ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

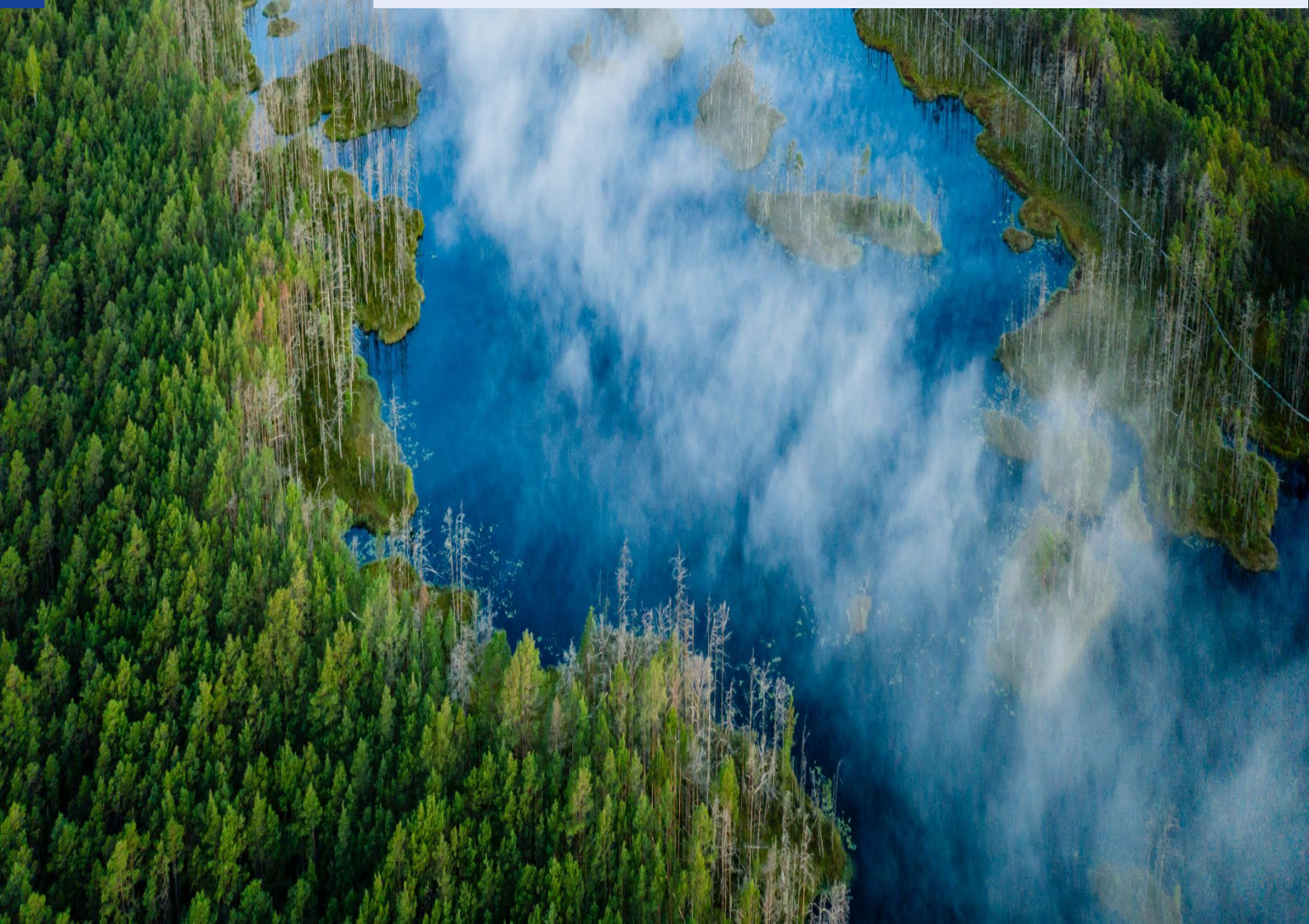
Inspire Policy Making with Territorial Evidence

FINAL REPORT//

Policy recommendations for embedding the concept of Green Infrastructure into legislation and formal planning processes in Latvia

ESPON GRETA Spin-off in Latvia

Final Report // June 2022



This FINAL REPORT is produced within the framework of the ESPON 2020 Cooperation Programme, partly financed by the European Regional Development Fund.

The ESPON EGTC is the Single Beneficiary of the ESPON 2020 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States, the United Kingdom and the Partner States, Iceland, Liechtenstein, Norway and Switzerland.

This delivery does not necessarily reflect the opinions of members of the ESPON 2020 Monitoring Committee.

Coordination:
Efren Feliu, Gemma Garcia Blanco, TECNALIA Research & Innovation (Spain)

Authors
Gemma García, Carolina Cantergini, TECNALIA Research & Innovation (Spain)
Karl Ruf, Mirko Gregor; Stefan Kleeschulte, space4environment (Luxembourg)

Advisory group
ESPON EGTC: Zintis Hermansons (project expert), Angela Emidio (financial expert)

Acknowledgements
Anita Līvija Rozenvalde, Mārtiņš Grels, Ingūna Draudiņa, Spatial planning and Land Management Department, Spatial Planning Policy Unit Ministry of Environmental Protection and Regional Development (Latvia)
Līga Bērziņa, Valmiera Municipality (Latvia)

Information on ESPON and its projects can be found at www.espon.eu.
The website provides the possibility to download and examine the most recent documents produced by finalised and ongoing ESPON projects.

ISBN: 978-2-919816-58-3

Layout and graphic design by BGRAPHIC, Denmark

Contact: info@espon.eu

ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

FINAL REPORT //

Policy recommendations for embedding the concept of Green Infrastructure into legislation and formal planning processes in Latvia

ESPON GRETA Spin-off in Latvia

Final Report // June 2022

Table of contents

Abbreviations 6

Glossary of Terms 7

1 Introduction 10

2 Overview of the methodological approach 11

3 Policy and planning context in Latvia 12

4 Policy considerations based on GRETA Spin-off findings 16

5 Simplified Green Infrastructure Strategic Planning Framework 20

5.1 Usability of the Simplified Strategy Planning Framework 22

5.2 Scale matters 23

6 Policy recommendations 24

6.1 General principles 25

6.2 Data and information services on Green Infrastructure attributes and benefits 26

6.3 Vision, common standards, and benchmarks 29

6.4 Supporting tools for planners 30

6.5 Enabling mechanisms 36

7 Opportunities, enablers, and constraints for embedding GI concept and approach in spatial planning 44

8 Online- workshop briefing 45

9 References 50

List of maps, figures, charts and tables

Figures

Figure 1 Methodological approach for in-depth characterization of Green Infrastructure in Latvia. Source: authors own elaboration. 10

Figure 2 Methodological approach outlining policy guidelines and recommendations to support the GI concept in active policy making in Latvia. Source: authors own elaboration. 11

Figure 3 Simplified strategic planning framework for embedding GI into planning. Source: authors own elaboration. 21

Figure 4 Main benefits provided by green infrastructure at urban, peri-urban and rural scale with indication of relevance and degree to which benefits are context dependent. The size of the circle represents relevance, and the opacity denotes context dependency. Source: GRETA, 2019. 23

Figure 5 Distribution of the Policy Recommendations according to the four modules of the Simplified Strategic Planning Framework. Source: authors own elaboration. 24

Figure 6 Approach for the formulation of policy recommendations in GRETA Spin-off for Latvia. Source: authors own elaboration. 24

Figure 7 Suggested data and information services on Green Infrastructures assets and attributes. Source: authors own elaboration. 26

Figure 8 Ecosystem services account relaying on extent and condition. Source: MAES, 2018. 27

Figure 9. Integration of GI and ecosystem services in the formulation of territorial plans and programs. Source: authors own elaboration. 31

Figure 10 Nature-based Solutions in context. Source: IUCN, 2020. 40

Figure 11 The Societal Challenges Nature-based Solutions can address. Source: IUCN, 2020. 41

Figure 12 Summary of the prioritization exercise undertaken during the online policy workshop. 43

Figure 13 Screen shoot of the ice breaking exercise in MIRO that helped participants to get familiarized with the tool and also for getting to know each other. 45

Figure 14 Screenshot of exercise one results. 46

Figure 15 Screenshot of the results of the second exercise. 47

Figure 16 Zoom- into the results on discussion around recreation demand. 47

Figure 17 Zoom- into the results on discussion around climate change perspective. 48

Figure 18 Zoom- into the results on discussion around GI disruptions risks. 48

Figure 19 Screenshot of the results of the third interactive exercise on implementation enablers and barriers. 49

TABLES

Table 1 Relationship of territorial policies with the main ecosystem services. Adapted from Technical information on Green Infrastructure accompanying document COM (2013) 249 final. 37

Table 2 Examples of NBS: how they contribute to meeting defined challenges for cities by improving people's well-being and health. Source: Openness, 2015 42

Abbreviations

EbA	Ecosystem based Adaptation
EC	European Commission
EIA	Environmental Impact Assessments
ERDF	European Regional Development Fund
ES	Ecosystem Services
ESM	Ecosystem Services Mapping
ESPON	European Territorial Observatory Network
EU	European Union
GI	Green Infrastructure
GUA	Green Urban Areas
HNV	High Natural Value
JRC	Joint Research Centre
LU	Land Use
LC	Land Cover
MAES	Mapping and Assessment of Ecosystems and their Services
MS	Member State
N2K	Natura 2000 sites
NbS	Nature Based Solutions
NUTS	Nomenclature of Territorial Units for Statistics
PM	Physical Mapping
RecPot	Recreation Potential
SDG	Sustainable Development Goals
SEA	Strategic Environmental Assessments
UHI	Urban Heat Island

Glossary of Terms

Term	Description
Green Infrastructure (GI)	"strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings" (EC, 2013)
Potential GI	A network of natural and semi-natural areas that is related to the spatial patterns of ecosystem services supplied by existing ecosystems and their conditions, and not in terms of areas already bound by policy measures and secured by their obligations.
Strategically planned	GI planning aims to conserve, restore or create networks of green (and blue) areas in order to provide environmental, economic and/or social benefits for urban and rural societies (at several institutional levels). Simultaneous maximisation of all potential benefits from GI is however unlikely, thus trade-offs need to be strategically assessed. Therefore, GI networks are strategically planned in that decisions about conservation, protection, and restoration of ecosystems incorporate information on how potential geographical areas fit within a network to optimise its functioning and maximise its benefits, the connections, complementarities and contributions to different sectors. Integrating GI considerations into governance and planning processes allows all the relevant issues to be assessed and a considered comprehensive decision to be taken in order to secure as many benefits as possible. GI planning can make a significant contribution to regional development, climate change, disaster risk management, agriculture/forestry and the environment.
Network	GI relates to the identification and mapping of ecological networks. Two primary components of ecological networks are hubs and links. Hubs are areas of natural vegetation, other open space, or areas of known ecological value, and links are the corridors that connect the hubs to each other. A set of hubs connected by links constitutes a network that can be used to inform conservation and other related land-use decisions.
Natural and semi-natural areas	Physical features that contribute to GI are diverse, specific to each location or place, and scale dependent. Natural and semi-natural areas include elements such as: **Core areas:** e.g., local nature reserves, landscape protection areas, Natura 2000 sites. **Natural and semi-natural connectivity features*:*** pastures, woodland, forest (not including intensive plantations), ponds, bogs, rivers and floodplains, wetlands, lagoons, beaches, hedgerows, small woodlands, ponds, wildlife strips, and riparian river vegetation (this list is conceptual and not all features were

	considered in the framework of this work – refer to Section 3.1 for further details on the features used).
Other environmental features	Other environmental features include elements such as: **Green urban and peri-urban areas:** street trees and avenues, city forests/woodlands, high-quality green public spaces and business parks/premises, green roofs and vertical gardens, allotments and orchards, storm ponds and sustainable urban drainage systems, and city reserves including Natura 2000 sites (this list is conceptual and not all features were considered in the framework of this work – refer to Section 3.1 for further details on the features used).
Ecosystem Services (ES)	The direct and indirect contributions of ecosystems to human well-being. Contributions can be of economic, social, cultural and/or ecological value. For example, a forest ecosystem might provide wood for forestry and/or for renewable energy, provide a recreational service, be part of a cultural landscape, regulate the supply of air, water and minerals, support biodiversity in the form of landscape cohesion and maintain ecosystem processes.
Other physical features	Other physical features include elements such as: Artificial connectivity features: e.g., eco-ducts, green bridges, animal tunnels (e.g. for amphibians), fish passes, road verges, ecological powerline corridor management.
Landscape scale	There is no single accepted definition of 'landscape scale'; rather, it is a term commonly used to refer to action that covers a large spatial scale, usually addressing a range of ecosystem and land uses (Ahern and Cole, 2012). In the GRETA framework, landscape scale refers to the spatial analyses performed outside the Functional Urban Areas. In the context of GRETA, landscape scale is also used as a synonym of the rural setting.
Geographical area	An area of land that can be considered as a unit for the purposes of some geographical analyses.
Trade-offs	Trade-offs describe situations that involve losing one quality of something in return for gaining another. This happens when the use of one ecosystem service directly decreases the benefits supplied by another. Trade-off situations require choices or management decisions to be made.
Synergies	Synergies describe situations where the use of one ecosystem service directly increases the benefits supplied by another service (Turkelboom et al., 2015). These are win-win situations that involve the mutual improvement of both ecosystem services.
Bundles of ecosystem services	A bundle is a set of associated ecosystem services that are supplied by or demanded from a given ecosystem or area and which usually appear together repeatedly in time and/or space (modified from Raudsepp-Hearne et al., 2010).
Multifunctionality	Multifunctionality refers to intertwining or combining different functions and thus using limited space more effectively (Ahern

	2012). Multiple functions should offer benefits for humans, for instance, in relation to human health or social cohesion, and likewise secure intact ecological systems (Tzoulas et al., 2007; Lafortezza et al., 2013). The concept of multifunctionality in GI planning means that multiple ecological, social, and also economic functions shall be explicitly considered instead of being a product of chance.
Connectivity	Connectivity can be defined as the degree to which the landscape facilitates the movement or dispersal of species and other ecological flows among habitat areas. The lack or loss of connectivity reduces the capability of organisms to move and can interfere with pollination, seed dispersal, wildlife migration and breeding. In the context of GI, hostile lands would be land uses with a low or null presence of GI elements (e.g. intensive agriculture, built urban areas, transport or grey infrastructure etc.), which constitute main obstacles to the inter-linking of high quality 'green spaces' of natural/semi-natural lands (Estreguil et al., 2016)
Islands	Hub areas that due to their physical configuration in the landscape resemble islands like features for species and habitats.
Green Infrastructure condition	In the context of this report, Green Infrastructure condition refers to the overall abiotic and biotic quality of the ecosystems. The condition has an effect on the GI capacity to deliver ecosystem services. (Maes J, 2018).

1 Introduction

The main objective of this project is to undertake **in-depth analysis and characterisation of green infrastructure (GI) in Latvia** from a multiscale perspective, and to outline **policy recommendations** that could build the basis for comprehensively embedding the concept of **GI into legislation and formal planning processes**.

Operationally, the project is organised into two distinct phases (see Figure 2).

The first phase provided the initial mapping backbone for GI and Ecosystem Services (ES) in Latvia with focus on recreation and flood regulation. The development of this analysis in Latvia is aligned with the methodological approach developed in the ESPON GRETA 2019 project *"Green infrastructure: Enhancing biodiversity and ecosystem services for territorial development"*[1] which has been optimised to respond to Latvia reality, data available and specificities of this service contract.

The second phase constitutes the focus of this present report that aims at **providing tentative policy messages** and recommendations to **further support the GI concept in active policy making** towards the development of a strategic planning framework for GI in Latvia.

