



- Identification and test of
- ESS stock exchange model
- methodology

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**Project Title:** LUIGI- Linking Urban and Inner-Alpine Green Infrastructure-Multifunctional ecosystem services for more liveable territories

**Work Package 2:** Tools and mechanisms for enhancing value chains for a more effective cooperation between urban and rural areas

**Project Output:** Identification and test of ESS stock exchange model methodology

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# The Ecosystem Stock Exchange: enhancing and fostering markets for Green Infrastructure

Ideally, the Stock Exchange works as a platform whereby local companies, NGOs and public institutions may encounter and get informed on the socio-economic and ecological context and, in particular, on the services and benefits provided by the local green infrastructures and their potential for market-based collaboration. By joining the stock exchange, non-state actors may get to know previously unknown opportunities concerning green infrastructures.

Policymakers have a fundamental role in the Stock Exchange as they provide the appropriate policy framework in support to ESs markets and, along with citizens' associations and grassroot movements, represent the public interest. It is important that this public interest valorizes and prioritizes the support ecosystem services, which might be ignored by private actors due to the indirect nature of their benefits.

The Ecosystem Stock Exchange is a tool that can be used to facilitate, verify, and establish basic conditions for the matching of supply and demand of ecosystem services (ES) on a regional and sub-regional basis. The Stock Exchange therefore provides a wide range of tools and information on the ecological and socio-economic regional and local features, with a specific focus on the benefits provided by green infrastructure, paving the way for new collaborations in the management of green infrastructures by involving a growing number of public and non-state actors in innovative market exchanges. It is based on the economic theories of markets and on specific studies on markets for ecosystem services.

## Economic & market background

- **Buyers & Sellers** (number, types, nature: private/public, etc.)
- **Level & type of competition** (industries, market characteristics, etc.)
- **Targeted markets** (level, segmentation, etc.)

## Features of traded service / benefit / good

- **Type of currency**
- **Ecosystem service features**
- **Type of benefits from GIs**
- **Metrics for benefits from ESS**
- **Biophysical constraints**
- **Units of measurement**

## Trade conditions in the region

- **Stakeholders involved**
- **Intermediary**
- **Non-compliance penalties**
- **Barriers to entry**
- **Regulations and governance**
- **Local human and social capital**

# Regional Level: LUIGI's socio-ecological informational basis for regional cooperation and market exchanges

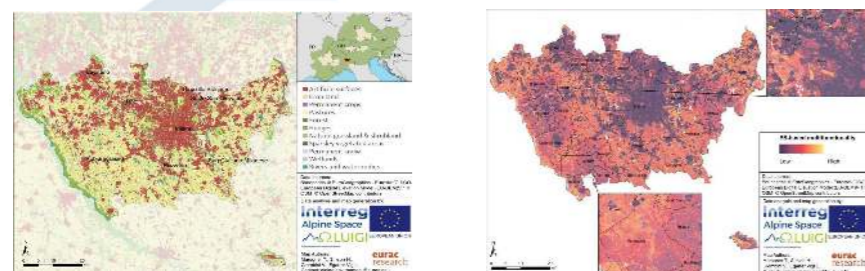
Indicators/tools		Market conditions and dimensions	
<b>Regional maps and ecological indicators</b> <ul style="list-style-type: none"> <li>• Conservation areas</li> <li>• Ecological corridors</li> <li>• Ecosystem services and bundles</li> </ul>	<b>Clear definition of service</b> <ul style="list-style-type: none"> <li>• Type of currency</li> <li>• Type of GI value: economic</li> <li>• Type of GI value: social</li> <li>• Type of GI value: ecological</li> <li>• Additionality</li> <li>• Biophysical &amp; physical constraint</li> <li>• Fungibility of currency</li> </ul>		

Indicators/tools		Market conditions and dimensions	
<b>Market potential assessment</b> <ul style="list-style-type: none"> <li>• Economic competitiveness</li> <li>• Employment structure</li> <li>• Main economic sectors</li> <li>• Ecosystem benefits and economic sectors</li> <li>• Ecosystem benefits and SDGs</li> </ul>	<b>Clear definition of service</b> <ul style="list-style-type: none"> <li>• Type of currency</li> <li>• Type of GI value: economic</li> <li>• Type of GI value: social</li> <li>• Additionality</li> <li>• Fungibility of currency</li> <li>• Level &amp; type of competition</li> <li>• Targeted markets</li> <li>• Non-compliance penalties</li> <li>• Barriers to entry</li> <li>• Regulations and governance</li> <li>• Local human and social capital</li> </ul>	<b>•Clear definition of service</b> <ul style="list-style-type: none"> <li>• Type of currency</li> <li>• Type of GI value: economic</li> <li>• Type of GI value: social</li> <li>• Additionality</li> <li>• Fungibility of currency</li> <li>• Level &amp; type of competition</li> <li>• Targeted markets</li> <li>• Non-compliance penalties</li> <li>• Barriers to entry</li> <li>• Regulations and governance</li> <li>• Local human and social capital</li> </ul>	<b>•Framework transaction conditions</b> <ul style="list-style-type: none"> <li>• Trade conditions in the region</li> </ul>

