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Green Infrastructure

Planning Strategies and Environmental Design

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Foreword by Stéphane Sadoux

If you run a quick search on any university library catalogue, you will notice an increase in the number of scholarly publications devoted to green and blue infrastructure in recent years. Although this trend is encouraging, the gap in literature is still significant and the publication of this edited volume is a particularly welcome addition to existing material. The COVID-19 pandemic has, sadly, made the content of this book all the more relevant. Where available and accessible, green and blue infrastructure has provided urban populations with outdoor recreational spaces in which they sought to mitigate the stress caused by the pandemic. The past few years have thus served as a powerful reminder that green and blue infrastructure caters for community as much as environmental needs and that their uneven distribution and quality in cities and regions is yet another indicator of social injustice.

That more attention should be paid to the roles and importance of green and blue infrastructure is old news. Calls for action at the supranational level, particularly those led by the United Nations and the European Union, have over the years contributed to fueling debates and raising awareness of populations and policy-makers. The various chapters included in this volume provide detailed and thought-provoking insights into the ways in which a range of stakeholders have sought to act through policies, plans and projects. The case study-based approach provides readers with thorough local and regional investigations showing how objectives, such as those found in the EU's Biodiversity Strategy, are locally translated into context-specific actions.

Water courses and networks of green spaces cut through administrative boundaries. Addressing green and blue infrastructure therefore requires a multiscale approach and this book clearly demonstrates the importance of joint-up thinking, from the local to the supranational levels. The devil is in the detail and authors successfully highlight the complex challenges which policy-makers and practitioners face when they attempt to transcend spatial and indeed sectoral boundaries. This book should also be praised for highlighting the positive outcomes of bottom-up initiatives, which allow local communities to take an active role in the governance of green and blue infrastructure management. Populations' knowledge of the places they live in is priceless and needs to be documented, understood and fed into action. This book stresses the role of academics in this process and the field work carried out by the

authors confirms the relevance of grounded and qualitative research in architecture, urbanism and landscape planning.

This book is a compelling call for the systematic integration of green and blue infrastructure in spatial planning policy and practice. It is also a cruel reminder that new approaches and skills are now required to address the complex and daunting contemporary challenges we face. The inclusion of practitioners' viewpoints in this publication is particularly inspirational and refreshing: these first-hand accounts stress the importance of retrofitting our fragmented and degraded environment.

This collection of multidisciplinary contributions from doctoral, postdoctoral and senior researchers as well as practitioners will undoubtedly be of interest to undergraduate and postgraduate students in architecture, urban, regional and landscape planning, geography, environmental sciences and engineering. The material will also provide policy-makers with much-needed practical knowledge and recommendations. In addition, and perhaps most importantly, it will encourage other scholars and practitioners to further investigate green and blue infrastructure.

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Foreword by Grazia Brunetta

The Green and Blue Infrastructure Projects in Spatial Planning as a Key Component for Adaptation to Climate Change

In recent decades, we have been witnessing on a planetary scale a weak or almost zero response capacity of the cities and territories to the events caused by the ongoing systemic dynamics of climate change. The significant effects of climate change are the result of the increasingly high temporal frequency of extreme natural phenomena and the greater vulnerability of soils, the result of the intense and growing dynamics of urbanization and the consequent fragmentation of natural environments. The process of fragmentation of natural environments due to anthropic causes is the primary cause of biodiversity loss, generating ecological losses and environmental and landscape challenges. The drastic loss of biodiversity is a consequence of the development model pursued up to now—strongly polarized on urban areas and primarily based on the intensive and extensive exploitation of natural resources—still supported today by a growing urbanization dynamic on a global scale. The United Nations estimates that 65% of the world's population (about 6 billion people) will be concentrated in thirty mega-cities which will consume 75% of the planet's resources, producing a widespread loss of biodiversity by 2050.

It is necessary to carry out new knowledge paradigms for urban projects and territorial actions oriented toward the regeneration of biodiversity. However, it should be considered that since the early 1990s, with the introduction of the Habitats Directive (92/43/EEC), the goal of conservation of biological diversity has established itself as a priority theme in community planning actions, in order to promote environmental conservation policies aimed at enhancing and protecting ecological resources and the landscape. Should be mentioned here of the first pioneering agreements on biodiversity promoted by the Council of Europe, such as the *European Network of Biogenetic Reserves* (1992),[1] followed by a package of global agreements—*Rio Convention on*

[1] CoE 1992. European network of Biogenetic Reserves. Strasbourg.

Biological Diversity (1992),[2] *IUCN Caracas Action Plan on Parks and Protected Areas* (1992),[3] *Pan-European Strategy for Biological and Landscape Diversity of the Council of Europe* (1996)[4]—which gave impetus to the launch of a political debate and initial objectives shared internationally. In that decade of activity, the first theoretical considerations and experimentations were promoted to direct the *ecological network* project in spatial planning at the different scales of action. Among the promising innovations in terms of local spatial planning practices of green and blue infrastructures (GBI), in the national context, it should be mentioned here the ecological approaches introduced in the 1990s in some urban plans and the multidisciplinary research promoted by the *National Institute of Urban Planning* and by the *National Environmental Protection Agency* to define the first national guidelines for the design of ecological infrastructures on a local scale.[5] In this perspective, the pioneering experiences of the urban plans of Faenza and Reggio Emilia should be recalled here for having introduced an ecological approach to the design of a continuous and open system of urban green areas with the aim of restoring an ecological balance in urbanized areas, and to regenerate the environmental resources in the collective urban spaces.[6]

Today, on this issue, there are various and consolidated international references which, in response to the climate crisis, promote the project of ecological regeneration in urban and regional policies. Among all, specific references for spatial planning are the *Paris Agreement on Climate Change* (2015),[7] the *New Urban Agenda* (2016)[8] and the *2030 Agenda for Sustainable Development*[9] with the Sustainable Development Goals 15 (life on the land) eight (water) 11 (human settlements), and 13 (climate action) and the recent *Nationally Determined Contributions Report* (NDCs—2022)[10] which analyzes the urban content of one hundred and ninety-three national strategies for adaptation to climate change. The NDCs Report clearly shows that there is a lot of work to do on the ecosystem and biodiversity issue, as only 26% of the adaptation actions introduced in national policies concern the recovery of biodiversity in urban projects.

In this perspective for action, the book presents a review of proposals on the GBI project in an attempt to overcome the operational difficulties and the sectoral nature that has always characterized the approaches and experiences of ecological heritage projects. As noted by the authors, the concept of GBI in spatial planning is

[2] UN 1992. Convention on Biological Diversity. Rio de Janeiro.

[3] IUCN 1992. Caracas Action Plan on Parks and Protected Areas. Caracas.

[4] CoE 1996. Pan-European Strategy for Biological and Landscape Diversity. Strasbourg.

[5] APAT-INU 2003. Gestione delle aree di collegamento ecologico funzionale. Manuale n. 26. Roma. ISBN: 88-448-0111-6.

[6] See: *Plan of Faenza* (1998), and *Plan of Reggio Emilia* (1999).

[7] UNFCCC 2015. Paris Agreement on Climate Change. Paris.

[8] UN 2016. New Urban Agenda. Habitat III: Quito 17–20 October.

[9] UN 2015 2030 Agenda for Sustainable Development. New York 25–27 September.

[10] UNFCCC 2022. Nationally Determined Contributions under the Paris Agrrement. Synthesis report by the secretariat. Sharm el-Sheikh Climate Change Conference, November.

an "old wine in new bottles," implemented with great weakness in urban design, that returns to being topical today. In the era of the Anthropocene, the GBIs become key components of the urban project for adaptation to climate change and regeneration of the terrestrial ecosystem in national and international strategies. The project of the GBIs requires an intersectoral and transcalar spatial planning approach capable of overcoming the mere regulatory vision of territorial and urban plans, with the aim to implement a strategy and a project through forms of co-planning and multiscalar governance. On these aspects, the book presents good practices and innovation experiences in the fields of territorial planning and urban design, focusing attention on the necessary elements of innovation to implement the concept of GBIs as a socio-ecological part of a path toward the sustainability of development processes. But as the volume shows in the third part, these practices need to be operationalized in order to become the engine of new urban projects capable of integrating the objectives of recovering ecological diversity in the processes of transformation. This new ecological vision for regenerating cities and territories is a promising work perspective, but it is still to be implemented in regional planning and design at different scales toward an ecological and socio-cultural transition path aimed at promoting sustainability, quality and liveability of development by 2030.

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Contents

Chapter 1
Framing Green and Blue Infrastructure

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Abstract Green and blue infrastructure (GBI) is increasingly popular in international literature and cultural debates. Indeed, international opinion agrees that GBI is a strategic planning and design tool to face current and upcoming societal challenges. However, goals and practical applications are not fixed and differ based on disciplinary approaches and geographical areas. Thus, the chapter attempts to provide a systematic frame on the current cultural debate on GBI, presenting the diverse contributions deriving from planning and design practices, from vast scale strategies to local projects.

Keywords Green and blue infrastructure · Sustainability · Resilience · Urban and regional planning · Urban and landscape design

1.1 Urban Challenges in the Post-pandemic Era

European urban areas are home to over two-thirds of the population, with a level of urbanisation that is expected to increase to approximately 83.7% in 2050. Most European cities are often characterised by a high concentration of economic activities and wealth, but they are increasingly vulnerable to pandemics, environmental and economic crises, social disaggregation, and climate change related impacts. Additionally, there is a growing concern about biodiversity loss and its implications on health, well-being, climate, economy, degradation of nature, and social inequality (Anguelovski et al. 2018). Ecosystem degradation erodes nature's ability to support

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human societies, as ecosystems provide a wide range of services (MEA 2005; TEEB 2010).

Biodiversity loss emphasises the effects of other current crises: climate, economic, and COVID-19. It is essential to start from biodiversity as a strategic component of natural processes providing ecosystems with the possibility to develop the vital functions for social direct or indirect benefits (De Groot 1992), interpreted in terms of ecosystem services (ES) provided to humans (Science for Environment Policy 2015). There is a scientific consensus that without biodiversity, many natural processes (such as climate regulation, limitation of urban heat islands, water and air purification, maintenance of soil fertility, reproduction of species, etc.) and human activities (such as agriculture, fishing, and outdoor recreation) would be impossible (Hooper et al. 2005). In this view, it is urgent to rethink urban planning and design approaches to restore biodiversity as defined in the EU Biodiversity Strategy 2030 within the European Green Deal.

Moreover, the Biodiversity Strategy 2030 calls for a comprehensive change to benefit people, climate and nature. It highlights the role of interconnected protected areas (PAs), green areas, ecological networks, green infrastructure (GI) and green and blue infrastructure (GBI). This interconnection allows for controlling biodiversity loss, enforcing ecosystems, connecting diverse natural and semi-natural areas, and delivering "a wide range of ecosystem services", maintaining and enhancing at least 15% of degraded ecosystems (EC 2013). Urban and peri-urban PAs and other green areas (such as gardens, yards, vacant lots, pocket parks, and wastelands) are all components of a connected and coherent network able to sustain biodiversity (Trzyna 2014; UNEP-WCMC and IUCN 2021). This multi-scale network must be integrated into the landscape, territorial policies, and urban planning to enhance ecological reticularity and ecosystem functionality (Barabàsi and Bonabeau 2003). Moreover, due to their multifunctionality, PAs and other green spaces play an important social role, bringing people closer to nature (Hockings et al. 2020). Biodiversity loss emphasises the effects of ongoing crises (e.g. COVID-19, economic and climate), making it essential to start with biodiversity as a strategic component of planning and design at diverse territorial scales, even in the light of interdependencies between humans and nature.

In this process, the pandemic event of COVID-19 represents a turning point from different perspectives, impacting economic development, everyday life, habits, planning, and design practices. Current national, EU, and international strategies (such as Biodiversity Strategy 2030, Green Deal, Next Generation EU and the various national plans such as the Italian *Piano Nazionale di Ripresa e Resilienza* and the French *Plan National de Reprise et de Résilience*) stress the attention on urban green spaces as one of the main elements determining the quality of life and ecosystem health (Noszczyk et al. 2022). In response to these impacts, planning and design practices are even more forced to rethink the urban project in an ecologically oriented way, restarting from natural and ecological assets.

In this evolving framework, GBI is a socio-ecological system strategically planned and designed for sustainability and resilience (Voghera and Giudice 2019), aimed at managing a large variety of ES (Hansen and Pauleit 2014) and playing a crucial role in

halting biodiversity loss. It can sustain the interrelation between "diversity (biodiversity), redundancy (ecological variability), cycles of adaptation (multiple equilibrium states), and interaction between spatial scales (hierarchy) and temporal (activation of different times responses)" (De Lotto et al. 2017, p. 780). Various studies underline the need for carefully planning, distributing, and designing a multifunctional and multi-scale GBI, integrating green (soils) and blue (water) spaces that can improve biodiversity values, the related ecological functionality, and socio-economic values.

1.2 Green (and Blue) Infrastructure as a Responsive Approach

Given the current situation of the COVID-19 pandemic emergency, GBI has become an urgent topic of the contemporary cultural, planning, and design approaches. Even though it is recognised as "planning and design-related measures" for urban resilience (Sharifi 2020), it still appears poorly developed in research and everyday practices. Given this gap, the book aims to develop an integrated approach connecting cultural and environmental features with planning and design dimensions, investigating both academic and practitioners' perspectives emphasising public policy innovation.

Rooted in the tradition of the twentieth century city since the earliest hygiene-based urban reflections (e.g. parks and gardens system by Jean-Claude Nicolas Forestier, public parks and parkways by Frederick Law Olmsted, garden city experience), GBI provides consolidated assets that refer to an environmental approach in spatial and landscape planning ("old wine in new bottles", Davies et al. 2006, p. 6). Later on, the American greenways movement relaunched the idea of creating a system of parks and parkways that integrated "corridors of private and public recreation lands and waters and to provide people with access to open spaces close to where they live, and to link together the rural and urban spaces in the American landscape" (Americans Outdoors 1987).

Nowadays, it is powerfully invoked as operative support in developing the resilient, sustainable, safe, inclusive, and climate-responsive contemporary city (Mell 2009). Furthermore, it has a key role in the ecologically and landscape-oriented design of public spaces (see Andreas Kipar interview) and is considered a fundamental element for urban regeneration strategies (see interviews with Magali Volkwein and Sébastien Roussel and Carlo Gasparrini).

GI appears to have several conceptualisations focused mainly on "(1) a greenspace planning, (2) an urban ecology concept, and (3) a water/stormwater management concept" (Matsler et al. 2021, p. 2). With regard to the first aspect, GBI tends to be an "integrated system" (Landscape Institute 2009) of green spaces that bring plenty of benefits, focusing on landscape multifunctionality (Lovell and Taylor 2013). It is thus configured as a system that links landscapes and ecological networks, penetrating the tissues of the consolidated city. This system also insists on urban metabolism based on resource recycling, identity reappropriation and care for the landscape

commons. It implies a design action that brings into play different scales of landscape design, considering building materials, eco-friendly public spaces, water cycle, vegetation performance, slow mobility systems, and settlement types. Furthermore, it also entails different forms of inclusive and innovative governance to activate green and circular economies.

The multidimensional and transcalar strategy of GBI grounds the design of cities and territories in landscape quality to trigger urban regeneration by redesigning vacant lands and open spaces (Secchi 1986; Lanzani 2015). This paradigm shift needs to move out of "sectoriality" and integrate ecological, environmental and landscape issues into the territorial project, according to a model now consolidated in theoretical elaboration, emerging practices, and international policies. These reflections fall under the second conceptualisation related to urban ecology.

The third conceptualisation is quite a narrow vision of GBI, and it needs to be further deepened to include the already mentioned characteristic of multifunctionality. Indeed, EU policies define GBI as 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" (EC 2013). This definition led many researchers to deal with multifunctionality. In this context, GBI can be considered a producer of multiple benefits (Ahern 2011; Hansen and Pauleit 2014; Lovell and Taylor 2013) for health and life quality. The international literature highlights that the several benefits and services supplied to urban environments by GBI contribute to climate change mitigation and adaptation (Demuzere et al. 2014). Additionally, the multifunctionality of GBI can mitigate the urban heat island effect, flood risk, and ecosystem resilience (Sussams et al. 2015).

Furthermore, the concept of GI "differs from conventional approaches to open space planning because it looks at conservation values and actions in concert with land development, growth management and built infrastructure planning" (Benedict and McMahon 2002, p. 5). Here, the inclusion of a sustainable development perspective in addition to a preservative one is evident. The various connotations given to GBI in the different disciplinary approaches configure GBI as a "boundary object" (Brand and Jax 2007).

GBI can be used to enforce ES (Arcidiacono and Ronchi 2021) through its integration into the landscape and regional planning (Voghera and Giudice 2021; Giudice et al. 2021), dealing with a multifunctional approach in planning and design (Austin 2014), or it can be a policy itself (Gasparrini 2015; Clergeau and Blanc 2013) implementing the EU biodiversity strategy for 2030, the COP 10 decision X/2 Strategic Plan for Biodiversity 2011–2020.

Together with ecosystem-based solutions, GBI-based planning is recognised as a relevant approach to addressing climate change in the EU strategy on adaptation. Indeed, GBI discourses are also strictly connected to disaster risk management and its relationship with the environment (we refer primarily to the Sendai Framework for Disaster Risk Reduction 2015–2030). The topic is also strategically relevant to implementing some of the UN Sustainable Development Goals: no. 3 "Good health and well-being", no. 11 "Sustainable cities and communities", no. 13 "Climate Action", no. 14 "Life below water", no. 15 "Life on land". To fulfil these

objectives, GBI development requires "both the conservation of existing biodiversity-rich ecosystems in good condition and the restoration of degraded ecosystems" (EC 2019, p. 2). In addition, it is also necessary to create ~~a~~ new GBI to valorise and create landscapes and values (as interpreted by the European Landscape Convention, CoE 2000). However, there is an increasing need to further integrate GBI synergistically and organically into ordinary and sectorial planning tools at different scales (e.g. river basin management plans and rural development programmes) and into voluntary agreements between regional and local authorities (for example, French *Contrats Verts et Bleus* and Italian *Contratti di Fiume*). Indeed, most of the spatial planning tools (above all, the ones developed at the local scale) don't include GBI as a "standard part" (EC 2019). Only a few countries, such as France, have decided to integrate GBI as a specific recognised part of their spatial planning tools (from regional strategy to local plan).

In particular, the book frames GBI within the conceptual contexts of sustainability and resilience. This background takes the cue from former research led by two of the proposing editors (Voghera and Giudice) and published in *Sustainability* in 2019. These contexts are also strictly connected to the social-ecological systems approach (on this issue, the work by the Stockholm Resilience Centre is exemplary). Existing literature on GBI, social-ecological systems, resilience, and sustainability show how GBI mainly applies to stormwater management (Ahern 2013), but it can contribute to providing other benefits, such as better air and water quality (Demuzere et al. 2014), urban heat island mitigation (Tzoulas et al. 2007), improved communities values and reduced social vulnerability (Meerow and Newell 2017), greater access to green space (Meerow and Newell 2017), increased landscape connectivity (Zhang et al. 2019), and control of land take (Giudice 2021). Nevertheless, if the role in promoting ecological resilience is consolidated and shared, scientific positions split consensus on its social impact (Anguelovski et al. 2019).

Another essential element of GBI is its multiscalar governance. Despite the absence of an organic and robust structure and reference framework for deploying GBI, many attempts and progresses at different levels have been made to achieve this deployment worldwide. Existing plans and projects often consider GBI only at a specific scale: some projects consider the elements of GBI only at a local scale of intervention without relating them to the surrounding areas. Nevertheless, on the one hand, some Italian experiences attempted to develop a GBI at the municipal level, connecting it with the surroundings and giving connectivity. On the other hand, France established a multilevel planning system in the early 2010s integrating the regional territorial scheme, metropolitan strategy, and local plan. GBI management remains an open issue, which requires focused research and cooperation between policymakers, private stakeholders, and non-governmental organisations.

1.3 Objectives and Contents of the Book

The description of GBI shows how the topic is still fundamental when speaking of ongoing ecological, social, and economic transformations. GBI represents indeed not only a relevant strategy and policy to promote ecological-related issues but it is recognised that it can potentially have economic and social benefits. With this book, we want to fill this gap by presenting various experiences that show how multifaceted the topic of GBI is and how it can be applied in practical case studies. The first point deals with the necessity to overcome the prevalence of ecological-related issues, including social and economic ones, while the second point allows for evaluating the operationalisation of GBI. To do this, the book discusses the emerging approaches within planning and urban design: not only ecological solutions but also architectural and social ones that contribute to the overall regeneration of territories. This research mainly focuses on French and Italian contexts but also provides some insights from experiences developed worldwide. The choice of France and Italy is not casual. On the one hand, France has developed a national strategy, the so-called *Trame Verte et Bleue* (see Fournier and Bonnefond chapter; Devillers & Associés interview), to integrate GBI into regional and local planning practices and urban design. On the other hand, Italy is attempting to build a GBI framework by reinforcing its role in the latest Regional Landscape Plans and raising awareness of the Italian National Strategy for Climate Change Adaptation. Other case studies come from England, Portugal, Spain, and the USA in order to put into perspective the French and Italian cases at the international level.

The chapters of this book highlight the innovations introduced by different GBI approaches in the field of territorial planning (part I) and urban design (part II).

The discussion involves experts in different sectors giving their opinion on some issues or presenting how they included the concepts of GBI in their projects and how this integration modifies their approaches to planning, urban project, and public spaces design. From this perspective, we interviewed planners, architects, and landscape architects (part III: Carlo Gasparrini Planning Studio, Studio Land, and Devillers et Associés). These interviews help to develop the link between the design conception and action (implementation and management). Interviewees are all involved in new planning and design forms, putting the GBI project at the centre. Interviews focused on different aspects based on each interviewee's background and field of experience. Considering the existing literature on this topic, we are trying to develop a multi-disciplinary approach which overarches the entire GBI building process, from planning scopes to the design phase, including management and implementation actions.

1.3.1 Experiences in Planning and Design

The case studies offer a varied selection of sustainable and resilient practices integrating vast and systemic actions with local design interventions: water connections, "green and blue textures" (as in the River Contract and the French strategy for the ecological and landscape quality of the territory; Voghera 2020) that rely on territorial strategies, free soils, ecological networks and vegetated spaces, networks of PAs, shared urban gardens, urban agriculture, networks of rural landscapes, cultural heritage, energy networks, slow mobility networks, networks of social and cultural associations that attempt to activate circular economies (such as the agricultural experimentation at diverse scale, see the chapter by Ingaramo and Negrello).

In this view, rivers are crucial for biodiversity enhancement (see chapters by D'Ascanio and Palazzo, Verdelli, Fournier and Bonnefond, Seigneuret, and Anastasia). They often undergo a process of trivialisation, which is reflected in the functional dystrophy of the ecosystems that compose them, with the result of making the system increasingly vulnerable, fragile, and costly in terms of remediation and public investment (Santolini 2010). So, it becomes strategic to focus on rivers as an ecological framework for integrating biodiversity in planning and ecological design at different scales (Schindler et al. 2016; see the chapters by Giaimo, Seigneuret and Arcidiacono, Ronchi, Di Martino, and Pristeri). The current situation results challenging for implementing GBI in planning at different scales, and it calls for planning guidance on how, where and when GBI and ES should be managed to enforce biodiversity and deliver multiple benefits to citizens in urban regeneration actions (such as in ecological reticularity strategies and experimentation; see the chapter by La Riccia).

These actions and projects aim at landscape enhancement, identified as the structural dimension of urban design that promotes urban regeneration strategies based on a renewed alliance between historical-cultural and ecological-environmental values. In fact, "greening the city" seems to be the goal shared by all the cases, together with the design of a diverse city as in Milton Keynes' "urban laboratory" (see Forget chapter). The setting of urban regeneration considers not only nature in the city as "mere context architecture, but a branched and complex connective system that links exterior and interior, historical legacies, environmental dynamics" (Gambino 2007), able to use new technologies for the smart city that can evolve through a collaborative approach.

Based on a participatory process for interpreting people's aspirations, the GBI in the Loire Valley reimagines the link between landscapes, heritages, and well-being, impacting the economy (Luginbühl 2014) to intervene in the quality of life of the inhabitants (see the chapter by Verdelli).

GBI is providing functional performance and design criteria and rules (Voghera and Giudice 2020) and developing place-specific settings and conforming open spaces, as in the River Contract of the Aniene (see the chapter by D'Ascanio and Palazzo), enhancing the functional taxonomy and considering environmental degradation areas and brownfields, complex cultivation patterns, and in-between spaces

(urban fringe areas, open spaces, ecological network). Affecting the performance in terms of ES provisions, the Iberian GBI case studies (see Anastasia chapter) are significant in terms of water corridors, mobility, and environmental and "cultural" infrastructures, supporting urban regeneration processes for the renewal of underused and vacant areas along the water, located in crucial and strategic urban and metropolitan enclaves through landscape projects and minimal architectural interventions ("confetti").

These aspects confirm that GBI is a multi-benefit solution that can integrate the transcalar approach from planning to architecture that can host many of the current nature-based solutions for healthy cities (such as green canopies, trees, green roofs, and other solutions; see the chapter by Aimar). A "transversal reticular paradigm" (Gambino 2009), multidimensional and multi-sectoral, capable of enhancing through a short-, medium-, and long-term strategies, the interactions between the different connection networks that cross the territory, linking facts, and actions in a frame of synergies that structures the environmental regeneration of public space and works for a different quality of living. A reticular paradigm that thus crosses practices of recovering open and built assets and soils and offers innovative services to redesign the landscape and build the foundations for a circular economy, based on social capitalisation, efficiency, and competitive recombination of factors of production and that needs (as the French cases also show) resources for operationalisation.

As emerges from the cases discussed, this reticular paradigm bases actions at different scales on multilevel governance and empowerment (e.g. the innovative design solutions at the diverse scales—i.e. interviews examples) to help achieve a new territorial and landscape balance and different habitability and sociality in the landscape. These landscape networks reconfigure systems of spatial, social, ecological, and economic value relations in dynamic ways.

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Part I
Planning Strategies

Starting from international case studies, the first part offers an overview of different planning practices that place the green and blue infrastructure at the centre of the process. The selected case studies allow us to highlight the major pros and cons of the possible uprising operationalisation of green and blue infrastructure. This first part focuses on the respective roles of regional, metropolitan and local scales in the matter of protection and restoration of ecological networks. Starting with some consolidated experiences of urban planning and cultural landscape preservation, this part provides innovative elements and approaches to green and blue infrastructure planning. Furthermore, the analysed experiences integrate various planning and design scales (from landscape planning and river basin actions to projects at the metropolitan and local scale) and try to imagine new forms of planning in order to balance on the one hand sustainability, resilience, biodiversity and climate change goals, and on the other hand economic, social and cultural development issues.

Chapter 2
Milton Keynes, the "Forest City". From the Landscape Planning to the Advent of the Car, Lessons for the Future Green Infrastructure?

Malaury Forget

Abstract This chapter presents the case of the British New Town of Milton Keynes. Programmed in 1967, this true urban laboratory is the setting of numerous experiments. From the origins of green infrastructure in landscape planning to city planning, we will explore how its designers contributed to preserving and creating habitat areas for wildlife. The landscaping project implemented is sophisticated and detailed, designed according to a search for efficiency in a long-term perspective. Milton Keynes foreshadows some of the current challenges related to territorial development and green infrastructure.

Keywords Milton Keynes · Landscape planning · Road verge · Park network · Biodiversity · Process

2.1 Introduction

The chosen case study is Milton Keynes, a New City in England. The chapter is organised in three parts. The first identifies the contextual elements necessary to understand the city's project and its challenges by studying the origins of landscape planning in England and its impact on the New Town movement. The second part details Milton Keynes' specific landscape planning; the means, methods and reasons for such a development will be discussed here. Finally, the third part puts into perspective the contributions brought through this project in relation to current issues. So, fifty years after the birth of the city, are there any lessons or reservations that can be drawn?

The chapter proposes a historical perspective on the concept of green infrastructure, allowing us to step back from the ambitions announced today. Through the study of a specific case study that was carried out and completed, this proposal provides practical tools for the creation and maintenance of green infrastructure in an urban environment. Numerous reports and articles were published at the time of the Milton

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Keynes development, which are useful sources for understanding the method used. Finally, a critique will be offered to highlight the successes and suggest limitations of the operation. Essentially based on field observations, they will allow us to deduce learnings from this project.

2.2 Elements of Context

2.2.1 Origins of an Urban Laboratory

The New Town movement began in England in 1946, following the publication of the New Towns Act. This document preceded the planning of around thirty new cities over a period of about thirty years, exceeding by far the initial objective to develop ten cities. The creation of these cities or city extensions took place during the reconstruction period following the Second World War and aimed to unclog the capital city of London, which had become saturated by polluting industries and insalubrious. Milton Keynes is one of the last planned New Towns and is the most important and ambitious New Town developed in Britain.

Programmed in 1967, Milton Keynes was implemented at a later date and in different circumstances as compared to the first New Towns. Reconstruction in the context of the creation of the first New Towns is marked by a strong development of industries accompanied by an improvement in living conditions and an increase in household consumption. The quest for opportunity and freedom of choice defines the time of Milton Keynes' construction.

Milton Keynes' master plan was designed between 1967 and 1970, just before the two oil crises of 1973 and 1979, which deeply impacted consciences and economies worldwide. These crises, among other situations, became triggers for ecological awareness. The 1970s and 1980s were defined by the development of a great variety of experiments around alternative lifestyles and autonomous housing systems (Maniaque 2014).

Influenced by this historical context and the experience of previous New Town developments, Milton Keynes is projected to offer a new way of life, redefining housing, work, travel and entertainment. Abundant experimentation on sustainable housing was carried out in the 1980s, and today autonomous vehicles are developed and tested in the New Town. Also, its urban planning is one of its most highlighted assets today, both in terms of its heritage value and as a reference for future planning.

The development area designated for the implementation of Milton Keynes was made up of agricultural land and composed of about ten villages that were integrated into the city project. Several masterplans were produced, the first one by Bucks County planner Fred Pooley and later by the planners of the Milton Keynes Development Corporation (MKDC)[1] before a feasible project could be achieved, taking

[1] The creation of each New Town is accompanied by the formation of a Development Corporation. Milton Keynes' was created in 1967 and dissolved in 1992.

into account the budgetary constraints imposed on the designers. Very different planning solutions were considered thanks to Milton Keynes' status as a New City, where almost everything was to be conceived and created from the beginning.

The city of Milton Keynes presents a number of specific urban and architectural features. We will focus on the development of green and natural spaces, one of the major aspects of city planning conditioning the quality of living environments. We shall see how issues that arise today related to territorial planning and green infrastructure are already taken into consideration in this context.

2.2.2 Green Infrastructure: Policy Tool and Precedents

Today, fifty years after Milton Keynes' planning, European natural areas are degraded, and their role as habitat for a great number of animal and plant species is compromised. To respond to this situation, the European Environment Agency (EEA) aims to develop green infrastructure as a planning policy tool. And so, the European Union, in its *green infrastructure strategy*, recommends fully integrating it into spatial planning policies.

Dige (2015) explains that green infrastructure is a tool to understand the advantages offered to human society by nature and to mobilise investments to sustain and enhance these benefits in order to generate ecological, economic and social services through natural solutions.

Here, we borrow the definition of green infrastructure from Dige (2015): a strategically planned network of natural, semi-natural areas and green spaces that provide ecosystem services. These services, defined as supporting our well-being and quality of life, include water and air purification, biodiversity conservation, biomass production or the mitigation of surface runoff. A combination of services can thus be obtained from one vegetated area. Most of these services are essential but require significant investment and maintenance efforts when implemented as "grey"[2] infrastructure solutions, while green infrastructure solutions prove more socially advantageous and less expensive.

Green infrastructure is a spatial and ecological concept aimed at promoting the vitality and resilience of ecosystems. It helps preserve biodiversity and promote ecosystem services for the benefit of humans, such as reducing the effects of global warming, identifying and maintaining critical habitat areas and connecting them.

In 2015 the EU biodiversity strategy aimed at preserving and improving ecosystems and their inputs through green infrastructure by 2020 and for 15% of degraded ecosystems to be restored.

Once again, according to Gorm Dige, green infrastructure remains a new and complex concept for which there is no widely recognised definition. He also points out a lack of indicators and quantitative analyses.

[2] "Grey" infrastructure involves the construction of elements such as roads or evacuation networks, often limited to a single function.

However, Banzo (2015) explains that green infrastructure originates in landscape planning, which is defined as the development of the urban environment through the landscaping of "open spaces". This planning model was introduced by Frederick Law Olmsted (1822–1903)[3] in the 1870s in the United States and aimed at ensuring a connection between landscape spaces at different scales, organising the city around public spaces and landscaped traffic lanes (Banzo 2015, Alonzo 2018). The green belt imagined in Ebenezer Howard's garden city project (1850–1928) falls into the green infrastructure project category. In fact, Ebenezer Howard and Raymond Unwin (1863–1940), with whom he collaborated, as well as Patrick Abercrombie (1879–1957), who put into application his recommendations for the Greater London Plan (1944), incorporated what is known today as green infrastructure in their development projects (Banzo 2015).

Later, the theory of Modern Movement—some of whose principles were applied in Milton Keynes (urbanism of sectors, hierarchisation of roads, linear parks, see II)—dissociates the agricultural or natural spaces from the urbanised zones which are crossed by green corridors (V7 walkways, according to the categorisation of roads proposed by Corbusier (1957)), mainly in linear form, which ensure the continuity of habitat of animal and plant species (Corbusier 1957). According to Le Corbusier, parks and tree-lined walkways allow wildlife species to travel across the city. Their linear shape is similar to the layout of traffic lanes allowing vehicles and their users to move within or around the city.

The green infrastructure, considered a policy tool by the EEA, stems from previous work related in particular to landscape planning. It is, therefore, possible to enrich future green infrastructure projects with elements from theories and applications developed since the end of the nineteenth century. Consequently, Milton Keynes allows us to study the application of principles defining the green infrastructure approach.

2.3 Milton Keynes' Landscape Planning

2.3.1 Milton Keynes: Supporting the Creation of Natural Habitats

Before 1967, most of the geographical area defined for the implementation of the New Town of Milton Keynes was composed of agricultural land hosting a small variety of wild animal species and few habitat areas. Wildlife in rural areas is, therefore, under great pressure from the use of pesticides (Kelcey 1975) and monocultures. Animal

[3] F.L. Olmsted is known as the "heir" to Andrew Jackson Downing (1815–1852)—himself considered the founding father of garden art in the United States—because of the convergence of their work and the fact that Olmsted, with Calvert Vaux (1824–1895), designed New York's Central Park, while Downing was suspected of doing so but died early in a boat accident. Downing was greatly influenced by Humphry Repton (1752–1818) who was responsible for the first road segregation.

species would take refuge in hedges, on roadsides and in the few remaining forests. Most of these habitats were already the product of the human intervention.

When Milton Keynes was conceived, two linear parks crossing the city from North to South were designed with the aim of safeguarding natural areas as biodiversity reserves. The Grand Union Canal and the River Great Ouse are two pre-existing natural or semi-natural elements. They host a variety of fauna and flora that the designers of Milton Keynes chose to preserve. The two linear parks are connected through the Milton Keynes city centre. The city centre is an area of activities and businesses with a lower density of vegetation and a lesser variety of species than the parks, but it aims at ensuring ecological continuity (Figs. 2.1 and 2.2).

As Edwards (2001) reviews the history of the city's planning project, he explains that the dense land reservations along grid roads result from specific traffic-related changes. Initially, the main roads had a speed limit of 50 km/h and intersections were managed by traffic lights. Activities, housing structures and bus stops were to be implemented along these main roads. But as traffic lights are replaced with roundabouts, automobiles start circulating at 100 km/h and houses and activities are pushed away from the grid roads and into the grid squares (see Fig. 2.3).

The density and activity zones, initially located along the main roads, are moved and end up being implemented in the middle of sectors, which has consequences on the activity of local centres and on the use of public transport. The entire organisation of neighbourhood units is also affected. And so, MKDC planners and landscape architects proposed a landscape plan to be applied along the grid roads.

2.3.2 Roadsides in the Service of Ecosystems

This landscape project is detailed in the Ecological Studies of Grid Roads in Milton Keynes (Kelcey and MKDC 1974). One year after the publication of the study, John Kelcey, a member of the MKDC, wrote an article in the journal Urban Ecology (Kelcey 1975) in which he analysed the development of road verges in the New Town from an ecological perspective, focusing on the diversity of wildlife habitat areas along roads (Fig. 2.4).

