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# Blueprint for Innovation in Urban Forestry

## Uforest Project Deliverable 3.3

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## GLOSSARY: KEY CONCEPTS IN URBAN FORESTRY AND INNOVATION

**Bioeconomy** ► The production, utilization, conservation, and regeneration of biological resources, including related knowledge, science, technology, and innovation, to provide sustainable solutions (information, products, processes and services) within and across all economic sectors and enable a transformation to a sustainable economy (IACGB, 2020).

**Emerging urban forests** ► spontaneously developing forests in cities (Kowarik et al., 2019).

**Entrepreneurship** ► the activity or skill in starting new businesses, especially when this involves seeing new opportunities and taking on financial risks in the hope of profit (Cambridge Advanced Learner's Dictionary, 2022; Oxford Advanced Learners' Dictionary, 2022).

**Environmental "eco" entrepreneurship** ► "an innovative, market-oriented and personality-driven form of value creation through sustainable environmental innovations in products and services exceeding the start-up phase of a company." (Mammadova et al., 2021).

**Green Care entrepreneurship** ► processes and outcomes of innovative value creation that harness health and well-being benefits of nature, and result in transformed human-nature attitudes, interactions and relationships (Mammadova et al., 2021).

**Green infrastructure (GI)** ► a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services' in both rural and urban settings (EEA, 2021).

**Innovation** ► The process, the outcome, and the mindset needed to create something novel in response to a problem (Kahn, 2018; Taalbi, 2014).

**Internet of Nature (IoN)** ► An approach where urban ecosystems can be described and represented through digital technologies and applications (Galle et al., 2019)

**Nature-based enterprises** ► is the most common organisation type and offers products or services where nature is a core element and engages in economic activity (mainly forestry and tourism). Community-benefit enterprises specifically involve communities in governance and management of forests, to provide direct and indirect benefits for the public and the community. Additional objectives include conservation, poverty alleviation, development, cultural revitalisation and political empowerment. For-profit forest enterprises can contribute to the conservation and sustainable use of forests while improving the livelihoods of local populations. Pro-biodiversity businesses contribute to biodiversity and sustainable use of ecosystems services while being financially profitable. The underlying principle is payments for ecosystem services, where beneficiaries are charged for its use through financial mechanisms, and profit is invested in conservation (Kooijman et al., 2021).

**Nature-based learning (NBL)** ► encompasses the acquisition of knowledge, skills, values, attitudes, and behaviours in realms including, but not limited to, academic achievement, personal development, and environmental stewardship. It includes learning about the natural world, but extends to engagement in any subject, skill or interest while in natural surroundings. It includes informal, non-informal and formal learning (Jordan and Chawla, 2019).

**Nature-based organisations** ► core use of nature, but no economic activity (public-private companies, community groups and network organisations in forestry, community gardens and tourism). They play an important role in the financing of, and in providing space and regulatory frameworks for NBS (e.g., city departments), as well as for the financing of nature, mainly for nature conservation, and for the empowerment of local communities (e.g., NGO environmental charities) (Kooijman et al., 2021).

**Nature-based products and services** ► delivered by enterprises or organisations, where nature is not at the core of activities (mainly, engineering and renewable energy companies that use nature as an input) (Kooijman, 2021).

**Nature-based solutions (NBS)** ► are defined as solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience; such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes,

through locally adapted, resource-efficient and systemic interventions (EC, 2021).

**Novel ecosystems** ► Ecosystems emerging after human-induced changes and composed of unprecedented species assemblages (Hobbs et al., 2006).

**Smart green infrastructure** ► green infrastructure that undergoes networked monitoring, management, and augmentation to ensure, for instance, adequate hydration of urban forests (Gabrys, 2022).

**Smart urban forest management** ► The design, establishment, monitoring, and management of urban trees and vegetation through the use of digital technologies, for the joint purpose of improving the urban environment and engaging all relevant stakeholders in its governance (Nitoslawski et al., 2019)

**Social entrepreneurship** ► aiming to provide innovative solutions to unsolved social problems, putting social value creation at the heart of their mission in order to improve individuals' and communities' lives and increase their well-being).

**Urban ecosystem services (UES)** ► benefits to sustain and improve human livelihood and the quality of life services provided by urban and peri-urban ecosystems: they include provisioning services, regulating services, habitat or supporting services, and cultural services (Haase et al., 2014).

**Urban forests** ► tree-based urban ecosystems comprising all woodlands, groups of trees, and individual trees located in urban and peri-urban areas; they include, therefore, forests, street trees, trees in parks and gardens, and trees in derelict corners (FAO, 2017).

**Urban Forest-Based Solutions (UFBS)** ► a subset of nature-based solutions that builds on tree-based urban ecosystems to address societal perceptions and demands, simultaneously providing ecosystem services for human well-being and biodiversity benefits. They are socio-ecological interventions that combine human management with nature's functionality within (peri) urban settings, offering great potential for more sustainable urban development (De Vreese, 2018).

**Urban forestry (UF)** ► integrated, interdisciplinary, participatory and strategic approach to planning and managing tree resources in urban areas for their economic, environmental and sociocultural benefits (FAO, 2017).

**Urban forestry Initiative** ► A given project or enterprise whose aim is to sustainably support, improve and/or promote urban forestry development and implementation.

## ACRONYMS AND ABBREVIATIONS

**AI** ▸ Artificial intelligence

**BVOCs** ▸ Biogenic volatile organic compounds

**COVID-19** ▸ Coronavirus disease 2019

**DPSIR** ▸ Driving forces, Pressure, State, Impact, Response

**EC** ▸ European Commission

**EEA** ▸ European Environment Agency

**EF** ▸ Ecosystem functions

**ERASMUS** ▸ European Region Action Scheme for the Mobility of University Students

**ES** ▸ Ecosystem services

**EU** ▸ European Union

**FAO** ▸ The Food and Agriculture Organization of the United Nations

**GI** ▸ Green infrastructure

**GS** ▸ Green space

**ha** ▸ Hectare

**HE** ▸ Higher Education

**IACGB** ▸ International Advisory Council on Global Bioeconomy

**ICT** ▸ Information and communication technologies

**ION** ▸ Internet of Nature

**IUCN** ▸ International Union for Conservation of Nature

**NBL** ▸ Nature-based learning

**NBS** ▸ Nature-based solutions

**NBIS** ▸ Nature-based innovation systems

**NGO** ▸ Non–governmental organisation

**NTFP** ▸ Non-timber forest products

**OECD** ▸ The Organisation for Economic Co-operation and Development

**R&I** ▸ Research and innovation

**SDGs** ▸ Sustainable development goals

**UES** ▸ Urban ecosystem services

**UF** ▸ Urban forestry

**UFBS** ▸ Urban forest-based solutions

**UFIF** ▸ Urban forestry innovation framework

**UGI** ▸ Urban green infrastructure

**UHI** ▸ Urban heat island

**UN** ▸ United Nations

**UNECE** ▸ The United Nations Economic Commission for Europe

# 1. INTRODUCTION TO URBAN FORESTRY

## 1.1. URBAN FORESTS AS NATURE-BASED SOLUTIONS

Urbanisation trends across the globe are increasing. According to the United Nation Department for Economic and Social Affairs 55% of the world's population lives in urban areas, which is expected to increase to 68% by 2050 (UNDESA, 2019). The increase in urban population, and urbanisation in general, has resulted in several challenges. Pollution, for example, has a negative impact on air quality and is a significant cross-cutting health hazard. In parallel, urban areas are expected to face an increase in urban temperatures (the urban heat island –UHI– effect) due to climate change (Gago et al., 2013). Even more so, urban areas are contributing to the latter. Urbanisation in the form of both densification and urban sprawl also threatens urban green spaces (GS) and natural areas, resulting in their loss, degradation, and fragmentation (Haaland and Konijnendijk van den Bosch, 2015). Overall, these kinds of urban developments have very negative impacts on the quality of life, biodiversity, and resilience in cities, but also on the health and well-being of their citizens, and on the environment as a whole (UN, 2021). Their negative effects also lead to increased costs for public infrastructure and healthcare sectors, which are struggling to find innovative, interdisciplinary, and cost-effective solutions.

The COVID-19 pandemic has brought new challenges, with physical distancing measures further restricting access to public spaces and closed venues in particular, exacerbating city dwellers' use of limited public GS. The growing demand for urban land for construction and industry results in the loss and fragmentation of urban GS. Thus, there is an urgent need to effectively manage competing pressures of urban expansion, while sustaining and enhancing urban ecosystems to preserve the multiple values and services they offer.

In recent years, two important approaches that promote solution-oriented actions and targets to addressing these challenges have emerged. The first is the set of 17 Sustainable Development Goals (SDGs) endorsed by the UN in 2015 under its 2030 Agenda for Sustainable Development. Comprehensive and universal, the SDGs are the world's shared plan to tackle global economic, social, and environmental challenges by 2030. They are considered the main frame of reference to develop policies and programmes at a national level to attain a global transformation towards sustainability (Eisenmenger et al., 2020; FAO, 2022). The second approach is the implementation of Nature-based solutions (NBS). The European Commission (EC) defines NBS as "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience; such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions" (EC, 2021). In the past years, the EC has made recommendations to help increase the use of NBS and bring nature back into cities, including a call to action to 'rewild' cities (Rewilding Europe, 2020). It also developed a Research & Innovation (R&I) agenda that promotes NBS and their benefits to cities and territories, aiming at improving the implementation capacity and evidence base for deploying NBS and developing corresponding future markets. These recommendations are also expected to foster an interdisciplinary R&I and stakeholder community and the exchange of good practices in this field (Faivre et al., 2017).

Urban trees and urban forests are considered crucial contributors to greener, healthier, more resilient and liveable cities. They are valued as effective NBS that address global and societal challenges, providing benefits for human well-being and biodiversity –and thus offer a strong link to SGDs delivery. Urban forestry (UF) sets out to deploy these NBS pertaining to trees and forests into an innovative context. However, despite its evident implications for increasing sustainability and quality of life in cities, the potential of UF has not been fully realised yet. In a recent survey on training needs for UF stakeholders (Basnou et al., 2021), urban forests were acknowledged as NBS that offer opportunities for innovation, with possibilities for delivering lasting, tangible and broad environmental, economic and socio-cultural benefits. Above all, the survey results highlighted a lack of awareness of UF as a distinct field and profession. The main knowledge gaps that were identified relate to assessing alternative forest management scenarios, including the estimation and delivery of ecosystem services (ES), or the development of marketing strategies for trading ES. In addition, a need to integrate strategic transversal concepts and disciplines –arts, storytelling, urban forest pedagogy, permaculture, artificial intelligence (AI), connecting technology with urban nature– was also perceived as

relevant to UF innovation. These training needs and knowledge gaps relate to a set of environmental and social challenges associated to urban forests, such as dealing with harsh growing conditions for vegetation, disservices that can be associated with urban trees, and social equity and governance issues, among others (see section 3.3.). It is imperative that these challenges are addressed to fully deploy the functions and services offered by urban forests.

The goal of the **Uforest** project is to create a cross-sectoral alliance that interlinks disciplines that often do not collaborate –on the one hand, urban planning, urban design and architecture; and on the other, forestry and urban ecology; and socio-economics and information and communication technologies (ICT) – to provide specialised training and support to students and practitioners working towards innovative UF projects. The Uforest project and alliance aims at promoting Europe's innovation capacity among universities, cities, and businesses to deliver a novel approach to UF.

## 1.2 URBAN FORESTS: DEFINITIONS, MAIN FEATURES AND TYPES

Urban forests can be defined as "all forest stands and other tree dominated vegetation in and near urban areas" (Konijnendijk and Randrup, 2005), including the sum of all woody and associated vegetation. A simplified classification by the Food and Agriculture Organization of the United Nations (FAO) lists the following five types of urban forests: peri-urban forests, city parks and urban forests (> 0.5 ha), pocket parks and gardens with trees (< 0.5 ha), trees on streets and public squares, and other GS –such as botanical gardens, urban agricultural plots or river banks (Salbitano et al., 2016). With 'peri-urban forests' and 'urban forests' the woodland / forest ecosystem component of the larger urban forest network is implied.

Urban forests should be viewed as socio-ecological systems comprising trees, other vegetation, and their related biotic and abiotic components, such as wildlife or water systems, and cultural elements like historical heritage (Wirtz et al., 2021; American Forests, 2012). Such socio-ecological systems can be found in any urban public or private space, ranging from an individual street tree to parks and woods, in areas that extend from the urban core to the city's outskirts and towns (Roman et al., 2018).

Urban forests produce multidimensional tangible and intangible outputs that impact, among others, air, soil and water quality, temperature, biodiversity, public health, culture and social relations, and the economy. These outputs can be socially perceived either as positive –ES– or negative –ecosystem disservices– depending on context (Escobedo et al., 2011). With the benefits widely seen as exceeding the drawbacks, a growing body of literature details the potential of urban forests as NBS (James et al., 2009; Krajter Ostoić and Konijnendijk van den Bosch, 2015; Kabisch et al., 2016; Tomao et al., 2017; Ferrini et al., 2017; Lafortezza et al., 2018; DeBellis et al., 2021). According to Seddon et al. (2020) and Haase (2021), urban forests are considered NBS because they embrace nature to tackle social and planetary interdependent challenges: mitigating and adapting to climate change, protecting and enhancing biodiversity, and ensuring human well-being and resiliency with a one health perspective. All of these are also key challenges addressed by the SDGs. Urban forests generate substantial benefits, such as offsetting carbon emissions, removing air pollutants (Yang et al., 2005), reducing noise, regulating microclimates, and providing recreation and amenity values (Konijnendijk et al., 2005). Various studies have documented significant public health benefits associated with people's exposure to trees (such as Takano et al., 2002; Lovasi et al., 2008; Lafortezza et al., 2009; van den Bosch and Ode Sang, 2017; Wolf et al., 2020). Recent research found, for example, that proximity to trees is related to a lower rate of antidepressant prescription; specifically, living within 100 meters of a tree is associated with lower use of antidepressants (Marselle et al., 2020). Moreover, compared to traditionally engineered solutions, urban forests not only are tree-based infrastructures and cost-effective ways to address expensive urban problems –ranging from water management to food provision–, but they also appreciate in value over time, offering long-term assets and services (American Forests, 2012; Turner-Skoff and Cavender, 2019). In addition, urban forests contribute to reducing energy demands and to revamping the economy by offering jobs in the green sector. A recent study in the United States found, for example, that about 0.5 million people are

employed as a result of urban forestry activities (Thompson et al., 2021).