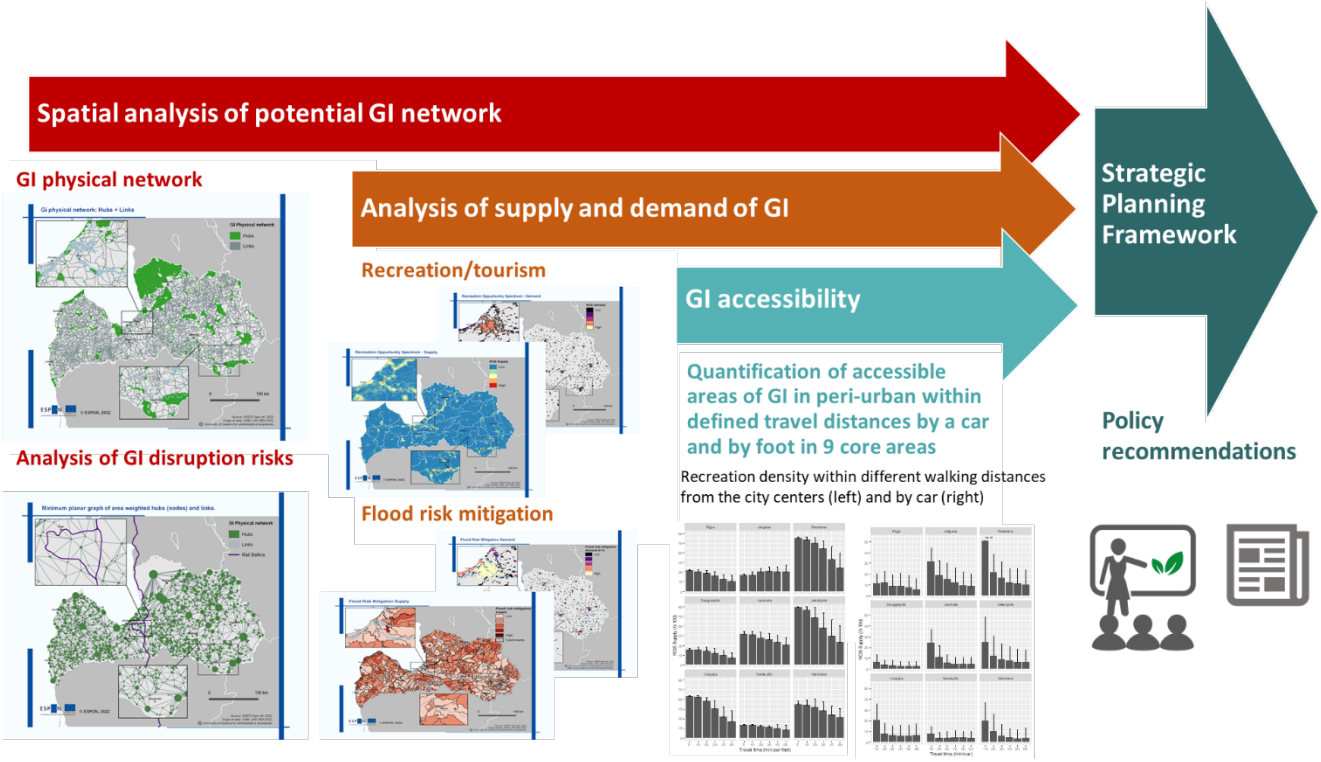


Figure 1 Methodological approach for in-depth characterisation of Green Infrastructure in Latvia. Source: authors own elaboration.

[1] See ESPON GRETA: https://www.espon.eu/green-infrastructure

2 Overview of the methodological approach

The methodology applied for outlining the policy guidelines and recommendations, is supported by (see **Figure 2**):

- **Desk-based research** for drafting strategic planning framework and preliminary policy messages.
- **Interaction with stakeholders** for the co-creation of final policy recommendations, and analysis of opportunities and mechanisms for embedding the concept of GI into legislation and formal planning processes.

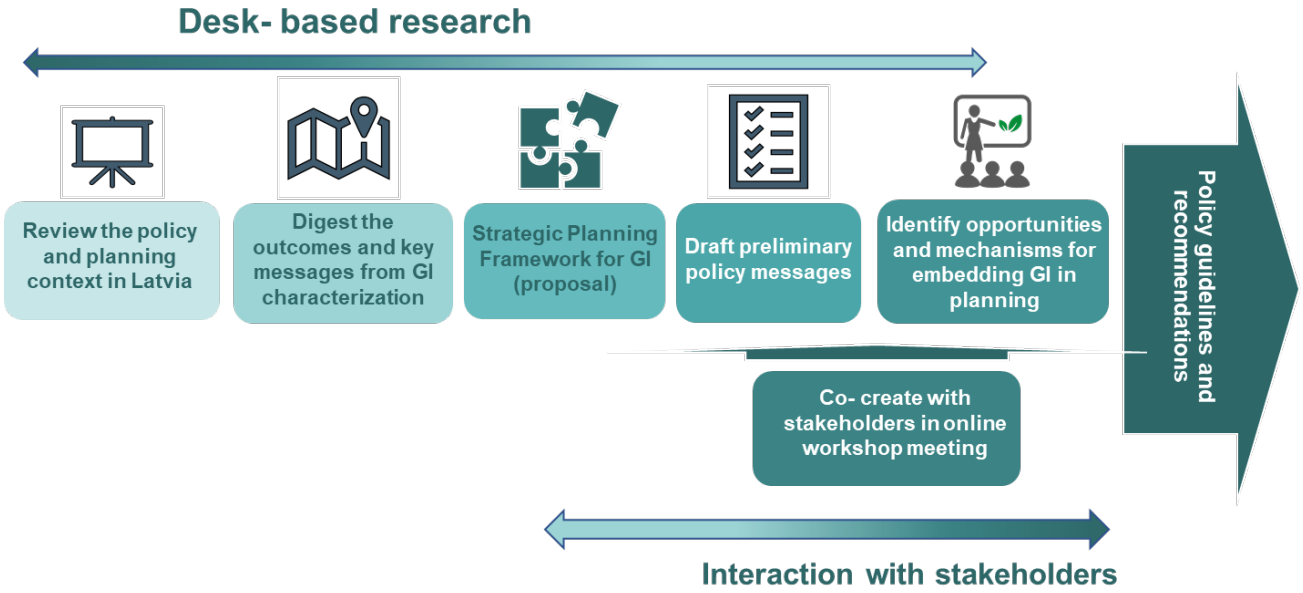


Figure 2 Methodological approach outlining policy guidelines and recommendations to support the GI concept in active policy making in Latvia. Source: authors own elaboration.

The policy guidelines and recommendations are informed by:

- a **state-of-the-art review** of policy and planning context in Latvia as well as the policy recommendations already derived from ESPON GRETA 2019 project *"Green infrastructure: Enhancing biodiversity and ecosystem services for territorial development"*[2]
- an **analysis of points crystalised during the GI network mapping and analysis of supply and demand for recreation and flood risk mitigation and accessibility analysis** in 9 core urban areas undertaken in previous phases of the project (see Deliverable Report 1).
- an **online workshop meeting** with the Ministry of Environmental Protection and Regional Development of Latvia, held on the 8th of June 2022, to enhance mutual understanding and facilitate development of the recommendations. The workshop specific aims are:

  a) Contrast and validate proposal for tentative spatial planning framework and preliminary guidelines.

  b) Discuss around disruption risks, recreation demand and the consideration of climate change scenarios for flood risk mitigation in future studies.

  c) Debate on the implementation: barriers/constraints, opportunities and mechanisms for embedding GI into planning.

Section 8 includes a briefing of the workshop.

[2] See ESPON GRETA: https://www.espon.eu/green-infrastructure

3 Policy and planning context in Latvia

Latvia has relatively high density of natural areas as compared to other EU countries. 11.53% of the national land area of Latvia is covered by Natura 2000 (EU average 18.1%), with Birds Directive SPAs covering 10.23% (EU average 12.3%). In Latvia, 333 territories listed in the European Union network of protected areas Natura 2000occupying more than 7.9 thousand km^2: four strict nature reserves, four national parks, 239 nature reserves, 37 nature parks, nine protected landscape areas, seven protected sea territories, and 24 micro-reserves.[3] Latvia has designated 332 Special Areas of Conservation (SACs) covering an area of 12241,37 km^2, from which 7877.3 km^2 correspond to the terrestrial part of the country's share of the Natura 2000 network, and 4364.07 km^2 to marine sites. Regarding Special Protection Areas (SPAs) for birds designated under the Birds Directive, Latvia has designated 102 sites covering 6609.6 km^2, from which 6183.9 correspond to terrestrial sites (97) and 425.7 km^2 to marine sites (European Commission, 2017)[4].

The Forest Policy in Latvia already recognised the multiple functions of forests and prevention of the fragmentation and ecological degradation are principles in such policy. Nevertheless, data demonstrate that there is decreasing connectivity between habitats which represent the main challenge in Latvia.

In Latvia there is not one single overarching national policy or strategy for GI. This is in compliance with EU Green infrastructure strategy (2013), as this strategy is not a directive and therefore not enforced to be included as national law in the member states. Based on the ESPON GRETA project findings (Carrao, H, et al, 2019; Garcia- Blanco, G. et al 2019), however, GI solutions and approaches are already incorporated in land use governance, for instance in terms of improvements of agriculture land management and in the territorial planning of the municipalities.

Currently in Latvia there are few plans or activities directly relating to GI, e.g., flood management in cities, landscape and Natura 2000 development. However, several programmes and priority areas have high potential for GI development, either as a potential tool to reach the policy targets or promoting Green Infrastructure through stimulation in co-financing competitions or through supporting activities.

The Ministry is the leading state administrative institution in the field of environmental protection, which includes the protection of the environment and nature, maintenance and rational utilisation of natural resources, as well as sub-sectors of hydrometeorology and use of subsoil. It ensures planning and coordination processes of state and regional development, local governments' development and supervision, territorial development planning and implementation of e-Government. It also liaises with international conventions and the EU. (Carrao, H, et al, 2019; Garcia- Blanco, G. et al 2019)

On national level, Latvia's National Development Plan 2021-2027[5] and the Sustainable Development Strategy of Latvia 2030 contain GI-principles. They both include the objective of restoring and increasing of natural capital which includes sustainable management of the natural resources, protection of the diversity of the Latvian nature and enhancements of ES. Some GI-related objectives like increasing of forest coverage and amelioration of the agricultural land are also incorporated as measurable outcomes for the goals of the plans. In particular Priority 4 of the National Development Plan for 2021-2027 include some relevant measures:

- Reducing GHG emissions through climate change mitigation and technological breakthroughs, increasing carbon sequestration

[3] https://www.csb.gov.lv/en/statistics/statistics-by-theme/economy/gdp/search-in-theme/119-latvia-statistics-brief-2017

[4] https://biodiversity.europa.eu/countries/gi/latvia

[5] https://pkc.gov.lv/sites/default/files/inline-files/Summary_Latvian%20National%20Development%20Plan%202021-2027_final_pdf.pdf

- Mitigation of climate change effects through adaptation measures, and improved materials and infrastructure for prevention and management of disaster risks
- Protecting habitats and species
- Management of nature protected areas, introducing species protection and nature conservation plans
- Mitigation of climate change effects through adaptation measures, and improved materials and infrastructure for prevention and management of disaster risks (Saeima of Latvia, 2020).

Latvia has carried out a Mapping and Assessment of Ecosystems and their Services (MAES) for its marine waters, internal marine waters, territorial waters and Exclusive Economic Zone (EEZ). It was performed in 2016 as one of the steps for implementation of the ecosystem-based approach within development of the national Maritime Spatial Plan (MSP) (MAES, 2018).

Ongoing activities in GI development in Latvia can be broadly divided into five main groups:

1. Development of the Natura 2000 network.
2. Sustainable and integrated coastal zone management.
3. Management of inland waters (including integrated water basin management plans and flood protection measures).
4. Wetland management and creation of new wetlands (including reed filters to purify wastewater); and
5. Local GI elements, such as bicycle roads, street trees, green (water permeable) street covers and green elements of buildings, improving connectivity between natural GI elements.

Findings of the ESPON GRETA 2019 project suggests that national policy followed by regional and municipal policy have the main responsibility for developing and implementing the GI policy and strategy in Latvia. NGOs and actors within research were considered to have third and fourth most significant role on *developing* the GI policy and strategy. (Carrao, H, et al, 2019; Garcia- Blanco, G. et al 2019)

Business communities' role was considered to be important on implementing the GI policy and strategy. Whereas NGO's role was considered with somewhat lower relevance. European policy was stated to have the least responsibility. Regional policy was not seen as relevant body for implementing the GI policy. This is likely to emphasise the municipalities' strong role for both developing and implementing GI policy in Latvia.

Based on the ESPON GRETA 2019 findings (Carrao, H, et al, 2019; Garcia- Blanco, G. et al 2019), GI principles are included within sectors of land use and spatial planning; agriculture, forestry, and fisheries; climate change mitigation and adaptation; environmental protection and rural development. Transportation; water management; disaster prevention; finance; energy; cultural heritage; health and social services were policy sectors that were not considered as having responsibility for developing GI-policy and strategy in Latvia. GI's and its principles broad representation under many policy sectors are visible for example through the measurable outcomes for the goals of National Development plan for 2021-2027 (Saeima of Latvia, 2020).

The European Agricultural Fund for Rural Development (EAFRD) and LIFE+ and Horizon2020 project funds from the European Union are important funds for implementation of GI in Latvia. Also, the Cohesion Fund (CF) and the European Regional Development Fund (ERDF) were considered as somewhat important funding sources, very relevant in line with the Biodiversity Strategy 2030.

On a national level in Latvia, information on protected area's locations, other nature areas and land use are considered as always easily available. The environmental quality of these areas is considered to be sometimes easily available. Findings of the ESPON GRETA 2019 project suggests that, this information, were stated to be used sometimes in spatial planning

on regional and local levels. The spatial information and GIS data for e.g. protected areas, natural habitats or land use restrictions are provided on-line on the natural data management system OZOLS[6] in Latvia (OZOLS, 2018).

The Sustainable Development Strategy of Latvia until 2030 suggests the creation of market instruments as a possible solution to sustainable management of natural values and services. The strategy states that *"For the needs of restoration of the natural capital taxes for activities degrading natural capital should be increased."* (Saeima of Latvia, 2010, p.59). The strategy also presents a programme of eco-gifts, which encourages landowners to transform ecologic-sensitive areas into nature reserves (Saeima of Latvia, 2010, p. 59). ESPON GRETA 2019 revealed that this is implemented, for instance in the assessments of projects that should receive project funds. Projects that consider GI elements get extra ranking points, which are profitable in the process for receiving state funds. (Carrao, H, et al, 2019; Garcia- Blanco, G. et al 2019)

It is worth mentioning that at EU level, GI are not sufficiently developed nor explicitly included in existing strategies and initiatives. While in the Baltic Macro Region EU Strategy[7], of which Latvia is a part of, does not develop specific guidelines on GI, the Pan Baltic Scope Project[8] does (on the context of Maritime Spatial Planning). The Pan Baltic Scope is a cross-border cooperation project in the Baltic Sea (2015-2017) that, although finalised some years ago, has developed tools and approaches for five thematic areas, one of them on marine GI[9]. Outcomes in terms of best practices and knowledge may still be used as reference for the production of future national plans.

In summary

- In Latvia there is not one single overarching national policy or strategy for GI.
- However, GI solutions and approaches are already incorporated in land use governance, for instance in terms of improvements of agriculture land management and in the territorial planning of the municipalities.
- Currently in Latvia there are few plans or activities directly relating to Green Infrastructure, e.g., flood management in cities and Natura 2000 development. However, several programmes and priority areas have high potential for GI development, either as a potential tool to reach the policy targets or promoting Green Infrastructure through stimulation in co-financing competitions or through supporting activities.
- Based on ESPON GRETA 2019 findings, GI principles are included within sectors of land use and spatial planning; agriculture, forestry and fisheries; climate change mitigation and adaptation; environmental protection and rural development. Transportation; water management; disaster prevention; finance; energy; cultural heritage; health and social services were policy sectors that were not considered as having responsibility for developing GI-policy and strategy in Latvia.
- National policy followed by municipal policy have the main responsibility for developing and implementing the GI policy and strategy in Latvia.
- The Sustainable Development Strategy of Latvia 2030 has relations to GI-principles. It includes the objective of restoring and increasing of natural capital which includes sustainable management of the natural resources, protection of the diversity of the Latvian nature and enhancements of ecosystem services. Some GI-related

[6] https://ozols.gov.lv/pub

[7] https://www.balticsea-region-strategy.eu/communication/news/590716-new-map-on-macro-regions-in-europe

[8] http://www.panbalticscope.eu/

[9] http://www.panbalticscope.eu/wp-content/uploads/2019/12/Green-Infrastructure-brochure-print-FINAL.pdf

objectives like increasing of forest coverage and amelioration of the agricultural land are also incorporated as measurable outcomes for the goals of the plans.

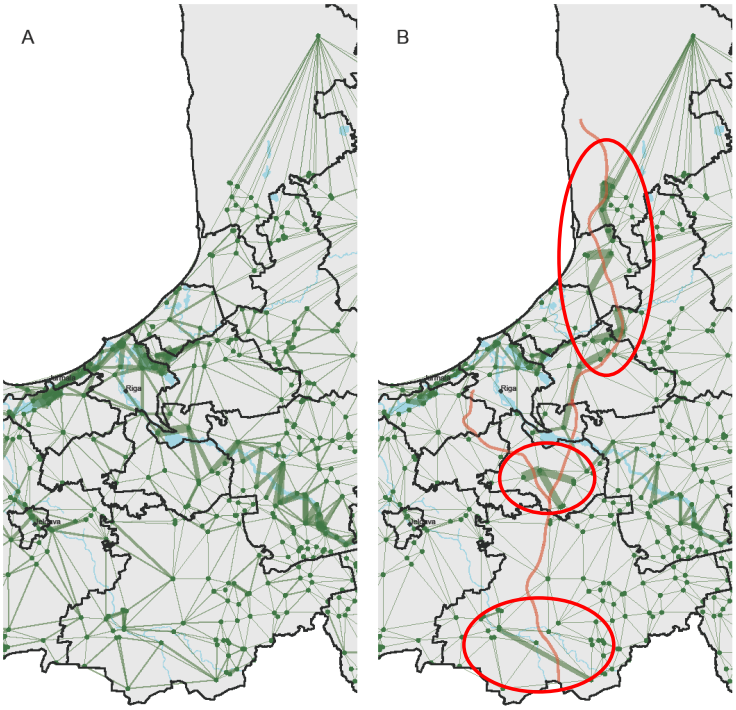
- Several Latvian municipalities are working on an initiative for implementing the GI concept into their local government spatial plans.
- To competently guide this initiative and any future ventures the Ministry of Environmental Protection and Regional Development of Latvia, as the authority responsible for overseeing planning and responsible for implementing policy for environment protection, is driving the process towards an elaboration of a strategic planning framework for GI.
- Ultimately, the Ministry hopes to comprehensively embed the concept of GI into legislation and formal planning processes and to go beyond just municipal initiative. In the future an initiative is considered to potentially address this via GI planning guidelines for municipalities.

