proGIreg

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Methodology on spatial analysis in front-runner and follower cities

Deliverable 2.1

Work package: 2

Dissemination level: PU

Lead partner: URBASOFIA

Author: Leopa and Elisei

First version: 31/08/2018

Revision: 28/07/2020

Deliverable	**Methodology on spatial analysis in front-runner and follower cities**
Deliverable No.	2.1
Work Package	2
Dissemination Level	Public
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Date	31/08/2018 (original), 28/07/2020 (resubmission)
File Name	D2.1_proGIreg_Methodology Spatial Analysis_2020-07-28
Status	Resubmitted
Revision	2
Reviewed by (if applicable)	Rieke Hansen, Axel Timpe, Margot Olbertz (RWTH)
Information to be used for citations of this report	Leopa, S., Elisei, P. (2020): Methodology on spatial analysis in front-runner and follower cities, D2.1, proGIreg. Horizon 2020 Grant Agreement No 776528, European Commission, 61 pp.

This project has received funding from the EU's Horizon 2020 research and innovation programme under grant agreement no. 776528.

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This work was financially supported by the National Key Research and Development Programme of China (2017YFE0119000).

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Document revision history

Version	Date	Modification reason	Modified by
1	31/08/2018	Final Draft revision - integration of comments from R. Hansen and A. Timpe (RWTH)	Sabina Leopa
2	02/05/2019	Update of layout	Rieke Hansen
3	22/05/2020	Review in preparation of update	Margot Olbertz
4	15/07/2020	Second Version	Sabina Leopa

Partner organisations

No.	Name	Short name	Country
1	RWTH Aachen University	RWTH	Germany
2	URBASOFIA SRL	URBASOFIA	Romania

Abbreviations

proGIreg	productive Green Infrastructure for post-industrial urban regeneration
WP	Work Package
FRC	Front-Runner City
FC	Follower City
NBS	Nature Based Solutions
GI	Green Infrastructure
SDG	Sustainable Development Goals
TRL	Technology Readiness Level

Executive Summary

This deliverable presents the proposed methodology for developing Spatial Analyses in the four front-runner (FRC) and four follower cities (FC) within the proGIreg project, and is part of Task 2.1, Work Package 2 – Planning, design and participation processes for nature-based solutions (NBS) coordination. The Spatial Analysis in FRC and FC aims to develop a common spatial framework based on data produced at city and LL / Regeneration analysis area level from existing administrative databases, completed by relevant qualitative information on the enabling policy and stakeholder environment, provided by each city.

The methodology is constructed as a two-part document, including an introduction, research design and methodological part addressed specifically to the proGIreg partnership and potential external scientific interest, followed by a guidance section assisting cities and their local partners involved in T.2.1 to perform Spatial Analyses. The guidelines support a number of subsequent activities and processes in the project, including the local processes of co-design in FRC (T2.2) and FC (T2.3), the NBS benefit assessment and monitoring (WP4) and communication activities (WP6). Beyond the proGIreg project, this approach can be useful for any given city interested in assessing existing conditions for either implementing NBS in Living Labs (LL), or for developing Urban Regeneration Plans in order to adapt NBS within their own urban context and respond to post-industrial development challenges.

The methodological approach developed by URBASOFIA considers the limitations of working with existing statistical and spatial data from administrative databases. It also seeks to provide a coherent framework for data availability disparities, planning and regulatory contexts between partners. It frames the rationale and scientific context and explains how spatial data, spatial analysis, analysis scales and boundaries will be interpreted and used in the methodology. The Methodology proposes six steps: 1) Data availability check, 2) Analysis of existing plan and policy framework, 3) Basic data collection and area-based stakeholder identification, 4) Quantitative data collection and interpretation, 5) Data synthesis and spatialization, 6) Formulation of conclusions. Due to the heterogeneity of cities and contexts, as well as significant limitations in data availability, the steps have been simplified from a scientific spatial analysis and made accessible to cities.

The partner data availability check highlighted a generally limited spatial data availability in cities, with three of the FC (Zenica, Piraeus and Cluj-Napoca) lacking a municipal GIS. To overcome this barrier, the Spatial Analysis connects and draws relevant local spatial development information from exiting local planning documentations, through a plan and policy framework. Furthermore, and because the Spatial Analysis is limited to operating with existing data, a „long list" of spatial data was developed for cities to collect, in order to ensure a minimum overlap between partner data during the actual Spatial Analysis (D.2.2). In cooperation with WP4, in total, a number of 85 spatial datasets were developed under the four key analysis domains of proGIreg. The next steps are to apply the methodology consistently across the eight cities involved in proGIreg, for which we recommend a strong focus on data collection, and a differentiated approach to updating the Spatial Analysis in FC.

1. Introduction

1.1. Introduction to the project

Productive Green Infrastructure for Post-industrial Urban Regeneration (proGIreg) focuses on developing and testing new Nature Based Solution (NBS)-oriented economies shared between public authorities, civil societies and industry / SMEs. Leveraging on the potential of Green Infrastructure (GI) as a driver for the creation of new ecosystems in cities, proGIreg will demonstrate the integration of a number of **8 NBS into business models** which will be economically self-sustaining, and which will provide multiple benefits for the economic, ecological and social regeneration of deprived urban areas suffering from the consequences of de-industrialization. **The NBS will be tested within 4 Front-Runner Cities** (FRC), while another **4 Follower Cities** (FC) will be supported to develop their strategies for embedding nature-based innovation at local level, though participatory processes (see Figure 1).

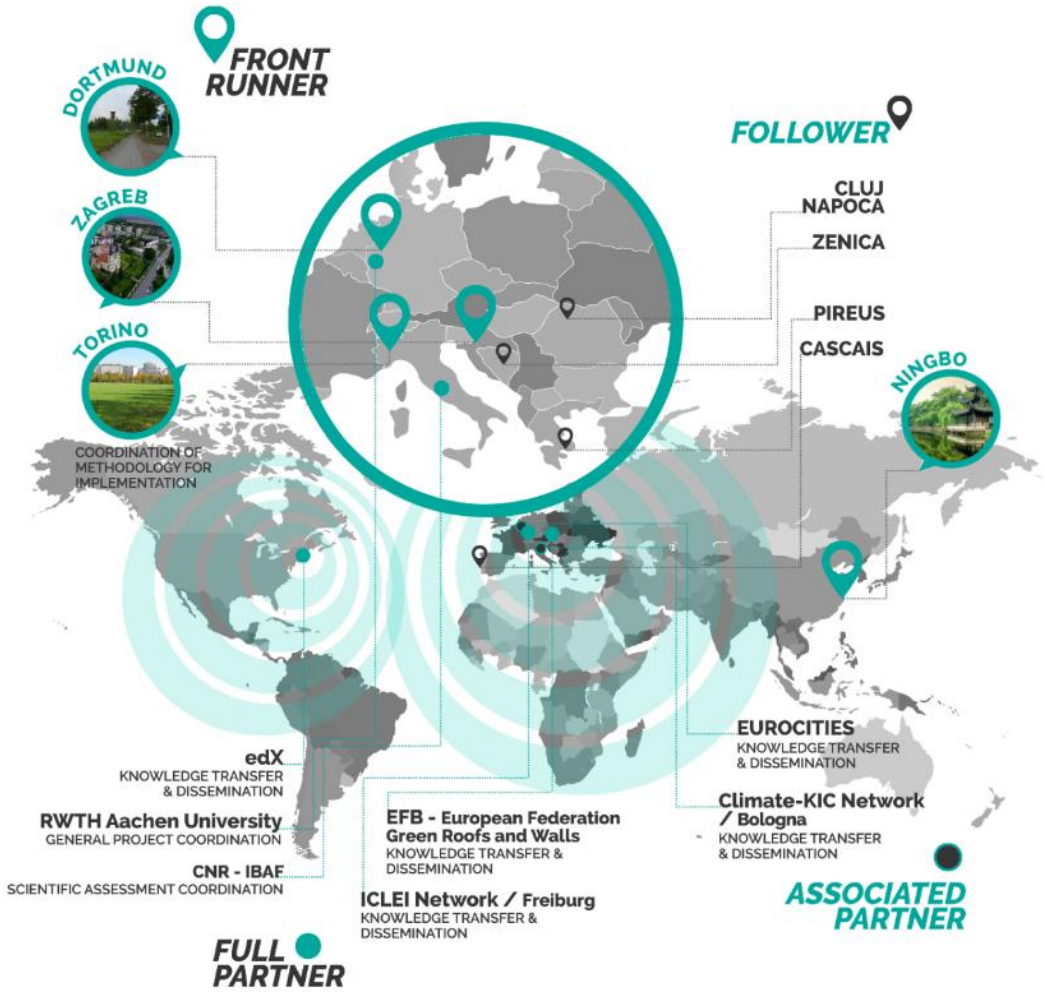


Figure 1 | The proGIreg partnership. Source: RWTH,proGIreg Application Form

The Front Runner Cities (FRC) of Dortmund, Turin, Zagreb and Ningbo will pilot implementing NBS within their GI network, creating, assessing and monitoring practices which will demonstrate:

1) **Technical innovation** – through deployment and improvement of the Technology Readiness Level of the 8 Nature-Based Solutions selected for proGIreg;
2) **Social innovation** – through locally-rooted processes of co-design, co-creation and co-implementation of green infrastructure solutions together with the local communities in the living labs areas, which will be integrated into participatory urban regeneration plans.
3) **Economic innovation –** through market-ready business models for productive GI, collected within a business model catalogue.

ProGIreg will deploy the following Nature-Based Solutions with varying Technology Readiness Levels (TRL)[1] embedded into Living Labs: working with the local stakeholder landscape will create ownership and locally rooted solutions:

Table 1 | Overview of proGIreg NBS

Overview of proGIreg Nature-Based Solutions	Initial TRL and proGIreg achievement
● NBS 1 - Renaturing landfill sites for leisure use and energy production	TRL: 8. Future TRL: 9
● NBS 2 - New regenerated soil thanks to biotic compounds for urban forestry and urban farming	TRL: 5. Future TRL: 8
● NBS 3 - Community-based urban farming and gardening on post-industrial sites	TRL: 7. Future TRL: 9
● NBS 4 - Aquaponics as soil-less agriculture for polluted sites	TRL: 7. Future TRL: 9
● NBS 5 - Capillary GI on walls and roofs	TRL: 5. Future TRL: 8
● NBS 6 - Making post-industrial sites and renatured river corridors accessible for local residents	TRL: 8. Future TRL: 9
● NBS 7 - Establishing protocols and procedures for environmental compensation at local level	TRL: 6. Future TRL: 9
● NBS 8 - Pollinator biodiversity improvement activities and citizen science project	TRL: 5. Future TRL: 9

[1] Technology Readiness Level represents an abstraction of the technology maturity of a certain technological solution, a method used by the European Commission to estimate progress towards technology *systems actually proven in operational environments* (TRL 9, the highest ranking). In proGIreg, the 8 NBS solutions have starting points ranging from TRL 5 („*technology validated in relevant environments*") to TRL 8 („*system complete and qualified*"). Source: EC (2014), Extract from Part 19 – Commission Decision C(2014)4995, Annex G. Technology readiness levels.

The embedding of proGIreg NBS within the local frameworks of the FRC and the planning frameworks of FC will be expected to contribute to:

1) European leadership in the global NBS market
2) Increased awareness in practice of NBS
3) Increased citizen ownership and understanding of GI as an urban common
4) Newly opened global market opportunities
5) Contributions to the implementation of several EU policies
6) Attaining of the Sustainable Development Goals (SDG), especially SDG 11 - Make cities and human settlements inclusive, safe, resilient and sustainable.

1.2. ProGIreg Spatial Analysis in FRC and FC

Work Package 2 – Planning, design and participation processes for NBS forms the basis for future planning and implementation in order to realistically measure success of the proGIreg interventions**.** WP 2 consists of three tasks (T) (see fig. 2), the first of which is partly constituted by this report. The overall aim is to enable and prepare a location-based and locally adapted implementation of the NBS to be developed within the proGIreg FRC and to identify the potential for their transfer to the project's FC.

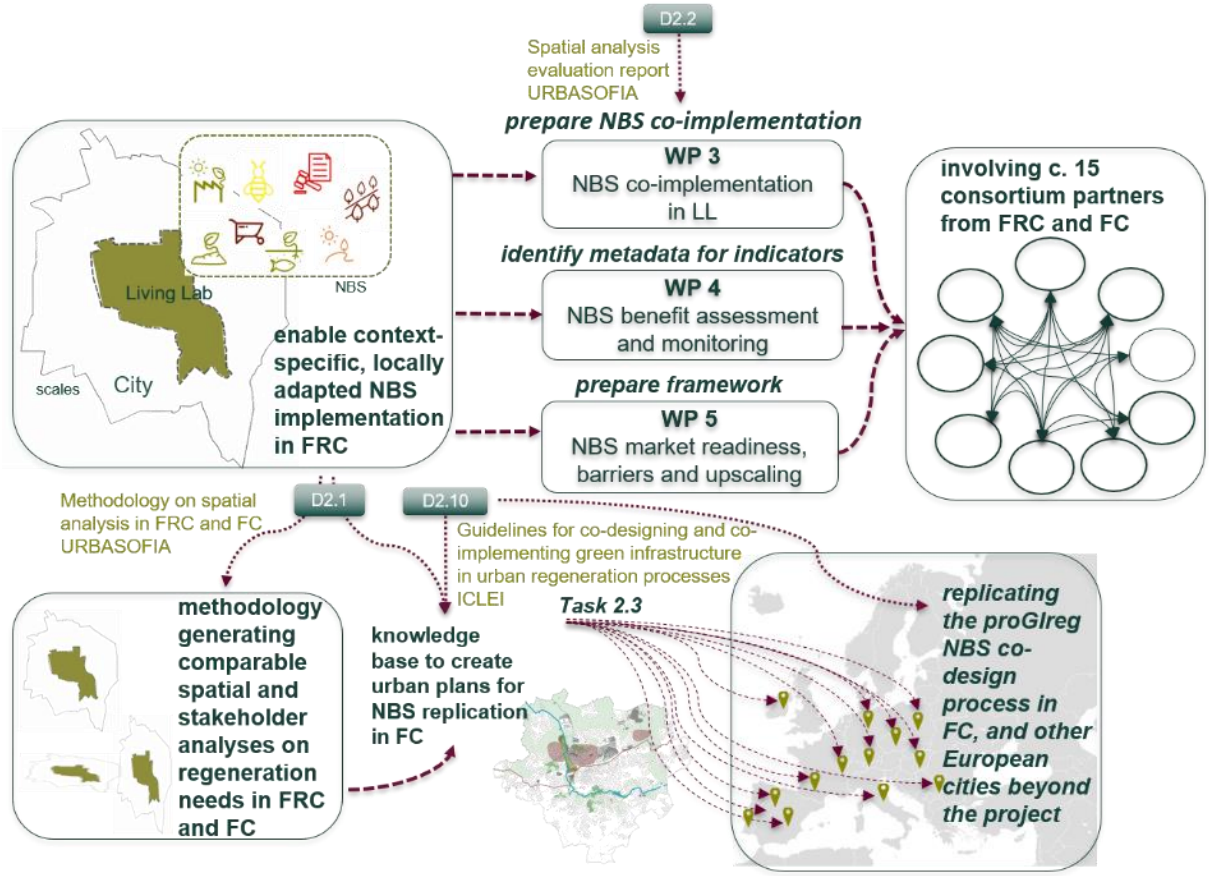


Figure 2 | Overview of Task 2.1 embedded in the project structure and the impact of deliverables D2.1 and D2.2 on overall project goals. Source: proGIreg, RWTH

Task 2.1 represents the first activity in the project (Fig. 2). The deliverables D.2.1 and D.2.2, developed in the first months of the project, will assist cities in creating context-specific spatial analyses using spatial baseline data and meta-databases.

Table 2 | Objectives of Task 2.1 within the proGIreg project

Objectives of Task 2.1
● Provide a **baseline situation of the spatial development of the FRC, FC and LL district areas**, and highlight relevant issues, trends, opportunities, and barriers for NBS implementation.
● Support the **co-design activities in FRC (Task 2.2)** through providing spatial analysis synthesis SWOT maps, useful to prepare and inform the participatory processes;
● Prepare the framework for the development of **Urban Regeneration Plans in FC (Task 2.3)** providing a baseline context analysis for replicating, embedding and integrating NBS at Regeneration Area scale.
● Support the **NBS benefit assessment and monitoring (WP 4)** with spatial data and metadata from existing databases (BASE) to be used for the benefit upscaling (City level) or assessment (LL district level).
● Provide relevant information and data, useful for the transition to the co-implementation phase in FRC (WP 3) and for the development of sustainable business models (WP 5)

The Spatial Analysis in FRC and FC aims to develop **a common spatial framework** based on spatial data produced at city and Regeneration Area / LL district level from existing administrative databases, completed with relevant qualitative information on the enabling policy and stakeholder environment, provided by each of the cities. The Spatial Analysis represents a baseline of the current situation within the proGIreg cities, at different scales:

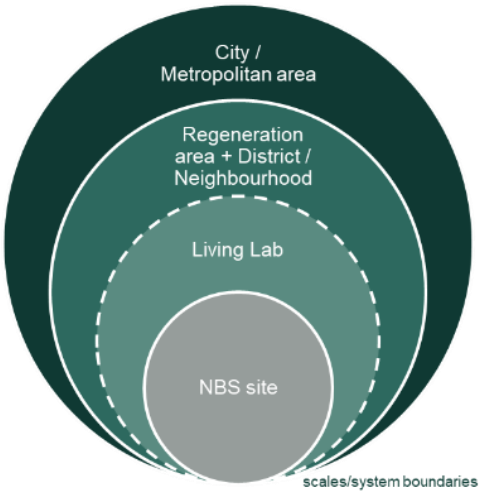


Figure 3 | Analysis scales in proGIreg Task 2.1. Source: ICLEI, after URBASOFIA model

1.3. Introduction to the methodology for Spatial Analysis in FRC and FC

1.3.1. Intended use for the Methodology. How to read this report

This report provides the common working methodology and analysis guidelines to support FRC and FC in carrying out their analyses. It aims at ensuring that the spatial analyses in all involved cities are coherent, comparable, in line with the objectives of the Task 2.1, and that they support the achievement of proGIreg goals.

The methodology is designed to support the analysis of baseline conditions („state of play") for the four key scientific assessment domains defined in WP 4, based on the cross-disciplinary, multi-benefit approach used by the NBS assessment framework developed by the Expert Working Group (EWG) of the EKLIPSE project under EU-DG R&I request and further developed in Raymond et al. (2017). It is focused specifically on assisting FRC and FC in transposing at spatial-urban level the key spatial characteristics of the four proGIreg assessment domains: Socio-cultural inclusiveness, Human health and well-being, Ecological and environmental restoration, Economic and labour market.

The contents of the methodology are structured into four main parts. First, the research design and methodology (Chapter 2) provides a literature review and state of art assessment, framing the context for the development of the methodology, and further expands on the latter and the components of the Spatial Analysis. Chapter 3 is addressed to cities, and contains the specific guidelines for the development of the spatial analysis.

An overview of the plan and policy framework survey is included in Annex A. Annexes B and C provide reference templates for the Spatial SWOT maps and for the basic city data respectively. The scoping survey on available data (results) is included in the Annex D, and lastly, Annex E provides the complete list of administrative spatial data requested to FRC and FC.

The deliverable as a whole is intended for use in the proGIreg project as a public deliverable, secondary objective is to inform and support replication or similar NBS implementation actions in other settings as well. Specifically for this reason, the Guidelines and Toolkit have been designed with the possibility of extraction and use stand-alone, for any city or stakeholder (mainly public institutions and urban authorities, such as metropolitan areas) aiming at assessing the opportunities for developing and implementing Nature-Based Solutions.

1.3.2. Target audience

This report was developed in the first three months of project implementation, setting out the approach through which proGIreg cities and their local partners will conduct the spatial

analysis, with support of the task and WP leaders. For Task 2.1, the following working groups are involved:

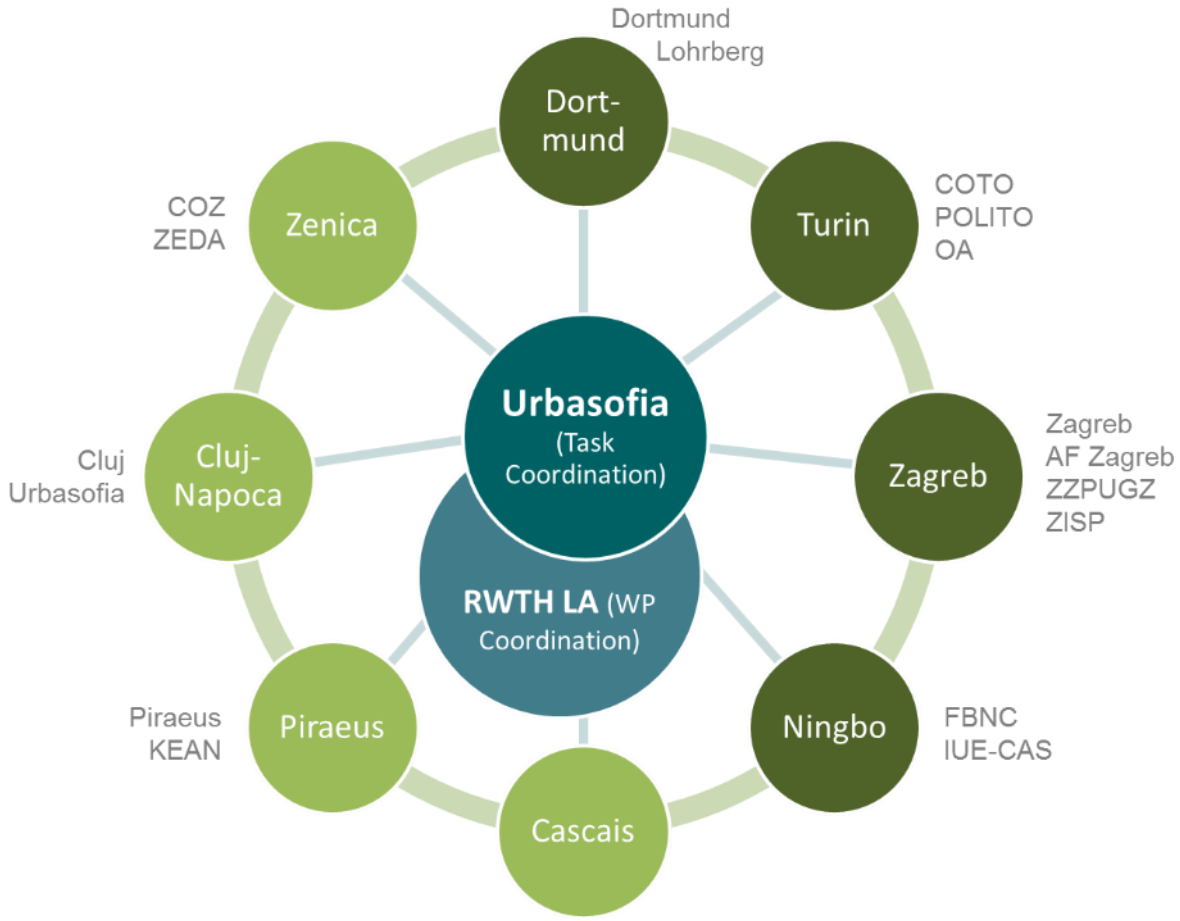


Figure 4 | The working groups involved in Task 2.1. Source: URBASOFIA and ICLEI

While the Methodology for Spatial Analysis is primarily addressed at FRC and FC working groups pictured in Figure 4, it is nevertheless a public deliverable useful for a much wider audience of policy makers, planning practitioners, city representatives and stakeholders interested in assessing existing local conditions prior to implementing Nature-Based Solutions.

