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Learning from Experience to Build Urban Green Infrastructure (UGI) in the Central Adriatic City (Italy) under the Life+A_GreeNet Project

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Highlights

- European Life+A_GreeNet project aims to implement UGI and their multifunctional benefits for cities and dwellers in the coastal Central Adriatic (Italy).

- Investigation of the best European and Italian projects on the topic to integrate methods, techniques and results.

- Innovative spatial planning tools at large and local scales to go beyond ordinary planning.

- Learning, listening and cooperation activities between researchers, decision-makers and local administrations for technical-operational, cultural and governance renewal.

Abstract

In Europe, the implementation of urban green infrastructure (UGI) in spatial planning remains slow, although the economic/financial limits of the past have been overcome due to the recent investment priorities established by the Structural Funds and Next Generation EU. The difficulties of integrating UGI in spatial planning regard the limits of researchers' theoretical approach and the unpreparedness of territories, administrations, and technicians. The Life+ A_GreeNet project aims to overcome these critical points. Several European and national experiences in implementing UGIs are investigated to assess their transferability into techniques and local and large-scale spatial planning tools in the Central Adriatic of Italy through a phase of interaction, learning and listening among local administrations (decision makers and technicians). The objectives shared among various local players are thereby identified. These involve regenerating settlement and environmental systems and beginning to interact on problems and possible solutions that, overcoming administrative limits, regard an entire territory. A framework of commitments for local and large-scale planning therefore emerges, with conditions for the transferability of some techniques and practical/operational procedures.

1. INTRODUCTION

In the last twenty years, urban green infrastructure (UGI) has gained a central role in the scientific and political debates due to increasing awareness of the importance of nature and its governance as an integral part of urban sustainability (Nesshöver et al. 2017). This infrastructure can generally be defined as organised systems of natural and semi-natural areas that provide multiple ecological and social benefits (EC, 2013). They are called to perform multiple functions: for well-being, health, and quality of life (Tzoulas et al., 2007; Marques Da Costa & Kallay, 2020), to conserve biodiversity and the landscape, to mitigate and adapt to climate change (Parris et al., 2018; Kowarik et al., 2020; Santamouris et al., 2018; Rupprecht & Byrne, 2014; Lafortezza et al., 2013) and for the presence of leisure and sports opportunities (Hillsdon et al., 2006; Clark & al, 2009). They may also contribute to creating employment and new opportunities for economic development (ESPON, 2019; Kovacs et al., 2019). In the scientific debate, there has been a progressive shift from an aesthetic (Cocozza et al., 2002) and quantitative vision of green areas to growing attention to multifunctional aspects and connectivity, such as key attractions (Madureira & Andresen, 2014) of the emerging concept of ecosystem services (Hansen et al., 2015; Cortinovis & Geneletti, 2018).

Over time, the principle of considering them an integral part of the urban spatial structure has also been reinforced, along with the networks of transport, services, and equipment (Matthews et al., 2015), and a discussion has begun about opportunities to conceptualise and implement them through spatial planning tools (Pauleit et al., 2019a; Benton-Short et al., 2019; Llausàs & Roe, 2012). First of all, the debate has examined the scale factor that affects the goals of UGI, the selection of stakeholders, and the combination of prevalent interests in their implementation (Rota & Ferlaino, 2021). The related levels of spatial planning, in harmony with the principles established by the EEA (European Environment Agency), should understand the local, urban, and regional level of planning (EEA, 2020), providing that each level of planning has a relationship with the next level (Lafortezza et al., 2013; Davies et al, 2015). According to some researchers, relying on regional-level 'strategic plans' are necessary to regulate, orient, and coordinate the objectives and proposals of municipal plans (Elinbaum & Galland, 2016; Soria & Valenzuela, 2012), to serve as reference for decisions taken at the local level (Oliveira & Hersperger, 2018), and to shift from sector planning to a holistic approach capable of addressing the urgent question of climate change (Davies et al, 2015). According to other researchers, a multilevel and transdisciplinary approach would be justified for their implementation by many actors who need different types of resources, tools, and means of activation that require both system/structure/network representations and geographically correct spatialities (Lindholm, 2017; Vidal et al., 2021).

The link with spatial planning was reinforced by the EU Biodiversity Strategy 2030, which identified measures aimed at cities to encourage them to set out plans for urban greening and to improve connections between green spaces. This document envisages the issuance of a new 'Green City Accord' with cities and mayors (EC, 2021) and the adoption of policies for the European green transition (Bush et al., 2020). This ambition is the same as that of the New European Bauhaus (NEB) (Widera et al. 2022), which, organised into three complementary values — sustainability, aesthetics, and inclusion — pursues goals and actions that combine global and local aspects, participation and transdisciplinary methods. In this vision, the issues of preservation and renewal of green spaces and their use as elements connecting different spatial environments are key, as is the use of nature-based solutions, which form the material for the regeneration project. The latter necessarily transcends administrative boundaries and promotes cooperation among entities on the same and different levels to jointly respond to climate challenges. It also involves broad participation of various groups and stakeholders in the different stages of constructing UGI (co-design, construction, management), building on various areas of expertise and interests.

Despite the liveliness of the scientific debate and European political documents, the integration of UGI in spatial planning still needs to be built in practice (Geneletti, 2013; Ronchi, 2018) because there is still no global consensus between researchers (Campagna et al., 2020) and practitioners (Monteiro et al., 2022). The gap between the theoretical way in which UGI is discussed and the practical world in which they are realised and managed persists (Ferreira et al., 2021)

