

# TeMA

Journal of  
Land Use, Mobility and Environment

print ISSN 1970-9889 e-ISSN 1970-9870  
FedOA press - University of Naples Federico II

DOAJ  Rivista scientifica  
di classe A - 08/F1

Scopus WEB OF SCIENCE



## NEW CHALLENGES FOR XXI CENTURY CITIES

Multilevel scientific approach to impacts of global warming on urban areas,  
energy transition, optimisation of land use and emergency scenario

Vol.18 n.1  
April 2025

TeMA Journal was established with the primary objective of fostering and strengthening the integration between urban transformation studies and those focused on mobility governance, in all their aspects, with a view to environmental sustainability. The three issues of the 2025 volume of TeMA Journal propose articles that deal with the effects of Global warming, reduction of energy consumption, immigration flows, optimization of land use, analysis and evaluation of civil protection plans in areas especially vulnerable to natural disasters and multilevel governance approach to adaptation.

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## NEW CHALLENGES FOR XXI CENTURY CITIES: Multilevel scientific approach to impacts of global warming on urban areas, energy transition, optimisation of land use and emergency scenario

1 (2025)

### Published by

Laboratory of Land Use Mobility and Environment  
DICEA - Department of Civil, Architectural and Environmental Engineering  
University of Naples "Federico II"

TeMA is realized by CAB - Center for Libraries at "Federico II" University of Naples using Open Journal System

Editor-in-Chief: Rocco Papa  
print ISSN 1970-9889 | online ISSN 1970-9870  
Licence: Cancelleria del Tribunale di Napoli, n°6 of 29/01/2008

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The cover image shows a composition of two photos of the Temple of Serapis in Pozzuoli (Italy). Giuseppe Mazzeo took them in January 2009 and March 2025. At the top, the 2009 image shows the temple flooded, with the pavement not visible. In the down, the 2025 image shows the temple's pavement dry and exposed. The Temple of Serapis is one of the leading visual indicators of the bradyseism phenomenon in the Phlegraean Fields. The bradyseism phase, highlighted by comparison, started in the first years of this century, as shown by the data published by the National Institute of Geophysics and Volcanology (INGV) on the website dedicated to the phenomena (<https://www.ov.ingv.it/index.php/il-bradisismo>).

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TeMA 1 (2025) 113-130

print ISSN 1970-9889, e-ISSN 1970-9870

DOI: 10.6093/1970-9870/11157

Received 10<sup>th</sup> September 2024, Accepted 6<sup>th</sup> April 2025, Available online 30<sup>th</sup> April 2025

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## Multilevel governance approach to adaptation. The construction of the Italian mid-Adriatic green infrastructure

**Rosalba D’Onofrio, Timothy Daniel Brownlee\*, Chiara Camaioni, Jonatha Cecchi,  
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### Abstract

There is a persistent discrepancy between the climate adaptation measures advocated by European and international bodies and the actual implementation of such measures. While implementation frequently occurs at the municipal level, which makes municipalities pivotal actors, this is insufficient. Indeed, the involvement of other levels of governance and the private sector is essential, as are adaptation actions that permeate all plans, programs, and projects of a public entity. An approach to adaptation that refers to multilevel governance and mainstreaming strategies for implementation is pioneered in the Life+ A\_GreeNet Project, which envisages the construction of the green infrastructure of the Italian mid-Adriatic city. This approach integrates adaptation actions into existing decision-making and policy processes, innovates the processes of construction of urban plans, and promotes the management and care of green with innovative and flexible tools.

### Keywords

Climate adaptation, Multilevel governance, Horizontal and vertical planning.

### How to cite item in APA format

D’Onofrio, R., Brownlee, T.D., Camaioni, C., Cecchi, J., Cocci Grifoni, R., Malavolta, S. & Marchesani, G.E. (2025). Multilevel governance approach to adaptation. The construction of the Italian mid-Adriatic green infrastructure. *TeMA - Journal of Land Use, Mobility and Environment*, 18 (1), 113-130, <http://dx.doi.org/10.6092/1970-9870/11157>

## 1. Introduction

Climate change is one of the most important challenges of our time, requiring rapid and effective responses at all levels of governance (De Waal et al., 2019; Di Gregorio et al., 2019) and robust collaboration among diverse public and private stakeholders (van den Ende, 2022; Termeer et al., 2013). The confluence of complexity, uncertainty, and conflicting values, coupled with the multitude of structural impediments inherent to the extant political system, renders the pursuit of adaptation policies a challenging endeavor (Eisenack et al., 2014; Tuhkanen et al., 2020; Moser & Ekstrom, 2010). The term “adaptation gap” (Eisenack et al., 2014) is used to describe this difficulty. It is primarily caused by a lack of political commitment, effective coordination, and cooperation between government departments involved at different levels (Persson et al., 2018), as well as the hierarchical, linear governance model employed (Lesnikowski, 2016; EEA, 2020; OECD, 2009; Keskitalo and Preston, 2019; Cha et al., 2024). The European Union has initiated an ambitious program to promote climate adaptation under the Green Deal (EC, 2019) and the new Adaptation Strategy 2021 (EC, 2021), emphasizing the necessity for involvement at all levels of governance (Clar, 2019), in particular at local level (Biesbroek et al., 2010; Pellizzaro, 2015). The latter is considered the most relevant for implementation (Zucaro et al., 2018), even if it occurs in collaboration with other levels (OECD, 2023). In the literature, the need to support local-level initiatives through a multilevel governance model (Adriazola et al., 2018; Birchall et al., 2022) takes on particular importance because it is recognized as having the capacity to avoid or resolve conflicts by different actors and at different levels of government (Ishtiaque, 2021; Gonzales-Iwanciw, et al., 2019).

This model appears:

- more suitable to overcome the same geographic boundaries that often make adaptation actions fragile on the local scale and thus more effectively implement strategies and projects that necessarily cross administrative boundaries and the limits of small and medium sized municipalities (Fila et al., 2024);
- more conducive to supporting a “place-based” (OECD, 2023) approach to adaptation on specific economic, environmental, and social contexts (Parks & Bertuzzi, 2022; Novalia et al., 2024);
- more capable in fostering the integration of national and subnational climate policies into urban and spatial development policies at all scales, avoiding watertight compartments and fragmentation of responsibilities and competencies (Candel & Biesbroek, 2018);
- more congenial to fostering polycentric governance arrangements (Ostrom, 2014) in which public and private actors engage in collective, simultaneous decision-making processes, prompting different actors to “learn, coordinate and cooperate” (Berardo & Lubell, 2019);
- more useful to exchange information and expertise between different levels, facilitating mutual learning (Bodin et al., 2017), encouraging the development of mixed-methods to coordinate actions, cooperating and resolving potential conflicts (Calliari et al., 2019).