1.3.3. Relation to other proGIreg activities and tasks

The aims and specific contributions of Task 2.1 to other tasks in the proGIreg project have been summarized in Table 2. Their achievement is dependent on constant exchanges between the task and WP coordinator, on one hand, and other related tasks and work packages in proGIreg on the other, in order to ensure consistency and an integrated approach to planning, implementing, monitoring and creating awareness about NBS. Figure 5 further elaborates on the specific ways in which Task 2.1 supports the development of concrete future proGIreg tasks:

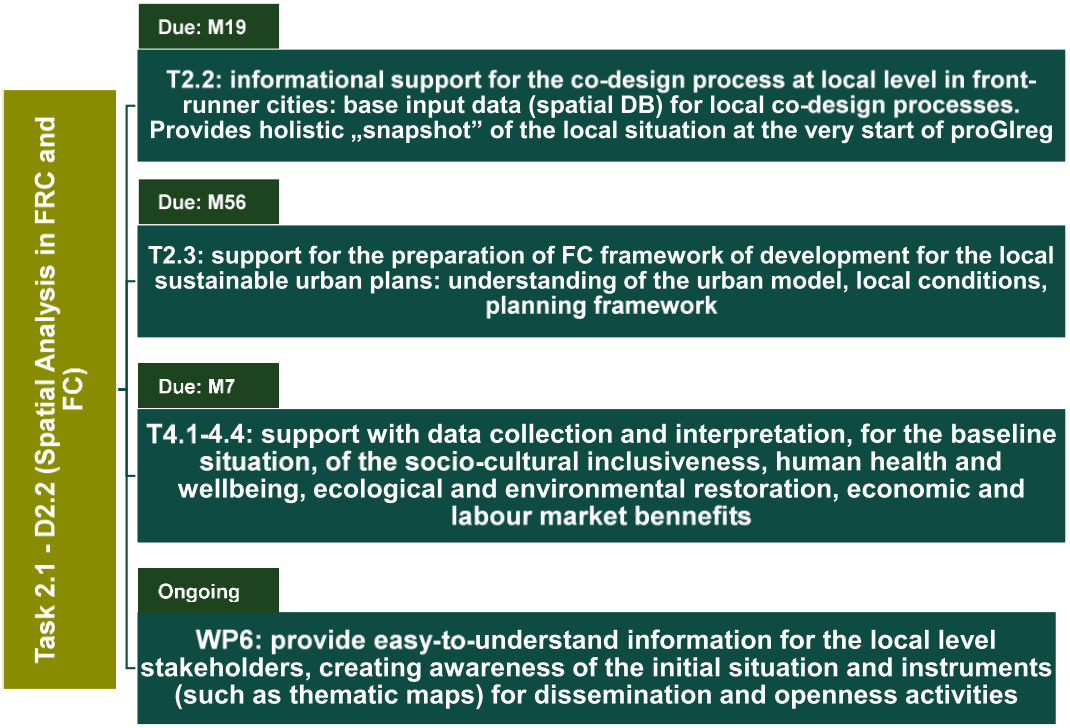


Figure 5 | Task 2.1 dependencies and linkages

The methodology has been developed based on the principles of the Theory of Change (ToC), which allowed mapping the linkages between the T2.1 results, the outcomes of their use in linked activities, and the contribution to the achievement of proGIreg main goals and overall objective (Figure 6).

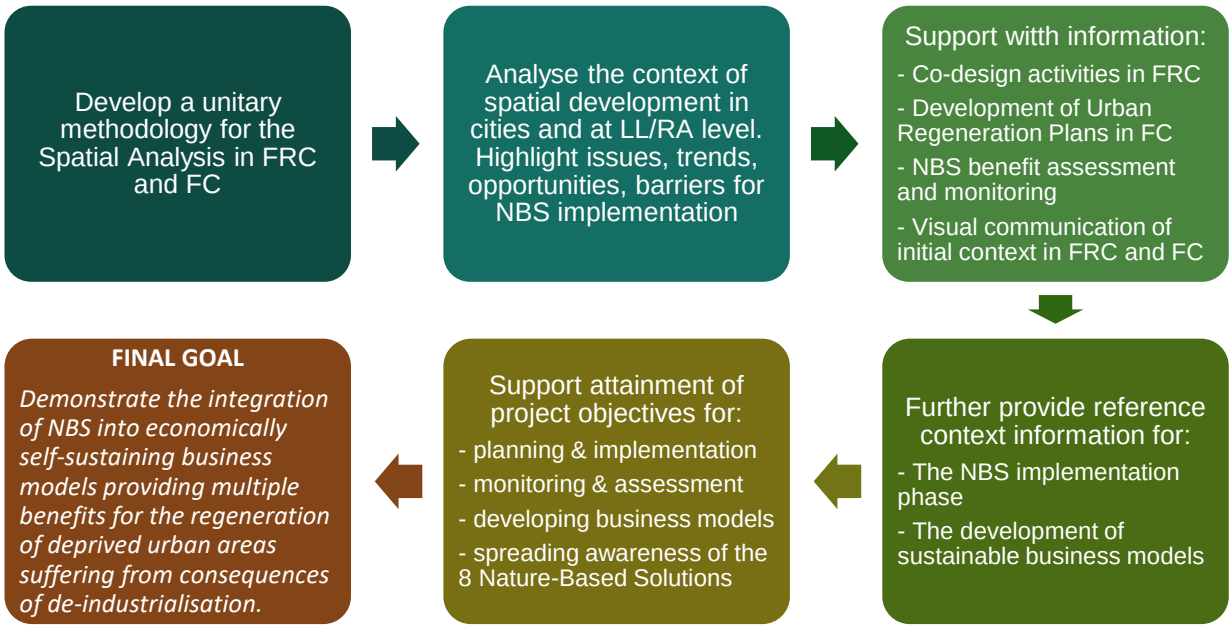


Figure 6 | Spatial Analysis in FRC and FC outcomes pathway and expected project contribution. Source: URBASOFIA

2. Research design and methodology

2.1. Rationale behind the spatial analysis in FRC and FC

The work carried out in the proGIreg project has the ambition of enabling a paradigm shift from the current state of the art, which perceives GI as a public good provided by state authorities, to the novel concept of GI as a common good: co-owned and co-provided by public authorities, the business sector and civil society (proGIreg, 2018). The expected impacts of such a shift are manifold: increased awareness of NBS in practice, increased citizen ownership of GI, development of global market opportunities, improvement of the capacity to implement EU policies, programmes and strategies, as well as promotion of EU leadership in Nature-Based Solutions. Over the last decades, GI and NBS have become focal points of European regional policies, among which:

- Sustainable Urban Development in the EU: a framework for action (COM (98) 605)
- The Leipzig Charter on Sustainable European Cities (2007)
- The Declaration of Marseille (2008)
- The EU 2020 Strategy
- The Toledo Declaration (2010)
- The EU Biodiversity strategy to 2020 (COM(2011) 244)
- The Roadmap to a Resource Efficient Europe (COM (2011) 571)
- The Charter of European Planning (ECTP-CEU, 2013)
- The Communication on Green Infrastructure (COM 2013/0249)
- 7th Environmental Action Programme (2014-2020)
- The Territorial Agenda of the European Union 2020 (2015/C 195/05) towards a more sustainable Europe
- The Pact of Amsterdam (2016)
- The New Urban Agenda (HABITAT III, 2016)

The **"Roadmap to a Resource Efficient Europe"** sets the goal to achieve zero net land take by 2050. An important contribution to reaching this target is the regeneration of brownfields instead of greenfield development.

In October 2018, the European Commission launched the **Sustainable Use of Land and Nature-Based Solutions Partnership Action Plan**, as part of the Urban Agenda for the EU. The plan highlighted several shortcomings and challenges at European level pertaining to a wider deployment of NBS, among which **the limited availability and quality of data on spatial development and urban governance** (EC, 2018).

This bottleneck is addressed in proGIreg through Task 2.1 and the present methodology, which can be replicated in other contexts as well, contributing to a wider understanding and easier acceptance and embedding of NBS into a city policy framework.

2.2. Work organisation, constraints and updates

In developing a methodology that supports achieving Task 2.1 objectives (Table 2), several factors were taken into account, such as the need to involve partners early on and develop a participatory approach to spatial analysis design, the amount of resources and know-how at the cities' and their working groups' disposal, and lastly, time constraints for developing the methodology (D.2.1) and the spatial analysis (D.2.2).

The following conditionalities and limitations were considered:

Constraints	Implications
● **Time constraints:** Methodology is delivered in Month 3 (Aug. 2018)	→ Limiting the data scoping extent and generating general datasets via questionnaire to partners since the compilation of a unified data request from WP2 and WP4 was still under development. In the end, the working methodology has been overly ambitious, including a significantly extensive data request to FRC and FC in an attempt to cover all baseline data needs for WP 2 and T4.1-T4.4.
● **Time constraints:** Spatial Analysis is delivered in Month 7 (Dec. 2018)	→ Time constraints on delivering the Spatial Analysis conflicted with usual data request practices and timeframes in cities (1-2-month response time from authorities and national / regional statistics institutes and agencies). → A more synthetic presentation of analysis results has been used, illustrating the main conclusion of the spatial analysis on the four key assessment domains, at city scale and (where available) at LL analysis area / Regeneration Area scale for each FRC and FC
● **Partner accession timeframe:** FRC Ningbo (China) formalizes accession in the project at a later stage	→ Initially, the methodology was delivered to seven of the proGIreg cities, and has been discussed with FRC Ningbo upon accession. D2.2 has been re-opened to include research and partner contributions toward the spatial analysis in Ningbo, China, in January 2019
● **Data acquisition:** D.2.2 does not acquire new data for the spatial analysis. It relies on already-existing data from partners	→ Disparities or differences between readily-available indicators, due to different practices of data collection and indicator development in each of the eight involved countries. Dataset coherence at city level has been prioritized over coherence

and readily-available administrative databases	between cities, which only relying on existing databases was unfeasible to achieve. → Tasks 4.1 – 4.4. will set out to deepen the understanding of the key assessment domains by collecting additional data. The D2.2 works as an initial "snapshot" of the context in which the LL implementation and Regeneration Plan design will operate.
● **GIS use and availability in proGIreg cities:** Not all cities have a GIS or georeferenced datasets.	→ In lieu of a geographic information system, spatial datasets for cities are presented as synthesis maps for the SWOT analysis on vector or raster maps of the cities and LL / Regeneration areas through the development of the best approximation of point location data or choropleth maps. → One proGIreg city could not deliver spatial maps to represent the results of the SWOT analysis.
● Spatial Data availability at city sub-unit level: limited beyond basic administrative data	→ For the FRC, relevant data at sub-municipal level (i.e. district, living lab analysis area) has been available only partially beyond basic demographic data. Spatial analysis synthesis representations depict in their majority point data (localisation of objectives of interest, e.g. schools). → Three of the four FC do not collect the required data at sub-municipal level. Synthesis representations have focused on city-level and qualitative assessments.
● Data coherence: Availability of requested data	→ In-depth partner queries on available spatial data and qualitative data conducted after the delivery of the methodology (August 2018) have revealed that a more pragmatic approach to data collection and aggregation is necessary. This has had an impact on the complexity of the spatial analysis.

Furthermore, among the FC, the selection process of NBS is still incipient. The analysis will be conducted strictly at urban / city level, while in the FRC the analysis will target both city and living lab areas.

Lastly, as some of the FRC are already in the process of implementing NBS at local level, the present analysis will not be a baseline in the strictest sense, but a snapshot of the state of play
in FC and FRC at the given time.

The following methodological core steps have been developed together with the cities and involved partners:

1. A first focused discussion has been conducted during the proGIreg kick-off meeting in Aachen (12-13 June 2018) pertaining to data needs and availability, as well as linkages and synergies, particularly with WP4;
2. Afterwards, a working group of partners has been appointed (see Figure 3) in order to set up the proper communication channels;
3. At the start of the task implementation, a short scoping survey on available data was developed, with the purpose of gathering insights on data availability in the proGIreg cities (both FRC and FC) with respect to the four key scientific assessment domains (core findings of the survey are enclosed in Annex A).
4. After clarifying any outstanding questions with the working group, based on the data provided through the questionnaire and the provisions of the Application Form, as well as previous work carried out through the EKLIPSE project referenced therein (Challenges 1-2, 4-6 and 8-10 of the EKLIPSE project), the methodology was prepared, and reviewed internally.
5. The initial list of spatial indicators has been amended to include a longer list agreed between WP 2 and WP 4 and collected through WP2 on behalf of T1 – T4 in October 2018.
6. Lastly, the present report has been reopened and amended over the period of June 2020, to include revisions following the first review assessment of the proGIreg project.

2.3. Definition of concepts

The methodology operates with several concepts related to data and information collection, interpretation and presentation, in order to achieve its purpose. This section provides a theoretical foundation to support the common understanding of these concepts, as well as the tools and instruments which will be further used by the cities and their partners.

2.3.1. ProGIreg key assessment domains

ProGIreg utilizes the approach proposed in the NBS assessment framework developed by the Expert Working Group (EWG) within the EKLIPSE project, which enables the assessment of impacts related to specific Nature-Based Solutions actions across **10 challenge areas**, selected from the expert report on NBS supported by DG Research and Innovation (European Commission, 2016) and a recent review of NBS frameworks (Kabisch et al., 2016):

1. Climate mitigation and adaptation;
2. Water management;
3. Coastal resilience;
4. Green space management (including enhancing/conserving urban biodiversity);
5. Air/ambient quality;
6. Urban regeneration;
7. Participatory planning and governance;
8. Social justice and social cohesion;
9. Public health and well-being;
10. Potential for new economic opportunities and green jobs (Raymond et al., 2017).

Based on this framework, proGIreg scientific partners involved in WP 4 identified **four key assessment domains:** Socio-cultural inclusiveness (challenges 7 and 8); Human health and wellbeing (challenge 9); Ecological and environmental restoration (challenges 1, 4, 5 and 6); Economic and labour market (challenge 10) – see **Figure 7**.

The Spatial Analysis starts from these four key assessment domains and further identifies subdomains and parameters (descriptors) for the spatial data collected, with the purpose of **assisting cities to develop a basic spatial baseline** of the state of art of each domain's development, at city and LL analysis / Urban Regeneration analysis areas, using previously-existing spatial data.

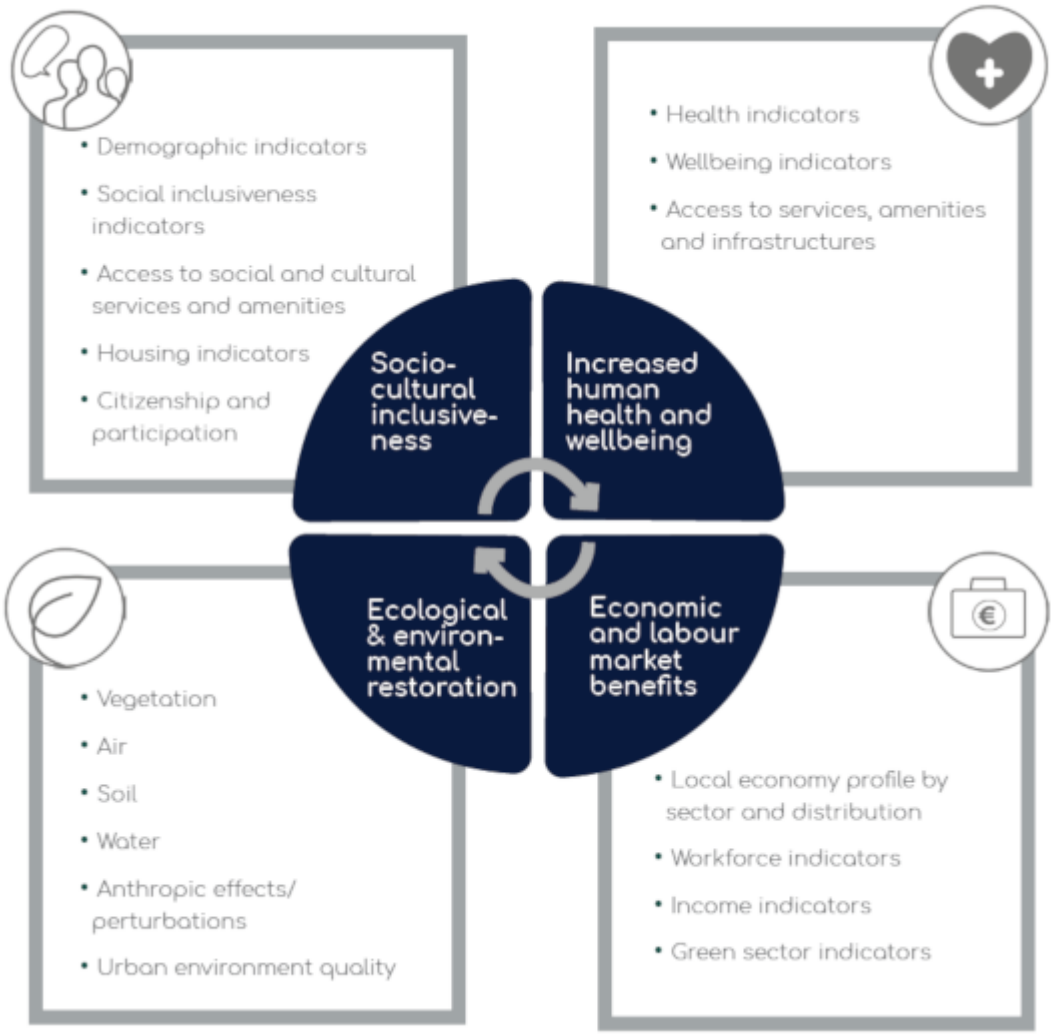


Figure 7 | ProGIreg key assessment domains. Source: ICLEI

2.3.2. Spatial Analysis

For the purpose of the analysis, this report uses the following INSPIRE Directive definitions of terms:

- **Spatial data:** any data with a direct or indirect reference to a specific location or geographical area.
- **Spatial data set:** an identifiable collection of spatial data.
- **Spatial data set series:** a collection of spatial data sets sharing the same product specification.

According to Topor et al. (2009), independent studies show that about 80% of all data have spatial features or a spatial reference (e.g. an address). Unhelkar (2010) also estimates that between 70% to 100% of all data sets have, apart from attribute and temporal information, a spatial component as well.

The analysis of spatial data, namely the observations with a known value and location, can represent a complex and rich source of information, offering important insights into any territorial analysis.

The purpose of a **spatial analysis** is to understand and explore the entanglement of the spatial positioning of objects and phenomena and their characteristics (Audric, de Bellefon and Durieux, 2018), being an important instrument for the study of spatial phenomena and the relationships between them.

The analysis of the context in which Nature-Based Solutions will be piloted (FRC) or used to develop Urban Regeneration Plans (FC) represents an **urban analysis** which uses administrative data from existing databases and spatial data elaborated from geographic information system sources, where available, to provide an understanding of the spatial differentiation and current characteristics of the four key assessment domains in proGIreg

According to Bailey and Gattrell (1995), **spatial statistical analyses** are techniques using statistical methods in order to determine the behaviour of a model. A wide range of methods have been specifically developed to analyse spatial data, each having different approaches depending on the nature of the spatial data involved.

Following the classification adopted by Cressie (1993), we can distinguish three types of spatial data, differentiated by the data generation process:

- **Point data,** characterised by the spatial distribution of observations. The data is generated in relation to the emergence of an observation, with the purpose of localizing the point, and not necessarily attributing it any value associated with the observation. For example, in proGIreg, point data would be identification of the ***distribution of health infrastructure*** (e.g. hospitals, clinics) or ***points of interest related to accessibility of green sites or general mobility in the analysis area*** (e.g. train stations, bus stops). Spatial analysis of point data is aimed at assessing the spatial distribution of a certain phenomenon or asset, for purposes such as cluster detection or identification of areas which fall outside the range of a certain service.

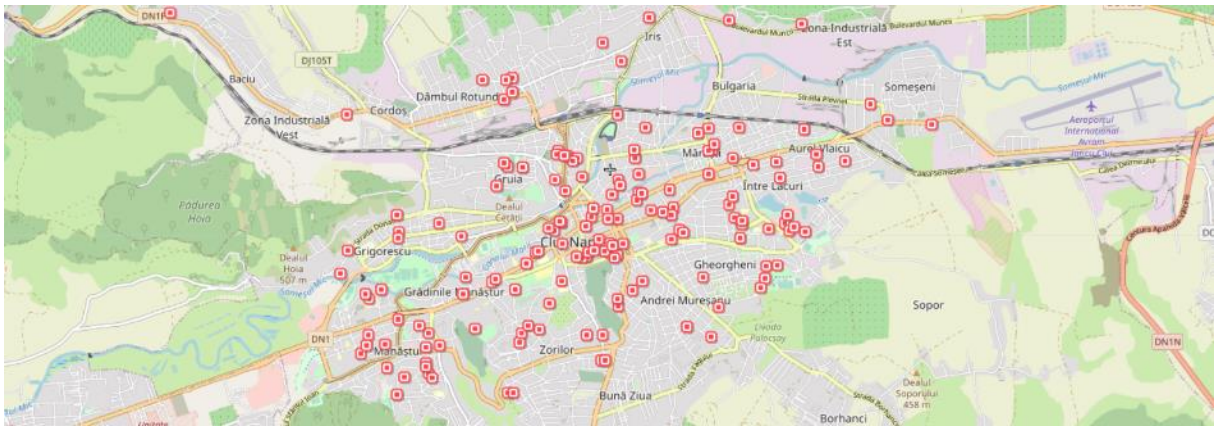


Figure 8 | Example of point data: identification of primary, middle, and high schools in the area of FC Cluj-Napoca. Source: wikimapia.org

- **Continuous data**, providing a value for the variable of interest at any point across the territory studied, through the measurement in a number of points (e.g. soil sample collection points).

Spatial analysis of continuous data, also referred to as geostatistics, is aimed at predicting the value of a variable at a point where it has not been sampled, as well as the reliability of this prediction. Geostatistics also helps optimise the data sampling plan (Audric et al, 2018).