This is attributed to the lack of interest from public administrations and practitioners in the use of principles that are too theoretical (Monteiro et al., 2020), the lack of human resources in public administration, practitioners' limited awareness and knowledge, and the silo approach that prevents the development of synergy between disciplines and between sectors of the public administration on different levels (Lennon et al., 2017; Grădinaru & Hersperger, 2018; Rall et al., 2015; Oliveira & Hersperger, 2018). In addition, other obstructing aspects lie in the insufficiency of data about the status of green and blue spaces in urban areas and their functional linkages to ecosystem services (Pauleit et al., 2019b). These difficulties mean that green
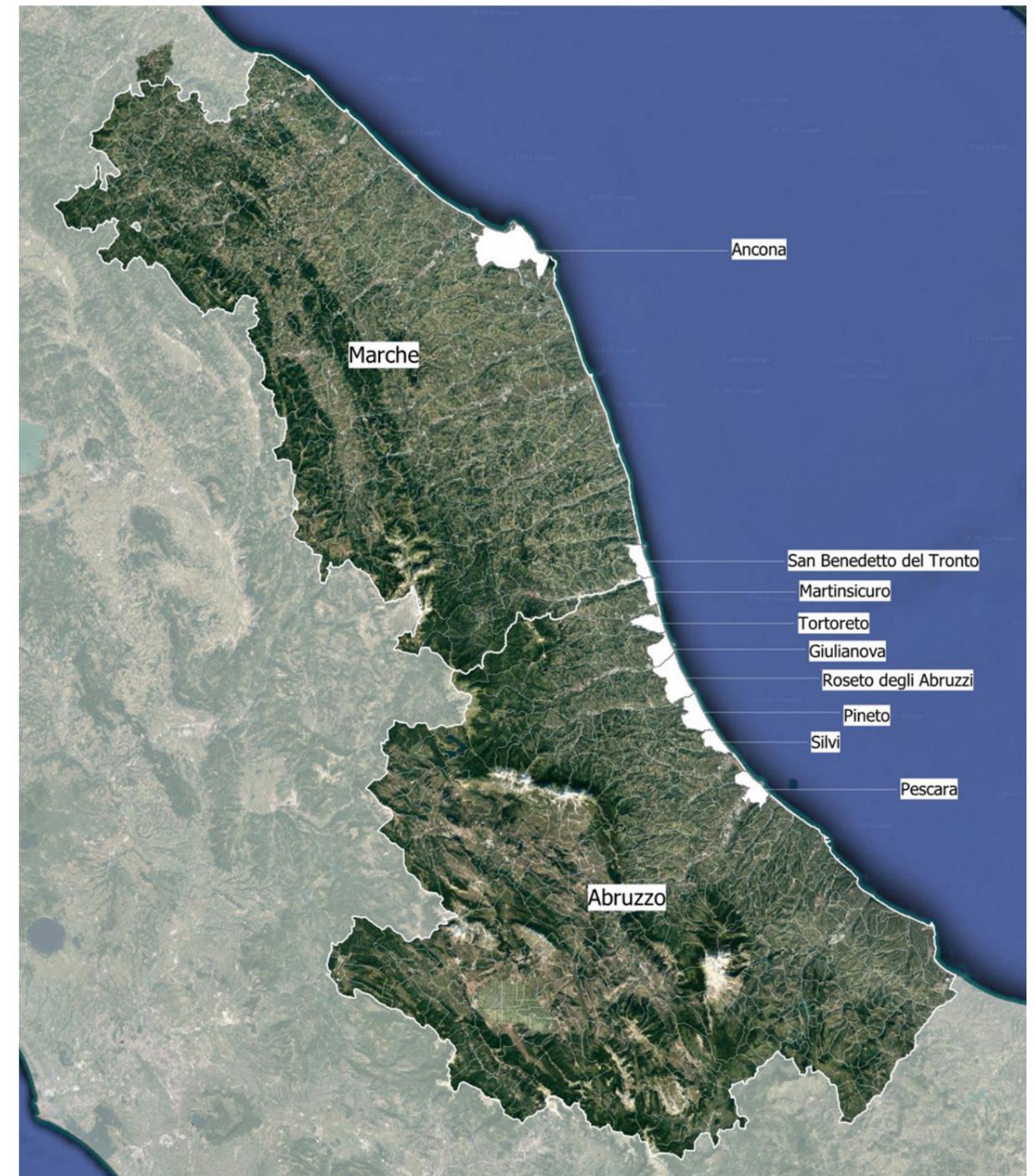
Figure 1: The territory and municipalities considered in the Life+A_GreeNet project. *Source: authors' elaboration on Maps Data: Google ©2023.*

spaces still have a low priority in urban development (Cilliers et al., 2015), a lack of consideration of their contribution in addressing the economic, environmental, and social impacts deriving from urbanisation (De Montis, 2020) and the eventual tradeoffs that might arise with other planning objectives, such as possible synergy (Depietri, 2022). These difficulties in implementing UGI in spatial planning is joined by a worrying emergency: the substantial stability or even shrinkage of green areas in European cities, as seen in the ESPON 'Green infra-structure: Enhancing biodiversity and ecosysTem services for territoriAldevelopment' (GRETA) research (ESPON EGTC, 2019). This research revealed how there was a substantial decrease in green areas in the 500 cities analysed in the period 2006–2012. This insufficiency was recently confirmed by the Barcelona Institute for Global Health – ISGlobal, which revealed how, based on mortality data from 2015, 62% of the population in 978 cities and 49 European metropolitan areas lives in less green space than what is recommended by the World Health Organization (WHO), equal to 5000 square metres of green areas at a distance less than 300 metres from each home (Pereira Barboza, 2021). The reason for this insufficiency may be due to several aspects: changes in land ownership and the lack of a long-term vision (Colding, 2020); the limited budgets of local governments, a situation that has negative effects on maintenance and the creation of green spaces usable by all and the lack of awareness, knowledge, and motivation of an entire series of actors (Butterworth, McIntyre, Silva Wells, 2011). These reasons are joined by the tendency of policies to prefer immediate, 'day-to-day planning' (Hrelja R., 2011), which does not favour the construction of a vision of greening which necessarily requires long timespans. It seems possible to overcome this framework of critical aspects and obstacles, at least regarding economic aspects in the light of enormous financing from the Structural Funds, proposals in the European Green Deal, and the 'Next Generation EU' Recovery Fund. The latter are today the great strategic axes and European funds pertaining to the new green revolution in Europe. Significant resources are and will be destined to widespread urban regeneration programs, with millions of trees for reforesting many green areas. At the moment, however, the question of how EU member states can guarantee in the long term that these policies become the flywheel to meet objectives related to biodiversity and the climate remains unanswered (Gerritsen, 2021).