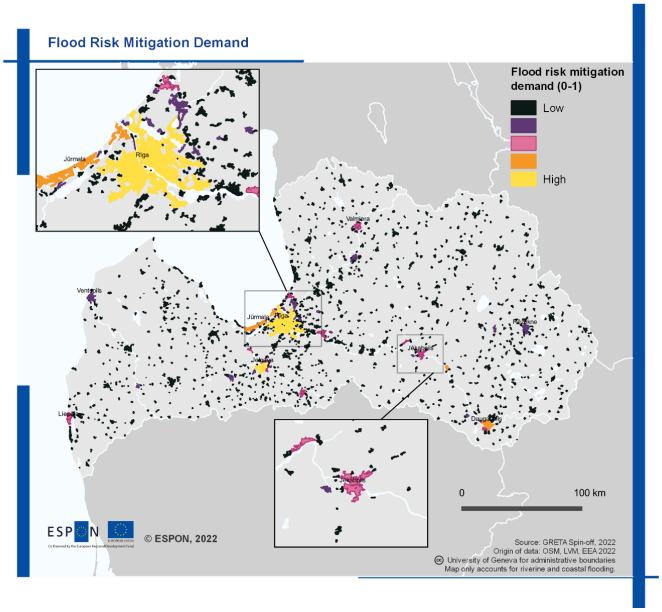
Key challenges

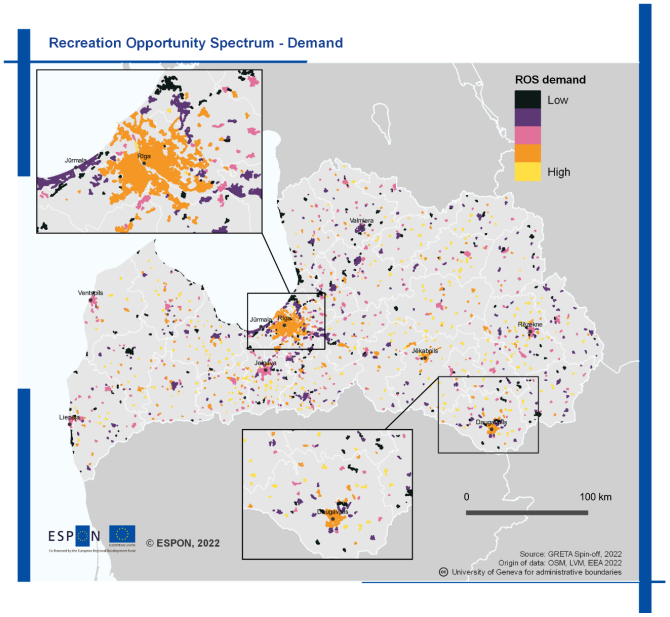
- Spatial information and GIS data for e.g., protected areas, natural habitats or land use restrictions are provided on-line on the natural data management system OZOLS in Latvia. A key challenge in this connection is integrating OZOLS data and information into TAPIS (Spatial Development Planning Information System) to be really used in spatial planning on regional and local levels
- Still, improving awareness and knowledge about the benefits of the GI network in the public administrations is needed in Europe. The need for a green network is known, but there should be guidance on how to calculate the benefits (establishment and service monetary value) with good examples. First and foremost, the benefits of the green network in cities (both direct benefits saved money and indirect benefits through human well-being). In particular there is still a lack of knowledge with regard to biodiversity and more data related to biodiversity indicators, connectivity and species distribution is required. How to use this data to build the GI network? How the network functions ecologically?
- Improving the access and exploitation of available information and data is seen crucial to inform decision making and planning is a common challenge, not only in Latvia by in many European coutnries. Planners seems to be keen on making decisions based on GI and ES principles but still there is a need for knowledge-based decisions. There is a need for clear criteria and recommendations for land use management. Data and guidelines about how to make use of it should be made available by National Authorities- so all regions could use it with a certain level of criteria.

4 Policy considerations based on GRETA Spin-off findings

Key findings	Policy consideration
In general terms, there is a need for quality and accessible data at appropriate scale.	There is a need to complement the delineation of GI (i.e., GI extent) with an assessment of the **GI condition**, meaning the overall physical, chemical, and biological quality which determines its capacity to deliver ES (*Maes, 2018)- linked to Policy Recommendation P0R1 see section 6.* **Long-term monitoring** of extent and condition to evaluate trends, requires quality and accessible data at appropriate planning scale. – *linked to Policy Recommendation PR04 see section 6.* **Articulation of GI at different planning scale**s- from national, to regional and local levels to guarantee coherence. – *linked to Policy Recommendations PR01 and PR06 see section 6.*
GI physical network Areas considered as Green Infrastructure hubs amount to approximately ~20% of Latvia´s terrestrial territory. These areas fall under different legislative protection status and vary extremely in size and landscape composition. Hubs appear to be predominantly well connected by links (i.e., potential distance-based movement corridors). This can be attributed to the high frequency of small, interspersed hubs allowing for improved movement opportunities and “island hopping”. There are only a few hubs that are more likely prone to isolation. These are situated in urban conglomerations	Further efforts to increase the “ecological” connectivity between habitats would be useful to establish protected areas as GI (EC, 2015). – *linked to Policy Recommendation PR08 see section 6.* Much of Latvia is connected by the small scale protected areas (“Mikroliegumi“) which serve as stepping stones between larger coherent patches of protected area, but also enhance the connectivity by acting as a multiplier on the density and availability of movement corridors. – Monitoring connectivity in the long term to reduce the risk of isolation of small, interspersed hub islands in urban areas. – Preserve this small-scale protected area. Isolation could affect its condition, reducing the GI capacity of delivering certain ES particularly regulation ones. An evaluation on how to improve their situation likely requires a tailored approach which parametrizes the links by the movement capacity of species that shall be supported. – *linked to Policy Recommendation PR08 see section 6.*
GI network disruption risks	Network disruption analysis to be incorporated in the decision-making process

Key findings	Policy consideration
In total, the railway interrupts potential links at 52 different locations. This translates into an average link interruption for every 11km of railway section. More than 120 different hubs are potentially affected by the network disruption due to interruption of links amounting to almost 40% of the total hub area due to its proximity to very large hubs. The southern section of the railway ranging from Grenctāle to Sarmas, located before the railway divides into the Riga mainline and bypass, crosses an area with lower overall connectivity. While due to the lower patch density a lower amount of animal movement can be assumed, it is essential not to further degrade regions that already poorly connected. The split of the mainline and bypass causes a drastic decrease in connectivity in the direct vicinity of the split by essentially creating two barrier lines and encircling a large area around Riga. Northeast of Riga the railway could potentially segregate two larger hub agglomerations thereby separating coastal from inland area.  	and SEA procedure of the Rail Baltica pathway. – *linked to PR07* Two alternative scenarios could be assessed: – network disruption in an area of poor connectivity – network disruption in an area of good connectivity Improved data on green bridges and passages required for further analysis on disruptions. – *linked to Policy Recommendation PR01 see section 6.* There is also a need to assess the existing protection plans of species and what are the shortcomings to improve the connectivity of suitable habitats/migration corridors. Further analysis on (GI) network thresholding to account for inter-species variation in dispersal capacity. – *linked to Policy Recommendations PR01 and PR07 see section 6.*
ES flood risk mitigation The highest demand for flood protection was determined for Riga which, like many coastal cities, features a geographically unfavorable situation in terms of being prone to both, riverine and coastal flooding. In general, flood mitigation demand was mostly proportional to population density. This can be explained by the circumstance that locations along major streams were historically more likely to be able to sustain a larger population and thus higher population density can be found along larger rivers. Simultaneously, these rivers are more prone to flooding as discharge may accumulate across the sub-catchments of the watershed. Flash floods were not considered as flood hazard due to missing data.	**Flash floods** were not considered as flood hazard due to missing data. Neither **extreme sea level rise, expected with the onset of Climate Change**. Considering that these extreme events are likely to increase with the intensification of climate change it may be important to **incorporate such data in future assessments within the Strategic Planning Framework for GI** in Latvia. - *linked to PR01*

Key findings	Policy consideration
Considering that extreme precipitation events are likely to increase with the intensification of climate change it may be important to incorporate such data. The large number of wetlands and forests present in the country contribute towards the water retention capacity of the landscape. Most of the four major river systems featured a medium to high water retention capacity. The lowest values for water retention capacity were observed in the Daugava River catchment. The methodological approach towards assessing water retention capacity remains simplistic and could not consider import aspects such as soil type and hydrology as well as the impacts of different discharge volumes.  	**Hydrological modelling exercises at sub catchment scales** are required in order to better assess the water retention capacity of the GI- a pilot exercise could be done in the Daugava River catchment to then upscale the exercise to other basins, also in Ogre digital twin. - *linked to Policy Recommendation PR08 see section 6.* See Flood Risk EU Directive Second cycle-
ES Recreation opportunity spectrum Latvia features a large range of outdoor activities considered under the recreation spectrum. The mapping approach showed that there are generally fewer immediate opportunities available to the rural population in comparison to the population of larger and medium sized cities. Thereby, the peaks of available activities are not located within the cities, but in their immediate surroundings. These surroundings are also frequently protected hubs. Although the rural population may have more direct access to natural areas, these are generally less developed in terms of available (and integrated) recreation opportunities. However, this does not mean that rural population is per se deprived of these opportunities. For example, despite the large abundance of natural lakes that are suitable for bathing around the country, the ROS supply only considers official bathing waters. The estimation of bathing water is thus kept conservative but is likely to underestimate the true amount of available swimming and bathing locations. This trade-off situation between overestimation (simply considering all-natural lakes as bathing water) and underestimation is a frequent problem in the design of ES and may be optimized by integrating an additional weighting mechanism.	Analyse and integrate additional data for the analysis of ROS and recreation demand which was not available during data compilation and reporting phase of the present report. This information contains a point layer indicating the location, type and visitation frequency category for touristic attractions and businesses. In absence of the required baseline data or mapping initiatives, proximity-based approaches offer a solution of bringing together supply and demand by highlighting recreation opportunities available to the population. Such data is ideally suited to map use intensity of recreation opportunities provided by GI across the Latvian landscape. Furthermore, it might improve insights on visitation patterns for specific areas and landscape compositions.

Key findings	Policy consideration
	*- linked to Policy Recommendation PR01 see section 6.* Customisation and review of methodological approach and weighting mechanism together with stakeholders to reduce a potential misconception that rural areas feature fewer recreation opportunities. – *linked to Policy Recommendation PR08 see section 6.* Assessment of socio-cultural ecosystem services is recommended at the local level. This assessment is particularly difficult due to the lack of systematic data statistics or research data scientific, as in biophysical evaluation, but it really offers valuable insights on recreation opportunities. A useful tool could be participatory mapping that aims at developing maps collaboratively, identifying local knowledge, which make it visible to everyoneThis type of mapping is useful for evaluating the perception of specific ecosystems, as well as the use that people give it. The inclusion of results of a sociocultural evaluation of ES can be very useful for the processes for the formulation of plans and programs for territorial planning, natural and urban resources, and can be done through citizen participation processes carried out in their review.
GI accessibility assessment The accessibility assessment showed that the largest population centre in Latvia, Riga, only provides medium recreation opportunities in comparison to the remaining 8 larger urban centres. With the exception of Jelgava, there was an evident decrease of ROS towards the outer perimeter of the considered travel times. Whereas the accessibility of recreation opportunities provided by GI were generally higher closer to urban areas. This does not necessarily mean that GI is sufficiently available to the citizen. Some specific functions remain inherently difficult to depict in a spatially explicit manner. This includes the intrinsic value of the natural landscape, the small-scale recreational use of forest resources or the positive impacts on well-being induced by spending time in natural environments.	Generally speaking, further efforts are needed to maintain and enhance GI accessibility in the urban- rural interface in all larger urban centers. – *linked to Policy Recommendations PR07, PR08, PR09 see section 6.*

5 Simplified Green Infrastructure Strategic Planning Framework

A Simplified Strategic Planning Framework (**Figure 3**) is proposed, which highlights a pathway through which a GI approach could be undertaken in planning.

In general, the integration of GI into spatial planning in Europe has followed two approaches (ESPON GRETA, 2019):

- GI considered as a distinct sector of policy at the same level as housing, land use and transport. In this approach, GI is seen primarily as an 'object' of planning rather than a result of planning – to be applied to existing protected areas such as the Natura2000 network.
- GI as a 'product' or result of an integrated approach to planning, where development needs, and protective demands, are reconciled into the same spatial plan– applicable at different levels (regional, local/city).

The content addressed in this report addresses the second approach – therefore considering GI as a result – with the idea that ecological processes should inform integrated spatial planning, and that this consideration is a pre-requisite for sustainable ecological, economic, and societal development.

The framework does have four main modules:

- **Data and information on GI attributes and benefits**: with national coverage, updated and available at appropriate planning scales, i.e., national, regional and local.
- **Co-created strategic GI vision and common GI standards & benchmarks**, that could led to the review of the GI national taxonomy (i.e. GI classification), determining objectives for GI protection/conservation, enhancement or new deployment and translation of this objectives at the regional and local levels.
- **Supporting tools for planners** to facilitate the consideration of GI data and information in planning processes: guidance and common criteria for data exploitation, long-term GI and ES monitoring and evaluation system, and improvement of visualisation and dynamic queries in the current natural data management system (OZOLS) and the **Spatial Development Planning Information System (TAPIS).**
- **Enabling mechanisms** for the operationalisation of the above: co-creation and governance structures, Strategic Environmental Assessment as the administrative procedure that accompanies the approval and adoption of strategies and plans.

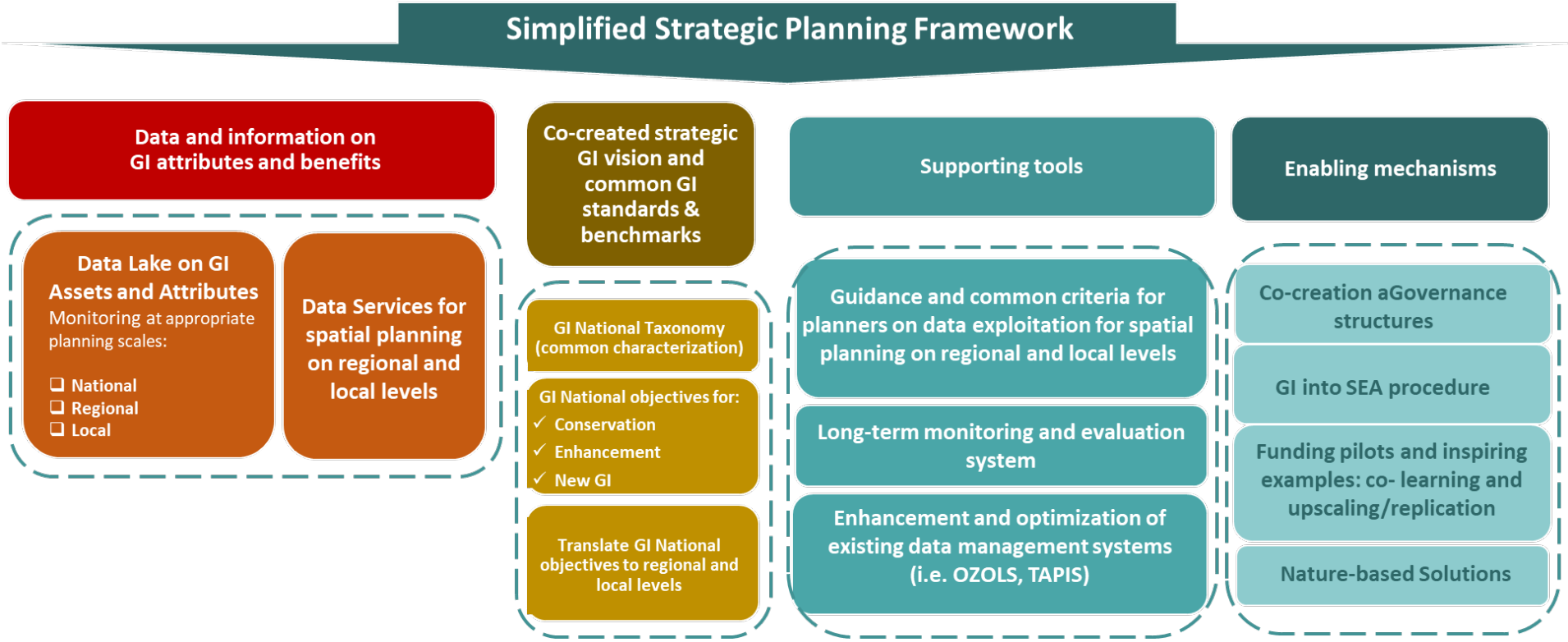


Figure 3 Simplified strategic planning framework for embedding GI into planning. Source: authors own elaboration.