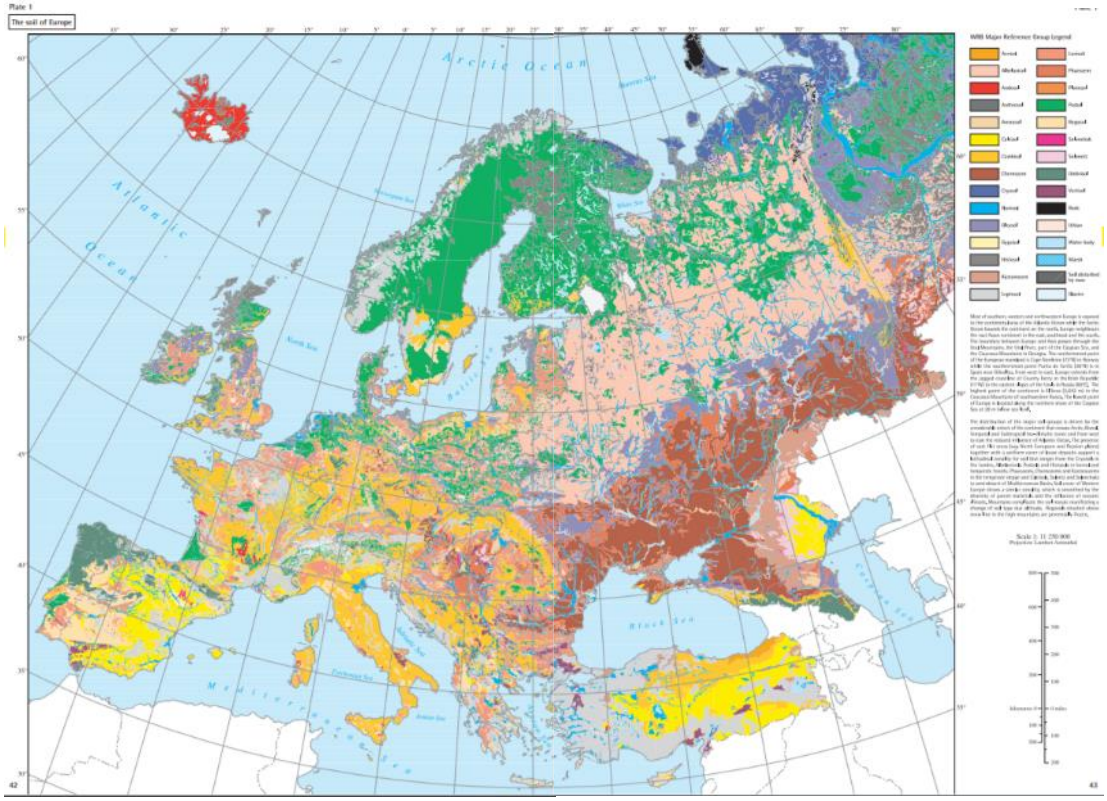


Figure 9 | Example of continuous spatial data: Soil map of Europe. Source: Akça et al., 2005

- **Areal data** are based on the partitioning of territory into contiguous areas, but are not always represented (contrary to the name) on the surface. Areal data can also represent data pertaining to a fixed point in a territory, such as the ***number of hospital beds in a hospital***. The data pertaining to hospital beds is areal data. The data pertaining to the existence in space of the hospital is point data (no value is associated with the observation except from its existence).

Spatial representations of areal data can differ based on numerous parameters, among which the delineation of the contiguous areas used for analysis. **Figure 10** represents the census data in a European population grid dataset. The data is represented on a grid of identical 1 km^2 cells. **Figure 11** shows areal data featured at NUTS 2 territorial level, associating the value of GDP per capita to the contiguous regions of central and southern Europe.

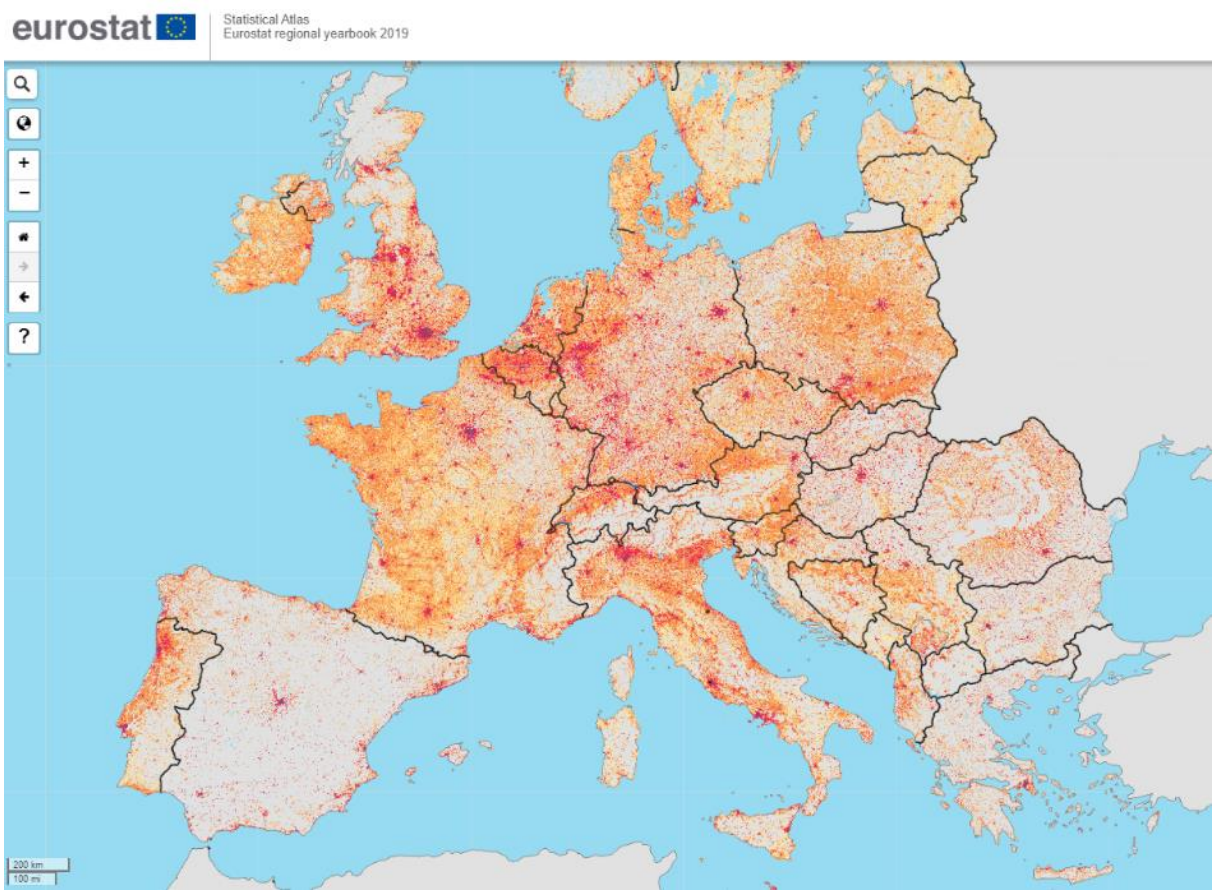


Figure 10 | Areal data - GEOSTAT population grid. Source: Eurostat, 2019.

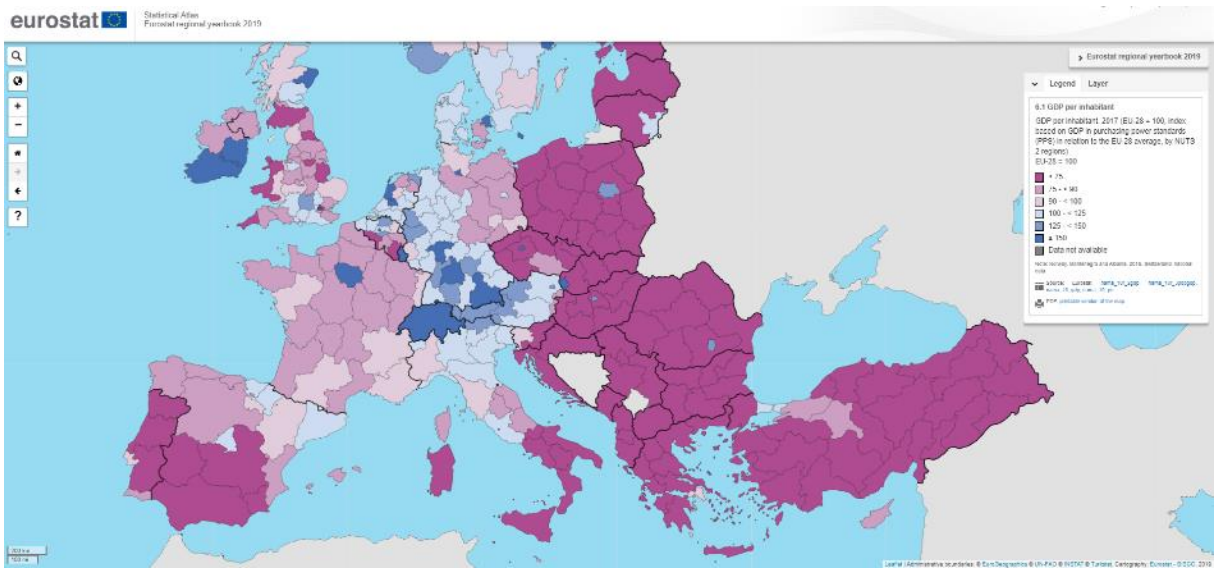


Figure 11 | Areal data – GDP per inhabitant (2017), per NUTS2 region, for the central and southern areas of Europe. Source: Eurostat, 2019.

The proGIreg spatial analysis is conducted primarily on the basis of **areal data and point data.** Continuous data implies the previous existence of on-site measurements, particularly in LL areas, an action which has not been conducted previous to the project.

While point data is dependent on the pre-existence of observations of amenities and infra-structures in the proGIreg cities and LL / Urban Regeneration areas, areal data will be used systematically across all cities at the level of two partitions: the surface contained within the administrative boundary of the city (**city scale analysis**), and the surface(s) corresponding to the **Living Lab analysis scale** (FRC) and **Urban Regeneration area scale** (FC). This allows the comparative analysis of key assessment domain data with respect to either scale, or time, and the understanding of local spatial dependencies or correlations between e.g. economic data and demographic trends.

Furthermore, based on the storing technique, spatial data is divided in:

- **Raster data,** composed of grid cells identified by row and column, in which the individual cells group together to represent an image (e.g. satellite images, ortophoto plans, etc.).
- **Vector data,** comprising of points, polylines and polygons. **LIDAR / point cloud data** is also a type of vector data, albeit oftentimes converted to raster formats for easier use.

The synthesis spatial representations provided in proGIreg D.2.2 will use vector data, wherever available. Raster ortophotoimagery will be used to replace vector information on the urban structure, in the instances in which municipal GIS is missing.

2.3.3. Spatial Analysis scales and boundaries

As defined above, any empirical spatial analysis is concerned with a **finite bounded region**. Spatial analysis is sensitive to both characteristics of the zoning system used to collect the data, as well as the scale at which data is reported (Fotheringham and Wong, 1991). Identifying this boundary and determining the proper **unit of analysis** is dependent on the scope of the spatial analysis, the issue of data availability, complexity, and time.

The purpose of the proGIreg spatial analysis is to **synthesize the main characteristics** of the FRC, FC and their LL / Regeneration areas with respect to the four assessment domains. It frames the general context and baseline assessment, while providing findings of key city and area characteristics in a way which can be **compared and disseminated at local and project level.**

Analysing these features for both the cities as well as the smaller, neighbourhood-level areas of the Living Labs and future Urban Regeneration areas, implies conducting a baseline spatial analysis at **two different territorial scales.** In order to achieve a comprehensive result, the Spatial Analysis (D2.2) follows a simultaneous approach at:

1) the city/metropolitan analysis scale, and
2) the LL analysis scale (FRC) / local level of the regeneration areas (FC)

The delineation of the spatial analysis area for the city / metropolitan scale will be conducted considering the **administrative border of the city and / or the limit of the metropolitan area or metropolitan association area**, depending on the partner.

The limit of the LL analysis area and the future FC Urban Regeneration areas is a more complex issue. An ample body of research has underlined the **boundary problem** of spatial

analyses: namely, while geographical study areas are bounded, spatial processes are not. The consequences of this misalignment may lead to inaccurate results, or improper understanding of causes and effects (Ripley, 1979, Fotheringham and Rogerson, 1993). The so-called **edge effects** can be reduced or eliminated by enlarging the analysis area and creating a buffer zone in which data is also examined in terms of their effect on the area of interest - LL / Urban Regeneration areas.

Setting up buffer zones is especially relevant for the analysis of GI and NBS impact. As an illustrative example, research by Huang, Chui and He (2018) on the cooling effect of green space with a coverage ratio of more than 60% in Harbin, China, delineated 500-meter buffer zones as study areas. The boundary was based on research indicating that within the 500-meter proximity zone, GI provides a significant contribution to cooling the surrounding environment (Wang, Zhan and Guo, 2016).

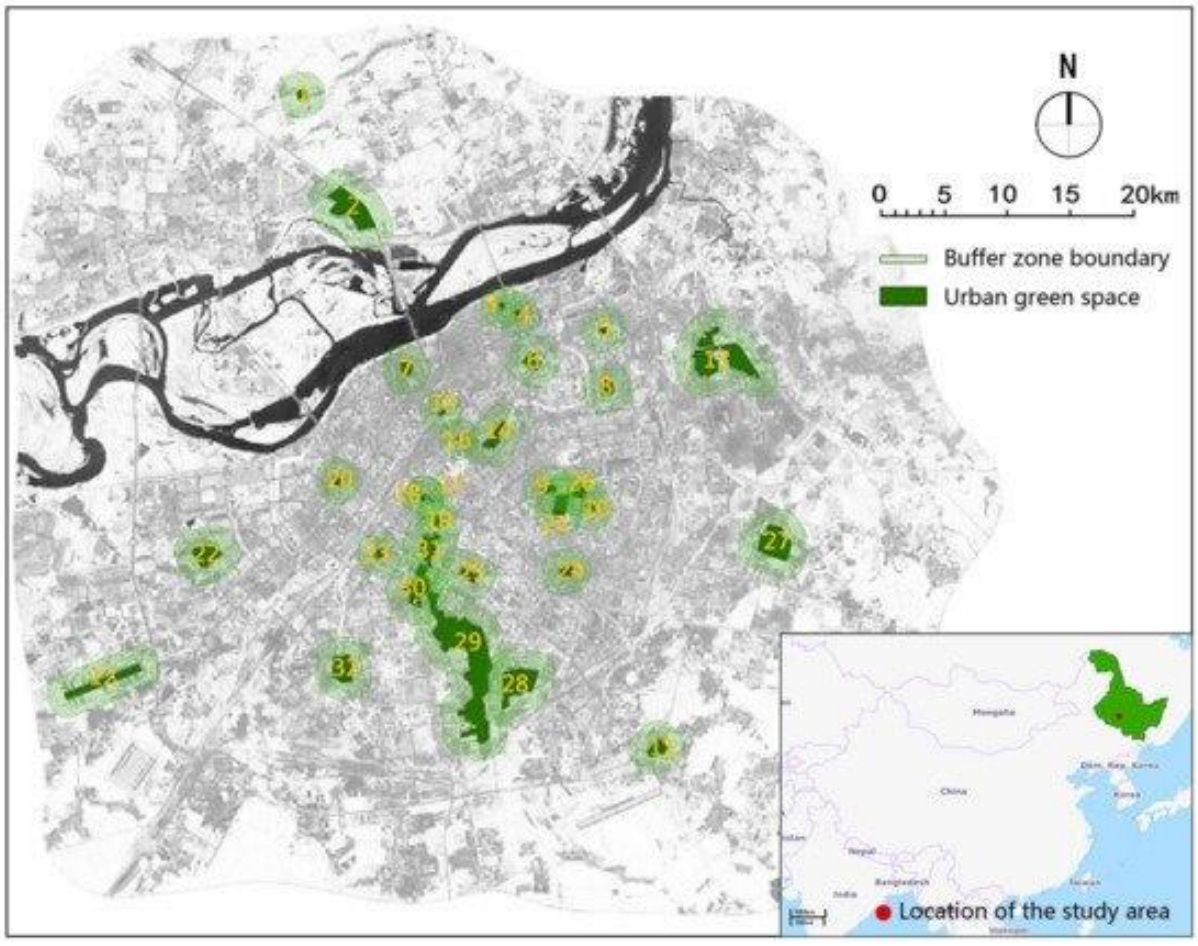


Figure 12 | Example of buffer zone set-up for GI in Harbin City, China. Source: Huang et al., 2018

The delineation of the spatial analysis area for the LL / regeneration areas was **a case-by-case decision** for each of the FRC and FC, considering two factors:

1. **The structure of the LL / Urban Regeneration area, its territorial coverage and potential impact area.**

This initial analysis is particularly important to inform the delineation of wider areas of impact: as described above, benefits of GI and NBS do not end at the Living Lab limit, but rather extend to provide benefits and services to a wider community around the area.

Delineating a wider area is also important for the NBS which represent more diffuse interventions, such as for example NBS 5 - Capillary GI on walls and roofs, or NBS 8 – pollinator biodiversity improvement.

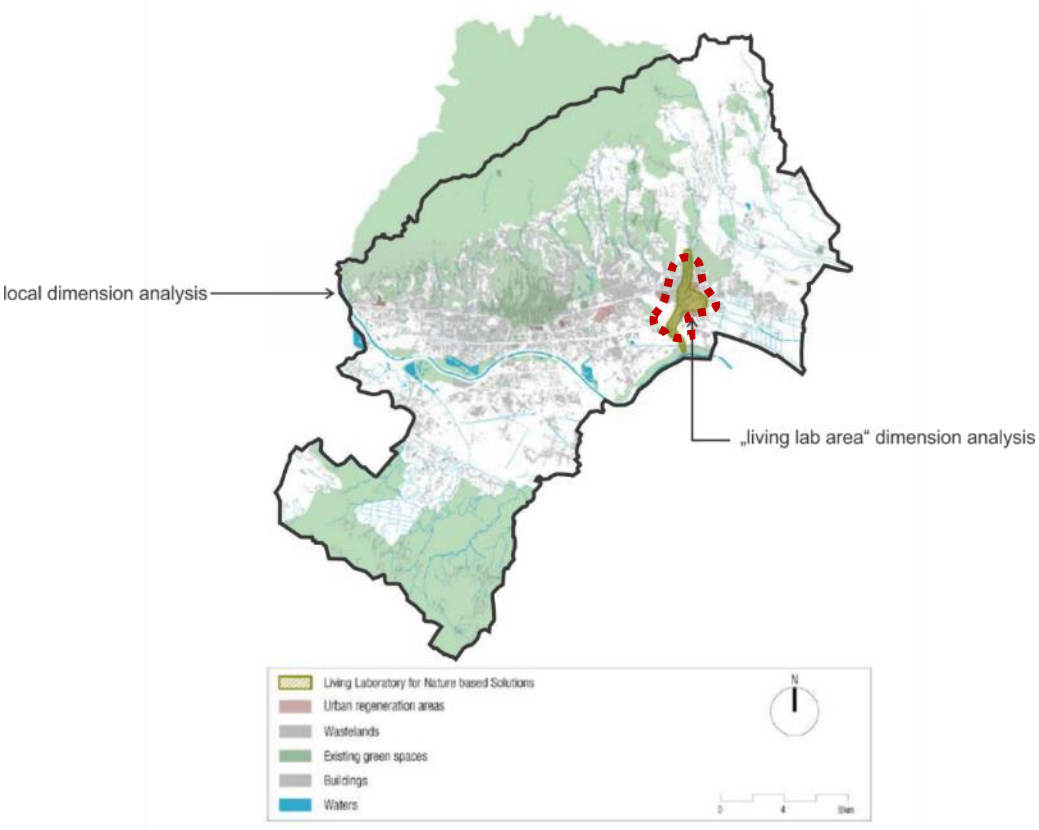


Figure 13 | The two scales of analysis and delineation of a general buffer zone for the Zagreb LL. Source image: proGIreg AF

2. **The availability of administrative data from existing databases at the scale of the analysis area.**

Secondly, approximated buffer areas were overlapped with the borders of the city's subdivisions: neighbourhoods and census data sub-units for which statistical data was available. For the example of Zagreb, the limits of the Local Committees were used, the second level of local self-government (see Figure 14).

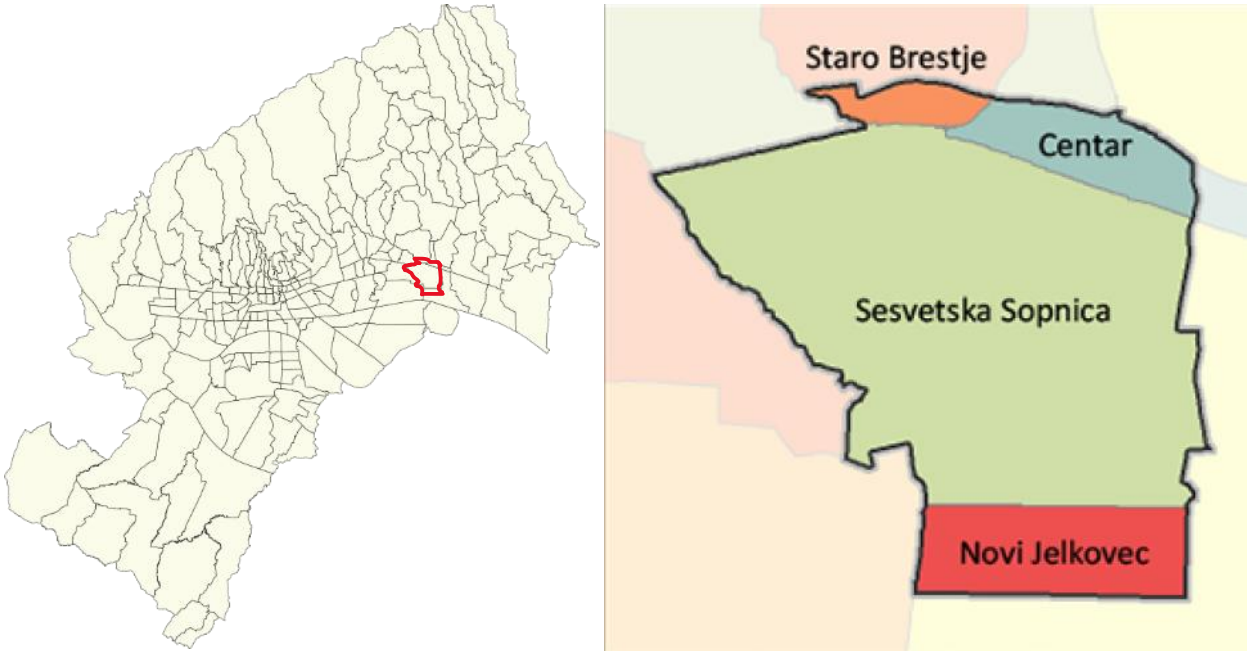


Figure 14 | Boundary of the LL Analysis Area for FRC Zagreb. Source images: Wikimedia.org (left), FRC Zagreb (right).