Indicators/tools		Market conditions and dimensions	
<b>Governance models</b> <ul style="list-style-type: none"> <li>• Type of regional governance</li> <li>• Relevant institutions</li> <li>• Relevant projects</li> <li>• Formal and informal instruments</li> <li>• Involved stakeholders</li> <li>• Type of funding programmes</li> </ul>	<b>•Clear definition of participants</b> <ul style="list-style-type: none"> <li>• Seller / beneficiaries</li> <li>• Level &amp; type of competition</li> <li>• Targeted markets</li> <li>• Non-compliance penalties</li> <li>• Barriers to entry</li> <li>• Regulations and governance</li> <li>• Intermediary</li> <li>• Local human and social capital</li> </ul>	<b>•Framework transaction conditions</b>	

## Regional Maps and Ecological Indicators (WP1)

The contribution of WP1 is related to the identification of three territorial categories, providing significant ecological information: conservation areas, ecological corridors, and Ecosystem Services and bundles. These features are essential to set up a market for ecosystem services, since a necessary element of any market or exchange scheme is the definition and measurement of the exchanged goods and services. The following maps show the land-uses and the ecosystem-based multifunctionality distribution in the Metropolitan City of Milan. This indicator shows in synthesis the capacity to provide multiple functions and services on the same spatial area.



## Market Potential Assessment (WP2)

The input given by the WP2 concerns the assessment of market potential at the regional level. A significant part of the LUIGI ESE depends on the very characteristics of a market for Ecosystem Services, that we divided into first and second order conditions. Particularly, second order conditions refer to market efficiency: meeting them should allow to achieve a functioning regional market for ecosystem services. A list of the features to be considered when assessing market potential at the regional level is presented in the first table below. Measuring market potential is feasible by following a six steps process, as shown in the other table below.

Criteria/PR
Clear definition of participants
Clear definition of service
Additionality
No compliance penalties
Opp cost vs ES provision cost
Biophysical & physical constraint
Fungibility of currency
Social & human capital (presence and efficiency)
Clear definition of participants

Steps for the market potential analysis
1. Definition of the size of the potential market (number of beneficiaries and value of the market)
2. Choice of the target market (e.g. regional, local, segment, etc.)
3. Analysis of the market needs (e.g. in terms of estimated investments or actions to be performed)
4. Assessment of the presence and level of competition (e.g. competitors' analysis)
5. Types and size of barriers to entry (e.g. regulations, market power, high transaction costs, etc.)
6. Assessment of regulations & governance methods: assessment of the type, contents and burden of regulations and governance modes adopted in the targeted market

## Governance Models (WP3)

The role played by WP3 for the purpose of LUIGI ESE involves the inclusion of fundamental governance variables in the assessment of regional suitability in hosting markets for ecosystem services. The main contribution from the analysis of alternative governance structures across the LUIGI pilot regions and case study areas refers to identifying a typology of regional governments and the identification and classification of the main private and public stakeholders active or influential in the area, the existing regulation and power structure. The table below shows an example of relevant institutions for the governance of the selected GIs in the Metropolitan City of Milano.

Type	Name of institution	Level
Government & administration	Superintendence of Cultural Heritage ( <i>Soprintendenza Beni culturali</i> )	National
	Lombardy Region Metropolitan City of Milan 133 Municipalities of the pilot region	Regional Local Local
NGOs & Associations	Italia Nostra Onlus through the Centre for Urban Forestation (managing Bosco in città Project)	Local
	Cultural Associations	Local
Community Authorities	Ecomuseum involved;	Local
	Regional Authority for Agricultural and Forest Services <i>ERSAE</i>	Local
Nature Conservation	Northern <i>Adda Park</i> and Parco del Ticino Park management body (Consorzium of the public authorities within the Park borders): <i>Parco Ticino PLIS</i> (Local Park of supra-municipal interest)	Local
	<i>Ferrovie Nord</i> – the infrastructure manager of the network of regionally owned railways – which is currently planning in collaboration with LUIGI partner <i>Fondazione Lombardia Ambiente</i> (FLA), to set-up a massive afforestation activity along its main train trajectories: FLA and MCM are currently assessing the technical feasibility to join forces and create synergies to LUIGI activities within MCM pilot area.	Local
Infrastructure operators	<i>LPT</i> – Local public Transport Agency	Local
	The Water Reclamation Consortia involved in the management of the main blue infrastructure of Milan metropolitan area, i.e. the "Navigli" system. An important example is given by the "Est Ticino Villorèse", which deals with the supply and protection of surface and groundwater, favouring all uses according to the priorities established by current regulations, and which takes all initiatives to support the development of agro-zootechnical and forestry production.	Local