A governance model with these characteristics may facilitate access to information and knowledge, enhance technical and financial capabilities, facilitate access to public funding, utilize private capital, and engage citizens and associations in the management of green spaces (Mattijssen, 2017). Casprini et al. (2021) posits that this model of governance will be fully operational by 2023. Additionally, in the event of a dearth of capacity and expertise among local authorities (especially smaller ones) on climate change issues, it may facilitate the creation of economies of scale (Blank & Niaounakis, 2021).

In a multilevel governance approach, the supra-local level of adaptation policies can play a pivotal role in guiding the process of implementation (Granberg et al., 2019). Indeed, subnational governments (regions and provinces) are expected to promote more coordinated planning and develop policy priorities than municipalities, which often lack staff and have scarce resources at their disposal (Fila et al., 2024). Planning tools at the supra-local (regional and provincial) scale can facilitate the integration of disparate policies, taking into account the multiplicity of goals (Kruse & Pütz, 2014) associated with adaptation, the diverse spheres and spatial levels (Ledda, 2020; Dupont & Jordan, 2021), and the multifarious public and private actors involved.

This article discusses the significance of an integrated approach, exemplified by the “Life+ A\_GreeNet” project. This initiative represents one of the initial efforts to implement a multilevel policy in the Italian Adriatic coastal territories. Furthermore, it serves as a testing ground for the governance model proposed by the PNACC (National Climate Adaptation Plan), which was approved by Italy at the end of 2023 (PNACC, 2023). The Life+A\_GreeNet project advocates the development of green infrastructure (Salata & Yiannakou, 2016) in the mid-Adriatic city-territory, spanning the cities of Ancona (Marche) and Pescara (Abruzzo). It addresses the challenges posed by rising temperatures, the importance of citizens’ health, and the role of green areas. The project’s objectives include establishing a unified governance structure, as proposed by Cittadino et al. (2022), which would integrate and enhance existing tools while coordinating the diverse competencies of various institutional levels, public and private actors, and partnership networks. Urban planning is of central importance to this path, as it plays a significant role in the implementation of many of the actions required to enhance urban resilience (Dabrowski et al., 2022).

The article aims to investigate:

- the enabling factors and obstacles of a multilevel approach in adaptation governance in the Life+A\_GreeNet project territory, which, although characterized by unitary characters for environmental, settlement, climate and risk aspects, belong to different regions and provinces, with their own instruments and regulations regarding environmental and spatial planning;
- possible public and private strategies to be deployed to overcome the criticalities of possible integration and to enhance the potential of network governance at the territorial and urban scale, with possible forms of replicability in other Italian and European contexts (Gustavsson, 2009).

Ultimately, the objective of the article is to highlight potential improvements to the methodology employed to facilitate the implementation of the identified adaptation actions over time. This may prove beneficial in the replication of interventions in other territorial contexts.

## 2. Climate adaptation in the Italian framework and in the context of the mid-Adriatic Sea

According to the European Environment Agency’s (EEA) first European Climate Risk Assessment, Europe is getting warmer twice as fast as the rest of the world, and current adaptation policies and actions are not keeping pace with the rapid growth in risk (EEA, 2024). The Italian territories are situated within the so-called “Mediterranean hot spot,” rendering them particularly susceptible to the effects of climate change (Doblas-Reyes, 2021; EEA, 2016). Furthermore, the national territory is prone to a multitude of natural hazards, including landslides, floods, coastal erosion, and water shortages. These risks are exacerbated by rising temperatures and the intensification of extreme events related to climate change, such as droughts, heat waves, strong winds, and intense rainfall. These factors contribute to amplified economic, social, and environmental impacts (PNACC, 2023). The National Strategy for Adaptation to Climate Change (SNAC) (Castellari et al., 2014) was initiated in 2015 and provided a national strategic vision regarding the mitigation of impacts on the land. Subsequently, in 2023, the National Climate Change Adaptation Plan (PNACC) was introduced, following a period of eight years during which the strategy was developed in full. The PNACC serves as a planning document, delineating *climate change* adaptation measures to be implemented at the national level. The document presents a series of recommended actions for adaptation, classified into 18 sectors: aquaculture, geological, hydrological and hydraulic disruption, desertification, inland and transitional water ecosystems, marine ecosystems, energy, terrestrial ecosystems, forests, hazardous industries and infrastructure, urban settlements, cultural heritage, marine fisheries, agriculture, water resources, health, transportation, tourism, and coastal zones. The trans-scalar dimension of adaptation is afforded considerable attention in the regional and local contexts (Annex I and II), with the objective of furnishing methodological guidance for the formulation of adaptation plans at each level and for the assessment of the efficacy of the

respective actions. Accordingly, the PNACC is based on the principle of subsidiarity, whereby subnational entities are tasked with providing the most effective responses to local adaptation needs, albeit within a unified planning framework ensured by the national level. Despite the lively debate that this Plan has provoked, with some environmental associations, the National Institute of Urban Planning (INU), and a few trade associations distancing themselves from it, there has been a general recognition of its high scientific value. It is observed that the Plan lacks sufficient operational value. This issue has been brought to light through the analysis of the press releases and web pages of numerous Italian environmental associations. These associations have expressed concerns regarding the inability to identify actions that can effectively anticipate the changes caused by the climate crisis, as well as the insufficient funding allocated to address these issues<sup>1</sup>. Further aspects regarding the operability of the PNACC pertain to its minimal projected impact on the realms of public administration, as well as on citizens and businesses, due to its marked deficiencies in the domains of implementation and governance<sup>2</sup>. This is compounded by the deterministic approach, as opposed to the need for a systemic and inclusive approach that includes the participation of local authorities and associations as a strategic element<sup>3</sup>. Other concerns include the lack of integration with other sectoral and territorial policies to maximize the effectiveness of adaptation measures, and coordination with other national strategies<sup>4</sup>. Nevertheless, it is evident that the Italian Ministry of the Environment (MASE) has endeavored to integrate climate change adaptation into the country's social and economic planning and to acknowledge the pivotal role of regions and local authorities in the formulation and execution of adaptation strategies. In order to achieve this objective, the PNACC requires subnational entities to develop their own adaptation strategies and/or plans. These entities must then proceed to "mainstreaming," as defined by Runhaar et al. (2018) and Baack (2024), in spatial and sectoral planning. Finally, they must provide themselves with the means to implement adaptation in practice. This entails integrating adaptation into existing development programs, policies, or management strategies, rather than relying on the development of new, separate adaptation initiatives (Runhaar, 2018; ten Brinke et al., 2022). This approach is pursued by the Life+A\_GreeNet Project, which is based on the central Italian Adriatic regions (Marche e Abruzzo). It implements an adaptation strategy that engages existing spatial planning tools and multiple levels of institutional expertise, with a particular emphasis on the involvement of local communities and stakeholders.