The effective provision of services from urban forests is linked to the deployment of adequate UF initiatives based on sound design, planning, implementation and management schemes: inclusive urban planning that applies collaborative planning, co-design, public participation, policies, and governance (Sipilä and Tyrväinen, 2005; Janse and Konijnendijk van den Bosch, 2007; Lawrence et al., 2013; Gulsrud et al., 2018; Konijnendijk et al., 2018; Basnou et al., 2020). Moreover, UF initiatives benefit from an interdisciplinary perspective, from connecting economic approaches (Tyrvänien and Miettinen, 2000; Gulsrud et al., 2013; Chan et al., 2018) to ICT sciences and emerging technologies, and from introducing novel concepts, such as the Internet of Nature, ION (Galle et al., 2019; Nitolawski et al., 2019), into UF projects and re-naturing strategies for cities. Galle et al. (2019) give examples of digitisation and of bringing nature 'online', for example through sensors that measure the water content and other properties of the soil in which urban trees grown. Recent years have also seen growth in ICT-based companies that support urban forest inventory and monitoring. For instance, the use of the i-Tree software for assessing urban forests and their benefits –initially in North America but now also in Europe and elsewhere– is an impactful example of using ICT for decision support (Nowak, 2020).

## 1.3 URBAN FORESTRY: AN EMERGING FIELD AND PROFESSION

For many years, the most broadly accepted definition of UF has been 'the art, science, and technology of managing trees and forest resources in and around urban community ecosystems for the physiological, sociological, economic and aesthetic benefits trees provide society' (Helms, 1998). This definition, developed in North America and listed in the Dictionary of Forestry, clearly indicates that the concept of UF goes beyond traditional forestry. It describes it as an interdisciplinary field and profession that studies, plans, implements and manages urban forests as the 'tree-based' component of wider urban green –and blue– infrastructure. Its goal is to harness the psychological, sociological, aesthetic, economic, and environmental benefits urban forests provide to society and reduce their disservices (Konijnendijk and Randrup, 2004; O'Herrin, 2016). For this reason, it involves both natural and social sciences, as well as their interactions with the humanities and planning sciences (Konijnendijk, 2003). Examples of contributing disciplines are forestry, horticulture, urban ecology, urban planning, urban design and architecture, landscape architecture, socio-economics, environmental psychology, and ICT. Thus, compared to classic forestry, UF adapts to the specific demands of local urban societies, focusing on a wide set of social and environmental values rather than on wood production (Konijnendijk, 2000) –although the production of wood and other biomass can be an important part of urban forestry in some contexts.

Interest in trees and green areas as contributors to more attractive cities dates back to the early days of urbanisation, including the ancient civilisations of Mesopotamia, Greece, and the Roman Empire (Konijnendijk and Randrup, 2004). However, although trees have been planted in human settlements for thousands of years, they were not a prominent feature of most cities prior to the mid-1800s (Roman et al., 2018). Trees were formerly brought into cities for utilitarian reasons, such as providing shade and food. Many European cities also owned and managed their own 'city forests' for the provision of food, fodder, medicines, fuel, and building materials (Konijnendijk, 2008). Especially during the 19th century, structural efforts to greenify cities intensified across Europe and beyond. Even though GS were mostly reserved for the elites, they later became part of the public services cities offered to all residents.

The concept of UF was officially coined in North America in the mid-1960s as an innovative and strategic approach to managing natural resources in urban environments, meeting the expectations and demands of the urban society (Konijnendijk, 2003). Relevant drivers for the initial development of UF were the many challenges trees were facing in cities, including pests and diseases –such as Dutch Elm Disease– and the debate on best practices on tree pruning and pollarding (Fini et al., 2015). Aimed at the integrated planning and management of all tree-based resources in cities and towns, the concept of UF found broad support in North America after initial resistance from both foresters –who hesitated about moving into the city– and urban green professionals –who saw parks and other urban green elements as their mandate– (Konijnendijk, 2003).

Although some European countries were early adopters of UF –like the United Kingdom–, wider interest did not emerge until the 1990s, when the first networks for UF professionals and experts were established, first in the Nordic countries and then Europe-wide. Although the emergence of an UF research community at the European level might suggest that broad acceptance of the concept has been achieved, the definition of UF within the European context is still under debate due to conception and language differences among countries (Konijnendijk, 2003). At the start of the 2000s, UF started to become a real global field, with a wider community of experts. Countries like China and South Korea started to embrace the UF approach for their intensive greening strategy of cities.

The UF field has influenced a wider socio-ecological urban perspective and has seen rapid growth over the years in terms of policy, practice, research, and education, and is now a globally used approach. As with other NBS, UF projects are best oriented at solving context-specific challenges (Toxopeus and Polzin, 2021), driving local action in line with the SDGs (Endreny, 2018; FAO, 2018). Moreover, the rapidly changing circumstances of the modern era compel UF to embrace an adaptive management strategy of learning from failure (Endreny, 2018) and call for governments, civil society, businesses, and the academia to join forces (Jim et al., 2018). Within this collaborative approach and operating in highly complex urban socio-ecological systems, urban foresters need to have strong people skills, jointly with having strong 'tree' and ecosystem knowledge. People skills and knowledge related to social aspects will allow urban foresters to navigate through different networks and communities to identify social needs, manage conflicts, be able to communicate with a wide range of stakeholders, establish partnerships, integrate marginalised and non-expert groups, and offer 'green' leadership (Mammadova et al., 2021; Konijnendijk, 2003).

UF is bound to play an even more significant role on urban ecosystems health and citizens' wellbeing after the approval of the 2030 Agenda for Sustainable Development by the UN. As recognized by the United Nations Economic Commission for Europe (UNECE) and FAO during the *UNECE 2022 Regional Forum on Sustainable Development*, UF can provide a key contribution to the achievement of the SDGs by increasing the sustainability of cities and urban communities, providing food and clean water, increasing incomes and job opportunities, promoting outdoor recreation activities, cleaning the air, producing renewable energy, contributing to climate change mitigation and adaptation, improving soil quality, hosting biodiversity, and fostering a green economy, among others.

Currently, UF is developing in a dynamic and challenging urban environment, with the pressures of global change affecting local environments, an increased citizen demand for various ecosystem services, and the endeavour to universally achieve SDGs by 2030. Even more so, there is a wide range of training needs and knowledge gaps related to urban forests and their capacity to provide environmental and social ecosystem functions and services. Therefore, deploying innovation in UF as a way of making it more effective, efficient, and equitable is essential, but often still not given sufficient attention.

# 2. OBJECTIVES AND METHODOLOGY

Courtesy Forestami

The main objective of this report is to provide a first framework for assessing innovation factors influencing UF (or the UF innovation concept, in brief). The analysis supporting the framework considered innovative trends in UF inside the EU, in alignment with the main challenges affecting urban forests and the planned global SDGs. The resulting UF innovation framework (UFIF) was applied to assess a selection of 20 UF best-practice case studies compiled within the Uforest project. This work was then aimed at providing a first real case-based overview of UF innovation in the EU, without attempting to analyse the perceived usefulness or effectiveness of the cases and solutions proposed. Further, the resulting framework and initial overview of UF innovation will be used as part of UF lobby and dissemination activities within the Uforest project, with the intention to reach a wider audience also and future initiatives.

The methodology to achieve the objective is divided into five main steps, which are illustrated in Figure 1:

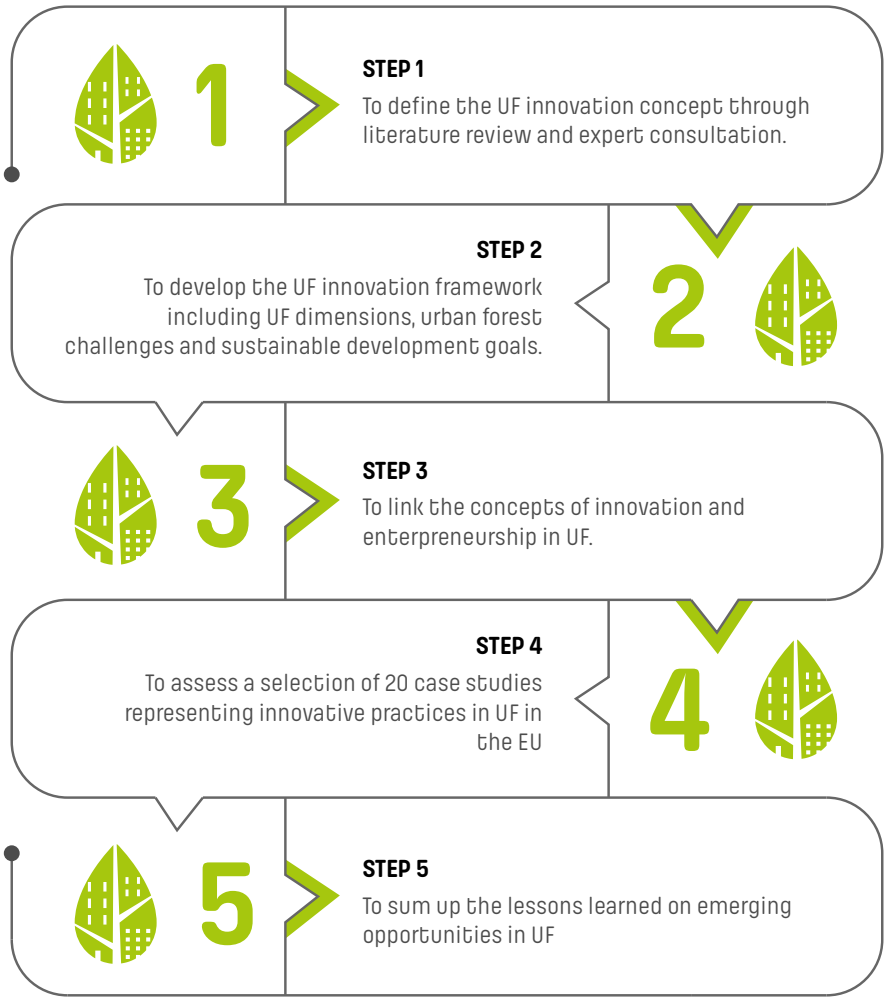



Figure 1 Methodology in five steps

**Step 1**
Based on a review of over 100 works of scientific and grey literature on innovation and the socio-cultural and ecological aspects of UF (see References), and further consultancy and cross-checks with key UF experts, an UF innovation concept with its associated dimensions and typologies was developed.

**Step 2**
Based on the literature review as well as cross-checks and interviews with key informants and experts, the most suitable dimensions were identified to apply to an assessment of UF case studies in order to provide an overview of UF innovation in the EU. The selected dimensions include the main challenges faced by urban forests, the goals to be achieved (summarized by the SDGs, as addressing these is expected to drive innovation), and the degree of innovation of each case study.

**Step 3**
Based on the results of the previous steps, UF innovation was linked to UF entrepreneurship as an additional exercise to highlight the importance of incorporating ecological, social, economic and environmental sustainability practices into UF entrepreneurial initiatives.

**Step 4**
Building on step 2, 20 case studies of UF solutions across the EU were identified, described, and analysed for their innovation components to provide a real-case based overview at EU level. The cases came out of an initial collection made by the project partners, who are experts in either UF research or practice, and where each partner identified 5 outstanding UF solutions of their knowledge. This resulted in 60 potential case studies being collected. From these, a further qualitative screening was carried out to arrive at the

final 20 cases, which included case studies from 9 European countries –Denmark, England, France, Ireland, Italy, Hungary, Romania, Spain, The Netherlands– that were either being implemented or in a pilot stages of development in the public, private or public-private sector. Moreover, the selection tried to achieve a balance of cases according to the following criteria (see Appendix 1):

► **Interdisciplinarity** of the key thematic disciplines that are the focus of the Uforest project –urban landscape planning, forest ecology, socio-economics, and ICT.

► **Complementarity** of urban forestry approaches that are poorly represented.

► **High level of applicability** pilot project, nascent or mature implementation.

► **High level of innovation and/or novelty** within the EU and specific local contexts based on expert partners knowledge.

► **Combination of public and private case studies**.

► **Geographical representativeness** across Europe.

Table 1 - Selection of case studies for assessment

| | Project | Country | Main sector | Uforest thematic discipline | Focus activity | Stage of development |
|---|---|---|---|---|---|---|
| 1 | Associazione Forestale di Pianura (AFP) | Italy | Public | Forest ecology | Afforestation | Implementation |
| 2 | Bankside Urban Forest | England | Public-private | Urban landscape planning | Afforestation | Implementation |
| 3 | Boscoincittà | Italy | Public-private | Urban landscape planning | Afforestation | Implementation |
| 4 | El bosque comestible de Alcalá de Henares | Spain | Public-private | Forest ecology | Afforestation | Implementation |
| 5 | ForestaMi | Italy | Public-private | Urban landscape planning | Afforestation | Implementation |
| 6 | GeForest | Spain | Private | ICT | Analysis | Implementation |
| 7 | Ghaemesh Digital Wetland | France-Hungary | Private | ICT | Analysis | Pilot project |
| 8 | LEAF Global | Denmark | Private | Socio-economics | Education | Implementation |
| 9 | Pla Natura Barcelona | Spain | Public | Urban landscape planning | Afforestation | Implementation |
| 10 | Plantăm fapte bune în România | Romania | Private | Socio-economics | Afforestation | Implementation |
| 11 | Pocket forests | Ireland | Private | Socio-economics | Afforestation | Implementation |
| 12 | Prato urban jungle | Italy | Public | Urban landscape planning | Afforestation | Pilot project |
| 13 | RE Lambro SE | Italy | Public | Forest ecology | Afforestation | Implementation |
| 14 | RPLP Kronstadt | Romania | Public | Socio-economics | Analysis | Implementation |
| 15 | The Northern Forest UK | England | Public | Socio-economics | Afforestation | Implementation |
| 16 | Transformem els patis | Spain | Public | Urban landscape planning | Education | Pilot project |
| 17 | Treemania | The Netherlands | Private | ICT | Analysis | Implementation |
| 18 | TreeTracker | The Netherlands | Private | ICT | Analysis | Implementation |
| 19 | Urban Júcar | Spain | Public | Urban landscape planning | Afforestation | Implementation |
| 20 | WOWnature | Italy | Private | Socio-economics | Education | Implementation |

The case studies were described and compiled through a survey (See Appendix: Model questionnaire) addressed to the case studies' managers/responsible to collect standardized information about the case studies. For two of the case studies, the responsibles were contacted for an interview to gain a deeper understanding of their expected impact. On the one hand, descriptive-technical aspects were of interest, such as the actors and motivations, the main goals and activities, the target audiences, governance, resources, communication strategies, the quality standards they followed, and their impact. Further, respondents' perceptions were gathered related to the uniqueness or added value each case study offered and their vision for the future facing their immediate needs and obstacles. The primary data collected through surveys and interviews were analysed in two steps. First, the data was used to draft factsheets that provide a bird-eye's view on the innovation processes and structure of each of the 20 case studies. The factsheets (refer to www.uforest.eu/case-studies/) were later confirmed by the respondents.