# Case Study Areas: LUIGI's Socio-ecological informational basis for local cooperation and market exchanges

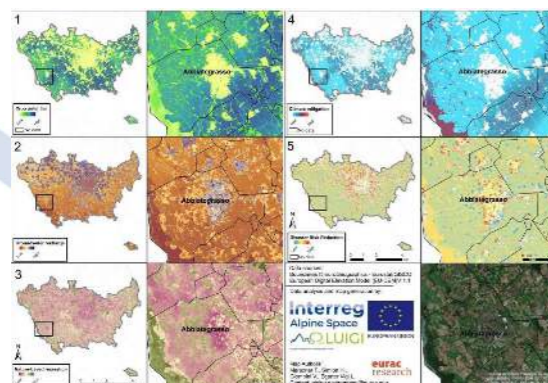
Indicators/tools		Market conditions and dimensions	
<b>Local maps and ecological indicators</b>	<ul style="list-style-type: none"> <li>•Support ecosystem services and bundles of services</li> <li>•Prioritised ecosystem services in the area</li> <li>•ES synergies and bundles</li> <li>•ES disservices and tradeoffs</li> <li>•Critical thresholds</li> </ul>	<b>Clear definition of service</b>	<ul style="list-style-type: none"> <li>•Type of currency</li> <li>• Type of GI value: economic</li> <li>•Type of GI value: social</li> <li>•Type of GI value: ecological</li> <li>•Additionality</li> <li>•Biophysical &amp; physical constraint</li> </ul>

Indicators/tools		Market conditions and dimensions	
<b>Value chain analysis and business models</b>	<ul style="list-style-type: none"> <li>•Enterprises, public utilities and stakeholders that benefit from priority ecosystem services</li> <li>•Enterprises, public utilities and stakeholders that benefit from other ecosystem services</li> <li>•Enterprises, public utilities and stakeholders that may potentially benefit from ecosystem services</li> </ul>	<ul style="list-style-type: none"> <li>•Clear definition of service</li> <li>•Framework transaction conditions</li> <li>•Trade conditions in the region</li> </ul>	<ul style="list-style-type: none"> <li>•Type of currency</li> <li>• Type of GI value: economic</li> <li>•Type of GI value: social</li> <li>•Additionality</li> <li>•Fungibility of currency</li> <li>•Level &amp; type of competition</li> <li>•Targeted markets</li> <li>•Non-compliance penalties</li> <li>•Barriers to entry</li> <li>•Regulations and governance</li> <li>•Local human and social capital</li> </ul>

Indicators/tools		Market conditions and dimensions	
<b>Governance models</b>	<ul style="list-style-type: none"> <li>•Resources (financial, knowledge, network, property, labor)</li> <li>•Local stakeholders</li> <li>•Discourses</li> <li>•Rules of the game (formal and informal)</li> </ul>	<ul style="list-style-type: none"> <li>•Clear definition of participants</li> <li>•Framework transaction conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Stakeholders</li> <li>•Level &amp; type of competition</li> <li>•Targeted markets</li> <li>•Non-compliance penalties</li> <li>•Barriers to entry</li> <li>•Regulations and governance</li> <li>•Intermediary</li> <li>•Local human and social capital</li> </ul>

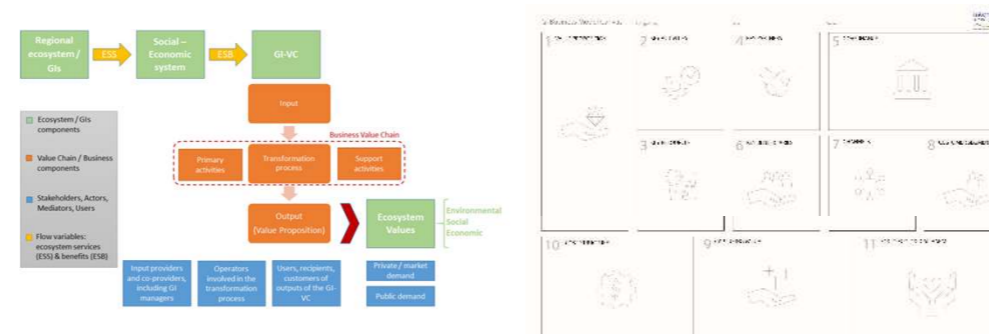
## Local Maps and Ecological Indicators (WP1)

At a local scale, it is possible to identify and quantify different types of ESS, determine the priority ones based on biophysical and ecological criteria (e.g. support services) and identify the ecological value they deliver in bundle (e.g. by using a multifunctionality index). Here they are shown maps of the South-West of Milan, where the ESS are mapped singularly. Under the market point of view, this information on local ESS and other ecological indicators is useful to ensure a clear definition of the service to be potentially traded and determine the contents needed to satisfy the specific requirements.