### 3. Materials and methods

The Life A\_GreeNet Project is a project co-funded by the European Union through the LIFE program. Its objective is to enhance the resilience of the Italian Mid-Adriatic coastline (between Ancona and Pescara) to the impacts of climate change, particularly rising temperatures and heat waves, through the creation of green infrastructure (Pantaloni et al., 2024; Kumar et al., 2024; Azmeer et al., 2024; Delgado Capel et al., 2023). In addition to addressing the environmental consequences of climate change, the green infrastructure project also aims to mitigate its economic and social impacts, including the potential effects on the local economy (Mobaraki, 2023), the environment and biodiversity (Garmendia et al., 2016; Lazzarini et al., 2024); human health and the quality of life (Climate Adapt, 2023; Palermo et al., 2024).

To effect this transformation, the project aims to develop multilevel and multi-actor governance, thereby strengthening the administrative capacity for climate adaptation of all levels involved in land planning and management (region, province, municipalities) (Ronchi et al., 2020; Monteiro, 2022; Marot, 2024), involving

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<sup>1</sup> See: <https://www.wwf.it/area-stampa/piano-nazionale-di-adattamento-tanto-rumore-per-nulla/>;  
<https://asvis.it/editoriali/3257-19920/il-pnacc-da-solo-non-basta-servono-risorse-e-politiche-coerenti-con-ladattamento>

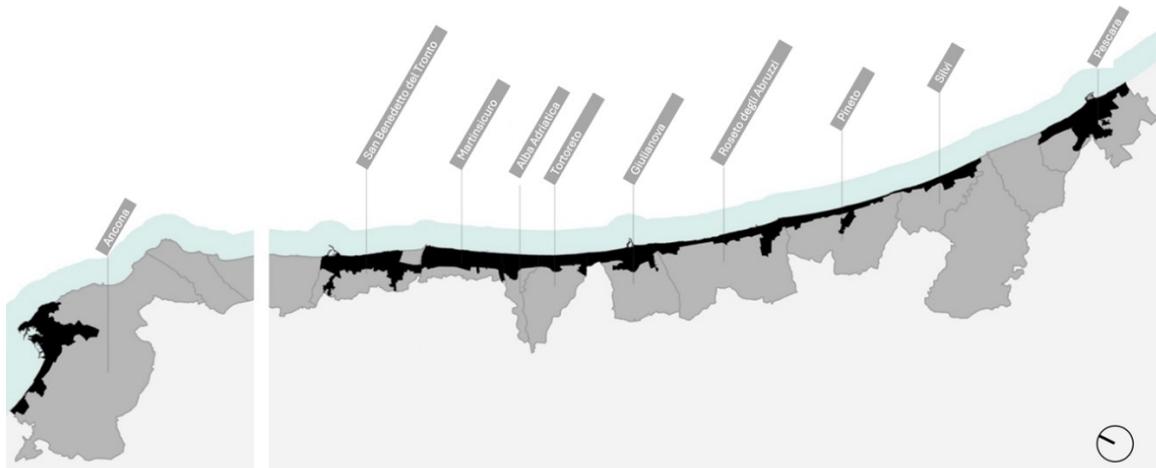
<sup>2</sup> See: <https://www.renewablematter.eu/arriva-pnacc-piano-nazionale-adattamento-cambiamenti-climatici-delude-tutti>

<sup>3</sup> See: <https://hubzineitalia.com/2023/05/16/pubblicazione-commenti-al-piano-nazionale-di-adattamento-ai-cambiamenti-climatici/>

<sup>4</sup> See: <https://www.agendadigitale.eu/smart-city/politiche-climatiche-ambizioni-e-limiti-dei-piani-pnac-e-pniec-del-governo/>

local actors (Scheiber & Mifsud, 2024). It is imperative that public and private actors collaborate in green management and design, thereby increasing their responsibility and awareness of adaptation measures. Furthermore, there is a need to integrate adaptation measures, namely mainstreaming (Ten Brinke et al., 2022), into ordinary urban practices (Storbjörk & Uggla, 2015; Uittenbroek et al., 2012; Newman, 2008). The Life+ A\_GreeNet Territory includes a population of 400,000 inhabitants, the territories of two municipalities in the Marche Region: Ancona and San Benedetto del Tronto, and 8 municipalities in the Abruzzo Region (the 7 coastal municipalities of the ATS city of the Coast of the Province of Teramo) and the Municipality of Pescara (Fig.1). The results of the indicators utilized by Ispra (Istituto Superiore per la Protezione e la Ricerca Ambientale), consistent with the indicator implemented by the European Environment Agency, "Landscape fragmentation indicator effective mesh density (Seff)," indicate that a very high level of fragmentation is present in the coastal area of the mid-Adriatic Sea in Italy (coastal areas of Marche and Abruzzo) (Ispra, 2022; Munafò, 2023). This level of fragmentation, which is equivalent to an effective mesh density greater than 250 meshes per 1,000 km<sup>2</sup>, is indicative of the extensive reduction in ecological connectivity that has resulted from phenomena such as urban expansion and infrastructure network development (Ispra, 2024).

These areas are characterized by a degraded forest heritage, a lack of quality in green spaces, and a dearth of attention devoted to adaptation policies at various levels of planning. Additionally, they are home to a significant proportion of vulnerable populations (approximately 40%), who are particularly susceptible to increases in mortality and the need for emergency medical care due to the adverse effects of high nighttime temperatures. With reference to this project, which is in progress and will end in 2025 (<https://www.lifeagreenet.eu/site/>), except for the After LIFE activities, the keys used to verify the correspondences and criticalities towards effective multilevel planning involved the development of two particular areas of investigation: vertical cooperation and mainstreaming, in this case between Region, Province and local authorities, and horizontal cooperation and mainstreaming (between municipalities).