The *Ecological Studies in Milton Keynes, Grid Roads* (1974) show that the design and implementation process developed into four phases and included recommendations for short- and long-term maintenances. Diagrams (plans, sections and drawings) shown in Figs. 2.5 and 2.6 were produced in order to provide landscape recommendations for roadsides.

The proposed spatial organisation is intended to produce variations that are pleasing to the eye. The diversity of plant species provides a wealth of habitats for animal species and can therefore accommodate a variety of animal species present on the site. Grid roads are a unique means of creating continuous landscaped areas that can compensate for or even increase the quality and variety of habitats for animal species and allow different species to move between natural or semi-natural areas.

Fig. 2.1 Grid road, park and river network plan, Milton Keynes and Campbell Park, Silver photography, November 2018. Field research. *Source* from the author

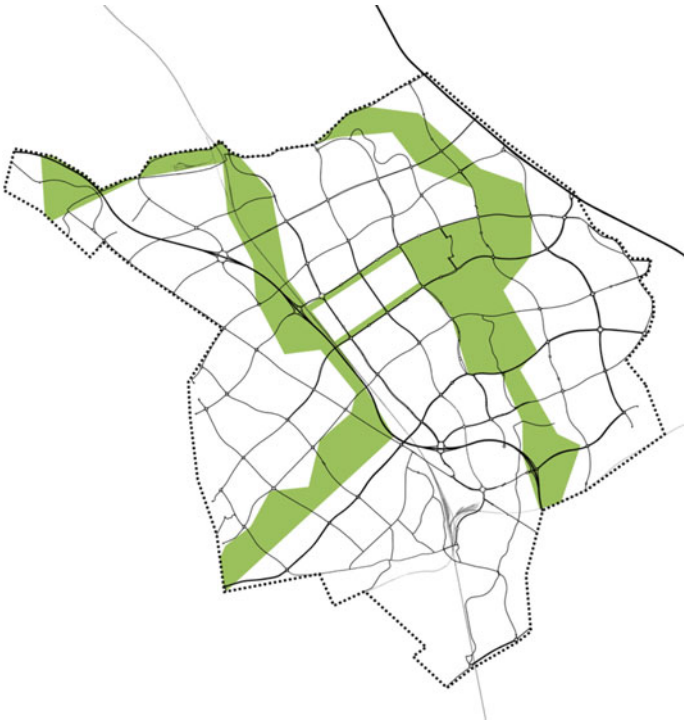

Fig. 2.2 Diagram of the park network, Milton Keynes. *Source* from the author

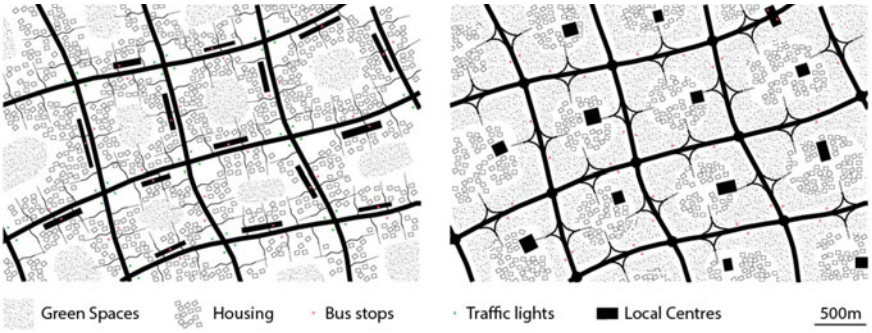

Fig. 2.3 Sector organisation around grid roads—project/development. *Source* Edwards (2001). Redrawn by the author

This potential improvement is due to the fact that agricultural monocultures preceded the city, limiting the diversity of natural habitats.

Fig. 2.4 View of a grid road. Silver photography, November 2018, field research. *Source* from the author

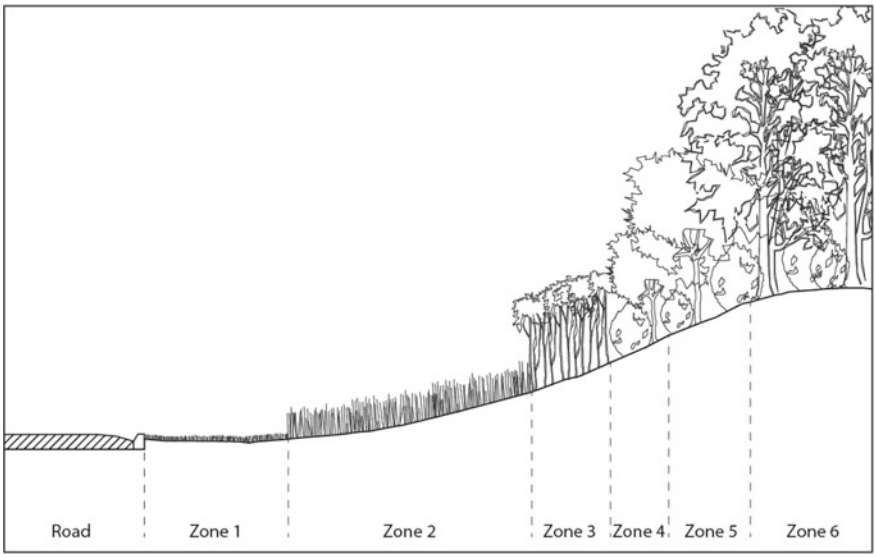

Fig. 2.5 Section across a grid road verge sowing the zonal structure. *Source* Kelcey and MKDC (1974)

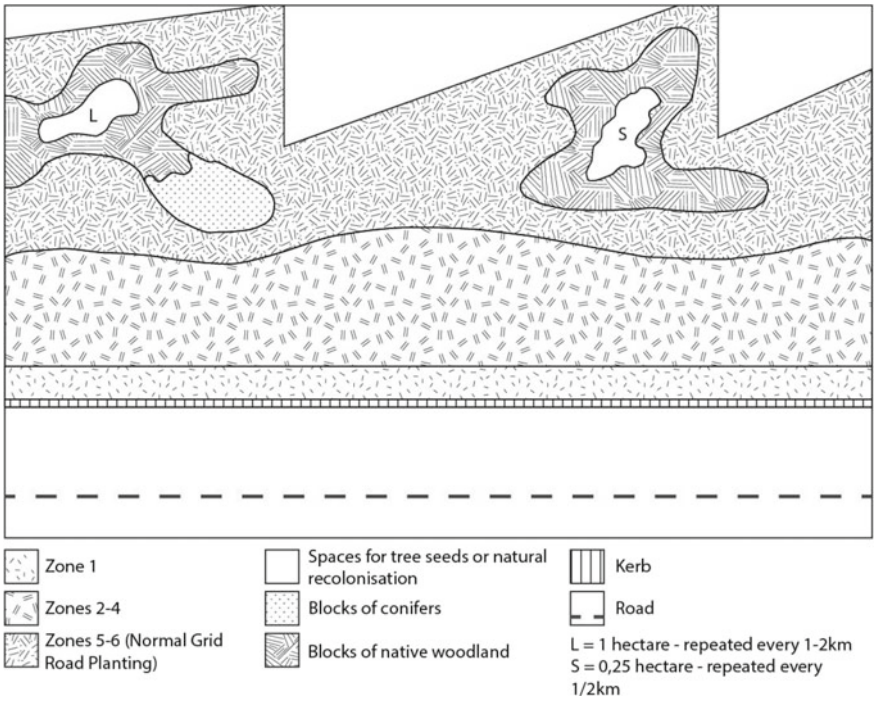

Fig. 2.6 Plan of the grid road zonal structure. *Source* Kelcey and MKDC (1974). Redrawn by the author

The recommendations are detailed and define planting areas and the vegetal species to be included, taking into account the maintenance required in the short and long term.

In terms of design, roadsides are divided into zones and structured together. Each zone plays one or more specific roles. The plant species that make up each area and the frequency of their maintenance are specified in the landscape plan.

As shown in Figs. 2.5 and 2.6, Zone 1, a strip one to two metres wide, hosts grasses that require mowing three to four times per year, while Zone 2 is occupied by medium-length grasses, to be cut once every year. Zone 3 is home to tall grasses that require cutting once every two to three years. Lastly, Zones 4, 5 and 6 require some intervention during planting and in the following years and very little maintenance once the plants are developed. Zone 4 is mainly composed of shrubs that form a visual screen between the road and the residential areas. Zone 5 is planted with small trees and shrubs, while Zone 6 is composed of forest trees combined with plant species found in Zones 4 and 5. An urban planning rule determines that the tallest buildings may not exceed the height of the tallest trees. This landscaping treatment makes it possible to circulate on the grid roads almost without seeing the city. What makes Milton Keynes its name as a forest city?

In addition to spatial instructions, the *Ecological Studies, Grid Roads* (1974) state that certain roadside areas are to be used for sowing seeds and plants from threatened areas elsewhere in the city, particularly during the construction phase of the project. Other areas are saved to carry out experiments making it possible to assess the impact of the use of certain soil types. Specific recommendations are also given for the maintenance of green spaces. For example, it is specified that no herbicides may be used except under exceptional circumstances. These clarifications provide indications as to the designers' vision, leaning towards respecting wildlife and preserving soils.

2.3.3 A Quest for Efficiency and Sustainability

The process of designing and setting up vegetated areas along grid roads unfolds over four stages, each playing a particular role in ensuring the quality of the final result. As stated by Kelcey (1975), the first stage concerns engineering and landscaping, that is, the study and development of conditions for the implementation of the future green infrastructure. This involves levelling the ground, making embankments or excavations and managing the slopes and type of soil, which are mainly dictated by the layout of grid roads and can be modified by engineering design. For example, on portions of grid roads located near residential areas, the excavated soil generated through road construction activities is used to create mounds that reduce vehicle noise. The second stage consists of depositing a layer of soil on the surface of the developments carried out during the first phase, then sowing a mixture of grass and herbaceous plant seeds. The third stage concerns the planting and short-term management of vegetation. This stage extends until the canopy is almost closed and therefore includes the required maintenance to control the development of vegetation during the first five to six years. Once the canopy is closed, the weeds give way to woody plants requiring less frequent interventions. It is specified that landscape project design and maintenance activities are complementary and may not be considered separately.

This organisation demonstrates that MKDC aimed to take into consideration the investment and maintenance required to operate the infrastructure from the design phase and with a long-term perspective. This reflects a systemic vision and a search for efficiency, defining the overall project as well as guiding the design of all of the city's infrastructure and facilities. While efficiency issues and even profitability issues in some areas remain central, MKDC never underestimated the aesthetic value of all solutions considered.

2.3.4 The Aesthetics of Diversity

Kelcey (1975) explains the decision to incorporate non-local plant species. England is not a region that naturally hosts a wide variety of plant species, so the designers chose to import plants from other regions that are compatible with the local climate in order to provide variety in landscaping. The designer ensured that these new species did not compromise the natural habitats of animal species but increased biodiversity. The variety of plants was also sought for its aesthetic aspect. The Ecological Studies on Grid Roads (Kelcey and MKDC 1974) specify in Appendix 1 that trees and shrubs must be planted randomly in order to achieve a natural appearance.

The aesthetic research linked to landscape design carried out throughout Milton Keynes is often associated with the notions of variety and diversity.

2.4 The Contribution of the Milton Keynes Case Study

2.4.1 Milton Keynes, an Example in the Face of Current Challenges

2.4.1.1 The Quality of the Living Environment

Clergeau (2012) invites us to consider environmental issues in the city as requiring an "act of construction and reinforcement" of natural spaces instead of a few measures aimed at avoiding their degradation. Today, landscape design is an intrinsic part of sustainable development and is no longer practised for merely sanitary or aesthetic purposes. Indeed, many ecosystem services can be made available through green spaces and are classified into three categories according to the Millennium Ecosystem Assessment, as follows: provisioning (production of food and water, biomass), regulating (of ecosystems, climate, disease) and cultural (aesthetics, recreation). These three categories of ecosystem services contribute to the well-being of dwellers across the cities and territories concerned through four essential components: security (food, access to resources), access to basic needs (balanced nutrition, employment, housing), health and social relations. These four components grant opportunity and freedom of choice (Millennium Ecosystem Assessment 2005), precisely one of the conditions Milton Keynes originally aimed to provide (Milton Keynes Development Corporation 1970a, b).

The three categories defined by the Millennium Ecosystem Assessment concern ecosystem services potentially provided by green infrastructure. In practice, oftentimes, they remain under-developed or untapped. The first category of services, provisioning, is rarely effective. Indeed, the food sovereignty of cities is an issue in the transition debate, and today many cities are unable to provide the necessary food for their local population. On the other hand, objectives in terms of aesthetics and recreation are most often met, and the importance of green spaces in connection to

climate regulation issues is also generally acknowledged. Open spaces such as parks or tree-lined ways are used for walking, contemplation, or to find a cooler spot when the weather gets hot. However, further information is still needed to determine the impact of vegetation on urban heat islands and to specify the species and forms that are better performing.

2.4.1.2 Questioning Density Through Mobility

Llewelyn-Davies (1966), who joined MKDC at the time of its creation in 1967, invites us to start a reflection on density and urban quality. He questions density in relation to traffic, considering the fact that many households own one or even two vehicles and pointing out a strategic threshold beyond which the travel time savings made possible by density no longer compensate for the increased maintenance costs of the latter. Between hyperdensity and urban sprawl, the English chooses an intermediary situation, which R. Llewelyn-Davies himself qualifies as being either the golden mean or a combination of the worst characteristics of each of the two extremes.

As for Milton Keynes, we can mention oversized road infrastructures in relation to the density currently supported by the city. Indeed, one hundred and sixty kilometres of expressways criss-cross the New Town on a grid of about one-kilometre intervals for a population of 250,000 inhabitants. Grid road traffic is congested at peak times due to the intensive use of private vehicles by a majority of unaccompanied drivers.[4] A shift towards new mobilities, collective or even autonomous, which seems to be a trend in Milton Keynes, could allow for optimised use of the existing road infrastructures.

2.5 Field Investigations, Observation of Ecosystem Services Provided

Part of the fieldwork was aimed at observing the different green spaces in the city to identify their diversity and uses.[5]

The parks and the edges of the pedestrian and bicycle paths, called redways because of the colour of the pavement, seem to be spaces that are respected by the inhabitants, with little littering or vandalism (tags or damaged street furniture). The use of these spaces depends on the time of the week and the day. The redways are used in the morning and evening by teenagers or young people who use public transport to get around. Cyclists are rarer, but their profile is more varied. People of all ages use these routes. The redways are more frequented on the way to and from work.

[4] Observations made during fieldwork, May 2019.

[5] For the sake of discretion and non-intrusive immersion, particularly near residential areas, the photographs taken show places empty of users. This is not always representative of reality, but precautions were necessary for the proper conduct of the observations.

The many parks in the city are leisure and meeting places. Indeed, many people go running or walking, alone, in groups or with their families. The parks are most popular on Saturdays and Sundays. The banks of Willen Lake are particularly popular. The city's parks also have an events dimension with an aqua park on Willen Lake and an attraction park located between Campbell Park and Willen Lake. Furthermore, the presence of a Wakeboard base on Willen Lake and a Cricket pitch in Campbell Park provides a diversity of possible sports activities. Finally, art installations punctuate certain parks, such as The Light Pyramid by artist Liliane Lijn created in 2012, from which a view of the great landscape can be seen, or Concrete Cows by artist Liz Leyh created in 1978, located in one of the two linear parks in the Bancroft district. The cultural aspect of ecosystem services is fully exploited in the case of Milton Keynes with aesthetically pleasing green spaces, entertainment, sports and meeting areas. The large presence of parks contributes to improving the quality of life for both human and non-human residents.

The field investigations, carried out at different times of the year, have shown that there is little local food supply. Some inhabitants choose to grow their own vegetables in their private garden, but this practice is not widespread and does not concern larger, shared spaces. Similarly, no energy use of biomass seems to be made. The provision of ecosystem services is therefore largely under-exploited in the case of Milton Keynes. It should be remembered that initially, in the garden city model on which the New Towns project is based, agriculture and local production played an important role in the urban ecosystem.

The green spaces in Milton Keynes are also intended to limit the risk of flooding due to the presence of two rivers. Large parks and ponds (Willen Lake) have been designed to limit the risk to homes (MKDC 1970a and b). A high level of biodiversity can also be observed throughout the city. Various species of birds and many squirrels live and move around in the proximity of the large shopping centre thanks to the continuous green grid that criss-crosses the city. The regulation aspect of ecosystem services is therefore exploited in the case of Milton Keynes.

There is, therefore, a significant imbalance between the different types of ecosystem services provided by the green spaces of the New Town, with a cultural dimension that is fully exploited, in contrast to the supply dimension. However, the networked nature of the green spaces, their large area and their diversity represent a great potential for developing under-exploited ecosystem services.

2.6 Conclusion

As a New Town, Milton Keynes functions as an "urban laboratory" and an experimental site for housing, mobility and landscape-related developments. The aim of this contribution is not to offer recommendations for the implementation of efficient green infrastructure solutions but to understand the objectives and choices made in this context by taking into account local characteristics and available resources. The

case of Milton Keynes allows us to question aspects of urbanity that are being re-evaluated today and which are common to many cities, such as density, mobility or our relationship to the landscape and to the ecosystem services on which we depend.

Browsing through studies and reports dating back to the city's construction period, we can see an evolution of the terminology and notions used in the field of landscape ecology. What was referred to as an interest in wildlife turned into a quest for the preservation of biodiversity and the search for a diversified flora involving ecosystems? Numerous and increasingly published studies on environmental issues have contributed to a redefinition of terms, but the designers of Milton Keynes put forward, as early as in 1967, a global vision that included life protection and soil preservation in an environment inhabited by humans. The proposed project is phased in the short and long term and takes into account the management and maintenance of spaces from their conception. Many spaces are self-regulating, which testifies to the project's quest for efficiency and cost control. MKDC, the entity responsible for designing, financing and maintaining green spaces and the entire city, aimed at creating and maintaining a quality environment for human life. The choice was also made to preserve soil quality and biodiversity. Operational, political and spatial dimensions linked to the development of parks and roadside areas prefigured the current notion of green infrastructure.

Milton Keynes, a project that stemmed from the New Town movement, is in continuity with the English garden landscape tradition, while at the same time, integrating elements from the radical break represented by the Modern movement. As such, this example helps deconstruct the myth of a polluted, polluting city versus a rural, natural countryside. Urban areas can be a refuge for animal species driven away from cultivated areas by pesticides and other soil sterilisation processes. The landscape project is designed to represent the aspirations of the designers over the long term, i.e. seventy-five and one hundred or fifty years after its creation, and so Milton Keynes may be perceived as a young and evolving venture, a future example and a viable context for experiments aiming for more optimal use of ecosystem services provided by an existing green infrastructure.

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Chapter 3
Towards a Method of Assessing the Well-Being Brought by Landscape and Heritage Along a Blue and Green Infrastructure: The Loire Valley (France)

Laura Verdelli

Abstract This paper summarises the progress of a research project that developed criteria to link well-being to landscape, heritage, and environmental issues, by experimenting a method that can bring operational extensions. The project was part of the economic evaluation of amenities that place well-being as one of the fundamental principles for assessing the quality of life in the context of enhancing ecosystem services, biodiversity, and urban resilience towards climate change. The research focused on the case study of the Loire Valley—UNESCO World Heritage, France—taking advantage of a 'natural' blue and green infrastructure supposedly comforting social well-being and not opposing biodiversity restoration. The methodology was based on (i) interviews with the different categories of actors—which helped identify conditions of well-being, prioritise them, and come up with a (non-exhaustive) list; validated during (ii) collective readings of the landscape and heritage; (iii) workshops were then used to validate these criteria and evaluate their importance in the perception of well-being. In the long term, the suggestions proposed should help influence economic dynamics, suggest spatial planning measures through urban planning documents, and improve performances of the environment and society through the enhancement of blue and green corridors, landscape, and heritage.

Keywords Cultural landscape · River · Well-being · Quality of life · Evaluation criteria

3.1 Introduction

A 280-km long stretch of the Middle Loire valley, including many riverside municipalities, was included in the UNESCO World Heritage list on 30 November 2000. To maintain the quality of the landscapes (including urban ones), a management plan was drawn up, and several actions were undertaken. However, many aspects still

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need to be investigated, including how the inhabitants perceive these landscapes and the kind of immaterial benefits they experience.

We will present here the first results of a research–action project trying to identify which components, explicitly linked to the landscape, were the source of well-being or ill-being for the inhabitants of these various landscapes in the Loire Valley (with special attention not to the labelled outstanding landscapes but more to the everyday lived landscapes) focusing on the natural blue and green infrastructure provided by the river. The overall objective is that the perception of well-being by the inhabitants could be considered in public policies (via the idea of new prosperity indicators—Chancel et al. 2014), including those concerning the establishment of economic activities that modify landscapes and heritages.

Funded by the ERDF European Regional Development Fund of the European Union, through the Centre Val-de-Loire Region, the research–action, named "For a new method of socio-economic evaluation of landscapes and cultural and natural heritages: heritages—landscapes—economy—well-being",[1] was conducted between 2016 and 2018 by the Val de Loire Mission (officially in charge of the Loire Valley UNESCO site for the French government) together with three research laboratories (granting a multidisciplinary approach): CITERES CItés, TERritoires, Environnement et Sociétés, CEMOTEV Centre d'études sur la mondialisation, les conflits, les territoires et les vulnérabilités, LADYSS Dynamiques sociales et recomposition des espaces, assisted by the help of a consultancy landscape architecture firm – Passeurs Paysagistes.

In this research, landscape and heritage are considered components of the daily living environment, in accordance with the EUP European Landscape Convention, signed on 20 October 2000. The relationships between well-being/landscapes/heritages have been partly explored in the context of the implementation of this convention, which states that "the landscape is a key element of individual and social well-being and that its protection, management, and planning entail rights and responsibilities for everyone" (EUP 2000). Well-being depends on many factors linked to the characteristics of the landscape itself, but, above all:

(i) on how the individual perceives[2] (mainly through the senses) and represents[3] it (use, symbolic, affective, and aesthetic values)

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[1] Translation by author.

[2] "*Perception is a primary relational process that proceeds (i) through the action of our senses, and thus in the presence of the phenomenon, and (ii) through a contiguous and immediate decoding related to a basic meaning by virtue of a* denotative *cognitive filter that allows us to translate and structure the sensory data in order to identify and name the said phenomenon. […] In more detail, perception is a half-objective and half-subjective mode of comprehension that is concerned with the sensory […]. To do this, perception is carried out in two concomitant stages of detection and then identification.*" (Bédard 2016) [translation by author].

[3] "*Representation is a secondary relational process of evocation and interpretation that proceeds by the work of our mind alone, by virtue of a connotative operation that allows us to qualify the meaning we attribute to the phenomenon and to our previous relationship with it. […] In other words, since it takes place in the absence of the phenomenon, representation is an indirect and abstract mode of understanding by means of which the human being not only makes sensitive again […] a forgotten or distant phenomenon that he has already perceived by virtue of an image. […] By*

(ii) on the modes of governance, particularly on the consideration that policies give to the place of individuals and social groups in spatial planning decisions.

This research examines the link between heritage, landscape, and well-being, intending to identify well-being criteria in different fields.

In recent years, the economic evaluation of goods related to heritage and the environment has undergone strong development and significant theoretical and methodological evolutions from the moment when specialists, not necessarily belonging to the discipline of economics, became aware of the difficulties of evaluating non-market goods in monetary terms (Gadrey and Jany-Catrice 2012; Jany-Catrice 2016). The economics of amenities[4] has progressed, amongst other things, thanks to reflections based on the socio-economic evaluation of sustainable development[5] and thanks to the introduction of the demand for social well-being (a notion that has long been equated with GDP Gross Domestic Product) and quality of life. Approaches to the socio-economic assessment of landscapes and heritages have often failed while trying to assess them in monetary terms by implementing the classical methods of economics. The CMEPSP Commission on the Measurement of Economic Performance and Social Progress report places well-being as one of the fundamental criteria for evaluating the quality of life in the context of environmental changes. The report asserts that well-being is multi-dimensional and that Material living standards, Social connections and relationships, and Environment must be considered within its dimensions (Stiglitz et al. 2010, pp. 14–15).

Rethinking the link between landscapes, heritages, and well-being should allow reviewing some aspects of the economy. The evolution of economic activities modifies the landscape; these modifications intervene in the quality of life of the inhabitants (who experience more or less well-being according to the transformations), and these impacts on social well-being have, in return, an impact on the economy (Luginbühl 2014).

One of the main interrogations was: what are the reasons the inhabitants mention when establishing a relation between landscapes, heritages, and their well-being. Knowing that inhabitants should not only passively observe landscapes' transformations but also be active actors, they need to intervene individually at the scale of their plot of land or collectively through practices in the above-mentioned evolutions (Davodeau 2005, p. 79).

Therefore, the starting point also considers that each citizen contributes to governing the landscape at an individual level. Thus, we suppose that the more the inhabitants are sensible to the questions of the landscape and the well-being it can

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giving access to a more elaborate layer of meaning, the process of (re)construction and expression of the subject that representation brings about is fundamentally qualitative because it emanates from a specific interpretation" (Bédard 2016) [translation by author].

[4] From an economic point of view, the landscape is generally regarded to as an amenity, since it can possibly positively influence the value of a location. For Faucheux and Noël (1995, p. 180), for example, the "aesthetic character of a river constitutes an amenity" [translation by author].

[5] Landscape is even seen as a possible interface between sustainability and development (Peyrache-Gadeau et al. 2013).

provide, the more they will ask for these criteria to be taken into account in public policies.

Consequently, the implemented methodology is not oriented towards the socio-economic evaluation of landscapes and heritages but towards the well-being they provide (Oueslati 2011, p. 16), according to their economic dynamics.

While intended to focus on the broad perimeter of the UNESCO inscription, research activities and interviews' questions since the beginning constantly proposed a global idea of landscape, but all results repeatedly pointed out the blue and green infrastructure constituted by the river as the main focus, both in terms of positive and negative aspects, since negative landscape evolutions along the corridor are perceived as being much more important and impacting than elsewhere. The power of this element is so high that the 'rest' of the landscape almost disappears, thus clearly establishing a ranking between the blue and green infrastructure and the rest of the territory even if rich in heritages and aesthetic landscapes.

3.2 A Method as a Tool for Understanding

The construction of the inquiry method was one of the objectives since the main goal was to have a new look at the link between perception by the inhabitants of landscape changes and well-being.

After the choice of two relevant study areas,[6] one at the East[7] of the UNESCO site and one at the West[8] (as to underline convergences and differences between two very different zones, one more relying on 'usual' monumental heritage, made of architectural landmarks, the other belonging to a decayed mine landscape, struggling to find itself an identity), the research team proceeded with five major steps:

- Step 1: producing a basic knowledge of 'objective' landscape changes in the study area

This stage was carried out using statistical, cadastre data and orthophotographs/satellite pictures relating to agriculture, demography, employment, housing, and protected areas between 1975 and 2016.[9] It included the production of diachronic maps and block diagrams of the study areas to measure and illustrate landscape evolutions.

[6] For reasons linked to the maximum length of the article, we will present only the results for the East site.

[7] The involved municipalities are: Châteauneuf-sur-Loire, Germigny-des-Prés, Saint-Benoît-sur-Loire, Saint-Père-sur-Loire on the right bank and Sully-sur-Loire, Sigloy, Guilly, and Ouvrouer-les-Champs on the left bank.

[8] The involved municipalities are: Saint-Saturnin-sur-Loire, Blaison-Gohier, Saint-Sulpice on the left bank and Saint-Mathurin-sur-Loire, La Bohalle, La Daguenière et Trélazé on the right bank.

[9] The dates were chosen on the basis of available data, on the date where in France the rural exodus slowed down, and on the idea of defining a time frame allowing to recall the evolutions in the memory of the inhabitants.

- Step 2: observing the actual situation of the landscapes

The observation was carried out through field walks, systematic taking of photographs and notes on landscape and heritage features. This examination provided a clear picture of the current state of landscape and heritage, which was compared to the changes measured by the previous mapping (step 1).

- Step 3: interviewing inhabitants

Once the multiple documents (maps, pictures, diagrams) were created, the research team held enough knowledge and visual supports to interview residents, institutions as well as various associations. Well-being criteria were extracted verbatim from the 33 semi-structured interviews (lasting between 30 min and 1.5 h and recorded) as well as aggregated into principal components for statistical analysis.

Interviews were conceived as times of exchange around questions that led the participants to map their comments, with the aim of identifying places of well-being or ill-being in the space. The interviews thus made it possible to identify well-being criteria and draw a (non-exhaustive) list which was validated during the collective reading of landscapes and heritages (stage 4).

The panel of inhabitants was selected starting from a list provided by the municipalities. Territorial distribution, diversity of socio-professional categories (including those that 'produce' the landscape, such as farmers), and age/gender representativity were assured.

In parallel, to cross-check the inhabitants' point of view with the one of people possibly coming to the site explicitly to observe its aesthetic, a questionnaire was realised between the 4 and 6 July 2017 amongst 46 tourists who cycled through the Val-de-Loire. This survey completes the sample of people interviewed, as the tourist perspective is particularly interesting for grasping visitors' perceptions of landscape and heritage.

The synthesis of the different interviews took the form of "heat maps" (Fig. 3.1), which transcribed all the maps produced individually. This synthesis brought to light convergent points of view on landscapes that provide well-being or ill-being, as well as divergent points of view on other landscapes.

- Step 4: collectively "reading" landscapes on the field

Several of the people interviewed individually took part in a field visit based on the summary of the interviews. The itinerary (including a part by boat on the Loire River) and the observation points were chosen to illustrate the divergent points of view. At each observation point, "bubbles of verbatims" (excerpted from individual interviews) and iconographic documents were used to stimulate the debate and compare representations and observations. The discussions amongst the participants were translated into representative maps.

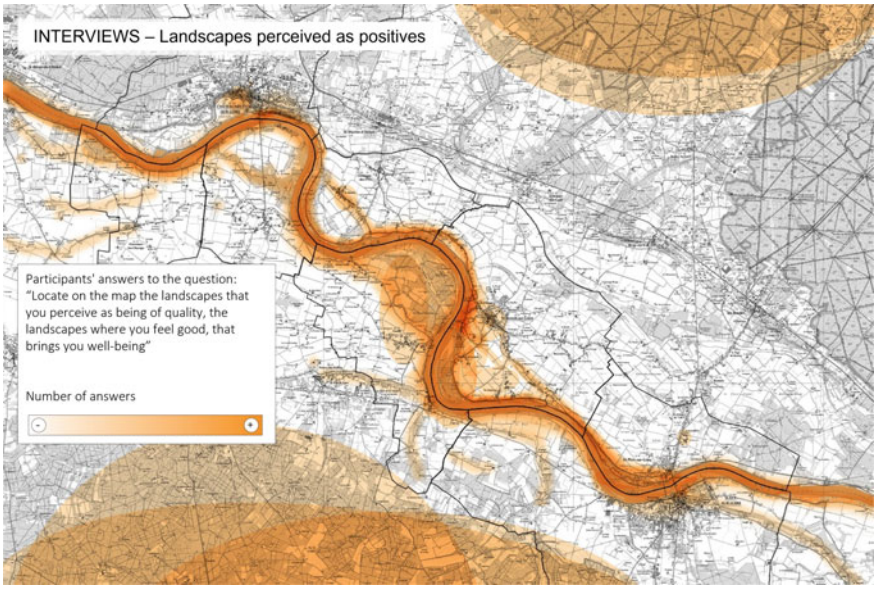

Fig. 3.1 Landscapes that make people feel good, clearly selecting the blue and green infrastructure as the structural support of 'positive' landscapes. *Credits* Passeurs Paysagistes (2018)

- Step 5: participatory workshops

Based on the field visits, individual interviews, and collective journeys, two videos of about 10 min were produced to illustrate the participants' convergent or divergent points of view, and they constituted the support for debate during the workshops. The video format was chosen as it allows a dynamic combination of people's words, views, and sounds of the landscapes and figures such as maps, block diagrams.

The same inhabitants were asked to participate in a "projection-debate-production" workshop. The video was used as a mediation tool to identify all kinds of criteria involved in representing well-being or ill-being.

3.3 Outcomes

Stages 1 and 2 of the methodology enabled us to draw a portrait of the territory and its evolutions as a prerequisite for the rest of the work.

Stages 3, 4, and 5 were used to nourish the debate with the inhabitants. In particular, the restitution workshops allowed the inhabitants to discuss in groups and to become more aware (i) of the attention to be paid to the conscious identification of the characteristics of the landscapes and heritages in connection with well-being; (ii) of the necessity of arousing interest and attention towards these themes amongst all categories of the population.

3.3.1 Portrait of the Territory and Its Evolution (Stages 1 and 2)

Unsurprisingly, the first analysis of the territory showed: a net decrease in agricultural land; a decrease in the number of farms (up to 80% between 1988 and 2010 and up to 60% between 2000 and 2010); a very high decrease in the number of agriculture labours, which is positive in only one municipality, Ouvrouer-les-Champs, due to the recent installation of some vegetable producers. It is, therefore, a rural landscape that is being transformed in a rather ordinary way, in line with the national situation, opening up, getting rid of all obstacles to mechanisation, and reforesting as a result of the abandonment of certain plots.

Another major landscape evolution in this sector is related to the housing and polarisation of the population. In the Châteauneuf-sur-Loire sector, the population increased everywhere between 1975 and 2013, but unevenly. More generally, the relationship between population variations and the landscape can be seen via the extension of built-up areas. The landscape of some municipalities has evolved (i) due to the extension of craft and industrial zones and the construction of industrial buildings; (ii) due to the extension of residential areas hosting inhabitants attracted by a new offer of jobs. The visible impact on the landscape of some industrial activities implies, for example, that in the municipality of St-Benoît-sur-Loire, the beetroot' processing (70% of the packaged beetroots in France comes from this area), whose water and sludge from the cooking process are spread in the fields, gives the soil a characteristic colour and smell.

In conclusion, these predominantly rural landscapes have significantly changed, losing the characteristics of peasant agriculture and moving to those produced by productive agriculture and arable farming (a few green grassland areas still remain, as well as small plots of vegetable gardening, both old and new). Urbanisation also had an impact on modifying the outskirts of towns and villages.

Although these landscape dynamics are not exceptional in relation to landscape transformations on a national scale, they are nevertheless specific and singular. Undoubtedly, the presence of the Loire River (together with its historical, monumental, natural, and cultural heritages) gives them a priceless uniqueness. The central role played by the blue and green corridor not only as a physical presence but also as a central element in inhabitants' life constantly emerges in the analysis.

3.3.2 *Description of the Experiences of Territorial Dynamics by the Inhabitants (Step 3)*

When we asked the inhabitants the reasons for their installation in the area, we discovered that after professional reasons came the living environment, the landscape along the river, the sociability and the living together. Professional reasons were often combined with an interest in the region's landscape and heritage since it offers opportunities for developing activities related to tourism.

The answers to all the questions of the interview grid revealed that the territorial dynamics are not experienced in the same way. For example, some people have a negative view of the recent increase in urbanisation, while others consider it acceptable because of its correlation with job creation, and others still complain about sprawl while recognising that the arrival of new inhabitants is an opportunity to make the territory more dynamic. Similarly, some inhabitants are nostalgic for the countryside of the past, while others believe that agriculture should be modernised and mechanised and farms should be expanded. There are also contrasting opinions on the effects of farming activities on the environment or the use of pesticides. Many residents criticise truck traffic because of the noise and air pollution it generates.

In the last thirty years, the inhabitants of this territory have witnessed a certain uniformity of the agricultural landscape and the progression of suburbanisation. The interviews highlighted that this evolution of agricultural landscapes is experienced as a risk of 'banalisation', causing the territory to lose identity.

Through the interviews and the mind maps produced by the people interviewed, it was possible to locate landscapes that were unanimously perceived as providing well-being, others as ill-being, and finally, landscapes for which opinions diverge. It was thus possible to identify the relationship between some well-being factors and the composition of the landscapes (Fig. 3.2). These maps served as the main support in steps 4 and 5.

Amongst the places that generate well-being, the blue and green infrastructure (the Loire corridor) clearly emerged as the first place that offers a landscape of well-being. The inhabitants present ports and banks that can be accessed from the levee as the most pleasant landscapes where they most often go to relax with their families, contemplate the islands or sandbanks, and even swim despite the prohibition due to the danger. The heritage of the castles was also identified as a landscape providing well-being, as well as other places such as the forest or former sandpits transformed into fishing ponds and leisure areas. The diversity of landscapes also appeared as one of the criteria for well-being.