## Local GI value chains and Business Models (WP2)

At a more local and microeconomic, or business-centred level, WP2 contributes to the establishment of an ESE with tools that enable the entrepreneurs to participate in the market, since they help them perform direct analyses of the economic and industrial context where they operate. Information retrieved through the use of such operational tools (e.g. LUIGI GI-value chain analysis, GI-Business Model Canvas, etc.) directly helps businesses and entrepreneurs assess a large set of features of the GI-based markets where they might decide to enter. In addition to the typical tools used for market analysis and business strategy, the ones collected and adjusted in the framework of LUIGI project tend to underline the social and ecological dimensions of business activities in terms of dependency, opportunities, and impacts. In the pictures below, the GI-value chain scheme and the Business Model Canvas are illustrated.

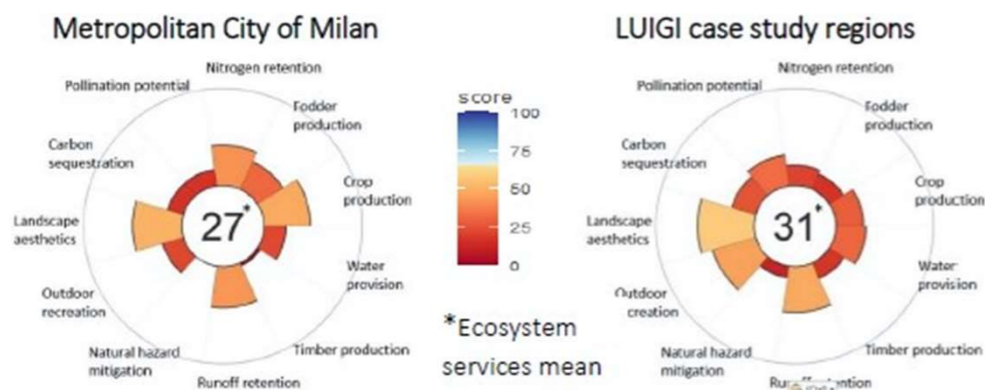


## Governance of GIs and local environmental legislation (WP3)

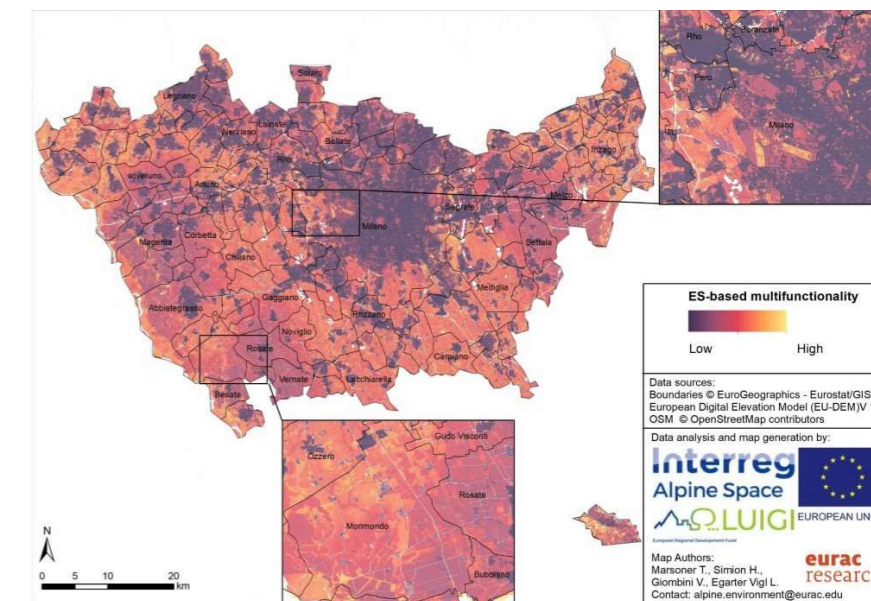
At a local scale (case study area), the contribution of WP3 is given by the identification of involved stakeholders (see Table below on the Metropolitan City of Milan) and by the analysis of the resources, the discourses and the formal and informal rules (see Hubner et al., 2021)

Involved stakeholders	Legend
<input checked="" type="checkbox"/>	Local public authority: All the Municipalities of the Adda Martesana Homogeneous Zone and MCM
<input checked="" type="checkbox"/>	Regional public authority: Lombardy region
<input type="checkbox"/>	Cantonal public authority:
<input type="checkbox"/>	National public authority:
<input checked="" type="checkbox"/>	Non-government organisations & Associations: Ecomuseo Adda Martesana, Fai (Italian Environment Foundation)
<input checked="" type="checkbox"/>	Community groups:
<input checked="" type="checkbox"/>	Business partners / SME: <a href="#">D.A.M.A.</a> (Distretto Agricolo Adda Martesana (D.A.M.A), 2020)
<input checked="" type="checkbox"/>	Education and research on GI: <a href="#">Eco Museum Martesana</a> (Ecomuseo del Martesana, 2020)
<input checked="" type="checkbox"/>	The public/inhabitants/visitors:

