e.g. Sentinel data).

Data quality requirements: (List in general terms the requirements for the suggested sources and themes with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards should be followed including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

Described in previous sections.

Data availability: (List the data availability for the suggested sources and themes or variables: 1) Geographically: national/regional/global (as well as comparability across countries), 2) Source: Accessible through services or download, 3) Commercial/legally: license conditions - are data free or are there restriction on use; 4) Timeliness; 5) Frequency of dissemination)

Described in previous sections.

Data collection: (Describe how the geospatial data for the indicator can be collected/made available, and issues to overcome – are there many sources to collect from, do they need to be integrated and normalized etc.)

Described in previous sections.

Geospatial data analysis and integration: (Describe which analysis, procedures and computations are needed to provide the results needed to support the reporting requirements - "to-be" situation)

Described in previous sections.

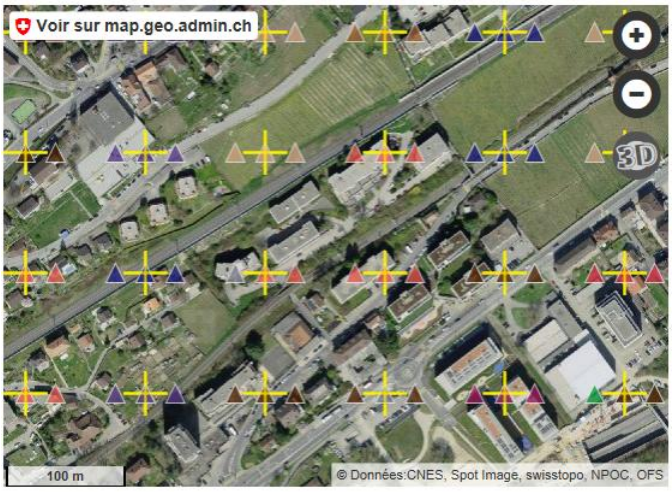
B. NATIONAL PRACTICE | Switzerland (NSI)

1. Current reporting situation

Responsibility: (Identify the agency responsible for the indicator and the situation regarding the ESS and NSS projects (including dissemination) and /or INSPIRE conformance)

Swiss Federal Office for Spatial Development ARE (thematic responsibility); Swiss Federal Statistical Office FSO (responsible for the data sources used).

At the national level, Switzerland calls this indicator «Urban recreational areas». It will be measured based on the national land use statistics which is established by visual interpretation of high-resolution aerial photography and distinguishes 46 categories of land use and 27 categories of land cover. For indicator 11.7.1, the percentage of the surface occupied by the land use types “Recreational areas and cemeteries” and “Surroundings of residential buildings” among the total settlement of urban municipalities is used as measured variable.



Indicator disaggregation: (List the indicator disaggregation by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts to support the monitoring of the implementation of the SDGs)

For the purpose of national monitoring, a spatial disaggregation is not essential. However, since the land use statistics is based on the interpretation of a regular grid of sample points at 100 m distance each from another, the indicator can be calculated for regions, cantons (NUTS3 units), agglomerations and even communes (LAU2 units). However, the smaller the surface of a geographic

subdivision observed, the higher the statistical error and the lower the statistical significance and reliability of the result.

Frequency of dissemination: (Describe the time interval at which information is disseminated over a given time period)

The existing time series of the land use statistics comprises three surveys based on aerial photographs of the years 1979/85, 1992/97 and 2004/09. From the present survey (using aerial imagery from 2013 to 2019) onwards, the land use statistics will be produced continuously. Every year, one sixth of the national surface will be updated, so that entire survey will have a six-year periodicity.

Timeliness: (Length of time between data availability and the event or phenomenon they describe. Describe the average production time for each release of data)

Typically, the land use statistics is published with a one-year time lag after the production of the aerial photographs.

Data sources: (List the data sources and themes or variables in use, including conditions of access situation, resolution, positional accuracy, frequency and timeliness regarding the ESS and NSS projects and /or INSPIRE conformance).

The Swiss land use statistics will be the only data source needed for the land use figures. However, a multitude of data sources, such as aerial photographs, topographic maps and land models, various other vector and raster geodata used to simplify and verify the human interpretation, are integrated and used in the production process of the land use statistics.

Urban municipalities are defined according to the FSO urban-rural typology 2012 (FSO 2017).

Geospatial data analysis and integration: (Describe spatial analysis methods, procedures and computations, including regarding data integration)

Data quality requirements: (List in general terms the requirements for the sources and themes in use with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards are being followed, including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

The Swiss land use statistics is well established and known for its high reliability and data quality. This is especially true for results at the national or regional level. However, the smaller the surface of a

geographic subdivision observed, the higher the statistical error and the lower the statistical significance and reliability of the result.