The same inhabitants were asked in reverse about the places where they felt unpleasant sensations. Formulating these answers was more difficult than for well-being, perhaps because they tried not to devalue their community or daily landscape. However, they managed to locate places where their lives were unsatisfactory: high-traffic roads, quarries, and industrial buildings. The factors that are often involved in unhappiness are numerous: traffic, urban extensions, the absence of view (blocked

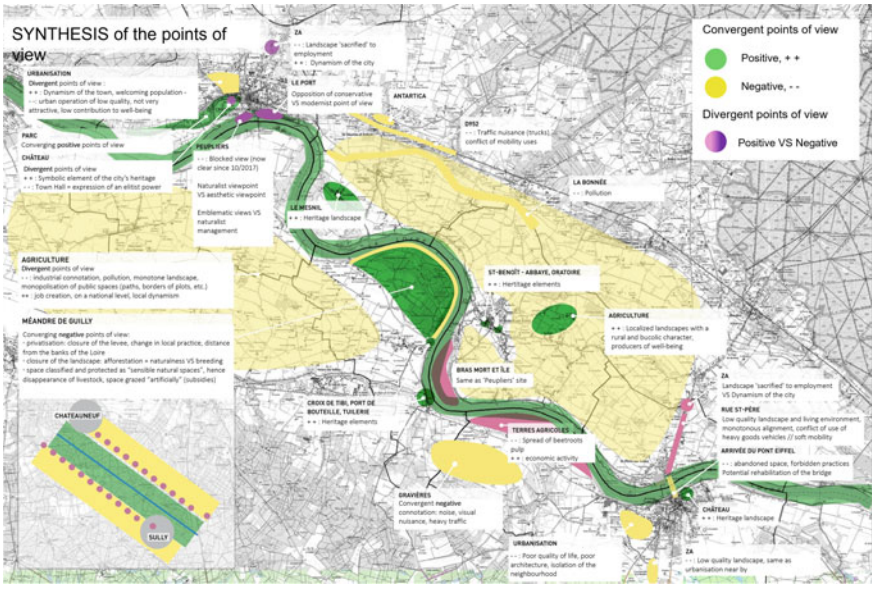

Fig. 3.2 Synthesis of the links amongst landscapes, economic activities, and well-being, clearly showing that all the critical points are not along the river. *Credits* Passeurs Paysagistes (2018)

by obstacles), and olfactory nuisance. In fact, the inhabitants often call upon the five senses, evoking sight, smell, sound, touch, and even taste.

The matter that is undoubtedly the most discussed is urbanisation. It crystallises two radically opposed points of view: on the one hand, the aesthetic and heritage conception advocating protection and restoration, and on the other hand, the functionalist vision, which considers that the evolution of the landscapes meets economic needs with the creation of jobs, the rationalisation of agricultural practices, and the realisation of housing.

3.4 Conclusions

The "economics of happiness" (Easterlin 1995, 2001; Sen 1985; Davoine 2009), by attempting to go beyond the question of the link between "satisfaction" and "income from market goods", studies the "subjective well-being" (Diener 1984). According to the OECD Organisation for Economic Co-operation and Development, it reflects the idea that quality of life depends on the impact of a set of specific circumstances on people's sense of their own existence and presupposes that the person best placed to judge the quality of life is the individual itself (OECD 2016).

This is the main reason that led the project team to work on the basis of interviews, collective visits, and workshops with the inhabitants, who showed an undeniable

interest in this approach and the associations that it allows to make. By exploring, in this way, the links between landscapes and well-being, the subjects that appear in the surveys are as varied as biodiversity, environmental issues, use of pesticides in agriculture, risks caused by invasive plants, traffic noise, employment, infrastructures, housing, economic activities, agricultural evolution, industrial development, tourism, etc.

The research also showed that specific outstanding landscapes, such as along the Loire Valley, greatly contribute to the quality of life, and blue and green infrastructure contribute to maintaining health amongst the population, in particular mental health, by reducing stress and providing a certain notion of beauty into everyday life (as often recalled by interviewees).

If we go to some specific results that came out from the fieldwork, we can observe that:

- some risks are perceived as more present and more dangerous than others.
- People underline that individualism is something that destroys the social link and goes opposite to well-being.
- Landscape and "ordinary" heritage allow the identification of local populations.
- People underline conflicts between landscape respect and economic and urban development.
- Some negative impacts on the aesthetic aspect of landscapes are instinctively perceived as more important than non-visible pollution.
- What is perceived as a natural landscape clearly emerges as a place of well-being.
- Daily enjoying the view of the blue and green corridor contributes to the quality of life to the point that people consider that aspect while choosing a living location.

These results could feed regional policies by providing them with structured elements for considering well-being in actions targeting heritage and landscapes. While the respect for the Outstanding Universal Value (as defined by UNESCO) seems to be acquired (even if frangible) along the river corridor, the idea that conservation could improve inhabitants' daily quality of living is still to go. And if we want to link directly public policies to the economy, they could help, for example, develop relationships between agricultural, environmental, and tourism policies to ensure that visitors (in particular, cyclists using the "Loire à vélo") can enjoy the natural surroundings, the local food production, as well as the landscape and heritage features.

Moreover, as the landscape can be seen as a "common heritage",[10] it seems necessary to take into account the question of the transmission. The landscape is made of a set of disparate elements: some of them will be 'protected' from the actions of people and their socio-economic activities, while others will be more easily transformed over time. The transmission of a culture based on both landscape and heritage could be measured not only through objective aspects but also subjective aspects that would emerge from inhabitants' consultations. This subjective dimension could be based on

[10] We deliberately chose to assemble the two concepts: heritage and commons, being aware that the debate about where to place the landscape is lively (for more information, see Sgard 2010).

the occurrence of the evocation of certain places of "well-being" that should therefore be preserved to be transmitted, as the presence of the blue and green infrastructure. It would then be necessary to consider inhabitants' preferences within economic analysis (Aznar 2002; Antunez et al. 2016). Researchers would then be able to consider these two dimensions, objective and subjective, of transmission, concerning both landscapes, remarkable or not, and natural and cultural heritages.

The consideration of green and blue infrastructure and landscapes as possible generators of well-being by the various public policies could be facilitated by the construction of a well-being indicator that takes landscape dynamics into account. Thus, a 'good' indicator of well-being could be constructed as a composite indicator integrating both monetary and objective components, as well as non-monetary and subjective components, according to the definitions given by inhabitants (and regularly updated).

In the long term, the suggestions proposed by the evaluation should help influence economic dynamics, suggest spatial planning measures through urban planning documents, and enhance the performances of the environment and society through the enhancement of green and blue infrastructure, via their landscapes and heritages.

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Chapter 4
Unfolding the Aniene River in Peri-Urban Rome. From Conflicts to Opportunities for a Sustainable Strategy

Romina D'Ascanio and Anna Laura Palazzo

Abstract Over the last decade, spatial planning tools have been embedding Green Infrastructure with the aim to preserve natural features and stimulate regeneration processes in open space, especially in peri-urban areas where suburbs mingle with agricultural and natural landscapes, and along the rivers, often neglected. This contribution frames the low course of the Aniene River, the main tributary of the Tiber River, as a potential 'blue–green infrastructure', deemed capable of countering landscape fragmentation in a crucial area of the Metropolitan City of Rome, crossing three Municipalities holding different local planning tools. This relevant area hosts some 500,000 people living in a low-density conurbation along the Aniene and Via Tiburtina, which is commonly referred to as 'Città Tiburtina'. Despite being the backbone of the *Città Tiburtina*, the Aniene is generally overlooked or perceived as no man's land, even due to institutional disregard of inherent natural and heritage value in the area. In recent years, several bottom-up activities such as urban agriculture and urban greening practices have gradually taken hold in the urban fringe, accounting for demand for small-scale solutions able to improve the overall quality of the living environment. Finally, the Aniene River Contract complements traditional planning and represents the main opportunity for participatory processes where community turns out to be central.

Keyword Green infrastructure · Collaborative governance · River contract

Both Authors have read and agreed to this version of the manuscript. Issues and contents were largely discussed and shared. Specifically, section 4.2.1 was edited by Anna Laura Palazzo; section 4.2.2, section 4.3.1 were edited by Romina D'Ascanio. Abstract, section 4.1, and 4.3.2 were edited by both Authors.

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4.1 The Green Infrastructure Approach for Spatial Planning

Despite general concern related to climate challenges and ecological performance within urban and metropolitan areas, fragmentation dynamics due to ongoing urbanisation as well as intensive agriculture processes are still hugely impacting biodiversity with a loss of production capacity carried out by ecosystem services (Colucci 2015). According to some estimates, over a quarter of the European territory is directly influenced by urban land uses; between 2000 and 2006, peri-urban areas increased four times faster than dense settlement (EEA 2006; Kasanko et al. 2006; Priorr et al. 2011).

Since 2011, when the EU launched the Biodiversity Strategy (EC 2011), setting objectives to be achieved by 2020, new approaches have been placing the concept of green infrastructure (GI) at the core of regeneration measures to improve both the Natural Capital and the environmental quality within urban areas (EC 2013; Andreucci 2017). As for the latter, slow mobility systems and green areas with high environmental and landscape quality provide communities with safe access to a variety of outdoor recreational and work activities.

The new European Biodiversity Strategy 2030 (EC 2020) reaffirms that the promotion of healthy ecosystems, GI and nature-based solutions in urban and peri-urban areas should be systematically integrated within urban practices and planning.

Definitely, in peri-urban areas, GI is mainly intended as a set of agro-ecological and socio-ecological networks linking together different typologies of open space. Accordingly, the evaluation of ecosystem services is carried out by addressing a wide range of tangible and intangible benefits (among provisioning, regulating and cultural ones) supplied to the environment and humans as well (Benedict and McMahon 2002, 2006; MA 2005).

The international debate assigned GI a cross-cutting and multi-scalar statute and a key role in targeting environmental sustainability goals and addressing the ecological transition (Davies et al. 2006; Hansen and Pauleit 2014). These stances, spurred by a decades-long reflection also stressing the importance of creating/restoring ecological connectivity to counter land fragmentation, are in tune with spatial planning initiatives throughout Europe. Indeed, GI, as an 'umbrella term' (Grădinaru and Hersperger 2019; Magaudda et al. 2020), has been increasingly recommended, adopted and implemented in planning and management tools (Lafortezza et al. 2013). In response to the 'wicked problem' of combining *species* and (open) *space* issues within urban environments, it has witnessed a semantic shift, proving a controversial and debatable yet vital concept (Clergeau and Blanc 2013).

In the Italian context, pionseering experiences related to ecological networks date back to Law 394/91 (Framework Law on Protected areas (Italian Ministry of Environment (1991))), along with regional laws addressing protected areas, territorial governance and ecological networks.

Ever since, a wide range of approaches has been deployed, ranging from exclusively ecological settings to advanced arrangements encompassing ecological

networks within spatial planning on a regional and city level. Lately, regional and local planning have marked a new chapter, encouraged by cutting-edge European policies, even more so in the aftermath of the COVID-19 pandemic. When implemented, GI proves suitable for addressing both functional issues (*performance*) and design criteria and rules concerning overall and place-specific settings and endowments of open space (*conformance*).

4.2 Designing and Performing the Aniene River as a Green Blue Infrastructure

4.2.1 Overlapping Identities Across Time and Space

This contribution frames the low course (or low valley) of the Aniene River, the main tributary of the Tiber River, as a potential Green Blue Infrastructure (GBI), deemed capable of countering land fragmentation in a crucial area of the Metropolitan City of Rome, that is the former Province of Rome. Such conurbation has to deal with a huge heritage dispersed within a complex context. In the making and renewal of the city, 'identity' and 'identities' belonging to specific communities are a main matter of claim. Hence, heritage and landscape are embedded in conflicting processes, from design to their making, from planning to their management, engaging different and often competing community expectations.

This transect of the Metropolitan City of Rome displays all the aspects of such complexity due to geographic and structural features crucial to the understanding of the peculiar 'sense of place', to human permanence over centuries and intense exchanges between Rome and its hinterland, and, last but not least, to the relentless interplay between economies and ecologies triggered by the river itself and often in a precarious balance (D'Ascanio and Palazzo 2017).

The area between Tivoli and the Aniene confluence in the Tiber, served by a heterogeneous system of grey infrastructures, such as the Tiburtina road, the highway and a regional railway, is home to some 500,000 inhabitants in the municipalities of Tivoli, Guidonia Montecelio, and in the Boroughs II, III, IV, V and VI of Rome. Excluding the compact urban settlement westward in the Municipality of Rome and eastward at Tivoli, the *Città Tiburtina* turns out to be one of the most important development and exploitation axes, hosting relevant manufacturing firms, displaying features and patterns of peri-urban settlements interweaved with agricultural plots and relics of historical and natural landscapes. At least 150,000 people dwell in proximity of the Aniene River corridor.

Currently, the Aniene is protected by the homonymous Natural Reserve (650 ha), falling within the Municipality of Rome and managed by RomaNatura, the regional Authority in charge of the protected areas in the Capital City, and by the association 'Insieme per l'Aniene', entrusted with the maintenance of the footpaths

and environmental education activities, running the visitor centre and environmental labs.

Over time, urban development has incorporated minor hydrographic networks, buried by backfill material or transformed into sewage collectors. In turn, the agricultural and natural landscape in the plain and low hills behind intensified at the expense of ecological connectivity. Indeed, small plots still survive in a land mosaic of extreme complexity bearing high biodiversity, encompassing small vegetable gardens, cultivated fields, fallow fields, olive groves and vineyards.

As stated by seminal essays, such long-term human–nature relationships are key aspects to be investigated (Calzolari 2012). Well before the Christian era, the Aniene had performed as the backbone between the two urban outposts of *Roma* and *Tibur*, marking long-lasting mutual interdependencies. Tivoli has maintained its status on account of its sulphur mineral water springs and the exploitation of water resources in the impressive sceneries of Villa Adriana (second century), Villa d'Este (sixteenth century), and Villa Gregoriana (nineteenth century). In addition, Tivoli's hills have always been producing high quality olive oil. Quarries lengthwise have been providing a particular white calcium carbonate rock—the *travertino* used in building most Roman monuments. The water power of the Aniene falls has been exploited since the early industrial period for paper mills and ironworks factories, and the city of Tivoli was home to imposing public works related to water systems management.

From the twentieth century onwards, the Aniene has largely provided for the Capital's electricity needs; in addition to this use for the power plant of the Acquoria downstream of Tivoli and civil uses, the river waters have constantly been the main cause for conflicts between irrigation and industrial uses.

Meantime, the valley kept a prevailing rural vocation, reported in the *Carta dell'Agro Romano* by Spinetti (1913), depicting a huge countryside with large estates dotted with sporadic farmhouses. In the 1920s, under the Fascist regime, the construction of rural hamlets called '*borgate rurali*' started the splitting up of larger plots into small extensions leased to farmers.

From now on, even due to the strong appeal of Rome, urbanisation hastens its pace, and the destiny of the countryside depends upon city needs, with rural areas waiting for urban uses (Clementi and Perego 1983; Palazzo 2005). Owners and tenants start subdivision processes for subsequent building exploitation of the Aniene low valley, taking advantage of pre-existing infrastructure.

In a few decades, waves of spontaneous settlement linked to migratory flows have led to the mingling of a brand new urban underclass with small rural properties. In fact, the strong industrial vocation along the Aniene and the Rome–Tivoli railway is the main reason for establishing in 1941 the II Industrial Zone of Rome for about 1000 ha (Doti 2000). These overlapping dynamics convey the image of a fragmented city, a sort of patchwork whose tiles are self-referencing (Longobardi et al. 2009).

As a result, despite being the main feature of such a complex linear city, the Aniene is currently perceived as a backside for human settlements, inaccessible in the vast majority of its length, enclosed by private fences or discarded; both banks hold fluvial terraces witnessing its width during maximum flood events (Rizzo 2016;

D'Ascanio and Palazzo 2018). Notwithstanding, the valley has been invaded by industrial and mining activities partly decommissioned (mainly paper mills, food processing industries and travertine quarries), landfills, earth-moving works and roadway construction.

Nowadays, many plants are abandoned, and brownfields holding landmarks of industrial archaeology lie among quarries, factories still in use, illegal settlements, large retail boxes and warehouses. Conversely, at the turn of the last century, the so-called Tiburtina Valley was established in the municipality of Rome, hosting internationally relevant high-tech firms in the field of aerospace, cyber security and informational technology. Lastly, in 2005 the 'Tecnopolo Tiburtino' started its activity in the boundary of Rome with start-ups and innovation services.

In the *Città Tiburtina*, next to the most densely populated areas, pollution, widespread degradation, sharp reduction in flooding areas, and illegal activities make accessing the Aniene and its tributaries difficult. Elsewhere, the low course still features some traditional landscapes of the *Agro Romano* with punctual heritage (*Ponte Mammolo, Ponte Nomentano, Tor Cervara, Tenuta del Cavaliere, Casale della Cervelletta*), along with awesome remains of the Tiburtina Consular Road and the Vergine aqueduct, and relevant natural landscapes in addition to the Natural Reserve (Site of Community Importance—SCI—*Acque Albule, Latomie di Salone, Forre di San Vittorino*) (Fig. 4.1).

4.2.2 Conformance and Performance Issues

As previously discussed, in urban fringe areas involving ever larger boundaries, GI tends to establish itself as (i) provider of environmental benefits on human behaviour and health through natural solutions while reducing dependence on 'grey infrastructure', which is more expensive to build and maintain; (ii) socio-ecological connections, conveying cultural, aesthetic, recreational, educational value.

The General Plan of the Metropolitan City of Rome (2010), in addition to recognising the Aniene as a 'primary component' of the ecological network acting as a major reservoir of biodiversity, identifies further provisions for so-called completion components, including some tributaries of the river itself and a wide range of green spaces through interspersed settlements and proximity paths networks linking built-up areas and residual strips of open space.

Ecological continuity is mandatory within the Metropolitan Tiber Plan (so-called PS5) of the Central Apennine Basin District Authority (formerly the Tiber Basin Authority), whose *iter* started in 2002 to obtain the first approval in 2009 and subsequent amendments in June 2019. Despite the long timespan, besides the redefinition of risk areas and compliance with the principle of hydraulic invariance (whereby the transformation of an area must take place without increasing the flood flow of the water body or the drainage network receiving the outflows originating from the area), a main innovation stays in the provision of the buffer zone of the river also for recreational uses, combining environmental with community needs.

Fig. 4.1 River landscape in the peri-urban area between Tivoli and Rome. In the background, the Tenuta del Cavaliere, which is a medieval fortress. Today, one of the farms managed by Roma Capitale is located in the building and in the surrounding countryside (*Agro Romano*). *Source* D'Ascanio (2019)

Additionally, the Natural Reserve of the Aniene River deals with rural practices, compatible agriculture and outdoor recreational activities. The extension of the Reserve, stretching from the *Grande Raccordo Anulare* (GRA), is expected to include further 1300 ha in the municipalities of Guidonia Montecelio and Tivoli, where the decommissioning of large travertine quarries accounts for a major regeneration concern (Fig. 4.2).

As for environmental dynamics and risks, strong pollution rates are annually reported for the river water quality, mainly caused by the depletion of its flow. Environmental fragility and hydraulic risks couple with land use fragmentation and a general loss of 'sense of place'.

Definitely, since the main causes for decay are rooted both in a reckless use of natural resources and in a serious lack of public services, a strategy to overcome these criticalities should be rooted in bridging human and nature aspects in the frame of spatial planning tools irrespective of administrative borders, called upon to integrate sectoral policies in governance schemes. Several issues and scales are at stake, tackling the Aniene as a GI; urban agriculture and urban greening practices as well as reuse schemes and small-scale solutions able to improve urban quality and overall resilience.

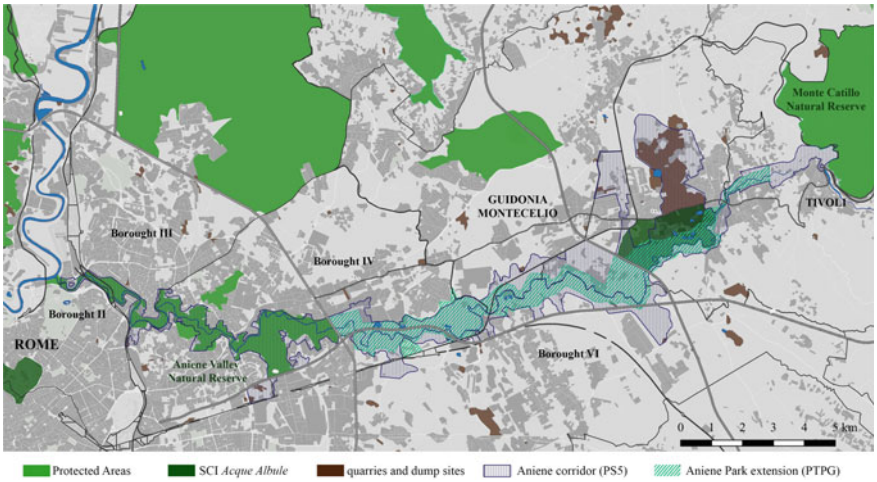

Fig. 4.2 Protected areas system and planning provision for the extension of the Aniene Park. *Source* Authors' GIS elaboration

However, both the Aniene basin, as a reservoir of biodiversity, and the *Città Tiburtina*, as a necklace of scattered settlements, challenge current overlapping planning tools bringing into play long-established techniques, notably the *zoning* requiring compliance to a priori spatial rules. Performance standards are also at stake when it comes to soil permeability, carbon capture and storage, decontamination of polluted sites, and so on. In other words, the effectiveness of the GI approach applied to the Aniene between Tivoli and Rome is to be tested and assessed based on coupling conformance and performance criteria.

4.3 Challenges and Perspectives

4.3.1 The Aniene River Contract as a Tool for Collaborative Governance

In the *Città Tiburtina*, municipal competencies keep limiting the understanding of overall settlement dynamics and prove a main obstacle to the construction of a shared agenda for ecological and functional continuity. The forecasted extension of the Natural Reserve to the whole Capital Rome and the Municipalities of Guidonia-Montecelio and Tivoli would impact large areas, such as landfills and travertine quarries still in place by revoking long-term concessions to entrepreneurs. Concerning the future boundaries of the Aniene Natural Reserve, two different options are now available: (i) in the space provided by the General Plan of the Metropolitan City of Rome as a main component of the ecological network; or (ii) following morphology

and hydraulic rationale stemming from the Tiber River Basin Plan, in a larger district encompassing agricultural areas as well as the *Aquae Albulae* spring and the entire travertine extraction site in the municipality of Tivoli (Fig. 4.2).

Being negotiation at a deadlock for at least two decades now, despite the lack of extension of the protected area, the functional and ecological performance of the living environment as a whole should be set through small yet relevant protection and enhancement opportunities. It would be sufficient to favour the fruition of the riverbanks for recreational uses while inhibiting incongruous exploitations.

A possible step forward could be envisaged according to provisions framed by the Italian Environmental Code, which recognises the River Contracts as collaborative tools and public–private agreements for water protection and management, prevention of hydraulic risk, and enhancement of river landscape and local development (Bastiani 2011; Scaduto 2016; D'Ascanio et al. 2018).

In fact, in 2014, the Aniene River Contract started, relying on long-lasting previous activities of the association 'Insieme per l'Aniene'. Such collaborative process, under the official management of the Mountain Community of the Aniene Valley, is currently ongoing for the whole course of the Aniene (some 100 km), counting on the participation of nearly one hundred public and private actors, facing the difficulties of decision-making (civic awareness, involvement of public bodies, economic support), even due to the overlapping of planning tools and conflicting stakeholders' interests.

In this respect, a main crucial issue is related to landscape quality objectives set up by the Regional Landscape Plan following the European Landscape Convention (Council of Europe 2000): they appear blurred, nonspecific and far from possible implementation, notably in blighted areas, where extra financial, design and management support is needed to bring a significant increase in the living environment. This is the case for brownfields where demand for transformation finds it hard to make its way and degradation dynamics extend. Therefore, planning tools should provide sensitive, site-specific, yet flexible guidelines (Mazza 1998).

Following the Italian Code of Cultural Heritage and Landscape (2004), landscape plans can identify priority guidelines for conservation, recovery, and regeneration (art. 143). These non-prescriptive measures, linked to voluntary, participatory, adaptive tools, such as River Contracts, call into question effective public–private partnerships. Consent is to be achieved in the frame of voluntary agreements on informal commitments and formal contracts between public and non-public stakeholders in accordance with ownership and financial capital to be shared.

In the low course of the Aniene, a possible functional taxonomy is expected to address three main patterns:

(1) Environmental degradation areas and brownfields: areas of decommissioning, former industrial areas, and illegal settlements, where public authorities are entrusted with coordinating private interventions within specific landscape projects.

(2) Complex cultivation patterns: rural space with weak or no protection, where environmental performance is to be restored in the frame of landscape planning entrusted to accommodating and connecting different patches.
(3) In-between space: within urban fringe areas, all kinds of open space among which natural relics interweaved with other land uses featuring so-called completion components of the Ecological network, including some tributaries of the river itself and footpaths networks among built-up areas and residual strips of open space.

4.3.2 Final Remarks and Ways Forward

For some time now, applied research paths have been addressing urban and landscape regeneration, boosting upscaling processes involving multilevel governance.

A main case in the Metropolitan City of Rome is the low course of the Aniene River, whose destiny is challenged both by the needs of the 'urban continuum' and by ecological connectivity issues. Although these aspects sound dissonant, convergence should be found to effectively intervene by matching different sectoral policies as recommended by EU documents and implemented in urban and metropolitan agendas all over Europe (D'Ascanio and Palazzo 2018).

In order to provide the maximum benefits from both the landscape and the ecological point of view, GI is to be framed within a coherent river project reconciling socio-economic needs with those of nature protection (Ingaramo and Voghera 2016). Being the Aniene the backbone of the *Città Tiburtina*, the River Contract turns out to be an effective 'activator' for discussing water issues along with topics related to the enhancement of landscape and heritage assets in connection with leisure activities. The competent institutions should implement, as requested by the objectives of green transition conveyed by the Italian Recovery and Resilience Plan (Italian Government 2021) and by the new European Biodiversity Strategy (EC 2020), strategies and projects linked to the rationales of the river itself: naturalisation measures and specific projects, such as phyto-purification systems, artificial wetlands, slow mobility systems linking to the settlements nearby, as already experimented in some areas of the Aniene Natural Reserve. Furthermore, recurring problems at different scales require joint and integrated processing in terms of administrative management and project layouts, using a repertoire of nature-based solutions at the micro-scale.

To this aim, on the one hand, planning tools should be attuned to an overall coherence with respect to structural and strategic objectives rather than rigid compliance rules. On the other hand, governance schemes in decision-making processes should encompass public partnerships and public–private agreements.

The unfolding of the Aniene valley featured by a broad variety of historical and naturalistic assets challenges multilevel governance and a strategy able to disclose

a wide debate among decision-makers and the community at large, shaping 'green and blue infrastructure' in the frame of landscape planning and management.

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Chapter 5
Landscape and Ecological Networks

Luigi La Riccia

Abstract This chapter proposes a reflection on the possible role of landscape and ecological networks within the local urban planning practices. We face a constant population growth in cities, and peri-urban and marginal areas are increasingly subjected to environmental degradation. Therefore, it is necessary to identify the ecological values of the environment. This contribution, starting from some pilots conducted in Piedmont Region, reflects on the operational urban planning paradigms. The importance of green infrastructures and ecological quality for sustainable and resilient cities is sustained by a proposal of local planning regulations. The chapter aims to tackle the quest for new forms of implementation based on integrating the approaches to planning the urban and ecological problems to ensure the complete compatibility between urban transformation and the demands for environmental quality. The ecological regulations described propose an evolution of the meaning of the planning schemes, especially those applicable to green space. Therefore, this contribution focuses on an innovative model of planning and management at the local scale, the role of ecosystem services, and the relationship between the biodiversity of the ecological network structural areas and peri-urban and agricultural residual ecological areas to be strengthened to improve connectivity between ecosystems.

Keywords Ecological networks · Regional and urban planning · Planning standards · Ecological regulations

5.1 Introduction: Ecological Networks, Protected Areas and New Urbanisations

Many studies in recent years focus on how ecological networks and ecosystem services can contribute to healthy and resilient cities. Nowadays, it could be too soon to know if the COVID-19 pandemic will lead to lasting demographic changes,

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but the long-term prospects continue to predict that the world will further urbanise over the next decade, from 52.2% today to 60.4% by 2030 (United Nations [UN] 2020).

Meanwhile, in cities, peri-urban landscapes and, beyond, concerns have grown regarding the loss of biodiversity and degradation of natural resources, recognising the central role that ecological networks have to play in these territories. The European Green Deal[1] maps a new, sustainable and inclusive growth strategy to boost the economy and improve people's health and quality of life: it covers nine policy areas, including "Climate action" and "Biodiversity". The ongoing loss of biodiversity occurs in the endangerment or extinction of species and the degradation or destruction of ecosystems: the Biodiversity Strategy 2030 "Bringing Nature Back Into Our Lives"[2] lays out the EC programme of future legislative and non-legislative initiatives for the protection or restoration of biodiversity as part of its European Green Deal.[3] The strategy underlines that green infrastructure may contribute to sustainable development, enhancing social cohesion, supporting the economy, and adapting to climate change. Furthermore, it highlights the importance of ecological networks and nature-based solutions in cities, where more than 60% of the EU population lives.

Given these data, in recent years, we have seen an exponential growth of urbanisation of natural spaces: external urban areas (uncultivated land, cultivated land abandoned, the burnt areas, degraded forests) have often been confined to an "inessential" position and sometimes simply considered as "waiting for a new urbanisation". Too often, this is due to the poor operability of local plans that propose an urban development uncoherent with the preservation of natural areas and ecological connectivity. We can identify the consequences of these processes in six significant phenomena (Benedict and McMahon 2002; Voghera and La Riccia 2015, 2016, 2019; Voghera et al. 2017):

- the substantial loss of natural areas: urban development has led in recent years to a reduction of natural areas (approximately 77% of all habitats and 60% of all species in the EU are in an unfavourable or deteriorating condition; for example, 37% of all species of freshwater fish are threatened by extinction[4]);
- the fragmentation of natural areas: a process that determines a breakdown of structural areas of ecological networks into smaller patches, and consequently, more isolated from the point of view of connectivity;
- the degradation of wetlands, which have always been an important ecological function for the control of water flows, for the ability to block the sediments, for

[1] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[2] https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en

[3] The EC wants to improve EU legislation addressing biodiversity, e.g. the Fauna-Flora Habitat [FFH] Directive (92/43/EEC), the Birds Directive (2009/147/EC), the Water Framework Directive (2000/60/EC), the Floods Directive (2007/60/EC) and the Marine Strategy Framework Directive (2008/56/EC).

[4] Cfr. Regional Assessment Report on Biodiversity and Ecosystem Services for Europe and Central Asia, 2018, pp. 6 and 288.

the support of plant and animal species (stepping stones function) and for the ability to provide nutrients for the ecosystems;
- the inability of ecosystems to respond to change and find a new ecological balance: that is to say, a significantly reduced resilience;
- the loss of ecosystem services (ES): natural systems have important "services", such as the control of water, the filter functions for pollutants, the preservation of the climatic risks;
- the increased costs for public services due to the response to natural disasters as a result of the ecological footprint by man.

Nature conservation in the city is one of the biggest challenges for sustainable urban development due to social and ecological coevolution. The value of nature in the city, however, goes far beyond its influence on the inhabitants' quality of life. Rather, it has an intrinsic value: urban areas are surprisingly rich in biodiversity. The conservation and management of nature and biodiversity in urban areas are often very complex (Antrop 2001, 2004): there are more people, stronger development pressures, less space, a multitude of actors involved, etc. Nevertheless, the analyses reveal that the urban natural reserves are few but large and have a high density.

Large natural reserves can be significant in urban landscapes, as the difference between the urban and natural environments can be high (Powell et al. 2002). However, it should be noted that the strategies of urban planning and those of nature are generally separated in Italy. One possible reason is that the protection of nature has favoured a purely "conservative" vision towards nature outside the city and has made trivial and distorted the vision of urban nature conservation.

However, the identification of urban nature is also part of a broader change in the field of conservation policies and remains a necessary point of reference for sustainable urban development. In many cities, this change of perspective has manifested itself through the institution of urban areas for nature conservation, supported by a general concept of "urban landscape". In the urban context, the establishment of these areas was started during the twentieth century as a reaction to the rapid degradation of the urban environment due to industrialisation and the consequent urban growth. It was therefore seen as a necessary step to keep nature and landscape away from private exploitations. Today, instead, the public interest is more oriented to the preservation of social values and biodiversity. In the last decades, the nature conservation and landscape policies have changed: today, a possible alliance between nature and landscape (Gambino and Peano 2015; La Riccia 2015) is assumed to be an essential condition for sustainable development and lays itself at different scales (United Nations Environment Programme [UNEP] 1992; European Council of Town Planners [ETCP] 2003; Hooper et al. 2005; Potschin and Haines-Young 2006; Selman 2006; International Union for Conservation of Nature [IUCN] 2021).

Until the 1970s, in Italian urban planning, we could not speak about a real ecological paradigm but of "urban greening", whose distribution was generally expected in new districts as well as in historical centres. The creation of urban parks also became one of the focal points of urban plans. Their maintenance indicated a fundamental aspect of environmental continuity in urban space. The consideration of nature and

landscape in the Italian urban planning tradition has privileged the aesthetic approach, oriented to the historical and cultural heritage of excellence. During those years, while in Italy the debate focused on the general "crisis of planning" (Gabrielli 1995), at the international level, it is possible to observe a significant shift towards the "landscape planning at the local level" (La Riccia 2017). It represented a new way of understanding the landscape in the plan, closer to the urgency of reducing ecological problems and supported by an emerging environmentalist currency in the cultural and political scenes. On the one hand, there was a growing need to end environmental disasters; on the other hand, the issue of landscape emerged forcefully in different disciplinary contexts.

Sustainable development requires more than designed landscapes that are created using sustainable technologies. Design is a cultural act, a product of culture made with the materials of nature, embedded within and inflected by a particular social formation; it often implies principles of ecology, but it does more than that, enabling social routines and spatial practices from daily promenades to commuting to work.

In the Italian experience, green areas acted as a common element for rejoining the city and countryside, that is to say, for the redevelopment of the modern districts to reduce the pressures on both historical centres and new districts. The ecological paradigm is, therefore, a different vision that guided the practice of urbanism towards a new direction. The environmental provisions now seem to articulate the new practices, coordinating behaviours and reconfiguring the spaces of the city: this means defining new and more ecological functionalist provisions.

However, a carefully conceived and experience-based approach is required to harness the full potential of local ecological networks. This contribution aims to support such an approach by providing information on how to plan for and develop local ecological networks. We can define local ecological network planning as a strategic planning approach that aims to develop and detail the networks of ecological structural areas designed and managed to deliver a wide range of ES and other benefits at the local scale.

5.2 Local Ecological Network Planning and New Urban Challenges

Among the lessons that come to us from the health crisis of the COVID-19 pandemic, one is of fundamental importance, which concerns biodiversity. The destruction of natural habitats and the pursuit of increasingly intensive models of agriculture, breeding and industry undermine the resources necessary for the well-being, health and economy of human communities and, at the same time, expose us to serious biological risks. Therefore, the dramatic biodiversity crisis today is one of the greatest challenges that deserve attention, even for health reasons. It is in this sense that the

massive reaction to the pandemic crisis implemented by the EU and largely represented by the "Next Generation EU" programme[5] should be read. This programme, confirming and adopting the sustainability of the Green Deal principles, demonstrates that the European Commission and the EU Member States, albeit through a difficult path of convergence, have at least, in theory, understood that it is really time to change and that the economic recovery must closely match environmental resilience and sustainability.

Since the 1970s, when the strong pressure of economic growth and demographic expansion of cities began to show concretely, there was a need for humankind to find harmony with nature (United Nations Conference on the Human Environment, Stockholm Conference 1972): climate and global changes, land consumption, deforestation, intensive agriculture, pollution, ecological fragmentation are contributory causes of the disappearance of biodiversity and the destruction of ecosystems which are accompanied by the degradation of ES. The main challenges perceived by people today, in terms of risk and impact, are environmental ones (World Economic Forum 2020).

The reduction of biodiversity damages the resilience of natural systems and favours the transmission of pathogens from animals to humans (zoonoses) (IUCN 2020). Many scientific data support that the emergence and re-emergence of zoonotic diseases are linked to the unnatural coexistence between wild animals and humans, as well as to the alterations of ecosystems and the subtraction of natural habitats from wild species due to uncontrolled urbanisation (IPBES 2018; IPCC 2019).