# Pilot Region example: The Metropolitan City of Milan

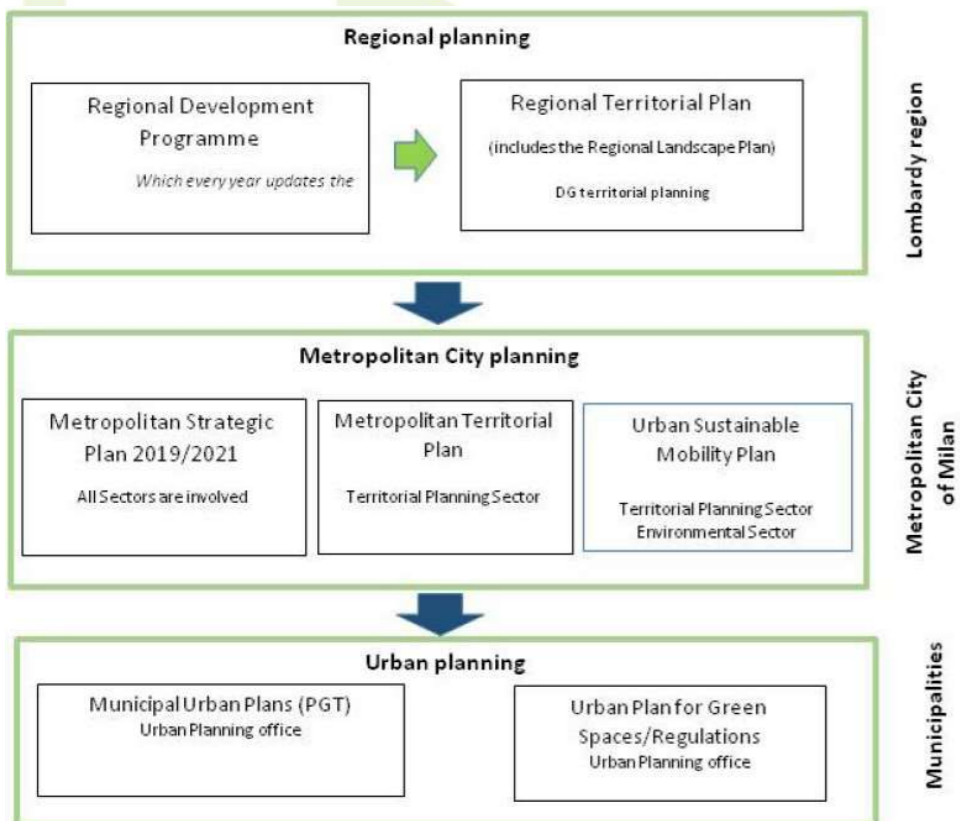


**Multifunctionality** based on Ecosystem Services is an indicator which is computed as the capacity of ecosystems to supply multiple ecosystem services on the same spatial area. It is calculated as the average of 11 provisioning, regulation and maintenance, and cultural ecosystem services mapped at high resolution (Giombini et al. 2022 Enhancing landscape multifunctionality and ecological connectivity across the Alps).



**A Collection of relevant institutions as important stakeholders** is necessary to identify the set of organizations involved multi-level governance system. This vertical structure, from the top has the Regional administration and its Regional Territorial Plan, followed by the Metropolitan City level (previously called Province) down to the municipalities, setting provisions for urban planning and green spaces regulations (Schrapp, L. (2020). Green Infrastructure governance approaches in the Alpine Space – Status analysis in selected Alpine Metropolitan regions and case studies. D.3.1.1. of the Interreg Alpine Space project “LUIGI”..

**Business Model Archetypes** are a different conception of the Business Model Canvas. They focus on the elements that render a GI-based business competitive and successful in those territorial contexts. These archetypes are a guiding tool for investors and policymakers who are interested in make investments in Green Infrastructures. This tool is a set of features for the categories of a canvas, where just some categories are filled to define the archetype. The tools we present here are characterizing by three general territorial features that include different types of GIs. They have been developed based on a specific type of GIs, which include the type of territory and cluster of activities.



**Periurban Farmstead: social work, high natural value, and economic sustainability**

The Archetype shown here above is based on a study performed in the area of Adda-Martesana, an agricultural district in the area of Naviglio Martesana. The main economic activities rely on food production and process of commodities produced in loco.