The opportunity to investigate these issues in the theoretical and practical debate was presented with the construction of actions preparatory to the European Life+A_GreeNet project (https://www.lifeagreenet.eu/site/).

This project involves the planning and creation of green infrastructure in the coastal settlement system of the Central Adriatic in Italy (the Marche and Abruzzo Regions) by reducing the fragmentation of the environmental system and increasing connection and functionality among green areas in urban and peri-urban areas. The goal is to adapt them to climate change and improve residents' health and quality of life.

In this project, which has been developing and will end in 2025, a repertoire of best practices and workshop/focus group activities with public administrations and local technicians are involved. The goal is to learn from the most important European experiences to promote a shift in urban governance in urban-planning tools and techniques with respect to green areas and to increase the skills of public administrations and technical offices in identifying possible design solutions for critical aspects of development in their territories, focusing on citizens' living environments.

The objective is to learn from the most important European experiences in order to promote a change in urban governance, tools and techniques with respect to the design, management and maintenance of green areas. Furthermore, the project promotes the development of skills of the PAs and technical offices involved by supporting them in identifying possible solutions to the fragilities of their territories and to the potential critical impacts on citizens' living environments.

This article draws on European experience and crosses the innovations and critical aspects of these experiences with the dynamics and problems of the Central Adriatic territory in Italy to answer the following questions:

- which processes, approaches, and issues in the debate on UGI have a significant presence in European and national practices and what impact can they be presumed to have on urban green planning?
- what are the spatial planning techniques and tools used by administrators to answer operational planning questions for participatory interventions between the public and private sectors on the one hand and for possible co-planned interventions with stakeholders and the local community on the other?

- what obstacles hinder the adequate consideration of green areas in the spatial planning of coastal territories in the Central Adriatic of Italy and what might be the levers of action to overcome these obstacles?

2. FRAME OF REFERENCE

The coastal area of the Marche and Abruzzo Regions is one of the most urbanised in Italy. The recent 'Rapporto ISPRA 2022' on land consumption shows that the land consumed in some municipalities in this area exceeds 30% of the gross municipal surface area (Cities of Alba Adriatica, Martinsicuro, and San Benedetto del Tronto), with points exceeding 51% in the case of Pescara (Munafò, 2022).

In fact, this area is configured as a linear city stretching 355 km with very few interruptions between built areas, where 39% (Marche) and 34% (Abruzzo) of the regional population lives, with a territorial extent in the Marche Region equal to 11% of the regional surface area and just 6.5% for Abruzzo. The population density is equal to 753 inhabitants per sq kmin Abruzzo (regional average 121 per sq km) and 696 per sq km in the Marche (regional average 162 per sq km).

Sixteen percent of all buildings built between 1946 and 2000 were built along the Abruzzo and Marche coast, practically one of every three buildings in the Marche and one of every four in Abruzzo. The band closest to the coast (within 300 m) is the most urbanised, with 36.8% of the land consumption in Abruzzo and 46.1% in the Marche (Munafò, 2021). The municipalities with the highest land consumption in 2021 include the City of San Benedetto del Tronto, with a land consumption of 37.4%, (Fig. 2).

This intense urbanisation has led to a progressive reduction in green areas and agricultural land, fragmentation of the natural heritage, and a reduction in ecological connectivity that negatively affects the resilience and capacity of habitats to provide ecosystem services, favour air quality in the urban environment, and the health of city inhabitants. An investigation of the physiographic unit between Pescara and Ancona (PU2) shows that 24% of the changes in land use between 2012 and 2018 regard a shift to urban land, for a total of 981 hectares (Zullo et al., 2021).

The areas with the highest level of fragmentation are those closest to the coast, i.e. urbanised areas, corresponding to 27.06% in 2021 for the Marche
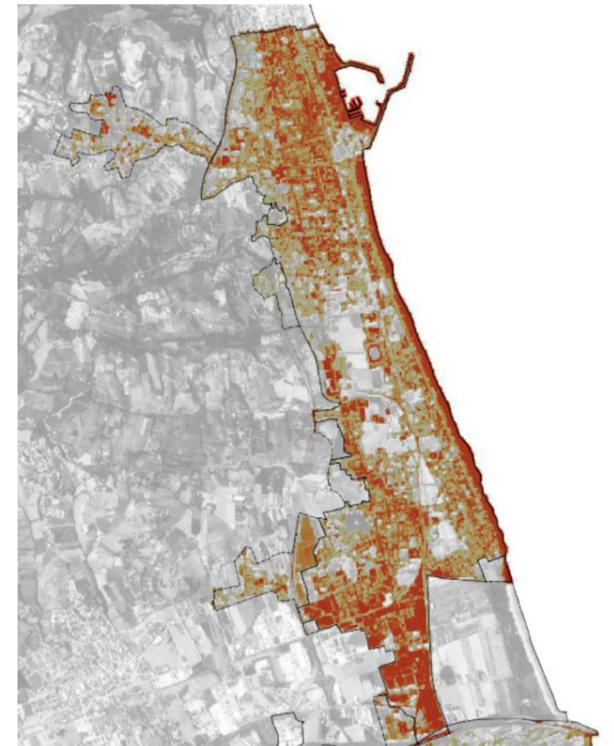
Figure 2: Soil consumption and soil sealing in San Benedetto del Tronto, within the project limits. Remote sensing application on 10th of May 2021 Copernicus Sentinel-2 satellite image (European Space Agency, ESA). *Source: authors' elaboration on Maps Data: Google ©2023.*

and 17.93% in 2021 for Abruzzo (Munafò, 2021). The degree of artificialisation of the few residual natural and semi-natural ecosystems — particularly the coastal psammophile ecosystems, but also forest ecosystems of Mediterranean pine and meso-hygrophilous ecosystems dominated by English oak — show a very high degree of artificialisation, equal to 38% in the Marche and 25% in Abruzzo (Mipaaf, 2022).