Then, a semi-quantitative, three-step analysis was performed for each case study:

1. Assessment of how many UF challenges the cases addressed, followed by a deeper study of each challenge's traits –or sub-challenges.

2. Assessment of how many SDG-focused goals the cases addressed, followed by a deeper study of each SDG's specific targets.

3. Evaluation of the case studies by degree of innovation through a survey conducted among the Uforest partners. The final categorisation resulted from the highest ranking given to each degree of innovation per case study.

**Step 5**

Lessons on emerging opportunities in UF were drafted. Drawing from the results of the three-phased analysis of the case studies against the literature review, enriched by Uforest project partners expert consultation, challenge-focused innovation typologies and recommendations to focus on pressing innovation areas in UF were identified.

# 3. THEORETICAL BACKGROUND

## 3.1 INNOVATION OVERVIEW

The concept of 'innovation' has become widely recognised and adopted in business development and the world of entrepreneurship (Kahn, 2018). However, its overarching quality makes it a complex umbrella term subject to multidimensional interpretations (Edwards-Schachter, 2018) and public perceptions (Mammadova et al., 2021; Wolf, 2010). Formal definitions describe innovation as a new idea, object or method, or the introduction of something new (Cambridge Advanced Learners' Dictionary & Thesaurus, 2022). Schumpeter's highly cited 1934 theory of economic development (1934) also covers innovation as the opening of new markets and the conquest of a new source of materials (Wijngaarden et al., 2019). However, these sources depict an incomplete, static and misleading picture of what innovation actually is. The concept of innovation implies both the process and the outcome of creating something novel, but it also considers innovation as a mindset, an innovative culture (Kahn, 2018). As innovation is essentially a creative response to a problem (Taalbi, 2014), there must be a pre-conditional challenge that, in turn, leads to a need and lights the creative spark of a solution. This thinking is reflected in the DPSIR model adopted by the EEA, as referred to by Lafortezza and Sanesi (2019) in a green infrastructure context: a Driving force (e.g., urbanisation) generates a Pressure (e.g., urban heat island), which alters the State (e.g., ecosystem services), which determines an Impact (e.g., thermal discomfort). All of these elements trigger a Response (e.g., create urban forests) to regulate driving forces, reduce pressures, balance the state and mitigate impacts.

Branching out, innovation goes well beyond the economic, scientific, and technical strands by which it has been dominantly framed (Martin, 2016; Wijngaarden et al., 2019; Joly, 2019). With its human-centred approach, it is especially valuable in addressing societal goals (Martin, 2016; Kahn, 2018). In this sense, the target actors, scope, qualities, or field can determine innovation typologies. They can be understood as technological, organisational, institutional, and social, or even inclusive, green, eco, open, user-driven, lean, low-cost, grassroots, public, and transformative (Mammadova et al., 2021, Edwards-Schachter, 2018). Being context-sensitive, an innovation depicts a dynamic nature, continuously recombining new and existing elements, re-inventing and re-imagining itself (Wijngaarden et al., 2019; Joly, 2019). The degree of innovation of an idea or process for society should be assessed in terms of costs and benefits. Wolf (2010) defined a set of qualities for understanding the perceptions of users –individuals or organisations– on the value of a new idea, object or process:

- **Relative advantage:** degree to which the novel element is perceived as being better than the one before.
- **Compatibility**: capability of the novel element to blend with past experiences, current practices, and perceived needs.
- **Complexity**: quality that determines if the novel element will be adopted or not according to its difficulty.
- **Trialability:** the ability to experiment with a novel element on a small scale to see if it works as expected.
- **Observability**: the ability to actually see the novel element in action.

Nonetheless, a key feature of innovation is that it can diverge from their original contextual purpose, either by changing scale, place, actors or by evolving over time to adapt to contemporary circumstances. For instance, the Bosco Verticale in Milan is considered the world's first vertical forest or 'treescraper' (Visser, 2019), while it was actually inspired by the concept of the hanging gardens of Babylon (Pribadi et al., 2021). In this way, not only do ecological contexts provide unique services for different urban stakeholders and present specific contextual challenges (Toxopeus and Polzin, 2021), but as social and environmental needs, knowledge, and policies develop, so do ES and disservices (Semeraro et al., 2021) and the solutions that arise thereafter. In this sense, innovations are continuously recombining new and existing elements (Wijngaarden et al., 2019) and reinventing themselves.

### 3.1.1 Phases of innovation

Although an innovative thought can be a light bulb moment, innovation is actually part of a structured flow. The innovation process is made up of a series of stages that not only propel initial creativity, but also guide the success of the whole initiative and nurture an ingenuity skill. Desouza et al. (2009) identify and describe five phases of a successful innovation: **Idea generation, Idea mobilization, Advocacy, Screening, Experimentation, Commercialization, and Diffusion and implementation**. Mammadova et al. (2021) add Prototyping, Development, and Evaluation. Additionally, Wolf (2010) offers 5 phases to gradually experiment the adoption of an innovation: Knowledge, Persuasion, Decision, Implementation, and Confirmation.

### 3.1.2 Degrees of innovation

While there is a general misconception that an innovation always needs to be radical or disruptive to be considered so, it can actually depict a wide range of degrees of novelty (Kahn, 2018). For instance, an urban park may not be considered innovative in its current state, unless we focus on how it actually addresses (new) urban challenges (Toxopeus and Polzin, 2021), and how its design and management adapt to contextual needs. Mammadova et al. (2021) identify the following degrees of novelty:

- **Incremental:** This involves small changes –e.g., in inputs, processes or outputs– with an aim for continuous improvement.
- **Complementary:** An innovation that paves the way for major innovation in other sectors or fields –e.g., innovative solutions for a part making it possible to change a product.
- **Radical:** This involves major changes to the outputs or development of totally new products or services –e.g., next generation.
- **Disruptive:** A game-changing breakthrough occurs that disrupts the existing system and creates new ones, and questions existing structures, approaches and attitudes.

## 3.2 ENTREPRENEURSHIP IN URBAN FORESTRY

Innovation and entrepreneurship are interlinked, whether we consider innovation to be an outcome of the act of entrepreneurial activities and behaviour (Bruyat and Julien, 2001; Dees, 1998), or as a core element and "specific tool" of entrepreneurship (Drucker, 1985; Schumpeter, 1942). Either way, entrepreneurs and an entrepreneurial mindset are fundamental to the innovation process, as entrepreneurs are agents of innovation in their continuous efforts to operate more effectively, efficiently, equitably – but also to find new areas of operation. Indeed, these clearly different, but equally important, considerations already indicate entrepreneurship as being either driven by creation of (new) value or organizations themselves (Koolman, 1971 Drucker, 1985; Gartner, 1990) or by the individual, the entrepreneur, thus considering at psychological and social aspects such as resourcefulness, riskiness or social values of the entrepreneur to define entrepreneurship (Palmer, 1971; Dees, 1998; Tan et al., 2005).

The social, economic, and even environmental context and the associated interests of the entrepreneur also define and further frame entrepreneurship. Indeed, in the evolution of the term, entrepreneurship is often compounded to its context; the context which helps to understand how and why some entrepreneurs recognise opportunities and others do not and why the outcomes of entrepreneurial activities vary across different contexts (Baker et al., 2005). For example, intrapreneurship is defined as creating an innovation of any kind within an organization (Pinchot, 1985); social entrepreneurship is defined as aiming to provide innovative solutions to unsolved social problems, putting social value creation at the heart of their mission in order to improve individuals' and communities' lives and increase their well-being (OECD, 2010); and environmental "eco" entrepreneurship which is defined as an innovative, market-oriented and personality-driven form of value creation through sustainable environmental innovations in products and services

exceeding the start-up phase of a company (Schaltegger, 2002). In a recent report assessing the innovation of Green Care initiatives, "Green Care entrepreneurship" was defined as processes and outcomes of innovative value creation that harness health and well-being benefits of nature, and result in transformed human-nature attitudes, interactions, and relationships (Mammadova et al., 2021).

The idea that innovation creates value in a given context is a transversal concept in all different definitions of entrepreneurship. This can be used to shape the idea of UF entrepreneurship, since it is not yet defined in the literature. It can be affirmed that a starting point for UF entrepreneurship should be the establishment, afforestation, reforestation and/or restoration of urban forests, or the increase of existing areas and their functionality (in terms of the amount of desired ecosystem services provided). In addition, we should consider that the social (individual and community) interactions of urbanites and their connections to urban forests are critical in this context. Connecting these points, a number of important aspects emerge that should be considered as fundamental to UF entrepreneurship, such as embedding the benefits provided by the urban forests in the innovations and the value generated from the services provided by urban forests. UF entrepreneurship should also consider social, economic, and environmental sustainability practices in the different stages of an UF innovation. To guarantee this effectively over time, including key stakeholders in the processes of planning and design of UF innovations should also be considered. Thus, entrepreneurship in UF should also embed inclusivity, participation, and engagement – and novel, better ways to achieve this. With this in mind, we define UF entrepreneurship as creating shared and sustainable environmental, social, and economic value, and physiological, sociological, economic, and aesthetic benefits, from the design, development, and management of urban forests for urban community ecosystems. UF entrepreneurs then are the agents that lead the design, development, and stewardship of sustainable urban forests.

### 3.3 CHALLENGES FACED BY URBAN FORESTS AND URBAN FORESTRY

Traditional, business-as-usual strategies and practices in UF are not always up-to-speed with current challenges, and they do not fully address the ever-changing, contextual socio-environmental barriers urban forests face, thus limiting the success and impact of UF. Indeed, in UF the one-size-fits-all approach is not a suitable solution since it prevents adaptation to local specific contexts because of multiple factors (Jim et al., 2018). On the one hand, physical aspects intertwine with intangible issues that impact the whole urban social-ecological ecosystem, such as social and economic inequality, extensive infrastructure development, ageing grey infrastructures, air and water pollution (Lafortezza and Sanesi, 2019; American Forests, 2012) and disservices such as wildfires, litter, or crime. On the other hand, there are specific constraints urban forests has to face: a harsh environment for establishment and growth of trees and other vegetation, encroachment due to urban development, overuse, the spread of invasive alien species, the increase of pests and diseases, political neglect and limited public recognition, inadequate funding, and the absence of effective dialogue between stakeholders (Pino and Basnou, 2022; FAO, 2014). These dynamic and unpredictable factors require theory and practice to constantly evolve to provide innovative and sustainable solutions and, as Prebble et al. (2021) acknowledge, to balance priorities, have access to resources and information, and to engage the community. Through literature review and a partner's expert survey, the most important challenges for urban forests and UF were identified and clustered into seven –often interlinked– categories (Figure 2). This categorisation offers a systematic and comprehensive framework for the further development of the UF innovation concept.

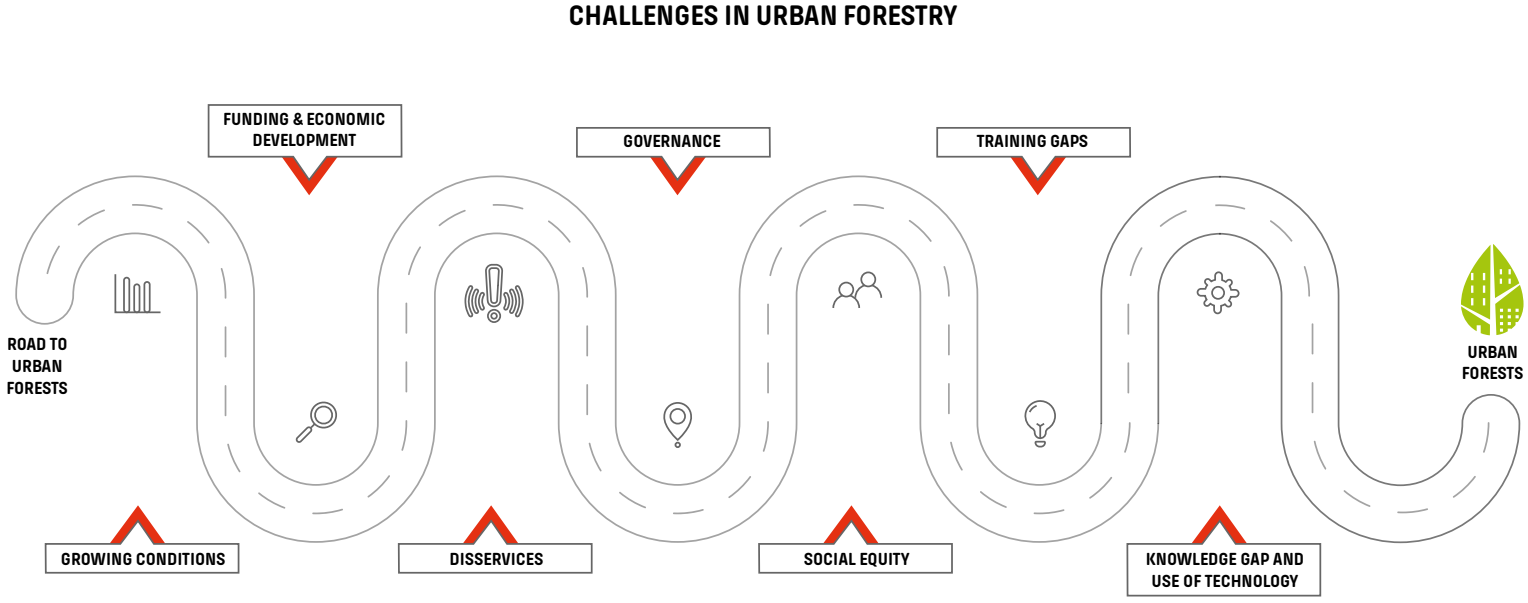



Figure 2 - Main urban forestry challenges identified

### Growing conditions

Compared to their hinterland counterparts, urban forests face multidimensional constraints to thrive from a physical point of view (Jim et al., 2018). Space for vegetation establishment and growth in urban environments is particularly meagre. Available soil is typically compacted, which reduces its water-holding capacity, or in another way degraded by pollutants, salinity or pathogens, with poor biological activity related to low nutrient stalk (Rogozinski and Saha, 2021). There is also limited access to sunlight, with shade-giving buildings hindering photosynthesis, or excessive doses from artificial light at night and diurnal pavement reflection. Air quality is also affected by pollution, which impacts plant enzymatic activity, among other physiological processes (Czaja et al., 2020).