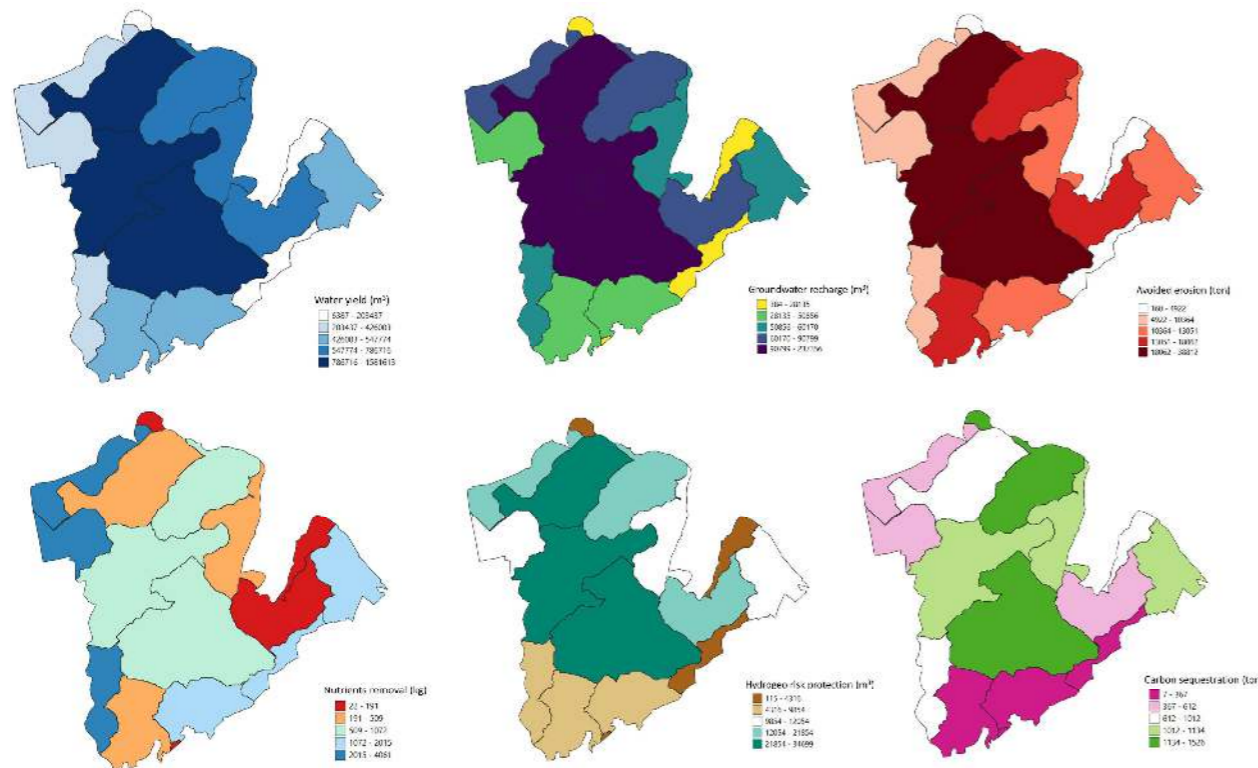
**Building together Natural Parks: coordinating different activities to reach common goals**

The Archetype shown here below has been inspired on a study made in Ticino Park. The economic activities are based on added value ensured by the quality of a protected area. It also emerged the power of cooperation among the actors involved in the park setting and sharing sustainability principles.

**Building territorial Networks to co-create values from GIs**

The Archetype, presented up here, refers to a complex territory that includes a cluster of different economic and non-economic activities that participate in the creation of different types of values, framed into the *Shared Value* paradigm. This model deals with a transforming and developing district.

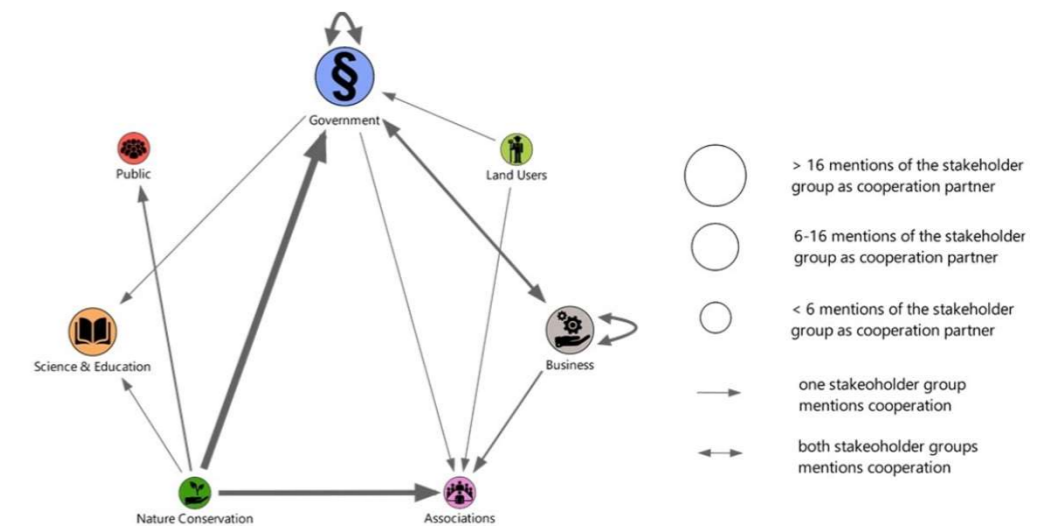
# Case study area example: The 5 Lakes of Ivrea