**Fig.1 The territory of the Life+ A\_GreeNet project**

The former was investigated with the objective of evaluating the efficacy of the regions' role in providing guidance and support to local authorities, with specific reference to certain aspects identified by the PNACC as requiring priority attention, including organizational, financial and technical aspects. In terms of *organizational aspects*, the PNACC identifies the need to ascertain the relevant stakeholders and select the most suitable methods for engaging them in project activities. The *financial aspects* pertain to the potential for allocating resources from a range of sources, commencing with the regional budget and subsequently targeting other available resources, such as European funds. In particular, Regions are able to establish dedicated funding for local authorities through the utilization of ERDF (European Regional Development Fund) allocations. The *technical aspects* pertain to the feasibility of streamlining the development of adaptation

measures through the formulation of incentive regulations, the creation of specialized instruments for the aggregation and examination of climate inventories, and the provision of assistance in the identification of projected potential consequences and prospective adaptation strategies.

In examining horizontal cooperation and mainstreaming, the investigations concentrated on pivotal mechanisms that local governments can leverage to advance territorial cooperation objectives, as delineated in the NACCP guidelines. These mechanisms were examined in light of the following considerations: new “place-based” *planning approaches* that shape a novel perspective on the quality of public action necessitate the promotion of synergies and the adoption of co-design and “stewardship” processes with local communities. The objective is to mobilize the resources and capabilities of the territory in order to implement climate resilience measures. The remaining aspects under investigation are *inter-municipal cooperation* for the “activation of the provision of shared services for the community” and the partnership of local government with social organizations, businesses, and technical professionals from various public or private entities. This potential influence can be leveraged to disseminate integrated models of intervention in projects and investments pertaining to homogeneous territorial areas, thereby fostering collective responses from the provincial or regional community to climate change. The investigation of these dimensions of multilevel governance should enable the verification of the effectiveness of the adaptation strategy envisaged by the “Life+A\_GreeNet” project, the critical aspects to be solved, and the possible possibility of its replicability in other contexts envisaged by the same project.

## 4. Vertical Dimension: aspects of cooperation and mainstreaming

### 4.1 Organizational aspects

The Life+ A\_GreeNet Project included an experience-sharing phase that enabled the involvement of institutional stakeholders at various levels and associations with the aim of improving the transparency and effectiveness of projects and processes, thereby fostering collective awareness and shared intent. Stakeholder involvement in the project was structured around several key phases, including the dissemination of information and experiences, the formulation of the “Interregional Forestry Contract,” the development of a regulatory document for green infrastructure design, and the establishment of an observatory for climate change, urban green infrastructure, and health.

The knowledge-sharing phase was attended by technicians from public administrations at various levels, professional associations, and local administrators. The objective was to enhance collective understanding through collaborative, multifunctional, and multiscale planning; innovative urban planning techniques (urban and spatial equalization, pre-greening, environmental offsets, etc.); and the targeted use of vegetation to construct livable and healthy urban environments. To gain insight into these subjects, a review was conducted of select national and international projects that exemplify best practices. The selection permitted the organization of two workshops and three focus groups, which were attended by planners and technicians from public administrations promoting best practices. This introductory phase permitted the researchers to become acquainted with local stakeholders, particularly public administration technicians and policymakers, and to ascertain their familiarity with adaptation issues.

A pivotal stage of the project entailed the formulation of a “CIoFU Interregional Forest Contract” and a prototype coastal pine forest management plan. The CIoF was developed and implemented through an open and inclusive participatory process. A series of eight plenary meetings were convened with relevant stakeholders and participants in the Interregional Contract formation process, predominantly held remotely to foster widespread engagement. The meetings saw the participation of over 80 entities, primarily from the public administration sector (24%), followed by associations dedicated to socio-environmental issues (20%), research and professional bodies (17%), including various universities and the Professional Orders of

Agronomists, Forestry, and Architects. Individual businesses or the representations of businesses accounted for 17% of the participants, freelancers constituted 17%, and finally, other public bodies such as various regional agencies, the forest ranger, and consumer advocacy associations accounted for 5%. The CIIdFU was concluded in December 2023 with the underwriting by 39 parties. The signatories of the contract included public and private entities, such as several universities, a province, a regional environmental agency, numerous environmental associations, three social cooperatives involved in green maintenance, and a number of municipalities that were not members of the project partners. The execution of the Forestry Contract obligates the signatories to incorporate the principles and actions stipulated within the Project into their respective programs, plans, and projects, and it shall:

- facilitate the implementation of the Green Infrastructure Project for Climate Change Adaptation and Community Health in the programs and policies under its jurisdiction, such as: the Regional Climate Change Adaptation Plan and the Regional Prevention Plan, giving priority to municipalities adhering to the Covenant of Mayors and municipalities affected by forestation contracts;
- prepare regulations (throughout the region) so that the implementation of green infrastructure becomes a founding principle of local urban planning, identifying useful methods and techniques for its implementation. It is also stipulated that regulations should contain a performance checklist for the purposes of health and welfare of urban plans and projects;
- carrying out activities to promote and involve the Marche Region so that it initiates the implementation of green infrastructure in its regional territory.

Another vertical activity involved the activation of the Climate Change and Health Observatory, which will be managed by the Abruzzo Region, to monitor the evolution over time of climate change effects on city dwellers.