In other cases, such as **Turin Mirafiori District**, the diffuse nature of NBS and coherence of the LL area with the district area determined an overlap between the LL and its analysis area. This approach of setting the boundaries of LL / Urban Regeneration analysis areas by the boundaries of administrative or census units **maximizes data availability** for the Spatial Analysis.

At the time of methodology development, the FC have not yet delineated the Urban Regeneration Plan areas with precision. However, for the purpose of the Spatial Analysis, it is still important to outline a strategic approach to their area-based plan and to already identify the general zones of relevance for proGIreg. If data at sub-local level for these areas exist, FC will conduct spatial analysis for both city and the selected potential areas of urban regeneration as well.

2.4. Methodological approach: key steps and components

The purpose of the Spatial Analysis in FRC and FC is to address the need for contextual data at both city and LL / Regeneration Area level, for a **proper but synthetic spatial understanding of local contexts** in the eight cities and LL / Regeneration areas. It collects administrative data from existing databases and interprets it together with information on existing plans, policies, projects supporting NBS to provide an understanding of the complex dynamics of FRC and FC spatial development contexts.

This is achieved by unpacking the spatial manifestation of social, economic, environmental, political and administrative factors that could potentially enable or hinder the implementation of NBS in the FRC LLs and / or the development and future implementation of Urban Regeneration Plans in FC. Lastly, the Spatial Analysis can help cities identify **practical and realistic entry points** when designing interventions that contribute to an effective Urban Regeneration strategy.

Developing a spatial analysis to support NBS design and deployment in the proGIreg context relies on **access to existing statistical data** at both city and LL / Regeneration Area scale, data on the local development and regulatory/normative frameworks in each city and on the end beneficiaries (target groups) of the proGIreg NBS solutions.

We consider this an **approximation of the initial situation and conditions** which exist at the beginning of the implementation of the proGIreg project in all eight FRC and FC. We underline however that the Spatial Analysis is **not a baseline in the strictest sense** defined by literature, because it offers a current “snapshot” of the eight cities, whereas some of them are more advanced in already implementing NBS in their cities (e.g. FC Cascais).

The Spatial Analysis profiles will be developed by each of the FRC and FC working groups, under coordination of the WP leader. Partners will apply a fundamental, descriptive research method model based on readily-available statistical data, geodata as well as qualitative/”soft” data and information available within plans, programs, policies and projects.

Table 3 | Spatial Analysis research matrix

Research questions	Method	Data sources, collection and analysis
1. Is there an enabling regional and / or local strategic, programmatic, regulatory and normative framework that can support LL / Urban Regeneration Plan development?	Qualitative survey on the existing plan, policy and regulatory frameworks regional and local level, screening for the degree of support (implicit, explicit) for key GI and NBS concepts;	Strategic, programmatic, regulatory and normative documents: partner survey (URBASOFIA), desk review (FRC and FC), consultations and integration of findings (URBASOFIA)
2. How do the NBS correlate with the territory and stakeholders planned to be included in the co-design processes?	Inventory of key stakeholder groups in each FRC and FC and NBS of interest (for FC specifically)	Stakeholder information (type, institution) provided by FRC and FC. URP areas provided by FC (LL areas already defined) Cross-analysis by URBASOFIA

3.	What is the current socio-cultural, human health and well-being, ecological, environmental, economy and labour market level of development in the eight proGIreg cities and their analysis areas? How does that translate spatially, at the two analysis scales?	Quantitative survey of context data (state and process) for the four key assessment domains. Development of SWOT analyses, with inclusion of qualitative fact-based assessments from FRC and FC. Spatial Analysis synthetic SWOT Maps to illustrate the four components at the two analysis scales.	Collection of statistical and spatial data by FRC and FC from existing sources (municipal databases, national / regional census, etc). Desk analysis by FRC, FC and their task partners, with support of URBASOFIA. SWOT Maps developed by FRC and FC, with support of URBASOFIA
4.	What is the overall context of spatial development, from the point of view of the four key assessment domains, in the proGIreg cities? How do they compare and what would be important focus points in implementation?	Review of sectoral and per-partner findings. Development of conclusions	Drawing of per-partner conclusions (FRC and FC) Interpretation, comparisons and final conclusions (URBASOFIA)

The Spatial Analysis relies on the following steps, which will be further developed in the following subchapters:

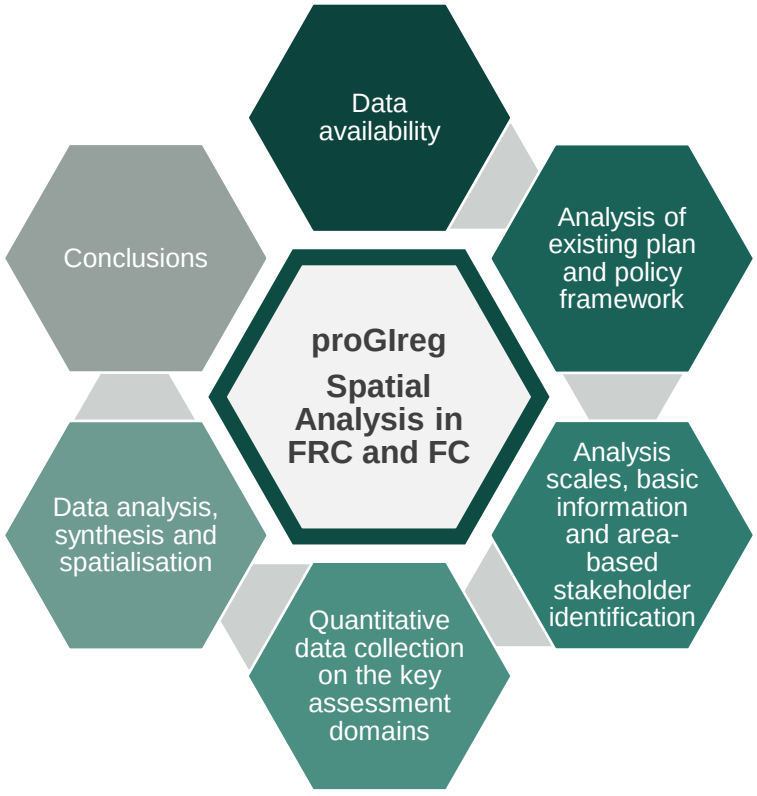


Figure 15 | Methodological steps of the Spatial Analysis. Source: URBASOFIA

2.4.1. Contextualizing spatial data needs

A critical point whose importance is sometimes overlooked when developing spatial analysis baselines, or `state of art snapshots`, is the fact that spatial analysis of data requires **a priori knowledge about the data and underlying processes** (Csillag and Boots 2005; Legg, 2010). This includes possibilities and limitations of the various spatial statistics available, but also knowledge of existing urban policies, spatial plans and regulations which allow contextualization of findings.

Baseline studies (e.g. for SEA) include reviews of the policy context and a collection of detailed evidence on the state of the environment (context) in which a project such as proGIreg will deploy its activities, either **NBS implementation in LLs** (FRC) or **strategic participatory planning and co-design** (FC).

The methodology for spatial analysis in FRC and FC sets out both baseline data needs as well as the policy context to identify the framework, constraints and opportunities applicable to the assessment.

In July 2018, a survey was developed by URBSOFIA addressing the FRC and FC availability of spatial data. The survey was filled in by seven of the eight partners, while FRC Ningbo was still in consortium accession procedure. It featured two sections:

A. **Planning Framework** – collecting information on the existence of plans, strategies, policies or projects at regional and local level, of interest to proGIreg implementation

B. **Spatial Data availability** – collecting information on the availability and use of GIS in the FRC and FC and availability of datasets.

The full results of the survey are included in Annex A (Planning Framework, full contents) and Annex D (Spatial Data availability).

1. Data availability context and collection

Generically, data required for the analysis are data already collected, categorized as:

(1) **Spatial data**: Available geodata, based on the Infrastructure for Spatial Information in Europe (INSPIRE) Directive (2007) Data Themes, targeting spatial data which can be used in environmental studies, planning framework and policy design:

→ Maps, either raster or vector - computer data files (GIS, dwg, etc.)
→ Remotely sensed data such as satellite imagery or orthophoto plans

(2) **Statistical data sets** pertaining to the spatial analysis scale of the city and the LL / Urban Regeneration area, collected as:

→ Tables
→ Graphs and charts

Statistical spatial data sets will be analysed and synthetically represented in SWOT Maps.

The main data sources for FRC and FC are the following:

1. Municipal databases, municipal / metropolitan GIS data (ideally microdata for pilot sites)
2. Data from service providers at municipal level (e.g. contracted GIS services outside municipal departments, utility management companies)
3. Data from other external stakeholders (business register, NGOs, chambers of commerce, etc)
4. Regional and national data (e.g. data available from the national statistics institutes, nation-wide census data)
5. Other databases at European level: EUROSTAT, OECD, ESA Copernicus, Europe's soil database, data from ECMWF, European vegetation survey, etc.
6. Existing documentations and grounding studies

The proGIreg database for Spatial Analysis will be an organized collection of this data, and city datasets will be collected within the proGIreg website intranet.

The city survey, completed afterwards with findings from FRC Ningbo, show that only four out of the eight proGIreg cities currently use a Geographic Information System (GIS) in the municipality (ESRI / ArcGIS, Intergraph, MapInfo, QGIS): FRC Dortmund, Torino, Zagreb, FC Cascais. FC Cluj-Napoca and Piraeus furthermore store basic municipal data in AutoCAD files, while FC Zenica does not have vector data for the municipality. All three cities are in the process of developing a municipal / metropolitan GIS.

Most partner cities use GIS and vector data for mapping and analysis, while only FRC Torino and FC Cascais use this data for modelling and sharing. FC Cascais and Cluj use it for inventory management.

Some municipal data is available throughout the whole FRC and FC selection. GIS Datasets have varying availability, with basic administrative data, GI, transport and infrastructure and population census data being available all proGIreg cities apart from Zenica (and Ningbo).

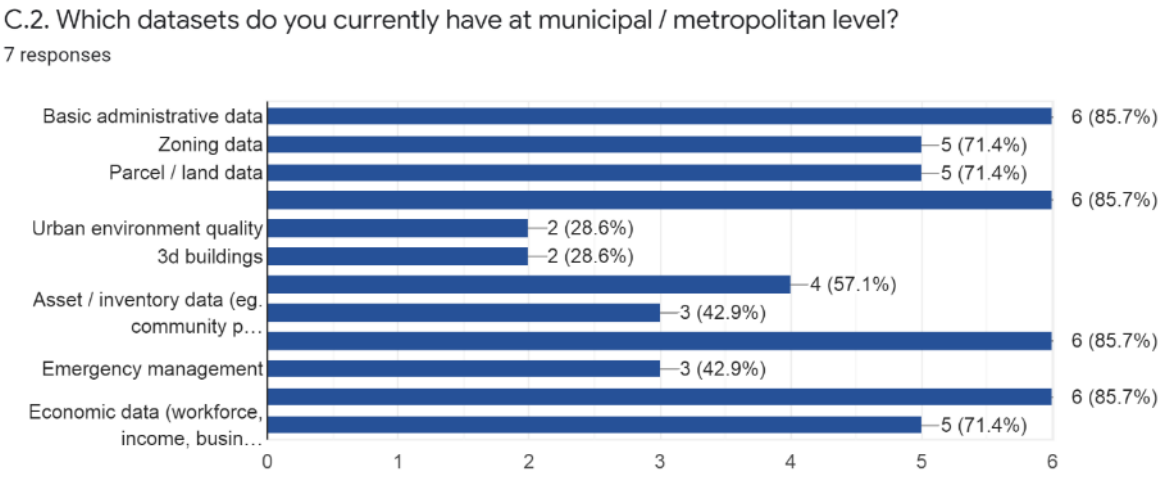


Figure 16 | Spatial dataset availability in FRC and FC. Source: Scoping survey, URBASOFIA (2018)

Microdata availability at district level, for usage in the LL / Urban Regeneration area analysis, has been identified as high by almost all cities. For example, economic and labour market

data has been marked available by FRC Dortmund, Turin, Zagreb and FC Cluj and Zenica. In practice, sub-municipal data on the Economic and labour market assessment domain was only available for very reduced number of datasets in Dortmund, Turin and one dataset in Zagreb (4.2.2 Unemployment Rate).

This disparity between cities will represent a **significant barrier** in achieving a coherent spatial analysis, both from the point of view of data collected and analysed, as well as from the point of view of data presentation heterogeneity (diverse designs of the SWOT maps).

One of the main challenges of the spatial analysis is to bring all cities to a **common denominator – framework for baseline analysis**. Given the wide variance of data availability, especially between FRC and FC, the missing data issue can be solved through several options:

- → **Exclude data** from the list until a coherent common database of primary indicators exists across partners;
- → **Define proxy data** or replace initial requested data with similar alternatives, available in the respective city;
- → **Include the indicators**, collecting data where it is available for the baseline and completing it through proGIreg WP 4, acknowledging that baseline measurements will not be available for some of the partners.

The Spatial Analysis **includes all indicators** and, wherever a very similar alternative to the proposed data exists at city level, it replaces unavailable datasets within the same domain and descriptor.

For FRC, this data will be completed and updated by WP 4, with the help pf FRC partners. Every two years, through the future Monitoring and Assessment activities coordinated by WP 4 leader CNR, the FRC will be requested to provide the same yearly data; i.e., in 2020, the FRC will collect data from 2019 and 2020, while in 2022 they will collect data from 2021 and 2022. The FRC will also have the opportunity to add data that were unavailable at previous requests, such as data that are measured on a multi-annual basis (e.g., census data).

Spatial data which is unavailable from existing databases and which will nevertheless be necessary for WP 4 will be obtained independently through the respective WP. This is the case, for example, of the Normalized Difference Vegetation Index (NDVI) and Walkability Index.

2. Regulatory, planning and policy context

Nature-Based Solutions can be implemented alone, or in an integrated manner with other solutions to societal challenges (Cohen-Shacham et al., 2016). NBS have a wide-ranging impact across the four key assessment domains, and interact in practice with many different other solutions and policies at urban level, being in practice an integral part of any challenge-oriented policy. **Policy coherence** is thus required between the implementation or embedding of the proGIreg NBS and the existing strategies, plans, policies and regulations in force in the cities.

Furthermore, a successful implementation of the eight NBS requires a **strong integration** with the cities' existing governance practices, institutional and regulatory frameworks. These dimensions are critical to the success of the Living Labs, and are oftentimes cited as the most frequent barriers to the implementing of NBS (Brink et al., 2016; Sekulova and Anguelovski, 2017).

Establishing a policy context is thus a key component of the Spatial Analysis because it informs on the determinants of the context in each FRC and FC and singles out the provisions which either explicitly or implicitly support or disincentivizes GI and NBS investments, enabling the further identification of **potential barriers, synergies or entry points** moving forward. This policy context inventory is limited in scope and directed at the particular issues pertinent to NBS development: it is **not a policy analysis**, as it does not follow the inventory with the identification, evaluation and selection of alternative policies. (Patton et al., 2012).

The regulatory, planning and policy context will consider three criteria: governance level, instrument character and policy domain.

First, regarding the governance level, specific local circumstances which led to the baseline situation are often outlined and analysed within **planning documentations at different administrative levels**. ProGIreg is implemented in seven different countries across the EU and in China. At the level of Member States Germany, Italy, Croatia, Portugal, Romania and Greece, as well as IPA (Instrument for Pre-accession Assistance) country Bosnia and Herzegovina, there are concrete differences in the system of distribution for formal and informal competencies in spatial planning. For instance, in Croatia and Romania the planning system comprises of 3 levels of government, while in Germany and Italy there are 4 levels, and in Portugal, 5 levels of directly elected bodies with decision making power. Policy-making competences are managed at upper administrative levels (state, region, federal states), where general development concepts and visions are established, with more operational visions as well as regulative instruments being usually developed at lower territorial levels.

Secondly, pertaining to their general character, spatial planning instruments of relevance to proGIreg can be (ESPON / COMPASS, 2018):

- **Visionary**: Setting out an agenda of principles or goals for a desirable future (uncommon at local level, and more prominent at national level);
- **Strategic**: Providing an evidence-based integrated and long-term frame of reference for coordinated action and decision making across jurisdictions and sectors (Strategic Agendas, Integrated Development Strategies, Regional Development Strategies, etc);
- **Framework-setting:** Establishing policies, proposals and other criteria for a territory that provide a non-binding reference for other plans and decision-making;
- **Regulative:** Legally binding commitments or decisions concerning land use change and development (comprising the bulk of the spatial planning instruments at local level).

Third, in what concerns the key policy domains of relevance for proGIreg, we have identified together with the partners the following broad priorities:

1. Urban development and strategic planning
2. Green Infrastructure
3. Urban Regeneration
4. Participation and social inclusion

Cross-cutting policy levers at local and regional level also include provisions pertaining to management, procurement, financial support and fiscal measures, as well as local regulation.

The city survey, Part A – Planning Framework (July 2018) has collected the basic information pertaining to the existence of the following:

- Regional planning documents or policy strategies that relate to A) urban development and/or B) green infrastructure development and/or C) regeneration of post-industrial landscapes;
- Municipal strategies, plans or policies relevant for urban development and in particular for urban regeneration
- Municipal strategies, plans or policies relevant for environmental management and sustainable development
- Plans and policies of importance for the topics of participation and social inclusion. Any experience with stakeholder identification or participatory planning processes.
- Any other local plans, policies and regulations part of the local framework for NBS implementation
- Other foreseen investments, projects or strategies to be implemented in the next 5 years which can be of interest to proGIreg
- Existing FRC grounding studies and surveys at LL analysis area scale.

The collected information represents the basis for the development of the analysis in D.2.2.

Within their reports, each of the partners (FC and FRC alike) will expand on the information provided in the survey, within a Plan and Policy identification matrix based on the three criteria defined above:

	Territorial level
Key policy domain	● Provisions of visionary, strategic, framework-setting and regulatory instruments in force in FRC and FC ● Local level investments and actions having a potentially synergic effect with proGIreg

2.4.2. Basic city data, NBS focus and stakeholder identification

The Spatial Analysis evaluation report (D2.2) will support both FRC and FC with a basis for their participatory processes, NBS implementation / Urban Regeneration Plan co-development, as well as assessment and monitoring.

In order to achieve these goals, after the identification of the plan and policy framework in each of the eight proGIreg cities, the following steps are important:

1. Delineation of analysis scales, presentation of basic city and LL / Urban Regeneration Area data
2. Identification of NBS of interest for all cities, including FC
3. Based on the previous two steps, identification of the local stakeholder ecosystem of interest to proGIreg.

Stakeholder identification is a first step of an iterative process of stakeholder identification, analysis and involvement in both FRC (through Task 2.2, ICLEI) and FC (through Task 2.3, URBASOFIA). There are several underlying motivations for including a stakeholder identification section in the Spatial Analysis:

→ The identification process needs to be performed as early in the project as possible, in a manner that ensures coherence and a unitary methodology between FRC and FC.
→ Identification is intrinsically linked to the selected NBS and analysis scales, thus D.2.2 is able to offer additional context to stakeholder identification (oftentimes performed in tasks related to general communication, such as WP 6).
→ Most importantly, a preliminary definition of key local stakeholder groups adds depth to the interpretation of data, particularly that of point data in the LL / Urban Regeneration analysis areas. Looking at the four key assessment domains in local stakeholder context is relevant: for example, knowing that an important component of the co-design process in Zagreb represents the involvement of education stakeholders and service providers, spatially identifying their distribution in both

the LL as well as the wider analysis area provides additional indications on shaping a co-design programme.

Hence, involvement of stakeholders in the NBS implementation and Urban Plan development processes is crucial from several points of view, allowing for:

- **Integration** (of information systems, institutions, resources);
- **Cooperation** (vertical, horizontal and transversal);
- **Continuity** (transcending political mandates);
- **Transparency** (open, public and understandable);
- **Accountability** (visibility of the shared policy process).
- **Sustainability** of the whole process.

All the above represent pillars for designing effective and efficient NBS implementation plans and future policies, both in terms of urban governance as well as results delivered to the affected / involved community. Defining a stakeholder base can furthermore help in dealing with potential future conflicts, before initiating any form of implementation.

Stakeholder identification within the Spatial Analysis

A first definition of the term **stakeholders** appears in the context of business strategy research: “Group of people who can affect or can be affected by the achievement of the organization’s objectives” (Freeman, 1984). In the process of public participation, **stakeholder groups** are parties affected by, or perceiving themselves to be affected by, a proposed governmental action (Babiuch and Farhar, 1994). Of the stakeholder analysis process, **stakeholder identification** represents a first step (Friedman and Miles, 2006).

Stakeholder analysis theories offer numerous techniques for prioritizing stakeholders and understanding relationships, but they do not provide practical guidance on how to identify stakeholders (Schiller et al., 2013). ProGIreg will rely on stakeholder surveys conducted by each FRC and FC at their own local level, building on the information already identified for the FRC in the application form.

Within proGIreg, NBS and Regeneration Plans are co-created in multi-stakeholder partnerships. **The quadruple helix approach** represents the core team in each Living Lab or FC Urban Regeneration partnership, consisting of four key stakeholder groups: civil society (NGOs and individual citizens), academia (universities and research institutions), governmental institutions (local governments and other public authorities) and the private sector.

The quadruple helix approach enables proGIreg to foster and sustain NBS innovations, in order to ensure the sound scientific grounding of the solutions implemented, the adaptation and fit within the legal frameworks of the FRC and the wider governmental actions, as well as the public acceptance and uptake, economic viability and sustainability.

Broad cooperation in NBS innovation through the project allows a shift towards a systemic, open and user (beneficiary) centric innovation policy for the testing of eight NBS in the Living Labs of FRC, as well as their embedding in the four FRC Urban Regeneration Plans for future implementation.

Stakeholder identification will follow the four helices of proGIreg (**Figure 17**):

- **Local government:** Government institutions and municipalities
- **Academia**: universities and research institutions
- **Civil society**: NGOs on different levels and individual citizens
- **Industry**: SMEs and entrepreneurs in developing, testing and replicating NBS

Figure 17 | proGireg quadruple helix approach. Source: ICLEI

Stakeholders can furthermore be divided according to their interests and influences into **primary and secondary stakeholders** (Clarkson, 1995). Primary stakeholders have a high level of interactivity and are vital for the success of a project. Secondary stakeholders affect or are affected by the project and its results, but are not essential for its success. As a starting point, the following distinction can be adapted at the different spatial scales, for example:

Primary stakeholders:

- Public authorities and decision-making groups on different administrative levels (municipality – relevant departments, Metropolitan Area, district government bodies if existing, neighbourhood structures);
- Policy-makers at local level;
- Service providers at city and local level;
- Deconcentrated institutions at local / regional level;
- Industry representatives and SMEs;
- Civil society (specific organisations relevant for the LL area, for example social, health, environmental organizations, housing associations, education / local schools in the LL areas, etc.)
- Citizens un-affiliated to an organisation, which can be considered target groups for an NBS implementation, for example refugees to be involved in the NBS no.5 implementation in the Dortmund Living Lab.