There are also aggravating pressures: droughts and extreme temperatures brought about by climate change (Khan and Conway, 2020; Ordóñez and Duinker, 2014), as e.g., reflected in the urban heat-island effect, human activities that further restrict root zones (Dreistadt et al., 1990) and upper branching (Czaja et al., 2020) or that remove healthy trees altogether (for example, to widen a driveway), and biosecurity risks (Watkins et al., 2021) posed by pests, biodiversity loss and invasive species, which increase competition for space, water, and nutrients. Chronic physical stress is especially problematic during tree establishment, and prevents trees from reaching maturity, with the highest rates of mortality occurring in a tree's first years of life (Wattenhofer and Johnson, 2021). Many urban trees never reach maturity because of this (Roman, 2014).

### Disservices

While urban vegetation has overarching positive impacts on cities and their inhabitants, it also provides some undesirable side effects. From a socio-economic viewpoint, some studies identify them as costs or trade-offs, as they are functions of ecosystems that are perceived as negative for human well-being, but that might be experienced differently between individuals and communities (Escobedo et al., 2011; Roman et al., 2021; Conway and Yip, 2016). Generally referred to as 'ecosystem disservices', they have been classified within the following categories (Roman et al., 2021; Conway and Yip, 2016, von Döhren and Haase, 2022; Draus et al., 2021; Dobbs et al., 2011; Turner-Skoff and Cavender, 2019; Maruthaveeran and Konijnendijk van den Bosch, 2014; Lee et al., 2015, Klein, 2019):

► **Health and safety impacts**: tree pollen allergies, dermatitis, poisoning by ingestion, air pollution from biogenic volatile organic compounds (BVOCs), injuries from falling trees or tree parts during storms, pest outbreaks (e.g., rats or other pathogenic vectors), wild dangerous animals (e.g., boars).

► **Mobility and infrastructure**: physical damages and obstacles due to falling trees, tree parts and street-invasive roots.

► **Financial**: management costs related to ecological disturbances (e.g., removing fallen trees and branches, clean up, damage repairs), maintenance (e.g., watering, fertilization, pruning), risk management, and healthcare costs.

► **Informal and illicit activities**: vegetation evokes the fear that it provides a safe space for marginalised, stigmatised or criminal behaviours, such as drug use, dealing, robbery, sex work, or homelessness. Nature also provides a hiding place for littering.

► **Aesthetics**: public perception of untamed, wild nature –dead woody debris, tree stumps, dying trees, fallen fruit and leaves, weeds– as messy, dirty and unsightly.

► **Environmental**: pollution and energy use associated with ecosystems and management activities that require fossil fuels.

Recent studies have looked at potential 'ecosystem disservices', as for example generated by urban forests. These disservices are not negative outcomes of ecosystem functioning per se, but rather relate to their negative (perceived) impacts on local residents (Roman et al., 2021).

These disservices have a strong social component, for example resulting from a lack of social awareness and understanding, or conflicting perceptions and preferences. Underlying societal dynamics frequently become a main barrier in urban forest development and maintenance. Indeed, the lack of effective dialogue and knowledge transfer between the diverse social actors and policy-makers make UF challenging from a social perspective (FAO, 2014). The lack of a community sense of ownership and responsibility, perception of the ecosystem disservices provided by urban forests, unawareness, and lack of knowledge about the social benefits of urban trees and forests are among the main responsible factors. This can be further worsened if there are language barriers to understanding outreach communications or if government officials and healthcare professionals do not promote spending time in green areas (Nesbitt et al., 2019). Negative citizen attitudes towards urban forests resulting from the above can range from indifference to vandalism and explicit requests to remove healthy trees or prune them (Operations Environmental Services 2017).

**Social equity**

A growing factor driving a non-positive perception on urban forests is its association with some lack of social equity, a multi-faceted concept (Friedman et al., 2018) that in the UF arena mostly translates into the equal right to have access to healthy green areas. It thus encompasses the concepts of environmental justice, accessibility, and inclusivity. Social equity applied to urban forests can be challenged by a set of factors. On the one hand, fair, universal access for all citizens is not achieved by simply having trees and public forests inside or around the city. First, location and scale should be noted as important factors in planning. Indeed, urban vegetation remains unevenly distributed, with the largest proportion of green areas concentrating in well-off neighbourhoods (Hungerford and Moussa, 2016; Fernández et al., 2022; Baró et al., 2021), where social density requires less space for housing, and where there is a high percentage of private gardens. This contributes to the overall perception that UF is a 'luxury' or 'extra' aimed at beautifying cities (FAO, 2014). It is also closely linked to the green gentrification phenomenon, with raising concerns about urban nature being used to promote a neoliberal green growth (Toxopeus and Polzin, 2021) and producing displacement of the population (Lee et al., 2015). Second, if urban forest planning overlooks physical barriers and suitable infrastructures, the availability for people with reduced mobility or disabilities is compromised. There can also be other social, economic or technological barriers that prevent marginalized or stigmatized

citizens from enjoying these areas. This especially relates to the exclusion of homeless people from urban forests –where they find valuable places to socialize, rest and be at peace with nature– (Koprowska et al., 2020), and to children with less exposure to urban nature (Baró et al., 2021).

**Governance**

Urban forests are the outcome of planning, design, implementation, and management processes that need to be properly scheduled and funded (Lawrence et al., 2013). Urban green infrastructure (UGI), including urban forests, is typically created and managed entirely by government stakeholders and continues to be primarily driven by policymakers and public managers who frequently have an insufficient connection with social and environmental realities (Tian et al., 2020). This detachment and fragmentation might result in perpetuating and amplifying social injustice (Gabrys, 2022), failing to embrace the urban landscape as a multidimensional habitat for humans and non-humans (Prebble et al., 2021), and overlooking opportunities for reaching agreements and collaborations beyond the public sphere.

On the one hand, urban politics use green branding tools to idealize and promote cities as modern, green, and healthy, while ignoring or under-addressing urban tensions and contradictions between different social groups, including the inequalities that sometimes come with urban greening projects (Oscilowicz et al., 2021). For instance, as also discussed above, public meetings and urban forest planning activities do not consider income inequity that prevent lower-income groups from engaging in governance because of work and family duties (Nesbitt et al., 2019).

On the other hand, local authorities commonly manage urban forests reactively, driven by human health and safety concerns and complaints about tree disservices (see above), instead of focusing on ensuring provision of regulating ecosystem services. Moreover, decision-makers and planners have yet to follow up and build on the scientific and technological advancements in UF (Semeraro et al., 2021), especially as regards the unresolved dilemma of native versus non-native vegetation (Khan and Conway, 2020). In this sense, researchers and political authorities should collaborate better to ensure an appropriate species selection (Rogozinski and Saha, 2021). As Sjöman et al. (2016) point out, "If 'native-only' approaches become incorporated in regional, national, or international policy documents or legislation, there is a risk that urban ecosystem resilience will be compromised, particularly in regions with extreme environmental conditions."

Nonetheless, active citizenship in governance is not exempt from limitations of its own. Buijs et al. (2016) note that not only is volunteer work subject to unreliable or short-term engagement, but volunteers may lack technical capacity to assume certain responsibilities. Moreover, these authors link active citizenship and ecological connectivity as two sides of the same coin: there is a risk of losing ecological connectivity due to fragmented management of urban GS, while rising tensions may appear between active citizen groups and higher scale institutions that get involved to ensure such connectivity.

**Knowledge gaps and the use of technology**

Urban forestry practice and governance need scientific knowledge and technological capacity to support and implement decisions that address the social underpinnings and the growth challenges of city vegetation. However, there are several ecological unknowns and habit forces blocking the way.

First, species selection frequently appears in a vast body of literature as one of the greatest unresolved issues (Khan and Conway, 2020; Endreny, 2018; Semeraro et al., 2021; Sjöman et al., 2016; Rogozinski and Saha, 2021; Watkins et al., 2021; Bengston, 2019). Urban trees should be chosen according both to the socio-ecological benefits they can provide –optimising services and minimising disservices–, but also to their life expectancy in the face of climate change and harsh urban environments with often limited growing space both above- and beneath-ground. A heated debate still exists around the question of whether to plant endemic species only or increase diversity by complementing them with non-native ones that could be better adapted to vulnerability scenarios, all the while assessing the risk of invasion. As Sjöman et al. (2016)

point out, "the catalog of native tree species may be too limited in some regions in order to fulfil ecosystem services and resilience in urban environments."

Second, there is still work to do in assessing the condition of trees and their surrounding habitat, especially the role of microbiome and soil life in tree health (Endreny, 2018), that would help design strategies for trees growing in hardscape areas (Operations Environmental Services 2017), including managing growing stresses like pests, fires, and pollution. In this sense, there is a gap between the understanding of stress-response processes and the methods that urban foresters use to apply this knowledge when it comes to responding to trees' vulnerabilities in urban environments (Watkins et al., 2021; Kahn and Conway, 2020).

Third, interdisciplinary research and planning is needed to understand the intricate relation between people and nature at different urban-ecological scales and to reduce knowledge gaps of single sectors or expertise. Semeraro et al. (2021) exemplify this by comparing biologists that study single individuals or ecosystems to planners that can also either work on the microscale (individual buildings), the mesoscale (neighborhood), or the macroscale (municipality). Buijs et al. (2016) contribute to this from a governance perspective: there is spare and unsystematic research reporting the multiple ways in which context –e.g., policies, available resources– and processes –e.g., evolving discourses, engagement techniques– combine to produce different types of governance outputs and outcomes. Nesbitt et al. (2019) introduce the need for research to improve urban equity by understanding where and how tree planting should take place to increase canopy cover in low-canopy neighbourhoods. Moreover, Lee et al. (2015) point out the need to do economic work to calculate the cost to benefit/utility of urban GS.

Fourth, both quantitative and qualitative data about urban green (in terms of its extent, structure and composition, functionality, etc.) is often insufficient or inexistent in cities, and this is even more the case when it comes to private property (Baycan-Levent and Nijkamp, 2009).

Fifth, Roman et al. (2021) note that much of the existing UF research comes from industrialized, developed countries, whose urbanisation patterns, socioeconomic contexts and environmental governance differ from developing countries, where the aforementioned research may not be applicable. Gender issues also relate to this, as UF and arboriculture have traditionally been male-dominated fields (Bardekjian et al., 2019), a situation that excludes valuable points of view in research and practice.

Finally, there is a risk of digital technologies –such as open data or crowdsourcing– not being able to provide a deep understanding of citizens' needs, and diminishing the bottom-up potential of co-creation (Brandsen et al., 2018).

**Funding and economic development**

Another recurring barrier to creating, maintaining, and improving UGI such as urban forests is long-term financial support, especially as regards structural funds and balancing private inflows. If there is funding for planting new trees and establishing new parks, there is often a lack of money for ensuring the future management of these. The main financial hurdle is that urban forests are still seen as economically unsustainable and as an expenditure rather than an –indirect– income provider for urban budgets (Gavrilidis et al., 2020). This relates both to the fact that available urban land is highly desired for commercial, housing development and services facilities –which become direct income sources–, and cultural undervalue by which urban forests are perceived as amenities and niceties instead of necessities (Nesbitt et al., 2019; Shams and Barker, 2019; Gavrilidis et al., 2020). As a result, urban forests have to compete with public services, as urban vegetation is considered a low-priority infrastructure and, as such, does not deserve a fixed, sufficient budget. A bare minimum used for tree planting, regular maintenance or activities focused on reducing risk and complaints (Davies, 2017) is not enough for targeted interventions –e.g., planting additional street trees in underserved neighbourhoods, establishing or upgrading parks in park-poor areas, etc. When insufficient resources are allocated for maintenance, urban infrastructure is perceived as run down and is at a higher risk of being developed rather than enhanced (Lee et al., 2015).

As for private funds, there is the risk of catering to biased interests. Toxopeus and Polzin (2021) show that private funding might progress a neoliberal 'green growth' agenda, aimed at developing NBS for well-off citizens instead of delivering widespread socioeconomic benefits. Nesbitt et al. (2019) related this to income inequality, as affluent neighbourhoods have influential capacity to leverage funds and establish partnerships that would bring about urban greenery enhancement and management in their own areas. Semeraro et al. (2021) add that incentives given to private businesses to use green technologies –such as green roofs– can foster a tendency of only adopting the solutions indicated by the incentives, and not the best one for a specific problem at hand. Some strategies aim at the return of NBS investment, which raises concerns about the impact on vulnerable people that cannot pay for such solutions (Toxopeus and Polzin, 2021).

Green entrepreneurship, in the shape of private companies that undertake business activities related to urban forests, could be expanded as well, especially when it comes to new, innovative business models and activities. These go beyond more conventional arboricultural and GS management activities that are contracted by public agencies or private residents, and can relate to e.g., the various services provided by urban forests. The Green4C project offers interesting examples within Green Care and public health promotion.

Despite the many services that urban forests provide, quantifying the attributable benefits is difficult (Lee et al., 2015). While conventional economic evaluation does not include ecosystem services, a practical accounting and valuation framework is yet to be generally accepted because, often, there is a lack of specific metrics (Toxopeus and Polzin, 2021).

**Training gaps**

As shown in section 1.3., UF is an emerging field with already a sound body of scientific evidence that underpins its purpose, main features, and practices. However, there is evidence of lack of awareness of UF outside the forestry disciplines (Vogt, 2016; O'Herrin et al., 2018). Also, specialised education and training in urban forestry is much less developed showing various challenges and gaps, especially in the Higher Education (HE) context (Andersen et al., 2002).

A previous document prepared within the Uforest project, the Uforest Training Needs' Assessment and Stakeholder Analysis Report identified the existing demands on training gaps among university students -undergraduates and graduates, as well as Ph.D. students- professionals and citizens from European countries and other continents (Basnou et al., 2021). The study identified a high demand for developing skills on complementary disciplines to UF including economics –management, business modeling, financial planning, and entrepreneurship–, social aspects –cooperative leadership, societal impact, and social business–, communications and technology –storytelling, cutting-edge technologies, ICT, marketing and communication strategies, networking. The study also identified a set of main knowledge gaps on UF, namely (i) properly estimating the potential production of Non-Timber Forest Products (NTFP); (ii) assessing alternative forest management scenarios for ecosystem services delivery; and (iii) developing marketing strategies for trading ecosystem services.

# 4. THE URBAN FORESTRY INNOVATION FRAMEWORK

As mentioned, UF innovation is defined here as an original set of management concepts and practices that sustainably support, maintain or promote trees and forest resources in and around urban community ecosystems, thus helping to solve prevailing challenges and to achieve objectives related to the presence and role of forests, trees, and associated vegetation in the urban environment. Because urban forests are a specific type of NBS (see section 1.1), the literature search was focused on this topic to specifically develop the UF innovation framework. NBS represent multiple social, economic, and ecological benefits for urban developments and operate in complex urban contexts, also in relation to different ecological, socio-cultural, political and economic systems, as well as industrial systems related to urban development.