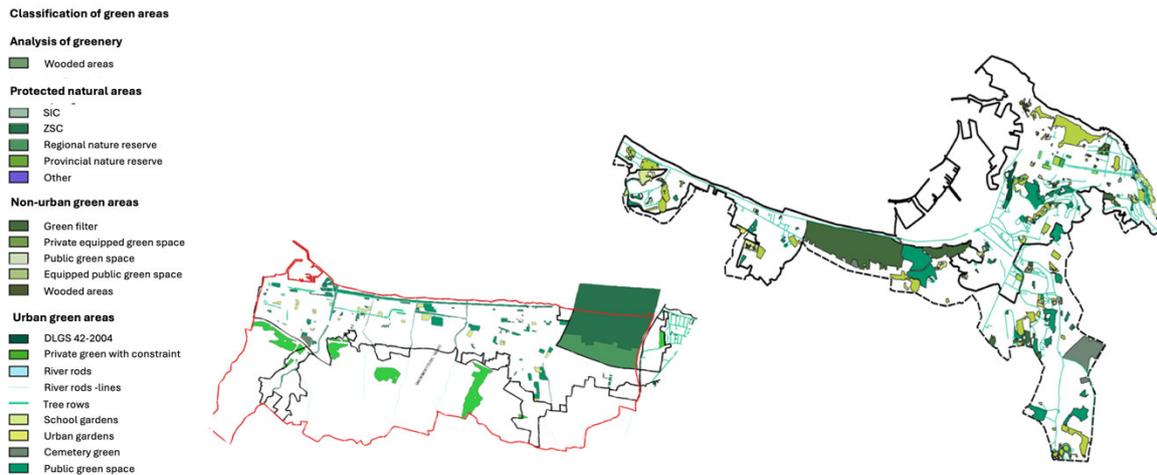
## 4.2 Financial aspects

The project encompasses three categories of demonstration actions: coastal forest restoration (Pinewoods), soil regeneration interventions, and urban microforestry interventions. Pine forest restoration interventions are designed to ensure the preservation and enhancement of biophysical and qualitative-quantitative attributes, thereby optimizing the forest's resilience to climate change and its capacity to sustain the well-being of local communities and visitors. Additional demonstration actions entail microforestry and soil regeneration interventions. In conclusion, during the After LIFE period, the Abruzzo Region has pledged to provide financial support for the most suitable measures for the design and implementation of green infrastructure within the context of European and national programming funds, in accordance with its authority and responsibility for managing and programming the use of these funds at the regional level.

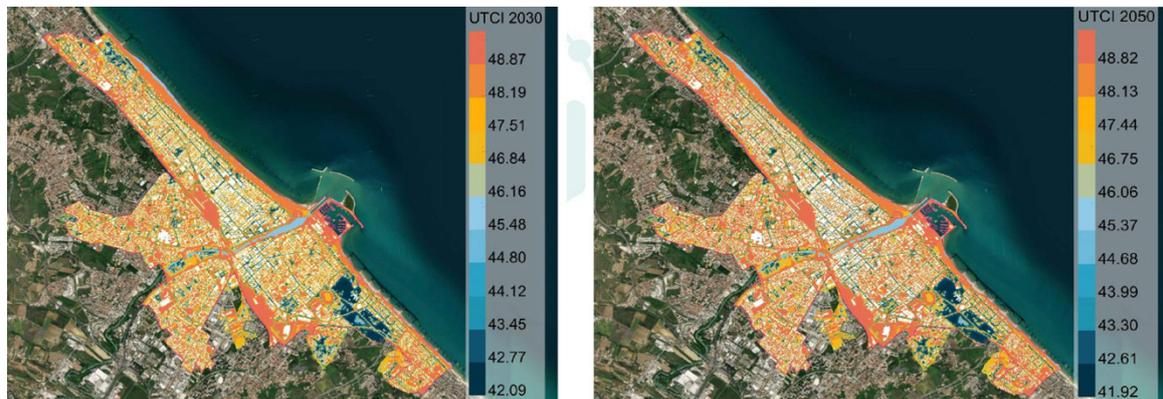
## 4.3 Technical aspects

The initial step in achieving mainstreaming is to gain an understanding of the territory, society, and the dynamics that shape places, transcending municipal boundaries. This involves both organizing existing information and acquiring new and updated data with the support of a single directorate. Consequently, the Life A-GreeNet Project initiated an initial assessment of the natural and semi-natural green assets of all the municipalities in the network (Fig.2). The assessment entailed evaluating the quality of these green assets using the SAVI index, which was clustered into four classes. This was followed by point analyses of sample areas and an assessment of the ecosystem services provided by green areas. The green area surveys were cross-read with climate maps, and the UTCI (Universal Thermal Climate Index) was calculated for the years 2019 to 2030 and 2050 (Fig.3). This analysis identified the most critical areas for hydrogeological disruption, spatialization of population fragility (children and the elderly), and health risks due to rising temperatures

(emergency room accesses and daily mortality during the hottest days over the past few years were investigated), allowed us to identify the present and future risks of the mid-Adriatic city in a large-scale view.



**Fig.2 Classification of green areas. Municipalities of San Benedetto del Tronto and Ancona**



**Fig.3 Map of the \_UTCI forecast of Pescara to 2030 and 2050. The column on the right shows the degrees of temperature perceived by people in different areas of the city in a time forecast to 2030 and 2050**

The subsequent phase entailed the interrogation of prevailing urban planning forecasts and the function of green spaces within the urban planning instruments of partner municipalities. This investigation led to the identification of homogeneous types across diverse urban planning instruments with regard to their prevailing functions, roles in the urban context, permitted interventions, ownership structures, and design interventions. The aggregation of this information enabled the identification of design opportunities for adapting to climate change within the frequently incomplete system of green areas in local urban plans. The analysis of the city's diverse settlement fabrics, informed by the voids, led to the identification of two distinct systems: "Homogeneous Systems and Areas of the Mid-Adriatic City". This identification was accompanied by the formulation of planning scenarios extending into the future, with projections extending to the year 2030 and 2050. These scenarios offer valuable direction for municipalities in their planning activities and interventions for adapting to climate change, both in the immediate and long-term future, with a view that extends beyond municipal boundaries. The integration of various geospatial information layers has facilitated the identification of critical areas in terms of climate and social vulnerability. These areas must be prioritized during the detailed planning phase, during which the objectives and actions to be implemented will be delineated. The development of a unified methodology for the analysis and evaluation of climate data, as well as the planning tools for all municipalities within the study area, employs a WebGIS platform for data storage and monitoring. This platform provides valuable information for future planning. The establishment of this platform and the

dissemination of information and planning forecasts on both a large and local scale represent a novel undertaking in this region.

#### 4.4 Critical issues, opportunities and suggestions

The vertical dimension of the project has brought to light several critical issues that must be addressed and resolved. Many of these difficulties, as anticipated in the previous section, stem from the challenge of municipalities participating in the network, which belong to different provinces and regions, sharing experiences and project proposals despite their similarity in geography, socioeconomics, and the presence of risks. This difficulty manifested, for example, in the construction of the cognitive framework on green areas. The Life+A\_GreeNet Project aspires to propose a shared methodology for the cataloguing of green areas; however, it faced challenges due to the lack of homogeneous information among the different technical offices of the municipalities involved. Furthermore, there was a shortage of personnel capable of managing and archiving spatial data. Another difficulty related to the inadequacy of current urban planning tools to conceptualize the green area system as spatial infrastructure and the inability to ensure the quality of green spaces. Urban standards, legally mandated, govern only the "quantity" of green spaces, frequently resulting in oversupply.