The discontinuity of green areas has negative effects on biodiversity and microclimate comfort in the densest urban areas, where there is a lack or only a residual presence of trees, which influence air temperature, the absorption of radiation and heat, relative humidity, turbulence, and albedo (Marando et al., 2022). Without green actions for adaptation and mitigation, there may be important consequences in the coming years for cooling capacity and air quality, as well as on the attractiveness and quality of life and health of residents and tourists. According to a report by the National System for Environmental Protection (Sistema

Nazionale per la Protezione dell'Ambiente, SNPA), temperatures may increase 4–10°C during the ever more frequent heat waves (SNPA, 2021).

The negative effects on ecological connectivity and the climate and therefore on the quality of life in the city are followed by the lack of a project design vision for green areas in local and large-scale planning in the coastal areas of the Abruzzo Region, and unsatisfactory activation of the Marche Ecological Network (Rete Ecologica delle Marche, REM) in territorial and local planning in the Marche Region.

Likewise, with regard to the implementation of urban planning in the various municipalities, local planning is marked by strong expansion and the senescence of current urban-planning tools which makes them inadequate for new environmental and social conditions (Romano et al., 2018).

This is joined by insufficient effectiveness of governance processes in guiding territories towards adaptation to climate change, which is often planned as a single objective tied to a specific action (see the mitigation/adaptation plans SEAP and SECAP from the Covenant of Mayors, to which all participating municipalities have adhered). Such objectives rarely involve the activation of a cyclic process, subsequent moments to involve stakeholders, spaces to analyse ongoing policies and define new interventions, and moments of monitoring and verification.

This is the context of the Life+ A_GreeNet project, which aims to contrast the current fragmentation of green areas by designing areas already envisaged in municipal urban-planning tools, but which have not been implemented or have a low quality, while not renouncing a strategic territorial vision, which is lacking or only partly present today in the Central Adriatic territory. The project does not intend to increase green areas "tout court". Data from the Italian National Statistics Institute (Istituto Nazionale di Statistica, ISTAT) on urban green areas show very different situations from city to city. There are very favourable situations in the City of Ancona, for example, with urban green space equal to 52 sqm per inhabitant and in Pescara with 39 sqm per inhabitant (ISTAT, 2021), as well as in most other municipalities, with more than the 9 sqm per inhabitant set out in national regulations. It seems more important to work on the quality of the green space and its management, as well as on the construction of a network of urban and territorial connections to guarantee the production of ecosystem services.

3.   MATERIALS AND METHODS

To build the preparatory actions in Life+A_GreeNet, the project refers to some experiences in European programming to recognise priorities regarding the integration of green infrastructure planning principles in spatial planning (Monteiro et al., 2022). This recognition first required an overall view of the levels of planning involved, the disciplines and sectors affected, and the role of actors and local communities. Secondly, it focused on more operational questions relating to the techniques and tools used to plan green areas, participatory processes with the community and local stakeholders, the means of implementing the interventions between public and private citizens, etc. This learning and assessment process for the European experiences was the object of interaction with administrators and technical offices in the municipalities participating in the project to increase their skills and assess the effective transferability of the innovative models and techniques to the Central Adriatic cities. The results of this interaction may be used to renew the models of planning and managing green areas in these areas and may also constitute a useful reference for other territories.

Out of a variety of European projects on the topic, two research projects were selected: FP7-ENVIRONMENT GREEN SURGE (Green Infrastructure and Urban Biodiversity for Sustainable Urban Development and the Green Economy) (https://cordis.europa.eu/project/id/603567) and ESPON 'Green infrastructure: Enhancing biodiversity and ecosystem services for territorial development' (GRETA, https://www.espon.eu/green-infrastructure). These projects were chosen for the vast sample of plans analysed as representative of the various territorial situations in Europe and because they combine the practices of spatial planning with a theoretical approach to the issue of UGI.

GREEN SURGE, in particular, used a sample of 20 planning documents integrated with 14 cases of good practice (Pauleit et al., 2019a). GRETA instead used a sample of 32 countries with more than 500 cities and 25 transferable examples of good practice which have a direct or indirect positive influence on green and blue infrastructure (Slätmo et al., 2019). Three central topics in the debate on implementing UGI were extrapolated from these two projects:
1. collaborative, multifunctional, multi-scale planning;
2. innovative urban-planning techniques;
3. use of vegetation to build liveable and healthy

Table 1:   Typical sheet.

Project or Activity Title	
Area of interest	1; 2; 3; 4;
Type of Funding	
Location	
Coordinator & Partners	
Project start and end	
General Project Goals	
Specific Project Objectives	
Project target groups	Administrators, Technicians, Citizens, Companies, Agencies...
Description of the area of interest for Life+ A_GreeNet	a) Detailed description of the process/procedures/methodologies used; b) Stakeholders/beneficiaries involved; c) Status of execution;
General project innovations and innovations in the area of interest	Why the project is significant in terms of methodological innovation, tools and technologies applied
Project/initiative results achieved in the area of interest	Outputs made by project: plans, pilot projects, regulations, tools, etc.
Difficulties found and possible solutions	During project implementation and management. Where not explicit, a questionnaire will be submitted to the project partners
Degree of satisfaction of the public administration in the design and management phase	Excellent; Sufficient; Poor; Where not made explicit, a questionnaire will be submitted to public administrations whose territories have been involved in experimentation
Added value of the programme/project	Social-economic benefits (qualitative/quantitative)
Strengths/Weaknesses of the present practice	**Strengths** - Ease of implementation - Good acceptance by actors - In line with legislation - Etc. **Weaknesses** - Difficulty in implementation - Resistance to behaviour change - Complex application - Regulatory difficulties/barriers - Etc.
Replication aspects of the solutions in the area of interest within the A_GreeNet territories	- Favourable aspects - Problematic aspects to be brought to the attention of the Focus Groups Sub-Action A1.2.
Contact person or project manager	
Telephone & Fax	
e-mail	
Website	

Data source: elaboration by authors

urban environments.

These topics formed the interpretative key for the selection of the most interesting practices for the Life+A_GreeNet project on the basis of existing European databases and the knowledge of the research team.