Secondary stakeholders:

- Civil society (other relevant organisations such as clubs, associations and activist groups, whose involvement in the project is beneficial, but not essential).
- Research and academia at local level (which can be even primary stakeholders, depending on the scope of piloting activities)
- General public
- Media, press

In guiding FC and FRC partners, the Spatial Analysis offers potential perspectives of interest but also indications on potential additional data sources. Sometimes, data on municipal infrastructure, workforce, social services, etc. comes from sources outside the municipality. This can be, for example, the case of district or microdata on waste management or energy consumption, which are collected by service providers but not often provided to the municipality at the scale or granularity useful for the LL implementation. Knowing whom to involve is an important step for ensuring sustainability, but even data access.

Next steps

The stakeholder identification in the D.2.2 Spatial Analysis will be followed in Task 2.2 by a more in-depth stakeholder mapping in each FRC in the first part of 2019 (ICLEI). The stakeholder mapping workshops will fill in the gaps and provide an assessment of the impact and influence with these stakeholders can have on the implementation of the Living Lab actions. Any missing stakeholders will also be supplemented during this exercise.

2.4.3. Collection of statistical quantitative data and geodata

In order to support the definition of a common spatial analysis framework for all FRC and FC, it is necessary to conduct a process of data collection. In this sense, the scientific literature presents a significant amount of methods and algorithms to support this process and to facilitate analysis, comparison, and decision-making.

Data refer to characteristics or information, usually numerical, that are collected through observation. Data are typically the results of measurements and can be visualised using graphs or images. A dataset refers to any organised collection of data, listing values for each of the variables and for each member of the dataset (Eurostat Glossary).

An indicator is a parameter associated with a phenomenon, which can provide information on the characteristics of the event in its global form (OECD, 2003). A **statistical indicator** is the representation of statistical data for a specified time, place or any other relevant characteristic, corrected for at least one dimension (usually size) so as to allow for meaningful comparisons (EUROSTAT Glossary). **Spatial analysis of statistical indicators** assumes that data often exhibit properties of spatial dependency (relatedness of variables measured in close proximity) and / or spatial heterogeneity. A spatial analysis considers these phenomena explicitly (Alessandra Petrucci, 2003).

Indicators can be quantitative or qualitative:

1. **Quantitative indicators** illustrate a number, index or ratio / percentage, being widely used in planning because they provide a **clear measure of the analysed situation** and are **numerically comparable**. Quantitative indicators are preferred to qualitative ones because they are not biased, requiring only mechanical collection methods that (theoretically) deliver the same results, no matter who they measure.
2. **Qualitative indicators** do not present numerical measures as such, but describe the status of a qualitatively analysed issue. Qualitative indicators can be translated into pseudo-quantitative indicators through scoring systems such as the Likert scale - a widely used psychometric scale that uses scalar response questionnaires (eg 1-5, where 1 = strongly disagree and 5 = strongly agree). Qualitative indicators are not used as often as the quantitative ones in territorial research.

The purpose of indicators is to transmit information about the state, or the state evolution (variation) of a phenomenon which cannot be measured directly. Thus, they allow us to perceive differences - territorial disparities, improvements or developments related to a desired change or in a certain context, in this case, related to the proGIreg cities and their LL / Urban Regeneration analysis areas).

The spatial analysis aims to achieve an approximation of the state of local spatial development in FRC, FC and their analysis areas. Consequently, for the purpose of the Spatial Analysis, **context spatial data** will be used to develop the analysis.

Context data is defined as a datum which provides simple and reliable information describing a variable relative to the context. It gives information about a situation and its evolution in a country, or an area relevant to the topic of interest or policy (EC Evaluation Unit DEVCO, 2017). Context spatial data and indicators in proGIreg have been selected based on the following criteria, enunciated by the ITU-T, ETSI, ISO and UN in the development of the Smart and Sustainable Cities and Communities KPI Framework (2015):

- **Comprehensiveness:** The collected spatial data should cover all relevant aspects pertinent to the four key assessment domains.
- **Comparability**: Data can be compared scientifically between cities according to different phases of urban development, which means that it must be comparable over time and space.
- **Availability:** Data should be quantitative and the historic and current data should be already available.
- **Independence:** The data in the same dimension should be independent or almost-orthogonal i.e., overlap should be avoided as much as possible.
- **Simplicity:** The concept of each sub-domain, indicator and data should be simple and easy to understand for FRC, FC and local stakeholders. The calculation of the associated data should also be kept intuitive and simple.
- **Timeliness:** This refers to the ability to produce data of actuality, and to collect it periodically with respect to the project progress.

Furthermore, selected and used spatial data must represent **free data:** This conditioning excludes any database that needs to be purchased. proGIreg will embed data that is either publicly available or provided by partner organizations or other interested parties in order to be analyzed and the results to be published freely, non-profit, online, including as a means for disseminating the project.

A single data point (e.g. % of residents in public housing for the year 2017 in Cascais) provides information of little consequence unless it is associated with a **system of spatial datasets and indicators**, able to provide systematic information for the purpose of the spatial analysis. A system of indicators consists of several indicators correlated from a logical and functional point of view, able to describe and provide information on several phenomena associated with each other, or which need to be interpreted in a coordinated way (Comino, Ferretti, 2016).

This is particularly important in proGIreg, where wide-scale deployment of innovative NBS can have a potential effect on an ample set of urban parameters ranging from the quality of the environment to the development or substantial growth of a local green job sector.

For this purpose, in cooperation with WP 4 (led by CNR), over the course of the first few months of proGIreg implementation, a matrix of descriptors / key reference sub-domains for the spatial statistical data requested to FRC and FC has been developed (Table 4). The matrix has been populated with indicators and statistical spatial data, which was requested to partners. In total, 85 spatial datasets are requested, whenever available, for the period of the last 10 years (2008 – 2017) in order to understand trends and dynamics at city and analysis area level.

The list of spatial datasets is provided in the following chapter, Guidelines for partners.

Table 4 | Spatial analysis subdomains and descriptors for the spatial data

ProGIreg reference domains	Spatial analysis subdomains
1. Socio-cultural inclusiveness	1.1 Demographics
	1.2 Social and cultural inclusiveness
	1.3 Education and access to social and cultural services and amenities
	1.4 Housing
2. Human Health and Wellbeing	2.1 Health
	2.2 Wellbeing
3. Ecological and environmental restoration	3.1 Land use and Vegetation
	3.2 Climate / Meteorological data
	3.3 Air Quality
	3.4 Soil

	3.5 Water
	3.6 Urban environment
4. Economic labour market benefit	4.1 Market labour and economy indicators
	4.2 Gentrification indicators
	4.3 Tourism and attractiveness indicators
	4.4 Taxes, Investment & Financing

2.4.4. Baseline assessment / SWOT Analysis

There are several ways of providing a context or baseline spatial analysis. The purpose of the methodology is to provide an instrument accessible to FRC and FC, which will be responsible with performing their self-assessments. Beyond accessibility however, the instrument needs to be useful for developing a comprehensive, but condensed characterisation of the local state of development in FRC and FC.

One of the best such Decision Support System (DSS) instruments is the **SWOT analysis** (Strengths, Weaknesses, Opportunities, Threats). SWOT is recognized by the European Commission as a strategy analysis tool, useful for identifying possible strategic approaches (EC, 2017).

First used as a business management tool in the 1960s, the SWOT analysis has since been applied in a very wide range of fields, especially in support to strategic planning procedures. It offers the possibility to condense different elements of an urban audit into **a comprehensive picture,** and to analyse alternative scenarios of urban and territorial development. The SWOT analysis is a **well-established approach** in the field of sustainability assessments due to its versatility and ability to represent in an organized way the influence played by multiple factors on different decision contexts (Comino, Ferretti, 2016).

From the methodological point of view, the SWOT analysis is structured into:

1. **Internal environment analysis:** endogenous factors (variables that are part of the system and that can be directly modified);
2. **External environment analysis**: exogenous factors (variables external to the system, but which can influence it).

The SWOT tool will be used for the ex-ante evaluation of the FRC and FC development in the key assessment domains. The analysis is performed at territorial level as opposed to, for example, stakeholder level (eg. Municipality) or NBS level.

The method of using the SWOT tool for spatial analyses, albeit not as prominent as in business management, is well established. The proGIreg approach is based on the research conducted by Comino and Ferretti (2016), proposing an indicator-based spatial SWOT to support the strategic planning and management of complex territorial systems:

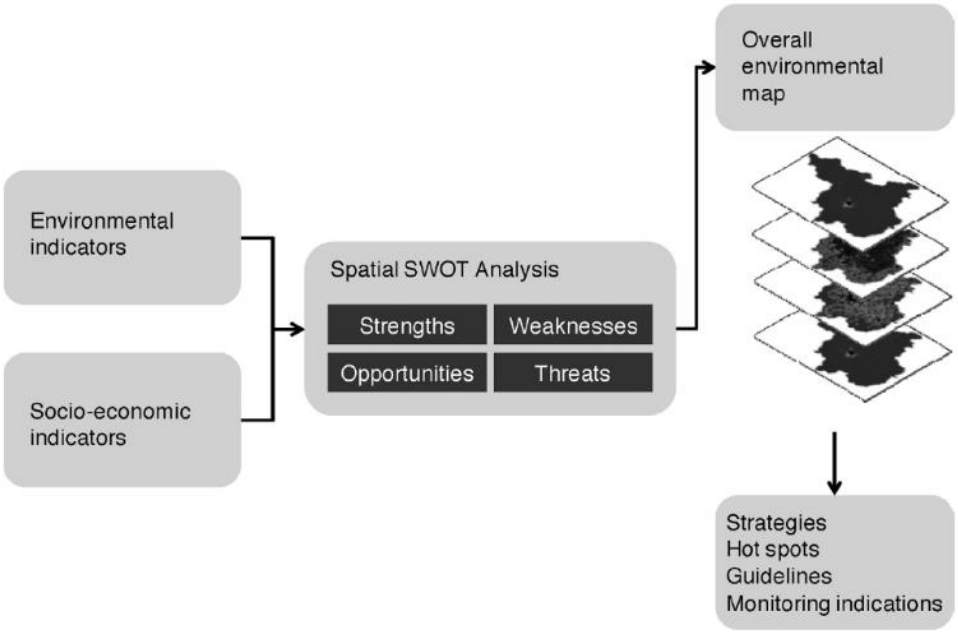


Fig. 3. Methodological flowchart for the analysis.

Figure 18 | Methodological flowchart proposed by Comino and Ferretti (2016) for Spatial SWOT Analysis

The analysis relies on the structured set of spatial indicators developed for the quantitative assessment of socio-cultural inclusiveness, human health and well-being, ecological and environmental restoration, economic and labour market, establishing a baseline for further re-assessment within the implementation lifetime of proGIreg. An interpretation of the data will be provided by each FRC and FC in the forms of:

1. **A textual assessment SWOT** on the four key scientific assessment domains of the NBS benefit assessment and monitoring (WP4), both at city / metropolitan area and LL / Regeneration area level (see chapter 2.2.2)

2. **A synthetic visual spatial analysis**, presenting the findings in the SWOT analysis, through a set of 8 thematic maps (2*4), corresponding to 1) the two territorial analysis levels and 2) the four key scientific assessment domains defined in WP 4: socio-cultural inclusiveness, human health and well-being, ecological and environmental restoration and economic and labour market.

Relying on each FRC and FC baseline assessment, an overall „state of art" overview will be provided by URBASOFIA. Finally, conclusions will be drawn both individually to each per-partner spatial analysis (by FRC and FC), and for the whole group of eight FRC and FC, outlining differences, particularities, possibilities of clustering future activities and other comparative findings.

3. Guidelines for the Spatial Analysis

3.1. Where to look for spatial data

When performing a spatial analysis for any reason, having **good raster and vector dataset support** is essential in order to visualize any elements of the analysis. The sets of available geodata are of particular importance also for **future monitoring and assessment** tasks, or any kind of more advanced analyses in proGIreg (or any project that implements and designs NBS). For example, available geodatasets pertaining to the street network, functional zoning and green spaces can support the calculation of the Walkability Index (see proGIreg D.4.3, CNR).

The basic list of spatial data necessary for the Spatial Analysis relies on the **INSPIRE Directive**, Annexes I, II and III (**Data specifications – Themes**), with **the first two annexes** being a minimum requirement for both FRC and FC inconducting a pertinent and useful analysis at urban scale, and the third Annex being necessary for the LL analysis. All spatial data needs to be INSPIRE-compliant:

ANNEX I	ANNEX II	ANNEX III
Administrative Units	**Elevation**	Agricultural and aquaculture facilities
Transport networks	**Land cover**	Area management
Hydrography	**Geology**	Atmospheric conditions
Protected sites	**Orthoimagery**	Bio-geographical regions
Cadastral parcels		Buildings
		Environmental monitoring facilities
		Habitats and biotopes
		Human health and safety
		Land use
		Meteorological geographical features
		Population distribution and demography
		Soil
		Species distribution
		Utility and governmental services

ProGIreg partners will use and further provide their sets of available geodata, as necessary project baseline input data. Most of the partners, according to the scoping survey, use their GIS systems for mapping (5/7), and analysis (4/7) – but **some of them do not have a GIS in place** (Zenica, Pireus, Cluj-Napoca). As a note, the software used for the Spatial Analysis differs by partner: 4 partners use AutoCAD (Zenica, Zagreb, Piraeus, Cluj), Dortmund uses MapInfo (DORIS and GRAPPA), Torino uses ESRI, ArcGis, QGis, Autocad and other

software as well, while Cascais uses QGIS. Partners will provide the above-mentioned geodata (as available), preferably in SHP / DXF and TIFF (for raster images, i.e. orthophotoplans) formats.

Considering the heterogeneity of data formats and availability, it is necessary to identify and use **alternative data sources as well, open and public**. In this regard, the following sources can be used (non-exhaustive list):

- **OpenStreetMap - OSM** can provide highly detailed free GIS data, including building inventory. It is crowdsourced, so accuracy may vary.
- **NASA Socioeconomic Data and Applications Center – SEDAC** provides over 300 thematic maps for the European region, of the interaction of humans with the environment.
- **NASA Earth Observations** – NEO provides over 50 global datasets on climate.
- **COPERNICUS Land Monitoring Service** – provides a wealth of high-resolution EO, satellite and in-situ sensor data pertaining to land cover, imperviousness, urban street vegetation and many more.

Figure 19 | Example of geodata layer: Street tree presence, 2018, in the Mirafiori Sud district / Torino LL. Source: Copernicus LMS

For compiling the spatial indicators, the following data sources should be considered by partners:

1. Multi-annual data from municipal databases (on e.g. demographics)
2. Data collected from regional or national statistics offices / institutes, national census, etc.
3. Data from other external stakeholders (business registers, NGOs, chambers of commerce, municipal service providers, etc)
4. Other databases at European level: EUROSTAT, OECD, etc.
5. Existing documentations and grounding studies.

Although some of these databases do not have an explicit spatial component, the collection of data relevant to the assessment domains of proGIreg at the level of the city and the analysis areas (Living Lab analysis area and Urban Regeneration Area) is **implicitly providing spatial information**: it tells of the current situation of a chosen topic, at the two territorial levels.

It is important that spatial data is also collected to show **trends and evolutions**: in this regard, the use of municipal or regional / national statistics office data offers the best possibility of extracting a multi-annual dataset. For proGIreg, the considered timeframe in terms of trend establishment is 10 years: between 2008 and 2017. This timeframe allows for the better understanding of processes induced by the global economic crisis, especially relevant in post-industrial areas such as the proGIreg LLs.

3.2. Developing a regulatory, plan and policy framework: why is it important?

Establishing both a development context as well as a policy background is key to a well-rounded Spatial Analysis baseline („state of play"). A regulatory, plan and policy framework contextualizes both the collected data, as well as any future NBS action. It provides insights into why the area looks the way it does, and what can be done to change the state of play.

One of the aims of proGIreg is to **streamline adoption, integration and embedding of NBS in local policy development processes**. In spite of a growing awareness and recognition for the potential of NBS, operationalizing them into policy and plans requires specific, additional efforts to translate evidence into policy and actions. FRC will be involved in actual NBS testing within the real-life scenarios of the LLs, while FC will co-create new NBS development scenarios with stakeholder inputs, embedding these in the local frameworks through Urban Regeneration Plans.

The regulatory, plan and policy framework in the proGIreg Spatial Analysis informs on the determinants of the context in each FRC and FC and singles out the provisions which either explicitly or implicitly support or disincentivize GI and NBS investments. It also helps further identification of **potential barriers, synergies or entry points** moving forward, which is useful both for FRC as well as FC.

This part of the spatial analysis will consider three criteria: **governance level, instrument character and policy domain.** Through the initial Scoping Survey, proGIreg partners have already identified the key strategic and normative plans in the 8 cities, as well as policies on urban development, urban regeneration, green infrastructure and other foci of interest for the proGIreg project. These documents will be further by the partners, for the following scopes:

- → To contextualize the LL interventions (FRC) and Urban Plans (FC) and to integrate the vision of proGIreg Regeneration Plans within the one of higher administrative levels;
- → To ensure alignment with normative provisions for the cities, especially FRC, and compliance with regulations at local level for the LL interventions;
- → To identify other initiatives pertaining to green infrastructure and NBS at higher territorial levels (national, regional) which have a potential impact on the proGIreg implementation and which could be capitalized upon during the project.

A selection of relevant objectives, policies, programmes, actions and projects as well as rules and regulations (normative) will be carried out by the partners, analysing existing plans and policies in regard to the following issues:

1. **At regional level (FC and FRC):**

   - → The vision and strategic objectives to which NBS development and piloting will adhere on the topics of: urban development, green infrastructure development and regeneration of post-industrial landscapes;
   - → Existing regional / higher-scale initiatives and projects on GI / NBS;

2. **At city / metropolitan area level (FC and FRC), with specific focus on the LL sites (FRC):**

   - → Provisions pertaining to social, economic and physical regeneration of communities within municipal plans, policies and strategies for urban development; to green infrastructure; environmental management; and sustainable development.
   - → Local policies and programmes for participation, community involvement, social inclusion and social innovation;
   - → Policies, instruments and facilities for supporting the local business environment and employment at local level, specifically in domains connected to GI;

3. **Existing grounding studies, surveys, programmes conducted at Living Lab scale** pertaining to: GI, social innovation and inclusion, economic redevelopment, participation and active citizenship.

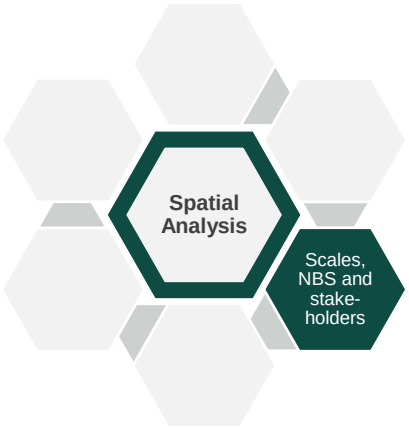
The following guiding matrix can be a useful tool for any city interested in surveying the plan and policy context before deploying GI and Nature-Based Solutions investments:

Table 5 - Topics and administrative levels of the Plan and Policy Analysis

Key topics of interest for NBS implementation	Regional / Upper territorial levels	Local level of the city and (for FRC) the LL	Other city investments / actions
TOPICS: **Urban development** **Green infrastructure** **Urban Regeneration** **Participation** **Social inclusion** **Other topics of interest**	Contextualisation: Vision and strategic objectives to which NBS development should subscribe: available strategies, masterplans, either integrated or sectorial for the key topics of interest Synergies: Existing regional / higher-scale initiatives and projects pertaining to GI / NBS Opportunities: Support for NBS implementation (i.e. Operational Programmes)	Contextualization: provisions of masterplans, sectoral plans and strategies on the key topics of interest for NBS implementation Constraints: provisions of normative plans, specifically for the LL / urban regeneration areas Opportunities: policies, instruments and facilities useful for NBS implementation	Synergies with other actions / projects of the cities, being implemented in parallel Specifically for FC: planning documents at local level foreseen to be developed or currently under development

3.3. How to identify and list key stakeholders for proGIreg

Each city has a specific stakeholder landscape and culture of participation. But in order to ensure that NBS and Urban Regeneration Plans are co-produced at local level and reflect the expectations and needs of all relevant stakeholders, their identification is a critical first point, so it is included in the Spatial Analysis.



ProGIreg follows **a quadruple helix-approach** to foster and sustain NBS innovations, in order to ensure the sound scientific grounding of the solutions implemented, the adaptation and fit within the legal frameworks of the FRC and the wider governmental actions, as well as the public acceptance and uptake, economic viability and sustainability. In all stages of the project, four types of stakeholders are of interest to be engaged in the testing of NBS (FRC) and the development of Urban Regeneration Plans (FC): Local government, Academia, Industry and the Civil society.

Defining this stakeholder base at the very beginning of the project allows to have a more comprehensive idea of local priorities and to design more “local rooted” solutions, fostering a high degree of sustainability for the proGIreg actions.

The first step for this cooperation is **identifying the relevant stakeholders** from each of the quadruple helix domains to support FRC and FC with a basis for their participatory processes. In the next steps, FRC (Task 2.2) and FC (Task 2.3) will refine this information and will analyse and engage the stakeholders in co-design activities.

For the Spatial Analysis, the following critical questions should be addressed in this chapter:

- Who will implement the selected NBS? Whom will they impact (FRC), at LL Analysis scale?
- Who will be affected by the future implementation of an Urban Regeneration plan in FC areas? In selecting the NBS of interest, do they reflect the needs of the intervention area and the community?

