

14.14 Areal sprawl

Project Name: Nature4Cities (Grant agreement: No. 730468)

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Areal Sprawl	Place Regeneration
Description and justification	<p>Areal sprawl is the territorial aspect of several urban transitions. According to literature (Speck, 2013; Saelens et al. 2003.) the planning of city centres can avoid areal sprawl. If downtown is liveable, less people will tend to move to the outskirts of the city and undertake the burden of daily commute for the desired quality of their place of residence. Nature-based solutions are highly relevant from compact urban form point of view. Compactness can be also achieved with the balanced availability of green spaces and ecosystem services. In addition, unrestricted urban sprawl endangers natural environment around the city and the protective zones that mitigates the intensity of urban heat island.</p>
Definition	<p>Areal sprawl indicator describes the level of compactness of a city, as the ratio between total building floor area to the area of the convex hull of the built space.</p> <p>The convex hull of a set of points is the minimal convex envelope that contains those points. Computing this shape gives a fair ground to compare different cities or neighbourhoods, and a closer approximation to the actual built density.</p>
Strengths and weaknesses	
Measurement procedure and tool	<ul style="list-style-type: none"> ● computation of convex hull ● collection or calculation of total floor area ● ratio $\text{Conv}(S) = \left\{ \sum_{i=1}^{ S } \alpha_i x_i \mid (\forall i : \alpha_i \geq 0) \wedge \sum_{i=1}^{ S } \alpha_i = 1 \right\}.$ <p>General formula for a convex hull: $AS = A_{\text{convex hull}}/A_{\text{built space}}$</p> <p>Output measurement unit: m^2 / m^2 (or m^3/m^2)</p>

	Tools: convex hull surface calculation software or library, like: Shapely, SciPy
Scale of measurement	Neighbourhood and city scale
Data source	
Required data	<ul style="list-style-type: none"> - Total floor area of buildings. If this is impossible to acquire directly it can be approximately calculated knowing the ground area of buildings and their heights. - To assess the impact of a future project, a tool that simulates urban evolution is needed.
Data input type	<ul style="list-style-type: none"> - Municipality databases - Open sources like Open Street Map - But in any case, data has to be georeferenced
Data collection frequency	Before / after the project's implementation, to characterize its effects on the local environment
Level of expertise required	It can be used after minimal explanation. The concept of total floor area against the convex hull area of a city can be translated roughly as built "volume" against the city size.
Synergies with other indicators	
Connection with SDGs	SDG 3 Good Life and Well-being, SDG 11 Sustainable Cities and Communities, SDG 13 Climate action
Opportunities for participatory data collection	-
Additional information	
References	<ul style="list-style-type: none"> - Skiena, S. S. "Convex Hull." §8.6.2 in The Algorithm Design Manual. New York: Springer-Verlag, pp. 351-354, 1997. - http://mathworld.wolfram.com/ConvexHull.html (downloaded: 2020.06.11.) - SPECK, Jeff (2013). Walkable City: How Downtown Can Save America, One Step at a Time. North Point Press - Saelens et al. 2003. Environmental Correlates of Walking and Cycling: Findings From the Transportation, Urban Design, and Planning Literatures" - Nature4Cities, D2.1 - System of integrated multi-scale and multi-thematic performance indicators for the assessment of urban challenges and NBS. https://www.nature4cities.eu/post/nature4cities-defined-performance-indicators-to-assess-urban-challenges-and-nature-based-solutions. - Nature4Cities, D2.2 - Expert-modelling toolbox

- Nature4Cities, D2.3 – NBS database completed with urban performance data
<https://www.nature4cities.eu/post/applicability-urban-challenges-and-indicators-real-case-studies>
 - Nature4Cities, D2.4 - Development of a simplified urban performance assessment (SUA) tool

14.15 Access to public amenities

Project Name: CONNECTING Nature (Grant Agreement no. 730222)

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Access to public amenities (Applied and EO/RS combined)	Place Regeneration
<p>Description and justification</p>	<p>Density of public amenities has been used as an indicator of compactness or urban sprawl (and less car use). Accessible local services and facilities can reduce travel, particularly by private cars and help ensure sustainable communities. It can also be viewed as an indicator of health/wellbeing and quality of life. Public amenities are services/facilities which are provided by the government or town/city councils for the general public to use, with or without charge, for instance libraries, social welfare points etc. (CITYkeys). Access to public amenities partially measures the mix and distribution of different facilities and uses in a city and the proximity of public services to the residential location of city dwellers.</p> <p>Remote sensing imagery has been widely adopted for analysis of spatial inequalities in distribution and accessibility to public amenities in cities (Joseph et al., 2012). Major techniques for this include dasymetric mapping, regression models and geostatistical models (Jensen et al., 2004; Joseph et al., 2012), spatial visualization and overlay analysis with georeferencing and digitization (Borana and Yadav, 2017; Travland et. al., 2017). There are some studies on accessibility of public amenities where amenities services are shown with the help of the database management systems by using GIS and RS (Nilsson, 2014; Taylor et al., 2017). Research indicates that urban population today prefer more open, well designed, structured, and built amenities as opposed to wildland recreation areas (Johnson et al., 2004; Travland</p>