How to measure innovation is a fundamental question in a field of constant evolution (Wijngaarden, 2019). Innovation metrics are commonly linked to social and cultural factors driving the adoption of an innovative solution. In the case of NBS, some proposals can be found (Rödl and Arlati, 2022; Barron et al., 2016), but standard metrics of effectiveness across social-ecological dimensions are rare (Seddon et al., 2020), with few exceptions (EC, 2021; IUCN, 2020). This is in part due to the fact that NBS do not account with conceptual boundaries but are actually conceived as an umbrella notion of urban nature across a range of related activities with the aim to shape urban transformation (Klerkx et al., 2010; Späth and Rohracher, 2010) and including very diverse nature-based innovations (Dorst et al., 2019; Nesshöver et al., 2017). A previous conceptualization on Nature-Based Innovation Systems (NBIS) based on a set of 'dimensions' or enabling and constraining factors (Van der Jagt et al. 2020) was borrowed to define the UF innovation concept. This shows a difference with other technological information systems that are based on a combination of functions and structures. Dimensions interact with one another to create an innovation environment that promotes newer innovation pathways, whose development will always be context-based and oriented to solve local needs and priorities. Thus, local conditions including ecosystem, socio-economic and cultural features will determine the specific development of the urban forestry innovation framework (UFIF).

Redefining the aforementioned concept of 'dimensions', we consider UF innovation dimensions as the combined set of addressed UF challenges, the contribution to one or multiple SDGs, and the degrees of innovation. In this way, we propose a simple UFIF, as shown in Figure 3.

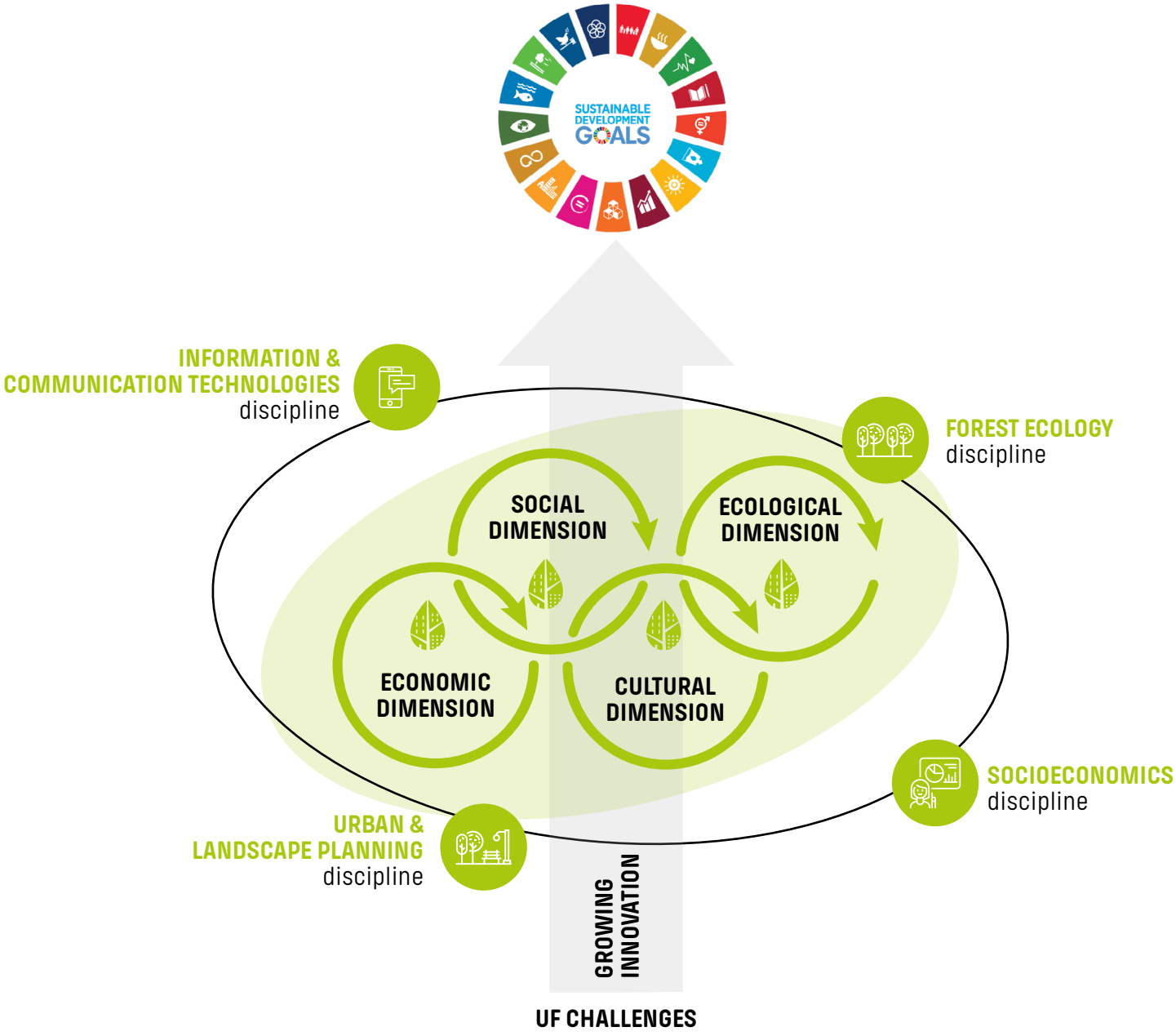



Figure 3 - Ilustration of the UFIF.

The proposed UFIF is based on the development of a given degree of innovation (see section 3.1.1) in a journey that starts by identifying the challenges faced by urban forests and ends in the achievement of the main economic, social and environmental goals pursued by UF. Coherent with current policies and priorities, the SDGs framework was used to assess the goals pursued, and societal challenges addressed by the innovative UF solutions. Finally, this journey is framed by the specific environmental context – ecological, social, cultural, and economic– and the main UF interdisciplinary approaches described in the Uforest project. In conclusion, context-specific challenges faced by urban forests are the starting points for UF innovation processes, which should pursue the achievement of defined SDGs embedded in a multidimensional perspective that links science, technology, field practice, governance, funding and socio-economic development.

The UFIF showing the main urban forest challenges as a starting point for the process of innovation in UF. The process leading towards innovation is defined by and tailored to context-specific combinations of cultural, socio-economic and ecological dimensions. The innovation is also informed and influenced by the disciplines involved in UF projects (see definitions given by Uforest project). Ultimately, UF innovations can be useful to contributing to the SDGs at different levels according to the disciplines involved, the specific context and the challenges they aim to solve.

# 5. ASSESSING INNOVATION IN URBAN FORESTRY

Using the UFIF, this chapter summarises findings from the assessment of the selected 20 case studies according to the dimensions previously described, i.e., identifying the UF challenges and SDGs each case study addresses, and classifying them by their degree of innovation. The factsheets prepared for each case study present detailed information on these UF case studies, their innovative ideas, activities, goals and interdisciplinary classification according to the Uforest standard (refer to www.uforest.eu/case-studies).

Through discussion with expert Uforest partners, these assessments helped with identifying new trends in the design, planning, implementation, and management of UF initiatives that, in turn, allowed for developing a classification for challenge-focused innovation in UF.

## 5.1 CASE STUDY ASSESSMENT BY URBAN FORESTRY CHALLENGES

As for the categories of urban forest challenges tackled by the selected case studies, we found that funding and economic development (FE) challenges are represented in almost all cases, closely followed by social equity (SE) and growing conditions (GC), with slightly less focus on governance (G) and knowledge gaps and the use of technology (KG&T) (Table 2). Disservices were not directly addressed in the case studies, although indirectly the building of stronger connections between local residents and urban forests can contribute to changed social perceptions of these. Training gaps were not covered in this assessment because we acknowledge neither of the selected case studies highlighted this as a core problem. However, references to these gaps are made when commenting the future avenues and opportunities of UF (sections 6 and 7), as further steps to build on the TNA report on training needs we carried out (section 3.3).

Table 2– Percentage of case studies addressing the identified challenges

| | |
|---|---|
| FE - Funding and economic development | **90%** |
| SE - Social equity | **80%** |
| GC - Growing conditions | **75%** |
| G- Governance | **65%** |
| KG&T - Knowledge gaps and technology | **55%** |

The case-specific analysis of the addressed challenges shows that, out of the 18 case studies that focus on funding and economic development, most of them also tackle social equity or growing conditions, followed by governance and knowledge gaps and the use of technology (Table 3).

Table 3 – UF challenges assessment by case study

| Project/UF challenges | SE | GC | FE | G | KG&T |
|---|---|---|---|---|---|
| Associazione Forestale di Pianura | x | | x | x | |
| Bankside Urban Forest | x | x | x | x | |
| Boscoincittà | x | x | x | x | |
| El bosque comestible de Alcalá de Henares | x | x | x | x | x |
| ForestaMi | | x | x | x | x |
| GeForest | | | x | | x |
| Ghaemesh Digital Wetland | | x | x | | x |
| LEAF Global | x | | x | | |
| Pla Natura Barcelona | x | x | | x | |
| Plantăm fapte bune în România | x | x | x | x | x |
| Pocket forests | x | x | x | x | x |
| Prato urban jungle | x | x | x | x | |
| RE Lambro SE | x | x | x | x | x |
| RPLP Kronstadt | x | | x | x | x |
| The Northern Forest UK | x | x | x | x | |
| Transformem els patis | x | x | | x | |
| Treemania | | x | x | | x |
| TreeTracker | x | | x | | x |
| Urban Júcar | x | x | x | | x |
| WOWnature | x | x | x | | |
| **20** | **16** | **15** | **18** | **13** | **11** |
| **Total Percentage** | **80%** | **75%** | **90%** | **65%** | **55%** |

Of the 10 case studies that target the challenge of knowledge gaps and the use of technology, the vast majority focus on selecting species, mainly by planting native trees and removing foreign vegetation. On the middle portion of the spectrum, case studies focus on the state of trees and soil or socially-oriented aspects such as land use. Fewer case studies tackle tree inventory and mapping (Table 4; see the specific sub-challenges addressed by each case study in Table 5).

Table 4 – Knowledge gaps and the use of technology assessment by percentage

| | |
|---|---|
| Species selection | **64%** |
| Condition assessment | **55%** |
| Inventory and mapping | **27%** |

Table 5 – Knowledge gaps and the use of technology assessment by case study

| Project/Knowledge gaps and technology | Condition assessment | Inventory and mapping | Species selection |
|---|---|---|---|
| El bosque comestible de Alcalá de Henares | | | x |
| ForestaMi | | | x |
| GeForest | x | x | |
| Ghaemesh Digital Wetland | x | | |
| Plantăm fapte bune în România | | | x |
| Pocket forests | | | x |
| RE Lambro SE | x | x | x |
| RPLP Kronstadt | x | | |
| Treemania | x | | |
| TreeTracker | x | x | x |
| Urban Júcar | | | x |
| **11** | **6** | **3** | **7** |
| **Total Percentage** | **55%** | **27%** | **64%** |

### Growing conditions

Of the 15 case studies that tackled the challenge of growing conditions, 80% focus on identifying available or potentially available land/sites for tree planting. While 40% also work with biodiversity protection and soil restoration or enhancement, 33% address water-related activities, such as sustainable water management or measures to reduce water pollution (Table 6; see the specific sub-challenges addressed by each case study in Table 7)

Table 6 – Growing conditions assessment by percentage of case studies addressing these

| | |
|---|---|
| Land | **80%** |
| Biodiversity | **40%** |
| Soil | **40%** |
| Water | **33%** |

Table 7 – Growing conditions assessment by case study

| **Project/Growing conditions** | **Land** | **Soil** | **Water** | **Biodiversity** |
|---|---|---|---|---|
| Bankside Urban Forest | x | | | |
| Boscoincittà | x | | x | |
| El bosque comestible de Alcalá de Henares | | x | x | x |
| ForestaMi | x | x | | x |
| Ghaemesh Digital Wetland | | | x | |
| Pla Natura Barcelona | x | | | x |
| Plantăm fapte bune în România | x | x | | |
| Pocket forests | x | x | | x |
| Prato urban jungle | x | x | x | |
| RE Lambro SE | x | | x | |
| The Northern Forest UK | x | | | x |
| Transformem els patis | x | | | |
| Treemania | | x | | |
| Urban Júcar | x | | | x |
| WOWnature | x | | | |
| **15** | **12** | **6** | **5** | **6** |
| **Total Percentage** | **80%** | **40%** | **33%** | **40%** |

### Social equity

Of the 16 case studies that target social equity, the vast majority focus on involving the community through volunteer activities, consultation, or financing. Most of them also tackle environmental literacy through educational or communication strategies that raise awareness on trees and forests, ecology, agriculture or circular economy. A smaller percentage include accessibility and inclusivity measures, such as activities for socially excluded groups, removal of physical barriers or fostering no gender differences (Table 8; see the specific sub-challenges addressed by each case study in Table 9).

Table 8 – Social equity assessment by percentage of case studies

| | |
|---|---|
| Citizen engagement | **75%** |
| Environmental literacy | **69%** |
| Accessibility and inclusivity | **25%** |

Table 9 – Social equity assessment by case study

| **Project/Social equity** | **Citizen engagement** | **Environmental literacy** | **Accessibility and inclusivity** |
|---|---|---|---|
| Associazione Forestale di Pianura | | x | |
| Bankside Urban Forest | x | | |
| Boscoincittà | x | x | x |
| El bosque comestible de Alcalá de Henares | x | x | |
| LEAF Global | x | x | |
| Pla Natura Barcelona | | | x |
| Plantăm fapte bune în România | x | x | |
| Pocket forests | x | x | |
| Prato urban jungle | x | x | |
| RE Lambro SE | x | x | |
| RPLP Kronstadt | x | x | |
| The Northern Forest UK | x | | |
| Transformem els patis | x | x | x |
| TreeTracker | | x | |
| Urban Júcar | | | x |
| WOWnature | x | | |
| **16** | **12** | **11** | **4** |
| **Total Percentage** | **75%** | **69%** | **25%** |

### Governance

Most of the 13 case studies that target governance challenges with some novel approaches or solutions propose some form of cooperation between public and private sectors, such as cultural, environmental or business associations managing or planting trees in public lands or designing civil activities. On the opposite side of the spectrum, though scarcely represented, co-creation processes receive external input from citizens of different ages and backgrounds or even from different departments within the same institution (Table 10; see the specific sub-challenges addressed by each case study in Table 11).