5.1 Usability of the Simplified Strategy Planning Framework

Embedding GI, and the ES that it provides, into the process of formulating territorial and urban plans, could successfully contribute to:

- *Identify multifunctional areas*, in which compatible land uses are favoured, that support well-preserved and biodiverse ecosystems. Identifying and quantifying the benefits and challenges of GI is important for strategic planning and development, providing options which link environmental, social and economic benefits within a single space, which may not be provided by traditional grey infrastructure.
- *Improve connectivity between existing protected areas* to counteract fragmentation and increase its ecological coherence. Hence, it positively contributes to biodiversity enhancement and climate change adaptation.
- *Move infrastructure works away from areas of greatest natural value*, directing them towards other areas, where could better contribute to the recovery of GI elements in the development proposal.

In addition, performing an assessment of the services that ecosystems provide could be useful in the formulation of plans and programs in terms of land use planning, urban planning and management of natural resources, allowing better informed decision making. Some examples of those are:

- Quantification of the services that the ecosystems of a territory provide.
- Identification of high value areas for the provision of multiple ES.
- Preparation of a proposal for the design of the GI, focusing on hubs and needed links to guarantee connectivity and accessibility.
- Analysis of synergies and conflicts between land uses and ES.
- Analysis of the mismatches between supply and demand for ES, therefore, identifying hot spots or areas in need for GI deployment.
- Enhancement of GI contribution to different policy objectives, i.e. climate adaptation, water management, biodiversity, recreation.
- Economic evaluation of ecosystem services.

5.2 Scale matters

Scale – both territorial and temporal – is an utterly relevant aspect in planning decisions, which must be taken into consideration when reading the tentative messages in the present report. Each planning scale – national, regional, local – may have particular aims, and require different scope and data needs.

As ESPON GRETA 2019 illustrated, GI benefits differ and are shown to a different extent depending on the scale. **Figure 4** shows a list of benefits of GI considering urban, peri-urban and rural scales.

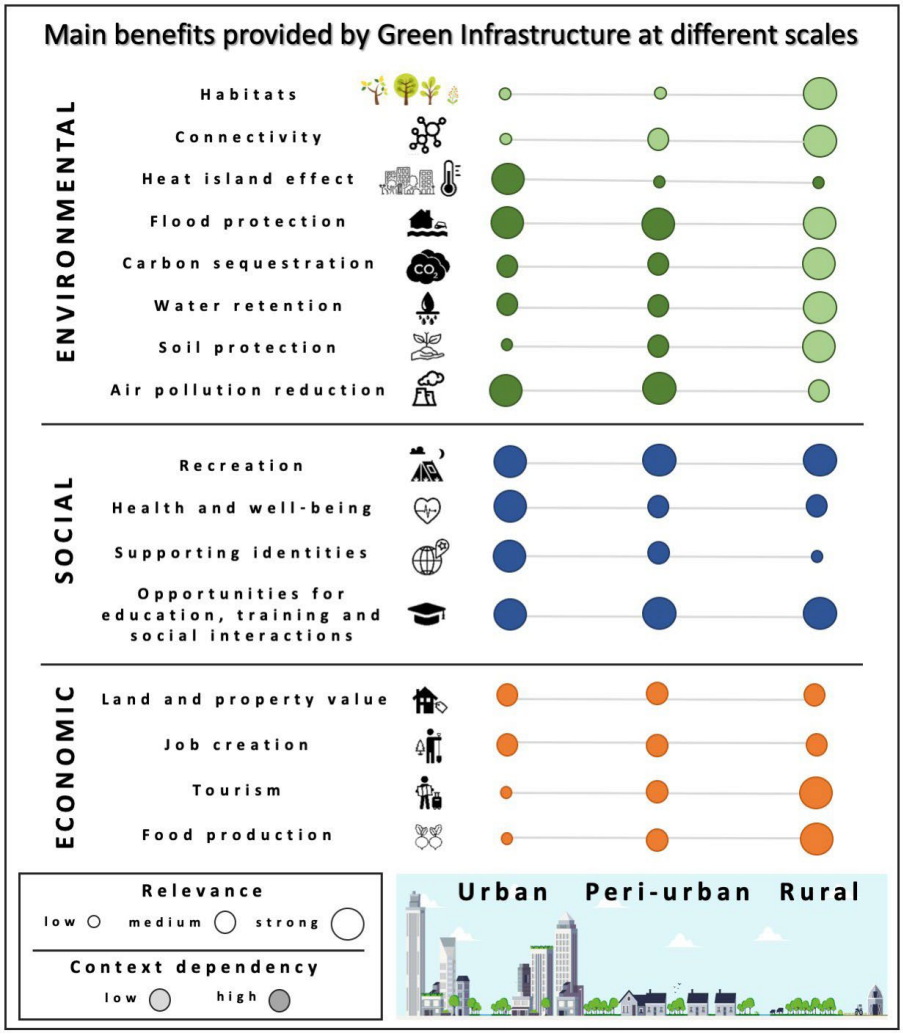


***Figure 4** Main benefits provided by green infrastructure at urban, peri-urban and rural scale with indication of relevance and degree to which benefits are context dependent. The size of the circle represents relevance, and the opacity denotes context dependency. Source: GRETA, 2019.*

6 Policy recommendations

The policy recommendations introduced in the present report, have been built based on, not only the analysis and research evidence presented in the Deliverable Report 1, but also on internal discussions and feedback within the project team and more specifically, on the results of the online co-creation workshop held on the 8th June 2022, with the Ministry of Environmental Protection and Regional Development of Latvia and other key stakeholders, to validate the policy guidelines and discuss on opportunities and constraints for implementation.

The policy guidelines and recommendations are structured **around the four modules of the simplified strategic planning framework** (Figure 5).

Figure 5 Distribution of the Policy Recommendations according to the four modules of the Simplified Strategic Planning Framework. Source: authors own elaboration.

For each policy recommendation, a factsheet has been elaborated, to answer why, *what, how, who, where and when* to implement the suggested policy. Whenever appropriate, policy recommendations are illustrated with a reference to the study findings out of Delivery Report 1. The Figure 6 shows the template for the formulation of the policy recommendations.

PR X Policy Recommendation
Why- Identified challenge/gap to which it is responding to.
What- Specific actions to be taken, and of the targeted step in the planning process.
How- Mechanism for its implementation.
Who- Who is responsable for succesfuly putting it in place.
Where- Relevant planning scale (national, regional or local).
When- Time-oriented implementation (short, medium or long-term).

+ Reference to study findings + illustrating map whenever appropriate

Figure 6 Approach for the formulation of policy recommendations in GRETA Spin-off for Latvia. Source: authors own elaboration.

Each policy recommendation has been qualitatively scored as High Medium Low with regards to three criteria, i) the relevance- how important is for Latvia, ii) the feasibility and viability, and iii) the urgency of its implementation.

6.1 General principles

- **Plan strategically**. Land-use planning should be implemented strategically, using the best data available. The maps produced in the GRETA Spin-off for Latvia provide an overview of potential GI networks and the delivery of ecosystem services in Latvia, based upon the best current existing data.
- **Adopt a strategic view for the consideration of GI approach in planning.** GI approach looks at connections – between different elements of nature in the geophysical area, between nature and people's quality of life, across ecological and political boundaries, and across policy sectors. It could be seen as a tool to articulate territorial distribution and development.
- **Apply a proactive and strategic planning,** to enable and maximise the GI provision of a range of benefits – environmental, social, cultural, economic – and to contribute to mitigating long term environmental challenges, such as climate change and biodiversity loss.
- **Facilitate vertical and horizontal collaboration for coherence between policies and planning documents-** Use GI development as a mechanism for a better governance at cross-scale, cross-sector and cross-stage in the planning process, aiming at promoting further collaboration, awareness, capacity building, and knowledge exchange, and to build a common understanding between professionals operating at different implementation stages and scales. Such collaboration is especially important to adapt co-governance and co-management among territories, e.g. river basin levels, functional regions, not necessarily within traditional administrative borders.
- **Create a shared vision.** It is important for stakeholders involved in the implementation of GI to have a shared strategic vision. For that, the use of strategies such as "Theory of Change"[10] allows both policymakers and planners to identify, discuss and share common goals, ensuring that the processes of planning, implementation and maintenance of GI are coordinated and successful. Training may be needed in order to ensure that the involved stakeholders across different sectors have a proper knowledge of the costs and benefits of implementing GI, as well as of its planning, implementation and maintenance processes, as well as of the functioning of ecosystems.
- **Recognise the importance of GI and the services it provides as an extra layer for spatial and urban planning.** The incorporation of aspects related to ES to planning and decision-making helps to reduce the loss of such services, being necessary a multifunctional territorial planning**.** The integration of ecosystems and their services requires three different types of information flows:
    - Science-based knowledge-sharing between the scientific community and panel of experts (for example, on the status and trends of biodiversity, the state of ecosystems and the provision of ES).
    - Capacity and capabilities exchange among the broader community of stakeholders and target groups to promote co-learning (for example, local knowledge to assess the relative importance of ES).
    - A co-created process of collaboration between decision-makers and the different regulatory sectors in order to nurture the exchange of information.
- **Use a multiscale approach in the analysis of the GI.** The European Environment Agency (EEA) recommends a multiscale approach (with two different scales) for the identification of the elements of GI, depending on the pursued objectives:
    - Landscape-level analysis (1 km resolution): GI elements are identified and mapped as well as their ecosystem services.
    - Analysis at a local level (recommended < 0.1 km resolution): urban GI elements, such as green areas, trees, parks, orchards, ponds, waterbodies, green roofs and walls, among others are identified and mapped. Recent studies at urban level already incorporate the evaluation of the ES provide by urban GI.
- **Plan for GI implementation in adaptive cycles**. Consider three-year timescale for decision-making and focus on GI strategy based in regional and local assessments. In order to continuously update the georeferenced data layers, it is crucial to ensure that land use changes based on monitoring are incorporated.

[10] https://unsdg.un.org/sites/default/files/UNDG-UNDAF-Companion-Pieces-7-Theory-of-Change.pdf)

6.2 Data and information services on Green Infrastructure attributes and benefits

PR 01 Produce High Quality and Accessible Data, and Generate Information Services

Relevance	Feasibility/Viability of implementation	Urgency
	"skill improvement necessary for municipalities"	

Why Need to improve quality data at relevant planning scales to better inform planning decisions.

What- Ensure the availability of data. Accurate and updated spatial data on potential GI network should inform evidence-based decision-making on spatial planning and on where to invest resources. Continued mapping of data such as protected areas, forests, agriculture, level of fragmentation should be developed.

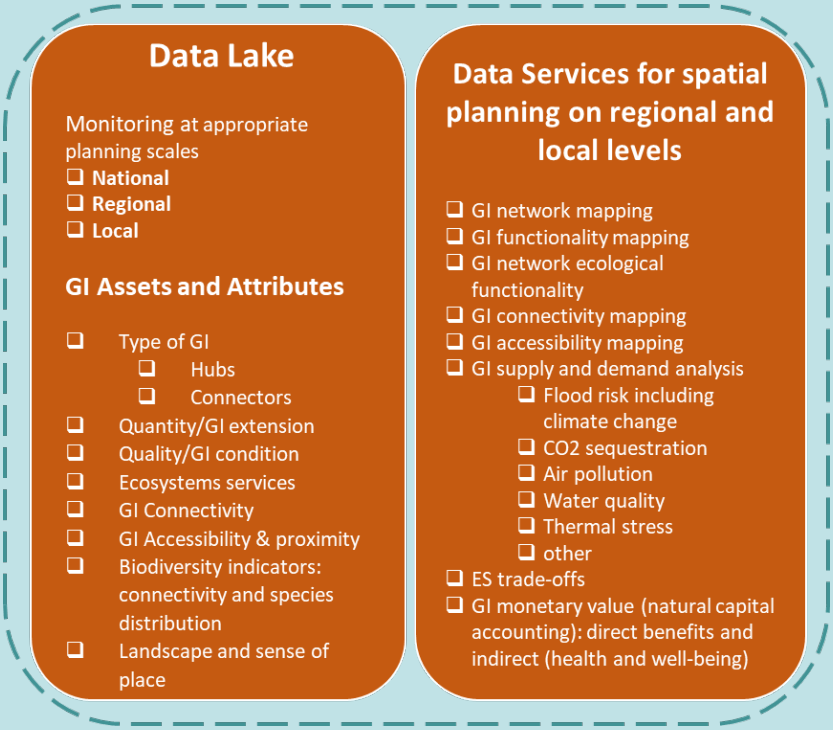


Figure 7 Suggested data and information services on Green Infrastructures assets and attributes. Source: authors own elaboration.

How- Customisation of already existing online service OZOLS Customisation of already existing online service OZOLS and its integration with TAPIS.

It may require even the development of *ad hoc* /tailor-made information system that integrates already existing and maybe dispersed data and information related to land use, green infrastructure, and natural resources.

A **standardised architecture** for this new information system is required:

- what kind of data is available? Thematic scheme
- at what planning scale? Local/municipal; regional/landscape; national levels

- in which formats? (INSPIRE standards for instance),
- what is the metadata?
- who´s responsible for delivery, update, monitoring, of the data?

Besides a **friendly interface** is required and specific functionalities for data access and visualisation:

- data services available for non-technical experts
- dynamic queries by theme, scale, and so on and so forth,
- downloadable functionalities
- online functionalities

A **Handbook for planners and practitioners** would be also very relevant- for effective exploitation of the integrated data system.

New data and information on GI delineation (Physical Mapping) ES provision (Physical mapping), GI condition (status and quality of GI), connectivity, accessibility, biodiversity indicators and landscape evaluation for recreation, as well as data services for supply and demand, ES trade-offs, GI monetary values, and climate change vulnerability and risk information, are amongst the most relevant to be delivered.

Who is responsible- Ministry of Environmental Protection and Regional Development (Latvia)

Where- Relevant for all planning scales

When-- Short term

Specific reference to study

Data gaps identified in the study that could have significantly improved the findings:

- **GI condition:** There is a clear need to complement the GI delineation and ES approach (i.e., GI extent) with an assessment of the **GI condition**, considering the physical, chemical, and biological quality and status of the GI, which determine its capacity to delivery ES (Figure 8).

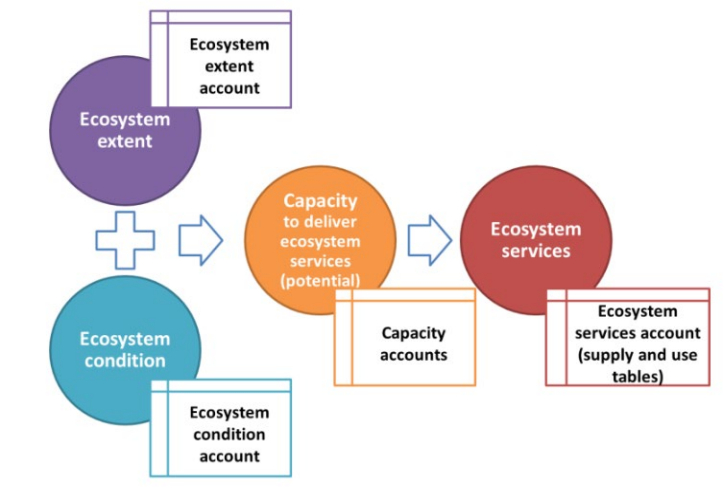


Figure 8 Ecosystem services account relaying on extent and condition. Source: MAES, 2018[11].

[11] MAES Report 2018 https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/5th%20MAES%20report.pdf

Improved indicators and metrics for assessing the quality of GI are needed, which could be linked to the ongoing development of indicators for the Sustainable Development Goals. Not only the amount of GI is relevant, but also its quality. Some references worth mentioning are the ones of DG Environment Reports, as well as those of EEA, such as the green infrastructure and territorial cohesion (2011), Landscape fragmentation in Europe (2011) and Spatial analysis of GI in Europe (2014).

- **Dedicated Hydrological modelling** exercises at sub catchment scales are required in order to better assess the water retention capacity of the GI
- **Climate change**: Climate change is an increasingly high-level challenge of high prominence. While Gi might not be first solution that comes to mind for adaptation and mitigation, it provides multiple benefits at urban and landscape scale. Trade-offs mean that policy makers need to have more evidence available to make informed and meaningful decisions. It is important to understand the relationship between the supply of and demand for GI. This research can help to inform the prioritisation of efforts to develop and invest in GI to meet current and future demand.