The COVID-19 pandemic has highlighted the vulnerability to the reactions of nature and the poor ability to mitigate their impacts (preparedness), with serious damage to health, social cohesion and socio-economic well-being. Therefore, most important of all is to account for current and potential economic costs through a correct quantification of ES, deriving from the degradation of natural assets: the positive externalities for biodiversity and ecosystems must undoubtedly be valued. Urban green space networks, together with natural and semi-natural ecosystems around cities, allow urban areas to be more sustainable and tackle many challenges, including air pollution, noise, heat waves, hydrogeological instability and better management of the water cycle, conservation of the resource through the strategy of green and blue infrastructure.

Therefore, since the Seventies, urban planning practices have demonstrated the potential of the ecological network to contribute to challenges such as health, species protection, biodiversity protection and climate change adaptation (Carson 1962). When understood as part of the local ecological network, these and other emerging challenges and trends must be considered not just as obstacles to overcome but as important drivers for investing in the future urban planning choices.

[5] https://europa.eu/next-generation-eu/index_en.

5.3 The Construction of the Ecological Network at the Local Level

Attributing ecological significance and therefore an ecosystem role, not necessarily secondary, to territory means reflecting on a general renovation of the urban planning paradigms, considering the importance of productive, business and policy interests. Therefore, there is the need to define clear objectives to avoid simple "territorial schemes" of new ecological corridors, which may be excellent in aesthetic terms but lack all meanings in terms of biodiversity. For this reason, it is important not to stop to analyse only the state of naturalness and diversity at different scales, but it is necessary to go further to give priority to the pursuit of ecological coherence of the whole territory: that is to say to link the network with the impacts deriving from human activities and, more generally, to define a framework for urban planning operability.

In this context, several interesting experiences have been launched in the Piedmont region (Italy)[6] with the aim to improve the overall ecological quality of the natural and landscape areas and specifically indicate the operational procedures to avoid the ecological fragmentation and the reduction of biodiversity. In the last years, the Polytechnic of Turin, in collaboration with the Metropolitan City of Turin and ENEA, carried out a specific study to define a proposal for implementing the ecological network at the local level in some municipalities of the Metropolitan City of Turin.[7]

In the last two years, other experimentations have been conducted in other municipalities (in Eporediese at vast scale and in Chieri, Mappano, Alpignano, Moncalieri) following the developed methodology, adapting it to different geographical contexts and considering new strategic objectives in the post-pandemic era. In Italy, in fact, the current reference given by the [PNRR] (National Recovery and Resilience Plan 2021) is contributing with substantial funds deriving from the Next-Generation EU and is pushing local governments to prepare new projects for the country's economic recovery. The goal is the ecological transition but also digitisation, competitiveness, training and social, territorial and gender inclusion.[8]

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[6] Those experience have been developed by the research group of Politecnico di Torino coordinated by Angioletta Voghera and financed by the Metropolitan city of Turin since 2014 and by others municipalities, such as Bruino, Chieri, Mappano, Moncalieri, Ivrea and Pavone. The group is composed by Luigi La Riccia, Stefania Guarini, Gabriella Negrini (Voghera and La Riccia 2015, 2016, 2019; Voghera et al. 2017).

[7] Between 2014 and 2016, the research "Guidelines for the Green System of PTC2" (convention between the Metropolitan City of Turin, ENEA and Politecnico di Torino) and the "Operational proposals for the ecological network of Chieri" (Politecnico di Torino and Comune di Chieri, Turin) were conducted with the objective of defining a proposal for the implementation of the ecological network at the local level firstly in two municipalities of Turin (Ivrea and Chieri).

[8] The six major areas of intervention (pillars) on which the PNRR focuses are: (1) Green Transition, (2) Digital Transformation, (3) Smart, Sustainable and Inclusive Growth, (4) Social and Territorial Cohesion, (5) Health and Economic, Social and Institutional Resilience and (6) Policies for the new generations, children and young people.

In these experiences, the proposed approach was reconsidered to guide local governments with specific measures to limit anthropogenic land use and, where possible, orient and qualify the conservation of ES. Habitats, natural areas and landscape have not been interpreted exclusively from the ecological point of view (a mosaic of ecosystems) but also considering a broader perspective that embraces cultural, social and economic aspects. The proposed methodology identifies the ecological character of the territory and defines the criteria for the evaluation of different types of land use: in Piedmont, 97 types of use, according to the Corine Land Cover database, were identified. Subsequently, we applied five key indicators for assessing the ecological status (see Fig. 5.1):

- naturalness: the types of land use are classified into five levels of naturalness, considering the closeness to the formations that would be present in the absence

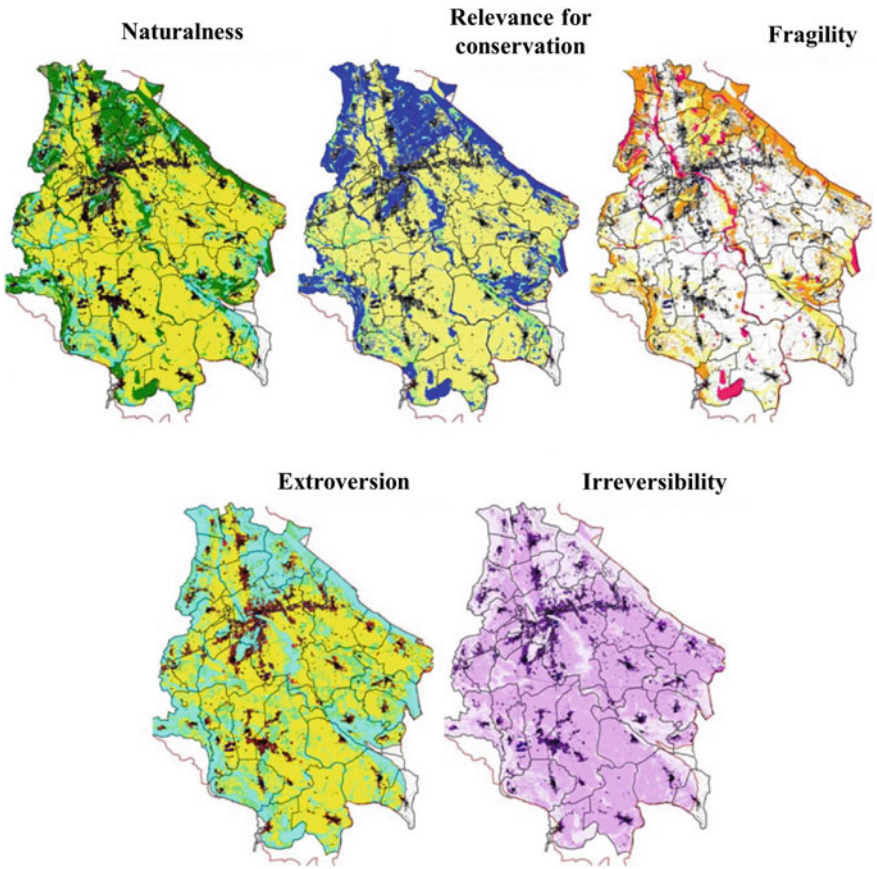

Fig. 5.1 Maps of Eporediese (Ivrea, Italy) territory according to the considered indicators (in order of appearance): naturalness, relevance for the conservation, fragility, extroversion, irreversibility. Processing: Politecnico di Torino and ENEA 2015

of disturbance (climax). So, the natural levels range from the first, which includes all the natural formations, up to the fourth considering the types of land at total anthropic use but not artificial (like almost all cropland) to the fifth level (maximum), which include the types of land use corresponding to artificial areas;

- relevance for conservation: the types of land use are classified into four levels of relevance based on the relevance/suitability of land use for biodiversity conservation and, at the same time, considering the importance for habitats and species. It introduces the concept of interest habitats for species of the Natura 2000 network, including not only the habitats of Community Importance but also the complex habitats whose conservation is necessary for the protection of species of the Natura 2000 Network;
- fragility: the types of land use are classified in terms of intrinsic fragility due to pressures such as pollution, ingression of exotic and invasive species and human disturbance in general. The first level includes types of land use that define both natural environments with very low resilience as rock fields or glaciers and semi-natural areas with significant anthropic determinism but easily fragile for both types of land use and poor resilience such as artificial water reservoirs or areas with sparse vegetation;
- extroversion: the types of land use are classified on the basis of the potential "capacity" to exert pressure compared to the neighbouring patches. We have considered the pressures in an integrated way that goes from pollution of productions to the spread of invasive alien species. It ranges from level first, which includes types of land use that coincide with the areas with the highest human settlement and able to exert pressure, to the fifth level, containing natural types of land use types of use of the natural ground;
- irreversibility: the types of land use are classified on the basis of the potential possibilities of change in the intended use. The first level includes all artificial types of land use totally characterised by the irreversible intended use (for example, urban, commercial and industrial zones);
- functionality: the combination of patches characterised by different levels of naturalness and relevance for conservation contributes to defining the zoning of the territory in terms of reticular value and ecological functionality. The fundamental attributes which can lead to the reading of the actual network are naturalness and relevance for the conservation.

From the integration of the results of different indicators, the so-called "Structural map of the ecological network" has been obtained (see Fig. 5.2). This map shows the elements of the Local Ecological Network system, chosen on the basis of the levels of naturalness, ecological functionality, and geographical continuity, and consists of three main elements:

- structural elements of the network (primary ecological network), namely the areas of high and moderate ecological functions, as well as areas that host the specific conservationist emergencies, i.e. of natural and significant importance for the conservation of biodiversity;

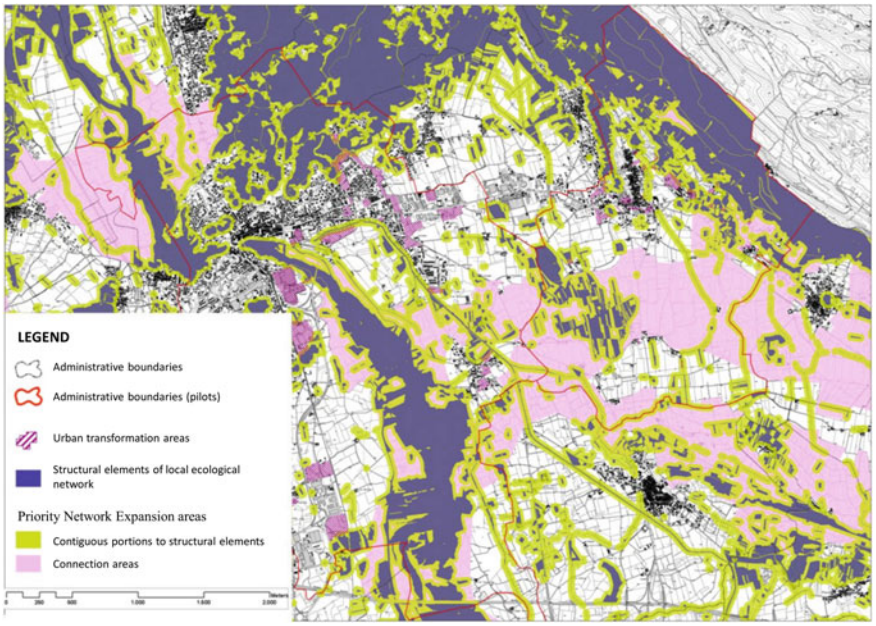

Fig. 5.2 Map of the ecological structurality of Eporediese territory. The picture shows the two components of ecological structurality (structural elements and the contiguous portions to the structural elements). Processing: Politecnico di Torino, 2015

- priority network expansion areas, namely the residual ecological function areas where priority action to increase the functionality of the primary ecological network and for which the implementation of protection measures for the maintenance of the primary ecological network are needed. These areas are further divided into Connection areas and Contiguous portions to the structural elements;
- possible expansion of the network areas, i.e. areas at residual ecological functionality, but on which it is possible to implement new interventions aimed at increasing naturalness useful to protect the habitat and species of interest for the conservation of biodiversity.

5.4 Rules for Implementation of the Local Ecological Network in Urban Planning

In the considered case studies, since an analytical process (framing of the territorial ecological system and public consultation through negotiating tables), it has been possible to drafting operational rules, directly integrated with the urban plans,

which include provisions for the implementation tools, such as spatial equalisation measures, compensation and mitigation of impacts and provisions for the urban green management.

These implementation mechanisms are designed to intervene where projects and actions included in the urban plan could lead to changes in the level of the local ecological functionality. The procedure for the definition of the compensatory measures for not mitigated impacts includes an analytical phase, an assessment phase, a phase of planning/design, an implementation phase and a phase of management and monitoring:

1. recognition and evaluation of the ecological relevance of the compensatory areas through the evaluation of the urban-environmental state;
2. definition of possible measures for improvement and protection of the ecological and landscape value for each area identified for compensation;
3. setting priorities for action to increase biodiversity and the sustainable use of the territory;
4. choice of the compensatory measures;
5. design of compensatory measures based on the characteristics of each lot chosen;
6. updating the natural value of the areas subject to compensation.

To implement the ecological network into urban planning, the selected measures must be concrete, feasible, included in the landscape framework and coherent with the sectoral strategies defined at higher levels. To enable institutions to act towards a well-implemented local ecological network, the following factors need to be considered:

- provisions of incentives, funding and authorisation to enable local action;
- strategic direction through regional level strategies and action plans;
- regional coherence of local urban plans and measures through coordinating activities.

Some rules are introduced for the urban green: the idea is that urban green spaces can contribute, together with the green development of the rural environment, to the landscape quality of the territory. The defined parameters for the green management integrated the list of plant species adapted to the general urban conditions (climate and soil), as well as the conditions imposed by the urban environment, such as the resistance to pollution and pests. In the selection of plant species, it is indicated to consider at least 50% of native species or particularly suitable to the urban environment and less than 25% of non-native species or naturalised (hence excluding the weeds or plants with relevant ongoing diseases).

Urban nature conservation also requires new conditions: ecosystems, such as landscape, transcend the scales, going beyond the urban area. Within the rules and projects, we need to understand that green is no longer just a mere architecture of context but contributes primarily to creating a complex system that is unitary and consistent with historical heritage and environmental dynamics. We can identify five key passages through which to build this system (Voghera and La Riccia, 2015, 2016, 2019; Voghera et al. 2017):

1. transposing the ecological network elements at the regional level and verifying the implementation and the possible expansion at the local level (the network project must become an integral part of the territorial vision);
2. defining the appropriate modalities for intervention favouring the natural use for the areas included in the network;
3. making the local ecological network also through the institution of urban and territorial equalisation models giving priority to the protection of rivers areas and public lands;
4. ensuring the correct inclusion of allowed building work and the prohibition of definitive elimination of trees and shrub formations, including rows, hedgerows, etc.;
5. defining compensations and mitigation measures of impacts deriving from urban transformations, consistent with the goals of enhancing the local ecological network and the landscape quality.

An important section of the rules for the construction and implementation of the ecological network at the local scale is represented by the penalty system, according to two main aspects. To protect the ecological–environmental system that constitutes an asset of landscape interest, the author of damage in the matter of the protection of landscape assets must, alternatively, either restore the state of the places at his own expense or pay a sum equivalent to the cost to restore the damage. In the first case, he will have to pay a sum equivalent to the greater amount between the damage caused and the profit achieved through the transgression. In the second case, he will be sanctioned with a fine equal to the payment of the expense to be sustained for the realisation of the project increased by 20%.

5.5 Conclusions

The presented case studies are an effective means of testing new approaches. They can encourage similar methodologies and convince decision-makers that an idea is worth pursuing. Learning from these examples can also help adjust and refine a local planning strategy.

Local priorities need to be defined before developing a planning strategy based on local ecological network implementation. Such priorities are often driven by widely recognised challenges that may present many opportunities for urban development and decision-making. The underlying principles of ecological network planning need to be understood as part of a holistic approach based on landscape and must be adapted to the local planning system and social, economic and environmental conditions, as well as the available stakeholders.

Local ecological network planning requires a complex set of interventions useful for the optimal provision of services and the quality of living conditions, aimed at producing public and private wealth distribution, characterised by an eco-systemic approach, with which the city is negotiable as a dynamic organism. Bringing natural

components into the different urban forms means to allow for recovering relations between open and built spaces, buildings, soils, and morphologies. Producing urban agriculture, new solutions for public lighting linked to sustainable mobility and energy production, the reconfiguration of urban fabrics to improve microclimatic conditions and for perceptive well-being, aesthetic quality and the functionality of the pedestrian and cycle paths, the connection among parks, city gardens, cultural assets are components of a positive environmental balance, that, at the same time, favour inclusion, propensity to care and sociality, restore degraded values, recover residual and abandoned spaces, produce common goods.

Local ecological network planning must be based on the integration and coordination of green infrastructure with the urban uses; creating and restoring connections to support and protect processes, functions and benefits that marginalised ecological structural areas cannot provide alone; delivering and enhancing multiple functions and ecosystem services; and finally, including collaborative and participatory planning.

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Chapter 6
A Multi-Scalar Green Infrastructure Project for the Landscape Enhancement and Regional Regeneration of Media and Alta Valtellina

Andrea Arcidiacono, Silvia Ronchi, Viviana di Martino, and Guglielmo Pristeri

Abstract In the process of updating the Lombardy Region's territorial and landscape planning tools, the Green Infrastructure has been defined as a strategic landscape infrastructure built based on the interpretation, assessment, and mapping of Ecosystem Services, with the aim of increasing their relative performance and, consequently, their Natural capital. The Regional Green Infrastructure is inspired by the European Commission's principles, defined as a network of natural, rural, and anthropic landscape elements planned at a strategic level to improve human well-being. The Green Infrastructure design is multi-scale in that it allows both for the analysis of Ecosystem Services using the most appropriate functional and ecological scale and for the formulation of strategies and objectives that can be taken up and systematised by the most appropriate planning and programming tools with respect to the scale of implementation. This paper describes the procedure for downscaling the project contents and design of the Lombardy Region's Green Infrastructure in the pilot area of Media and Alta Valtellina, as a fragile landscape context subjected to significant planning projects scheduled for the coming years. The Green Infrastructure downscaling procedure also becomes an opportunity to systematise and highlight the synergies among the various strategic and design-related components developed in support of the Lombard landscape planning tools.

Keywords Landscape planning · Ecosystem services · Landscape regeneration · Performance objectives · Strategic guidelines

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6.1 Regional Green Infrastructure (RGI): A Resilient Spatial Structure for Landscape Planning

In recent years, there has been significant growth in Green and Blue Infrastructures (GBI) projects as an important field of design experimentation useful for increasing territorial resilience and counteracting the effects of climate change. This has been made possible also through Ecosystem Services' (ES) assessment and mapping, which identifies vulnerabilities and performance requiring associated planning actions, strategies, and solutions (including nature-based) with the aim of improving human well-being and the quality of life. The GBI are intended as a spatially and strategically planned network, composed of a set of interconnected areas with different characterisations (natural, rural, anthropogenic in addition to watercourses and water bodies) capable of providing a broad spectrum of ES (European Commission 2013). The ES constitutes a qualitative and quantitative approach based on the performance of ecosystems, both directly and indirectly, that support the definition of strategies, guidelines, and actions to improve human living conditions (Millennium Ecosystem Assessment 2005).

The innovative character of the GBI lies in their mainly anthropocentric vocation, which goes beyond the ecological–environmental sense oriented towards the conservation and protection of habitats, instead established as the backbone of contemporary regional landscape planning.

Recent experiences have demonstrated that the adoption of an ES-based approach in regional and landscape planning can provide qualitative and performance support to the design and development of GBI and that GBI are a vehicle for the integration of ES into the planning process (Arcidiacono and Ronchi 2021a; Ronchi 2021). The link between planning, ES, and GBI has also undoubtedly been strengthened by the increasing focus on ecological and environmental issues and the need to respond to the important and urgent challenges of the climate change in progress (Estreguil et al. 2019; Ronchi et al. 2020).

GBI are a strongly multi-scale, spatial organisation model and facilitate the integration of ES into the regional and landscape planning process and support the definition of its strategic and planning content. More than that, GBI are also recognised as a key instrument in the EU biodiversity strategy for 2030 requiring a multi-scale framework to guarantee and monitor territorial cooperation (European Commission 2020).

As part of the process of revising and updating Lombardy's regional landscape planning tools, the LabPPTE (Lab Plans, Landscape, Territories, and Ecosystems) of the Politecnico di Milano's Department of Architecture and Urban Studies (DAStU) has developed the design experimentation of a GBI that could constitute the strategic regional spatial and landscape structure, aimed at enhancing and preserving Natural capital and at providing strategic and planning guidelines for the landscape enhancement and regeneration, even in degraded and vulnerable areas (Arcidiacono et al. 2018).

Considering the guidelines set out by the European Commission, the Regional Green Infrastructure (RGI) was defined based on the examination of the ecosystem functionalities of the Lombardy territory with the objective to provide, govern, and expand multiple ES, assuming the community guiding principles and aligning itself with these guidelines (European Commission 2013). The assessment and mapping of ecosystem functionalities covered: (i) habitat quality, understood as an indicator of overall biodiversity (Salata et al. 2017); (ii) the value of the rural landscape, expressed in terms of agricultural productivity and biodiversity in rural areas; and (iii) the state of cultural-anthropic heritage, as a cultural ES derived from an analysis of the protected and historical/identity elements of the Lombardy region, with the associated aesthetic, spiritual, identity, educational and recreational values of the landscape (Arcidiacono et al. 2016a; Arcidiacono and Ronchi 2021b).

The articulation and integration of the three ecosystem components (natural, rural, and cultural-anthropic) allowed to define the scope of the RGI, i.e. identify the areas to be included in the strategic design, considering the principles defined by Benedict and McMahon (2001), Kambites and Owen (2006), and Hansen and Pauleit (2014), namely: (i) the integration of green spaces (natural and semi-natural areas) and grey spaces (densely populated areas); (ii) the multifunctional nature of the spaces with different functions (ecological, social, landscape, cultural, etc.); (iii) the connectivity of the elements of the network necessary to create connections and relationships between spaces; (iv) the multi-scale aspect useful for evaluating a specific ES using the most appropriate functional ecological scale; (v) the plurality of spaces with different size, potential, morphology, land uses and cover, etc.

The combination of the different strengths of ecosystem also allowed to formulate strategies and actions calibrated according to the level of ES supply and associated landscape maintenance and planning, for different categories of regional areas: those with an existing strong ecosystem; those requiring landscape regeneration; those featuring degradation and compromised Natural capital.

The strategic design of the RGI also identifies specific guidelines of connection (to be strengthened or newly created) that can stitch together elements of the landscape, defragment peri-urban areas, and stimulate the use and organisation of recreational activities through sustainable mobility (Fig. 6.1).

The characterisation of the RGI and the detailing of the planning strategies in relation to the ecosystem qualities and potential enable their effective breakdown on the different territorial scales. The RGI constitutes, in fact, a multi-scale landscape structure of a vast area in that it relates to not only the institutional administrative levels of spatial planning, but also achieves a close synergy with intermediate and inter-municipal regional systems, aligned in terms of landscape and ecosystem. The Geographic Landscape Units (*Ambiti Geografici di Paesaggio*—AGP) have been identified by the Regional landscape plan (*Piano Paesaggistico Regionale*—PPR) as territorial aggregations characterised by homogeneous landscape features, with associated quality objectives and strategic operational guidelines for landscape and territorial planning. In this sense, the AGP, which is positioned at an intermediate

level between the large-scale scenario and the processes taking place on a local scale, outlines a direct reference for the project definition and the operational downscaling of the RGI.

The RGI is therefore defined on a regional scale but can be broken down to a local dimension, where the design of the infrastructure is more detailed, activating targeted and timely planning actions with the aim of protecting and increasing the ES through the design of resilient open spaces (urban, peri-urban and rural) integrated with Nature-Based Solutions (NBS), with mitigation and compensation strategies for urban transformations (which can lead to a decrease in ecosystem functionalities), and with actions for the recovery and regeneration of degraded areas (such as brownfield sites) by rebuilding lost or severely compromised Natural capital (Arcidiacono and Ronchi 2021).

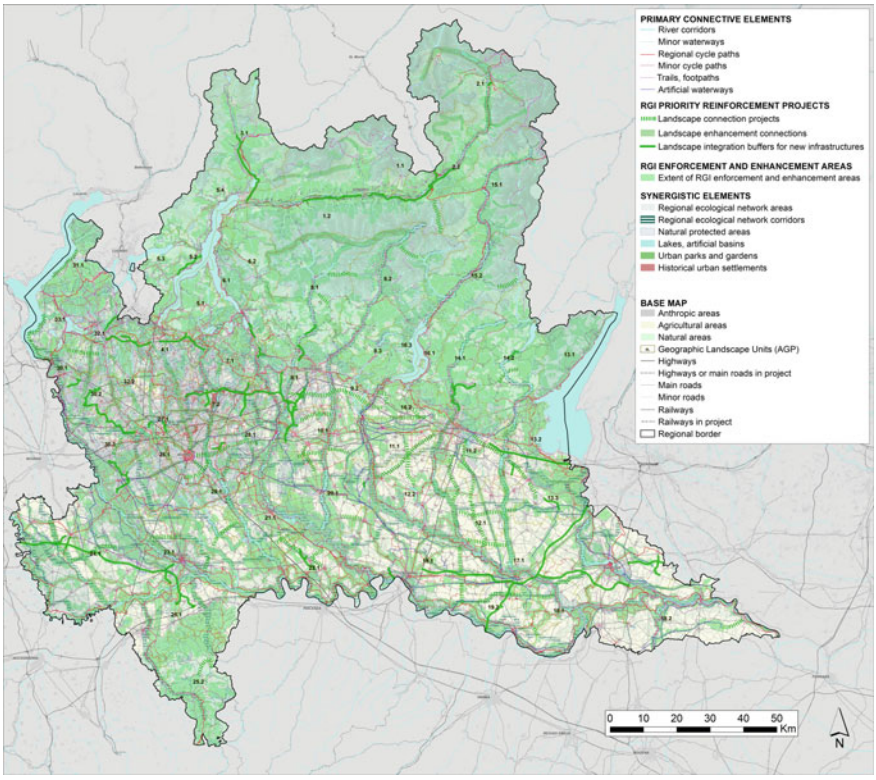

Fig. 6.1 Regional Green infrastructure (RGI) (above), detailed RGI for the area of Media and Alta Valtellina (below) (*Source* Authors elaboration)

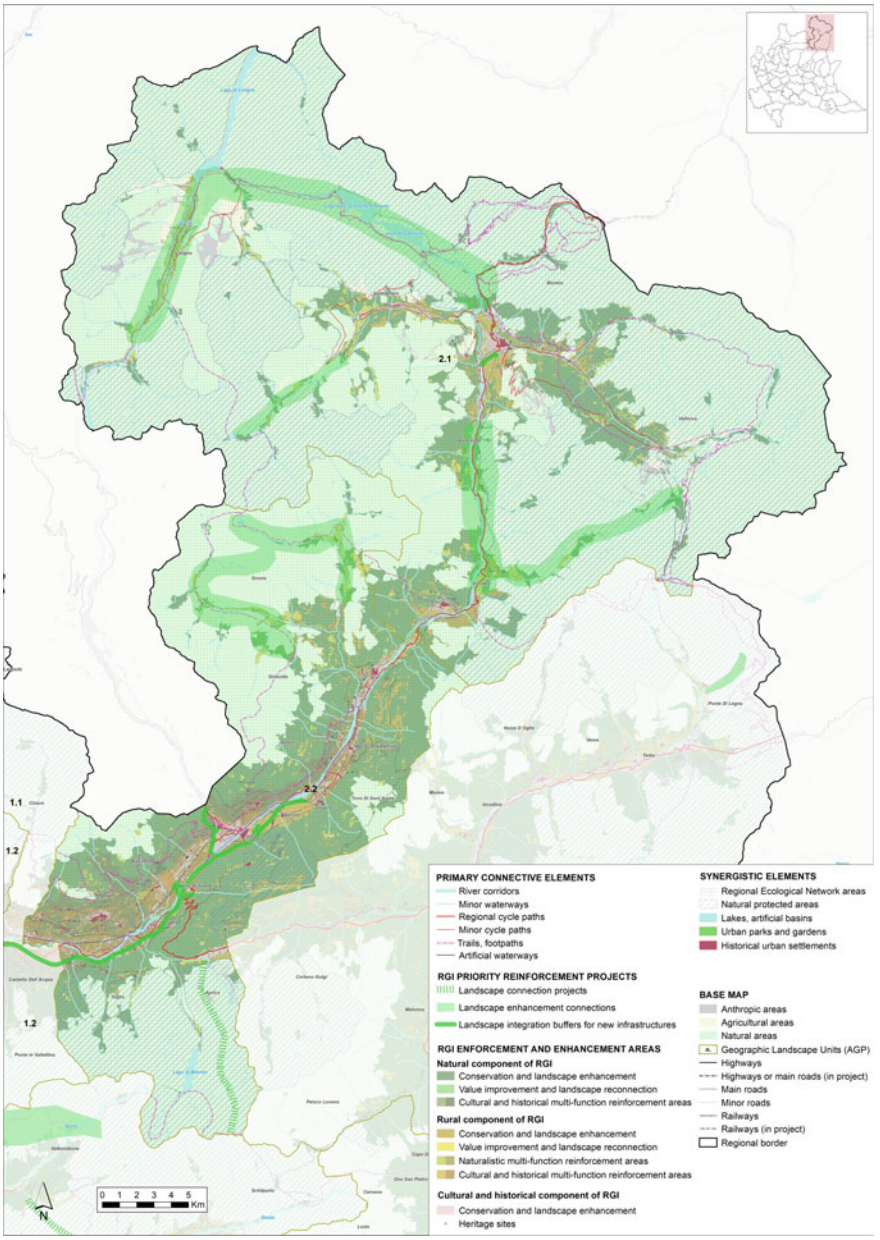

Fig. 6.1 (continued)

6.2 Quality Objectives for Landscapes in Lombardy

Dealing with landscape planning on a regional scale means approaching the landscape in its plurality (Gambino 1997), made up of rich and varied contexts, each characterised by its values and pressure dynamics that require measured responses concerning the specific characteristics of the areas. Whilst, on the one hand, the design of the RGI defines a consistent strategic and spatial structure for the entire region, on the other hand, the richness of the landscapes in Lombardy, together with the complexity of the distinguishing risk and pressure factors, has demanded the introduction of regional sub-divisions that overlay the RGI design synergically, contributing to the definition of more detailed operational guidelines and thus contributing to the pursuit of greater operational effectiveness of the large-scale vision (di Martino and Restelli 2021).

A first level of interpretation is represented by 'Landscapes of Lombardy', regional divisions on an intermediate scale that coincide with morphologically unitary macro-areas, and which are taken as a reference to identify a first set of general objectives for the protection and enhancement of the regional landscape. These macro-areas include: alpine mountain landscapes (distinguishing between the open landscapes of the high mountains, the alpine landscapes of the valleys and slopes, and the landscapes of the pre-alpine valleys); the landscape of the Apennines; the hilly landscapes (comprising on the one hand the landscapes of the foothills, hill conurbations, and moraine amphitheatres and on the other hand the valleys and ridges of the Apennines); lake landscapes; river landscapes (which have different characteristics depending on the environments they pass through, such as a high dry plain, a low irrigated plain, or the Po river valley system); the lowland landscapes (in turn divided into irrigated lowland landscapes planted with rice, feed, and cereal crops and the landscapes of the Oltrepò plain in the Pavese and Mantua areas), as well as the metropolitan conurbation landscape, which develops along the east–west axis between the Piedmont foothills and the northernmost part of the irrigated lowland, covering almost the entire dry plain.

Thus defined, the 'Landscapes of Lombardy' are also the main reference for identifying homogeneous features related to geographical, hydrological, geomorphological, environmental, ecological, anthropic, historical, and cultural components that have enabled the entire region to be further subdivided into 57 AGP.

The definition of smaller homogeneous units in the region is the first useful tool for addressing specific issues concerning the different regional and landscape environments and identifying targeted priority actions, facilitating the implementation of strategic guidelines developed on a regional scale through the definition of measures that can guide landscape planning decisions on a local and supra-local scale (Lussignoli 2014). In this sense, the AGP is both an analytic tool for the identification of the qualities and dynamics existing in individual homogeneous contexts and an operational tool through which to define quality objectives and strategic priorities to activate multi-scale landscape planning and regeneration processes, in response to

the specific risks and vulnerabilities in the areas, with reference to local peculiarities and qualities (Arcidiacono et al. 2016b).

The regional subdivision introduced through the AGP can thus outline a reference scenario on a supra-local scale through which to articulate in greater detail the strategies and guidelines defined at a regional level and thus identify a system of site-specific quality objectives for the safeguarding, protection, development, and regeneration of the landscape in the various homogeneous units.

The definition of landscape quality objectives and related operational guidelines to support local planning derives from a careful analysis and understanding of the values and pressure or degradation factors found in each AGP to reveal the landscape's structural elements. Precisely in order to maintain a multi-scale approach that always allows local themes and elements to be framed in terms of the broader regional context, the structural elements of the landscape and the related quality objectives are organised according to thematic territorial macro-systems that have also been used as a reference for other large-scale studies and analyses, including preliminary work for defining the RGI: the hydrological/geological/morphological system, natural ecosystems, rural systems, urbanised areas, and historical and cultural systems.

At the same time, we identify four strategic macro-objectives to guide the definition of more site-specific quality objectives on an AGP scale: (i) safeguarding and promoting the constituent features of the landscape, in terms of perception and culture; (ii) safeguarding and developing the ecological network and biodiversity to protect and strengthen the quality of the ecological functionality of both natural environments and areas affected by intense human activity; (iii) promoting sustainable ways to enjoy the environment and use its resources; and (iv) improving the conditions of quality and landscape/environmental compatibility of built-up areas and transformations.

Therefore, a grid of site-specific landscape quality objectives, organised according to a common regional matrix based on the previous mentioned territorial macro-systems, and on the four strategic macro-objectives listed above, is created for each AGP, defining a system of priorities for landscape protection, planning, or regeneration that overlap coherently with the design and strategic planning of the RGI.

This tool for addressing local planning decisions is organised in a series of summary data sheets for each AGP that also includes specific guidelines for implementing the RGI within the homogeneous landscape unit. It lays the foundations for the definition of planning actions to regenerate areas subjected to degradation, identifying the places that are in priority need of landscape planning strategies. The definition of objectives on a supra-local scale starts from the identification of the structural landscape elements of the AGP and can be a strategic tool to launch operations and projects on a supra-local scale that, grafted onto the strategic design of the RGI, can overcome the fragmentary nature of administrative limits, maximising the positive effects for the landscape and the Natural capital.

6.3 Synergies and Integrations Between the Landscape Quality Objectives and the Planning Actions of the Regional Green Infrastructure

In order to strengthen the connections between regional landscape strategies and local planning guidelines—considering the multi-scale relations and the relationships between large-scale plans and local projects as key principles of landscape planning (Gisotti 2016)—a pilot study has been launched that aims to clarify the correlations between the RGI project and the AGP quality objectives from regional to supra-local scale within the framework defined by the regional planning for the research areas.

The proposed study area is Media and Alta Valtellina, an Alpine area that stretches along the river Adda in the north-east quadrant of the Region, on the border with Switzerland. The context in question corresponds to AGP 2.1 (Alta Valtellina) and 2.2 (Valtellina di Tirano), as well as to the area of application of the 'Regional Plan for the Area of the Media and Alta Valtellina' (*Piano Territoriale Regionale d'Area*—PTRA).[1] The area is strongly affected by the landscape and regional transformations occurring in Alpine territories (Schirpke et al. 2013; Campagnaro et al. 2017; Jiménez-Olivencia et al. 2021); moreover, it assumes particular importance in view of the Milan-Cortina Winter Olympics Games scheduled for 2026, in which the area of Alta Valtellina will be one of the main competition venues, while Media Valtellina will be an important logistical and infrastructural hub and it will therefore undergo significant transformations.

The downscaling of the RGI project according to the AGP guidelines was divided into three main phases: (i) representation of the structural landscape elements in the area concerning the quality objectives identified in the corresponding AGP (Chapter 2) and RGI (Chapter 1) data sheets; (ii) making consistent the objectives of the strategic and directional guidelines contained in the various regional landscape planning tools (i.e. Landscapes of Lombardy, AGP, RGI, and Aggregations of constraints[2]), in the PTR and the main supra-local planning tools in force in the territories in question; iii) synthetic representation of the main strategic actions concerning the structural elements of the landscape, spatially located in the study area and deducible from cross-reading the planning tools examined (Fig. 6.2).