Each city should identify the specific organisations which should be involved in the proGIreg activities (either for implementing LL activities – FRC, or for developing the Urban Plans – FC) and provide a **stakeholder identification overview:**

Table 6 | Framework for stakeholder identification in proGIreg spatial analysis

ROLE OF STAKEHOLDERS	TYPE OF STAKEHOLDERS
Users / Beneficiaries *Who will directly use / be involved in the different kinds of NBS in FRC (e.g. community gardens)? Who will benefit from the creation of the Urban Regeneration Plans in FC?*	proGIreg quadruple helix stakeholder types: **Local government** **Academia** **Industry** **Civil society** *The more detailed, the better: identifying sub-type (i.e service providers, SMEs) is a valuable step to assist in future proGIreg activities*
Governance *Who are the multi-level government representatives, decision makers, policy makers and urban planning experts which will have the responsibility and authority over the implementation / co-design process? These are enablers and help setting the frameworks for NBS implementation. They are not necessarily always local government: a planning expert may represent academia, for example.*	
Providers *Who are the specific stakeholders engaged in the service supply chain (social services, environmental, municipal services, training, etc) who will need to be included either directly in implementation, or as suppliers of data necessary for the project?*	
Influencers *These are stakeholders who can sway opinion or facilitate support of the project and adoption of its results (i.e. positional authorities, institutions with persuasive power, investors, media)*	

3.4. Collecting, structuring and analysing spatial data

For the purpose of the baseline („state of art") analysis, a set of spatial indicators was developed combining basic state and pressure indicators, common to integrated baseline assessments. It was based on existing research and indicator frameworks developed by Horizon 2020 „EKLIPSE" Project (**http://www.eklipse-mechanism.eu/**), Horizon 2020 „CITYKEYS" Project (**http://citykeys-project.eu/**), and UNECE ITU-T Smart and Sustainable Cities and Communities indicators (**www.itu.int**). But as most of the indicators within these publications **are key performance indicators (KPI) aimed at assessing the impact of a certain action or project** (e.g. success of

implementing a Nature-Based Solution in a proGIreg LL), for the purpose of the baseline, these process indicators have been transformed into state indicators. For example:

Process indicator	State indicator
EKLIPSE: Number of green jobs created (Forestry Commission, 2005);	ProGIreg Spatial Analysis: Existing number of green jobs

This list has been refined in cooperation with WP 4, and extended to reflect data needs which will be relevant for the interim and final assessments of proGIreg NBS implementation in the FRC Living Labs. A critical point is the usefulness and comparability of data: as described in the previous chapters, data should be **comprehensive, comparable, available, independent, simple and timely** for the purpose of the analysis.

Yet, the cities in proGIreg come from different regions, and have vastly different administrative and planning frameworks, as well as data collection protocols. Some are in the European Union (like Turin and Dortmund), while others are not (Zenica, Ningbo). Some are part of the OECD and may benefit from an enhanced data availability, some are not (like Cluj-Napoca, or Zenica). Availability and granularity of basic demographic data may vary from block level to city level, and may be collected monthly, yearly, or even just at 10-yearly censuses.

How can a minimum base of comparability be achieved under these circumstances? The approach of the proGIreg Spatial Analysis is to prepare and request an extended list of spatial data and indicators from the FRC and FC, in order to ensure that, from any spatial analysis sub-domain, at least 1-2 datasets are available and can support the development of a spatial SWOT analysis.

The WP 2 – WP 4 „long list" of basic administrative datasets comprises of 85 such datasets and is available below. In the annex to this report, the model spatial data collection sheet is provided, with indications on the required level (City / Analysis Area) for FRC and FC.

SPATIAL ANALYSIS SUBDOMAINS	SPATIAL DATASETS REQUESTED FROM FRC AND FC
1.1 Demographics	1.1.1 Total population and evolution
	1.1.2 Population density
	1.1.3 Population growth rate
	1.1.4 Migration rate
1.2 Social and cultural inclusiveness	1.2.1 Material deprivation rate
	1.2.2 Work intensity
	1.2.3 Diversity statistics
	1.3.1 Educational attainment

1.3 Education and access to social and cultural services and amenities	1.3.2 Recreational or cultural facilities
	1.3.3 Accessibility of public urban green spaces
1.4 Housing	1.4.1 Housing quality
	1.4.2 Public housing
	1.4.3 Housing affordability
	1.4.2 Density of the built environment
2.1 Health	2.1.1 Incidence of cardio and respiratory diseases
	2.1.2 Incidence of allergic disease
	2.1.3 Incidence of chronic stress, stress-related diseases, mental health diseases and NCDs
	2.1.4 Obesity rate
	2.1.5 Life expectancy at birth
2.2 Wellbeing	2.2.1 Green space per capita
	2.2.2 Urban safety – crime
	2.2.3 Urban safety – accidents
3.1 Land use and Vegetation	3.1.1 % of green spaces
	3.1.2 structure of green spaces
	3.1.3 structure of green spaces
	3.1.4 structure of green spaces
	3.1.5 % Surface of brownfields
	3.1.6 % Surface of polluted brownfield areas
	3.1.7 Canopy cover
	3.1.6 Leaf Area Index
	3.1.7 NDVI
3.2 Climate / Meteorological data	3.2.1 Precipitation
	3.2.2 Relative humidity
	3.2.3 Air temperature
	3.2.4 Wind strength
	3.2.5 Wind direction
3.3 Air Quality	3.3.1 Ozone concentration
	3.3.2 NOx concentration
	3.3.3 PM 2.5 concentration
	3.3.4 PM10 concentration
	3.3.5 VOC Concentration
	3.3.6 GHG inventory
3.4 Soil	3.4.1 Soil quality

3.5 Water	3.5.1 Water quality
3.6 Urban environment	3.6.1 Heat island effect
4.1 Market labour and economy indicators	4.1.1 GDP per capita
	4.1.2 Businesses in the area - Industrial
	4.1.3 Businesses in the area - Commercial
	4.1.4 Businesses in the area - Offices
	4.1.3 Public jobs
	4.1.4 Private jobs
	4.1.5 Public green jobs
	4.1.6 Private green jobs
	4.1.7 Qualified jobs
	4.1.8 Non-qualified jobs
	4.1.9 Turnover in the green sector
4.2 Gentrification indicators	4.2.1 Employment rate
	4.2.2 Unemployment rate
	4.2.3 Revenues by household
	4.2.4a Current property sale value for residential use
	4.2.4b Current property rental value for residential use
	4.2.5a Current property value for commercial/ industrial/ office use
	4.2.5a Current property rental value for commercial/ industrial/ office use
	4.2.6 Free services
	4.2.7 Basic utilities
4.3 Tourism and attractiveness indicators	4.3.1 Current number of tourists
	4.3.2 Number of temporary events
	4.3.3 No. of foreign students
	4.3.4 Local expenses
4.4 Taxes, Investment & Financing	4.4.1 Local taxes
	4.4.2 Green investment programs/funds

All cities will collect the indicators listed above, based on their availability (including for the LL analysis / urban regeneration area if existing and listed). If yearly data is available, cities will use the last ten (2008-2017) in the analysis to compile process indicators and assess the trends in local development on the four key assessment domains.

3.5. Preparing a synthetic spatial SWOT analysis in proGIreg

Both FC and FRC will synthesize the findings of the analysis in a short SWOT analysis on the four main categories of the NBS benefit assessment and monitoring (WP4).

A SWOT Analysis is a strategic planning tool used to evaluate the **Strengths, Weaknesses, Opportunities, and Threats** of a certain territory or pertaining to a component – in this case, to the four key assessment domains of proGIreg. Its main purpose in the Spatial Analysis is to provide input to the creative generation of possible strategies for co-design, in both FRC (T.2.2) as well as FC (T.2.3):

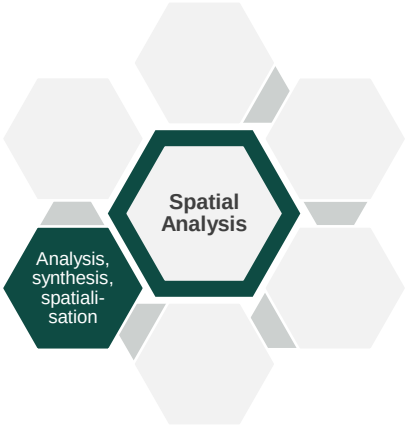
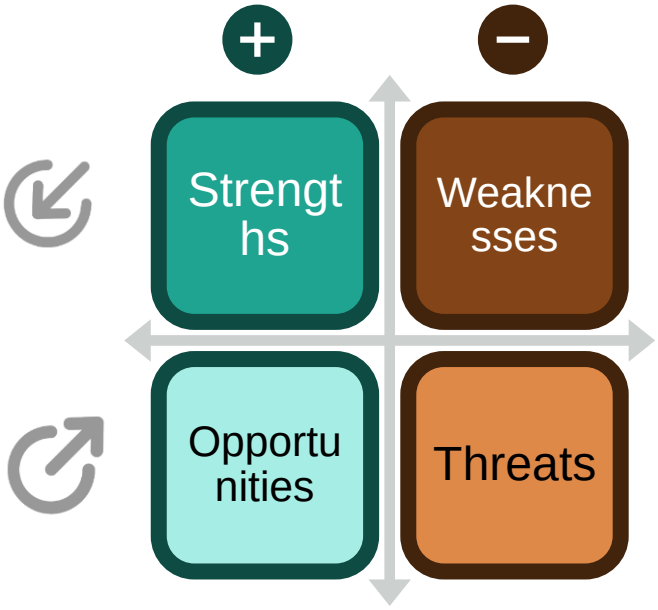


Figure 20 | SWOT Analysis. Source: URBASOFIA



- How can we valorise the strengths (i.e. well-developed human capital)?
- How can we overcome weakness? (eg. low accessibility of green spaces)?
- How can we exploit opportunities?
- How can we mitigate or overcome threats?

The SWOT will be incorporated in the final assessment of the FRC and FC spatial profiles by URBASOFIA, in charge of developing the final overall D2.2 Report.

Task 2.1 conducts data collection and prioritisation, subsequent tasks will validate some of the data in participatory processes (T2.2, T2.3, WP4). Because of the concentration on quantitative indicators, a further validation with local stakeholders of the findings is necessary.

The spatialization of this data, using the geodata collected, will be conducted at the two spatial levels outlined in Chapter 2.2.2. Eight thematic maps (Four maps at each of the two analysis scales) will be generated by the partners, providing an easy-to-understand visual

assessment of the conclusions within the SWOT analysis, touching on synthesis aspects such as for example:

- Degree of connectivity / fragmentation of green areas in the city
- Areas concentrating social problems – deprived neighbourhoods
- Quality of connections between residential and green areas
- Areas with high population density outside the radius of a green space (300m)
- Property values in conjunction with GI, etc.

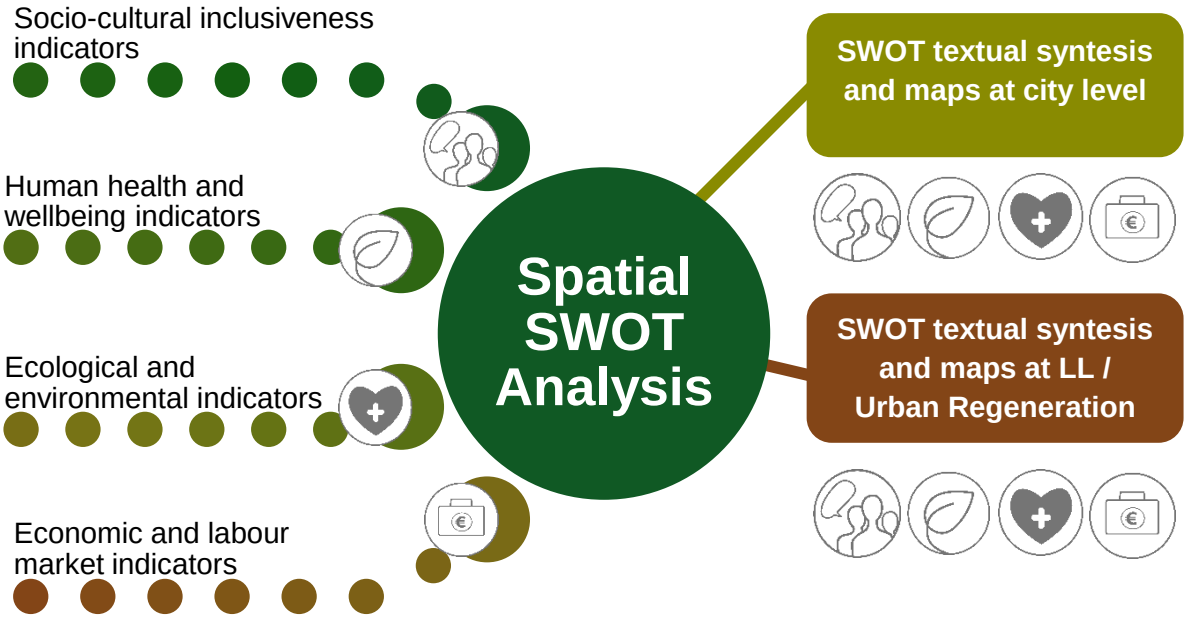
Proposed two-level SWOT Spatial Analysis in FRC and FC:

TEXTUAL ASSESSMENT (QUALITATIVE)				
CITY LEVEL				
	Strengths	Weaknesses	Opportu-nities	Threats
Socio-cultural inclusiveness	*E.g. High social housing availability*			
Increased human health and wellbeing				
Ecological and environmen-tal restoration				
Economic and labour mar-ket benefits				
LIVING LAB LEVEL (FRC) / REGENERATION AREA(S) (FC)				
	Strengths	Weaknesses	Opportu-nities	Threats
Socio-cultural inclusiveness	*E.g. Low median age – active population*	*E.g. Higher ma-terial deprivation rate*		
Increased human health and wellbeing				
Ecological and environmen-tal restoration				

Economic and labour market benefits				

The thematic spatial maps will conform to the NBS benefit assessment and monitoring (WP4) key scientific assessment domains:

1. **Socio-cultural inclusiveness,**
2. **Human health and well-being,**
3. **Ecological and environmental restoration**
4. **Economic and labour market**



5.

Each partner will develop a set of **four thematic maps at two levels** (city / metropolitan and LL / regeneration area), summarizing the findings of the SWOT analysis for each of the key reference domains.

As a general principle, the maps should be simple for ease-of-understanding, as they will be used as a communication tool with the local stakeholders in the co-design processes in FRC and FC.

In total, **eight thematic spatial SWOT maps** will be compiled by FRC and FC: four at city level, and four at LL analysis scale, or Urban Regeneration Area scale, if the UR area can be identified during the development of the Spatial Analysis in Follower Cities.

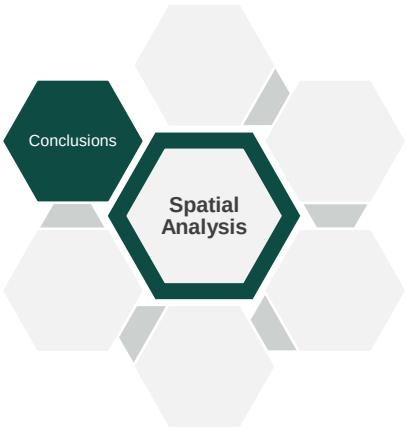
If the Follower Cities cannot yet identify the Urban Regeneration area, or lack sub-municipal data necessary for the development of the four UR area spatial SWOT maps, they will perform this step in preparation of Task 2.3 (starting January 2021).

At the moment of Version 1 submission for this Report, ProGIreg's visual communication guidelines were currently under development in Work Package 6 (Communication). After their publishing, in order to allow for a clear design of the thematic maps regarding specifications for proGIreg corporate layout, project colour schemes etc., a simple template at city level was provided to partners. This template is included in the Annexes.

All partners will be supported by the task leader in elaborating their SWOT analyses and thematic maps, with partner cities not using GIS technologies for the latter being further assisted to visualise the state of art through the Spatial Analysis (D2.2) deliverable.

3.6. Drawing conclusions. How to use this knowledge further

The Spatial Analysis offers the opportunity to gather an in-depth understanding of the city development stage and potential for NBS-led regeneration, for each of the four topics addressed by proGIreg:

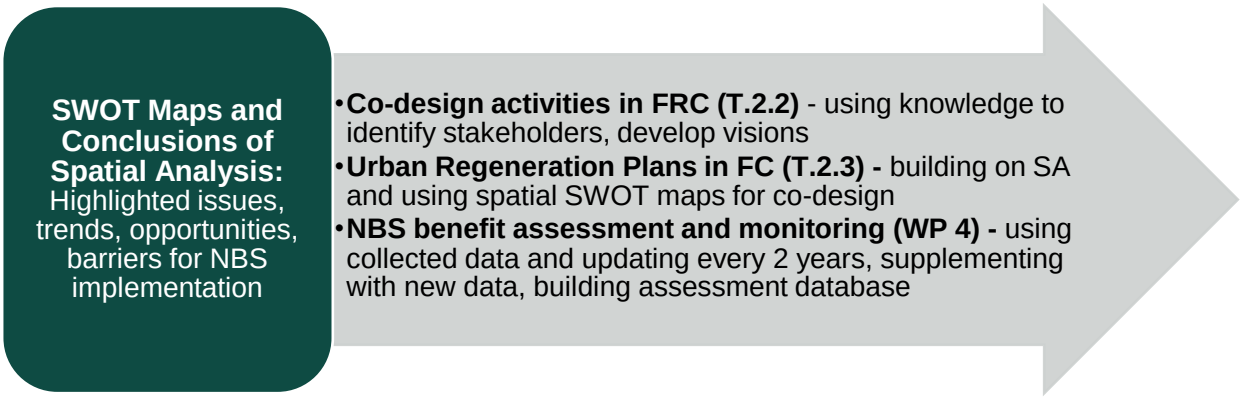


- Socio-cultural inclusion
- Human health and wellbeing
- Ecological and environmental situation
- Economy and labour market

Drawing conclusions from the spatial SWOT analysis is important for **synthesizing, in a qualitative assessment, the state of art** in each city before they enter the next activities of the project: co-design and LL implementation (FRC) and the participatory development of Urban Regeneration plans (FC). This synthesis is drawing on the textual SWOT and interpretation of the visual data in the maps, but it goes further than just summarizing problems and potentials: conclusions offer the opportunity to **integrate the sectorial findings** into one overall „snapshot" of city development:

- What are the major development trends in the city? What about the LL / Regeneration analysis area?
- How does the area stand out? What are the gaps and particularities in terms of public services, access to green space, social cohesion, urban safety, entrepreneurship opportunities?
- What is the potential of developing NBS in the area: is land available, is there a specific need at local level?
- Is the analysis bringing new perspectives to the approach of FRC, or resolution to the hypotheses of FC?

Partner conclusions will be completed with an overall comparative assessment by URBASO-FIA, and will be an important step in the local clarification of each city's priorities. Overall, the conclusions together with the spatial representations produced by FRC and FC will help to prepare the next steps of proGIreg:



Beyond the specific project-related tasks, gathering an understanding of the spatial manifestation of urban challenges in the cities (social, cultural, health & wellbeing, environmental and economy related) can be valuable for numerous other applications and programmes. These can support the actions carried out in the Living Labs in FRC, as well as the ambitions of FC to enhance the sustainability of their cities via NBS-led urban regeneration.

4. Conclusions and recommendations

In the context of the proGIreg project, a spatial analysis is defined as a multi-level, multi-dimension “state of play” performed by the cities, on the basis of existing administrative spatial data for the purpose of highlighting the current level of spatial development and conditions for implementing NBS in Living Labs (FRC) in WP3 and for developing Urban Regeneration Plans (FC) in WP2/Task 2.3.

The multi-level analysis approach defines two analysis scales to collect, process, analyse and assess administrative spatial data and data on plans, policies and stakeholders. It is also multi-dimensional, assisting cities to develop a basic spatial development baseline for each of the four key assessment domains defined in proGIreg: socio-cultural inclusiveness, human health and wellbeing, ecological and environmental restoration and lastly economy and labour market. The purpose of this approach is to ensure coherence with the monitoring and assessment tasks in the project (WP 4), and to assist cities to understand both the city-wide context in which NBS will be implemented or designed, as well as the area-specific spatial indicators that can be used for assessing the local development.

The methodology proposed in this report guides the proGIreg spatial analysis, taking into consideration the resources at the cities’ disposal. Constructing a baseline spatial analysis on existing administrative data and other qualitative information which cities and their local partners possess is a task which is primarily constrained by data availability. The data availability survey performed at the beginning of the methodology development highlighted this problem: availability of geodata sets ranges from relatively limited (in Torino, Dortmund, Zagreb and Cascais) to limited at basic vector data at city level (Piraeus, Cluj-Napoca), to a complete absence of data (Zenica, Ningbo).

Lack of statistical spatial data can hinder the creation of a sufficiently robust profile for one or several of the key assessment domains, leading to a limited understanding of the pre-conditions and potential for NBS planning and implementation, while also significantly reducing the comparability of findings between proGIreg cities. One way of mitigating this risk, the Methodology is proposing to include a “long list” of spatial indicators. In other words, we aim to ensure that all key assessment sub-domains are characterised by a minimum of two alternative spatial data sets, selected from the most commonly used datasets of statistical offices across Europe.

However, this approach poses another challenge: national statistical offices often define indicators slightly different or use different proxies. As examples, the following may differ between countries: the educational attainment levels, the way brownfield surfaces (%) are calculated, and the rental and sale property value calculations – especially at LL-level. Furthermore, some indicators may differ all-together, with cities being able to provide proxies indicating the same broad state of play: e.g. in Torino (Italy), material deprivation in a spatial area can be gauged from the percentage of population receiving economic support provided by the local municipality and several other institutions.

While starting from a long list of spatial datasets to be collected based on availability and using proxy indicators where possible assists the definition of a more robust dataset for each city, it may prevent the development of common recommendations in the overall interpretation of the D.2.2 Spatial Analysis. Grouping cities to support transfer between FRC and FC based on common traits, trends or characteristics may also be a challenge in this context. These are trade-offs which have to be taken 'as is' at this stage, which is conditioned by using only existing administrative data. Potential data gaps which are relevant for the subsequent NBS implementation and assessment may be obtained independently through other work packages, most notably WP4.

Furthermore, we consider the need to inform the analysis from a survey of existing urban development frameworks. All the cities participating in proGIreg have a range of policies, plans, strategies and regulations addressing urban development, urban regeneration, GI management and other domains which the project partially contributes to, such as social inclusion and participation. In the multi-level governance framework, they are also operationalising plans and strategies at higher territorial level, such as metropolitan or regional / provincial landscape plans, while operating in a regulatory framework that is established at national, regional or local level. This methodology proposes a simple framework to address their provisions, in order to understand both the contexts, as well as possible ranges of action or synergies for the future NBS design and implementation in proGIreg. It also collects a first indication of potential stakeholders to be involved, both at FRC as well as at FC level, acknowledging the important link between policy, process and partnership in NBS co-implementation, which is critical to be addressed as early as possible.

In closing, there are two recommendations we consider important for the development of the D.2.2 Spatial Analyses. The first is the allotment of sufficient time for data collection, as a task in itself which often involves sending out data requests to other institutions (e.g. regional offices). Furthermore, beyond data availability, one of the key factors for the success of the Spatial Analyses will be the capacity of the cities themselves to interpret data and most importantly to represent it in spatial SWOT analyses. The list of spatial datasets from administrative sources may prove overly ambitious. The lack of geodata sets in some FC may hamper producing the SWOT maps. In order to reduce these risks, we recommend a differentiated approach between the more advanced FRC and FC, allowing the latter more time to develop their analyses or to update them in preparation of Task 2.3 – development of Urban Regeneration Plans.

Nevertheless, the methodological steps included in this report aim at supporting each city with scientific knowledge and guidance to perform the spatial analyses in order to base decision-making of future urban developments on solid grounds.