Sixteen case studies were chosen from Life+, Horizon 2020, Urban Innovative Actions (UIA), and Interreg Europe projects, as well as from some urban-planning projects centred on urban green infrastructure.

Each of the selected projects/plans was investigated with the support of a matrix with Table 1 contents.

For the first topic of interest the following projects were selected: Life Gaia; Life Blue AP; Life Roll-out-ClimAdapt; Life Metro Adapt; UIA-PUJ- Prato Urban Jungle; LIFE UrbanProof; Life Clivut; Interreg Europe Perfect.

For the second topic of interest the following plans and projects were chosen: DESIO – 2020 partial modification to the PGT and PGT 2015; Giussano PGT 2020; POC City of Prato and PUJ- Prato Urban Jungle; LIFE UrbanProof; SOS4Life.

For the third topic of interest the following plans and projects were selected: Life Heatland; Life Metro Adapt; Horizon 2020 'Urban Green Up'.

The selection of these projects, which relied on official databases of major European programmes, is due to their proximity to areas of reflection in the Life+A-GreeNet project, regarding:

- a desire to create synergy between multiple local actors to reach the common objective of developing innovative tools and operational methods to use urban forestation as a tool of environmental governance (topic 1);
- the development of design solutions and urban-planning techniques capable of implementing green infrastructure. Italian experiences were chosen for evident reasons tied to the type of urban-planning tools in the Central Adriatic territory (topic 2);
- the application of NBS and targeted use of vegetation to build liveable and healthy urban environments (topic 3).

However, the projects were also selected based on relationships developed on other occasions with public entities and other institutions promoting the selected projects. In these cases, the associations that have been strengthened over time have favoured interaction and also guarantee the possibility of expanding on topics and problems even when implementing the Life+A_GreeNet project and during After Life, which regards implementation of the project.

Knowledge about these projects was gained through official documents that could be consulted at the corresponding websites or websites of the public bodies of reference and through the spread of a questionnaire addressed to the coordinators. The purpose was to better understand the innovations, difficulties found in the implementation, the degree of satisfaction of the designers and public administration, added value, and the strengths and weaknesses.

Another project step concerned the selection of nine experiences considered significant for the potential transmission of some of the models, techniques and tools used and tested to the cities of the Central Adriatic. These projects were shared with the decision-makers and technical offices of the municipalities in the network through two workshops and three focus groups held in February and March 2022.

The workshops were held via the web due to the ongoing pandemic and focused on exploring some of the selected experiences in order to learn from the successes and criticalities, open a dialogue with project promoters and consultants, receive suggestions for effective design proposals, involve various stakeholders and citizens, and introduce economically sustainable urban planning innovations in the management and creation of green infrastructure in Central Adriatic cities.

The three thematic focus groups focused on the following topics:

1. involving stakeholders and the local community in urban forestation interventions (10th March);
2. urban planning and green infrastructure (17th March);
3. nature-based solutions (NBS): costs and benefits for adaptation to climate change in cities' (22th March).

4.   RESULTS

The first phase of the Life+A_GreeNet project involved a cross-reading of the two previously mentioned projects — GREEN SURGE and GRETA — useful in framing topics and recommendations of general interest to guide the debate among partners. These topics regarded:

- the opportunity for a strategic approach when planning green infrastructure based on long-term spatial visions and actions that are flexible over time. This aspect, common to most of the plans examined in GREEN SURGE, appears as a final recommendation in the GRETA project.
- the need for a transdisciplinary and multi-player approach to build synergy among the disciplines and between science, politics, and practice. The reference to integrating knowledge and an invitation to close collaboration between different local actors, between sectors of the public administration and local communities does not seem to be fully gathered by the experiences examined in GREEN SURGE and GRETA. The inclusion of researchers in project design activities is scarce in some countries (particularly in the United Kingdom and Central Europe), as is the involvement of stakeholders and companies (Central and Northern Europe). GREEN SURGE also notes the potential of early and broad inclusion of selected groups of stakeholders in all European areas, especially around the Mediterranean.
- the search for multifunctionality in green infrastructure is rarely pursued, except for a limited number of functions. Thus, there seems to be a notable margin for improving the planning of green areas and ecosystem services which can be a key to reinforce multifunctionality in planning (Hansen & Pauleit, 2014).

Other aspects to be encouraged according to GREEN SURGE and GRETA:

- broader participation of citizens in different forms;
- work among different scales of project design, involving the different levels of governance and different sectors of the public administration, breaking free of administrative confines;
- a 'learning-by-doing' approach that favours a multidisciplinary path and confirms the centrality of the context for which a suite of adaptable approaches are favoured over one-size-fits-all solutions;
- attention to 'hot points' of the green infrastructure, meaning situations that require greater protection or restoration, also with respect to intervention priorities.

Finally, the incremental, gradual approach to spatially implementing UGI should favour adaptive planning and a mix of public and private financing mechanisms. One last aspect regards the need for a repository for specific assessment data used to monitor the progress of adaptation to climate change.

The next step regards the application of the investigation and assessment sheet shown before (Tab.1) to the 16 experiences selected by the Life+A_GreeNet project. These different experiences were classified by: design scale; integration with spatial planning; measure of adaptation used; participation and co-design activities with different actors; intervention procedures; presence of monitoring measurements and replicability of actions in other contexts (Annex 1).

This comparison showed that the most common design scale is local, except for the Life Metro Adapt, Life Imagine, and Life Roll-out projects, which worked on the large scale. Nearly all projects showed a search for interaction and integration with the planning framework and existing programming and measures of adaptation to climate change integrated among green, soft, and grey infrastructure (https://climate-adapt.eea.europa.eu/knowledge/adaptation-information/adaptation-measures).

Another important aspect regarded participation, which in many cases involved different categories of public and private actors, technicians, citizens, companies, and students. The processes to design and realise adaptation measures related to the green infrastructure also involve different types of public and private subjects, and only in some cases there is the exclusive prerogative of the public (Life Metro Adapt, Life Asti). Not all projects contain monitoring and assessment systems, but most show a good possibility for replicating the measures in other contexts.