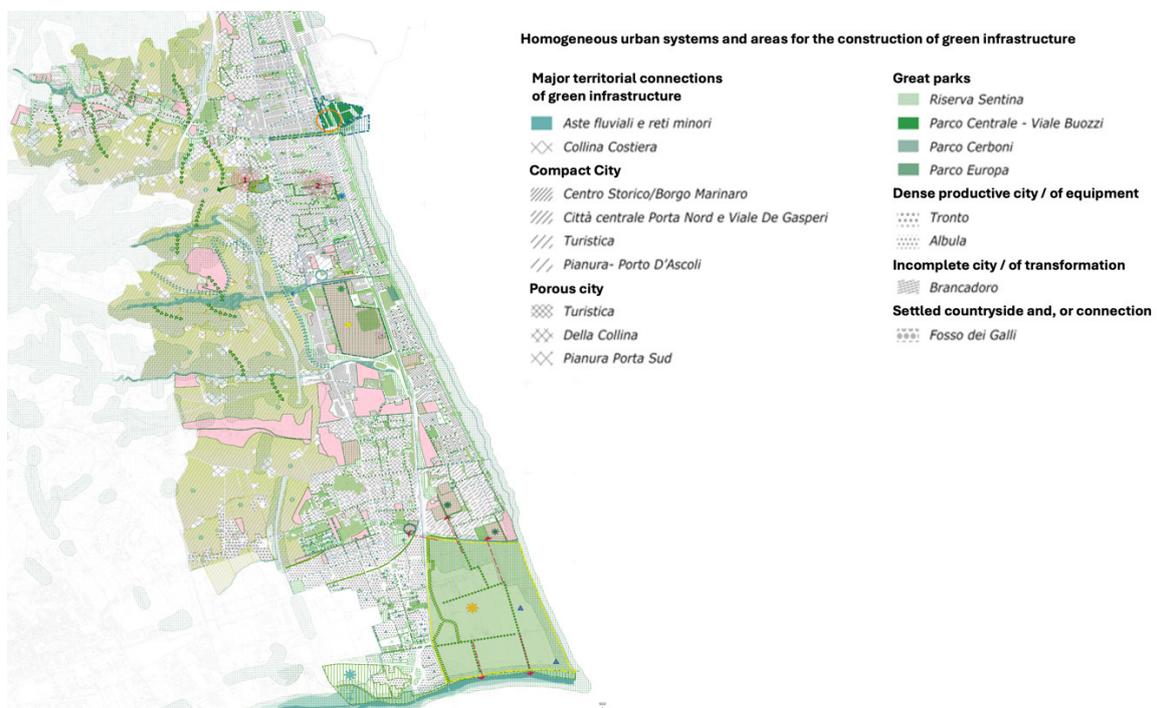
In addition to the aforementioned objective difficulties, which complicate the operational development of green infrastructure in the mid-Adriatic city, a cultural challenge must also be considered. Focus groups and workshops conducted during the initial phase of the project revealed a pervasive lack of knowledge regarding the impact of climate change among technicians and administrators. A survey of administrators, technicians, and citizen representatives revealed that only a few of them were aware of studies and research on the impact of environmental and climate change on the quality of life in cities and the application of Nature Based Solutions (NBS) (Mazzeo & Polverino, 2023; Santoro et al., 2024). The aforementioned challenges notwithstanding, the relationships cultivated with local stakeholders, as evidenced by the workshops, focus groups, and capacity-building activities that preceded the Forestation Contract, initiated a process of sharing and awareness concerning some fundamental aspects that form the basis for implementing the construction of green infrastructure in the coming years. The culmination of this journey, marked by the signing of the Forestation Contract, signified the signatories' commitment to a comprehensive spatial vision encompassing coastal green infrastructure, including the network of green areas and the facilitation of urban ecosystem development. This vision transcends the confines of municipal boundaries, proposing solutions on a larger scale. This shared vision is further complemented by a collective awareness and commitment to a unified approach in the retrieval of cognitive and evaluative data, their dissemination, and the involvement of all stakeholders. In this context, the strategic role of regions becomes evident, as they are called upon to assume full political responsibility for promoting and facilitating the integration of adaptation into overall processes. This will necessitate active engagement with stakeholders and local governments, as well as the various sectors of public administration.

### 5. Horizontal dimension: aspects of cooperation and mainstreaming

#### 5.1 New planning approaches at the local scale

The construction of a Design Framework shared among network partners for the realization of the green infrastructure of the City of the Middle Adriatic has led to the identification of environmental, climatic, socio-anagrammatic characters and recurring risk scenarios at the local scale. The project also includes operational tools that facilitate the realization of the green infrastructure at the local scale. Primarily, this involves the establishment of a Directory of urban planning techniques (e.g., urban equalization and compensation, ecological compensation, etc.) to facilitate the implementation of green areas in compliance with the provisions

of current PRGs, through forms of involvement of private operators and innovative financing measures. Additionally, the dissemination of these techniques among various municipalities is accompanied by the integration of “nature-based” design for building codes, which is based on the utilization of a Nature Based Directory (Fig.4) and the application of the “Green Suite A\_GreeNet Explorer”<sup>5</sup>. The latter is configured as a “Friendly” platform that, on the basis of a map that identifies a 500x500 m grid, returns a series of climatic, sociodemographic parameters, urban planning and design forecasts to 2030 and 2050 for each “tile” into which the Middle Adriatic city is divided. This interactive map fosters an in-depth and multidimensional understanding of the urban environment, offering a comprehensive perspective on the challenges and opportunities in the Middle Adriatic city. It thereby facilitates the formulation of more effective urban policies and projects that can enhance the quality of urban life and mitigate the adverse impacts of climate change. Each of the “tiles” is associated with a “type” design solution, which contains references to NBS solutions and their integration within settlement systems. Each “type” design solution is associated with behaviors/performances that recur within the Mid-Adriatic territory; it can be applied to multiple areas/sub-environments, where similar conditions occur, including in the territory of other municipalities. The parameters provided and the suggested typological design solution constitute the “materials” to be brought to the attention of planners and public administrations to guide the construction of green infrastructure. These tools serve as an exploratory mechanism, facilitating the identification of potential typological design solutions. These solutions are subsequently investigated and verified through a comprehensive analysis of the Life+A\_GreeNet Project databases, which are accessible via the WEB Platform. The “friendly platform” offers design recommendations at the local scale, providing a valuable resource for decision-making regarding the interventions to be implemented (Fig.7). It also enables the comparison of design solutions proposed in other territorial contexts with similar characteristics. This methodological approach fosters collaboration among diverse municipal administrations and facilitates periodic reviews, information exchange, and suggestions for the development of green infrastructure.