Glossary

An area-based approach seeks to address an urban planning issue starting from its delineation at the spatial, or geographic level, rather than from a theme / category or a beneficiary group. Area-based approaches develop integrated actions for a purpose (i.e. urban regeneration) and a target group specific to a particular area, defined and delimited beforehand.

Spatial analysis is a type of geographical analysis which seeks to explain patterns of human behavior and its spatial expression in terms of mathematics and geometry, that is, locational analysis. (Mayhew, 2004)

Spatial data, geospatial data or geographic information it is the data or information that identifies the geographic location of features and boundaries on Earth, such as natural or constructed features, oceans, and more. Spatial data is usually stored as coordinates and topology, and is data that can be mapped. Spatial data is often accessed, manipulated or analyzed through Geographic Information Systems (GIS). (Beal, Webopedia)

State of play represents the particular way in which an event or a situation is happening, or developing. Pertaining to urban analysis, a state of play analysis offers a clear snapshot in time of a particular development situation.

A **baseline study** is an analysis of the current situation to identify the starting points for a programme or project. It looks at what information must be considered and analysed to establish a **baseline** or starting point, the benchmark against which future progress can be assessed or comparisons made. (EUROSTAT Glossary)

Urban Plans are, in the context of the project, strategic planning documentations developed by Follower Cities for the purpose of embedding innovative NBS within their strategic development framework at local level, geared toward implementation of GI solutions which will address the sustainable development and renewal of communities from a physical, ecological, socio-cultural, and economic point of view.

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Annex 1 – Survey outcome for the FRC and FC – Policy and planning framework, references

1.1 FRONT RUNNER CITIES

1. Policies at the regional level

Front Runner City	Urban development	Green infrastructure	Regeneration of post-industrial sites
Dortmund	Gebietsentwicklungsplan Regierungsbezirk Arnsberg, Teilabschnitt Oberbereich Dortmund - westlicher Teil -/ Regional plan (2004)	Emscher Landschaftspark/ Emscher Landscape Park, Position 2020+ ELP/ Position 2020+ELP (2013), Masterplan/ Master plan (2005)	Route Industriekultur
Torino	Regional Landscape Plan /Piano Paesaggistico Regionale - PPR (2017), Regional territorial plan/Piano territoriale regionale - PTR (2011), Integrated Territorial Programs /Programmi Territoriali Integrati – PTI (2005), European structural and investment funds/POR FESR 2014/2020 (Axis VI, "Sustainable Urban Development"), Territorial coordination plan/Piano territoriale di coordinamento – PTC2 (2011)	Regional Forest Plan/Piano Forestale Regionale (2017)	-
Zagreb	City of Zagreb Development Strategy 2020 (2017), Urban agglomeration Development Strategy Zagreb 2020 (2017), Spatial Plan City of Zagreb (2016)	-	-

2. Policies at local level

Front Runner City	Urban development/Urban regeneration	Green infrastructure	Environment management and sustainable development	Participation or social inclusion
Dortmund	Flächennutzungsplan der Stadt Dortmund/ Zoning Plan City of Dortmund (2004),	Landschaftsplan der Stadt Dortmund/ Landscape plan City of Dortmund (3 parts: 1990, 1996, 2002 and first amendment: 2005), Radial-konzentrisches Freiraumkonzept / radial-	Masterplan Energiewende/ Master plan Energy Transition (2014), Handlungsprogramm Klimaschutz 2020/ Action Programme Climate protection	Aktionsplan Soziale Stadt Dortmund / Action Plan Social City Dortmund (2007), Agenda 21

	Entwicklungsbericht Dorstfeld/ Development Report Dorstfeld (2014), nordwärts / going North (project, 2015-2025)	concentric green space concept (1998), Umweltplan/ Environmental plan (2004)	2020 (2011), Lärmaktionsplan Dortmund / Action Plan Noise (2015)	
Torino	Complex urban programs/ Programmi Urbani complessi (1990-2015): Urban Regeneration Programme/Programma di rigenerazione urbana PRU/PRIU (1996/1998)- Special Project for suburbs/ Progetto Speciale Periferie (1999), Metropolitan Turin 2025 /Torino Metropoli 2025 (2015), Municipal General Master Plan/ Piano Regolatore Generale PRGC (1995- under revision), Metroplitan Strategic Plan/ Piano strategico metropolitano 2018-2020 (2017), Actions for suburbs/Azioni per le periferie torinesi AxTO (2017)	Turin City of water/ Torino Città d'Acque (1995), Unesco Man and Biosphere Programme -Piano gestione MAB Po Collina (2016)	Sustainable Urban Mobility Plan/ Piano urbano della mobilità sostenibile – PUMS (2010), Sustainable Energy Action Plan/ Piano d'Azione per l'Energia Sostenibile PAES (2010), Smart Mobility, Inclusion, Life&Health, Energy Master Plan /Torino S.M.I.L.E. (2013), Cycle plan/ Piano della Mobilità ciclabile - BICIPLAN (2013), Turin City to Cultivate/ Torino Città da Coltivare T.O.C.C. (2013)	Turin Smart School (2012), Regulation on urban common goods/Regolamento sui beni comuni urbani (2016), City Plan 2018-2021/ Documento unico di programmazione 2018-2021 (2017)
Zagreb	Master Plan City of Zagreb (2015), Master Plan Sesvete (2015). Among these plans, several studies were conducted: Green and Blue Sesvete (2016), Landscape study Sesvete, Archaeological sites in a tourist offer Sesvete,	Green and Blue Sesvete (2016), Bicycle lane from Sesvete to Vugrovec (5 km, 2016.)	Sustainable Energy Action Plan Zagreb - SEAP (2010) Among this plan: Green and Blue Sesvete (2016).	Law on the Right of Access to Information (2015).

1.2 FOLLOWER CITIES

1. Policies at the regional level

Follower city	Urban development	Green infrastructure	Regeneration of post-industrial sites
Zenica	Spatial plan of special characterics for Federation of Bosnia and Herzegovina "Corridor 5C Highway"	-	-
Cascais	PROT-OVT: Plano Regional de Ordenamento do Território do Oeste e Vale do Tejo (The West and Tagus Valley Regional Land Use Plan), PROT-AML: Plano Regional de Ordenamento do Território da Área Metropolitana de Lisboa (Lisbon's Metropolitan Area Regional Land Use Plan - year of adoption: 2002)	Plano Setorial da Rede Natura 2000 (Natura 2000 Network Sectorial Plan - year of adoption: 2008), POPNSC: Plano de Ordenamento do Parque Natural Sintra-Cascais (The Sintra-Cascais' Park Land Use Plan)	-
Piraeus	Urban planning document at Ministry of Environment	Green areas at the Municipality	Renewal postindustrial documents
Cluj-Napoca	Integrated Strategic Plan for Cluj-Napoca Metropolitan Area (2017), Sustainable Urban Mobility Plan (2017)	-	-

2. Policies at the local level

Follower city	Urban development/Urban regeneration	Green infrastructure	Environment management & sustainable development	Participation or social inclusion
Zenica	Spatial plan of the City of Zenica for period 2016-2036, adopted in 2017, General Urban plan for the City of Zenica , adopted 1985, Regulation plans (8) for certain parts of the city - implementation phase 2018 and 2019 - to be adopted,	-doesn't have any The Regulation plans for certain areas include conservation plans/landscape plans in needed. All those plans are integrated into Regulation plans for specific area of the city.	SEAP - for period from 2011 to 2020 They are in process of creating SECAP document which is to be done this year.	Each plan before being adopted by the city council must pass the phase of public hearing. It is a part of procedure for plan adoption. Public is included.

	Integrated Local Economic Development Strategy for 2012-2022			
Cascais	PDM: Plano Diretor Municipal (Municipal Master Plan - year of adoption: 2015), PEDU: Plano Estratégico de Desenvolvimento Urbano (Urban Development Strategic Plan)	Plano de Ação da Estrutura Ecológica Municipal (Municipal Ecological Structure Action Plan - year of adoption: 2015), PAAACC: Plano de Ação para Adaptação às Alterações Climáticas de Cascais (The Cascais' Climate Change Adaptation Action Plan - year of adoption: 2017)	PAAACC: Plano de Ação para Adaptação às Alterações Climáticas de Cascais (The Cascais' Climate Change Adaptation Action Plan - year of adoption: 2017), POPNSC: Plano de Ordenamento do Parque Natural Sintra-Cascais (The Sintra-Cascais' Park Land Use Plan), Estratégia Terras de Cascais ("Terras de Cascais" Strategy - year of adoption: 2017), Matriz Energética de Cascais (Cascais' Energy Matrix 2015)	Orçamento Participativo (Participatory Budget - year of adoption: 2011), Rede Social (Social Action Network)
Piraeus	Masterplan, Greenway planning, Develop green strategy, Organise Green Urban plan	Ecological network plan, biodiversity strategy, green infrastucture strategy	Sustainable energy and climate actions, climate change adaption plan, air quality pan, urban agricultural plan, sustainable mobility plan	environmental strategy, public participation, biodiversity strategy
Cluj-Napoca	General Urban Plan (2015), Neighborhood Regeneration Plans (2018), Sustainable Energy Action Plan (2011)	Somes River Masterplan (2018)	Sustainable Energy Action Plan (2011), Sustainable Urban Mobility Plan (2017)	Public participation initiatives

1.3 RECENT STUDIES AT LL / REGENERATION AREA SCALE

FRONT RUNNER CITIES

- **Dortmund** - Grünzug Emscher Nordwärts / green corridor Emscher North (current planning process), Stadtumbaugebiet Huckarde/ urban restructuring area Huckarde (current process), Internationale Gartenausstellung Metropole Ruhr 2027/ International Garden Exhibition Metropolis Ruhr 2027 (current process)
- **Torino** – Living Lab Campidoglio Evaluation document (Politecnico of Torino), Bachelor thesis on Turin Living Lab (University of Torino)
- **Zagreb** - Urban regeneration projects: Gredelj, Blok Badel, Zagreb Fair

FOLLOWER CITIES

- **Zenica -** They do not have regulations or laws to support such actions. For example, it is still impossible to register electrical car in Bosnia and Herzegovina due to lack of supporting legislation. The country in not in EU and they must obey existing regulations and laws.
- **Cascais** - PAAACC: Plano de Ação para Adaptação às Alterações Climáticas de Cascais (The Cascais' Climate Change Adaptation Action Plan - year of adoption: 2017), Estratégia Terras de Cascais ("Terras de Cascais" Strategy - year of adoption: 2017)
- **Piraeus** - They are planning to have a policy in place for managing green infrastructure based on innovative approaches.
  Projects that are currently implemented in Piraeus:

  1- Transformation of the Saint Dionysus area, previously used for industry purposes, into a bicycle lane, low traffic roads and greened walking routes.

  2-.Transformation of the Mikrolimano area (part of the Piraeus shore), including the demolition of unauthorized constructions, rearrangement of road traffic and restoration of the view over the sea

- **Cluj-Napoca -** There isn't a strategy for managing GI. The plan is to prepare one and include it in the GUP.

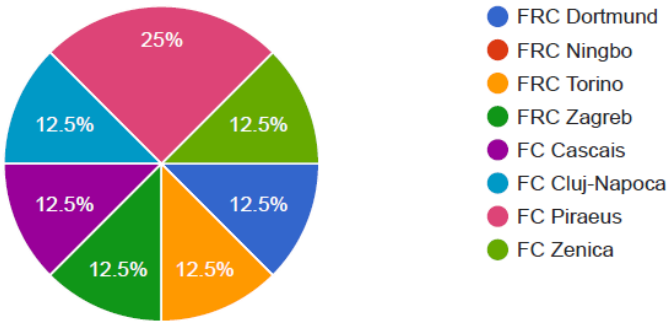
Annex 2 – Scoping Survey on available data

proGIreg T2.1: Scoping survey on available data

8 responses

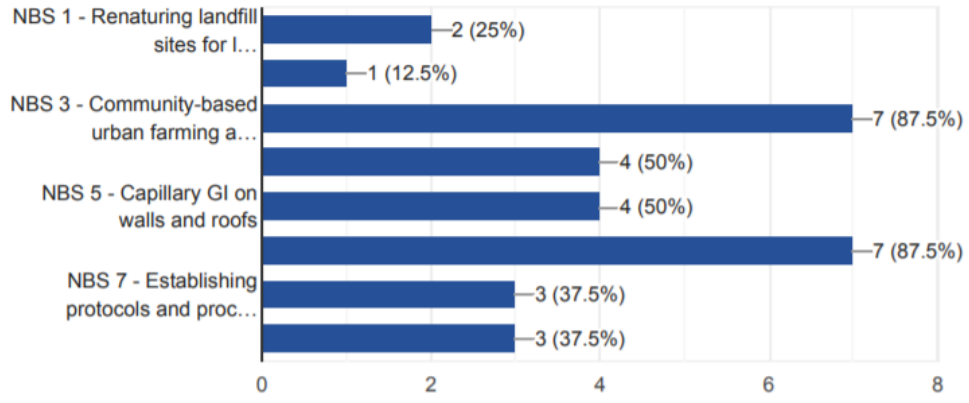
1. Responding organisation

8 responses



2. Which NBS are you focusing on in proGIreg?

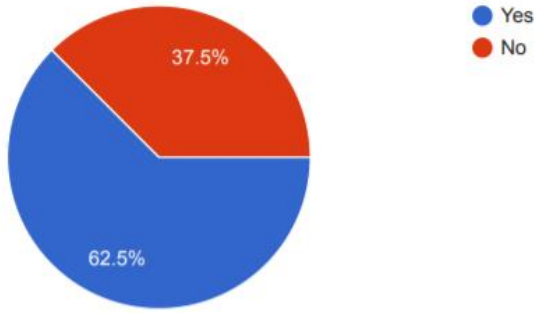
8 responses



B. GIS data

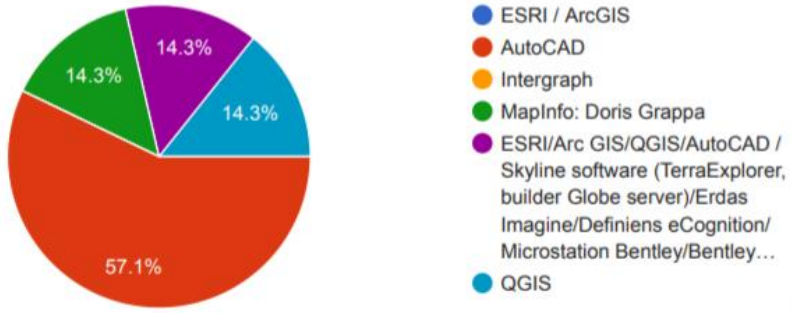
B.1. Does your organisation currently use GIS?

8 responses



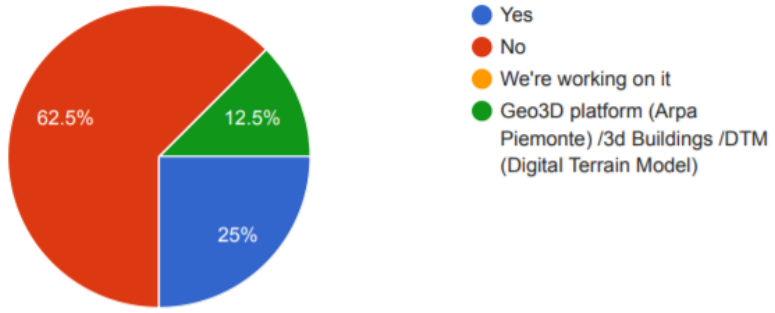
B.2. If so, what software do you use?

7 responses



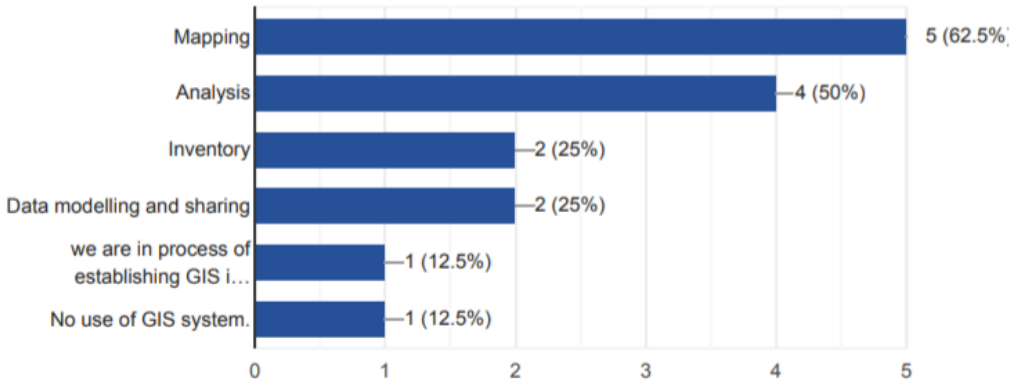
B.3. Does your municipality have a 3d city model (eg. using CityGML) integrating GIS, CAD and BIM data?

8 responses



B.4. What are the main activities you use the GIS system for?

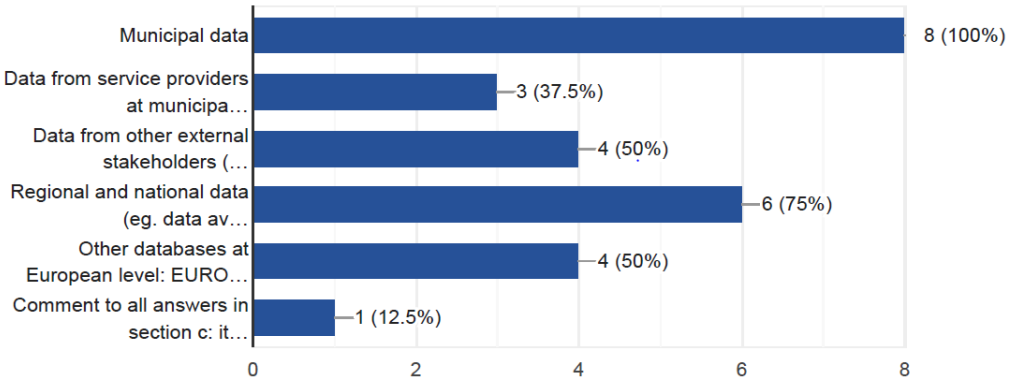
8 responses



C. Spatial analysis: available data

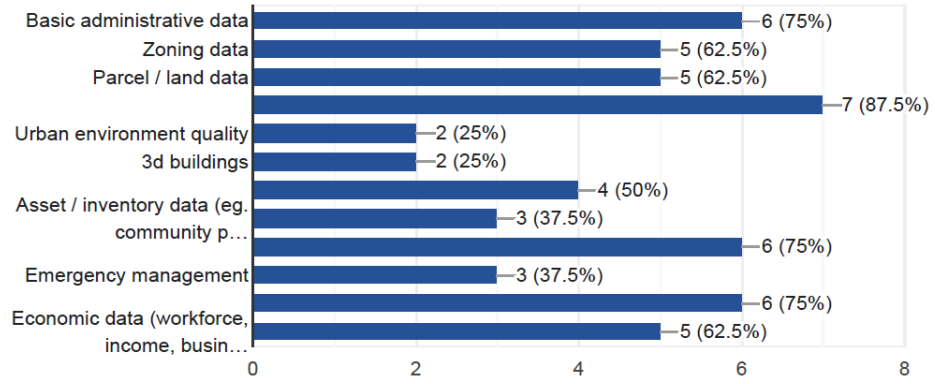
C.1. What data sources can you get access to for use in the spatial analysis of WP2?

8 responses



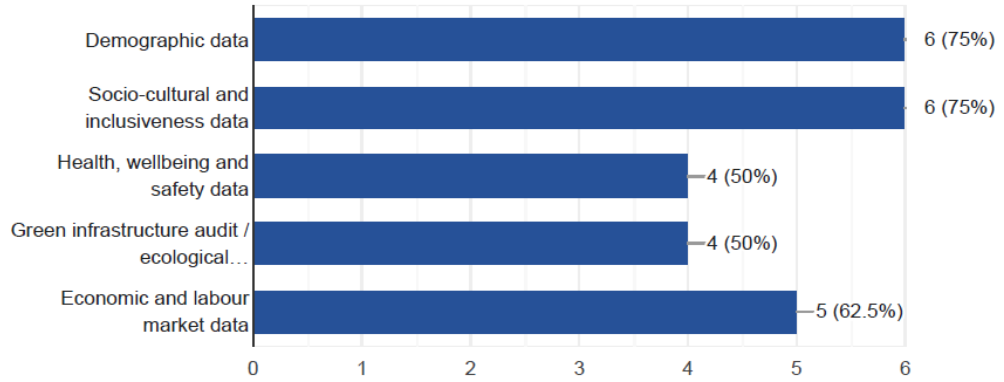
C.2. Which datasets do you currently have at municipal / metropolitan level?

8 responses



C.3. Do you have micro-data (at sub-community / Living Lab level) for the following categories?

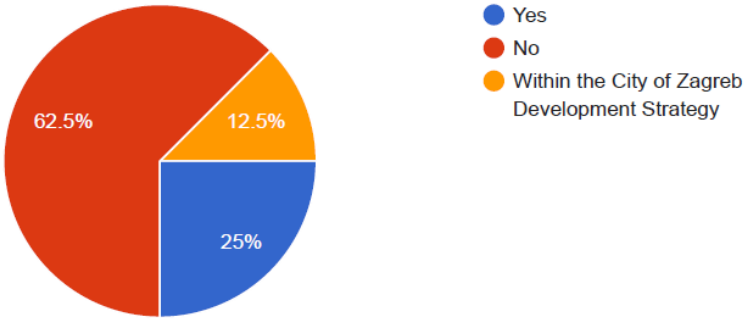
8 responses



D. In closure

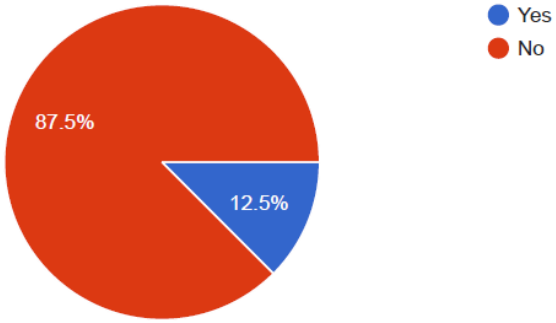
D.1. Do you use a standard set of indicators at local level for monitoring implementation of urban projects?

8 responses



D.2. Does your city use a key performance indicator (KPI) set to assess the quality of its green infrastructure?