Current use of geospatial data for the indicator: (Describe the current use of geospatial data, as suggested by the existing metadata – the "as-is" situation)

A multitude of geospatial data, which is publicly available and sometimes analyzed and pre-processed in-house in order to meet the requirements of the human interpreters optimally, is used to simplify and verify the survey of the Swiss land use statistics.

2. Suggested Methodology

GAP analysis: (Describe what changes in use of **applied methods** are needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

The present example shows to which extent it is possible to use existing data and data collection programs to fulfil the reporting requirements as they are understood in Switzerland. Due to limited resources all possibilities are used in order to define variables and indicator calculations which allow to be implemented without requiring expensive adjustments of the present or establishment of new surveys or measurement programs.

3. Suggested geospatial data integration

GAP analysis: (Describe what changes in use of **data** needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

Described in previous sections.

List required geospatial data: (Develop a list from the GAP analysis, which lists the geospatial data sources and themes which are required to support the to-be situation, including INSPIRE conformance)

- High-resolution aerial photographs taken at regular intervals and covering consistently the entire national territory.
- Urban/rural typology at municipality level
- Population and economic data geocoded to address.

Data quality requirements: (List in general terms the requirements for the suggested sources and themes with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards should be followed including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

Described in previous sections.

Data availability: (List the data availability for the suggested sources and themes or variables: 1) Geographically: national/regional/global (as well as comparability across countries), 2) Source: Accessible through services or download, 3) Commercial/legally: license conditions - are data free or are there restriction on use; 4) Timeliness; 5) Frequency of dissemination)

Described in previous sections.

Data collection: (Describe how the geospatial data for the indicator can be collected/made available, and issues to overcome – are there many sources to collect from, do they need to be integrated and normalized etc.)

Described in previous sections.

Geospatial data analysis and integration: (Describe which analysis, procedures and computations are needed to provide the results needed to support the reporting requirements - “to-be” situation)

Described in previous sections.

C. EU SDG | No corresponding indicador available

1. Current reporting situation

Responsibility: (Identify the agency responsible for the indicator and the situation regarding the ESS and NSS projects (including dissemination) and /or INSPIRE conformance)

Indicator disaggregation: (List the indicator disaggregation by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts to support the monitoring of the implementation of the SDGs)

Frequency of dissemination: (Describe the time interval at which information is disseminated over a given time period)

Timeliness: (Length of time between data availability and the event or phenomenon they describe. Describe the average production time for each release of data)

Data sources: (List the data sources and themes or variables in use, including conditions of access situation, resolution, positional accuracy, frequency and timeliness regarding the ESS and NSS projects and /or INSPIRE conformance).

Geospatial data analysis and integration: (Describe spatial analysis methods, procedures and computations, including regarding data integration)

Data quality requirements: (List in general terms the requirements for the sources and themes in use with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards are being followed, including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

General comments: (Please provide any additional information or comments)

2. Suggested Methodology

GAP analysis: (Describe what changes in use of **applied methods** are needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

3. Suggested geospatial data integration

GAP analysis: (Describe what changes in use of **data** needed to go from the suggested/current procedure for monitoring the indicator, to a future procedure which better fulfils the reporting requirements - going from the "as-is" situation in the present metadata proposal to a "to-be" situation)

List required geospatial data: (Develop a list from the GAP analysis, which lists the geospatial data sources and themes which are required to support the to-be situation, including INSPIRE conformance)

Data quality requirements: (List in general terms the requirements for the suggested sources and themes with relevant parameters: Resolution, completeness, logical consistency, positional accuracy, temporal accuracy etc. List if certain international standards should be followed including classifications/nomenclatures. Data quality should allow computing results to the needed level of resolution and disaggregation). Please take into account the EURO-SDMX Metadata Structure (ESMS) 2.0.

Data availability: (List the data availability for the suggested sources and themes or variables: 1) Geographically: national/regional/global (as well as comparability across countries), 2) Source: Accessible through services or download, 3) Commercial/legally: license conditions - are data free or are there restriction on use; 4) Timeliness; 5) Frequency of dissemination)

Data collection: (Describe how the geospatial data for the indicator can be collected/made available, and issues to overcome – are there many sources to collect from, do they need to be integrated and normalized etc.)

Geospatial data analysis and integration: (Describe which analysis, procedures and computations are needed to provide the results needed to support the reporting requirements - "to-be" situation)