Servizio Ecosistemico	Valore economico medio annuo (Mln euro)
Fornitura superficiale	3.55
Fornitura sotterranea	8.36
Rimozione nutrienti	0.14
Stock cO2	0.42
Erosione evitata	3.32
Dissesto	0.04
<b>Totale</b>	<b>15.83</b>

Stakeholders: beneficiaries	Public beneficiaries are identified as the most relevant category to be addressed Local collectivity Regional collectivity National and global collectivity Farmers Agricultural processors Resource dependent businesses Municipal Drinking Water Plant Operators Electric and other energy generators Tourists/viewers Hunters Sports Researchers and students
Existing/potential trade-offs between ESs and conflicts between co-providers and beneficiaries	Potential tradeoff preliminary identified: tourism vs regulating services, agriculture vs forest production, agriculture and forest production vs regulating services

<b>Green management duties</b>	The Piedmont Region plans the regional ecological network, establishes with regional law new Parks and manages protected areas and Natura 2000 zones of regional interest. The metropolitan city of Turin plans the GI network at provincial level and manages provincial parks and Natura 2000 areas over which the Region delegated the competence. Each municipality is responsible for the management of the local public green areas (urban parks) as well of the hydrogeological safety and proper management of its territory.
<b>Green subsidies</b>	"PSR funds for agriculture development (e.g. organic agriculture: <a href="https://bandi.regione.piemonte.it/contributi-finanziamenti/psr-2014-2020-misura-11-agricoltura-biologica-nuove-adesioni-alle-op-1111-conversione-1121">https://bandi.regione.piemonte.it/contributi-finanziamenti/psr-2014-2020-misura-11-agricoltura-biologica-nuove-adesioni-alle-op-1111-conversione-1121</a> ) PSR funds for biodiversity conservation ( <a href="http://www.provincia.torino.gov.it/territorio/strat_strumenti/misura323/sperimentale.html">http://www.provincia.torino.gov.it/territorio/strat_strumenti/misura323/sperimentale.html</a> ) Ecological restoration incentives ( <a href="http://www.cittametropolitana.torino.it/cms/ambiente/risorse-idriche/progetti-ridriche/riqualificazione/decreto-forestazione">http://www.cittametropolitana.torino.it/cms/ambiente/risorse-idriche/progetti-ridriche/riqualificazione/decreto-forestazione</a> )
<b>List of NGOs</b>	Circolo Legambiente Dora Baltea Ecoredia Association/local products fare trade groups The cooperative of consumers managing the drinking water plant in Chiaverano Il Patto del Parco della Polveriera



# Conclusions

The Ecosystem Stock Exchange (ESE) methodology works as a checklist to test a region as potentially fit to host a GI/ESS market. It can be used at different levels from a simple qualitative check to a deeper investigation supported by information and application of appropriate tools. The ESE is a platform where information is made available to buyers and sellers to ease trade. It grounds on the theory of “market design” combined with research and practice on markets for ESS / PES, setting some basic conditions for an ESS market to be set up and host a sufficiently large number of transactions. The ESE methodology relies on the information collected by LUIGI on the objects of trade (ESS) and their biophysical characteristics and accounting; the market participants and their motivations; the regional governance context where a GI-market could be set up. The ESE is directly supported by instruments developed in LUIGI, such as Focus Groups methodology, ESS & eco-functionality maps and calculation methods, lists of benefits from specific GIs, regional governance indices and information, GI-business model canvas & archetypes, GI-courses and training. When the conditions for an ESE are met and tools properly applied, a growing number of stakeholders are likely to access the market, bringing to a large number of buyers and sellers (market thickness). Policy-makers may intervene by supporting ESS markets by ad hoc policies (market rules, non-compliance regulation, etc.) that also support the provision of information on the regional socio-ecological dynamics. More information opens up potential room for new products and services based on GIs, and business models for sustainable use of natural capital from regional GIs help make GI-markets more attractive for SMEs and startups and mobilise private finance to be used for sustainable GIs management.