8 responses



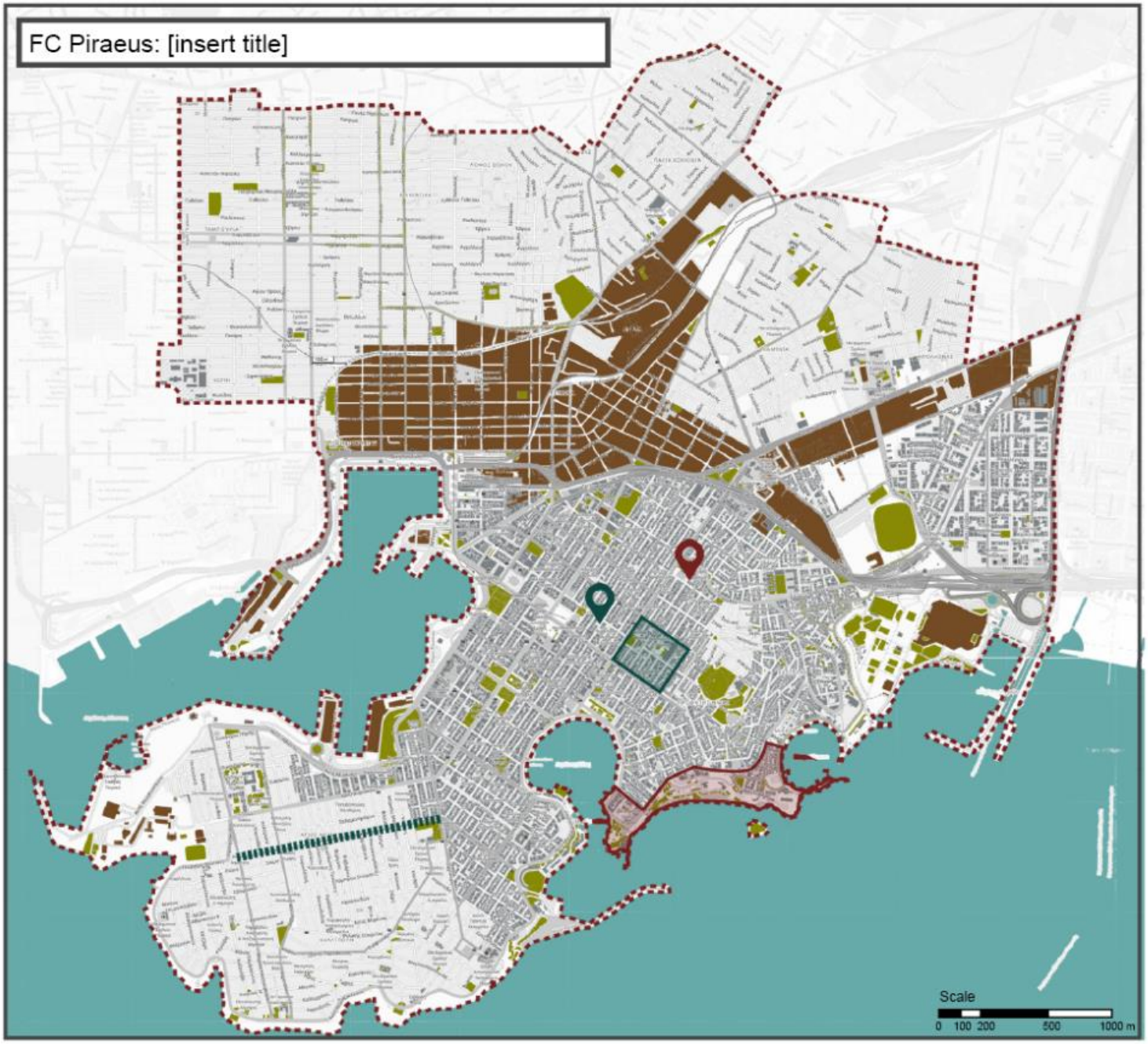
D.3. If yes: What kind of data do you collect for that?

2 responses

no

Distance from green areas - ecosystem services

Annex 3 – Reference model for Spatial SWOT Map



Annex 4 – Additional reference data collection tables

PROGIREG FRC AND FC IDENTIFICATION FICHE			
Localization of City / Living Lab	Region / NUTS 2*		
	Province / NUTS 3*		
	Coordinates		
Information about the city / metropolitan area	Population		
	Surface Area (km²)		
	Density		
	Average elevation (m)		
	Climate		
	Average temperature in winter	Avg. High °C	
		Avg. Low °C	
	Average temperature in summer	Avg. High °C	
		Avg. Low °C	
Information about the LL Analysis area (FRC) / regeneration areas (FC)	Population		
	Surface Area (km²)		
	Density		
Contact and information from the municipality	Municipal website		
	Contact e-mail address of municipal offices		
	Data sources		
Description of context	Specific objective(s) for proGIreg implementation		
	Past interventions		
	Planned interventions		
City plan (map)			
LL / regeneration area(s) maps, delineated			

Annex 5 – Complete list of spatial data requested to FRC and FC

REF. DOMAIN	SUBDOMAIN	SPATIAL DATASET	DESCRIPTION	SPATIAL SCALE	ID	UNIT	VALUE YEAR (2008 - 2017)	SOURCE / NOTE
Socio-cultural inclusiveness	**1.1 Demographics**	**1.1.1 Total population**	Total number of persons living in the specific area. Indicator should be collected for both the city/MA scale and the LL/regeneration area district scale.	**CITY**	**1.1.1.a**	persons		
				LL / RA scale	**1.1.1.b**	persons		
		1.1.2 Population density	Number of persons per square km of land area. Indicator should be collected for both the city/MA scale and the LL/regeneration area district scale.	**CITY**	**1.1.2.a**	persons/ sqkm		
				LL / RA scale	**1.1.2.b**	persons/ sqkm		
		1.1.3 Population growth rate	Average annual rate of change of population size (%). Indicator should be collected for both the city/MA scale and the LL/regeneration area district scale.	**CITY**	**1.1.3.a**	%		
				LL / RA scale	**1.1.3.b**	%		
		1.1.4 Migration rate	Net number of migrants (immigrants – emigrants) per 1,000 population. Indicator should be collected for both the city/MA scale and the LL/regeneration area district scale.	**CITY**	**1.1.4.a**	%		
				LL / RA scale	**1.1.4.b**	%		
	1.2 Social and cultural inclusiveness	**1.2.1 Material deprivation rate**	Material deprivation rates gauge the proportion of people whose living conditions are severely affected by a lack of resources	**CITY**	**1.2.1.a**	%		
				LL / RA scale	**1.2.1.b**	%		
		1.2.2 Work intensity	% employed out of total economically active population (15-64 years of age)	**CITY**	**1.2.2.a**	%		
				LL / RA scale	**1.2.2.b**	%		
		1.2.3 Diversity statistics	% foreign born residents (if available, for both scales, or)	**CITY**	**1.2.3 a**	%		
				LL / RA scale	**1.2.3 b**	%		
		1.2.3 Diversity statistics	Population by ethnicity	**CITY**	**1.2.3 c**	%		
				LL / RA scale	**1.2.3 d**	%		
	1.3 Education and access to social and cultural services and amenities	**1.3.1 Educational attainment**	Average level of education completed by the 20-64 year-old population (% per level)	**CITY**	**1.3.1.a**	%		
				LL / RA scale	**1.3.1.b**	%		
		1.3.2 Recreational or cultural facilities	Relevant for LL/regeneration level: no. and identification of recreational and / or cultural facilities	**CITY**	**1.3.2.a**	number		
				LL / RA scale	**1.3.2.b**	number		

REF. DOMAIN	SUBDOMAIN	SPATIAL DATASET	DESCRIPTION	SPATIAL SCALE	ID	UNIT	VALUE YEAR (2008 - 2017)	SOURCE / NOTE
		1.3.3 Accessibility of public urban green spaces	% population having access to green space within a 30 minutes walking distance or within 30 minutes travel time by public transportation.	**CITY**	**1.3.3.a**	%		
				LL / RA scale	**1.3.3.b**	%		
	1.4 Housing	**1.4.1 Housing quality**	Average useful floor area per person, calculated in sqm	**CITY**	**1.4.1 a**	sqm/person		
				LL / RA scale	**1.4.1 b**	sqm/person		
		1.4.2 Public housing	Percentage of residents in public housing	**CITY**	**1.4.2 b**	%		
				LL / RA scale	**1.4.2 b**	%		
		1.4.3 Housing affordability	Homeownership rate	**CITY**	**1.4.3 b**	%		
				LL / RA scale	**1.4.3 b**	%		
		1.4.4 Density of the built environment	Building Coverage Ratio, or if unavailable, Floor Area Ratio (Total residential floor area divided by total residential area surface)	**CITY**	**1.4.4 a**	number		
				LL / RA scale	**1.4.4 b**	number		
2. Human health and well-being	**2.1 Health**	**2.1.1 Incidence of cardio and respiratory diseases**	Rate of new (or newly diagnosed) cases of the disease per 1,000 persons	**CITY**	**2.1.1.a**	number and %		
				LL / RA scale	**2.1.1.b**	number and %		
		2.1.2 Incidence of allergic disease	Rate of new (or newly diagnosed) cases of the disease per 1,000 persons	**CITY**	**2.1.2.a**	number and %		
				LL / RA scale	**2.1.2.b**	number and %		
		2.1.3 Incidence of chronic stress, stress-related diseases, mental health diseases and NCDs	Rate of new (or newly diagnosed) cases of the disease per 1,000 persons	**CITY**	**2.1.3a**	number and %		
				LL / RA scale	**2.1.3.b**	number and %		
		2.1.4 Obesity rate	*Possibly available by region / in specific studies (or possibly at school level)	**CITY**	**2.1.4.a**	%		
				LL / RA scale	**2.1.4.b**	%		
		2.1.5 Life expectancy at birth	Average life expectancy (possibly available at higher levels / regional level)	**CITY**	**2.1.5.a**	years		
				LL / RA scale	**2.1.5.b**	years		
	2.2 Wellbeing		Sqm of green space / person	**CITY**	**2.2.1.a**	sqm / person		

REF. DOMAIN	SUBDOMAIN	SPATIAL DATASET	DESCRIPTION	SPATIAL SCALE	ID	UNIT	VALUE YEAR (2008 - 2017)	SOURCE / NOTE
		2.2.1 Green space per capita		**LL / RA scale**	**2.2.1.b**	sqm / person		
		2.2.2 Urban safety – crime	Yearly number of reported crimes per 1,000 persons	**CITY**	**2.2.2.a**	‰		
				LL / RA scale	**2.2.2.b**	‰		
		2.2.3 Urban safety – accidents	Yearly number of reported road accidents involving pedestrians and / or bicyclists	**CITY**	**2.2.3.a**	‰		
				LL / RA scale	**2.2.3.b**	‰		
3. Ecological and environmental restoration	**3.1 Land use and Vegetation**	**3.1.1 % of green spaces**	% of total surface which is destined for green spaces	**CITY**	**3.1.1.a**	%		
				LL / RA scale	**3.1.1.a**	%		
		3.1.2 structure of green spaces	% of tree covered areas	**CITY**	**3.1.2.a**	%		
				LL / RA scale	**3.1.2.b**	%		
		3.1.3 structure of green spaces	% of shrub covered areas	**CITY**	**3.1.3.a**	%		
				LL / RA scale	**3.1.3.b**	%		
		3.1.4 structure of green spaces	% of meadow covered areas	**CITY**	**3.1.4.a**	%		
				LL / RA scale	**3.1.4.b**	%		
		3.1.5 % Surface of brownfields	Total surface which is destined for brownfield areas	**CITY**	**3.1.5.a**	ha		
				LL / RA scale	**3.1.5.b**	ha		
		3.1.6 % Surface of polluted brownfield areas	% of polluted brownfield areas	**CITY**	**3.1.6.a**	%		
				LL / RA scale	**3.1.6.b**	%		
		3.1.7 Canopy cover	the proportion of the forest covered by the vertical projection of the tree crowns	**CITY**	**3.1.7.a**	%		
				LL / RA scale	**3.1.7.b**	%		
		3.1.8 Leaf Area Index	Leaf area index is defined as the projected area of leaves over a unit of land (m2 m−2), so one unit of LAI is equivalent to 10,000 m2 of leaf area per hectare. This index takes into account the leaf stratification within the canopy.	**CITY**	**3.1.8.a**	m2 / ha		
				LL / RA scale	**3.1.8.b**	m2 / ha		
		3.1.9 NDVI	Normalized Difference Vegetation Index	**CITY**	**3.1.9.a**	number		

REF. DOMAIN	SUBDOMAIN	SPATIAL DATASET	DESCRIPTION	SPATIAL SCALE	ID	UNIT	VALUE YEAR (2008 - 2017)	SOURCE / NOTE
				LL / RA scale	**3.1.9.b**	number		
	3.2 Climate / Meteorological data	**3.2.1 Precipitation**	Average annual precipitation (mm)	**CITY**	**3.2.1.a**	number		
				LL / RA scale	**3.2.1.b**	number		
		3.2.2 Relative humidity	Relative humidity	**CITY**	**3.2.2.a**	number		
				LL / RA scale	**3.2.2.b**	number		
		3.2.3 Air temperature	Annual mean temperature (°C)	**CITY**	**3.2.3.a**	number		
				LL / RA scale	**3.2.3.b**	number		
		3.2.3 Air temperature	Winter mean temperature (°C)	**CITY**	**3.2.3.c**	number		
				LL / RA scale	**3.2.3.d**	number		
		3.2.3 Air temperature	Spring mean temperature (°C)	**CITY**	**3.2.3.e**	number		
				LL / RA scale	**3.2.3.f**	number		
		3.2.3 Air temperature	Summer mean temperature (°C)	**CITY**	**3.2.3.g**	number		
				LL / RA scale	**3.2.3.h**	number		
		3.2.3 Air temperature	Fall mean temperature (°)	**CITY**	**3.2.3.i**	number		
				LL / RA scale	**3.2.3.j**	number		
		3.2.4 Wind strength	Wind intensity	**CITY**	**3.2.4.a**	(km/h)		
				LL / RA scale	**3.2.4.b**	(km/h)		
		3.2.5 Wind direction	Main wind direction	**CITY**	**3.2.5.a**	direction		
				LL / RA scale	**3.2.5.b**	direction		
	3.3 Air Quality	**3.3.1 Ozone concentration**	µg/m3 / ppb	**CITY**	**3.3.1.a**	µg/m3 / ppb		
				LL / RA scale	**3.3.1.b**	µg/m3 / ppb		
		3.3.2 NOx concentration	µg/m3 / ppb	**CITY**	**3.3.2.a**	µg/m3 / ppb		
				LL / RA scale	**3.3.2.b**	µg/m3 / ppb		

REF. DOMAIN	SUBDOMAIN	SPATIAL DATASET	DESCRIPTION	SPATIAL SCALE	ID	UNIT	VALUE YEAR (2008 - 2017)	SOURCE / NOTE
		3.3.3 PM 2.5 concentration	µg/m3 / ppb	**CITY**	**3.3.3.a**	µg/m3 / ppb		
				LL / RA scale	**3.3.3.b**	µg/m3 / ppb		
		3.3.4 PM10 concentration	µg/m3 / ppb	**CITY**	**3.3.4.a**	µg/m3 / ppb		
				LL / RA scale	**3.3.4.b**	µg/m3 / ppb		
		3.3.5 VOC Concentration	µg/m3 / ppb	**CITY**	**3.3.5.a**	µg/m3 / ppb		
				LL / RA scale	**3.3.5.b**	µg/m3 / ppb		
		3.3.6 GHG inventory	Inventory of greenhouse gases (GHG) emission at city level and LL level	**CITY**	**3.3.6.a**	tCO2e		
				LL / RA scale	**3.3.6.b**	tCO2e		
	3.4 Soil	**3.4.1 Soil quality**	Concentration of C	**CITY**	**3.4.1.a**			
				LL / RA scale	**3.4.1.b**			
		3.4.1 Soil quality	Concentration of N	**CITY**	**3.4.1.c**			
				LL / RA scale	**3.4.1.d**			
		3.4.1 Soil quality	bulk density	**CITY**	**3.4.1.e**			
				LL / RA scale	**3.4.1.f**			
		3.4.1 Soil quality	permeability	**CITY**	**3.4.1.g**			
				LL / RA scale	**3.4.1.h**			
		3.4.1 Soil quality	water retention capability	**CITY**	**3.4.1.i**			
				LL / RA scale	**3.4.1.j**			
	3.5 Water	**3.5.1 Water quality**	- Free O	**CITY**	**3.5.1 a**			
				LL / RA scale	**3.5.1 b**			
		3.5.1 Water quality	- Nutrients	**CITY**	**3.5.1 c**			
				LL / RA scale	**3.5.1 d**			
			- pH	**CITY**	**3.5.1 e**			

REF. DOMAIN	SUBDOMAIN	SPATIAL DATASET	DESCRIPTION	SPATIAL SCALE	ID	UNIT	VALUE YEAR (2008 - 2017)	SOURCE / NOTE
		3.5.1 Water quality		**LL / RA scale**	**3.5.1 f**			
		3.5.1 Water quality	- eutrophication level	**CITY**	**3.5.1 g**			
				LL / RA scale	**3.5.1 h**			
		3.5.1 Water quality	- hydrocarbons	**CITY**	**3.5.1 i**			
				LL / RA scale	**3.5.1 j**			
		3.5.1 Water quality	- other pollutants	**CITY**	**3.5.1 k**			
				LL / RA scale	**3.5.1 l**			
	3.6 Urban environment	**3.6.1 Heat island effect**	Difference (*C) between urban and rural surface temperatures	**CITY**	**3.6.1 a**			
				LL / RA scale	**3.6.1 a**			
	4.1 Market labour and economy indicators	**4.1.1 GDP per capita**	GDP (PPP), Euro	**CITY**	**4.1.1.a**	Euro		
				LL / RA scale	**4.1.1.b**	Euro		
		4.1.2 Businesses in the area - Industrial	Amount of Industrial companies per 1,000 inhabitants	**CITY**	**4.1.2.a**	fraction		
				LL / RA scale	**4.1.2.b**	fraction		
		4.1.3 Businesses in the area - Commercial	Amount of commercial companies per 1,000 inhabitants	**CITY**	**4.1.3.a**	fraction		
				LL / RA scale	**4.1.3.b**	fraction		
		4.1.4 Businesses in the area - Offices	Total amount of offices companies per 1,000 inhabitants	**CITY**	**4.1.4.a**	fraction		
				LL / RA scale	**4.1.4.b**	number		
		4.1.5 Public jobs	- Total number of jobs in public sector	**CITY**	**4.1.5.a**	number		
				LL / RA scale	**4.1.5.b**	number		
		4.1.6 Private jobs	- Total number of jobs in private sector	**CITY**	**4.1.6.a**	number		
				LL / RA scale	**4.1.6.b**	number		
		4.1.7 Public green jobs	- Total number of public green jobs	**CITY**	**4.1.7.a**	number		
				LL / RA scale	**4.1.7.b**	number		

REF. DOMAIN	SUBDOMAIN	SPATIAL DATASET	DESCRIPTION	SPATIAL SCALE	ID	UNIT	VALUE YEAR (2008 - 2017)	SOURCE / NOTE
		4.1.8 Private green jobs	- Total number of private green jobs	**CITY**	**4.1.8.a**	number		
				LL / RA scale	**4.1.8.b**	number		
		4.1.9 Qualified jobs	- Total number of qualified jobs	**CITY**	**4.1.9.a**	number		
				LL / RA scale	**4.1.9.b**	number		
		4.1.10 Non-qualified jobs	- Total number of non-qualified jobs	**CITY**	**4.1.10.a**	number		
				LL / RA scale	**4.1.10.b**	number		
		4.1.11 Turnover in the green sector	Green companies' turnover in EUR	**CITY**	**4.1.11.a**	Euro		
				LL / RA scale	**4.1.11.b**	Euro		
	4.2 Gentrification indicators	**4.2.1 Employment rate**	the proportion of employed adults in the working age (20-64 years)	**CITY**	**4.2.1.a**	%		
				LL / RA scale	**4.2.1.b**	%		
		4.2.2 Unemployment rate	the proportion of unemployed adults in the working age (20-64 years)	**CITY**	**4.2.2.a**	%		
				LL / District Sesvete	**4.2.2.b**	%		
		4.2.3 Revenues by household	Average household disposable income	**CITY**	**4.2.3.a**	Euro/gross/montly		
				LL / RA scale	**4.2.3.b**	Euro/gross/montly		
		4.2.4a Current property sale value for residential use	Property value, average, EUR/sqm, for single- and collective housing, sale price	**CITY**	**4.2.4a.a**	Euro/sqm		
				LL / RA scale	**4.2.4a.b**	Euro/sqm		
		4.2.4b Current property rental value for residential use	Property value, average, EUR/sqm, for single- and collective housing, renting (monthly)	**CITY**	**4.2.4b.a**	Euro/sqm		
				LL / RA scale	**4.2.4b.b**	Euro/sqm		
		4.2.5a Current property value for commercial/ industrial/ office use	Property value, average, EUR/sqm, sale price	**CITY**	**4.2.5a.a**	Euro/sqm		
				LL / RA scale	**4.2.5a.b**	Euro/sqm		
		4.2.5b Current property rental value for commercial/	Property value, average, EUR/sqm, renting (monthly)	**CITY**	**4.2.5b.a**	Euro/sqm		
				LL / RA scale	**4.2.5b.b**	Euro/sqm		

REF. DOMAIN	SUBDOMAIN	SPATIAL DATASET	DESCRIPTION	SPATIAL SCALE	ID	UNIT	VALUE YEAR (2008 - 2017)	SOURCE / NOTE
		industrial/ office use						
		4.2.6 Free services	Total number of free services (parks, librairies, cycle trials, skate parks…)	**CITY**	**4.2.6.a**	number		
				LL / RA scale	**4.2.6.b**	number		
		4.2.7 Basic utilities	Monthly cost of basic utilities (Electricity, water, Garbage…)	**CITY**	**4.2.7.a**	Euro		
				LL / RA scale	**4.2.7.b**	Euro		
	4.3 Tourism and attractiveness indicators	**4.3.1 Current number of tourists**	Measured as average number of overnight stays in tourism accommodations	**CITY**	**4.3.1.a**	number		
				LL / RA scale	**4.3.1.b**	number		
		4.3.2 Number of temporary events	Trade Fairs, Congresses, Symposiums, Concerts, Parades before NBS application (in number)	**CITY**	**4.3.2.a**	number		
				LL / RA scale	**4.3.2.b**	number		
		4.3.3 No. of foreign students	% of foreign students out of total enrolled higher education students	**CITY**	**4.3.3.a**	number		
				LL / RA scale	**4.3.3.b**	number		
		4.3.4 Local expenses	Expenses in local retail businesses	**CITY**	**4.3.4.a**	Euro		
				LL / RA scale	**4.3.4.b**	Euro		
	4.4 Taxes, Investment & Financing	**4.4.1 Local taxes**	Average local taxes per capita	**CITY**	**4.4.1.a**	Euro		
				LL / RA scale	**4.4.1.b**	Euro		
		4.4.2 Green investment programs/funds	Public investment programs, and investment funds	**CITY**	**4.4.2.a**	MEuro		
				LL / RA scale	**4.4.2.b**	MEuro		