In summarising what emerged from this selection with reference to the three questions posed in the introduction, we could highlight:

- substantial uniformity of interest in looking for innovative methods to classify the quality of green areas and the land, often referring to ecosystem services;
- common consensus for interdisciplinary approaches and necessary collaboration between different sectors of public entities;
- a shared way of approaching the knowledge of aspects tied to climate change and the role of green areas in developing cognitive and assessment tools for local planning;
- application of NBS as a necessary way of intervening in planning and designing green areas for adaptation to climate change, also assessing them over time with respect to economic benefits and the health of inhabitants;
- searching for ways to create green areas tied to urban-planning techniques, such as compensation and 'pre-greening', and providing a multitude of forms of public-private involvement in urban forestation, even when implementing the projects.

Some critical aspects emerge, such as:

- discord between the different project coordinators in judging the effectiveness of the compensatory measures aimed at creating green areas. In fact, while the experience of Prato is considered a success, the one in Ferrara is not, in which the issues of forestation and urban greenery have in general been difficult to integrate when developing the new urban plan;
- the difficulty of transferring assessment and design innovations present in the projects to ordinary planning, with the risk that the implemented interventions exhaust their effectiveness within the individual pilot actions. While the selection of the tree species most suitable for meeting climate vulnerabilities is, in fact, an integral part of Bologna's building regulations, and therefore binding, this aspect is not addressed in the other projects, which rely on matrices, guidelines, etc.

As mentioned above, and in light of the results of the

comparative study, two workshops were organised on some sample experiences. This was designed to favour direct interaction with the promoters of the projects and learning on behalf of technicians and local administrators participating in the Life+A_GreeNet project. One preliminary aspect regarded the types of participants and knowledge of the topics in question, in order to probe the preparation of the territory. A questionnaire administered via the 'Mentimeter' platform showed that more than 60% of participants were technicians, 15% were public administration workers, and 22% were administrators. Forty-six percent answered that they knew about the webinar topic and 32% said that they knew it very well; 14% said that they were not or only slightly familiar with it, and 7% said they were experts. More than 80% said that green infrastructure is a topic to be addressed on a large scale, although 19% said that this was not sufficient.

The first workshop, entitled 'Adaptation to Climate Change: the role of participation and involvement of local communities in improving cities environmentally, economically, and socially', was held on 8 February 2022. It focused on experiences in the Life 'Gaia' and 'Blue AP'; Interreg Europe 'Perfect'; Life 'Clivut' projects. These were selected because the role of climate change and local stakeholders in them was essential in creating green areas and protecting the land as a measure for adaptation to climate change, even by providing innovative forms of public/private partnership.

The second workshop, held on 17 February, was entitled 'Adaptation to Climate Change, Green infrastructure and urban forestation: relationships with territorial and urban planning'. It presented the experiences in the Municipal Operational Plan (Piano Operativo Comunale, POC) of Prato; the PUJ Prato Urban Jungle project; the Life SOS4LIFE project; and the Territorial Governance Plan (Piano Generale del Territorio, PGT) of the Municipality of Giussano. In these projects and plans, the vision of green areas and urban forestation interventions is entrusted to unconventional means of intervention and realisation, such as urban equalisation and preliminary planting.

The examination of the different plans and projects within the workshops yielded some aspects for innovation and critical points for attention in the Life+A_GreeNet project (Annex 2):

- the application of innovative methods in classifying the quality of green areas and the land, often referring to ecosystem services;
- the search to quantify the benefits provided by the green area in absorbing CO_2 and attempts to refer to economic benefits and with respect to citizen health;
- the provision of multiple forms of public/private involvement in urban forestation operations, distinguishing the various target groups and asking the different subjects for an operational contribution to complete the interventions;
- the use of management platforms and apps for citizen involvement to manage the project and other design opportunities;
- the search for ways to realise green areas tied to techniques of urban planning, such as equalisation and preliminary planting, also through a preliminary selection of the areas based on their ecosystem value;
- the application of NBS and their assessment over time as a necessary means of intervention for adaptation to climate change;
- the centrality of desealing processes to implement adaptation strategies;
- a common consensus for interdisciplinary approaches and the necessary collaboration between different sectors of the public administration;
- the value of changing lifestyles, starting with participatory processes that involve schools and students.

The comparison also yielded criticalities and discord in judging the effectiveness of some measures, first of all urban-planning equalisation measures aimed at creating green areas. For example, while the Prato POC is considered a success, the experience of the City of Ferrara in the Interreg Europe 'Perfect' project is not, whereas the issues of forestation and urban greening had difficulty integrating in the construction of the new Local Urban Plan. Public administrations also expect certain difficulty in creating green areas through direct interventions by private citizens, who prefer to 'monetise' as much as necessary.

Another aspect that is not sufficiently investigated by these experiences is the effective transferability of assessment and design innovations within ordinary planning, with the risk that the interventions exhaust their effectiveness within the individual actions. There is also another approach in choosing how to create green areas. As an example, the Municipality of Bologna imposed the use of the most suitable tree species to respond to climatic vulnerabilities through the Municipal Building Regulations considering also other aspects on the basis of

schemes and guidelines. This experience increases the conviction of the possible cooperation between researchers and local administrations, initiating a necessary and hoped-for cultural process.

Some specific aspects of the different projects constitute interesting grounds for comparison for the Life+A_GreeNet project, for example, the value attributed to sensors in the Urban Innovative Action (UIA) 'Prato Urban Jungle' to measure and model NBS interventions with a before-and-after approach to quantify the benefits of the interventions.

The next step was to select the most important experiences for the possible transferability to the Central Adriatic cities regarding some solutions, techniques, and tools experienced. The activity focused on the current state of planning and management of green areas, using focus groups to verify the favourable/unfavourable conditions for the transfer and contextualisation of practices and technical solutions in the specific territorial situations.

This series of three thematic focus groups had an average of 30 participants, for a total of 97 people among the research team, public administration workers, and administrators in the project territories.

In relation to the first focus group on civic engagement the following emerged:

- an interest in continuing a multi-subject participatory process in the Central Adriatic territory within an organised, codified system, in which the stakeholders may interact based on clear, well-defined technical input;
- the role of stakeholders in the management of green areas, including through new modes of public/private interaction and on the basis of agreements/pacts that can guarantee municipalities from the risks of maintenance carried out by other parties.