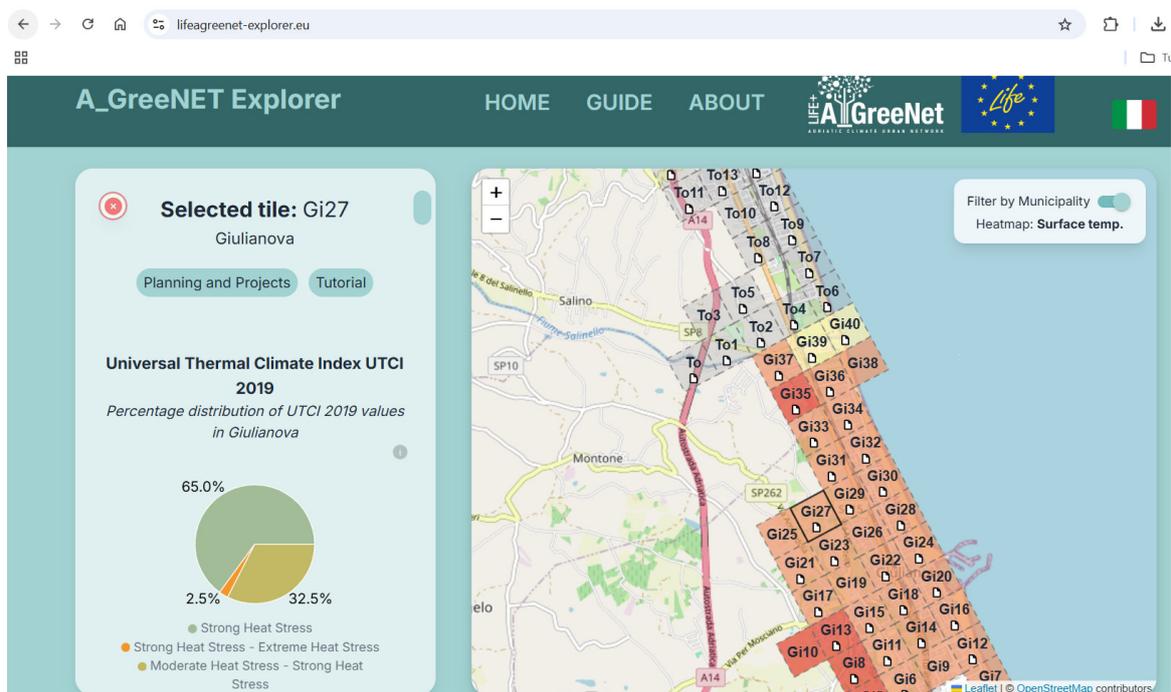


**Fig.5 Strategic scenario of the municipality of San Benedetto del Tronto**

<sup>5</sup> See: <https://lifeagreenet-explorer.eu/>



**Fig.6 Typological solutions and identification of NBS: typological solutions for different homogeneous areas of the mid-Adriatic city, with reference to the NBSs to be used**



**Fig.7 Home Page Friendly platform (https://lifeagreenet-explorer.eu/)**

## 5.2 Local actions supported by open calls

Top-down interventions, in the form of demonstration actions aimed at selecting optimal design solutions, are complemented by bottom-up interventions. The latter involve private projects financed by municipalities and regions through open calls. Demonstration projects funded directly by the Life Project have been joined by projects co-funded by partners through “open calls.” This type of call for proposals is characterized by the possibility of continuous application until the available resources are exhausted. In contrast to “ranked” calls, where all applications are evaluated and ranked after a predetermined deadline, over-the-counter calls adhere to the principle of “first come, first served,” meaning that applications are processed in the order in which they are received and meet the specified criteria. These mechanisms facilitate the allocation of resources for micro-forestry interventions within the urban landscape, in alignment with the Action Program of the Forestation Contract, with the financial participation of the beneficiaries. The total budget allocated for this initiative is €300,000, with €50,000 designated for each municipality, €50,000 allocated for ATS Cities of the Coast, and €100,000 set aside for the Abruzzo Region. The call is open to both public and private entities, including management entities of protected natural areas, third sector operators (i.e., social and environmental

associations), and economic entities (e.g., construction companies, businesses). Each project proposal includes a share of co-financing guaranteed by the beneficiary entity of at least 50-20% of the total project cost depending on whether the beneficiary is an economic entity or a park entity/third sector entity, respectively. The verification of eligibility for funding is based on several technical evaluation criteria: contributions to the forestation contract strategy (consistency with the lines of intervention of the Strategic Document integration of the proposal with the interventions indicated in the Action Program); governance of the project (presence in support of microforestation interventions of community education and awareness activities, completeness and heterogeneity of the partnership and presence of partners subscribing to the forestation contract, sustainability of the project in environmental and economic terms, commitment to the management and maintenance of the intervention for example by signing a collaboration pact, co-financing share greater than the maximum percentage required); quality of the project proposal (technical quality and completeness of the proposed project consistent with the technical indications of the NBS abacus developed by the Project).

### 5.3 Intermunicipal cooperation with social organizations, business and local professionalism

The municipalities participating in the project have committed to integrating the tenets of the Green Infrastructure Regulations into their urban planning instruments, building regulations, and public works specifications over the course of the "AfterLife" initiative. Furthermore, the project encompasses the construction of a "Model Management Plan for Coastal Pine Forests," which will be disseminated among the participating municipalities. This plan will encompass all agronomic, cultivation, and phytosanitary interventions necessary to enhance the bio-static characteristics of each pine forest. The activation of the "Network of Pine Forest Management Plans" will enable the different municipal managers to share data and knowledge. It is of paramount importance to facilitate integration and information sharing, as this will prove instrumental in preventing and containing the potential spread of diseases. In order to encourage citizen participation in the implementation of green infrastructure and to relieve administrative bodies of the onerous task of management, it is also planned to draft a "Model Collaboration Pact" for urban green spaces. This is a tool that encourages citizen participation in the care of public green spaces. It can be used by citizens in individual or associated form, or directly by municipal administrations. The agreement, which is of a provisional nature, may provide for a range of maintenance tasks, including the upkeep of green spaces, the cleaning of premises, and the routine maintenance of recreational facilities and equipment.