Table 10 – Governance assessment by percentage of case studies

| | |
|---|---|
| Public-private cooperation | **85%** |
| Co-creative processes | **23%** |

Table 11 – Governance assessment by case study

| **Project/Governance** | **Co-creative processes** | **Public-private cooperation** |
|---|---|---|
| Associazione Forestale di Pianura | | x |
| Bankside Urban Forest | | x |
| Boscoincittà | | x |
| El bosque comestible de Alcalá de Henares | | x |
| ForestaMi | | x |
| Pla Natura Barcelona | x | |
| Plantăm fapte bune în România | | x |
| Pocket forests | | x |
| Prato urban jungle | | x |
| RE Lambro SE | | x |
| RPLP Kronstadt | x | |
| The Northern Forest UK | | x |
| Transformem els patis | x | x |
| **13** | **3** | **11** |
| **Total Percentage** | **23%** | **85%** |

### Funding and economic development

Most of the 18 case studies that target funding and economic development are resourceful in getting funds for their activities, mainly using mixed private-public funds, but also receiving donations from citizens and companies, or establishing cooperation agreements to use external facilities. Half the case studies also impact the economy and employment, either by promoting job creation in the green sector or by targeting forest bioeconomy. Scarcely represented are low-cost systems, such as low energy consumption or self-sustaining solutions, and certified training for professional capacity building (Table 12; see the specific sub-challenges addressed by each case study in Table 13).

Table 12 – Funding and economic development assessment by percentage of case studies

| | |
|---|---|
| Diversified funding | **83%** |
| Economy and employment spur | **50%** |
| Low-cost systems | **22%** |
| Build professionalism | **11%** |

Table 13 – Funding and economic development assessment by project

| **Project/Funding and economic development** | **Diversified funding** | **Low-cost systems** | **Economy spur** | **Build professionalism** |
|---|---|---|---|---|
| Associazione Forestale di Pianura | x | | x | |
| Bankside Urban Forest | x | | x | |
| Boscoincittà | x | | | x |
| El bosque comestible de Alcalá de Henares | x | x | | |
| ForestaMi | x | | | |
| GeForest | x | | x | |
| Ghaemesh Digital Wetland | x | | | |
| LEAF Global | x | | | |
| Plantăm fapte bune în România | x | | x | x |
| Pocket forests | x | x | x | |
| Prato urban jungle | | x | x | |
| RE Lambro SE | x | | | |
| RPLP Kronstadt | x | | | |
| The Northern Forest UK | x | | x | |
| Treemania | x | | | |
| TreeTracker | | | x | |
| Urban Júcar | | x | x | |
| WOWnature | x | | | |
| **18** | **15** | **4** | **9** | **2** |
| **Total Percentage** | **83%** | **22%** | **50%** | **11%** |

## 5.2 CASE STUDY ASSESSMENT BY SUSTAINABLE DEVELOPMENT GOAL

Of the 10 SDGs that were addressed by the case studies, we found SDGs 15, 11, 13 and 12 being highly represented. Perhaps unsurprisingly, 100% of the case studies address SDG15 (Life on land) and 85% target SDG11 (Sustainable Cities and Communities). In the middle portion of the spectrum, SDG8 (Decent Work and Economic Growth) and SDG9 (Industry, Innovation and Infrastructure) appeared in 25% and 20% of the cases, respectively. The lower end of the scope shows SDGs 2, 3, 4 and 6 in 5% to 15% of the case studies (Table 14; see the specific SDGs addressed by each case study in Table 15). In the following sections, the analysis of each SDG addressed by the case studies is further detailed by target.

Table 14 – SDG assessment by percentage

| | |
|---|---|
| 15-Life on land | 100% |
| 11-Sustainable cities and communities | 85% |
| 13-Climate action | 50% |
| 12-Sustainable consumption and production | 40% |
| 8-Decent work and economic growth | 25% |
| 9-Industry, innovation and infrastructure | 20% |
| 3-Good health and well-being | 15% |
| 4-Quality education | 10% |
| 6-Clean water and sanitation | 10% |
| 2-Zero hunger | 5% |

Table 15 – SDGs being addressed by the case studies

| **Project/SDG** | **2** | **3** | **4** | **6** | **8** | **9** | **11** | **12** | **13** | **15** |
|---|---|---|---|---|---|---|---|---|---|---|
| Associazione Forestale di Pianura | x | | | | | | x | | | x |
| Bankside Urban Forest | | | | | x | | x | x | | x |
| Boscoincittà | | | | | x | | x | x | | x |
| El bosque comestible | | | | | | | x | x | x | x |
| ForestaMi | | x | | | | | x | | x | x |
| GeForest | | | | | x | x | | | | x |
| Ghaemesh Digital Wetland | | | | x | | x | | | x | x |
| LEAF Global | | | x | | | | x | | | x |
| Pla Natura Barcelona | | x | | | | | x | | x | x |
| Plantăm fapte bune în România | | | | | x | | x | | x | x |
| Pocket forests | | | | | | | x | x | x | x |
| Prato urban jungle | | | | | | x | x | x | | x |
| RE Lambro SE | | | | x | | | x | | | x |
| RPLP Kronstadt | | | | | | | x | | | x |
| The Northern Forest UK | | | | | x | | x | | x | x |
| Transformem els patis | | x | x | | | | x | | | x |
| Treemania | | | | | | x | | x | | x |
| TreeTracker | | | | | | | x | x | x | x |
| Urban Júcar | | | | | | | x | x | x | x |
| WOWnature | | | | | | | x | | x | x |
| **20** | **1** | **3** | **2** | **2** | **5** | **4** | **17** | **8** | **10** | **20** |
| **Total Percentage** | **5%** | **15%** | **10%** | **10%** | **25%** | **20%** | **85%** | **40%** | **50%** | **100%** |

### SDG15 targeting


Of the 18 case studies that address Life on Land, twelve target afforestation or biodiversity enhancement (including soil microbial biodiversity), seven contribute to sustainable forest management, three restore degraded soils, and two remove exotic plant species (see the specific targets addressed by each case study in Table 16).

Table 16 – SDG15 assessment by case study

| Project/SDG15 targets | Sustainable forest management | Afforestation | Restore soil | Enhance biodiversity | Reduce alien species |
|---|---|---|---|---|---|
| Associazione Forestale di Pianura | x | x | | x | |
| Bankside Urban Forest | | x | | | |
| Boscoincittà | | x | | x | |
| El bosque comestible | x | | | x | |
| ForestaMi | | x | x | x | |
| GeForest | x | | | | |
| LEAF Global | | x | | x | |
| Pla Natura Barcelona | | x | | x | |
| Plantăm fapte bune în România | x | x | x | | |
| Pocket forests | | x | | x | |
| Prato urban jungle | | x | | | |
| RE Lambro SE | | x | | x | x |
| RPLP Kronstadt | | | | x | |
| The Northern Forest UK | | x | | x | |
| Treemania | x | | x | x | |
| TreeTracker | x | | | | |
| Urban Júcar | x | | | x | x |
| WOWnature | | x | | | |
| **18** | **7** | **12** | **3** | **12** | **2** |
| **Total Percentage** | **39%** | **67%** | **17%** | **67%** | **11%** |

### SDG11 targeting


Of the 17 case studies that address Sustainable Cities and Communities, 16 offer or promote access to public GS, and 13 have civil organisations, volunteers or children experiencing active citizenship, either by co-creating or planting trees as a community. Seven also contribute to protecting heritage by conserving and using historic buildings, connecting ancient woodlands, securing Natura 2000 sites or sustainably managing forests from a social-environmental viewpoint (see the specific targets addressed by each case study in Table 17). Although not explicitly mentioned in the factsheets, an increase in urban or peri-urban canopy cover also results in reducing the adverse per capita environmental impact of cities as regards air quality.

Table 17 – SDG11 assessment by project

| Project/SDG11 targets | Protect cultural/ natural heritage | Access to green spaces | Citizen engagement |
|---|---|---|---|
| Associazione Forestale di Pianura | x | | |
| Bankside Urban Forest | x | x | x |
| Boscoincittà | x | x | x |
| El bosque comestible | x | x | x |
| ForestaMi | | x | x |
| LEAF Global | | x | x |
| Pla Natura Barcelona | | x | |
| Plantăm fapte bune în România | | x | x |
| Pocket forests | | x | x |
| Prato urban jungle | x | x | x |
| RE Lambro SE | | x | x |
| RPLP Kronstadt | x | x | x |
| The Northern Forest UK | x | x | x |
| Transformem els patis | | x | x |
| TreeTracker | | x | |
| Urban Júcar | | x | |
| WOWnature | | x | x |
| **17** | **7** | **16** | **13** |
| **Total Percentage** | **41%** | **94%** | **76%** |

### SDG13 targeting


Of the 10 case studies that address Climate Action, 8 target increasing resilience, either by adopting preventive measures against landslides, desertification and hydro-metro risks, by improving overall air and temperature quality, by harnessing the positive impact of trees, or by creating climate shelters. Two focus on raising awareness about the climate crisis among the community, and the remaining one integrates ecological criteria into the City Council management strategies (see the specific targets addressed by each case study in Table 18).

Table 18 – SDG13 targeting by case study

| Project/SDG13 targets | Increase resilience | Management measures | Awareness raising |
|---|---|---|---|
| El bosque comestible | x | | |
| ForestaMi | x | | |
| Ghaemesh Digital Wetland | x | | |
| Pla Natura Barcelona | | x | |
| Plantăm fapte bune în România | x | | x |
| Pocket forests | x | | |
| The Northern Forest UK | x | | |
| TreeTracker | x | | |
| Urban Júcar | x | | |
| WOWnature | | | x |
| **10** | **8** | **1** | **2** |
| **Total Percentage** | **80%** | **10%** | **20%** |

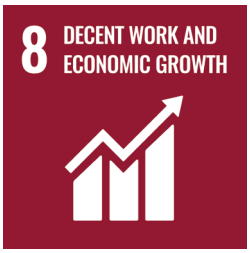
### SDG12 targeting


All of the eight case studies that address Responsible Consumption and production tackle the same target: the efficient use of resources, either by restoring soil, repurposing derelict areas, or by using low-maintenance, energy and water efficient systems. Only one additionally repurposes waste materials (see the specific targets addressed by each case study in Table 19).

Table 19 – SDG12 targeting by case study

| Project/SDG12 targets | Efficiently use resources | Reduce waste |
|---|---|---|
| Bankside Urban Forest | x | |
| Boscoincittà | x | |
| El bosque comestible | x | |
| Pocket forests | x | x |
| Prato urban jungle | x | |
| Treemania | x | |
| TreeTracker | x | |
| Urban Júcar | x | |
| **8** | **8** | **1** |
| **Total Percentage** | **100%** | **13%** |

### SDG8 targeting




The 5 case studies that address Decent Work and Economic Growth tackle these targets by promoting new jobs and diversifying capacity-building (40% each), or by fostering local investments for economic growth (20%) (see the specific targets addressed by each case study in Table 20).

Table 20 – SDG8 targeting by case study

| Project/SDG8 targets | Job creation | Diversification | Local growth |
|---|---|---|---|
| Bankside Urban Forest | x | | |
| Boscoincittà | | x | |
| GeForest | x | | |
| Plantăm fapte bune în România | | x | |
| The Northern Forest UK | | | x |
| **5** | **2** | **2** | **1** |
| **Total Percentage** | **40%** | **40%** | **20%** |

As for the rest of SDGs, only three case studies addressed Good Health and Well-being (SDG3), and all tackle the same target: reduce health risks by increasing UGI. The two case studies that address Quality Education (SDG4) tackle one of these targets: ensure equal access and no gender differences in education and offer skills in sustainable development. The two case studies that address Clean Water and Sanitation (SDG6) tackle these targets equitably: reduce water pollution and restore water-related ecosystems. Finally, Associazione Forestale di Pianura is the only case study that explicitly addresses Zero Hunger targets, specifically by promoting agricultural productivity of small-scale food producers.

### SDG9 targeting


The 4 initiatives that address Industry, Innovation and Infrastructure tackle the same target: the use of smart technologies, while only one of them additionally upgrades infrastructure to make them sustainable. Though not an SDG9 target per se, it is interesting to note that one of them also includes an innovation management strategy (see the specific targets addressed by each case study in Table 21).

Table 21 – SDG9 targeting by case study

| Project/SDG9 targets | Smart technology | Upgrade infrastructure |
|---|---|---|
| Geforest | x | |
| Ghaemesh Digital Wetland | x | |
| Prato urban jungle | x | x |
| Treemania | x | |
| **4** | **4** | **1** |
| **Total Percentage** | **100%** | **25%** |

As for the rest of SDGs, only three case studies addressed Good Health and Well-being (SDG3), and all tackle the same target: reduce health risks by increasing UGI. The two case studies that address Quality Education (SDG4) tackle one of these targets: ensure equal access and no gender differences in education and offer skills in sustainable development. The two case studies that address Clean Water and Sanitation (SDG6) tackle these targets equitably: reduce water pollution and restore water-related ecosystems. Finally, Associazione Forestale di Pianura is the only case study that explicitly addresses Zero Hunger targets, specifically by promoting agricultural productivity of small-scale food producers.

### 5.2.1. Limitations

Limitations of this analysis are important to mention. The first of these is that the number of SDGs assigned to each case study had a maximum of four and a minimum of two. The second one is that there was a subjective interpretative component, with assessors leaning towards selecting some SDGs for one particular project but not others, based on their own expertise. Some of the SDGs are very broadly formulated and can be up for interpretation. This is closely related to the explicit connection made by the case studies' managers/representative themselves, the fact that some SDGs targets actually overlap, e.g., in relation to climate action, social equity or citizen engagement. For instance, SDG8 could be present in Urban Júcar, but this case study already addressed 4 other SDGs we gave priority to. Another case is SDG3, which although underrepresented could actually be applied to all the case studies that increase urban canopy cover, as most ES offered by trees benefit human physical, mental and emotional health: air quality, noise reduction, temperature regulation and social benefits. The same happens with SDG2, as it can actually be found in far-reaching case studies that create vegetable gardens, such as Boscoincittà or Pla Natura Barcelona, or that increase biodiversity –especially pollinators– close to agricultural areas, such as ForestaMi. Moreover, SDG13 could be present even further in any case study that increases canopy cover, with trees contributing to carbon sequestration and regulating temperatures –which happens more or less, depending on the species.

The third limitation is that community involvement tends to (partially) overlap with the social equity and governance dimensions, promoting both a community sense of responsibility and ownership. Thus, it was decided to classify it as a governance challenge when citizens and associations (social, environmental, business, etc.) take part in the design, planning and managing of projects or activities as a non-profit activity. On the other hand, it was considered a social equity challenge when citizens, associations, or businesses act as enablers of the implementation phase, with co-productive volunteering activities, donations or other contributions.