[1] The Regional Territorial Area Plans (PTRA) are strategic regional planning tools for the development of areas affected by regional or supra-regional works, operations, or functional destinations. PTRAs are identified by the Regional Territorial Plan (PTR), the supporting tool for regional governance in Lombardy. The PTR aims to render the strategic vision of general and sectoral planning consistent with the physical, environmental, economic, and social context of Lombardy.

[2] The 'Aggregations of properties and areas of landscape value' constitute one of the outcomes of the research to support the updating of the regional landscape planning tools and group together Lombardy's protected assets into *bellezze d'insieme* (ensemble of attractions), on the basis of homogeneous or significantly connected landscape, regional or geographical features, and into aggregations of *bellezze individue* (individual attractions) on the basis of similar characteristics. The Aggregations are described in detail in special data sheets, which also contain specific guidance and protection objectives.

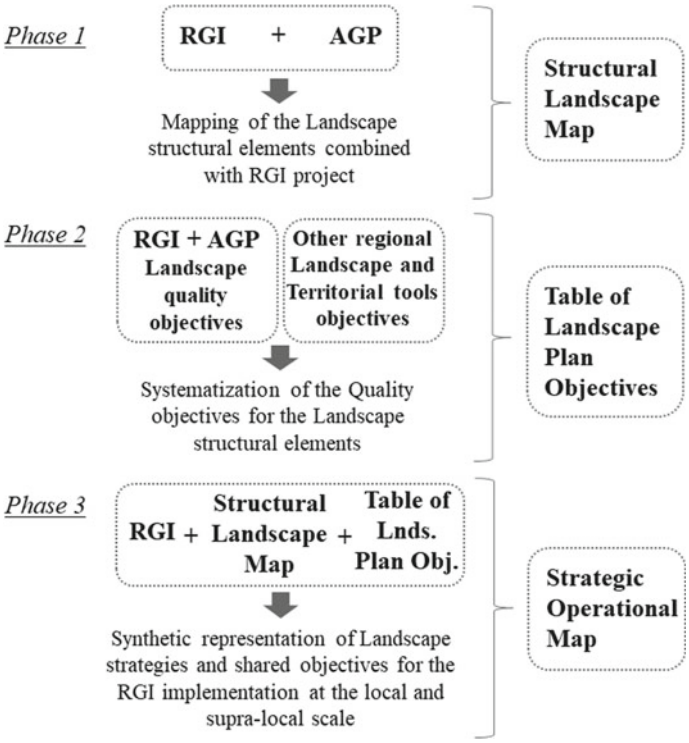

Fig. 6.2 Conceptual scheme of the Regional Green Infrastructure (RGI) downscaling process (*Source* Authors elaboration)

In the first phase of the work, the identification of the study area's structural landscape elements was derived from data sheets AGP 2.1 and AGP 2.2, particularly from the 'Quality Objectives' and the 'Guidelines for the Implementation of the RGI'.

The structural elements are organised following the matrix of the four thematic territorial macro-systems previously used for the AGP objectives, i.e. (i) hydrological, geological, and morphological systems; (ii) ecosystems, environment, and nature; (iii) agrarian and rural systems; (iv) areas affected by human activity and historical and cultural systems.

In the cartographic mapping (named Structural Landscape Map), the structural elements of the AGP are superimposed and combined with the design of the RGI, which, compared to its regional organisation, is developed in greater detail in terms of planning strategy on the scale of the specific AGP. The RGI interacts and is integrated with the structural landscape elements, qualifying as an additional design level that applies to areas of high ecosystem and landscape value. The superimposition of the RGI project on the structural elements of the landscape not only provides indications

of the concentration and distribution of landscape values, but also enables these elements to be scaled to support their local implementation.

The second phase of the work was devoted to the systematisation of the objectives envisaged for the Media and Alta Valtellina included in the several tools developed in support of the Lombardy landscape Plan and in the main regional planning tools (PTR, PTRA of the Media and Alta Valtellina), including in the comparison the main supra-local Plan (PTCP[3] of the Province of Sondrio). The objectives and strategic guidelines resulting from cross-reading these planning tools are set out in a synthetic matrix named 'Table of Landscape Plan Objectives'. The table supplements the 'Structural Landscape Map' enabling the objectives defined by the Plan tools for each structural landscape element to be viewed simultaneously.

The 'Table of Landscape Plan Objectives' first contemplates the quality objectives of the AGP data sheets, listed according to the four thematic territorial macro-systems of reference to which they belong. In addition, there are also the planning objectives associated with the various components of the RGI (i.e., General Objectives; Objectives for the Nature RGI; Objectives for the Rural RGI; Objectives for the Historical and Cultural RGI; Objectives for the Landscapes of Lombardy; Objectives for priority reinforcing projects) and those envisaged by the other tools considered.

The table is intended to guide planners and support policymakers in defining integrated methods of implementation shared among the different scales of action. In particular, concerning the GBI, the simultaneous reading of its objectives for individual landscape elements and the guidelines from other tools provide a coherent and coordinated planning framework among the different levels of planning acting in an area.

The third and final research phases involved the construction of a 'Strategic Operational Map' that defines the main regional areas subjected to thematic strategies common to the various tools of the plan.

The objectives included in the different tools of the plan have been aggregated into a synthetic set of shared planning objectives and mapped with reference to each structural element of the landscape. To maintain coherence with the various components of the Landscape Plan, the mapping of the shared objectives was organised according to the four main strategic macro-objectives that guided the definition of the site-specific quality objectives of the AGP, namely: (i) safeguarding and developing the constituent and identifying features of the landscape; (ii) safeguarding and improving the ecological network and biodiversity; (iii) promoting environmentally friendly exploitation; and (iv) improving the quality and compatibility of the landscape and environment.

[3] The Provincial Territorial Coordination Plan (*Piano Territoriale di Coordinamento Provinciale*—PTCP) defines the general objectives relating to the organization and protection of the territory in relation to provincial or supra-local interests or to the implementation of regional planning.

The ‘Strategic Operational Map’ is the tool that scales and details the project objectives, considering the RGI design. In this sense, the identification of specific thematic elements linked to the quality objectives of the AGP, located within the RGI areas, in itself defines certain procedures of local implementation of the RGI. For example, the location of the high-density conurbations identified by the ‘Strategic Operational Map’ guides the implementation of the green and blue systems envisaged by the RGI to counteract these trends and increase porosity in highly urbanised areas. At the same time, the spatialisation of residual crops or those subjected to trivialisation substantiates the RGI objectives dedicated to maintaining or restoring the landscapes in rural areas; the mapping of areas of typical local agricultural production and of the main historical and cultural sites of interest can, on the other hand, guide the local implementation of the objectives for landscape use and qualification.

In conclusion, the research presented aims to define a methodology that can be replicated in other areas of Lombardy and, more generally, in landscape strategies that include multi-scale integration processes. In this sense, organisation on different scales of the operations of a GBI, such as Lombardy’s GBI, and its interaction with multiple strategic and quality objectives, is a fruitful example for future developments in methodology and application (Fig. 6.3).

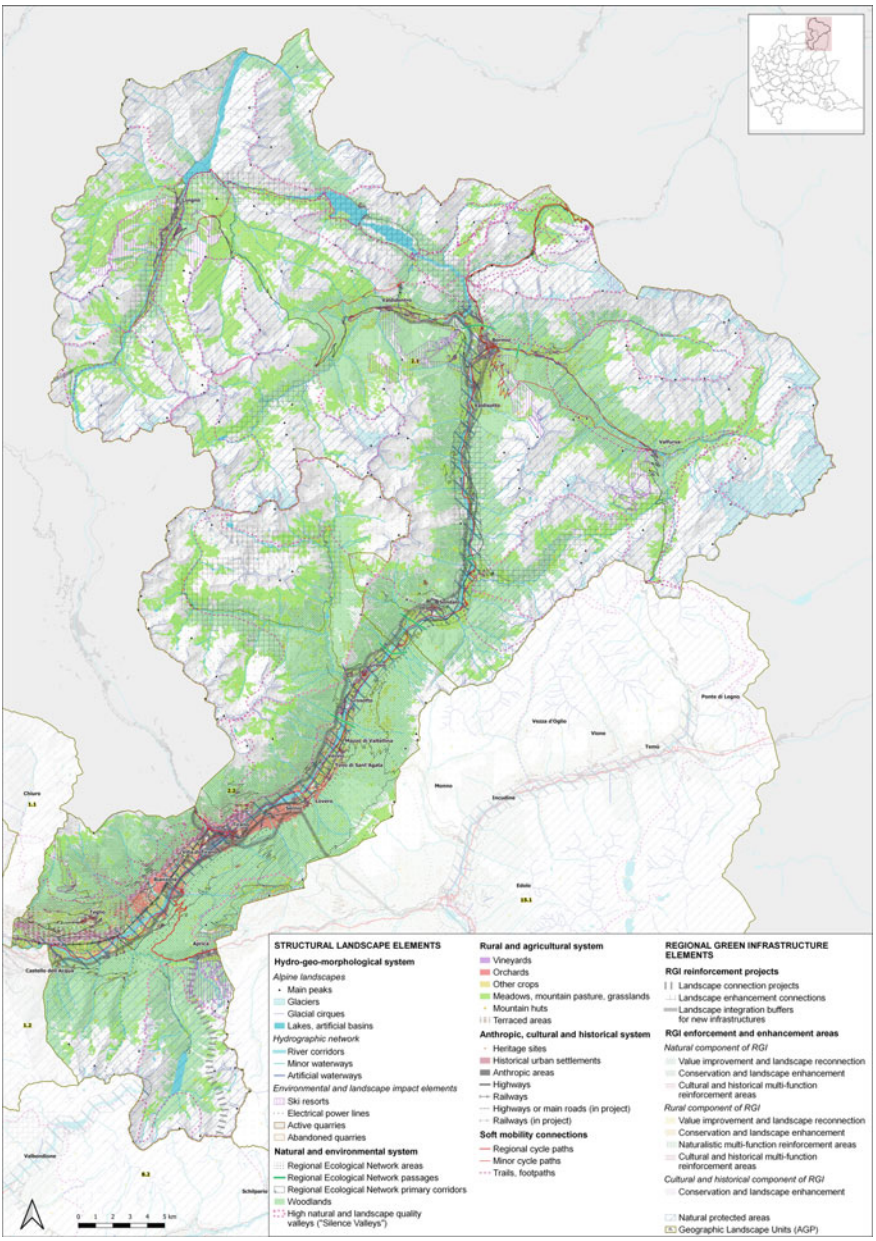

Fig. 6.3 Structural landscape map for the area of Media and Alta Valtellina (*Source* Authors elaboration)

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Chapter 7
Re-urbanising the Contemporary City: Spatial Planning and Green Strategy in Turin

Carolina Giaimo

Abstract Among the different configurations that public and private space takes on in the city, green space is undoubtedly the component where the improvement of the health and well-being of urban communities and the quality of settlements, as well as social inclusion and the mitigation of the impacts produced by climate change, are most at stake. The environmental, social, economic and technological challenges the contemporary city faces require the revision of traditional models of modern urbanism. That is, they call for a rethinking, above all, of the more recent spatial models that have mostly focused on the punctual government of transformations and reconversions of urban brownfields, without however succeeding either in limiting the persistent intensity of widespread urbanisation processes or in grafting broader effects of urban regeneration (in its multiple components: environmental, social, housing and employment). Through the case study of the City of Turin, this paper tackles the theme of green infrastructures as a frame of a broader and anthropocentric ecological-environmental reorganisation of the contemporary city. In this perspective, the urban scale opens up new ways of working through the use of design devices capable of becoming a structuring part of the urban spatial project, contributing to directing choices towards objectives of complex regeneration (ecological-environmental, social and economic) of the city aimed at an optimal use of resources.

Keywords Green infrastructures · Public space · Urban regeneration · Spatial planning

7.1 Introduction

The urbanisation processes that have taken place in recent decades, often in the absence of adequate territorial planning, have generated—and continue to generate—a series of negative impacts on the environmental balance of territories and may

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be considered one of the main threats to sustainable development (European Commission 2012; EEA 2016a, b).

Unsustainable urbanisation and intensive land use contribute to amplifying the impacts of climate change and make cities increasingly vulnerable to the risks of extreme events such as heavy rainfall and heat waves (Revi et al. 2014). People living in urban areas are also exposed to high levels of vulnerability and risk associated to air pollutants (Manes et al. 2019). And there are additional possible threats to be considered, as is the case for the COVID-19 virus, which spreads very easily through the air, with negative effects both in the short and long term. It may cause health functional alterations (respiratory, pulmonary and cardiac) as well as increased mortality, with strong repercussions on the well-being of citizens, on the public sphere (specifically on health) and on the quality of urban living (ISPRA 2016).

Conversely, many past and recent studies have documented the positive role of vegetation to consistently reduce pollution levels, both through the absorption of fine particles on the leaf surface and through the absorption of ozone through the stomata of the green organs of plants (Diener and Mudu 2021). The benefits provided by the different types of urban greening in terms of support, regulation and cultural ecosystem services, green areas, among all the other space (especially the public one) components in urban areas, play a key role in contributing to health improvement, to the well-being of communities, the quality of settlements, as well as promoting social inclusion and climate change impact mitigation (Daily 1997).

In this perspective, the urban scale opens up new working paths based on design devices that can be structurally integrated into urban design and thus help target the objectives of urban complex regeneration (ecological-environmental, social and economic) as well as optimal use of resources.

7.2 New Paradigms for Urban Design

Among the design options for the new resilient, adaptive and anti-fragile city, the concept of urban green area has evolved into the more complex notion of urban "green infrastructure". The latter entails fertile deployment potential when acknowledged as essential in the policies for conservation, environmental protection and enhancement, sustainable development, mitigation and adaptation in the urban environment (Ahern 2007).

The importance of green (and blue) infrastructures for the environment and society has been acknowledged in the European (European Commission 2013), international and national political agendas on the environment and green economy, climate change (EEA 2016), biodiversity and sustainable development (United Nations 2030 Agenda, Goal 11).

The concept of green infrastructure implies the opportunity to triangulate different fields of public action while simultaneously fulfilling a range of different functions: production reservoir of ecosystem services, dynamic system to adapt to climate change phenomena, reorganisation of urban metabolism and frame of the new public

city (Gasparrini 2018a, b). In this sense, the evolution of green spaces becomes embedded in the urban structure, shaping its formal design as well as the layout of both open spaces and buildings.

At the international level, the numerous experiences gathered in urban planning and design have produced innovative urban-territorial regeneration, both in terms of the proposed design and operational solutions (nature-based solutions) and in terms of new knowledge acquisition methodologies to deal with current challenges and adequately support the assessment of possible land use scenarios.

In Italy, the topic of green infrastructure has been widely covered in the urban planning debate (integrating the semantic shift towards resilience). A substantial paradigm change has occurred in the way of thinking and designing the city (Gasparrini 2015). However, the urban planning practice still struggles to deal concretely with issues like urban heat island, saving resources, risk prevention, urban resilience, which are hardly translated into policies, design practices and specific regulatory systems.

In the face of this, the new social, environmental and ecological challenges of contemporary cities and territories require a radical change in the paradigms and forms of urban planning. This change necessitates both the revision of conventional models of modern urban planning, mainly based on the governance of urban growth and local infrastructure and a rethinking, especially of the more recent models. Against the backdrop of the profound crisis hitting the industrial economic systems, indeed recent models have been mostly focused on the punctual management of transformations and reconversions of urban brownfields, without succeeding either in limiting the intensity of urban sprawl or in triggering wider effects of urban regeneration (environmental, social, housing and employment) in a less efficient and liveable consolidated urban fabric (Arcidiacono et al. 2018). There are still few and sometimes disappointing experiences of urban plans applying these concepts and therefore introducing planning devices targeted on the urban green infrastructure. Unfortunately, the latter is still rarely applied as one of the design categories of municipal urban plans.

7.3 A Far-Sighted Vision: Green Paradigm in the Programmatic and Planning Contents of the Turin Land Use Plan

The current Turin Land Use Plan, drawn by architects Vittorio Gregotti and Augusto Cagnardi and in force since 1995, frames the topic of green areas within more general considerations about the ‘environmental condition’ understood as “the set of transformations produced and induced in building the city” (Città di Torino 1989: 31). One of the main goals is to improve the built environment and the image of the city but especially improve urban environmental quality, as a prerequisite for transformations and a guide for planning.

The first line of intervention aims at rehabilitating the main degraded resources to improve the flat part of the city through a strategic use of river strips and non-urbanised areas. The subsequent step aims at recovering residual spaces in urban organisms as far and as well as possible. The redevelopment of riverbanks will ensure maximum continuity through reforestation. To this purpose, the Po axis plays a vital role as a multifunctional area for leisure, rest, sports and as a green lung. For an improvement of urban conditions, Parco della Collina will also be included as parkland—public and restricted private—with improved itineraries along public paths starting from public parks. The park is no longer planned as a physical geographical limit of the city but as a possible 'central park' with respect to an inter-municipal area expected to expand in future. Rather than a frame or a margin of the urban structure towards the east, the Collina torinese is intended more properly as the centre of a wider area, where the urban body extends both into the plain area of the city and over the hills, wrapping it on all sides (Città di Torino 1989: 43).

The plan also provides for the development of a system of urban parks resulting from the reuse of dismissed industrial areas (Susa area and Dora area) and of the railway yard between Lingotto and Porta Nuova. The new parks will be the cornerstones of an urban redevelopment of the most densely populated and least serviced districts with the aim of improving the general environmental conditions of the city but also, in a more direct way, the living conditions of innermost districts, crowning the historical city.

7.3.1 The Spatial-Functional Green Model

Although Turin and its metropolitan area expanded and grew substantially not unlike other Italian metropolitan areas, Turin stands out in its exceptional geographical position and Baroque territorial presence granted by its large parks and suburban paths, which stemmed undifferentiated growth and imposed a demarcated compactness and density on the inhabited flat area of the city.

At the end of the 1980s, Turin is no longer an expanding city and is already showing the signs of a new dramatic urban transformation. As observed by Cagnardi (1992: 2), "a new era is being prepared in which the city is rebuilt on itself; the empty spaces of the large factories become fertile lands for the birth of the new city within the existing city".

The 1995 Land Use Plan has reset the spatial layout of green spaces (and other activities) along essentially north–south axes with the declared intention of disrupting the hierarchy between centre and periphery and reopening the city towards the two plains that it previously separated (to the north towards the Canavese, the Eporediese and the Vercelli areas, to the south towards the Asti and Cuneo districts).

According to the Land Use Plan, the design decisions related to green spaces are susceptible of promoting a different aspect of the city: within the urbanised area, four main green systems are outlined, with an axial configuration vis-à-vis the Turin territory.

For the Po valley, the first axial system, a sort of natural trunk placed between the city and the hill, the plan foresees an intense forestation of the valley to recreate a continuous, compact natural presence with a strong landscape impact. The aim with the Po river system is to create a consistent green volume, morphologically juxtaposed to the built flat volume of the city and a 'hub of leisure and free time' within the urban space.

The second axis, parallel to that of the Po river, is the Spina Centrale, along which the design scenarios envisage four areas of urban transformation for a total of almost 3 million square metres of land area. It is designed to be a place of urban innovation and host the operations of public and private tertiary companies. As a result of the plan implementation rules, 50% of these spaces, made available by the decommissioning of large industrial plants, are re-naturised and equipped as a park (while construction is allowed in the remaining space). The (planned) forested spaces are expected to make a significant contribution to creating a 'new balance between the green and built environment' in the city. Given their extension and location in the urban fabric, these new parts of the city "will play a structural role in the morphology and functionality of the future city, comparable at least partially to that played by the new urban areas which in past centuries have taken the place of military facilities and infrastructures" (Città di Torino 1991: 117). Along the Spina, which crosses the urban part of Turin, as a sort of barycentre, the planned transformations include the construction of the Rebaudengo, Dora, Susa, San Paolo Parks and one more on the roof of the Scalo del Lingotto. The construction of Spina Centrale, which overlaps the railway line from Piazza Rebaudengo to the Lingotto through a moderate lowering of the railway tracks, allows the railway furrow to be closed through a roof slab with a green cover, a sort of green boulevard marking the city from north to south.

The third axis, the so-called corridor in urbanisation, is Corso Marche, on the western edge of the city (from the Stupinigi Park to the Venaria Royal Residence), in a north–south direction, for mainly tertiary activities requiring large spaces and vehicle accessibility. It is surrounded by pre-existing agricultural areas redesigned with greenery and woods (along the axis) and by the large space of the former Campo Volo di Collegno expected to host the new Parco della Dora (as an extension of the Pellerina urban park).

The last axis, of lesser importance, orthogonal to the previous ones, develops along the east–west direction and consists of Corso Tirreno, close to the former Piazza d'Armi, the gardens of Piazza Marmolada and the existing Ruffini Park, extended to an adjacent green area.

The riverbanks of the Stura, the Dora and the Sangone overlap this axial system. Their elements are almost orthogonal to the system of the aforementioned axial system and areas. The plan provides for a thick and substantial green volume of tall trees so as to recreate 'strong' natural elements in a balanced and landscape-positive relationship with the built urban space volume.

For the hills of Turin, the plan provides for the forestation of free areas, the creation of a large park of regional relevance and an adequate system of pedestrian paths, car access routes and multimodal public transport systems, to enhance the recreational function of this area. The rest of the existing and planned green areas

include a plurality of large and small historical and recent spaces, either equipped or not. Taken as a whole, these green areas fulfil an important connective function of the urban fabric at various levels.

Therefore, the overall scenario envisioned by the plan consists of structural elements clearly identifiable in a set of built-up spaces, well set around the historic and newly built infrastructural networks, as well as another set of 'green volumes' made up of potential river forests framing the built-up area and the network of urban parks connected to them.

7.3.2 Green as an Urban Standard

In the Turin 1995 Plan, green spaces are encompassed within urban planning standards, as is customary and pursuant to legislative provisions (starting from Ministerial Decree no. 1444/1968).

The endowment of existing services, confirmed as areas, public and private, as regards' public green, parks and sports facilities', is equal to about 10 million square metres, albeit a strong increase is expected: the plan envisages 30 million square metres as green spaces, thus tripling the existing ones (at the date of drafting the plan). The recovery of additional areas to increase the supply of existing services can essentially take place in two ways: the use of areas not yet built up and the reuse of areas freed from urban transformation processes.

The free areas beyond the continuous built-up area (25 million square metres in 1989) and mostly located on the hills and north of the Stura stream are classified as protected areas in the plan and deemed a resource for a 'system of green spaces' in the metropolitan area, including both equipped and non-equipped public areas (the urban parks provided for in the standards), and private agricultural or wooded areas. Urban areas not yet built up (about 5 million square metres in 1989) are designed to increase the supply of services in absolute value, although their marginal location is not functional to all types of services. A possible alternative is that of transformable areas (old industrial plants, obsolete equipment and plants) that became available in the 1980s following the technological transformation of production. They were certainly an opportunity—perhaps unique—to renew the image of Turin, the one-company-town (Bagnasco 1986) and redevelop, as well as enhance, its infrastructure and service system. The recovery of the central areas occupied by disused railways or metal and steel plants—the so-called Spina Centrale—offered a design opportunity of exceptional urban significance, almost a metamorphosis of the city.

The plan also shows a certain sensitivity to non-quantitative issues, for instance, the profound crisis in public finance already clearly underway in the 90s of the last century. It also addresses the still uncertain legal and regulatory framework since the five-year validity limit of the constraints and services envisaged by urban plans raises challenges in the medium-long-term planning of interventions. In this sense, the current plan re-evaluates the resources available when it was drafted, in terms of the two fundamental public and private components, paying close attention to the

consistency, characteristics and level of public structures present in the area. The aim is ensuring maximum functional integration between existing and planned services and maximise the effectiveness of the service system. Finally, the plan leverages the resources that the private sector can make available through the existing facilities to partially meet the demand (also through agreements with the public bodies) and through investments for concession interventions in public areas.

7.3.3 The Urban Planning Regulation for Parks

The river and hilly urban park areas envisaged by the Turin Land Use Plan (under the urban planning and building implementing regulations) are specific regulatory areas where the equalisation mechanism, apparently similar to that of Urban Transformation Zones, works in a different and more complex way in this case. Since building rights in situ are not provided for, transferring volumes to other areas implies uncertainties about the result. Therefore, the river and hilly urban park areas are classified as public service areas. Due to their territorial relevance (because of their wide extension and location), they are designated mainly for public services of general interest, as provided by the Piedmont spatial planning law.

In the course of the over 25 years of the plan, however, due to implementation obstacles, these measures largely remained on paper: private operators, differently from the Urban Transformation Zones, did not show any interest in these additional building opportunities, especially in the case of hilly parks (with the lowest indices). In response to these critical issues, in 2001 the Plan Variant no. 37 introduced some flexibility, extending the possibility of assigning areas to the category of areas to be transformed for services.

With a planned surface area of currently 20,616,198 square metres, the 18 urban and river parks measure a total of just over 14 million square metres of land area (equal to 68% of the total), while the 15 hilly parks extend for about 6.5 million square metres of land area (about 32% of the total).

7.3.4 A Sectoral Plan for the Green Infrastructure

In 2017, the City of Turin defined, among the government's programmatic objectives (Città di Torino 2017), to complete the implementation of the urban park system and to adopt a Green Plan (Città di Torino 2018): a tool introduced into Italian legislation with Law 10/2013 (Regulations for the development of urban green spaces), which flanks the traditional municipal Land Use Plan. The Green Plan is an optional device, left to the sensitivity and capacity of individual municipalities, supplementary to general urban planning.

Consistent with these intentions, in March 2021, the City of Turin approved the Strategic Plan for Green Infrastructure (Città di Torino 2021), supported by the

signing of a Memorandum of Understanding between the Ministry of the Environment, the National Committee for the Development of Public Green Areas, the Piedmont Region and the Metropolitan City of Turin to develop a common strategy for the enhancement of green infrastructure, urban forestation and related ecosystem services through planning tools and mechanisms for the management of environmental contributions and compensations.

The objective enunciated by the Strategic Plan is to support the direction of investments and the definition of intervention priorities in the medium-long term for the public urban green infrastructure system based on the various analyses constructed on an urban scale.

The Strategic Plan identifies the multiple functions performed by green spaces in the ecological-environmental, socio-cultural and economic categories. It provides a considerable cognitive framework for the quantitative and partly qualitative components of Turin's various types of green spaces. It also devotes a particular focus to recreational greenery (understood as green areas freely accessible and usable by citizens for walking, free sports activities, playing, socialising and relaxing) and to its degree of accessibility in the city, also in relation to specific social categories of users.

Other elements of interest concern the introduction of ecosystem services evaluation, the focus on urban horticulture and 'cultivated' green, the attention to climate vulnerabilities and the evolution of management approaches.

Although the plan does not reveal any significant deficiencies in the coverage and accessibility of green areas in Turin, the strategy defined for the evolution of the public green system emphasises the need to implement future interventions following the destination for green services of the current Land Use Plan. Therefore, the Strategic Plan's context of action is exclusively that of the areas destined for public use by the Land Use Plan, whether existing or planned, without defining planning hypotheses for unbuilt private areas.

Considering the two plans together (the Land Use Plan in force since 1995 and the Strategic Green Plan approved in 2021), it can be observed that there is no explicit and systematic system of relations between them, i.e. of choices and provisions capable of triggering regulatory relations. Moreover, since in 2020, the City of Turin had also started a process of revision of the 1995 Land Use Plan, it remains to be clarified whether, in the near future, the strategy for the green system in Turin will be able to constitute a structuring design criterion to orient actions and policies of the urban Land Use Plan, in an ecological perspective for the overall urban environment.

7.4 Conclusions

In Italy, public green spaces are a good indicator of the state of green infrastructures in urban settlements. As the case of Turin has shown, if Decree 1444/68 represented an undoubted reference for directing urban planning towards the criteria of quality

of life—building expansion has to be matched by minimum public equipment facilities—its validity has to come to grips with the urgency of guaranteeing the sustainability of transformations as well as territorial resilience. From the environmental point of view, therefore, the priorities for the future are to protect nature and citizens' contact with it, ensure the adequacy of settlements to climate change, reduce hydrogeological risk and resource scarcity, reduce energy consumption and waste, protect landscapes and natural resources, with particular attention to non-renewable ones, such as the soil.

Urban green infrastructures (along with blue ones) are an important field of design experimentation where the design of public (but also private) open spaces performs multiple functions depending on the urban connotation and land use options. Green infrastructures expand the concept of network (its ecological definition points to the protection of biodiversity and connections between natural areas) to encompass multifunctionality. Open areas and spaces, natural and anthropic are integrated with the networks of slow mobility as well as energy and digital infrastructure: waters, urban and agricultural landscapes, green areas and waste and neglected areas interact and build systems of spatial, social and value relations, cohesive and inclusive, linked by multilevel governance processes (Arcidiacono et al. 2018).

In this sense, green infrastructures will serve as an actual frame of urban design in the contemporary city, a supporting structure to assess and verify the settlement and infrastructural choices of the plan.

This design perspective overturns the conventional quantitative and functionalist urban planning approach, proposing new performative criteria and design guidelines based on natural solutions to be adapted to local physical and social contexts as an anchor for methods of evaluation and control of urban regeneration processes.

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Part II
Environmental Design

A crucial node of green and blue infrastructure operationalisation is related to design issues. The presented case studies were mainly designed to respond to current global challenges. Indeed, they offer a broad overview of emerging assets that integrate natural, agricultural and cultural aspects, focusing on biodiversity, heritage preservation and climate change adaptation. The variety of case studies is also reflected in scales; indeed, they range from the territorial to the plot scale, including both urban and architectural elements.

Some case studies also try to consider management issues to redefine the city and the landscape perspective, starting from the green and blue infrastructure paradigm.

Chapter 8
When Constraints Become Assets in the Design of Blue-Green Infrastructures: An Insight from Two Cases in the Western Part of France (Loire River Basin)

Marie Fournier and Mathieu Bonnefond

Abstract This chapter focuses on projects of blue-green infrastructures (BGI) located in two middle-sized French cities in the Western part of France, on the Loire river basin (the Ile aux Planches urban park in Le Mans and the Parc Balzac in Angers). They constitute illustrations of recent and innovative approaches in the design of BGI in France. In both cases, planners had to face major challenges, whether technical or political. Innovative solutions were found to overcome technical difficulties (projects located in flood-prone areas, on brownfield sites and facing heavy pollution). Local oppositions and strong involvement of inhabitants forced planners to redefine and improve their projects. We point out how planners successfully turned those various constraints into assets and synergies to design multifunctional BGI in both cases. However, when comparing the projects, we see important differences. In Parc Balzac, planners clearly succeeded in designing a project with strong synergies between its various functions (biodiversity protection, leisure and education to environment, flood risk management). In the case of the Ile aux Planches, in Le Mans, synergies are not so obvious. In a broader perspective, this chapter questions the concept of BGI and its capacity to address the question of synergies between functions in green parks.

Keywords Flood risk management · Flood retention areas · Urban planning · France

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8.1 Introduction

Since a few years, green infrastructures have become a cornerstone in the urban projects of most major cities. Locally, they improve the quality of life and may contribute to the image of metropolises worldwide. Some cities, such as Berlin, London or Toronto, are at the forefront and provide great case studies (Kazmierczak and Carter 2010), but it is also interesting to explore smaller scale projects in medium-sized cities, which are not so well-known but might be more easily replicated in most urban areas. In this context, this chapter focuses on two recent projects of green infrastructures in middle-sized French cities located in the Loire river basin (Western part of France). As stated by the European Commission (2013), those two cases are examples of "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" (p. 3).

More specifically, they can be defined as blue-green infrastructures (BGI) as they consist of a network of wetlands and associated open spaces along rivers (Ghofrani et al. 2017). The Ile aux Planches in Le Mans (Sarthe) and the Parc Balzac in Angers (Maine-et-Loire) are BGI which have been planned and designed around 2000. The two cases share similarities and constitute good illustrations of recent and innovative approaches in the design of multifunctional BGIs. Both were urban or industrial areas in the past, close to city centres. Planners had to face similar challenges: high flood risk, heavy pollution, but also a strong involvement of local inhabitants in the definition of the projects and conflicting situations with "un-invited participation" (Wagenaar 2014) of local residents in the decision-making process in Le Mans. In this chapter, we describe how planners progressively turned those challenges and constraints into assets and found solutions to build synergies. In both cases, multifunctionality is at the very roots of the projects. As often defined (Ahern 2011; Hansen and Pauleit 2014), the objectives of planners were to combine different functions (ecological, social, but also economic) in limited space, also leading to various services for local inhabitants (but flood protection before all). All along this chapter, we mainly focus on the case of the Ile aux Planches (Le Mans, Sarthe), which we have studied extensively for several years (Gatien-Tournat et al. 2016; Fournier et al. 2017a; Thaler et al. 2019) and we compare it with the Parc Balzac case (Angers, Maine-et-Loire).

First, we describe how both BGI projects were planned by local authorities to better address the flood risk locally and define multifunctional projects in urban areas where flood risk regulation had banned or strongly limited urbanisation. Then, we show how the design of the two BGIs benefited from citizens' and communities' involvement.

8.2 From Brownfield Sites to BGIs

The two cases of the Ile aux Planches (Le Mans) and Parc Balzac (Angers) share many similarities. Both sites are really close to city centres, along the main river (the Sarthe river in Le Mans and the Maine river in Angers). The Ile aux Planches is a 3-hectare blue-green infrastructure, while the Parc Balzac is about 50 hectares. In the beginning of the 1990s, they were still heavily polluted brownfield sites, owned by the French national power company (Electricité de France, EDF). In Angers, 50% of the area was covered with alluvial meadows, and 50% was a former controlled landfill. On the Ile aux Planches, industries were derelict, and most grounds were polluted. However, both sites were identified by local municipalities as potential areas for new urban projects, taking into account their strategic location nearby city centres.

However, the 1995 flood strongly hit the two cities and solutions needed to be found by municipalities to better deal with the risk. Local authorities decided to define and design mitigation projects on those sites. Since 2007, mitigation has been identified by the Floods Directive as a key strategy within Flood Risk Management policies. As defined by Hegger et al. (2016), "Flood risk mitigation focuses on decreasing the consequences of floods through measures inside the vulnerable area. Consequences can be mitigated by a smart design of the flood-prone area. Measures include spatial order, water retention within the protected area, or (regulations for) flood-proof building".

Most flood risk mitigation projects include measures to retain water in flood-prone areas. If mitigation projects have been quite common in several North-western European countries since the 1990s, it remains quite an innovative strategy in France (Fournier et al. 2016). However, more and more French local authorities have started to launch such projects (Fournier et al. 2017b; Morisseau 2012; Rode 2017). Indeed, if central government authorities prohibit building in the most exposed zones or limit projects in moderate-hazard flood-prone areas, developers must also consider various "necessities" and make sure they do not increase flood exposure either locally or at the level of the overall urban system. In this context, BGIs constitute a great potential for "resilient urban planning" (Liao 2012; Barroca and Serre 2012; Barroca and Hubert 2008).

In our two cases, the need to deal with those constraints had a great impact on the design of the local projects. First, both parks follow a topographic gradient of several levels. The Ile aux Planches (Fig. 8.1) is a hydraulic system. A discharge channel is at a low level on the island. It is about 50 m wide and is covered by a lawn which cannot be planted, so that the water flow may run easily. Other uses were defined and organised on the island. A playground was settled much higher. It is not accessible in case of flooding, and several gates prevent children from running towards the water. Tiered seats were installed on the side of the discharge channel so that concerts, plays or any other public events could take place in open space. The southern part of the island is occupied by a residential building, and a small patch of land remains non-accessible because of ground pollution. If multifunctionality is in

Fig. 8.1 Ile aux Planches, Le Mans (*Credits* M. Fournier 2019)

operation in the case of the Ile aux Planches, the park has been first defined as a key hydraulic infrastructure. It contributes to the protection of the neighbouring estates and, in case of flooding, no other use of the park is allowed.