  The spatial analysis methodology applied in the study for Flood risk and Recreation ES, which correlates the number of inhabitants in an area (demand) with access to green areas (supply), can be useful in identifying deficiencies in the availability of potential GI.
- Need to incorporate data on extreme sea level rise, expected with the onset of climate change, so that **flash floods** hazards may be considered in the analysis, since extreme events – such as sea level rise – are likely to increase with the intensification of climate change. It is crucial to incorporate such data in future assessments within the Strategic Planning Framework for GI in Latvia. Suggested data:

  Flood hazard: high extreme of river runoff
  Included in the "Hazards: floods, drought and water resources": XXI century projections of river-related hazards (floods, droughts, water resources) at European scale, used in the PESETA IV project[12].
  [Dataset] PID: http://data.europa.eu/89h/20247f06-469c-4607-8af1-a5a670082471
  It includes future projections of high extremes of river runoff at global warming levels (1.5°C, 2.0°, 3.0°, 4.0°).
  Extreme sea level rise
  Coastal flood risk assessment for Europe until the end of the 21st century, by incorporating the impacts of global warming and the different socio-economic development scenarios[13].
  The main objective is to provide Extreme Sea Level (ESL) for Europe. They provide 100-year ESL (ESL100). ESL is driven by the combined effect of Mean Sea Level (MSL), astronomical tides and water level fluctuations due to waves and storm surges.
  They get historical, RCP4.5 and RCP8.5.
  Extreme Sea level – Historical
  https://data.jrc.ec.europa.eu/dataset/9e5ba6f1-8d03-4834-8488-2353e504560f
  Extreme Sea level – RCP4.5
  https://data.jrc.ec.europa.eu/dataset/e9e42344-119d-479e-9bc7-57400d12a8a2
  Extreme Sea level – RCP8.5
  https://data.jrc.ec.europa.eu/dataset/a565eea4-5422-4c7d-a000-2e10ae872da7
- At urban level also relevant to incorporate climate projections on **temperature. IPCC, Copernicus data.**
- **Recreation demand** data- already available but not possible to be included in the ESPON GRETA Spin-off study.

[12] Mentaschi, Lorenzo; Alfieri, Lorenzo; Dottori, Francesco; Cammalleri, Carmelo; Bisselink, Berny; De Roo, Ad; Feyen, Luc (2020): Hazards: floods, drought and water resources. European Commission, Joint Research Centre (JRC)

[13] Michalis Vousdoukas, Lorenzo, Mentaschi, Evangelos Voukouvalas, Martin Verlaan, Luc Feyen (in press 2017). Extreme sea levels on the rise along Europe's coasts. Earth's Future. DOI:10.1002/2016EF000505

- **Improved data on green bridges** (for large infrastructure projects, e.g. in the case of RB planning) is required for further analysis on **disruptions of GI network**, thresholding to account for inter-species variation in dispersal capacity.
- **Indicators that allow to monitor the connectivity in the long-term** could reduce the risk of isolation of small, interspersed hub islands (e.g. movement capacity of species). The identified isolation of some hubs could affect its condition, reducing the capacity of delivering certain ES, particularly regulation ones.
- There is a lack of information on **areas in-need for GI restoration and enhancement**, as well as for development of new GI elements, to cope with territorial challenges (i.e. climate adaptation) and GI disruptions.
- Refine input data for hubs; e.g. incorporate minimum size; Natura 2000 conservation status. Target specific habitats

6.3 Vision, common standards, and benchmarks

PR 02 Co-create Strategic Green Infrastructure Vision, Common Standards and Benchmarks

Relevance	Feasibility/Viability of implementation	Urgency

Why- Coherence amongst the establishment and management of GI elements between different planning scales – national, regional and local.

What- Elaborate a comprehensive GI taxonomy identifying all GI elements and defining protection and land uses restrictions. Having a common categorisation would better inform protection ordinances and provide guidelines for planning and management on how to make use of them.

Guidelines for defining the different elements that encompass the GI at different territorial scales, as well as its characteristics, highlighting their benefits through the Ecosystem Services they provide. This implies, among others: (i) delimitation of protected spaces their environmental value and other multifunctional spaces, (ii) preservation and restoration of the ecological corridors of interconnection between habitats, (iii) preservation of the vegetation, (iv) preservation of GI elements with ecological value and reinforcement of the ES provided, and (v) identification of areas in-need to deploy GI to enhance connectivity and increase ES provision.

This would imply specifically:

- Delimit protected spaces for their environmental value and other multifunctional spaces
- Preserve and restore the ecological corridors of interconnection between habitats, that guarantee genetic exchange
- Preserve the vegetation and, very especially, to the conservation of the wooded masses. Measures will be taken to restore ecological connectivity where it has been lost, and corrective or compensatory measures where a loss is anticipated. possible loss. Habitats of community and regional interest will be protected and conserved.
- Preserve the elements of the GI with ecological value and reinforce the ecosystems services they provide
- Identify areas in need to deploy GI to enhance connectivity and increase ES provision
- Matrix o uses- linked to natural risks including climate and adaptation enhancement of ES
  - Prohibited uses
  - Allowed uses
  - Conditioned uses

How - GI characteriszation guidelines for planners, with a clear definition of a common categorization of elements with different levels of protection status and regulation of land uses aiming to preserve, enhance, restore, and/or define new GI elements.

Who is responsible - Ministry of Environmental Protection and Regional Development (Latvia)

Where - Relevant at all planning scales

When - Short term

Specific reference to study

In particular, more efforts would be needed to address biodiversity: a number of rare species in this area that are affected by the felling of old forests. Attention needs to be directed at the ecological cohesiveness of the green network, in particular where the density of large structures in the green network is lower and cohesiveness is at risk (for instance, in the hinterland of main cities).

6.4 Supporting tools for planners

PR 03 Define Guidelines for Embedding Green Infrastructure Approach in Legislation and Spatial Planning

Relevance	Feasibility/Viability of implementation	Urgency
	"Difficulty to define thresholds for GI; Different functions may be relevant for different landscapes".	

Why- Improving the access and exploitation of available information and data is seen crucial to inform decision making and planning. Planners seems to be keen on making decisions based on GI and ES principles but still there is a need of knowledge-based decisions. There is a need for clear criteria and recommendations for land use management. Data and guidelines about how to make use of it should be made available by National Authorities- so all regions could use it with a certain level of criteria.

There is currently a moment of opportunity with the actualisation of municipality plans by 2025 required by law.

What- Elaborate a comprehensive Guidelines for planners. Guidelines about how to make use of available should be made available by National Authorities- so all regions could use it with a certain level of criteria. Planners and decision-makers should identify and quantify the main benefits and challenges of implementing GI for strategic planning and development, regardless of the of scale of governance. This should be informed by the existing data, information and knowledge about the multiple benefits and challenges associated with GI. It is important to recognise the multiple benefits provided by GI. Using a 'learning-by-doing' approach, based on scientific results and led by multi-disciplinarian scientific teams can help identify these multiple benefits.

How- Guidelines for planners on the use of exploitation of available GI data for informing planning decisions at different levels i.e. regional and local. Using common criteria, objectives and GI standards.

The **tentative guidelines for embedding GI approach into legislation and formal planning** are structured around the main ("theorical and common") phases of a territorial and urban planning process, and the main GI entry points, as well the specific GI analysis to be performed to inform planning decisions.

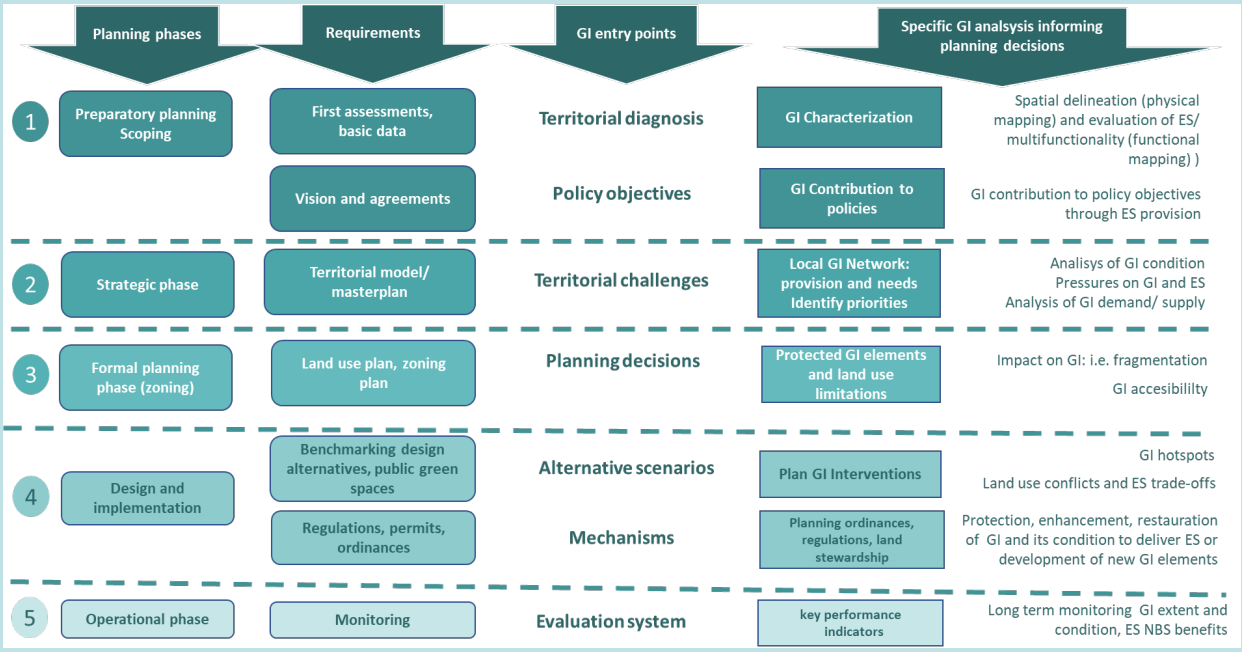


Figure 9. Integration of GI and ecosystem services in the formulation of territorial plans and programs. Source: authors own elaboration.

Phase 1 Preparatory planning- Scoping

GI entry point →Territorial diagnosis

Physical mapping: To determine the current GI, i.e., what natural and semi-natural features are currently present in the geographic area.

Functional mapping: To assess the provision of ES.

- Know and value the capacity of the identified ecosystems to provide services that have been considered relevant, i.e. biophysical evaluation of ES.
- Identify areas of high value to provide ES, since it allows to know distribution of ES in the territory, and this will facilitate establishing priorities in decision-making related to land use planning.
- Locate areas with a high capacity to provide multiple ES (multifunctional spaces) that should be a priority in territorial planning, since they concentrate the ecosystems that provide the most services to society.
- Prepare a proposal for the establishment of a GI.

GI entry point →Policy objectives

The identification of potential GI contribution to certain objectives may be done by identifying ES provision and understanding their supply capacity for supporting those policies.

One method to include GI benefits into decision making is via cost-benefit analysis. Use this insight to inform investment decisions in GI.

Another method is to conduct a 'State of evidence' for Benefits and Challenges of GI, i.e. where are the gaps – for example, developing a scale of evidence (e.g. 5-point scale to illustrate depth of knowledge 1 = weak to 5 = very strong).

Phase 2 Strategic

GI entry point →Territorial challenges

Analysis of GI condition: Numerous data is available on local, regional and national levels, for assessing the extent of GI; however, there is lack of data and metrics for assessing the quality and condition
Identify the main pressures on ecosystems and how to emerge to the provision of ES.

- Changes in land use: They involve the direct replacement of one ecosystem for another and, therefore, the replacement of the services provided by the disregarded ecosystem by those provided by the newly established ecosystem, which may mean, for example, the direct transformation of a forest area into an urban area. This is the aspect that is most directly related to the preparation of territorial and urban planning plans.
- Climate change: The 6th Report of the Intergovernmental Panel on Climate Change (IPCC, 2022) includes how climate change aggravates the degradation of ecosystems, with changes in the structure and functions of said ecosystems being very likely.
- Pollution: It is one of the drivers of change that, in general, destroys most ecosystems. Atmospheric pollution and contamination of water and soil are the most important drivers of loss of services, especially supply and regulation services.
- Invasive species: The existence of invasive species is one of the greatest threats to the conservation of native species according to the International Union for Conservation of Nature (IUCN) and the second threat to world biodiversity, after the destruction of habitats.

Phase 3 Formal planning (zoning)

GI entry point → Planning decisions

Incorporate GI as a conditioning factor superimposed on the management of the physical environment that will limit or condition the established regime of land uses. Including it indirectly contribute to the normalisation of mainstreaming GI in formal planning.

- Protected GI elements and land use restrictions
- Impact on GI i.e. fragmentation
- GI accessibility analysis

Phase 4 Design and implementation

GI entry point → Alternative scenarios

- Benchmarking design alternatives: considering GI and public green spaces as key criteria. green infrastructure approach could be used for benchmarking planning and design alternatives, considering green infrastructure and ecosystem services as planning criteria:
  - Enhancing the ES, when diminishing trade- offs.
  - Promoting balance between supply and demand of ecosystem services to support sector policies.
  - Supporting physical and functional connectivity for natural processes and for the sake of biodiversity.
  - Providing land use principles for spatial planning based on the main elements of the green infrastructure definition/concept: i) Connectivity – the idea of a network which implies not only physical but functional connectivity; ii) Multifunctionality; iii) Multi-scale approach.
- Facilitate the analysis of synergies and conflicts (trade-offs) between different ES.
- Analyse the existing mismatches and unbalances, between the supply and demand of ES and potential land use conflicts. The identification of land use conflicts should inform decisions on where to invest resources, so that it is critical not only to solve direct planning challenges, but also to guarantee an integrated, and efficient cross-sectoral planning (e.g., financial departments).
- Analysis of supply and demand aimed to identify areas with unbalances in-need for enhance, or even develop, new green areas.
- Identify the points of interaction of green infrastructure with gray infrastructure and establish measures to manage these interactions.
- Identify hotspots for GI enhancement or in need of new GI deployment. Planners and decision-makers should identify GI “hotspots” that either require increased safeguarding or restoration, or in need of new GI, informed by accurate and updated spatial data on potential GI networks.
- Protection, enhancement, restauration of GI and its condition to deliver ES or new GI elements.
- Design measures to e.g., adapt to climate change through GI and Nature-based Solutions. What green and blue elements already exist in the area, or could be restored, enhanced or created to be part of a GI network? Use existing available data to look for ways to spatially connect these elements across the area. Think creatively – are there rooftops or other structures that could have vegetation planted on them? Are there agricultural lands

that could be enhanced by adding, for example, hedgerows thereby providing habitat for wildlife and contributing to management of water?

Phase 5 Operational

GI entry point → Evaluation System

- Incorporate key performance indicators for GI and ES into the evaluation system of the plan
- Long term monitoring GI extent and condition
- ES NBS benefits

Who is responsible - Ministry of Environmental Protection and Regional Development (Latvia)

Where - Mainly regional and local scales.

When - Short term

Specific reference to study

Establish the criteria, measures and actions to achieve an effective ecological continuity: the recovery of vegetation and ecosystems, the restoration of the elements that permeabilise the agricultural matrix and that constitute ecological connectors, as well as the maintenance of traditional agricultural uses.

PR 04 Develop a Long-Term Monitoring System for Green Infrastructure

Relevance	Feasibility/Viability of implementation	Urgency
"Relates to PR01 and PR05 - a question of setting up a highly integrated system for data management and utilisation, as well as collection"	*"System integration may be costly and should only be done when experts have the skills to interact"*	

Why- Lack of long-term monitoring data on GI extent (trends) and GI condition (status/health). Need to monitor GI and ES impacts, benefits (and disbenefits) along different period (short and long terms) to be aware on how they impact a specific territory.

What- The measurement of impacts of GI and ES provides knowledge on how they affect the territories where they are embedded, besides allowing an easy identification of the barriers and levers, which supporting a good planning. To identify their short and long-term benefits, it is necessary that specific KPIs are co-designed and integrated into the planning evaluation system. The relationships between GI, biodiversity, and ES are dynamic and must be monitored and examined over long time periods to develop effective and adaptive management measures. Previous efforts in ecosystem services evaluation and GI delineation can be used as a strong baseline to inform decision-making on monitoring. Iterative monitoring over a certain period of time may assure the provision of empirical evidence on the benefits of implementing GI. Time series and change/trend analysis in this context of monitoring and data would be beneficial.

How- Monitoring framework and evaluation system:

Develop a repository for valuation data specific to GI, which could provide comparative data and facilitate benefit transfer analysis. Suggested data to include detailed description of the GI under study (type, size, ecosystem services provided, facilities, location), socio-demographic characteristics of the population profiting from the GI, and detailed description of its implementation and evaluation methods (date of study, specific benefits being valued, etc.

Having a centralised monitoring framework and evaluation system, would facilitate planners to develop ad hoc Key Performance Indicators for measuring and evaluating GI and ES into the planning evaluation system (i.e. within SEA procedure) and as a basis for adaptative management towards future changes, to:

- Assess the effects of the spatial plans with a long-term perspective, considering GI physical and functional indicators to address territorial challenges (including social).
- Evaluate the progress of the actions that are planned, defining process indicators and how often they will be updated.
- Determine coverage percentage of GI,
- Assess number of core areas connected by GI
- Assess number of ecosystem services supplied by GI
- Determine number of policy frameworks benefiting from GI

Who is responsible: Ministry of Environmental Protection and Regional Development (Latvia)

Where- Relevant at all planning scales

When-
Operational set-up in the short term
Long-term monitoring for data capture required.

Specific reference to study
See data gaps identified in the study, described in PR1

PR 05 Customise the Existing Online Spatial Planning System (TAPIS) and integrate the information of the Data Service and Visualisation Tool on the Natural Data Management System OZOLS

Relevance	Feasibility/Viability of implementation	Urgency

Why Improving the access and exploitation of available information is crucial for informed decision-making and planning

What- Dynamic online searching of data and information regarding GI characterisation and GI condition, GI and ES supply and demand against different policies, at different planning scales for better informed planning.