### 5.4 Critical issues, opportunities and suggestions

Some of the planned activities are currently being implemented, including the open calls. Consequently, it is premature to conduct a review of the efficacy of horizontal cooperation and mainstreaming. Nevertheless, some preliminary observations can be made regarding the innovative aspects of the methodology employed in the design of green areas. This methodology introduces a number of relatively unexplored concepts, including the option of selecting potential design solutions, with a particular focus on the most critical areas. A selection was made by integrating the needs that emerged from analyses and assessments of social and climate impacts with the needs/opportunities for funding by local governments.

The friendly platform offers the possibility of selecting the best performing project solutions through the sharing of a working method that constitutes an effective decision support tool, which can also be transferred to replication territories. Concurrently, several pivotal concerns have been brought to light due to the lack of familiarity among municipalities in addressing the ramifications of climate change. This has resulted in a dearth of involvement in the construction of knowledge and the formulation of potential project solutions.

In this regard, the recently enacted regional legislation governing territorial government, together with the regulations and guidelines of the LifeA-GreeNet Project, offers a promising foundation for advancing the project's objectives.

## 6. Debate and conclusions

The effects of climate change will continue to manifest in a variety of ways, including a deterioration in living standards, an inability of urban areas to withstand external shocks and stresses, a decline in the resilience of territories, and a reduction in the conservation of natural areas. Nevertheless, the measures taken by the array of institutions and the private sector to address these challenges and prepare for them are, as yet, insufficient (EEA, 2024). Despite the existence of numerous agreements and efforts over the past decades aimed at raising awareness of the risks posed by disruptions in the climate environment, these have unfortunately not had a significant impact on policies. In order for adaptation to climate change to become more sustainable, it is essential that these concepts be incorporated and integrated into the policies (plans, strategies, and programs) with which administrations of different levels are or have been equipped. This is a priority for the present moment. The Life+A\_GreeNet project proposes a comprehensive strategy for adaptation that is not confined to a single, comprehensive instrument. Rather, it employs a more inclusive, collaborative, and agile approach that transcends the limitations of a single administrative level or sector (Cáceres et al., 2024). In lieu of incorporating climate change adaptation as an additional policy, this project endeavors to integrate it into existing policy and decision-making processes.

Working on existing urban plans, modifying existing actions with an adaptive perspective and inserting new adaptive actions, is a choice of this project, which anticipated first and accommodated later both the determinations of the new PNACC and the new Spatial Government Laws of the two regions involved in the project. There are risks, however, as reflected in the project itself: the difficulty of coordination, poor collaboration or even divergence on the part of some public actors (Biesbroek et al., 2017). To overcome these obstacles, a key condition is to have strong political support within different level entities at any step of the adaptation journey and agile governance (Janssen, 2020). Without these, the process cannot be developed. On this point, the partners of the Life+ A\_GreeNet Project will have a lot of work to do in the terminal phase of the project and in the AfterLife. In an effort to implement mainstreaming more effectively and efficiently, some corrective/additional measures are suggested to be implemented:

- The creation of a territorial coordination unit. This could take different forms, depending on the resources and capacities of the entities involved, but also on their willingness to invest in the issue. This coordinating office could be tasked with organizing, providing and coordinating data collection, climate tools and services at the local level, providing decision makers, policy makers, administrators and local authorities with the necessary tools to make informed decisions (Pörtner, 2022). Thus, a robust scientific database is needed because unfamiliarity with globally accessible climate data contributes significantly to slow progress in local climate change adaptation planning and decision-making (Lorenz et al., 2017);
- Improve, integrate and implement more climate data within routine urban planning and increase adaptation actions in urban planning documents (Hurlimann et al., 2021);
- The eventual definition of a shared "Strategy for Adaptation" document that can make comprehensible and organized in a single document the objectives that all the public administrations concerned set themselves and that is matched by an institutional commitment to finance adaptation actions at any level. This commitment would mean to make more explicit precise goals and actions, to be simultaneously flexible and adaptable according to the renewed needs of the entities concerned and by the sensitivities of the administrations of the super-ordinate as well as the sub-ordinate levels;
- The development of synergies between short-term sectoral benefits and long-term adaptation benefits represents a significant challenge. Frequently, greater emphasis is placed on short-term sectoral goals,

which can act as a barrier to progress. However, this can be overcome to achieve both immediate goals and enhance long-term resilience.

At all levels, the overarching objective should be to create win-win situations. In this regard, local governments could consider introducing reward systems and tax breaks in certain areas to encourage investment and innovation in adaptation (Adriázola et al., 2018). Finally, the project entails the replicability of the methodology in other Italian and European coastal areas. Specifically, the project involves four Italian coastal areas: the Province of Latina (municipalities of Gaeta and Formia); the Province of Salerno (Eboli, Capaccio-Paestum); the Province of Grosseto (Marina di Grosseto, Marina di Alberese, Talamone-Orbetello); and the Province of Barletta, Andria, Trani (Barletta, Trani, Bisceglie). Additionally, the project encompasses the Croatian city of Poreč. With respect to these cities, the project entails the signing of a transferability memorandum for the application of the methodology and the creation of a manual for the design and implementation of the Green Infrastructure. This manual will be instrumental in providing step-by-step guidance to the municipalities during the experimentation phase. The project will also involve mentoring actions by the project partners, ensuring the effective and comprehensive support of the municipalities throughout the process. To verify the outcomes of the project over time and possibly propose corrective actions, it is planned to select environmental and socioeconomic impact indicators that will monitor the project after its conclusion (After Life). The goal is to steer the implementation of the project after the projected deadline of September 2025, in the hope that public and private administrations will be able to live up to their commitments and test the project in their territories. Indeed, the risk is that the multilevel governance tested in this project, which aims to standardize environmental policies to a high and effective level of protection, will find resistance and inaction in the local and regional spheres. In the face of this risk, advantages should always be kept in mind. Among them: the ability to adapt and tailor adaptation measures to local needs and their characteristics; improved interaction with civil society, increasing the contribution of private individuals, as well as their adherence to the change process. To all this is added the dissemination of good practices and virtuous competition among the different actors in the process.

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## Image Sources

All images are extracted from the Life+ A\_GreeNet project.

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