The design of the Parc Balzac infrastructure in Angers (Fig. 8.2) also intended to favour multifunctionality (Ville d'Angers). It makes the best out of local constraints. The whole project uses height differences to meet several objectives (environmental, social and safety objectives). At a low level, a network of ditches and channels was dug and organised to restore a wide wetland (instead of the former landfill area). This wetland is flooded regularly in winter and spring. More than 1000 trees were planted on about 12 hectares (poplar trees, willows, alders and so on). The water level can be controlled with hydraulic works in this low wetland. This is particularly important in springtime as the network of ditches has been designed to provide spawning grounds for fish. Higher in altitude, wet meadows were restored for cattle grazing. Planners chose rustic breeds (Highland cattle, donkeys (baudets du Poitou, ânes du Cotentin)), adapted to wetlands and able to stay outside for several days with little care. Thanks to cattle grazing, the whole area is kept as prairies, which is also interesting for biodiversity. Some protected bird species nest in the meadows. Meadows are flooded when the river Maine is high, but most of the time, they remain out of water. In some meadows, a landscape of "green dunes" has been created, and vegetation varies depending on the altitude. Information about various environmental issues (biodiversity, floods, landscape) is provided for the public on several spots,

Fig. 8.2 "Parc Balzac", Angers (*Credits* M. Bonnefond 2022)

and it is possible to walk all through the area, even in case of flooding. Higher in altitude, orchards with fruit trees, bushes and oak trees were planted so that a variety of birds may nest. About 120 family gardens were settled and managed by a local association. This upper area is only flooded in case of major events. Contrary to the case of the Ile aux Planches, where the flood issue really dominated the definition process for the project, the functions of Park Balzac are more diversified: the control of water flow is important, but the objective is also to make the most of water to maintain a wide variety of natural habitats locally. As such, the Parc Balzac appears as a biodiversity reservoir first, nested in the very heart of the city.

Our two cases illustrate well planners' current strategies in middle-sized French cities to create synergies between various uses and services in BGIs (Scarwell et al. 2014). The need to give space back to rivers, even at the very heart of cities, leads to such flood mitigation innovative projects. Flood management is a key issue, but planners define projects within which water flows and water retention areas are designed to address other objectives (biodiversity protection, landscape, leisure activities and so on). Designed as multifunctional parks and BGIs from the start, both Ile aux Planches and Park Balzac have also been connected to the network of green areas at the agglomerations' scale, within which the river tends to become the spine of the network. If those projects may seem quite innovative, it is also important to point out that their design has been strongly debated locally, between the municipalities and local communities, all along the definition and implementation phases of the projects. In both Ile aux Planches and Parc Balzac, residents and associations have been strongly involved, leading to major evolutions in the final projects.

8.3 From "Un-Invited Participation" to Bottom-Up Initiatives in the Design of BGIs

When considering public participation processes in the design of the two projects, major differences quickly appear.

In the case of Parc Balzac, local communities' involvement was granted from the start (Meaujean 2007, Ville d'Angers). A first public inquiry was launched in 1992 to identify some potential uses for this derelict land. The municipality of Angers launched the definition and design phases of the Parc Balzac with local NGOs. The Ligue for the Protection of Birds (LPO) took an active part in the project of orchards as well as in the definition of maintenance practices for the prairies. A local fishing association was involved in the design of the ditches' network. Local gardeners' associations (*Fédération des Jardins Familiaux Angevins and Association des jardiniers de Belle-Beille*) contributed to the organisation of the family gardens. Today, those associations are still strongly involved in the management of the park. The LPO monitors bird populations, and the fishing association participates in the maintenance and monitoring of the network of ditches as they are potential spawning grounds for fish (pikes). In springtime, the water level is controlled in this water network for fish reproduction. A gardeners' association (*L'Amicale des Jardiniers de la Doutre*) is also responsible for the management of the family gardens. At last, biologists from the University of Angers have been involved in monitoring oak trees. As described, various actors have been involved from the start in the decision-making process and the design of Parc Balzac. Today, it proves to be quite successful thanks to this collaborative local governance. As already stated and discussed in the literature, this case is a good example of inclusive governance leading to environmental and social benefits (Buijs et al. 2016).

In the Ile aux Planches case, public participation started from a conflictual situation, which led to "un-invited participation" (Wagenaar 2014) of local residents first. By nature, planning projects often prove to be conflictual (Subra 2014) as they transform local land uses and activities. Several authors also point out the various outcomes of those conflicts on planning projects (Melé et al. 2004; Melé 2013). In the case of the Ile aux Planches, the conflict between the municipality and local residents contributed to the transformation of an initial housing project (promoted by the local authorities) to the definition of a multifunctional urban park as we know it today. In this case, we can speak of active citizenship, as defined by Moro (2012, quoted by Buijs et al. 2016, p. 1), that is to say: "citizens' ability to organise themselves in a multiform manner, to mobilise resources and to act in the public […] in order to protect rights and take care of common goods".

The conflict started during the 1990s when the municipality of Le Mans decided to launch a housing project on this island which had been recently bought from EDF. Two public inquiries were carried out in 1996 and 1997. The commissioner came to the conclusion that the housing project was not beneficial to the general interest and showed how vigorously residents were opposed to such a project. Claims were

written down to turn the island into a public park. A petition was initiated by a resident who had lived in the district his whole life, Mr Marcel Bréjou. He went door to door for several weeks in 1998 and collected 800 residents' signatures. After two years of failed negotiations with the municipality and EDF, the Ile aux Planches association was created to defend the project of an urban green park. Active members were present every Saturday at the local market to inform residents and collect ideas. Several press articles were published between 2000 and 2003. The association members were district residents, made of diverse socio-professional profiles. Aldermen and Department representatives also supported them. In the end, in 2003, the City Council approved the creation of a green park instead of a housing estate. The safety issue and the need to build a protection system for the neighbouring estates were a priority, but local authorities and members of the association reached an agreement so that the area would be designed as a green park. After the project was completed, the island association began to lose members. However, some active members wanted it to continue and started to diversify their activities (towards leisure, entertainment and cultural activities). Today, the association is still active and carries out various educational and social projects. Every year, the association participates in several social events which take place on the Ile aux Planches, and its members organise educational activities.

8.4 Conclusion

If many middle-sized French cities still lack public urban green spaces in the very heart of city centres, it is interesting to see how the flood risk issue and growing uncertainties about our capacities to deal with major floods lead to the definition of innovative projects in flood-prone areas. Today, the Ile aux Planches and Parc Balzac are multifunctional urban green parks in two middle-sized French cities, making the most of the fact that they are located in flood-prone areas. The design of the parks has been very much influenced by the various constraints that planners had to face, but they succeeded in overcoming them and even turning them into assets in their final projects. Today, both parks play a major role as BGIs. Since their creation, and at a larger scale, they have been identified by planners as part of the networks of green infrastructures of both urban agglomerations and constitute a connection between the riversides in the city centre and larger green areas on the outskirts of the urban area.

To conclude, can we consider that they really meet the same objectives? If both are multifunctional, priorities are not the same in the two projects. In the Ile aux Planches, flood risk management is the leading objective. Multifunctionality is identified as a target for the infrastructure, but the flood issue is central. All other uses stop when a flood occurs. In Parc Balzac, ambitions are more diversified. Flood retention is an objective, but the presence of water is also crucial for other functions (especially biodiversity protection). In this project, planners succeeded in transforming the flood risk from a constraint to an opportunity and made the most of the presence of water.

As such, the Parc Balzac may also be identified as a "Nature-Based Solution" (Cohen-Shacham et al. 2016) by local planners and flood managers: the presence of water addresses both biodiversity and flood risk management issues equally, and specific attention has been paid to the involvement and discussion of priorities with local communities. If such a planning strategy is already quite frequent in other European countries like Germany or the Netherlands (Kerr 2017), this remains less frequent in France. Literature (Haase 2021) also shows that the concept of "Nature-Based Solution" stems from the existing notions of BGIs or multifunctionality and brings progressively complementary approaches to integrating nature in urban planning. Eventually, those two projects have been successful thanks to the great involvement of local inhabitants and communities. Such involvement is mainly explained by the variety of functions and services which have been developed in the two projects and still contribute to their value.

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Chapter 9
'River Movie', Nature, and Culture Projects on the Banks of Lyon's Rhône and Saône Rivers

Natacha Seigneuret

Abstract In this chapter, we examine how three major regeneration projects to enhance green and blue infrastructure in Lyon's metropolitan area have evolved in recent years on the banks of the Rhône and Saône rivers. Already in the 1990s, Anneau bleu offered some solutions that have come to be viewed as central to preserving drinking water resources, natural areas, and biological corridors. In the 2000s, with the Berges du Rhône, the city dwellers' appetite for nature was satisfied with the creation of a relaxing place within a décor laid out as a natural space. Since the 2010s, with the Rives de Saône project, the riverbank riparian zone has become a natural and ecological connection between various elements of the metropolis. This project, named 'River movie' by its artistic director, was conceived as a journey along the Saône River featuring works by artists and a waterfront redesigned by environmental designers and landscape architects. It takes into account the reality that rivers sometimes overflow and proposes to adapt intelligently to the rivers that cut through the city. Thus, strategies and urban design are being reconceived to better address sustainable development and give more prominence to artistic interventions.

Keywords Green and blue infrastructure · Artistic interventions and sustainable development · Urban design and climate change · Lyon Métropole

9.1 Introduction

The challenges that metropolises are currently facing, including climate change and other anthropogenic pressures on the ecological system, require innovative ways of thinking about planning and design to ensure smart development and urban resilience (Emelianoff 2000). In this global context that increasingly prioritises sustainable development (fighting global warming, improving air quality, preserving biodiversity, etc.), the densely populated Metropolis of Lyon is an example worth studying. In this urban area, strategies and urban design are being rethought to better address

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sustainable development and give more weight to artistic interventions. The consideration of environmental issues is essential; however, it cannot be the only object of a design project, there must be a search for balance between sustainability, perennity, use and aesthetics of ecosystems composed of green and blue infrastructure.

In this chapter, we examine how practices in the metropolitan area's regeneration projects for green and blue infrastructure, as well as their relationship with the metropolitan territorial strategy, have evolved. After presenting our methodology, we examine the context of the Metropolis of Lyon and the evolution of its practices in three projects: Anneau bleu, Berges du Rhône, and Rives de Saône. The aim of this paper is to outline how public policies have been revamped to better meet the challenges of embarking on an ecological transition. In these emblematic projects carried out by the city over the past three decades, we observe how the gradual redevelopment of the Rhône and Saône riverbanks also demonstrates the renewal of the relationship between the metropolis and its green and blue infrastructure. Although we talk about renewal, we also take into consideration the words of Thierry Paquot, who reminds us that the idea is not new. Indeed, the demand for nature in the city is not a recent idea linked to an awareness of ecological issues but belongs to a kind of ancient "collective subconscious" (Paquot 2004). We will see how these projects have enriched urban design know-how in Lyon and form part of a long-term strategic vision.

9.2 Methodology and Context

9.2.1 Methodology

This chapter draws on research (Seigneuret and Novarina 2016) conducted on strategies and projects implemented in French metropolises. It is also based on a decade (2008–2018) of teaching architects, urban planners, and engineers at "Designing public spaces" workshops at the École Nationale des Travaux Publics de l'État and the Institut d'Urbanisme de Lyon. This teaching was carried out in collaboration with the Metropolis of Lyon. The work was done, on the one hand, by studying strategies of territorial planning and landmark urban projects at the local level and, on the other hand, by carrying out in situ investigations, conducting a series of interviews with architects and urban planners, and paying visits to architectural and urban operations. This approach enabled us to understand the developments that favour a systemic consideration of green and blue infrastructure and seeks to produce representations of an urban reality by giving equal weight to observation, description, and analysis (Chalas 2000).

9.2.2 Context: Metropolis of Lyon

In their construction of structured relations between the city and nature, the city of Lyon and later the Metropolis of Lyon has followed a classical French path. As early as the nineteenth century, the first urban park was created with the aim of providing all social classes with a place for pleasure and health. The Tête d'Or Park was opened in 1856 as a large urban breathing space and already conveyed the idea of using a plant network to structure and irrigate a densely urbanised territory.

In the twentieth century, this plant network was identified with the route of the rivers to support development. It was included in an urban development guideline (SDAU, *Schéma directeur d'aménagement et d'urbanisme* 1990). At the same time, the community's policy in favour of biodiversity was initiated with the drafting of an urban ecology charter (Charte d'écologie urbaine 1992) and the first climate plan in 2009 (Plan climat 2009). The green and blue infrastructure was mapped by the urban planning agency and included in a territorial plan (SCOT, *Schéma de cohérence territoriale*, 2010). Then, Gilles Clément, landscape designer, proposed the main orientations, included in a specific master plan (*Plan de développement des espaces naturels lyonnais* 2015).

The Metropolis of Lyon, which is home to some 1.3 million people, is a local authority created in January 2015 when the Communauté du Grand Lyon merged with the Conseil Général du Rhône to cover some 59 municipalities (Rapport de présentation de La Métropole 2015). This transformation was undertaken to establish Lyon's place in the cities that shape the global economy. It was also done to improve the efficiency of local public action and make it easier to understand.

Green and blue infrastructure—*Trame verte et bleue*—is explicitly specified in the local development plan (PLUH, *Plan local d'urbanisme et d'habitat* 2019). The main idea is to plan while keeping green and blue infrastructure in mind: on the one hand, to preserve and connect this green and blue framework, which supports ecological corridors, projects, and uses; on the other hand, to introduce more nature into the city, thereby improving the quality of the living environment and adapting to climate change. The metropolis also takes urban density into account. The impacts of this concentration of people create many issues, and the Metropolis of Lyon has chosen to transform these constraints into opportunities with a general approach that considers all areas—energy, mobility, new services, economic development, environment, urban planning, and the inhabitants—at the heart of the strategy to implement concrete projects and direct benefits. Recently, maintaining and reconstituting the green and blue network became part of the city's nature plan so that every inhabitant would have a piece of nature close to their home (Plan nature 2021).

9.3 Lyon's Regeneration Projects for Green and Blue Infrastructure

9.3.1 The Classical Relationship Between Nature and the Metropolis of Lyon

Most of Lyon's population live in urban areas and crave proximity to nature—a need that the Metropolis of Lyon decided to satisfy. Very early on, the metropolis' territorial strategy identified the two rivers—the Rhône and the Saône—as central to the city's future development. This strategy was validated and developed by elected officials from different political stripes and implemented thanks to the partnership between public urban planning departments and private architecture, landscape, and urban planning agencies (*Schéma directeur d'aménagement et d'urbanisme* 1990). The Rhône and Saône had suffered serious damage over the previous decades, and it was essential to produce a master plan that took stock of the existing projects and the main directions of the conservation and development actions to be promoted (*Schéma d'aménagement des berges du Rhône et de la Saône—Plan bleu* 1991). The first project of this master plan, Anneau bleu, aimed to preserve drinking water resources, natural areas, and biological corridors and was followed by an urban reclamation project, Berges du Rhône.

9.3.2 The Anneau Bleu Project: Water as a Natural Element

When it was launched, the Anneau bleu project provided answers that are now considered classic in terms of the relations between natural spaces, recreation, and urban development to create a sustainable metropolis. In the 1990s, to the east of the Lyon area, Anneau bleu aimed to fulfil numerous strategic functions for the metropolis, such as supplying drinking water, protecting against flooding from the Rhône, preserving the area's natural heritage, creating areas for leisure, and producing hydropower. As a result of the project, several large-scale operations have been carried out through a public partnership. They have concerned the development of a large natural ecosystem in the metropolis: the creation of the Feyssine Natural Park and the Saint-Clair Park, the development of the Crépieux Charmy Nature Reserve (the largest and primary source of drinking water for the city), and the development of the Miribel-Jonage Park on the banks of the Jonage Canal (*Charte d'objectifs de l'Anneau bleu* 2005).

9.3.3 *Berges Du Rhône Project: Water as an Element of Urban Décor*

The Berges du Rhône project has benefited from the knowledge acquired from the Anneau bleu project and the city's undertakings during its urban public spaces' (re)development. In the 1990s, different approaches were explored to forge links between nature and urban areas. Study tours were organised in Europe and enabled a common vision of sustainable urban development for practitioners and local elected officials. As a result, the Metropolis of Lyon embarked on projects that integrate the concepts linked to the development of an urban ecosystem:

- A global transport offer
- An integrated approach at the scale of the urban block
- Energy efficiency in buildings and housing
- A stronger presence of nature in public spaces: gardens make it possible to minimise the urban heat island effect, and sidewalks and riverbanks are designed so that rainwater can penetrate the soil and generate water absorption areas throughout the city.

This approach is more than a mere series of solutions to occasional problems. Along with the requirement to produce an urban environment that prioritises nature, this new practice also improves the inhabitants' quality of life. For the Metropolis of Lyon, intervention in public spaces is part of a wider strategy that includes territorial planning, economic development, quality of life, and the quest for social cohesion. From the point of view of planning professionals and local elected members, public spaces play a major symbolic and social role in city life and are, in a way, essential to it.

In the centre of Lyon, the Rhône River was the focus of urban reclamation in the 2000s precisely because it still projected an image of an attractive natural space. As part of the reclamation effort, the riverbanks were cleaned of traffic lanes and parking lots. The framework stressed the need to rediscover soils, water resources, flora, and fauna in cities where the ground has been waterproofed and sterilised. Thus, the banks were redeveloped into green spaces for leisure and now have lanes for soft modes of transport. The aim was to create a large shared space in park-to-park continuity by enhancing the architecture of the banks from the Tête d'Or Park all the way to Gerland Park in the south (Berges du Rhône 2006).

In this project, however, nature has remained under the control of man. The Rhône remains channelled, and its banks are developed for human activity as an element of urban décor (Fig. 9.1). Public spaces and riverbanks are designed to showcase the metropolitan area. Therefore, they contribute to perfecting the image of the metropolitan area and strengthening its attractiveness in the context of increasing competition between metropolises at the international scale. And we can observe with this emblematic place of the banks of the Rhône what Rosemberg calls an instrumentalisation of nature at the heart of urban marketing issues (Rosemberg 2000).

Fig. 9.1 Rhône remains channelled and Berges du Rhône is developed for human activity with mineral soils as an element of urban décor (*Source* Seigneuret 2022)

9.4 New Ways of Working with Sustainability and Climate Change

The Rives de Saône project was also part of the process of river reclamation that the Anneau bleu and Berges du Rhône projects had initiated. It aimed to make the riverbanks a place of life and well-being for all inhabitants of the metropolis: from the heart of Lyon to the Saône Valley. But, in various ways since the 2010s, this project has been designed to fit in with the landscape and the ecosystem rather than radically transform them:

- by taking into account the ongoing developments in nature-based solutions for a renaturation of the Saône and its immediate surroundings
- by distinguishing itself from other metropolises and proposing a different layout of the riverbanks: the Metropolis of Lyon decided to integrate contemporary art as a non-negotiable element of the project (Rives de Saône 2010).

9.4.1 Rives De Saône Project and Nature-Based Solutions

This project sought to preserve the natural area of the Saône Valley and stretch it to reach the centre of the conurbation, thereby reinforcing the relationship between the river and the districts and villages. The aim was to strengthen biodiversity by extending the vegetation of the Saône Valley to the heart of Lyon's urban area.

In the northern part of the metropolis, the objective was to protect the natural riverbanks by combating bank erosion and the spread of invasive exotic species that had degraded the original natural environment. In the southern part of the metropolis, where human presence is very visible, the vegetation has become impoverished and sometimes even disappeared. Plant species native to the Saône had to be reintroduced. In the centre of Lyon, the project took into account that the river overflowed and flooded its banks every year. In response, the development of the Terrasses Presqu'île will consist in intelligently adapting to the river to create a river garden along the Saône after demolition of the old mineral quays (Fig. 9.2). Hydrologists and landscapers are working on the creation of groves which will become real islands of vegetation during floods. With a very dense root system to resist the force of the water, the selected vegetation will be able to adapt to wet soil but also to periods of drought (Les Terrasses Presqu'île 2016).

Fig. 9.2 Creation of a river garden on the Terrasses Presqu'île in progress with demolition of the old mineral quays (*Source* Seigneuret 2022)

9.4.2 Rives De Saône: A Public Art Project

The Rives de Saône project aimed to create places for recreation and contemplation by strengthening existing uses and developing a public art project that involved a team of artists prior to the design. The artistic project named 'River movie' by Jérôme Sans, the project's artistic director, was conceived as a journey along the Saône River, a long breathing space featuring works by high-profile artists, Tadashi Kawamata, Elmgreen and Dragset, Lang and Baumann, Jean-Michel Othoniel, and a waterfront redesigned by environmental designers and landscape architects. According to Jérôme Sans, the story told in this 'River movie' can be read in two ways, a linear walk following the course of the Saône and a free walk following the contemporary artworks. Choosing works of contemporary art is finally leaving room for the imagination of artists who have the capacity to express contemporary societal issues regarding climate change and ecological transitions (Sans 2012).

9.5 Discussion for a New Conception of Green and Blue Infrastructure

In France, planners have become accustomed to adapting natural elements to urban constraints. This desire to control the natural elements was based on the modern Western dissociation and, thus, the supposed discontinuity between nature and culture—i.e. between natural spaces and cultivated, controlled, and domesticated spaces. A "French know-how" has been developed to control vegetation and watercourses, particularly since the work undertaken at Versailles for gardens, fountains, and water features and, later, in Paris with the work carried out under the direction of Baron Haussmann to introduce nature into Paris. Parks, promenades, and large avenues planted with trees became the setting for the movement of people and goods while promoting hygiene, comfort, and the aesthetics of the city (Donadieu 2007). This reference to Haussmann, as well as the theory of urban hygienists and urban modernists, was central to the design of French public spaces until the 1980s. It is characterised by high-quality layouts, and special attention was paid to having floor coverings and urban furniture and controlled plant and water elements, which are channelled and used as decorations to enhance urban facades.

Although modernity sparked the idea that man could master his environment and appropriate nature, we now know this is not the case, and it is time to change the paradigm. Cities and metropolises are studied as urban microclimates both in their geographical variations and in the diversity of their fabric according to the site, orientation, natural elements, hydrography, and vegetation, which are part of the green and blue infrastructure (Escourrou 1991). Among others, anthropologist Philippe Descola has made us reconsider the idea of nature and proposed a new approach to distribute continuities and discontinuities between humans and non-humans (Descola 2005). Over the past 20 years, there has been an ongoing debate over the urban design

of the future and sustainable development (Levy 2009). Climate change and the need to alleviate anthropogenic pressures on the earth system have forced planners and designers to propose new planning practices and designs. Thus, French urban planners and landscape designers are working on the concept of "*Trame verte et bleue*" and taking into consideration the penetration of this green and blue infrastructure, which offers ecological corridors between the natural areas surrounding urbanised spaces.

The originality of the Rives de Saône project lies in the dual objective pursued by the Metropolis of Lyon to create an innovative link between wild nature and sophisticated culture:

- An environmental project with a return to the wild character of the riverbanks with a restoration of the fauna and flora
- At the same time, an artistic project, 'River movie', with the use of contemporary art to enhance the green and blue infrastructure, and works of art selected to encourage awareness of the fragility of the biodiversity.

9.6 Conclusion

Our study shows there has been a renewal of the relationship between green and blue infrastructure and the Metropolis of Lyon. We note a progression and a growing focus on implementing old know-how while addressing new ecological concerns. The Anneau bleu and Berges du Rhône projects were the first steps in taking the environmental reality into account. Since the 2010s, the metropolitan authorities have gradually greened public spaces and favoured a quality of life that can be supported by the ecosystems.

The Rives de Saône project is a second step towards taking full account of the environmental reality and searching for a balance between sustainability and aesthetics, even though it is a 'top-down project', decided mainly by the elected officials of the metropolis. In line with the strategic development of Lyon's metropolitan area, the project has an economic and political dimension as the metropolis and its main stakeholders attempt to position their city among the greenest and most artistic ones in the European world. In a context of globalisation and the struggle for clout among metropolises, the latter are trying to anchor their specificity by relying on strong and consensual images (Lussault 2009). In this respect, highlighting the territory's natural spaces and biodiversity is a strategy for selling the image of a city with real or symbolic qualities. In the case of the Metropolis of Lyon, the qualities brought to the Rhône and Saône rivers are real.

First, this project's major challenges are its ecological and environmental dimension. The aim is to reinforce biodiversity by extending the vegetation of the Saône Valley to the heart of the urban area and to take into account that the river overflows and floods its banks every year. As a result, the metropolis was chosen as the "French Capital of Biodiversity 2019" in the category "Climate: nature as a source of solutions" (Lyon, capitale de la biodiversité 2019). The city has demonstrated that

biodiversity can offer positive solutions to climate change. The evolution of practices makes it possible to build new relationships between the city's residents and nature because protecting nature is now a necessary condition for a successful ecological transition (Plan nature 2021). And it shows how a metropolis learns to adapt to the character of its rivers and no longer adapt rivers to urban constraints.

Second, the Rives de Saône project demonstrates an "increase in the renaturation" of rivers and nearby spaces with the artistic project 'River movie', designed as a long walk in an open-air museum of contemporary art. This project reflects the idea that contemporary art should not remain in museums. Contemporary art should be exported to these ordinary places, and everyday places that are public spaces should be shared by as many people as possible (Ringlet 2011). In this example, contemporary art plays an important role in reshaping the relationship between man and nature with new spaces for reflection at a time when society is questioning itself and committing to evolutions and new approaches that are more respectful of ecosystems. The project's continuity was achieved thanks to an artist, Tadashi Kawamata, whose works can be used by everyone and allow people to walk along, see and touch the water. The other selected artists were invited to adopt a certain humility by adapting their interventions to the environmental characteristics. They sought a balance between perennity, use and aesthetics of the green and blue infrastructure and proposed a renewal of the Vitruvian virtues of firmitatis, utilitatis, venustatis around the Rhône and the Saône (Vitruvius 1486). Thus, they have shown that it is possible to move from functional urbanism that fails to respect nature to a sensitive urbanity (Desveau 2011).

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Chapter 10
Designing a Captivating Proximity to Water: Two Case Studies of the Iberian Peninsula

Caterina Anastasia

Abstract Although today the proximity to the hydrographic network is no longer a necessary condition to settle, riverfronts and blue-green corridors seem to be an appealing and winning urban regeneration formula and a support for landscape and urban projects that tend towards an urban habitability. When analysing how densely urbanised areas historically marked by watercourses become terrain where urban policy aspires to build a greener and liveable urban future, the goal is to understand what kind of role water is called to play with regard to the urban surroundings: from water as historical 'sign' and memory to water as one of the most immediate and affordable public space and connection. This paper focuses on two interventions implemented in Loures (Tagus Estuary humid system, Lisbon Metropolitan Area, Portugal) and Girona (Ter River Basin, Catalonia, Spain). Through the case studies of the Iberian Peninsula, both part of ongoing interventions aiming to create new 'vicinity' to (water) landscape for the general public, the work concludes that new-found accessibility and a captivating proximity to the waters—achieved even with limited intervention (by involving careful use of money and resources)—can be the first tool to value, recognise and appropriate urban open spaces.

Keywords Water landscape · Water-related urban project · Proximity to water · Tagus Estuary · Ter River Basin

10.1 Introduction

Nowadays, urbanised areas bound to water are, with good reason, potentially laying the groundwork for urban and landscape regeneration projects that aspire to deal with and challenge environmental resilience, a broader integrated water-urban arrangement, and context-based design strategies (Ranzato 2017; Muñoz 2019). Hence the current and future terms of water-related projects are mainly configured to adapt

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cities to the current climate emergency (UN Water 2010), contextualise the intervention on the basis of the physical, social and cultural characteristics of the local milieu (Muñoz 2019), and to address social justice in promotion (gentrification) and heritage preservation processes (Avni and Teschner 2019).

The water network can be the support for an advocated efficient construction and management of an 'urban ecological corridor'. The latter is seen as a possible way of resolving the contradictions in the process of rapid (or spreading) urbanisation by combining urban environmental problems and increasing human ecological demands (Biscaya and Elkadi 2021).

Water corridors, from mobility to environmental infrastructures, have been the foundation for continuous and profound functional transformations. As a 'cultural infrastructure', for being an important vital resource and a place of monumental identification, the river is also turned into an opportunity for a sort of 'redemption' (Farinella 2005). That is to say that it becomes a supporting element for urban regeneration processes, and, at the same time, it forms the basis of their verification.

This article will illustrate two public regeneration projects bound to water and located in the Iberian Peninsula: from the huge Tagus Estuary's water space and its humid system (in the Lisbon Metropolitan Area, Portugal) to the Lower Ter River Basin (in Catalonia, Spain).

The first intervention to be analysed is located in the Municipality of Loures, on the north bank of the Tagus Estuary, along a drainage watercourse flowing towards the main riverbed. The second intervention is located in the Municipality of Girona along the Ter main riverbed.

Among the characteristics of the two selected projects, we can identify a preeminent role given to water in the process of valuing, structuring and integrating/increasing the permeability of urban open public spaces. The latter are neither rural nor properly urban, but terrains (often neglected) located in-between constructions and part of our inhabited conurbations.

Both projects are part of huge ongoing interventions aiming to create new 'vicinity' and 'proximity' to (water) landscape for the general public. The work notes that, even if different in size, these two examples (and the design strategies that support them) show us a sought-after new nearness and connectedness to water. Both of these aspects are understood as a human sense that moves from the vicinity in space or relationship to a state of being joined and linked to local waters, towards a feeling of belonging to territories marked by visible water bodies.

Starting from the hypothesis that visible waters offer us both a 'scenic privilege' and a 'natural continuum' (Anastasia 2021), able to agglutinate vacant and underused contiguous spaces (Anastasia 2019), the article highlights how watercourses are today one of the most immediate (maybe the nearest) and affordable potential grounds for urban and landscape regeneration projects that are not necessarily wasteful in terms of resources and money.

The following paragraphs will show how, through a few targeted interventions, the geographic support represented by the waters becomes the medium par excellence to value, recognise and appropriate public (and not only public) open spaces, before neglected.

10.2 Water Resources as a Support for Urban/Territorial Regeneration: Two Project Experiences

In recent years, the Municipality of Loures (Portugal) has been particularly active in the rehabilitation of its entire hydrographic network. In this line, to improve the riverside habitat and the accessibility by the inhabitants, all along the 250 kms of existing municipal inland waterlines, the recently launched Strategic Plan for the Rehabilitation of Water Lines—*Plano Estratégico de Reabilitação de Linhas de Água no Concelho de Loures* (PERLA)—implements an integrated rehabilitation proposal (cleaning, re-naturalisation and requalification)**.**

The Route along the Tagus River in Loures—section from Santa Iria de Azóia to the BP Pier—is the first intervention, part of a large-scale project that foresees a path of about 6 kms along the north bank of the Tagus through the entire municipality of Loures and will link Lisbon (west of Loures) to Vila Franca de Xira (to the east). The future cycling-pedestrian route in footbridge on stilts made up of several 'shadow tunnels', observation points and bridges that will cross the drainage waterlines towards the Tagus aims to promote accessibility and observation of protected humid natural habitats. The footbridge is planned to coexist with the delicate environment it crosses. In fact, the route is designed to always meet two conditions: being one meter higher than the ground on which it sits and being higher than the maximum flood quota (due to rising estuarine water levels).[1]

The Ter River Pilot Project (Spain) is one of the on-site interventions which is part of the large-scale infrastructural umbrella project dubbed 'Girona's Shores'. Based on the idea of 'shore' as '" the space" and "the relationship" that we claim is fraternal between the interests of the natural and the urban in the urban ecotone' (Girona's shores 2020, p.7), the umbrella project is an effort—a 'territorial, applied research project', in the author's words (Franch 2016)—to reclaim, develop and promote a multifunctional green infrastructure at the town's edges (Franch 2018).[2]

The Martí Franch Office's self-initiated and self-sponsored project 'Girona's Shores'—not emerged from previous public demand or funding—is an experimental low-cost action with the aim to set up a replicable project method to mesh a green urban infrastructure in a short period of time with limited resources. The project site is divided into thirteen loops referring to Girona's major geographical elements: mountains, riverbanks, and plains. The project was offered to the city of Girona in 2014; in exchange, the city committed to executing and maintaining it for one year. Although modest, the projects were convincing and cheap and gave way to commissions for two pilot prototypes—one in the mountains and the other on the Ter riverside.

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[1] The characteristics of the future intervention are extracted from the project report: '*Percurso ribeirinho de Loures; fase 2 – Troço entre o rio trancão e Póvoa de Santa Iria; Projeto de execução de arquitetura paisagista; Memória descritiva e justificativa'* (February 2018), provided by the authors.

[2] '*Vora*' in Catalan means 'edge' and, at the same time, '*a la vora*' means 'near' or 'nearby' (within walking distance, close by).

By testing ideas directly on the ground and following maintenance protocols, the two Spanish pilot (prototype) projects are laboratories where operations and instruments are applied to implement design through the authors' definition of 'differentiated management design'. The 'differentiated management' is set up together with the municipal technicians—the head of the landscape management brigade and his team –who modulate the protocols in relation to technical know-how in landscape management. Through site-management procedures related to the maintenance regimes, the on-site design celebrates site peculiarities and facilitates its appropriation by the citizens (Franch 2018) also by exploring potential synchrony with cultural/sports events held by the city in its open spaces.

10.3 Two Case Studies: Making New Proximity to Water Possible

10.3.1 Route Along the River in Loures: 'New' Proximity to Water Through Elements Already Present in the Site

Route along the river – section from Santa Iria de Azóia to the BP Pier
Loures; north bank of the Tagus Estuary; Lisbon Metropolitan Area, Portugal
authors: Topiaris Arquitectura Paisagista + FTD Consultores de Engenharia LDA
promoter: Municipality of Loures (*Câmara Municipal de Loures*)
completed in 2017
700 m long
cost: 150.000 Euros

In this first case study, the new-found proximity to water is achieved by making accessible pieces of the industrial heritage located in a privileged position with respect to the Tagus' waters and by connecting them to public transport. The route unfolds from Santa Iria train station to an ex-industrial pier, now used by local fishermen. The path develops largely along a drainage watercourse that flows towards the main course of the Tagus, through a fragile environment of great natural value since it has marshes, reed beds, and streams, as well as areas of the estuary margin. Before the intervention, the area, occupied by disused industrial facilities, was fenced off.

With respect to the huge project of the future footbridge (see Sect. 1), the intervention carried out so far may be 'minor' in terms of surface area, cost, and elements of new construction. Despite this, we highlight the great value of an intervention that guarantees, for the first time in years, an 'official' public access to the Tagus River that can be adapted and repeated in all the ex-industrial vestiges with similar characteristics located along the river hydrographic network. The project strategy also seems to support and 'officialises' insured accesses and paths that the inhabitants and fishermen have used during the years when entry to the area was forbidden.

As materials of the project, such as to build and guarantee access to the Tagus riparian areas, Fig. 10.1 shows us the following main elements: a pedestrian walkway

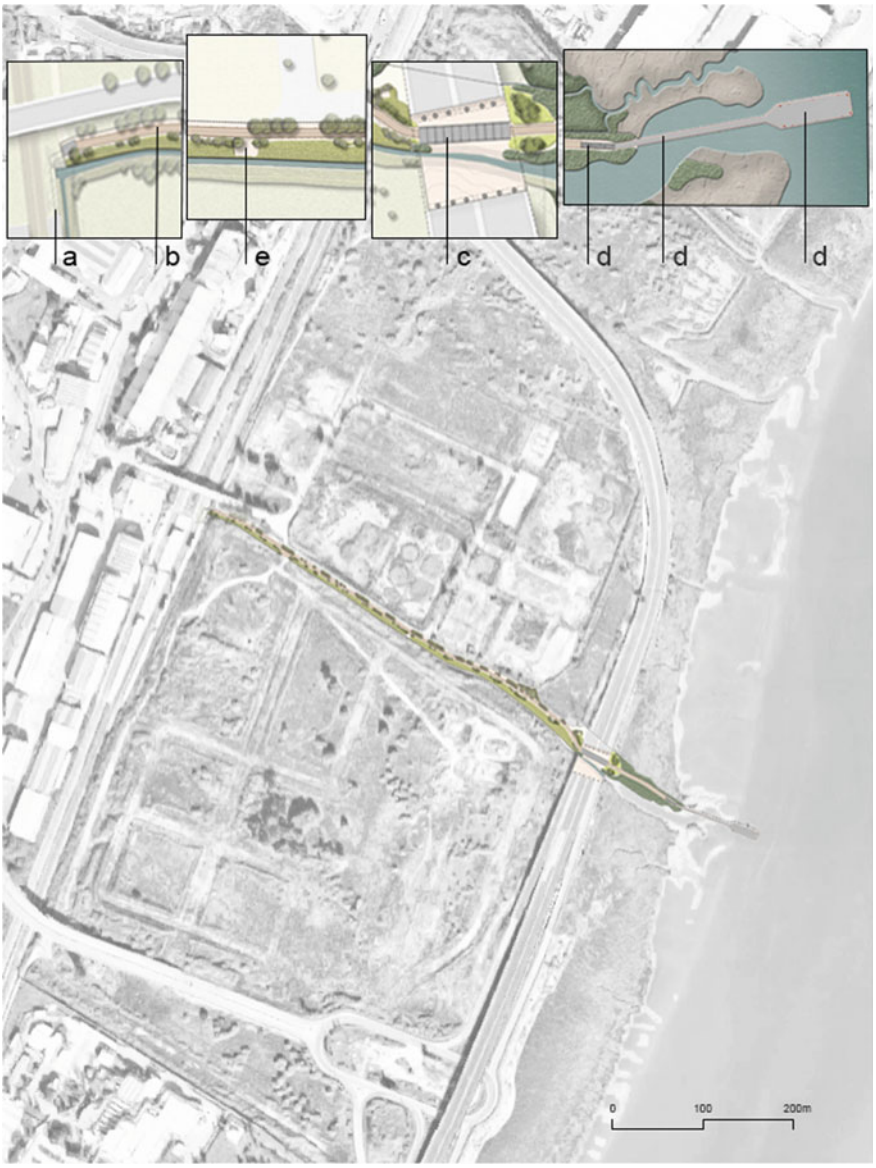

Fig. 10.1 Route along the river in Loures: aerial view and details (*Source* author's composition based on the map of the general project provided by Topiaris Arquitectura Paisagista)

that connects to the train station platform ('a' in Fig. 10.1); a cycling-pedestrian path made by clay on stabilised base, topped by wooden ridges and beacons denser near the canal (b); a passage under the road (c); a grating ramp and protective metal railing for the use of the rehabilitated pier (d). Along the route, rest areas are associated with

'zones of expansion of the view towards the water' (e). The latter are obtained by eliminating or pruning the already present vegetation (Fig. 10.1).