How- In terms of existing spatial data, OZOLS is a viewer that allows the user to visualise and represent the information selected, as well as navigate through different areas with varying levels of details. Although, the GI-related information may be extended and updated to allow a better use of the tool as part of the planning process.

There is also Spatial Development Planning Information system (TAPIS). This spatial development planning system public part - https://geolatvija.lv/geo/tapis3 (for planners there is also interface where one needs a login)

- In order to improve this, the **data content could be extended** to include all types of GI and the data gaps identified in this project, as a fundamental GI related data that may support the decision-making process (see PR1 for description of data gaps identified in the study).
- By having the **metadata** of each of the elements included in the tool, the robustness of the systems could be guaranteed.

- **Updating information** is key for such a tool to work properly and be reliable and useful in practice and could follow a systematic process to be implemented. The proper coordination of activities of gathering, processing, representing, categorising and publishing existing information is paramount.
- Since the information to be used is mainly public, it would be desirable to develop a specific guide to guarantee the **compliance of spatial data with INSPIRE** or any other directive, such that the interoperability of data is considered, and so that both domestic (among regions and municipalities) and international (among neighbouring countries) cross-border areas could be better planned in terms of GI connectivity.
- For that, it is also essential to count on a **consistent capacity and capability building program** for different actors to take responsibility for the information and data being uploaded, going through a quality-check and following the INSPIRE directive, confirming that data is truly interoperable.
- Since GI mapping may be complex, the **link to documents reporting the methodological processes** behind each information presented, would be a useful source of information for policy development.

Other actions are also recommended in terms of extending the services provided in the existing tool, that is based basically on the representation and information of existing spatial data:

- As scale matters, it is important to provide **links to access and connect different databases**, which may give support to an integrated and multiscale decision process, in case the system does not have direct access to information provided at different scale (regional and local).
- **Dynamic and interactive tool to include real-time information** by the citizens through a co-creation process – this could work for the detecting of irregular activities, propositions for new installations, and a monitoring of the GI in place. Online and interactive tools.
- **Visualisation tools** to share results with the community in an intuitive and attractive way and so that they understand and are aware of the importance of GI and its benefits.
- **Summary diagrams, KPIs and monitoring data**, could also be included in the same system, so to avoid incompatibilities and bring all related information into a unique robust, trust-worthy and transversal resource.

Who is responsible: Ministry of Environmental Protection and Regional Development (Latvia)

Where- National level, in close connection with regional and local information systems.

When - Short and medium term, depending on the regularity of the information gathering and capacities.

Specific reference to study

See data gaps identified in the study, described in PR1.

6.5 Enabling mechanisms

PR 06 Reinforce Vertical and Horizontal Collaboration in Green Infrastructure

Relevance	Feasibility/Viability of implementation	Urgency
	"Currently lacking capacity for extensive, beyond formal collaboration"	

Why - Lack of dialogue between sectorial teams and administrative levels could lead to an unconsciously biased GI plan, which should necessarily have a systemic and holistic perspective

What - Ensure the better governance through generating in-depth debate and active discussion among different sectoral and administrative levels, aiming to establish a shared view and common objectives, but mainly to produce the expected impacts from a successful GI planning.

How - Considering that GI is an integrated and such transversal concept and approach a good governance is required for maximising positive territorial impacts. In addition to an efficient vertical collaboration among different levels of the administration in support to the planning process, it is also imperative to promote a **close and fruitful collaboration among sector policies, sector strategies, and the different competent departments and teams within the administration**. The vertical but more important the horizontal collaboration, would visibly improve the quality of the spatial plan, which would be able to incorporate concerns, visions, evidence and expertise coming from different perspectives.

- A good way of promoting it is through the **organisation of debate roundtables to enhance and coordinate cross-sector discussions** at each step of the planning process, among staff from the same administration coming from different departments and backgrounds. Existing mechanisms of territorial governance could be enhanced with new dynamics of knowledge sharing and connecting capacities to fulfil both the common and particular needs in terms of GI. Inviting experts in GI and ES could be an effective driver for the debate, and naturally launch the exchange focused to problem-solving.
- Promoting **join multisectoral and interterritorial roundtables** could also be positive to get inputs and needs from a holistic perspective, improving plans with the systematic approach, which is considered fundamental in order to make them more realistic and just.
- Besides impelling these worthwhile debates, it would be desirable to establish a **systematic review process** among different administrative departments in an organised structure. It would allow a methodical share of data and information to support the cross-sectoral and multilevel understanding of challenges, and a clearer identification of enablers and barriers from different perspectives.

The Table 1 provides the relationship between the territorial sectoral policies and main ES that could inspire the configuration of multisectoral and interterritorial roundtables

POLICIES	ECOSYSTEM SERVICES
Natural resource management (more efficient/sustainable)	Maintenance of soil fertility biologic control pollination storage of water resources
Climate Change: Adaptation	Temperature buffering, urban heat island effect reduction Strengthening the resilience of ecosystems to climate change Floodwater storage, surface water retention runoff to reduce the risk of flooding
Climate Change: Mitigation	Carbon storage and capture flood control

Disaster Prevention	Forest fire reduction Flood hazard reduction Reduction of landslides-landslides Protection against coastal erosion
Water use and quality management	Regulation of the hydrological cycle Contaminant retention water supply
Quality and usage management ground	Reduction of soil erosion Increased soil fertility
Conservation of biodiversity	Maintenance of habitats, species and genetic diversity agriculture and forestry Resilient, multifunctional agriculture and forestry Improved pollination Improved pest control Improved maintenance of soil fertility Regulation of the hydrological cycle
Health & Wellness	Regulation of air, water and soil quality noise reduction Accessibility to recreational spaces Improved health and social conditions Temperature buffering, reduction of heat island effect
Tourism	Ecotourism and recreational activities

Table 1 Relationship of territorial policies with the main ecosystem services. Adapted from Technical information on Green Infrastructure accompanying document COM (2013) 249 final.

In addition to these proposed governance mechanisms, it is crucial to mention that an **innovative governance should also count on the inputs from the local stakeholders**, who may improve the process from a more practical point of view. Sessions of open debate and co-creation instruments involving the local community are also welcome to these planning processes, through which a better horizontal governance may be promoted (PR 02).

Who is responsible: Ministry of Environmental Protection and Regional Development (Latvia)

Top-down approach from national to local and in some case regional administrations (depending on the planning competence)

Where- National and local planning scale mainly, but in some cases, may be applied to regional planning scale.

When- Not a priority.

Specific reference to study
Multi-level governance has already proven to be needed, for example, in the case of Rail Baltica - transport planning has been done, but little on nature crossings.
Lack of specialists on GI and spatial planning particularly at municipality level. Integrating all aspects (physical, environmental, social, economic, in a climate change context) into spatial planning, remains a challenge for most municipalities/local administrations.
There is a need for capacity building.

PR 07 Integrate Green Infrastructure into Strategic Environmental Assessment for Spatial Planning

Relevance	Feasibility/Viability of implementation	Urgency
"SEA should look at GI, but it is more important for planners to do it, not as request from SEA consultants"	*"Difficulty to define thresholds for GI; Different functions may be relevant for different landscapes".*	

Why. The Strategic Environmental Assessment (SEA) is an administrative procedure and an instrument that accompanies the approval and adoption of strategies and plans with a potential environmental impact.

The SEA aims to provide a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of all plans. It is applicable at various planning scales (i.e. national, regional, local).

It supports the implementation of EU sector policies (i.e. Climate Change, Water, Biodiversity, Marine, Waste, Energy, Transport, Rural development, Fisheries, Structural Funds & Cohesion)

The SEA is a tool based on Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014[2] and there are minimum standards and provisions that have been transposed into national law across Europe.

The SEA is intended to ensure that all parties integrate environmental assessment into the preparation and adoption of all SP at the earliest opportunity in order to provide a high level of protection for the environment and encourage long- term sustainable practices.

Article 3 of the Directive states that: "*The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the context of each individual case, the direct and indirect significant effects of a plan on the following factors:*

a. *population and human health;*
b. *biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/ EC;*
c. *land, soil, water, air and climate;*
d. *material assets, cultural heritage and the landscape;*
e. *the interaction between the factors referred to in points (a) to (d)"*

The integrated nature of the GI and ES concepts ensures that the above factors listed in the Directive (a) to (d) and their interactions are addressed.

What - Strategic Environmental Assessment (SEA) as an example of a suitable policy tool for incorporating GI into strategies, plans and programs

How - SEA guidelines

Who is responsible: Ministry of Environmental Protection and Regional Development (Latvia)

Where - Mainly regional and local

When Short-term

Specific reference to study

Rail Baltica SEA procedure

PR 08 Funding Pilots and Inspiring Examples: co- learning and upscaling/replication

Relevance	Feasibility/Viability of implementation	Urgency

Why - Need for evidence and best practices on land stewardship, payment for ES and other mechanism to enhance GI while involving the private sector

What - The role and relevance of private sector (e.g. developers, landowners) with regards to GI. For example, contributing to GI is it an opportunity or a restriction for private landowners?

How - Public funded hand-on interventions.

There is certain momentum from currently implemented and new initiatives such as digital twins (e.g. Ogre River).

EU funds can be well-capitalised on: Horizon Europe, NextGeneration, INTERREG, LIFE Programme, ESPON Programme.

MoEPRD and 3 municipalities (including Valmiera) are also in a LIFE project to facilitate it.

Who is responsible: Ministry of Environmental Protection and Regional Development (Latvia)

Where - Mainly regional and local

When - Short term.

Specific reference to study

- **Recreation demand: There is a need for an in-depth reflection on the culturally unique interaction with nature in Latvia and how to evaluate it.**
  - Customisation and review of methodological approach and weighting mechanism for analysing ES recreation opportunity spectrum, together with stakeholders to reduce a potential misconception that rural areas feature fewer recreation opportunities.
  - Link Recreation (Visitation) data with Travel Cost models for ES valuation.
  - Local Tourism information centres as a stakeholder can be involved in helping to solve the information gap.
- **GI network disruption risks:** Further analysis on GI network thresholding to account for inter-species variation in dispersal capacity.
  - Landscape assessment done currently in Latvia could provide also some useful data.
  - Road (and other barrier) and clear-cut analysis could help improving the data, municipality scale data could be needed.
  - Species protection plans and some nature project data could be used as a source for more detailed analysis.
- **Potential for use the resistance analysis carried out in GRETA Spin-off as a template to be implemented to other large infrastructure projects** as decisions move forward – once details are pinned down (e.g. Rail Baltica).

- **Climate change perspective in GI:** Suggested pilot studies:
  - **Hydrological modelling exercises at Daugava** River catchment in order to better assess the water retention capacity of the GI- to then upscale the exercise to other basins.
  - **Ogre** River **digital twin**
  - **Vulnerability and risk assessments under climate change scenarios**
    - **Flash flooding especially in urban areas:** Mapping areas with risk of flash flooding could highlight the problem and make arguments to fund adaptation measures as NBS
    - **Thermal stress on humans** in the 9 urban core areas and evaluation of NbS effectiveness as adaptation measures.
    - **Digital twins and advanced modelling** very relevant
    - **Citizen involvement** (citizen science) in data gathering
  - **Phenology study of GI under climate change scenarios**, to explore possible impacts on nature of the changes on temperature and precipitation patterns.

PR 9 Prioritise Nature-Based Solutions

Relevance	Feasibility/Viability of implementation	Urgency

Why - Nature-based Solutions (NbS) compasses all actions that are supported by ecosystems and the services they provide, to respond to various societal challenges such as climate change, food security or disaster risk.

What - Nature-based Solutions: a tool for improve the ES in urban environments. Internationally, the concept of NBS is taking hold, providing a genuine opportunity for the cities to adapt to climate change and improve sustainability, and at the same time responding to various environment, economic and social challenges. Besides, NBS innovate favouring the active participation of citizens in both the design and the management of the city. NBS should be promoted as they improve biodiversity and the well-being of the population.

At the level of urban planning, it is key to promote urban GI through the use of NBS to improve natural processes in the urban environment, such as improved drainage and water quality, mitigation of urban flooding, improvement of air quality and isolation acoustic. In this sense, it is also crucial to increase the provision of trees in the surroundings of the infrastructures to improve acoustic insulation, as well as a regulating factor of the climate comfort.

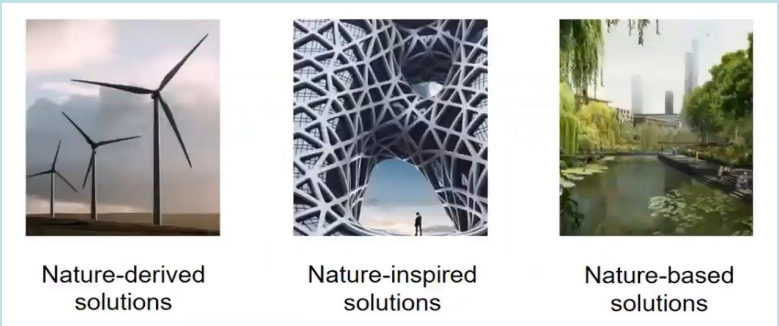


Figure 10 Nature-based Solutions in context. Source: IUCN, 2020.

In recent years, the European Union has had a prominent role in boosting the deployment the NBS in cities, also in the Euro-Mediterranean region. Beyond the general framework provided by the European Urban Agenda 2050, NbS

in the EU are horizontally promoted in the European Cohesion Policy (2014- 2020), and now the new EU Framework Programme for Research and Innovation for 2021-2027, connecting urban, regional, and environmental policies, bringing together established ecosystem-based approaches such as ecosystem-based adaptation and ecological engineering with the social and economic dimension.

Figure 11 The Societal Challenges Nature-based Solutions can address. Source: IUCN, 2020.

Notwithstanding the developing global evidence base on the benefits of NbS in cities, it is still in the relatively early stages of development and made up of evidence that is currently not sufficiently detailed to enable the development of city specific NbS strategies. Nor is there a sufficiently broad portfolio of case studies that are relevant, transferable and replicable outside of their original location; those profiled to date, typically relying on tailored investment and delivery mechanisms.

Most people live in cities and in cities GI impact will hast most impact, e.g. climate change adaptation and mitigation, air quality, water management. Landowners don't want GI; they want to build houses. This means that policy makers have to be strong and they have to understand what is GI and why cities need GI (what is benefit of GI for cities). Human wellbeing is a popular theme for them thus couching GI in terms of benefits for human wellbeing would be good way to get GI into their thinking and policies.

In many countries the primary sector is highly relevant for GI strategy and development (rural areas). As they have big impact (plus and minus) on biodiversity water, connectivity, climate change, etc. Message is about multi-functionality of GI (e.g. ecological): focus less on provisioning services, much more on regulation, cultural service and ecological functions. Integrate clear messages of this multi-functionality of GI into these regulations (e.g. CAP)

As an emerging area of policy, cities are therefore currently having to deliver bespoke local research and pilot projects to generate the knowledge and evidence base on NbS benefits, co-benefits and effectiveness they require for local policy development and investment attraction

How - NBS mapping guidelines. See best practice example here: Nature-based solutions for local climate adaptation in the Basque Country http://growgreenproject.eu/wp-content/uploads/2018/05/NBS-Climate-Adaptation-Basque-Country.pdf

Natural capital accounting https://ec.europa.eu/environment/nature/capital_accounting/index_en.htm

NBS standards https://www.iucn.org/theme/nature-based-solutions/resources/iucn-global-standard-nbs

NBS impact assessment – Evaluating the impact of NbS: a handbook for practitioners https://op.europa.eu/en/publication-detail/-/publication/d7d496b5-ad4e-11eb-9767-01aa75ed71a1

Who is responsible - Ministry of Environmental Protection and Regional Development (Latvia)

Where - All scales, but very relevant at urban scale

When - Short-term

Specific reference to study
At the level of urban planning, the urban GI must be articulated with the GI at landscape level to guarantee connectivity and also to maximise the benefits provided. In this case, NBS could play an important role.

Challenges	Nature Based Solutions
Aesthetic enjoyment **Improve community cohesion and recreation options** **Raise environmental awareness** **Role of the ecosystems in the food production**	Community gardens: herbaceous, vegetables, vegetables, fruit trees, plants ornamentals, flowers, etc. Community fishing areas (fishing ponds). Agricultural plots for production and education in unoccupied areas of the cities (fields, meadows, pastures, orchards etc.). Recreational forests of limited economic use (urban and peri-urban forests).
Adaptation to future impacts of climate change **Ensuring ecological resilience** **Prevent nuisance conditions of local weather** **Protect people from noise and air pollution**	Indoor and outdoor vegetation as a climate regulating factor. Green roofs: landscaped green roofs, vertical gardens and green walls. Water management measures in unoccupied areas: reduction of soil sealing, components that favour percolation, irrigation, improvement of soil structure etc. Small bodies of water within public green spaces: reduction of runoff, improving the natural purification capacity of water. Retention areas and polders in selected locations, designed for the flood. Complete the functionality of the plant system in the city: create core areas with vegetation (with a minimum area of 2 ha and a minimum tree cover 60%), interconnected through linear elements (corridors). Promotion of ecological networks: connection of the landscape and green and blue spaces to through linear components (such as hedges, riparian vegetation, ecoducts, etc.). Ecological restoration of watercourses, recovery of vegetation from riverbank (fundamentally outside built-up areas), revitalisation of courses of water in urban areas. Give preference to autochthonous deciduous trees in the repopulation of urban vegetation (a quota of 85% minimum). Revitalisation of old industrial zones and abandoned areas increase of the natural components (renaturation). Plant barriers against the wind (wind breaks, tree belts, …) planted especially to windward. Isolation with green vegetation, barriers and acoustic screens.
Improve wellness, physical and mental health **Provide opportunities for place attachment** **Safeguard historical values and cultural**	Gardens and health parks: designed for psychotherapy, aromatherapy, rehabilitation, ecotherapy (such as forest baths). Recreational forests (e.g. urban and peri-urban forests) and parks, facilities recreational and educational with an environmental character. Playgrounds and constructions with vegetation and natural elements. Areas that support cultural identity and sense of place based on elements natural (including tourist points). Protection and reconstruction of historic green spaces (parks, gardens, alleys, singular trees, etc.). Protection of vegetation within sacred areas (cemeteries and gardens of churches): reconstruction, restoration, adaptation.