Overall, the assessment of SDG targetting by case study should be seen as mostly indicative and illustrative, demonstrating that there are some similarities in urban forestry project focus and objectives. This is also interesting from an innovation perspective, as the most frequently addressed SDGs (and with that, societal challenges) will have specific innovation needs and opportunities.

## 5.3 CASE STUDY ASSESSMENT BY DEGREE OF INNOVATION

The results of the survey to assess the degree of innovation of the case studies –addressed to the expert partners representing NBSI, CREAF, ETIFOR, AGRESTA, Forest Design, Green City Watch, Trinity College Dublin, UNITBV, EFI, POLIMI– shows that the large majority of the case studies (16, accounting for 80% of the total) are considered incrementally innovative, while complementary and radical degrees of innovation were only identified in 15% of the cases. There were no disruptive cases of innovation among the case studies according to the evaluators (Table 22; see the specific degrees of innovation of each case study in Table 23).

Table 22 – Degree of innovation assessment by percentage of case studies

| | |
|---|---|
| Incremental | **80%** |
| Complementary | **15%** |
| Radical | **15%** |

Table 23 – Degree of innovation assessment by case study

| Project/degree of innovation | Incremental | Complementary | Radical |
|---|---|---|---|
| Associazione Forestale di Pianura | x | | |
| Bankside Urban Forest | x | | |
| Boscoincittà | x | | |
| El bosque comestible de Alcalá de Henares | x | | |
| ForestaMi | x | | |
| GeForest | | | x |
| Ghaemesh Digital Wetland | x | | |
| LEAF Global | x | | |
| Pla Natura Barcelona | x | x | |
| Plantăm fapte bune în România | x | | |
| Pocket forests | | | x |
| Prato urban jungle | | | x |
| RE Lambro SE | x | | |
| RPLP Kronstadt | x | | |
| The Northern Forest UK | x | | |
| Transformem els patis | x | | |
| Treemania | | x | |
| TreeTracker | x | x | |
| Urban Júcar | x | | |
| WOWnature | x | | |

# 6. MOVING FORWARD IN URBAN FORESTRY INNOVATION

The case study assessment presented in section 5 suggests that there is great potential for innovation in UF, in terms of addressing current societal and more specific challenges, meeting SDGs and for providing novel opportunities for developing the profession.

The study also addressed the degree of innovation associated with the main challenges in designing, planning, implementing, and managing urban forests. Indeed, the analysis shows that being radical or disruptive is not the only innovative value that can lead to success. On the contrary, case studies exemplify the tendency to make small improvements to adapt existing solutions or ideas to context-specific challenges in an incremental or complementary manner. However, results from the case studies assessment also leave room for developing radical and disruptive innovative processes, outcomes, and mindsets. It is then expected that future contextual needs determined by social and environmental shifts and conditions will influence the further evolution of UF innovation typologies.

In addition, UF innovation will be important for helping to meet the UN Sustainable Development Goals (SDGs), perhaps the best framework for current global challenges and priorities. The analysis showed that the reviewed case studies (often implicitly) targeted 10 out of 17 SDGs. The most addressed SDGs are Life on land (SDG15) with direct connections with urban forests biodiversity conservation, which is in line with Reid et al. (2017)'s assertion that 'maintaining ecosystem health (...) is a necessary precondition to achieving the 2030 Agenda for Sustainable Development.' However, case studies addressing Quality education (SDG4) and Zero Hunger (SDG2) leave room for improvement. Moreover, many of the selected case studies tackle core aspects of environmental justice, attending to SDGs 11 and 13. There are also opportunities to explore other goals that are not being primarily targeted; more specifically SDGs 1, 5, 7, 10, 14, 16, and 17. With UF playing a central role in addressing many SDGs, especially from an urban area perspective, further needs and opportunities for innovation will emerge.

The case study assessments show that some challenges affecting urban forests are given more attention than others. Almost all cases address funding and economic development, which is closely followed by social equity and growing conditions, and with slightly less focus on governance and knowledge gaps and the use of technology. Challenges that are not addressed by the 20 case studies, at least not explicitly, are forest disservices and the social equity aspect of green gentrification and displacement. Another subject that is still receiving little attention is suitable species selection. Case studies mainly tackle this by mainstreaming native tree plantation and alien species removal, while other innovative solutions (i.e., integrating both native and climate-change resistant, non-invasive alien species) are rarely proposed. The question of governance failing to tackle urban tensions and contradictions between different social groups is also a relevant topic yet to be covered, as well as economically quantifying the attributable benefits of ES. On this note, further research is also needed to calculate a metric that indicates the extent to which an innovative UF initiative is cost-efficient.

Following the assessments of the 20 case studies and based on a further discussion with expert partners, innovation in UF was observed to be occurring in line with (and maybe in response to) the main challenges cities around the globe are facing in relation to urban forests and other GS, from tackling harsh growing conditions for trees to achieving social equity in terms of fair, evenly distributed access to urban forests. In this process, it was possible to identify and group key types of urban forestry into five categories:

**Innovation for growing conditions**, aimed at solving environmental needs for urban vegetation to maintain the ecosystem functions (EF) and ES in relation to land, soil, water, and biodiversity:

- ► Monitoring daily conditions –e.g., moisture and temperature sensors, control of pests / insect activity– and anticipating periods of drought.
- ► Improving soil conditions and quality –e.g., efficient watering, enriching soil life.
- ► Identifying and mapping potentially available urban and peri-urban land / plantable space for urban forests –e.g., derelict areas, brownfields, rooftops.
- ► Making more land/sites available for urban forests –e.g., redeveloping areas controlled by land-use regulations, coordinating and partnering with private landowners.
- ► Enhancing and protecting existing green areas –e.g., expanding an existing tree's immediate space,

applying rewilding measures, managing water supplies.

► Maximising the survival of young trees and expanding the life of urban trees –e.g., better selection and growing of trees in nurseries; ensuring there is enough soil for a tree to reach maturity; supervising tree planting; implementing better planting practices; post-planting care; designating citizen stewards to monitor individual trees; creating tree nurseries inside or close to the city; selecting optimal nursery production types, such as container and/or balled and burlapped.

► Appropriate management and stewardship of individual trees and woods that will ensure longer life spans and EF, and with that ES provision.

**Innovation for social equity** aimed at solving social concerns related to urban vegetation:

► Providing inclusive and accessible GS and services for all segments of urban communities –e.g., removing physical barriers, creating public climate shelters, promoting green activities and access to GS for vulnerable residents, facilitating access to private resources, fostering outdoor education activities for schools located in greyer contexts, supporting community initiatives for tree planting and stewardship. Having frequent access and closeness to green areas is directly related to developing a sense of ownership and respect for them, as well as contributes to tightening ties of culture, identity and belonging.

► Raising awareness about the purpose of urban forests and the challenges they face –e.g., public debates, community activities–, minimising perceived disservices –e.g., risk prevention measures.

► Ensuring housing stability –e.g., anti-displacement policies, equitable development planning– and managing the impacts of green gentrification.

► Preserving cultural values and heritage of neighbourhoods, welcoming diversity and respect of local values and customs to strengthen social identity and bonds –e.g., heritage conservation policies.

► Promoting food security with edible landscapes –e.g., edible urban forests, school gardens, allotment gardens and community urban vegetable gardens, domestic and home gardens, edible green roofs and vegetable rain gardens, edible green walls and facades, peri-urban agricultural lands, etc (Russo et al., 2017).

► Strengthening the preventive mental, physical, and social health contributions of urban forests and their recognition in the public health system.

**Innovation for knowledge gaps and the use of technology**, tackling knowledge gaps in UF and the ecology of cities:

► Integrating up-to-date information on urban forest resources, ES, disservices, social implications, and management costs in comprehensive decision-support systems to better inform urban forest policy and management.

► Developing indicators of change to identify potential opportunities and threats that would enable decision makers to plan accordingly and take timely action.

► Assessing the quality of GI in terms of ES and user values and the resilience to withstand pressures.

► Understanding the multiple relations between people, trees, and forests in urban settings.

► Identifying optimal trait combinations –e.g., growing needs, climate adaptability, survival rates, services– and functional diversity principles to select species.

► Analysing whether non-native species are better adapted to climate change than regional ones, and if they could maximise services without becoming invasive.

► Examining the tolerance of new cultivars –cultivated varieties– of native species, considering their

lack of genetic diversity.

► Studying novel habitats and emerging ecosystems to:

- Inspire new GS that support a unique ecology –e.g., green roofs, vertical gardens, living walls.

- Conserve cultural heritage –e.g., identify which species are damaging, protective, or benign for heritage.

- Contribute to the societal benefits of connecting people with culture and nature and creating a sense of local identity and place.

► Assessing the impact of adaptation strategies such as assisted migration of trees (Chagnon Fontaine and Larson, 2016).

► Establishing mutually beneficial links between UF and conventional forestry, as well as between UF and other fields –e.g., (landscape) architecture, planning, engineering, ecology, social sciences.

**Innovation in governance**, addressing the setting, application and enforcement of rules to establish and protect urban forests as social-ecological systems:

► Strengthening mosaic governance with (and sometimes even without) government, involving institutional decision-makers, civil society individuals or organisations and the private sector in urban planning, design, implementation and management of natural resources –e.g., co-creative school greening processes–, striking the balance between the autonomy of active citizens and institutions that strengthen social and ecological connectivity.

► Developing more inclusive and participatory forms of governance.

► Building partnerships between governmental transversal areas –e.g., ecology, health and education.

► Developing sound governance arrangements for urban forests in support of longer-term visions and objectives, with clear 'rules of the game' as well as roles and responsibilities.

► Creating hybrid forms of land ownership and land management.

► Encouraging non-governmental actors to implement NBS on their private properties –e.g., residential, commercial– or in new development projects –e.g., housing, industrial.

► Managing urban wilderness through a 'non-action' planning approach to hinder vector jumps to humans as enough non-human species are available.

► Strengthening the role of urban foresters as green leaders and facilitators.

**Innovation in funding and economic development**, aimed at:

► Obtain better ways of comprehensively assessing the economic impacts and benefits of urban forests, including e.g., cultural ecosystem services.

► Developing flexible models of public-private collaboration and funding –e.g., private management or maintenance contributions for public GS, business improvement districts.

► Develop funding mechanisms to raise income and reduce costs –e.g., grants, donations, marketing of goods and services other than timber, promotion of nature benefits by insurance companies to reduce insurance claims related to health problems.

► Promoting funding schemes shared by diverse governmental areas –e.g., environment and health departments.

► Stimulate entrepreneurship and business opportunities in UF.

# 7. EMERGING OPPORTUNITIES IN URBAN FORESTRY

The analysed case studies suggest that stimulating innovative approaches in UF can help optimize services, even in dense urban contexts, while also solving local problems with a multidisciplinary perspective. However, there is a need to further explore innovation in UF at all levels, (i) scaling up the UF initiatives, (ii) exploring and strengthening the collaborations among disciplines and between public and private sectors, as well as civic society; and (iii) facilitating the co-creation of knowledge at the university-city-business partnership in the EU, all the while promoting a mosaic governance of natural resources and their ES. It is fundamental to embed the benefits provided by urban forests in the innovations and the value generated from the provided services. Public-private partnerships are especially important in this context where benefits mostly accrue to communities and not to companies, and combine social and economic perspectives with more and less tangible aspects –such as physiological, sociological, economic, and aesthetic.

UF innovation should go hand-in-hand with entrepreneurship, exploring sectors and collaborations for creating new opportunities. Cross-cutting areas that also mobilise new ecologies, green economy, ICT, social services, and human health are promising sources of innovation and entrepreneurship. These should also consider social, economic and environmental sustainability practices and promote inclusivity, and participation and engagement in the different stages of project development.

From the UF innovation typologies identified in the previous section, some further emerging areas for opportunities in UF can be highlighted:

**Opportunities in growing conditions:**

► **Novel forest ecosystems**: There are excellent opportunities for creating new urban forests in unexpected places –such as cultural heritage sites (Coombes and Viles, 2021)–, for protecting emerging urban forests, or for planting forests in degraded areas to restore them. Moreover, the COVID-19 pandemic has shown how 'wild' UF, as a supplement to more managed UF, can have socioecological and health benefits. Haase (2021) stated that we need cohabiting GI and urban nature in our future cities, but not in the same place. We need both designed GI, where people can experience recreation, enjoyment, and physical activities, and adequate areas of untouched (successional) spaces, where plant and animal species can find undisturbed homes and habitats to allow for vector trapping and maintaining intact ecosystems, thus lowering the disease risk through zoonotic pathogens. Urban planning experts with a deeper understanding of urban forests as socioecological systems and of urban ecological novelties are needed for addressing this paradigm shift (Patoilo Teixeira et al., 2021).

► **Urban versus regional ecology**: Urban forests exhibit a set of ecological particularities that make them different from other forests and vegetation in a given region. Urban woodlands are commonly made up by simplified biotic communities, with a more homogeneous composition and with a larger proportion of generalists and even alien species (McKinney, 2006). On the other hand, urban forests can be very diverse, including a large number of non-native species. Promoting connectivity and species exchange between more natural urban woodlands –such as on the urban fringe– and the rest of the regional GI is an opportunity for ensuring ecological fluxes at regional scale. However, at the same time, there is the challenge of avoiding or at least managing the disservices associated with the spread of these urban-like species. Specific training of urban foresters and the involvement of urban ecologists is needed to address these opportunities and challenges.

► **'Trees first' thinking**: Currently, trees are not often prioritised in urban planning and (re)development process. However, urban forests provide an important and critical infrastructure in cities, and they are not easily dispensable. Therefore, urban design, planning, and building practices need to include trees and their requirements, ensuring sufficient growing space, protective measures, and management.

**Opportunities in social equity**

► **Environmental justice**: Evenly distributing GI should be a primary goal of new urban forestry projects.

Areas with low urban forest cover and areas where vulnerable populations live should be a priority. Urban vegetation should not be a luxury, but provide ES available to all, especially to vulnerable groups, such as children and socially marginalised people. Moreover, it should especially not lead to social segregation and, thus, exclusion –such as as green gentrification and displacement (Anguelovski, 2019; Haase, 2017).

### Opportunities in governance

► **Mosaic governance**: Urban forests are an opportunity for increasing contact with nature, and to build 'nature labs' aimed at exploring new perspectives of management and use, in accordance with the stakeholders' opinion. New forms of governance and participation can be essayed in the framework of urban forests to bring more (younger) voices to the halls of power, and policy-makers and decision-takers to the social and environmental realities to tackle urban tensions and contradictions. UF experts can lead this shift in governance models promoting higher engagement of public officers from different city council departments, civil society, businesses, and organisations in urban planning, design, implementation and management of natural resources. Thus, there is a connection between UF entrepreneurship and training in community mediation and conflict coaching, among others.