10.3.2 Ter River Pilot Project (Girona's Shores): 'New' Proximity to Water Through Rediscovered and Meshed Open Spaces and Views

Ter River Pilot Project – Umbrella project: Girona's shores
Girona; Lower Ter riverbanks; Catalonia, Spain
authors: Estudi Martí Franch
promoters: Estudi Martí Franch + Municipality of Girona
2014–2020
Ter's right bank Pont Major: 3,5 *hectares*; left bank: 10 *hectares*
cost: 3 €/m^2 - Maintenance: 1 €/m^2/year

In the Ter River Pilot Project, a new proximity to the Ter's waters is achieved by a flexible protocol that is constantly being rewritten in relation to the condition of the site. By applying the dubbed 'differentiated management'—the different intensity of vegetation management—the intervention redraws on the Ter's banks an ecological mosaic of forests and meadows and hierarchises a number of trails and paths. Once more, in this example, the project rediscovers (or re-colonises), empowers, and meshes open public spaces along the water by using means and 'materials' already present in the site.

New paths and trails obtained through different cutting regimes (i.e., high and low prairie zones) find their foundation in the 'view' they can offer to visitors. In fact, by encouraging a new outlook on the site, new 'relational visuals' (Franch 2018, p. 24), and, at the same time, new experiences of place, the riverbank landscape management provides three types of actions that involve the visual accessibility of the users.

For habitats that have to remain inaccessible, secluded and protected from the sight of human users, the project envisages a 'shelter' type vegetation management with little or no intervention. On the contrary, through the 'window' and the 'cutting' type of vegetation management, the visitors' views become the protagonists.

Thus, the view is the main tool for constructing a meshed green infrastructure along the water. That is how strategic mowing, through marks made in the prairie, visually attracts towards 'rooms' of low meadows that reclaim the best views and shaded spots. In addition, visual axes (as cuts across the landscape) connect people with local heritage landmarks. Depending on the context and through strategic pruning, the intervention designs a series of new and unfamiliar perspectives, such as strategic views of the river or beyond it (e.g., Girona Cathedral) (Fig. 10.2).

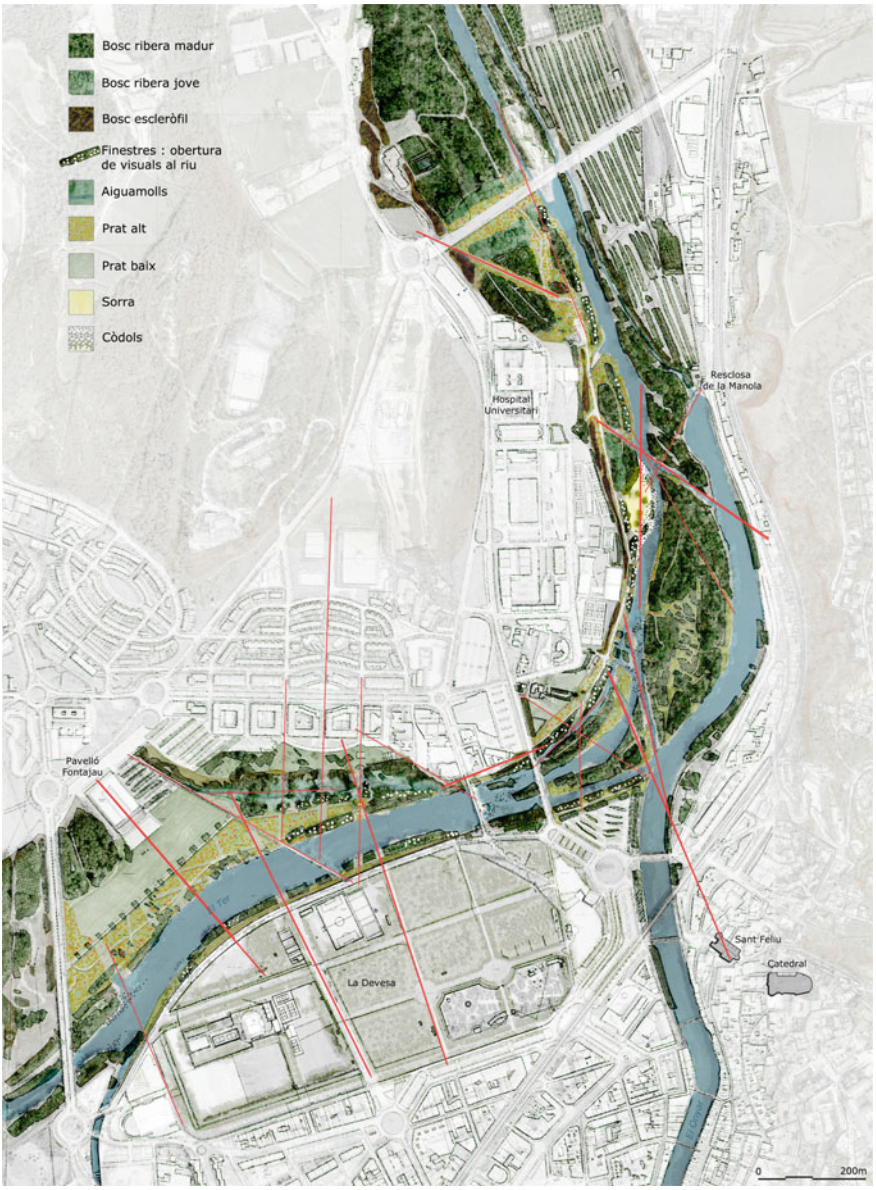

Fig. 10.2 Ter River Pilot Project: diagram of the Ter River proposal. From top to bottom: mature riparian forest; young riparian forest; sclerophyll forest; windows (opening of visuals towards the river); wetlands; high meadow; low meadow; sand; pebbles and visual axes (in red) (*Source* Estudi Martí Franch)

10.4 Final Considerations: To Build an Immediate and Affordable Proximity to Water

As part of the ongoing author's postdoctoral research that, in this phase, focuses on regeneration projects carried out along watercourses, this article aims to study examples that propose a renewal of underused and wasted areas along the water located in crucial and strategic urban and metropolitan enclaves.

As is often the case in riverside interventions, those analysed are mainly landscape projects (and planned by landscape architects) with minimal architectural interventions. The latter are almost always pieces of street furniture or '*confetti*' (ad-hoc micro-interventions that celebrate the site's specificities), like those planned in Girona.

Based on the hypothesis that water is, once again and today more than ever, a key resource for the design of inhabited environments (Anastasia 2013), the two interventions analysed above show us that water is the most immediate and affordable element of a given site, capable of easily meshing contiguous open spaces.

In a line that looks at water as the way and the place to design a greener and liveable metropolitan future, the article highlights some notes towards a new-found vicinity to the river achieved by both interventions.

Firstly, we note that, taking advantage of the 'break' in the urban built environment offered by the water space, both analysed projects envisage an expansion of the existing views as a tool to 'construct' and potentiate the new-found mesh of public spaces. Ad-hoc and targeted interventions such as: 'zones of expansion of the view' towards the river, the tributary, and the water landscape (in Loures), 'windows' and 'cutting' type of vegetation management that built strategic views and visual axes across the landscape (in Girona), become material of the projects. Hence spatial and visual relations move towards the construction of a territorial identity linked to waters. 'Vicinity in space and relationship' becomes a trigger of identity and encourages the public to engage with local water(scapes) and imagination.

Secondly, we stress that the process towards a structured, integrated, and increased open public spaces network supported by water does not necessarily require a great expenditure of resources and money. Both analysed projects show that even with minimal interventions –also in terms of added elements and physical impact– an advocated 'captivating proximity' to the waters can be achieved first and foremost through providing a (first of all visual) access to water spaces. That is to say, in addition to accessibility, as an unequivocal feature, a minimum intervention can ensure and sustain a green infrastructure along the water. Few elements, such as pathways (often already present in territories marked by watercourses, in the form of canal maintenance routes) and resting places, can be considered the minimum elements to implement a green infrastructure supported by waterlines.

To conclude, by borrowing Desvigne's suggestions, we note that, in urbanised contexts, intervention now means repairing, transforming, and redefining spaces and territories already inhabited and occupied (Desvigne 2012). In this line, the two analysed water-related projects show us strategies which can be gathered under the

label of 'maintenance'. As recently suggested by Panozzo, at the moment, it is a 'matter of maintenance'; that is to say, instead of big projects today, we need to deal with small 'mendings'. 'Maintenance as mending' and 'management as maintain'.[3]

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Chapter 11
Limiting Soil Sealing and Depaving: Local Actions for Regenerating Public Spaces to Build Green Infrastructures

Fabrizio Aimar

Abstract Green Infrastructure (GI) is part of nature-based solutions to mitigate and adapt the local microclimate and climate of urban areas to climate change. In Italy, the lack of green elements in urban spaces of medium-sized cities calls for improvement of the urban ecological network due to citizens' demands for better well-being and health. This chapter indicates the need to launch a national campaign to deseal over-paved public urban spaces and plant new green elements by 2030 as public space design actions. Limiting and then stopping soil sealing is the first condition to rethink public spaces in Italian, and even European, cities in a more holistic and resilient way. Secondly, encouraging citizen activism towards urban GI is strategic in resilient policies to improve connectivity and networking of the social fabric, as confirmed by the reported international and national cases. In this regard, GI is considered a multi-benefit solution that should be planned according to new digital tools in planning and architecture. The aim is to identify the most critical areas within the urban context that need to be depaved to accommodate green canopies, trees, green roofs, and other solutions with an approach potentially replicable in Italian and European cities.

Keywords Depaving · Heat island effects · Soil sealing · Nature-based solutions · Urban resilience

11.1 Introduction

"Green infrastructure is a planned network of natural and semi-natural areas in urban areas strategically designed to solve problems with storm water management, heat stress, air quality, and biodiversity, to name just a few examples. Urban trees, green roofs and facades, and constructed wetlands are some common examples." according to Johnson's definition (2019).

To support this description, semi-natural and artificial surfaces contribute significantly to higher summer temperatures in cities caused by their low albedo. This

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issue, known as the 'urban heat island effect', can produce "a monthly maximum UHI intensity varying from 1.7 to 4.5 °C" (Currà et al. 2019, p. 731), where "the temperature increase is more evident in the densest urban areas, near street level" (ibid., p. 731). Consequently, higher electricity supplies are becoming more and more necessary for air-conditioning work and living spaces "from 20 to 45% in the Mediterranean climate" (ibid., p. 731), with peak quantities and costs that could, however, be avoidable. Moreover, the rise in temperatures and sunlight contribute to the formation of tropospheric ozone, combined with "chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC)." (EPA 2021). All these factors are just some of those related to the Mediterranean region due to the impacts of climate change in Europe, according to Fig. 11.1 of the 2018 European Commission Communication (European Commission 2018, p. 3) (Fig. 11.1).

As a consequence, depave can promote the removal of unnecessary pavement from urban areas (e.g., asphalt and concrete) to recreate green spaces to host new green elements and vegetation (i.e., trees and shrubs) with the aim of mitigating the multiple and interrelated impacts of climate change.

Although the discourse around soil sealing seems more interrelated to ensuring food security (FAO, IFAD, UNICEF, WFP, & WHO 2021) in the framework of continued population growth (JRC-ESDAC 2014; Gardi et al. 2015) and limiting hydrogeological risk (D'Ambrosio et al. 2021) under the main challenge of climate change (Aimar & Repetto, in press) also health care and the quality of public spaces should be more considered in the coming city of the future.

In terms of health care and climate change-related issues, "mortality for populations in the EU has been estimated to increase by 1–4% for each degree of increase in temperature above a (locally specific) threshold." (European Commission 2014, p. 56). For instance, in Turin, Italy, "considering the period from 15 May to 15 July, again for the over-65 age group, the excess mortality observed over that expected is approximately 6 deaths per day on heatwave days. The overall excess mortality […] was 155 (an increase of about 33%) in the presence of a heat wave, while it was

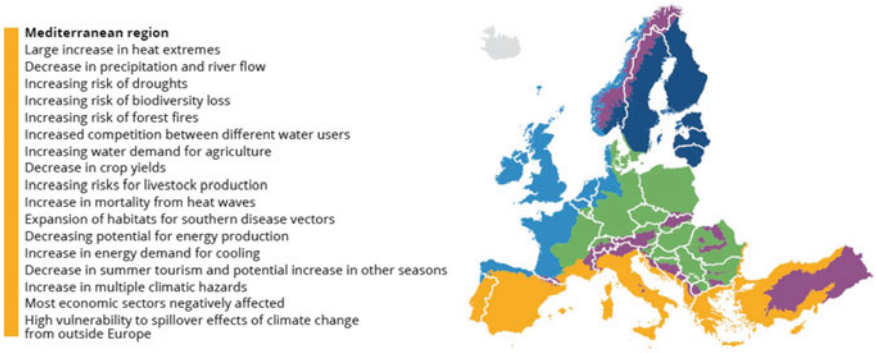

Fig. 11.1 Climate change impacts in the Mediterranean region of Europe. *Source* http://eur-lex.europa.eu, © European Union, 1998–2022

zero in the absence of a heat wave." (ARPA Piemonte 2015). Even when death does not occur, heat-associated pathologies may occur, such as dehydration and hypernatremia, heat-related cutaneous eruption, cramps, oedema, lipotimia, stress, and burn (Ministero della Salute, CCM 2019, pp. 11–16).

In addition, Italy is the second country in the European Union (EU) to record the risk of more premature deaths associated with exposure to PM2.5 and O_3 concentration levels in 2019, raising first in the rank of those attributable to NO_2 exposure (EEA 2021a). 63,710 deaths are estimated out of 364,200 in the EU-27 (i.e., 17.5% of the total) (ibid.). The worst affected area is confirmed to be the Po Valley, with the highest concentrations of particulate matter with a diameter below 2.5 and 10 μm, as well as ozone (EEA 2021b). PM10 concentrations are hazardous to health and cause decreased lung function (De Donno et al. 2018), while PM2.5 causes reddening of the eyes and skin, tumours, cardiovascular and human respiratory system dysfunctions (Xing et al. 2016).

In light of the above, the Guidelines on best practices to limit, mitigate, or compensate soil sealing by the European Commission (2014) propose a connection between health and the quality of public spaces. They mention that "the temperature under a tree is an average of 3 °C lower than the temperature of a pavement exposed to direct sunshine when the ambient temperature is around 30 °C." (European Commission 2014, p. 55). Specifically, they highlight how "a tree with a crown of 10 m in diameter evaporates 400 l/day, consumes 280 kWh of solar energy, and cools with a power comparable to that of more than 10 air conditioners." (ibid. 2014, p. 56). Moreover, "a tree captures an estimated 100 g net of fine dust per year (average value)." (ibid. 2014, p. 16).

Green Infrastructure (GI) would provide several other physical, psychological, aesthetic, and social benefits associated with vegetation. These include shading from the sun's rays in the summertime, protection against strong winds, evapotranspiration of rain on leaves, restoration of local habitat for the urban wildlife (small amphibians, reptiles, birds, and mammals), and reduction of road noise.

In a practical way, the abovementioned Guidelines continue stating that the "calculations for the city of Valencia indicate that 10 ha of vegetation are required to generate a drop in temperature of 1 °C; 50 ha and 200 ha of vegetation are required to reduce the temperature by 2 °C or 3 °C, respectively. With a size of some 135 km^2, approximately 1.5% of the city should be turned green in order to reduce the temperature by 3 °C (Van Zoest and Melchers 2006)." (European Commission 2014, p. 56). It follows that 2 km^2 of new green is needed to reduce the temperature by 3 °C for the city of Valencia, Spain.

What is mentioned above clarifies the need to act on the local scale to provide effective measures to counter these pathologies and limit the impacts of climate change in urban areas. Amongst those, this paper wants to propose an extensive depave of public spaces to create new areas useable for GI through their redesign. This project-based process needs to be based on urban planning measures in order to limit, mitigate, or compensate for the extreme effects of solar irradiance through new digital approaches.

11.2 Depaving as a Strategy to Implement GI in Urban Spaces

Land consumption occurs by artificial land cover due to buildings, infrastructures, solar parks, caves, and landfill areas, for instance. In Italy, the Italian Institute for Environmental Protection and Research (ISPRA) reported that about 64% of land consumption between 2012 and 2020 took place in a context of medium/low artificial density and 21.6% in a predominantly artificial context (Munafò 2021). Therefore, prevention measures seem necessary to avoid fragmented landscapes as well as residual urban areas.

Starting from a literature review (e.g., Taylor & Francis, Elsevier, and Springer journals and books, etc.), the early goal should evaluate how to manage the transiency of the soil sealing, from "zero balance" to its permanent arrest. Indicators for territorial evaluations would be individuated into a multicriteria spatial decision support system. Organising land use in the next planning policies could be carried out with big data and spatial analysis led by simulation tools. Investigations could involve several city plans, using high-resolution layers/CORINE to define sealed soil levels, as well as existing databases and GIS/web-GIS tools to explore geomatics, spatial analysis, and urban/land morphology, amongst others. A Geographic Information System can help map the solar irradiation potential by processing a digital elevation model (DEM) of the area under analysis, as well as the variations. Moreover, the urban traffic plans and maps, as well as changes in land surface temperature measured by the Copernicus Sentinel-3 satellite over the short to mid-term, should be consulted to better calibrate potential strategies and related actions.

One of the possible research outcomes concerns the creation of a software tool useful to determine a 'zero balance' between urban/periurban transformation areas and the re-naturalised ones, both at the municipal and provincial scale. This one would also help to determine a precise ratio between permeable/sealed areas and suggest measures as depave of the over-paved areas to be included in the local policies. Areas that could potentially be suitable for this are portions of churchyards, public schoolyards, market spaces, redundant parking spaces for vehicles, and existing avenues. The action will aid the increasing and/or creation of Green and Blue Infrastructures and their sustainable planning and management, mapping and protecting existing lands with high-production capacity (Land Capability Classification—classes I, II, and III). It could be a possible upgrade of two ongoing projects: the LIFE SAM4CP one, when combined with the existing Playsol simulator, and the SOS4LIFE project, to specify programs of urban soil desealing with analytic data.

According to the National System for Environmental Protection (SNPA) data, the 2019 report still confirms "a low incidence of public green areas on the municipal territory: if we consider the municipalities with two-thirds of the provincial capitals, the percentage value is lower than the average of the 109 municipalities (3.03%), and […] in 82 cities, this indicator does not reach 4%. In as many as 32 provincial capitals, the percentage is less than or equal to 1%" (Chiesura et al. 2020, p. 7). In particular, the report affirms that "particularly low values (less than or equal to

0.5%) are concentrated in the South and the Islands, and some cities in the Centre" of Italy (ibid.). Among this group, there are Genoa, Imperia, Belluno, Lucca, Pistoia, Massa, Grosseto, Arezzo, Viterbo, Teramo, Foggia, Lecce, Brindisi, Crotone, Enna, Syracuse, Nuoro, and Sassari (ibid., p. 8).

Consequently, a large campaign of depaving, combined with the plantation of new green elements, could be planned for the public spaces of most relevant cities and towns in Italy (e.g., regional and provincial capitals), according to the ongoing modifications imposed by the global climate change. As pointed out by Bastin et al. (2019), Turin will, in fact, suffer from an annual temperature increase of 2.1 °C by 2050, where its increase during the warmest month will be 7.7 °C, while that of the coldest month will be 1.7 °C of 2.5 °C by 2050, where the warmest month's temperature gain will be 7.2 °C and that of the coldest month 3.6 °C. Finally, Rome will undergo an annual temperature increase of 2.5 °C by 2050, where the temperature growth of the warmest month is 5.5 °C and that of the coldest month is 2.8 °C. In a nutshell, Turin and Milan will experience the current climate of Dallas, Texas (U.S.A.), while Rome that of Adana (Turkey).

All these data are to be understood and used as design inputs for more resilient cities, whose ultimate goal is the well-being of citizens and communities rather the merely GDP growth (Ripple et al. 2020). These objectives refer to the United Nations Sustainable Development Goals, in particular to the targets 3.9, 11.3.1, and 15.3 (UN 2015).

11.3 Best Practices and Community-Based Approaches in Depaving Private and Semi-public Urban Spaces

The community-based approach to depaving is already widespread in Anglo-Saxon countries such as Great Britain, the U.S.A., Australia, and Canada, and in Europe in France and Germany. For instance, the Depave association, based in Portland, Oregon (U.S.A.), "empowers disenfranchised communities to overcome social and environmental injustices and adapt to climate change through urban re-greening. Depave transforms over-paved places and creates resilient community greenspaces […]" (Depave n.d.).

However, Depave Paradise is operating as a project of Green Communities Canada, which was established in Peterborough in 2012. During this period, it has desealed 14,565 m^2 in 28 cities, with a benefit of 5485 m^3 of stormwater diverted annually (Depave Paradise 2022). In the same line, the Mayor of London in the UK provided "A Guide to Community-Led Depaving Projects" entitled "Grey to Green" (Mayor of London 2019), which refers that "a community planting event is a great way to involve the local community in the fun parts of the project." (ibid., p. 10).

In Italy, the option of depaving "and planting trees on grey areas" (Pastore et al. 2020, pp. 90–91) is envisaged by the project 'ForestaMi' by the Metropolitan City of Milan, the Municipality of Milan, Parco Nord, Parco Agricolo Sud, and ERSAF.

It asserted that "21% of new trees will instead be housed in grey areas, i.e. on paved soils" (ibid., p. 116), in which "a 'top-down' quantitative estimation work" is to be placed side by side with a "bottom-up listening and mapping work of the Milan Metropolitan City territory." (ibid., p. 112). The numbers of the pilot project mention "130,407 square metres of car parks and squares to be depaved" in "19 Areas for forestation measures on impermeable soil" by 2030 (ibid. p. 225).

Before planting, an analysis of the soil after the depaving process should be carried out to check for the presence of pollutants such as lead or hexavalent chromium. Using native plants is recommended in order to create an urban habitat for native plant and animal species that can reduce water volumes for irrigation and fertiliser quantities. Such low-cost measures would allow the implementation of ecological infrastructures aimed at increasing biodiversity in the urban environment.

As recommended by The Nature Conservancy, "finance and policy to enable tree planting for public health" should be developed more to sustain this practice (McDonald et al. 2017).

In terms of policies, these bottom-up approaches could be part of the studies and analyses includable in the amendments to the clauses of the bill DDL S.2383, "Limiting land consumption and reuse of the built-up land" ["Contenimento del consumo di suolo e riuso del suolo edificato"] (Senato della Repubblica 2017), in particular to the article 2.1, point g. It suggests, concerning environmental compensation, "the adoption […] of measures to recover, restore, or improve, […] the functions of already sealed soil through its de-permeabilisation and to restore the natural condition of the soil." (ibid., p. 5). The bill is still being examined by Commissions no. 9 'Agriculture and agri-food production' and 13 'Territory, environment, environmental goods' of the Senate of the Italian Republic as of 2017. Likewise, the development of new Green Infrastructures "… could also be considered in the revision of Interministerial Decree 1444/68 on urban standards." (Munafò 2021, p. 40).

In terms of funding, more studies should be carried out to understand the costs of the correct management of these urban GI. Planting has to be followed by proper management of the plant elements, ensuring appropriate pruning, health treatments and replacement of dead, felled, or decaying ones. The management is a sensitive issue, both in terms of funds and workforce available to municipalities. By the way, the white paper issued by The Nature Conservancy estimated that "spending just $8 per person per year, on average, in an American city could meet the funding gap and stop the loss of urban trees and all their potential benefits." (McDonald et al. 2017).

For instance, in Asti, Piedmont, Italy, joint surveys carried out by the Landscape Observatory, together with Legambiente Asti and Valtriversa, highlighted the occurrence of a good number of dead/felled or decaying trees in two local avenues in March 2019. In Corso Torino avenue, 42 out of a total of 203 specimens need to be replaced in about 900 m (Osservatorio del Paesaggio per il Monferrato e l'Astigiano 2019a), while out of a total of 204 trees in the 720-m-long Corso Matteotti avenue, as many as 84 were found to be dead, absent, and/or in a serious condition of decay (Osservatorio del Paesaggio per il Monferrato e l'Astigiano 2019b) (Fig. 11.2).

Appropriate replanting will be carried out by the Municipality of Asti in participation with the retailers of the two avenues to remedy this situation through "concrete

Fig. 11.2 Some photos of the arboreal surveys in the tree-lined avenues of Asti in March 2019. From left to right, a missing tree (Maple negundo) in a plot later cemented over or left green, while on the right, a felled flowering cherry tree. *Photos courtesy* Osservatorio del Paesaggio per il Monferrato e l'Astigiano

actions of sharing management activities to achieve effective rooting and development of the trees over time." (Osservatorio del Paesaggio per il Monferrato e l'Astigiano 2019a).

11.4 Green Infrastructures Projects

Next, some international design examples of urban greening through the inclusion of Green Infrastructure are proposed. In Tirana, the capital of Albania, the adoption of green specimens when resurfacing driveways is carried out by the goodwill of the municipality as the urban Green Plan is absent. The chosen trees (mostly birches, but also magnolias, maples, sycamores, etc.) are selected on the basis of the available road section and planted usually 6 m apart (Fig. 11.3).

In Italy, Law No. 10 of 14 January 2013, titled 'Rules for the development of urban green spaces', imposes some legal obligations that can be leveraged for the enhancement of Green Infrastructure, synergistically with the design of urban public space. Article 2, in this regard, states that "Two months before the natural expiration of the term of office, the mayor shall make known the arboreal balance of the municipality, indicating the ratio between the number of trees planted in publicly owned urban areas at the beginning and the end of the term of office, respectively, giving an account of the state of consistency and maintenance of the urban green areas under the mayor's jurisdiction" (Italian Parliament 2013).

To cite some Italian examples of mid-sized cities, in Pescara, Marche, the planting of 140 specimens in 14 city streets and squares follows the strategy of "… restoring the failures that have been created, especially on streets and squares, enhancing the greenery in some public areas" (Il Tirreno 2019). In 2019, stone pine, wax-leaf privet,

Fig. 11.3 Project for new Green infrastructure added to the renewal of the road surface and pedestrian pavement in Rruga Dora D'Istria in Tirana, Albania. The width of the pavement is 2 m, while the distance between the two tree boxes is around 5 m. *Source* the author

Callery pear, judas-tree, Carpinus Orientalis, and common Hibiscus were planted, and other specimens of Viburnum Lucidum followed in 2022.

In Novara, Piedmont, "… thousands of new trees were planted, resulting in a very high number of trees in the city, more than 30,000." (Novara Today 2021). In March 2021, 420 more trees were being planted by the Municipality of Novara. Plantings included Norway and field maple, London plane, ash, hackberries, tilia, tulip tree, plum, elm, oak, Aesculus, pear, hawthorns, crepe myrtle, sweetgums, and hornbeam. Furthermore, "In addition to laying, the work also includes triennial maintenance with punctual watering." (ibid.) as a correct ex-post management strategy.

However, despite calls for urban forestation and obvious needs, ISTAT found a modest increase in the urban green/inhabitant ratio, from 31.1 (2011) to 31.7 (2017) (ISTAT 2017).

11.5 Conclusions

As the discussion makes clear, soil plays a central role as a microclimate regulator in urban and suburban areas. Indeed, its virtuous management can mitigate the adverse effects of 'urban heat islands' on human health thanks to the Green Infrastructures deployment (GI). Urban greenery is a bio-compensation measure that also ensures energy saving, reducing energy bills related to heating and cooling during the winter and summer seasons.

Depaving could be a valid project strategy to be implemented in the urban planning agenda to obtain usable land for planting a network of green elements, in addition to the green roofs and vertical gardens; however, the latter are not the subject of this

chapter. Moreover, it can be useful for achieving the targets 11.6, 11.7 and 11.b of the Sustainable Development Goal 11 "Make cities and human settlements inclusive, safe, resilient and sustainable" (UN 2015). These scalar measures, therefore, go from the size of the street to the city to add value, creating a better urban dimension thanks to the redesign of public spaces. From this perspective, Green Infrastructures should be considered multi-benefit solutions, instrumental in creating adaptive and resilient thinking through shared outlooks with citizens.

In this regard, ensuring biodiversity through the provision of ecosystem services is fundamental in designing future cities with high population density and low emissivity. Therefore, starting from a census of existing green elements in the urban and peri-urban context, the interdisciplinary collaborative work between architects, planners, and agronomists becomes necessary to intervene in the public space in a conscious and targeted manner through the selection of the most suitable and native plant species.

In addition, other similar cities in Europe can benefit from the study and calculations led by Van Zoest and Melchers (2006) for Valencia, Spain, such as Turin (130.17 km^2) and Rimini, in Italy (135.79 km^2), Seville, in Spain (140 km^2) and Nîmes, in France (161.85 km^2), amongst others.

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Chapter 12
"Surviving the City". Nature as an Architecture Design Strategy for a More Resilient Urban Ecosystem

Roberta Ingaramo and Maicol Negrello

Abstract In a scenario in which cities will be the environment inhabited by more than 80% of the world's population, architecture has to respond to the challenge of shared living in a critical environmental context. Climate change has pushed the architecture profession to expand its knowledge for more adaptive design towards the environment and its inhabitants. Nature becomes the strategy that can help reduce the impacts of climate change on cities and improve people's mental and physical well-being. This essay investigates the architect's new role in the green transition. This necessary transition opens up new scenarios: design should overcome the individual building and the massive use of technologies or simple retrofitting but deal with the relationship the building has with its context. New tools derived from research and the ecosystem-based approach can help respond to the main goals of Agenda 2030 and the values of the New European Bauhaus. The analysis of case studies will demonstrate the effectiveness of this trans-scalar approach, from the single building to the urban scale.

Keywords Climate change · Adaptation · Mitigation · Urban design · Landscape design · Nature-based solution

12.1 Introduction

Urban resilience is the goal cities are trying to achieve. However, the effects of climate change, such as sudden cloudbursts or extreme heat waves, have shown how inadequate cities are to adapt to these phenomena (Roggema et al. 2021) that are caused by the interaction of climatic factors and anthropic activities within cities (Panno et al. 2017).

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In the European context, Mediterranean cities are particularly exposed to extreme events that undermine human safety and wellbeing (Sanesi et al. 2011).

Scholars (Dolney and Sheridan 2006; Hajat and Kosatky 2010; van den Bosch and Ode Sang 2017) have shown how high urban temperatures cause significant health problems. These issues mainly occur in urban fabrics with low or medium incomes, particularly in areas with deficient green spaces (Astell-Burt et al. 2014; Wen et al. 2013). Urban density, the scarcity of vast green areas, and the choice of materials (and consequently of reflection coefficients) increase temperatures (Oleson et al. 2015), exacerbating thermal discomfort (Stone 2012), and generating problems of psychophysical origin (Evans 1984; Hartig et al. 2003; Noelke et al. 2016).

The ongoing urban growth scenario estimates that 80% of the population will live in cities by the middle of the twenty-first century (Kabisch and Haase 2011; Panno et al. 2017). Establishing strategies for a healthier and less polluted urban environment can contribute to better well-being, reconsidering the living space not limited to the residential unit but for the whole urban scale. Using nature as a mitigation tool increases the resilience of the urban environment. It also contributes to reducing psycho-physical problems generated by degraded places, amongst the leading causes of reducing the quality and duration of life (de Vries et al. 2003; Negrello and Ingaramo 2021; van den Bosch and Ode Sang 2017). It prevents socioeconomic inequality, offering access to natural spaces to more people. Indeed, public space and urban design become crucial for achieving equal resilience.

Moreover, studies on the regenerative potential of green space design show that the use of nature as a design strategy contributes to improving urban conditions, in particular: by reducing urban heat islands (Inostroza 2014) and improving air quality, approaching climate mitigation and adaptation goals (Kabisch et al. 2016). In Europe, urban planners have continuously advocated that nature and climate factors, proximity, and ease of access to natural spaces should be integrated into sustainable urban planning (Fan et al. 2017; Gehl 2010).

However, it is crucial to transpose guidelines and policies into projects, managing these ecological networks (so-called blue and green infrastructures) as individual pieces of an urban project. It follows that the boundaries of this project go beyond the logic of the separate building. Although aiming at maximum local energy efficiency, this approach does not contribute to generating an adequate impact on the urban energy transition goals in a decisive way because it tends to consider each building cell as a closed-loop system (Leone and Tersigni 2018). This reflection highlights the need for a scale shift involving individual building structures and public space in a comprehensive transition project that impacts the urban microclimate and, consequently, energy consumption, the environment, and the well-being of citizens.

This shift in scale, or rather extension of the sphere of living, includes the overcoming of the concept of energy efficiency, which in turn is part of a multidisciplinary and multi-scalar project that merges and has to manage human action, the balance of natural systems, and socio-economic effects (Leone and Tersigni 2018).

The transition to an urban environment that can meet the challenges of the city's ongoing climate scenarios is revolutionising the concept of urban development. This rediscovered form of environmental humanism, where the well-being of the environment merges with that of the user, shows that the concept of the "city-machine"—also referring to Le Corbusier's vision of the *machine à habiter*—is outmoded.

Architecture becomes a super-efficient machine, in which technology is the crucial element to ensure ephemeral comfort. The massive use of technology represents man's tool to defend himself against nature and the possible climate hazards. In the 1960s, this approach was evident in Buckminister Fuller's visionary 3-km-diameter geodesic domed projects above New York City and the Minnesota Experimental City designed by Spilhaus Athelstan under Fuller's influence. Maximum efficiency is overcome in favour of promoting well-being and an adaptive, biophilic urban space.

In this new paradigm shift, greenery represents an urban standard with a decorative character and becomes a climate device capable of creating environmental conditions in symbiosis with the inhabitants' well-being (Eekelen and Bouw 2020).

The intensification of the impacts of climate change on urban areas, both now and in the future (according to the 2050 and 2100 scenarios studied by the IPCC in its annual reports), shows how the public space adaptation can transform these places into resilient urban systems. Those systems consist of widespread networks of site-specific architectural interventions, which assume that every urban space can have a new scenario and role in urban metabolisms.

Every urban element contributes to urban resilience: not only current green spaces (parks or gardens) but also hardscapes such as squares, small green areas, sidewalks, small "third landscape" spaces, and roofs.

12.2 Professional Adaptation: The Architect's New Skills and Tools for Design

Climate impacts are expected to change how we live, plan, and design our cities and landscapes (Roggema et al. 2021). From policy to action, the architect plays a crucial role in creating and managing adaptation and mitigation projects. Climate change requires architectural solutions able to solve not only the technological efficiency of the building but, primarily, the inhabitant's wellbeing. Architecture needs to redesign buildings considering the relationship with the public realm being part of the urban metabolism: spaces in-between are the core of interaction and the main object of design experimentation for green transition and climate-proof spaces.

Hence, the architect's role requires additional knowledge to deal with a new design form that integrates urban and environmental needs, as they are two sides of the same coin. Today, it is possible to see an evolution of this role which has become the emblem of a multidisciplinary professional able to approach different implementation scales.