In reference to the second focus group on the urban planning-green infrastructure relation, the following emerged:

- the need to integrate skills in governing green areas and recognise difficulties of local urban-planning tools to govern the quality of green areas, as well as guarantee the quantity according to the legal urban-planning standards;
- the need for a territorial vision of the green coastal infrastructure that includes the rivers and agricultural areas, works on the network of green areas, and favours the construction of the urban ecosystem; this vision must overcome the logic of municipal borders to present large-

scale proposals and solutions that are missing today;

- the presence of some good local practices for orienting private proposals in creating greening in implementation plans, even through operations of environmental compensation and the involvement of citizens in managing the green areas;
- the need to increase the designing and realising skills of green areas.

In reference to the third focus group on the NBS for climate-change adaptation the following emerged:

- the substantial lack of experimentation with NBS in cities of the Central Adriatic;
- the lack of a culture that allows public administrations and technicians to change the approach to addressing issues, for example, urban water drainage;
- the problem is related to the lack of maintenance and difficulty for administrations to work in this direction.

The path of mutual interaction and learning yielded a framework of common objectives to pursue in local and large-scale planning to transfer the most innovative solutions identified in European and national experiences, with particular reference to:

- the need to refer to spatial planning to build a vision of an ecosystem type of green infrastructure on both the large and small scales. This would require the regions in question (Marche and Abruzzo) to develop regional laws to assign skills and roles, as well as innovative tools for design and management.
- the refinement of shared operational methods capable of orienting ordinary planning tools, such as equalisation and ecological compensation (Boscolo, 2008; Pileri, 2007) to create green urban areas;
- the development of micro-regeneration greening interventions accompanied by operations aimed at inclusiveness, integration, and also economic sustainability. In micro-regeneration interventions, the so-called active citizens' actions are not exhausted in the decision-making process, but continue in the step to implement the decisions, assuming the form of care that is the regeneration of the urban common good in question.
- multi-subject participatory processes to design and manage the coastal green infrastructure, thus also involving companies in the area;
- new forms of managing and realising green areas through unconventional means, for example:

forest contracts, collaboration pacts with citizens to manage green areas; crowdfunding that involves local communities, actors from various areas and different scales, from local to regional, etc.

- the opportunity to favour the growth of professionalism in the design of greening, in close relation with the adaptation and mitigation of climate change;
- the need to better involve administrations in understanding the use of nature-based solutions, in envisaging projects that are more attentive to aspects tied to the quality of urban green areas and public spaces, and in proposing possible solutions regarding maintenance.

5. Discussion and Conclusions

In Europe, the implementation of UGI in practice remains slow (Dhakal & Chevalier, 2017; EC, 2019), despite the recognition of multiple benefits (direct and indirect, short- and long-term; quality of life, health, ecological, economic, social and cultural). Among the causes of this weak spread, those of an economic/financial nature have now been overcome since green infrastructure has been identified as an investment priority on which structural funds should be concentrated (e.g., Next Generation EU and National Plans for Recovery and Resilience). As confirmed by the Life+A_GreeNet project, the reasons for the slow uptake include the following: the scarcity of available data, the weak awareness of practitioners, the lack of personnel in public administrations and their low knowledge about the multiple benefits of green areas, long considered just a mere aesthetic element within cities, and in Italy only as a minimum urban-planning standard to guarantee a balance between empty spaces and built spaces.

The European Commission favours and requests the implementation of UGI through spatial planning to favour climate-change adaptation to meet the environmental, social, and economic needs of urban areas (Sturiale & Scuderi, 2019) in the conviction that their urban and especially regional dimension may serve to regulate, orient, and coordinate the objectives and proposals for their implementation (Elinbaum & Galland, 2016). The theoretical approach of researchers is not sufficient. Although different studies have highlighted principles of planning green infrastructure to be transferred to operational planning (Benton-Short

et al., 2019; Mell et al., 2017) these principles have often proven to be difficult to apply and implement in practice (Monteiro et al., 2020). In addition, objective impediments are often found in the application of UGI in ordinary planning practice, tied to local socio-political dynamics, private interests, and a lack of experience among administrations. Faced with these objective difficulties, the Life+A_GreeNet project proposes starting from experiences. These can (or may) be a useful test-bed to learn from successes and failures, to focus on theoretical and applicative knots that still need to be resolved, such as the actual feasibility of certain actions according to the priorities of administrations and the needs of the community under social and ecological aspects (Teixeira & Fernandes, 2020).

The experience begun in this project to recognise the role of UGI in contributing to the political objectives of sustainable urban development, (Vargas-Hernández & Zdunek-Wielgołaska, 2021), which will be monitored over time, offers a solid test base for the role that UGI may play in spatial planning on all scales. The ultimate goal is their integration in strategic planning, guaranteeing a vision that crosses administrative borders and recovers a cross-scale dimension, down to local plans closer to the communities and the concept of 'care' for the territory (De La Pierre, 2020). To do so, in promoting the conservation of biodiversity and ecosystem services, local and large-scale administrations, within their own skills, should make use of innovative spatial planning techniques and tools such as urban planning and territorial equalisation and ecological compensation that overcome the limits and quantitative standards of ordinary planning, to begin to compare the performance of green areas (Ronchi et al., 2020). Likewise, work should be done to overcome the difficulties inherent in management and maintenance through governance agreements (forest contracts, collaboration pacts, etc.) capable of facilitating socio-ecological integration and local and large-scale commitments, as well as favoring the empowerment of local communities in caring for the territory. This shift in the planning, conservation and management of territories for adaptation to climate change, as a result of mutual learning and sharing between researchers, administrators, and technicians, will engage the territories in the coming years and may be used and transferred to other Italian and European territories starting from those included in the project. This way of working, which is innovative for territories in the Central

Adriatic, falls in line with the means advocated by the New European Bauhaus, starting with the opportunity to learn from innovative and emblematic projects. The goal is to share ideas to propose collaborative activities between different sectors, institutional actors, or groups that are as diverse as possible, breaking down compartmentalisation and initiating collaborative partnerships for shared territorial objectives.