# LUIGI's tools and resource for an ESE

Market conditions	Dimensions of GI-based markets	Data / Indicators	Source (WP)	Tool / Output
<b>Clear definition of participants</b>	Buyer	Stakeholders (case study area)	WP2 (2.2.1,2.2.2), 3 (3.2.1)	In-depth interviews Questionnaires
	Assessment of the presence and level of competition (e.g. competitors' analysis)	European Regional Competitiveness Index	WP2 (2.2.1,2.2.2), 3 (3.2.1)	Socio-economic data (Eurostat)
	Seller / beneficiaries	Stakeholders (case study area)	WP2 (2.2.1,2.2.2), 3 (3.2.1)	In-depth interviews Questionnaires
	Choice of the target market (e.g. regional, local, segment, etc.)		WP2 (FIBL Manual for Focus Groups)	Focus groups
<b>Clear definition of service</b>	Type of currency	Ecosystem services, Ecosystem services multifunctionality	WP1 (1.1.1a)	Ecological assessment and maps (GIS)
	Type of GI value: economic	Ecosystem benefits and values GI-value chains	WP2 (2.2.1, 2.2.2)	Socio-economic indicators Questionnaires Value-chain analysis
	Type of GI value: social	Ecosystem benefits and values GI-value chains	WP2 (2.2.1, 2.2.2)	Socio-economic indicators Questionnaires Value-chain analysis
	Type of GI value: ecological	Ecosystem benefits and values GI-value chains	WP2 (2.2.1, 2.2.2)	Socio-economic indicators Questionnaires Value-chain analysis
	Additionality	"Ecosystem benefits and values GI-value chains"	WP2 (2.2.1, 2.2.2)	Ecological assessment and maps Value-chain analysis
	Biophysical & physical constraint	Ecosystem services (supporting), Ecosystem services multifunctionality	WP1	Ecological assessment and maps
	Fungibility of currency	Ecosystem services, Ecosystem services metrics and multifunctionality	WP1	Ecosystem services multifunctional and functional maps
	Opportunity cost vs ES provision cost	Business models, Business model archetypes	WP2	GI-business model canvas, GI-business model archetypes
<b>Framework transaction conditions</b>	Intermediary	Stakeholders (case study area)	WP2 (2.2.1,2.2.2), 3 (3.2.1)	In-depth interviews Questionnaires
	"No compliance" penalties	Governance: rules of the game (case study area)	WP3 (3.2.1)	In-depth interviews Questionnaires
	Types and size of barriers to entry (e.g. regulations, market power, high transaction costs, etc.)	Governance: rules of the game (case study area)	WP3 (3.2.1)	In-depth interviews Questionnaires
	Assessment of regulations & governance methods: assessment of the type, contents and burden of regulations and governance modes adopted in the targeted market	Governance: rules of the game (case study area)	WP3 (3.2.1)	In-depth interviews Questionnaires
	Social & human capital (presence and efficiency)	Market potential assessment indicators: education attainment level, ngos	WP2 (2.2.1,2.2.2), 3 (3.2.1)	Questionnaire



# The LUIGI's ESE Checklist

Region: \_\_\_\_\_

Market conditions	Dimensions of GI-based markets	Check	Comments	Values
Clear definition of participants	Buyer			
	Assessment of the presence and level of competition (e.g. competitors' analysis)			
	Seller / beneficiaries			
	Choice of the target market (e.g. regional, local, segment, etc.)			
Clear definition of service	Type of currency			
	Type of GI value: economic			
	Type of GI value: social			
	Type of GI value: ecological			
	Additionality			
	Biophysical & physical constraint			
	Fungibility of currency			
	Opportunity cost vs ES provision cost			
Framework transaction conditions	Intermediary			
	"No compliance" penalties			
	Types and size of barriers to entry (e.g. regulations, market power, high transaction costs, etc.)			
	Assessment of regulations & governance methods: assessment of the type, contents and burden of regulations and governance modes adopted in the targeted market			
	Social & human capital (presence and efficiency)			

# How to use the LUIGI ESE Checklist?

- The checklist shows the three main market components that need to be checked in a region: market participation; service traded; trading conditions.
- For each of the components, the checklist introduces categories that help the analyst control whether the region under inquiry shows suitable conditions for GI markets set up.
- The Checklist can be used at first by experts willing to provide a general overview of the situation within a region simply by identifying the categories in the region and adding comments in column 4, if any.
- At a more advanced stage, the Checklist can be used in association with more specific datasets, figures or information on the region which can be collected on purpose (see the case with the LUIGI Pilot Regions and Case Study Areas in the table on p. 8, column 4)
- Information and data can be retrieved by using specific tools, some of which have been developed and applied by LUIGI project, but are suitable to be used also in other regions (see the available instruments developed by LUIGI in the table on p. 8, column 5)



Cetara L, Ballarin Denti A, Lapi Mita, Azzimonti O, Saracino R, Carolli S, Pianegonda A. (2022). Assessment of the market potential of ESS from regional GIs, particularly in the Alpine Space and in the pilot-regions

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