### Opportunities in funding and economic development

► **Bioeconomy**: Feeding an increasing urban population and ensuring economic well-being for urbanites will be the primary challenge for cities in the coming decades (Virgen Castro et al., 2018). According to FAO (2022), food systems occupy the biggest niche of the bioeconomy. In the EU, food systems –including agriculture, forestry, fisheries and aquaculture, as well as food and feed manufacturing– account for 71% of all value added in a bioeconomy, followed by around 28% for bioproducts, and the remainder for bioenergy. The GreenEconomy Strategy and Implementation Plan 2016-2030 (UN and Kenya's Ministry of Environment and Natural Resources, 2016) is aimed at promoting a low carbon, resource efficient, equitable and inclusive socio-economic transformation, in which local products and services will be of primary importance. Thus, UF experts will be able to deal with the dilemma of prioritising local product growing and exploitation –e.g., timber and food in urban forests– and key social ES provision –e.g., recreation– in urban forests. Providing experts addressing challenges as such will also be a clear source of entrepreneurship in UF, especially as regards edible landscapes (McLain et al., 2012).

► **Urban forests and ES valuation**: Although urban forests are being increasingly recognised as a cost-effective and efficient solution for ES provision, it is still a long way from wide recognition and communication of all of these benefits to beneficiaries and funding to support the providers. The monetary value of ES is still not adequately defined (Kumar, 2010), as they are frequently calculated in both indirect and estimative ways (e.g., willingness to pay or public avoided costs instead of real income). Thus, more work is needed to set up the causal connections between ES management and economic benefits in urban forests. A financial and banking sector response which will 'capture values' is also needed. This basically means making profits for those prepared to develop and trade new financial instruments and fund financial initiatives which will trade biodiversity and ecosystem assets as new financial assets.

► **Urban forests and well-being:** Scientific and gray literature agrees on ES being essential for human existence and consider health and well-being as outcomes of a synergistic flow of these services (Mammadova et al., 2021). The analysis of innovation in selected UF case studies from across Europe shows that the healing and public health potential of nature and ecosystems could be harnessed more systematically, in order to be used for creating opportunities and processing into services (public or private) that address the needs of different types of beneficiaries. UF initiatives for human well-being involve the creation of new occupations and revenue streams while enhancing the access to forests for a wide variety of beneficiaries. The primary focus of these UF initiatives is to increase human-nature connectedness and stimulate active engagement and exercise in nature. In most of the cases,

implementing these activities requires conservation and minimal interventions to nature. Forest-based care initiatives also support the development of new business models (organisational innovation) and create new networks and arrangements with the health, social, and education sector. There is a clear connection with green care and UF that should be explored, identified also in other EU-funded projects such as the Horizon 2020 "Connecting Nature" and the Erasmus+ Knowledge Alliance "Green4C". UF innovators and urban entrepreneurs (Osorio and Özkazanç-Pan, 2014) should create synergies with green care experts in the disciplines of medicine, psychology, social care, forestry, education, and tourism and bring together skills and backgrounds, not only from research but also from a training and continuing education perspective.

**Opportunities in knowledge gaps and the use of technology**

► **Internet of Nature (IoN)**: An innovative approach (Galle et al., 2019) to collect 'ecosystem intelligence' to understand and link socio-ecological systems. This promising approach for UF will require standardized and transparent data stewardship, and therefore, clear data protocols and sound ethical principles. IoN will be especially relevant in urban context for monitoring and management, and it will bring new opportunities in various fields, i.e., employment opportunities, education, urban planning, etc. Future lines of research in smart urban forest management could focus on the effectiveness of a particular smart application in improving and promoting innovation in urban forestry management processes at the municipal level (Nitoslawski et al., 2019).

► **Nature-based learning (NBL)**: Although further frameworks to understand and implement NBL are needed, it is clear that trees and forests should be part of teaching. On the other hand, urban forests and urban greening provide excellent opportunities to reconnect with nature and for outdoor learning, especially important also during the post-COVID-19 era. One of the outcomes of this approach is how NBL can contribute to stewardship values or conservation behaviours, or what are the key elements of nature experiences that affect children. One of the issues in environmental psychology relates affordances with urban children's relationships with trees as elements of the landscape that invite to actions, i.e., playing (Kyttä 2004; Laaksoharju and Rappe, 2017). Recent EU projects of increasing interest in urban areas have already tackled NBL by developing innovative educational packages, with guidelines for both students and teachers –e.g., "City of trees."(Kilpi and de Kezel, 2021).

► **Species selection:** Proposals to integrate native and climate-change resistant, non-invasive, alien species are needed to adapt the UGI to ever-frequent extreme weather events.

# APPENDICES

## APPENDIX 1 - Case studies results

Table 1 - Geographical representation of the case studies

| Country | Total |
|---|---|
| Denmark | 1 |
| England | 2 |
| France | 1 |
| Hungary | 1 |
| Ireland | 1 |
| Italy | 6 |
| Romania | 2 |
| Spain | 5 |
| The Netherlands | 2 |
| **9** | **21** |

Table 2 - Overview of the main sectors represented by the case studies selected

| Main sector | Total |
|---|---|
| Public | 8 |
| Private | 8 |
| Public-private | 4 |
| **3** | **20** |

Table 3 - Uforest thematic disciplines representation

| Uforest thematic discipline | Total |
|---|---|
| Forest ecology | 3 |
| ICT | 4 |
| Socio-economics | 6 |
| Urban landscape planning | 6 |
| **4** | **20** |

Table 4 - Overview of the main focus activities of the case studies

| Focus activity | Total |
|---|---|
| Afforestation | 12 |
| Analysis | 5 |
| Education | 3 |
| **3** | **20** |

Table 5 - Stage of development

| Stage of development | Total |
|---|---|
| Implementation | 17 |
| Pilot | 3 |
| **2** | **20** |

**APPENDIX 2 - Model questionnaire**

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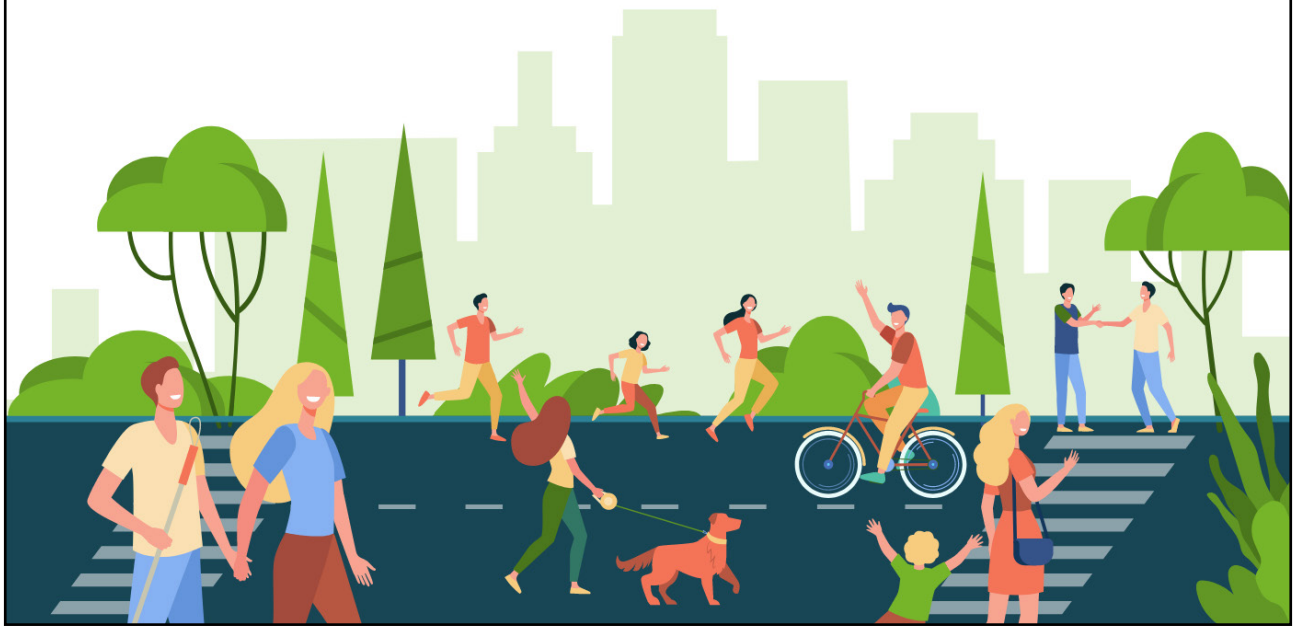
WP3. T3.2. Case study questionnaire

# A forest of knowledge



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# Do you see the forest?

Green, healthy cities filled with trees. **Is it just a dream?**
No, but we need to keep working to make it a reality.

For this task of the Uforest project, **your input is as crucial as it will ever be.** Your unique point of view and experience will help stimulate innovative urban forest projects.

Let's get started!

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# Mind the gap!

How about a little madlibs game?

My name is _____ (your name and surname)
and I am _____ (your institutional role)
at _____ (name of your institution).
Together with _____
_____ (partners/actors of the initiative)
we are developing _____ (name of the initiative),
which is _____ (a clear, brief definition of the initiative)
that helps _____ (target audience)
_____ (solve a problem).

Example: *My name is* ***Corina Basnou*** *and I am* ***a researcher*** *at* ***CREAF****. Together with* ***ERSAF****,* ***POLIMI****,* ***ETIFOR****,* ***EFI****,* ***UAB****,* ***AGRESTA****,* ***UNITBV****,* ***Forest Design****,* ***Trinity College Dublin****,* ***NBSI and Green City Watch*** *we are developing* ***Uforest****, which is* ***an urban forestry knowledge alliance*** *that helps* ***universities, cities and businesses*** *deliver a new approach to Urban Forestry.*

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# Let's pick your brain!

1

**How would you DESCRIBE your initiative?**

(include main goals, why was it founded, by whom, how did it start, when was it born, years in operation, etc.)

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2

**How do you MEASURE your goals?**

(e.g., number of trees planted, citizens engaged, air quality improved. Include three qualitative and quantitative Key Performance Indicators: https://bit.ly/3ldtJzY)

3

**What are the key ACTIVITIES or SERVICES?**

(e.g., urban reforestation, urban mapping, urban planning)

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4

**What three traits make your project UNIQUE? Do you think it is innovative (socially, technologically, etc.)? Why?**

5

**Who are your target BENEFICIARIES?**

(e.g., wider public and citizens, young people, city councils, scientists etc. Indicate if they pay for the activities/services offered by your initiative and how big is your market)

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## 6 How do you best REACH your beneficiaries?

(include channels, strategies and cost-efficiency)

## 7 Please indicate your initiative's key RESOURCES:

☐Personal qualifications (training, experience, quality certification)

☐Relationships (networking, partnership, trust)

☐Finances (funding, investment)

☐Natural resources (landscape features, ecosystem services)

☐Infrastructure (welcome cabin, transport options, roads, etc.)

☐Other (please, specify below)

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8

**How is your initiative FUNDED? Please describe the business model.**
(include costs, percentage of public and private funding, activity/service payments, reinvestments of revenue)

9

**What are the LOGISTICS and IMPACT of accessing and using the natural resources?**
(indicate if you need permits, if you follow guidelines to avoid negative environmental impact or create positive ones, whether your activity is certified by FSC, GSTC, etc.)

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10

**How does your initiative assure QUALITY and STANDARDS?**
(e.g., do you adhere to ISO standards, national legislation or other standards/specific legislations/policies?

11

**How is your initiative STRUCTURED and GOVERNED?**

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12

What is your 5-year VISION for your inititative?

13

List the three most significat NEEDS to make your vision happen and the three main BARRIERS related to the establishment and the daily management.

Promoted by:

In partnership with:

# Thank you!

The Uforest WP3 team

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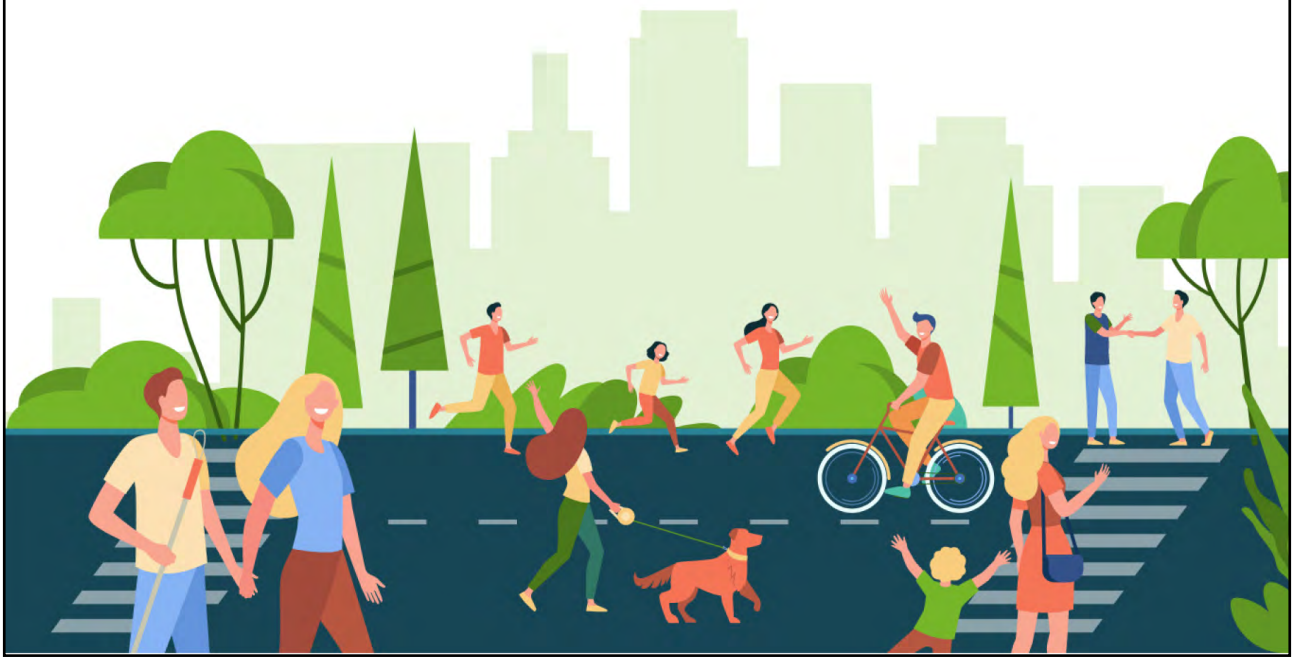

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For further information

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