Table 2 Examples of NBS: how they contribute to meeting defined challenges for cities by improving people's well-being and health. Source: Openness, 2015

The **Figure 12** bellow summarises the results of the qualitative exercise undertaken during the online workshop, for the assessment and valuation of each of the suggested policy recommendations in view of their relevance, viability (understood as feasibility for implementation) and the urgency of action.

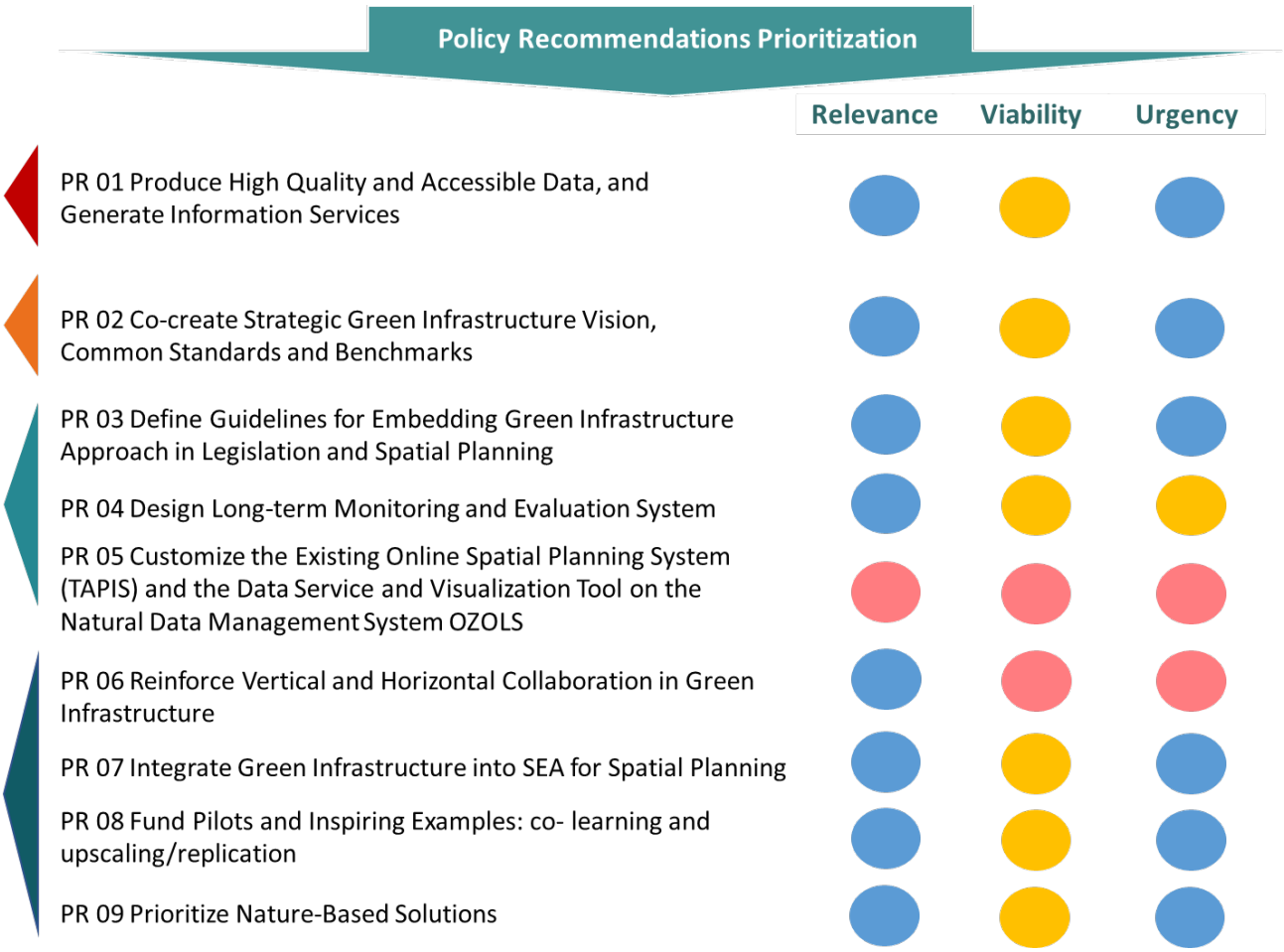


Figure 12 Summary of the prioritisation exercise undertaken during the online policy workshop.

Each policy recommendation has been qualitatively scored as High Medium Low with regards to three criteria, i) the relevance- how important is for Latvia, ii) the feasibility and viability, and iii) the urgency of its implementation.

7 Opportunities, enablers, and constraints for embedding GI concept and approach in spatial planning

ENABLERS	SPHERES	BARRIERS
√ *National, regional and local institutions show interest in GI* √ *Communal climate change / conservation certification schemes*	**Political will**	√ *No policy planning document currently for GI*
√ *Integration of GI in planning related regulations*	**Legal/ regulatory**	√ *Lack of thresholds and standards* √ *Lack of legal basis to promote GI*
√ *State institutions as the resource hubs* √ *Landscape planning as starting point for GI*	**Resources: knowledge sharing, data**	√ *Still long way to go on organising and streamlining data infrastructures* √ *Complexity of the issues and lack of specialists* √ *Insufficient knowledge and capacity of institutions to deal with GI planning and nature-based solutions*
√ *Active involvement in EU programme funding application* √ *Prioritisation of investments that are nature-based solutions* √ *Nature based solutions as alternative infrastructure with lower costs in many cases*	**Financial**	√ *Tangibility of GI and ES mostly restricted to specific applications e.g., flood control* √ *GI will need consistent funds, so national budget will have to be involved, but currently other priorities trump climate adaptation*
√ *Promoting capacity building* √ *New generation of professionals are slowly bringing in new skills*	**Technical capacities**	√ *Lack of experience in planning GI on all governance levels in Latvia*
√ *Nature as culture and valued highly*	**Perception/ social acceptability**	√ *Fragmentation of ownership for GI network development*

8 Online- workshop briefing

On the 8th June 2022 an online workshop was organised under the **GRETA Spin-off Latvia: Policy recommendations for embedding the concept of Green Infrastructure into legislation and formal planning processes**

The online workshop, facilitated by TECNALIA; was attended by members of the Ministry of Environmental Protection and Regional Development of Latvia, an expert from Valmiera Municipality and the GRETA project team.

Communication was done via MS TEAMS.

The two and a half hours' working session was dynamised in **MIRO** which is an **online collaborative whiteboard platform to facilitate online meetings and workshops.**

Figure 13 Screen shoot of the ice breaking exercise in MIRO that helped participants to get familiarised with the tool and also for getting to know each other.

A brief introduction was provided on the methodological approach applied for the formulation of the policy recommendations for embedding the concept of GI into legislation and formal planning processes in Latvia.

A document with the proposal for tentative policy recommendations was circulated to all participants prior the workshop.

Three interactive exercises were then carried out.

The first interactive exercise consisted of an individual qualitative valuation of the draft proposal for policy recommendations considering their relevance, viability/ feasibility for implementation and urgency. Group sharing of ideas and discussion followed.

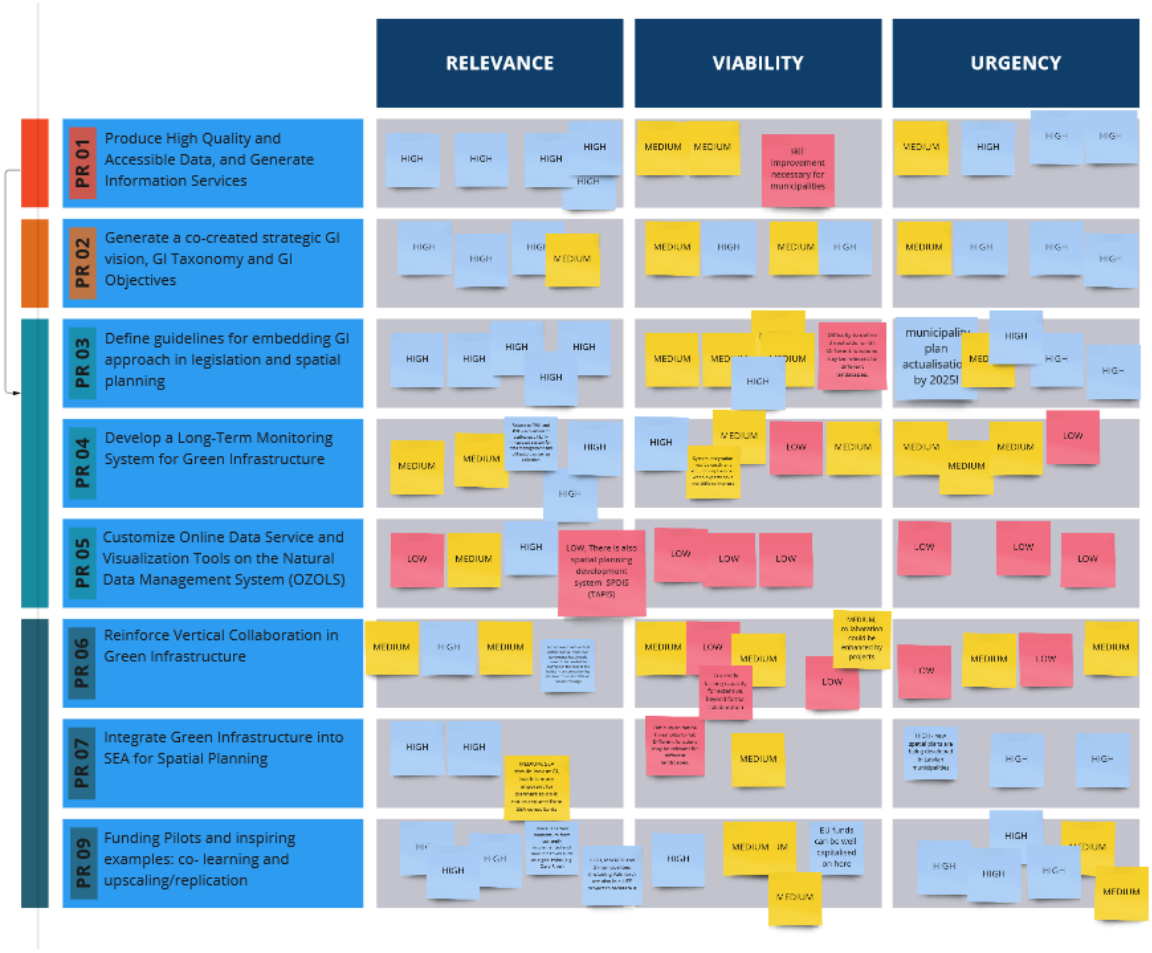


Figure 14 Screenshot of exercise one results.

The second interactive exercise was devoted to a focus discussion around three particularly relevant issues that were found out in the spatial analysis carried out during the first phase of the project for GI characterisation, namely: recreation demand, climate change perspective and disruption risks.

Participants reflect on key challenges related to each theme and provided potential solutions to overcome them.

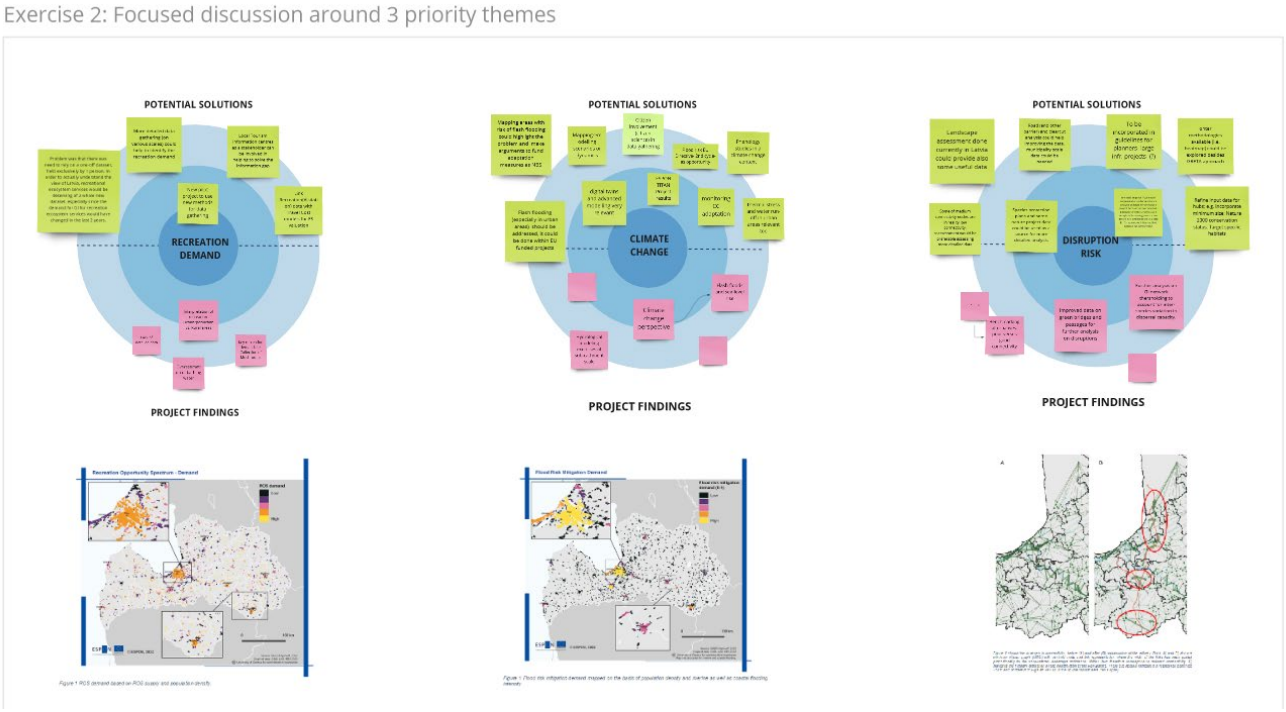


Figure 15 Screenshot of the results of the second exercise.

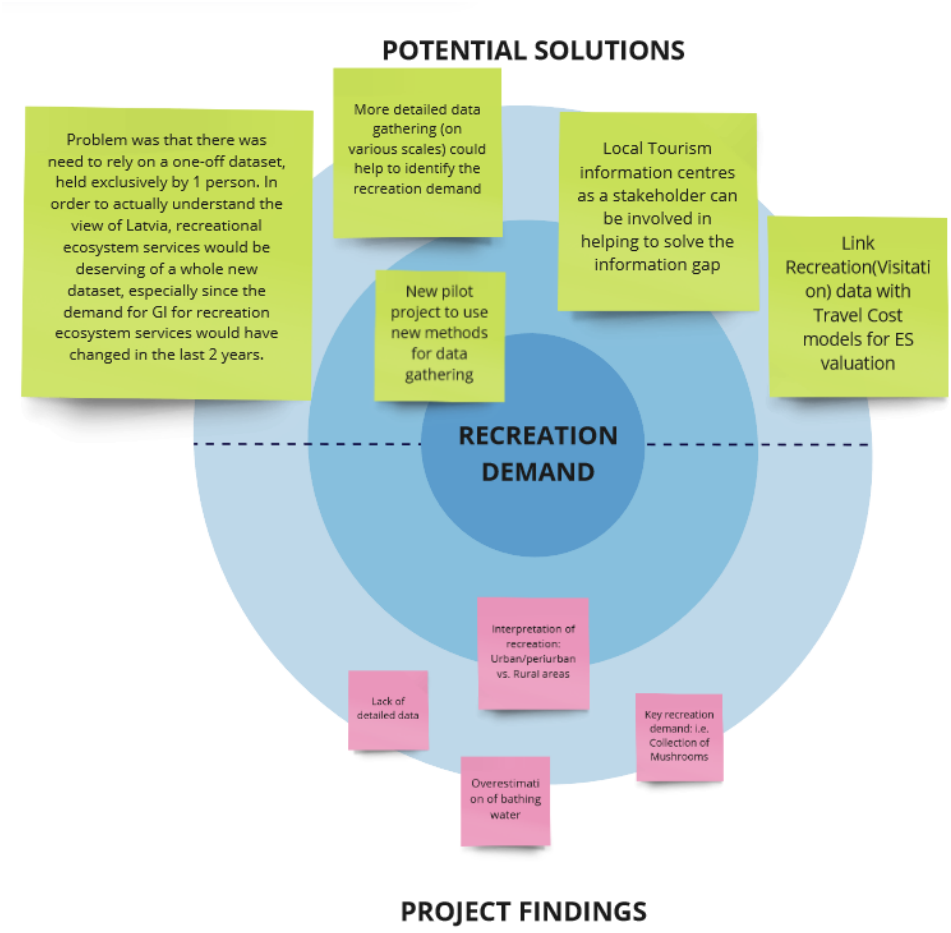


Figure 16 Zoom- into the results on discussion around recreation demand.