An unanswered question remains the effective capacity of public administrations to gather this challenge and implement the role of UGI in its own planning and programming tools. This objective, as requested by the local administrations themselves, requires a large-scale boost from the Regions, which should promote an overall vision of green infrastructure (Scott & Hislop, 2020), introducing innovations with respect to standards, regulation, and management. This role of the large scale is envisaged by the Life+A_GreeNet project through the development of a valid regulation across the entire regional territory such that the realisation of green infrastructure becomes a founding principle of urban planning, in the awareness that it may constitute a first step to be followed by others that are much more demanding for the Regions and local administrations. The world of research, for its part, has a great responsibility in this respect (EEA, 2020). It should strive to combine expertise to foster a transdisciplinary approach to problem assessment and problem-solving driving the cultural growth of administrations and raising awareness in local communities about the central role of green infrastructure in adapting to climate change and improving the quality of life in urban areas. Finally, the fundamental role of technicians and the public administration, in general, should not be overlooked. With the knowledge gained from the project, through workshops, seminars, direct confrontation, and concrete achievements, they are called upon to test the decision support system (DSS) model prepared through the project for green areas in daily practice, and to exert their influence on overcoming a 'case by case' logic.

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Annex 1. Classification of projects involved in the exploratory investigation. *Source: elaboration by authors*

BEST PRACTICES	AREA OF INT.1 "Collaborative, multifunctional and multiscale planning" for ..	AREA OF INT.2 "Innovative urban planning techniques"	AREA OF INT.3 "NBS solutions "	AREA OF INT.4 Thematic Aspects	START DATE	DEADLINE	TERRITORIAL	LOCAL	INTEGRATION WITH SPATIAL AND LOCAL PLANNING	VULNERABILITY ANALYSIS AND CLINICAL RISKS	ANALYSES OF HEALTH RISKS	GREEN	SOFT	GREY	PARTICIPATION, CO-DESIGN Municipalities/Citizens/Technicians/Companies/Schools/Agencies	INTERVENTION PROCEDURES Public, Private or Public/Private	MONITORING	ACTIONS/ REPLICABLE SOLUTIONS
LIFE UrbanProof	x	x	x		10/1/2016	4/30/2021		x	x	x	x	x	x		All categories	Public/Private	x	x
UIA PUJ PRATO	x				9/1/2019	8/31/2022		x	x			x	x	x	All categories	Public/Private	x	x
LIFE METRO ADAPT	x		x	x	9/3/2018	9/30/2021	x		x	x		x		x	Citizens,Technicians	Public		x
LIFE Roll-out	x				7/1/2019	3/31/2023	x		x	x			x		Municipalities/ Technicians	Public		x
POC PRATO		x	x		11/15/2019	5 years		x	x	x		x	x	x	All categories	Public/Private	x	x
PGT GIUSSANO		x	x		5/6/2020	5 years		x				x	x	x	All categories	Public/Private	x	x
PGT DESIO		x	x		3/4/2015	Variation 12/2020		x	x			x	x	x	All categories	Public/Private	x	x
LIFE HEATLAND			x		10/2/2017	12/31/2021		x				x	x		Municipalities/ Technicians/Agencies	Public	x	x
HORIZON2020 GREN UP			x		6/1/2017	5/31/2022		x	x	x		x	x		Municipalities//Technicians/citizens/companies	Public/Private	x	x
LIFE ASTI			x		01/09/2018	8/31/2022		x		x	x	x	x		Municipalities/citizens	Public	x	x
LIFE+ IMAGINE	x		x	x	7/2/2013	01/07/2016	x	x	x	x	x	x	x	x	Municipalities/ Technicians	Public/Private	x	x
LIFE+ BLUE UP	x				10/1/2012	9/30/2015		x	x			x	x	x	Municipalities/ companies/ Citizens	Public/Private		x
LIFE GAIA	x				10/10/2010	4/30/2013		x	x			x	x		Municipalities/ companies/ Citizens	Public/Private	x	x
LIFE CLIVUT	x			x	9/1/2019	2/28/2023			x	x					Municipalities, businesses, citizens, students	Public/Private	x	x
SOS 4 LIFE		x	x	x	01/07/2016	September 2020		x	x	x		x	x	x	Municipalities/ Technicians/ companies/citizens	Public/Private	x	x
INTERREG EU Perfect	x	x	x		3/1/2017	2/28/2022		x	x	x	x	x	x	x	Municipalities,companies, citizens, students	Public/Private	x	x

Annex 2. Interpretational grid of features of the selected projects. *Source: elaboration by authors*

PROJECT	BLUE AP	GAIA	CLIVUT	PERFECT	ECOLIFE	POC PRATO	PUJ Prato Urban Jungle	SOS 4 LIFE	PGT Giussano
Cognitive/assessment framework									
Climate analysis/profile	X			X					
Repository of appropriate tree species		X				X			
Ecosystem services assessment			X	X			X	X	
Censuses / Urban heat island						X			
Assessment of the state of the environment and air quality before and after							X		
Map of land quality								X	
Environmental and ecosystem values and worth						X			X
Daily behaviour					X				
Project results									
Pilot actions/scenarios	X						X	X	
Regulations/plans		X		X (PGT)		X (Urban equalization)			X Preliminary planting
Guidelines/manuals				X		X		X	
Schemes				X		X			
Tree planting		X		X					
Web APP			X (Census)						
Toolkit			X				X		
CO_2 reduction					X				
Training courses							X		
Forms of stakeholder/citizen/association involvement									
Focus groups	X		X				X		
Co-design				X (6 pilot actions)			X		
APP			X				X		
Game/simulation					X		X		
Signing commitments					X				X
Crowdfunding							X		
Means of involving other public administration entities/sectors									
Conventions/agreements/other forms of involvement	X			X		X			
Monitoring activities									
Before and after indicators	X					Number of plans presented	X		
Sensors							X		
Management tools									
Platform			X (Aspects of tree life)			X (Container of activities tied to forestation)	X		