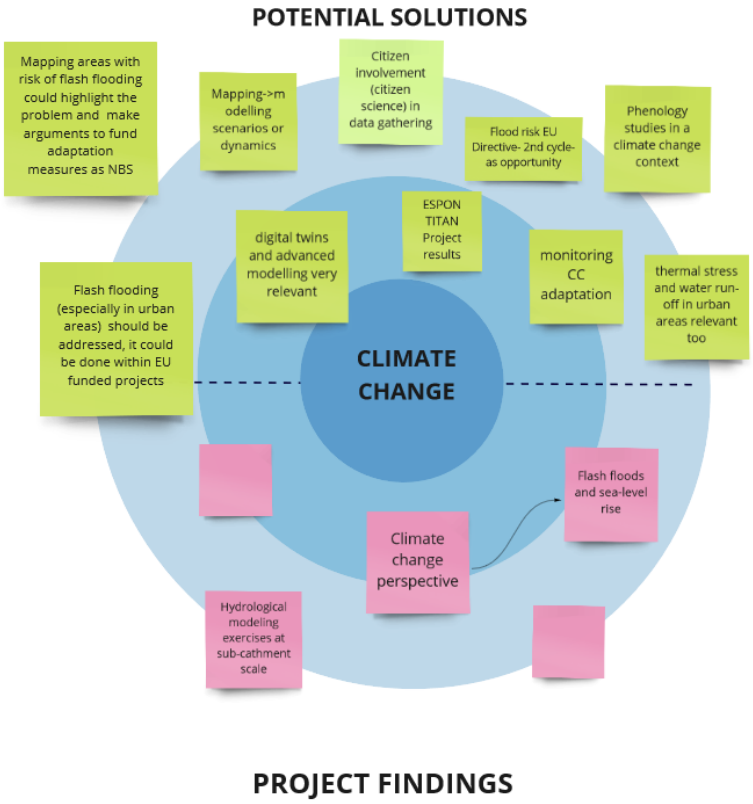


Figure 17 Zoom- into the results on discussion around climate change perspective.

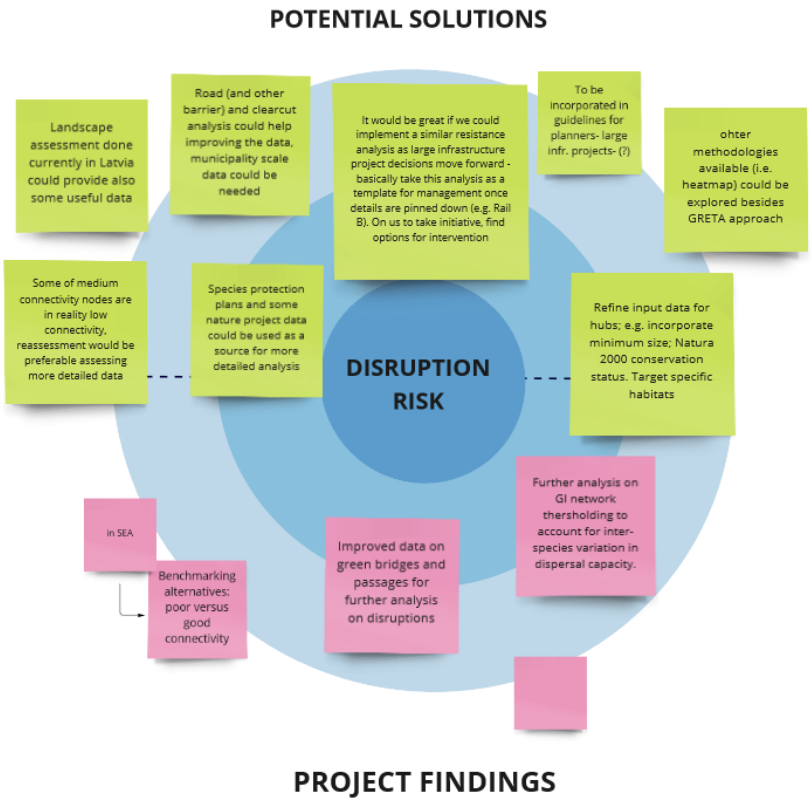


Figure 18 Zoom- into the results on discussion around GI disruptions risks.

Final exercise was devoted to reflecting of the enablers and constraints for the operative incorporation of GI approach in planning processes and formal planning instruments and more generally for the implementation of the suggested policies.

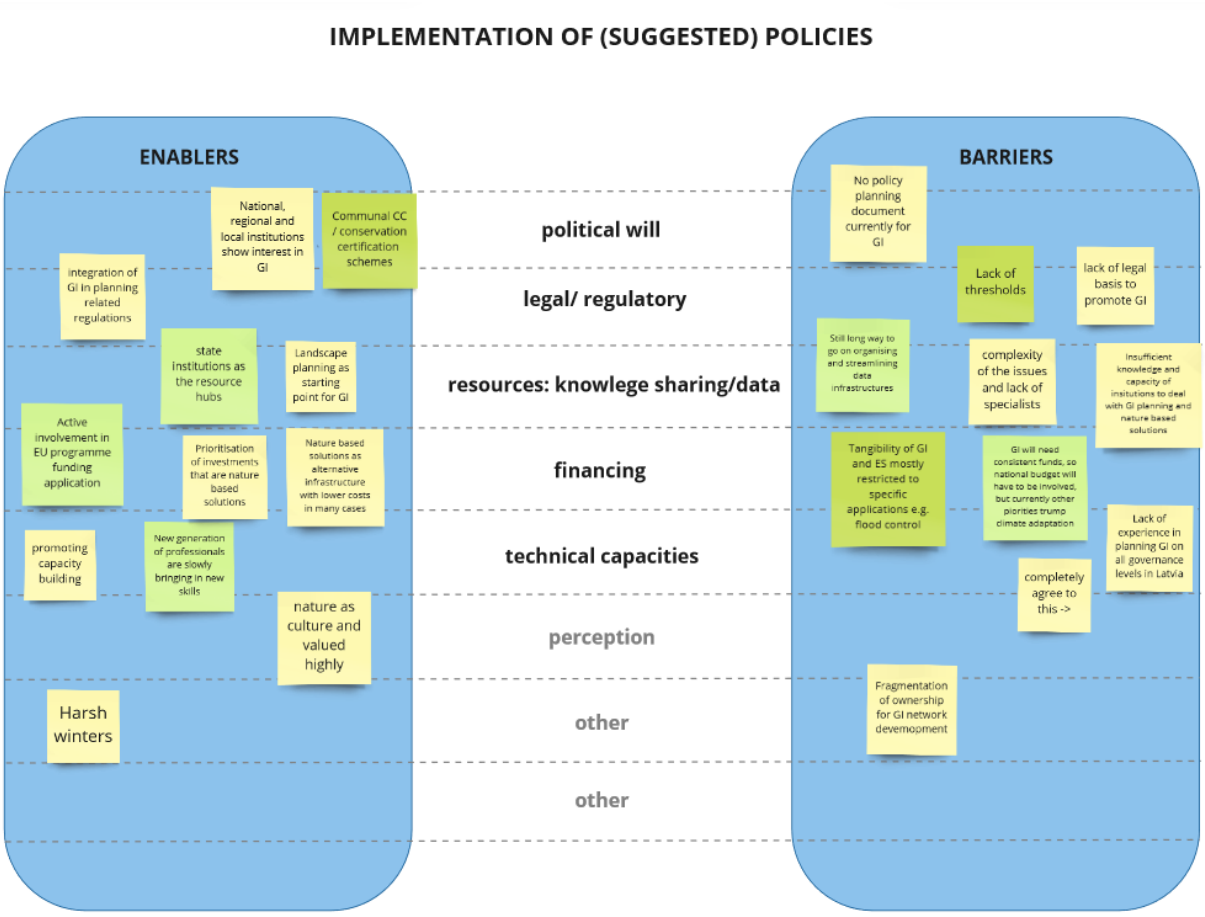


***Figure 19** Screenshot of the results of the third interactive exercise on implementation enablers and barriers.*

In summary, the workshop as a whole, received positive feedback from the participants, since it allowed this sharing of knowledge, the generation of a rich debate and the clarification of specificities about both, the consolidated stage on findings, and on the proposed policies included in this report.

9 References

Ahern, K. and Cole, L. 2012. Landscape scale – towards an integrated approach. ECOS, 33, pp. 6-12.

Carrao, H. et al 2019 GRETA - “GReen infrastructure: Enhancing biodiversity and ecosysTem services for territoriAl development”. Final Report.

EC. 2010. Towards a green infrastructure for Europe, Developing new concepts for integration of Natura 2000 network into a broader countryside, EC study ENV.B.2/SER/2007/0076. Available from: http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructure_integration.pdf , accessed 06 November 2017.

EC. 2011. Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions 'Our life insurance, our natural capital: an EU biodiversity strategy to 2020' (COM(2011) 244 final, 3.5.2011) (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0244:FIN:EN:PDF) accessed 25 August 2017.

EC. 2013. Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions 'Green infrastructure (GI) — Enhancing Europe's natural capital' (COM/2013/0249final) (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0249) accessed 25 August 2017.

EC and UN-Habitat (2016): The State of European Cities 2016. Cities leading the way to a better future. https://unhabitat.org/books/the-state-of-european-cities-2016-cities-leading-the-way-to-a-better-future

EC. 2018. The Natura 2000 Biogeographical Process
http://ec.europa.eu/environment/nature/natura2000/seminars_en.htm

European Commission (2013). EU Green infrastructure strategy. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Green Infrastructure (GI) - Enhancing Europe's Natural Capital Retrieved from http://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.htm , accesssed 2018-05-18

EC, European Commission (2015): Green Infrastructure in Latvia – fact sheet http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_LT.pdf , accessed 15 May 2018

EC, European Commission (2017). The EU Environmental Implementation Review Country Report – Latvia: http://ec.europa.eu/environment/eir/pdf/report_lv_en.pdf

European Environment Agency. 2011. Green infrastructure and territorial cohesion: the concept of green infrastructure and its integration into policies using monitoring systems. Publications Office of the European Union, Luxembourg.

European Environment Agency, 2014. Spatial analysis of green infrastructure in Europe, EEA Technical report No 2/2014, European Environment Agency (http://www.eea.europa.eu/publications/spatial-analysis-of-green-infrastructure) accessed 25 August 2017.

European Environment Agency, 2018. Similarities and diversity of European cities. A typology tool to support urban sustainability. ETC/ULS. Report | 03/2018. https://uls.eionet.europa.eu/Reports/ETC-ULS_report_CityTypology_final

Estreguil, C., et al. 2014. Connectivity of Natura 2000 forest sites in Europe. F1000 Posters 5, 485.

Estreguil, C. et al 2016 Enhancing Connectivity, Improving Green Infrastructure; EUR 28142 EN; doi:10.2788/170924

Garcia- Blanco, G. et al 2019 GRETA - “GReen infrastructure: Enhancing biodiversity and ecosysTem services for territoriAl development”. Case Study Report. Estonia- Latvia Cross Border Area.

IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In press, doi:10.1017/9781009157896

IPCC, 2022; Climate Change 2022 Impacts, Adaptation and Vulnerability Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. ISBN 978-92-9169-159-3

Lafortezza, R., Davies, C., Sanesi, G., and Konijnendijk, C. 2013. Green Infrastructure as a tool to support spatial planning in European urban regions. iForest - Biogeosciences and Forestry, 6, 102–108.

Loomis, J.B., Richardson, R.B., 2006. An external validity test of intended behavior: Comparing revealed preference and intended visitation in response to climate change. J. Environ. Plan. Manag. 49, 621–630. https://doi.org/10.1080/09640560600747562

Maes, J., Paracchini, M. L., Zulian, G., Dunbar, M. B., & Alkemade, R. 2012. Synergies and trade-offs between ecosystem service supply, biodiversity, and habitat conservation status in Europe. Biological Conservation, 155, 1–12. https://doi.org/10.1016/j.biocon.2012.06.016 .

Maes, J., Barbosa, A., Baranzelli, C., Zulian, G., Silva, F.B. e, Vandecasteele, I., Hiederer, R., Liquete, C., Paracchini, M.L., Mubareka, S., Jacobs-Crisioni, C., Castillo, C.P., Lavalle, C., 2015. More green infrastructure is required to maintain ecosystem services under current trends in land-use change in Europe. Landsc. Ecol. 30, 517–534. https://doi.org/10.1007/s10980-014-0083-2

Maes, J., Fabrega, Domenech N., Zulian, G., Barbonsa, A., Vizcaino, P., Ivits, E., Polce, C., Vandecasteele, I., Mari Rivero, I., Guerra, C., Perpina Castillo, C., Vallecillo, S., Baranzelli, C., Barranco, R., Batista e Silva, F., Jacobs-Crisoni, C., Trombetti, M., and Lavalle, C. 2015. Mapping and Assessment of Ecosystems and their Services: Trends in ecosystems and ecosystem services in the European Union between 2000 and 2010. Publications Office of the European Union, Luxemburg.

Maes, J., Teller, A., Erhard, M., Liquete, C., Braat, L., et al., 2013. Mapping and Assessment of Ecosystems and their Services. An Analytical Framework for Ecosystem Assessments under Action 5 of the EU Biodiversity Strategy to 2020. Discussion Paper. European Union, Luxembourg, 57 pp.

Maes, J., Teller, A., Erhard, M., Murphy, P., Paracchini, M.L., et al., 2014. Mapping and Assessment of Ecosystems and their Services. Indicators for Ecosystem Assessments under Action 5 of the EU Biodiversity Strategy to 2020. 2nd Report.European Union, Brussels, 80 pp.McGill, B., Enquist, B., Weiher, E., Westoby, M., 2006. Rebuilding community ecology from functional traits. Trends Ecol. Evol. 21, 178–185. https://doi.org/10.1016/j.tree.2006.02.002

Maes J, Zulian G, Thijssen M, Castell C, Baró F, Ferreira AM, Melo J, Garrett CP, David N, Alzetta C, Geneletti D; Cortinovis C, Zwierzchowska I, Louro Alves F, Souto Cruz C, Blasi C, Alós Ortí MM, Attorre F, Azzella MM, Capotorti G, Copiz R, Fusaro L, Manes F, Marando F, Marchetti M, Mollo B, Salvatori E, Zavattero L, Zingari PC, Giarratano MC, Bianchi E, Duprè E, Barton D, Stange E, Perez-Soba M, van Eupen M, Verweij P, de Vries A, Kruse H, Polce C, Cugny-Seguin M, Erhard M, Nicolau R, Fonseca A, Fritz M, Teller A(2016) Mapping and Assessment of Ecosystems and their Services. Urban Ecosystems. Publications Office of the European Union, Luxembourg.

Maes J, Teller A, Erhard M (2018) Shaping an EU wide ecosystem assessment. Scoping paper for an assessment of the state and trends of ecosystems and their services under Action 5 of the EU Biodiversity Strategy to 2020. 21 pp.

Maes J, Zulian G, Günther S, Thijssen M, Raynal J, Enhancing Resilience Of Urban Ecosystemsthrough Green Infrastructure. Final Report, EUR 29630 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-98984-1, doi:10.2760/602928, JRC115375.

OZOLS (2022), accessed 15 March 2022 Centralized Nature Data Portal - LatViaNature (daba.gov.lv)

Raudsepp-Hearne, C., Peterson, G. D., & Bennett, E. M. 2010. Ecosystem service bundles for analyzing tradeoffs in diverse landscapes. Proceedings of the National Academy of Sciences, 107(11), 5242–5247. https://doi.org/10.1073/pnas.0907284107

Richardson, R.B., Loomis, J.B., 2005. Climate Change and Recreation Benefits in an Alpine National Park. J. Leis. Res. 37, 307–320. https://doi.org/10.1080/00222216.2005.11950055

Saeima of Latvia, (2020), National Development Plan of Latvia for 2021-2027, NAP2027 prioritātes | Pārresoru koordinācijas centrs (pkc.gov.lv)

Turkelboom, F., Thoonen, M., Jacobs, S., García-Llorente, M., Martín-López, B., & Berry, P. 2016. Ecosystem services trade-offs and synergies. Unpublished. https://doi.org/10.13140/RG.2.1.4882.9529

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., James, P. 2007. Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. Landsc. Urban Plan. 81, 167–178. https://doi.org/10.1016/j.landurbplan.2007.02.001

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

ESPON 2020

ESPON EGTC
11, Avenue John F. Kennedy, L-1855 Luxembourg
Grand Duchy of Luxembourg
Phone: +352 20 600 280
Email: info@espon.eu
www.espon.eu

The ESPON EGTC is the Single Beneficiary of the ESPON 2020 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States, the United Kingdom and the Partner States, Iceland, Liechtenstein, Norway and Switzerland.