At the same time, skills from different disciplinary fields, such as urban temperature management, wastewater management, biology, environmental psychology, sociology, anthropology, and a certain degree of empathy, become fundamental knowledge for redefining an urban environment with adaptive and comfortable microclimates. This integration of technical disciplines such as architecture and botany also merges with the social sciences to enhance the user's well-being. Nature also becomes a solution for the physical and psychological care that can be a tool for architecture, such as in the project of the new Policlinic in Milan by Stefano Boeri. The building has a rooftop garden, with areas dedicated to horticultural therapy and immersive spaces dedicated to nature-chromotherapy for hospital patients.

12.2.1 Research as an Adaptation Tool

Just as the figure of the architect changes, so do the strategies and tools of design, contributing to creating an increasingly liveable urban environment for all.

The approach to building an adaptive environment is not only focused on designing new neighbourhoods or single efficient buildings but also on strategies that consider the existing urban tissue: reusing, demolishing, adding, retrofitting, and, most of all, greening.

It is essential to consider that actions for an adaptive transition to "survive" future conditions place the well-being of the citizen and the environment at the centre of the research.

For this reason, in recent years, significant architectural practises have equipped themselves with in-house tools and research centres that could transform innovative experimentations into architectural practice. In particular, this continuous research has brought new tools to architectural practises based on the relationship between architectural form and environmental impact.

A case in point is MVRDV NEXT, which experimented with combining environmental and architectural modelling to achieve an optimal building morphology. LAND, with its Research Lab, adapts the concept of BIM to the landscape to assess environmental performance. Our research team in Politecnico di Torino (Ingaramo, Negrello, Pollo, Trane, Giovanardi, and Fregonara) has also experimented in research, thesis, and final design studios with the use of software and technologies (ENVI-met) to conceive architecture and public space able to create more resilient and climate-responsive habitats (Fig. 12.1).

The figure of the architect has therefore changed to adapt more quickly to climate requirements and the use of new tools to realise climate-resilient projects.

The novelty lies in integrating the concept of architecture with urban design and landscape, overcoming the idea of a clear separation of the two strategies. Architecture, to be adaptive, must be able to dialogue with its context and landscape not only by focusing on the challenge of Net Zero Energy Building with the use of a very high degree of technology but also by choosing an approach that integrates architectural choices and Nature-Based Solutions (NBS). The underlying concept is, therefore, to

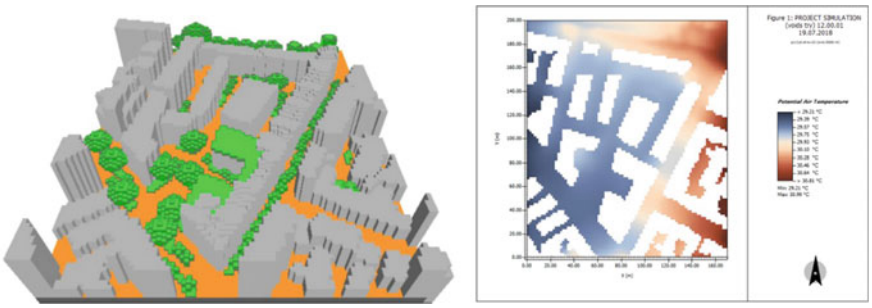

Fig. 12.1 Example of ENVI-met modelling and analysis of post-design urban microclimate. Architectural and urban design studio 'Adaptive to resist + mitigate'. *Source* elaborated by Politecnico di Torino research team (with Ingaramo and Negrello)

go beyond (and partly integrate) the idea of extreme technical efficiency but to focus on creating places, architectures, and spaces for inhabitants' well-being that help the city "survive" the demographic increase and climate change effects.

12.2.2 Nature as a Strategic Device for Adaptation Plans

Major European cities are developing plans to adapt the urban fabric to the climate crisis based on nature. The plans' goals are common: prevent the damage, minimise the damage, and reduce the city's vulnerability. These plans adopt adaptation and mitigation strategies that refer to the ecosystem-based approach, from which originate Nature-Based Solutions (Eggermont et al. 2015).

The European Commission defines NBS as "actions that are inspired by, supported by, or copied from nature"; those have an enormous potential to be energy and resource-efficient and cope with the challenge of climate change in urban areas (European Commission 2015). The EU community also funds programs such as Urban By Nature to promote networking amongst cities, researchers, SMEs, and NGOs to build bridges with the NBS communities across Europe, Asia, and Latin America, to find common strategies to be applied.

The various actions aimed at greenhouse gas storage, reduction of air, soil, and groundwater pollutants, temperature reduction, and permeabilisation result in projects to restore urban and non-urban degraded areas and ecosystems through the tool of the natural elements that merge with the built environment.

However, it is necessary to emphasise how these strategies must be adapted to local conditions (such as climate, biotypes, culture, and urban morphology) to provide economic, social, and environmental results (European Commission 2015). Since the NBS are ecosystem services, they increase the well-being and influence the environment, local community, and economy. For those reasons, the results of these NBS play a critical role in promoting a cultural shift from a resource-intensive growth model towards a more resource-efficient, inclusive, and sustainable one. Those radical innovations involve actors from different sectors, domains, and scale levels in the co-design and co-implementation of solutions (Faivre et al. 2017; Nevens et al. 2013; van de Meene et al. 2011), where applying negotiation and cooperation amongst multiple stakeholders from municipality level to the community (Xu et al. 2021).

12.3 Applications: From the Dwelling to the City

12.3.1 Reconnecting Home with the Environment

In the transition to a responsive environment for climate adaptation, domestic spaces also play a crucial role in the user's psychophysical well-being.

Especially after the pandemic, it has emerged how much the living spaces need to be rethought by overcoming the concept of existential minimum and reasoning

Fig. 12.2 Lufa farms rooftop greenhouse in Montreal. *Photo* Maicol Negrello 2018

about the role of filter areas that allow a more direct connection with the outdoors in-between spaces (such as balconies, rooftops, greenhouses, and gardens).

The concept of new filter spaces expresses a high grade of flexibility, such as greenhouses that—mainly used in Nordic countries—become places for interaction and indoor agricultural production (Negrello 2019), becoming an increasingly present trend in new architecture design experiences and research (Ingaramo et al. 2020).

The greenhouse element can become a solution for improving environmental conditions, especially indoors, producing food (Fig. 12.2), and contributing to the well-being of inhabitants. Three representative cases of this device have been chosen, which can be applied to existing buildings and new construction.

12.3.1.1 Transformation of 530 Dwellings—Bordeaux

The project, designed by Lacaton & Vassal with Frédéric Druot and Christophe Hutin architecture, consists of fully occupied transforming three modernist social housing buildings. The approach was to reconsider the existing building (without demolishing and invasive interventions) while preserving the structure and enhancing it through a new glazed envelope. This choice achieved savings in economic, social, and environmental terms, as residents were able to inhabit their homes during this transformation.

The new greenhouse envelope increased the outside/inside (in-between) space, creating a new domestic filter between the building and the environment (Fig. 12.3). Winter gardens increase the flexibility of housing and improve psychophysical conditions through extensive use of natural light, thermal comfort, panoramic views, and more flexibility of movement.

The intervention is exemplary and demonstrates how a biophilic approach can be applied even in the built environment: nature and natural elements (such as natural light) become devices for improving living conditions.

Fig. 12.3 Transformation of 530 dwellings, Bordeaux. Courtesy of Philippe Ruault

12.3.1.2 Boréal—Nantes

French firm Tetrarc applied sustainability and resilience principles in the Boreal project. The building designed for social housing has a new flexible space: a glazed envelope that increases the surfaces and possibilities of uses and allows a direct connection with the surrounding environment, improving comfort conditions and making the structure more efficient. The presence of nature, which surrounds the building, becomes an element of aesthetics and biodiversity and a tool for community engagement—essential in these socially-oriented transformations—for agricultural production, self-sufficiency and micro agricultural economy.

This brand-new project, with excellent placemaking potential, is characterised by architectural choices that have a social impact, offering even less wealthy segments of the population to enjoy a more excellent biophilic relationship.

12.3.2 Urban Nature as Adapting Device: The Case of Copenhagen Redesigning the Climate-Resilient Public Realm

Amongst the cities that have acted on morphological modification of urban space to increase the resilience of the built fabric, Copenhagen turns out to be the one that has displayed an exciting approach and high transition speed in Europe. The Danish capital represents a virtuous example of how climate change represents an excellent chance for urban development (Xu et al. 2021).

The municipality to face the climate crisis has adopted, starting in 2011, three proactive plans to reduce the impact of the future hazard: the Copenhagen Climate Adaptation Plan (adopted on 25 August 2011), the Cloudburst Management Plan (adopted on 13 December 2012) and the Climate Change Adaptation and Investment Statement (2015).

The Danish capital has adopted the Climate Change Adaptation Plan that defines urban regeneration areas. The plan has invested in the reconversion from single urban tassels to more ambitious projects such as climate adaptation parks able to respond to the heavy rainfall. Copenhagen has taken the opportunity to redesign its city, considering that water may represent a risk, but is also a resource. Rethinking water management allows the conception of new attractive urban spaces that aim at biological diversity, cultural exchange, and sociality.

In this section, we illustrate some projects for their characteristics in aesthetic, social, and environmental terms (the three values of the New European Bauhaus). These represent best practise case studies of resilient urban development based on NBS strategies.

The Copenhagen adaptation project starts from a systemic vision of interventions in the public space; the first phase of implementation has been defined as an area particularly subject to climate risks as the district of Østerbro. The idea was to create

the first Climate Resilient Neighbourhood by developing a series of urban redesign interventions to increase public space quality and ecosystem services. This plan expects to realise green spaces for 50,000 m^2 and slowly disconnect 30% of the stormwater from the underground mixed storm sewer network (City of Copenhagen 2016).

In 2013, the Danish firm Tredje Natur realised the master plan for the project, identifying major development areas characterised by low permeability. Amongst them, Skt. Kjelds Plads and Bryggervangen are representative of the NBS approach.

12.3.2.1 Skt. Kjelds Plads and Bryggervangen

The project realised by SLA has transformed a congested infrastructure (the 13-m-wide traffic circle Skt. Kjelds Plads and Bryggervangen road) into a new green space (Fig. 12.4) that is responsive to different climatic hazards, such as extreme heat waves or flooding. The project brings a new nature into the city to benefit the environment and the well-being of all citizens. The intervention consisted of the asphalt removal of a large area around the traffic circle and along the inner avenue.

Fig. 12.4 Skt. Kjelds Plads and Bryggervangen. Courtesy of SLA

The new retention surface hosts an ecosystem of 586 native trees belonging to the local biotype, which absorb CO_2 and pollutants and phytoremediation of the water. The Bryggervangen has become a "green corridor": the green part that currently occupies some previous parking places creates a zig-zag shape that slows down cars and acts as an infiltration and detention area for rainwater. The plaza of 34,900 m^2 contains and delays rainwater in numerous specially designed green urban spaces. Amongst the outcomes of this NBS approach, biodiversity has increased, and new vibrant places have improved health and quality of life for all the residents. In fact, inside the green infrastructure, there are paths (some of them paved, others made in sand or stones) and spots for sociality and leisure.

12.4 Conclusion

The excursus demonstrates how the renewed role of the architect, enriched with new knowledge in other fields, is fundamental to the green transition to ensure a liveable and adaptive urban (and nonurban) environment for future critical scenarios.

Nature, an element that throughout history has been increasingly reduced within the city, becomes a possible solution to the adaptation and mitigation of the already current effects of climate change in the urban environment. In addition to more concrete actions of GHG emission reduction policies, NBS and biophilic approaches become vital in achieving social, environmental, and economic resilience by reducing the costs of extreme climate hazards. These approaches are trans-scalar and can be applied from the architectural scale (through choices such as in-between flexible spaces, greenhouses, and natural materials) to the urban scale, with urban space regeneration that enhances the "green and blue infrastructure". The use of NBS for urban design represents not only a design choice related to the practise of landscape architects, but it becomes a necessity for any designer to meet the needs of well-being, climate adaptation, and reduce the emission of GHG and pollutants.

The case of Copenhagen represents how managing natural resources (water) becomes fundamental to designing new public urban spaces. Green is not a mere necessity prescribed by urban standards. However, the functionality of natural elements also meets the need to create an environment that responds to extreme events and provides an eco-systemic service. Outcomes of this approach are a better quality of life and well-being for the communities.

It is essential to emphasise how the different cases show extremely site-specific design choices. Architectural choices, the natural elements (from the selection of plants to the construction materials), and the urban design solutions adopted must respond to the logic of climate, exposure, culture, and local uses. It follows that the skills involved in those projects are vast and different, as reflected by multidisciplinary teams–such as the architectural firms mentioned in the text–and the presence of sections dedicated to the R&D.

Social and community engagement are also fundamental in designing a project responsive to residents and neighbourhood needs, as in the case of the Climate

Resilient Neighbourhood project in Copenhagen, where the municipality, stakeholders, and over 10,000 residents were involved in co-design processes.

Nature–demonised first and domesticated later–has become the element that can re-define architecture and urban design. The landscape is not just the construction of green infrastructure but the merge of built and open space that, only when put in relation, can contribute to improving urban conditions. The essay demonstrates how this approach applies to new construction (buildings and new neighbourhoods) and the built environment. The application of site-specific NBS is one of the win–win solutions for cities. Only through specific policies can NBS be applied widely for specific design sectors, not only for landscape architects, who have been experimenting with this approach for years.

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Part III
Innovative Practices. A Dialogue Between Researchers and Practitioners

Interviewing planners and architects operating at different scales (from the wide scale of spatial and urban action and open and green space design to architecture) is essential to overcome the gaps when implementing and operationalising green and blue infrastructure (GBI) in territories and cities.

Despite its multifunctional approach, GBI often seizes several aspects in a non-integrated way: for example, water security and management are characterising topics in the USA. In France, GBI is a field of action for biodiversity and innovation in urban design through interaction with the experience of eco-districts. In Italy, GBI is generally a topic of wide area and landscape planning that is being implemented into the local land use plan, urban design and architecture. The result (see, for example, the city of Milan in the project by Studio LAND) is the regeneration of the city starting from the system of green areas and mobility.

The three interviewees (Carlo Gasparrini, Studio LAND and Agence Devillers et Associés) were selected as they work both in the planning and design field and coordinate interdisciplinary teams with different competencies. Their fields of action are the urban and territorial plan (Carlo Gasparrini), the landscape project for the city (Studio LAND) and the project for the biodiversity in the city through the design of urban public green spaces (Agence Devillérs et Associés).

Chapter 13
From Theory to Planning Practice. The Green and Blue Infrastructure in the Land Use Plan of Ravenna. Interview with Carlo Gasparrini

Benedetta Giudice, Gilles Novarina, and Angioletta Voghera

Abstract Carlo Gasparrini is an architect, planner and full professor of Urbanism at the University of Naples Federico II. He is a member of the INU Executive Board. He is a designer of urban, territorial and landscape plans and projects, amongst which the Masterplan for the eastern area of Naples, the Vesuvius National Park Plan, the local land use plan and the strategic projects of Rome. He has published numerous research, monographs and essays on the contemporary city and the themes of landscape and ecological regeneration. The interview focused on the cultural innovation of resilience and the role of green and blue infrastructure as a strategic planning and design paradigm to regenerate the city, focusing on the Ravenna Land Use Plan experience.

Keywords Social resilience · Urban plan · Performative norms · Strategic projects

13.1 Planning for Biodiversity and Green and Blue Infrastructure

The topic of GBI has matured slowly over the last 15 years. This slowness is mainly due to the nature of GBI as it moves in a more complex and integrated direction than traditional ecological networks that have dominated discussions and experimentations for several years, guiding thus the innovation of introducing environmental issues in land use plans. The complexity of GBI entails different matters

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at once: the adaptation to risks, the production of ecosystem services, the issue of urban metabolism and the production of the contemporary public city. The density of components that compose a strategy of GBI is always the result of a progressive and incremental path of various experimentations. These four matters, the ones to which I pay more attention when planning in a resilient and ecosystemic perspective, pose, however, differentiated questions according to the territorial context in which we work.

The job of the urban planner takes shape in urban experiences, and the plans I am practising range from provincial capitals to medium and small cities. All these experiences show that GBI is not a thematic map or a legislative chapter but a substantial change. This new planning paradigm foregrounds the entire structure of the city, incrementally guiding its resilient metamorphosis. Being an integral part of the land use plan results in a path to radically rethinking the form of the plan. Furthermore, this process is even more eased in regions where regional planning laws facilitate this path. Nevertheless, besides legislative frameworks, the paradigm of GBI is included in the broad issue of environmental and ecological transition that is profoundly modifying urban planning. In Italy, GBI is indeed a cultural problem on which we should affirm principles and future directions of planning, and it must be one of the central elements of the plan's strategies. From this perspective, it is important to understand how much this topic can feed strategies dedicated to resilience, antifragility and adaptation to risks.

Additionally, GI is not only a vision of and for the city, but it forecasts scenarios where to locate practical actions that guide public action and where it is possible to imagine the necessary operability of land use plans. The issue of concreteness is fundamental in such a period of massive funds (in Italy, for example, there is the National Plan of Recovery and Resilience–PNRR). In this sense, it is necessary that Italian land use plans implement this demand for concreteness that allows us to be selective, and actions need to be commensurate with the possibilities of each institutional and financial context of public and private resources.

An example is the land use plan I'm drafting for the city of Ravenna in Emilia-Romagna (Italy). It is quite interesting because it valorises the new regional planning law, currently one of the most innovative from the legislative point of view. Nevertheless, we should not delegate the duty to guide local planning choices to the legislative framework.

13.2 The Ravenna Land Use Plan

The 'ingredients' of the plan of Ravenna are strategies, plans and programmes, norms, policies and resources. These five ingredients must coexist in a new form of plan. Strategies must be both urban and local, while plans and programmes must be concrete and inserted into a timeline that needs to be continuously adjusted and verified. Norms are performative instead of being confirmative as of current.

This awareness is also present in the public actor of the municipality; for example, it is evident that urban policies are little considered in the Italian '*governo del territorio*' even though they represent a supporting and soliciting component to build a resilient metamorphosis and an ecological transition. This assumption reflects in a change in the way the public sector works. As previously said before, the case of Ravena fits into a regional planning law that places great importance on the 'plan office' and where the public action is transversal to all the network of stakeholders. This action leads to triggering mechanisms of integration and complementarity of resources to be put into play. At this moment, urban planners can modify the praxis of a public administration that, usually, after approving its land use plan, waits for private actors to propose some interventions. It is a question of having a public actor protagonist in the entire planning process, above all in the strategic component.

In Ravenna, we have approved a strategic document (after a long debate with the population) with five strategic objectives: (I) Ravenna resilient, adaptive and antifragile; (II) Ravenna city of sustainable agriculture; (III) Ravenna an international city interconnected and accessible; (IV) Ravenna city-mosaic, multifunctional and creative; (V) Ravenna a regenerated, liveable, welcoming and safe city. In particular, GBI has been specified in the strategic document through a specific strategic map that indicates the specialisation of actions, features and projects (Fig. 13.1). Thus, these two documents are strictly connected and represent one of the main references when it comes to selecting the possible interactions between resources. The strategic map of GBI has a design function towards which the public administration more often tends. Such a document allows for aggregating public resources, such as the ones of PNRR, and constituting a place for interaction between different stakeholders.

In its strategic dimension, the plan identifies four guiding projects (Fig. 13.2) that allow for determining a selection of actions. All four guiding projects are animated and structured by the project of GBI. The first project is the Candiano Canal, a big port infrastructure that enters the city centre, thus connecting the sea and the dockyard to the city. To do so, the intervention consists mainly of the dredging of the canal. Furthermore, the intervention brings with it the redefinition of a new system of public spaces, the renovation of former industrial areas and the creation of new conditions of ecosystemic regeneration. Even though it is a very mineral area, the port is considered an integral part of GBI; in this view, we forecast a new connotation to the water, waste and energy cycles.

The second project concerns the dynamic thickness of the coast that is undergoing critical deterioration and erosion processes. The third project is the realisation of a green crown around the city. This idea is not so new in urban planning, but in the Ravenna context, it represents an ample transition space between the highly developed agricultural plain, the urbanised territory and a forestation area. Compared to the traditional greenbelt, this green crown forecasts a leap of scale. It is financed by both private and public funds. The fourth project is the 'metro railway' of historical, archaeological and environmental resources. This metro railway connects to the canals and rivers system and works on river parks to adapt to flood risks.

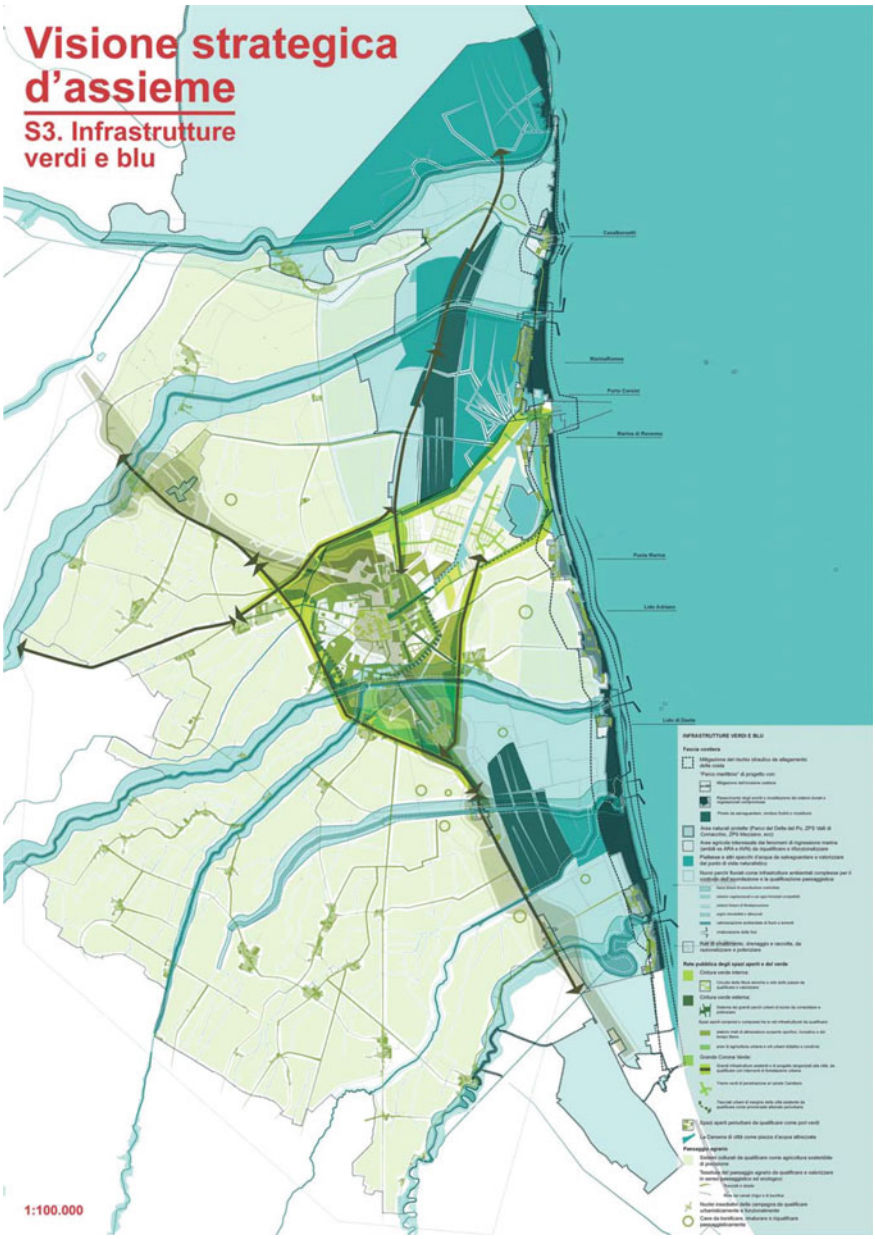

Fig. 13.1 Strategic map of Ravenna's GBI. *Source* Comune di Ravenna (2020)

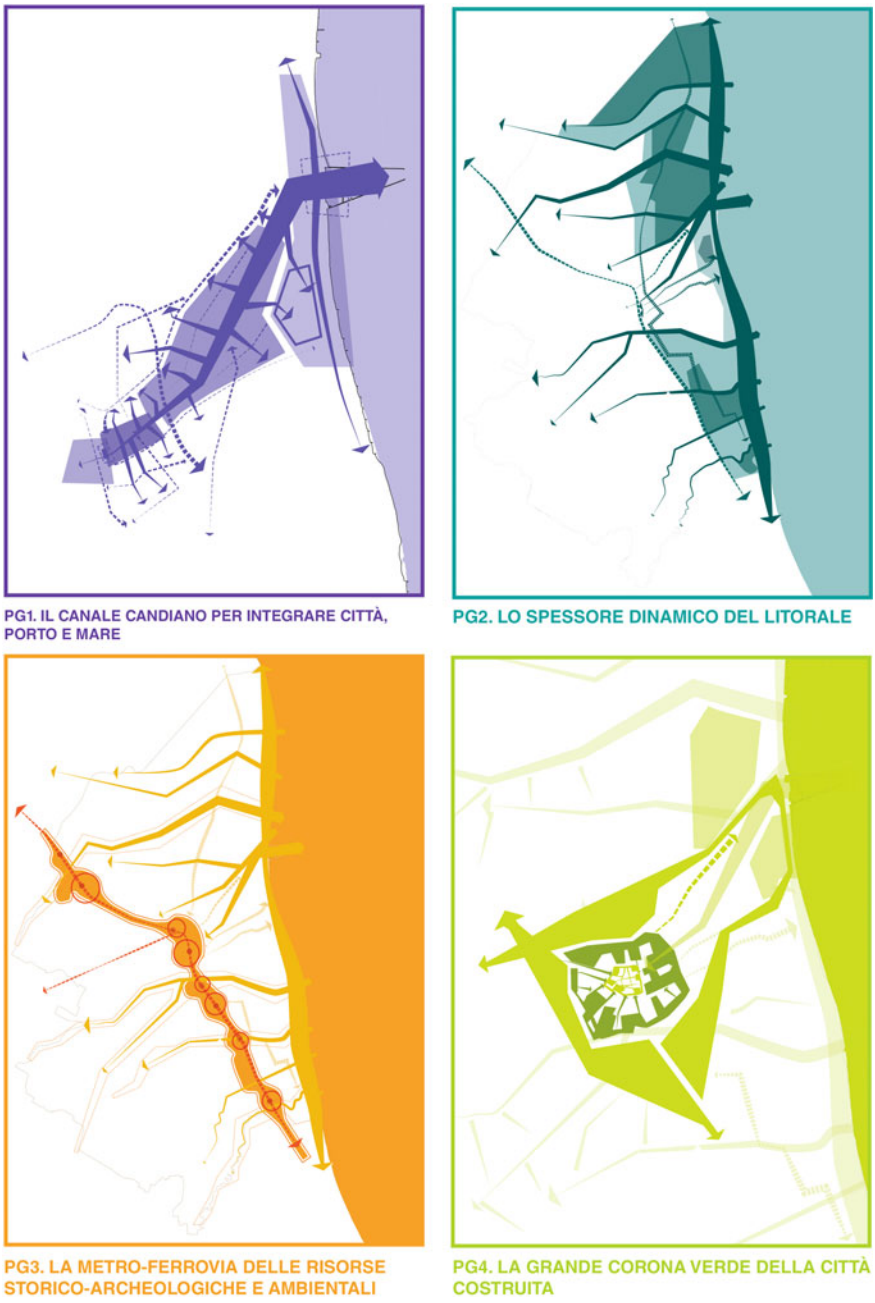

Fig. 13.2 Four guiding projects of the Ravenna's land use plan. *Source* Comune di Ravenna (2020)

Besides selecting priority actions, these projects allow for the governance of all these processes, involving various actors (such as the port authority, the park authority, the drainage consortia, farmers and social actors). In this perspective, the public administration must have the capacity to manage the guiding projects, stimulating and soliciting new economies bound to the urban metabolism (water and waste cycles, the production of ecosystem services and the construction of public space).

Next to strategies and projects, there is a change in the way we define norms. Indeed, we tried to valorise performative norms, including them in a guide that accompanies the project path. This guide identifies 21 performative requirements: a substantial part of these norms is connected to the ecosystemic dimension (water, soils, vegetation, energy), while others relate to functional and social characteristics of uses. The core comprises eight performative requirements, four of which are strongly connected to GBI. The first is the one on permeability and the reconstruction of the urban drainage system. The second concerns the increase of vegetation, depending on each landscape context. The third refers to the increase of GBI of proximity to qualify public spaces in a reticular way. Lastly, the fourth concerns the intensification of urban and territorial equipment, thus providing an important leap of scale.

Performative norms are associated with landscape components that allow defining minimal thresholds of action. The chance of overcoming the minimal threshold required gives the possibility to have fiscal 'rewards': that is, the more you fulfil performative norms, the more you get a fiscal reward. In this way, the public administration has indirect resources coming from the capital gains of each intervention. This path is assessed from the economic and financial feasibility perspective and is governed by cost-incremental management.

The abovementioned guide is a guide to urban and ecological-environmental quality that identifies the design guidelines for each landscape component to realise ecological and environmental quality interventions. Landscape components are characterised by a high degree of naturality or refer to the city centre. In this sense, this topic is related to the complex network of GBI that penetrates the city centre, and for each component (roads, squares, gardens, parks), a design guideline is provided. The project is an integrated project that refers to the idea of landscape as an engine and a holistic element on which ecosystemic, functional, social and management dimensions converge. This guide is a compulsory tool that must be used when making regeneration interventions.

13.3 Social Resilience as a Topic

Social resilience and inclusiveness are specific topics of the plan. In 2019, there was a very intense participatory process in Ravenna, which has a long tradition of social processes like all the cities of Emilia-Romagna. 2019 was indeed a year full of initiatives from the provincial capital to minor towns and inner areas (notice that the territory is very big with an extension of 650 km^2).

Currently, we need to provide a set of tools to reinforce the final approbation of the plan, its management and implementation and the launch of other initiatives to build a 'regeneration culture' and solicit the participation of citizens involved in the construction of forms of entrepreneurship, including innovative ones. GBI poses a change of mind-set that requires a strong involvement of such new entrepreneurial and social forms.

The new plan also allows for building a participatory condition inside the public administration between different sectors, forecasting an improved capacity to locate economic resources in the general vision for the future city. In Ravenna, we are trying to move out of a phase of 'lazy' regulatory planning and have entered a phase of institutional, entrepreneurial and social activism that is indispensable if we want a transition to a different city.

These new forms of participation and inclusion highlight the importance of the new public city structured in a reticular and multiscalar way (GBI is *par excellence* a multiscalar strategy). Thus, we are moving towards a logic that overcomes regional norms and traditional equipment of the public city and enables a systemic solution of continuity between micro- and macro-practices. This is also reflected in how citizens use and live the territory; there comes the issue of proximity.

13.4 Post-pandemic Innovation

In Italy, we have huge disparities between the different geographical areas, and this is also reflected in the 'offer' of the public city, which is often undersized (for example, in the southern part of the country). Nevertheless, a high quantitative dimension does not necessarily lead to greater satisfaction with urban equipment. Also in Ravenna, where the standard of public equipment is very high, the issue of proximity gained importance with the pandemic outbreak. It is not only an issue of green facilities but also socio-sanitary and education. This changing demand is also visible in the participatory processes activated.

We have rediscovered proximity after a period of abandonment; the issue of neighbouring was indeed traditionally a crucial aspect of planning. Nonetheless, we must not interpret it in parallel to zero-kilometre strategies, enclosing it in the refusal of globalisation to rediscover the level of micro-local identities. I think the city will always have the capacity to live between proximity and diffused reticularity; in this sense, currently, GBI provides the necessary link between continuity and transcalarity. GBI thus allows somehow overcoming these conceptual compartmentalisations, which prove to be a loss for the complexity of the city. Despite this, in the plan, we also identified some 'parts of the city' (as the regional planning law defines them): urban parks that constitute a sort of mosaic in the territory and dwelling places that express the identity and the demand for proximity. This fluidity and diffused permeability of open spaces are identified in a map of local landscapes, showing how territories can be used and their richness.

The last element I would like to mention is the role of resources. Indeed, also in Ravenna, we have a real problem with how to use these resources. We rely on private resources coming from capital gains, but it is evident that public resources must be questioned further. In this perspective, we must understand how the PNRR was built, recognising the importance of each of the six missions (one out of all, the one on ecological transition). Starting from this, we can express the proper demand for ecologically and socially oriented cities. Unfortunately, our land use plans were not originally thought to include qualitative issues; we inherit careless planning that does not forecast adequate qualitative standards. The real question is if we will be able to build the proper transition with the funds given by the PNRR. It means that urban planners must anyway question how to change land use plans in the medium and long term.

The experience of Ravenna is not unique, but it taught me that making completely different land use plans can trigger virtuous processes. As an example, the design guideline of the green crown was actively experienced in the local debate and the implementation of practices proposed by public actors. This demonstrates that also the construction path of new plans can affect how we respond to the calls of PNRR. This path must be done day by day, and it will lead to producing innovative virtuous processes and a new culture in planning. Surely, this is a unique occasion for a transition in Italian urban planning.

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Chapter 14
Green and Blue Infrastructure. Integration of Landscapes. Interview with Andreas Kipar (Studio LAND)

Benedetta Giudice, Gilles Novarina, and Angioletta Voghera

Abstract Andreas Kipar, landscape architect, is the founder and creative director of the international landscape architecture studio LAND, with offices in Germany, Italy and Switzerland. He is the inventor of the "*Raggi Verdi*" [Green Rays] model in Milan, favouring new slow mobility and green urban planning. This model was also applied in Essen, the 2017 European Green Capital, and in the award-winning Smart City of Rublyovo-Arkhangelskoye in Moscow. He was charged with drafting urban and peri-urban green plans in several cities, including Milan, Cagliari, Piacenza, Reggio Emilia and Essen, and with developing territorial strategic plans, such as in the Ruhr basin, on the Karst Plateau, in the Langhe, on the Lake Garda and various Italian islands. The dialogue insists on diverse skills and sensitivities to reimagine the contemporary city aiming at promoting a sustainable and resilient organisational model.

Keyword Landscape architecture · Biodiversity · Green–blue focus · Multidimensional approach

14.1 A Green and Blue Infrastructure for a Future City

Today, as never before, water is once again a central and vital element in our daily lives. From a simple liquid to be disposed of, it becomes a resource to be conserved, made visible and used for the transformation and regeneration of our territories

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Fig. 14.1 Krupp Park in Essen. LAND. ©RalphRichter

and cities. Therefore, many of our projects start from this assumption of greater integration between green and blue infrastructure.

Starting from our decades of experience with the Ruhr industrial basin and the Emscher river, we cannot fail to mention the first large green and blue infrastructure that became an urban park in the "European Gren Capital", Essen (Fig. 14.1).

Starting from this experience that has been able to put water at its heart, more and more processes are being developed to integrate water into urban and suburban landscapes. In Milan, the major projects of Santa Giulia, the former Falck area in Sesto San Giovanni and the reuse of the EXPO 2015 area in the MIND district are reclaiming this green–blue focus (Fig. 14.2).

In particular, in the innovation district born from the redevelopment of the Expo 2015 area and developed in a public–private partnership by Arexpo and Lendlease, a new part of the city of the future is being realised that is climate-neutral and socially inclusive, where the innovation is generated in a collaborative way for the benefit of the entire community. The important waterways project will have to return to the centre of our attention when the whole area is destined to become one of the most popular districts for students, researchers, visitors and inhabitants of the future. A great bet that will not lack that precious 'Blue Gold' in support of collective well-being.

Also in the field of research, the most advanced European UNaLab programme has focused on the city of Genoa, considering urban ecological water management as a premise for regenerative and inclusive urban design. Already now, we can see the first results on the Gavoglio Park construction site, which takes on the characteristics of a large sponge amidst the density of the Lagaccio district.

Looking to the horizon, we cannot forget entire communities such as the municipality of Lecco, which for the past few years has been refocusing on its five landscape elements: lake, lakefront, city, hills and mountains, through the rivers that represent the 'Blue Gold' waiting to be the real drivers for future urban development.

Fig. 14.2 Vista of the MIND district. ©LAND

Last but not least, the strategy adopted by the BrianzAcque consortium: the need for flywheels is an opportunity to develop new water parks. The Arcore example should be understood in this vein as a new design strategy that adapts to the emerging challenges of climate change to bring together the elements of soil, water and greenery for a regenerative and resilient nature for the whole local community. In line with the objectives of the United Nations 2030 Agenda and the sustainable development promoted by the New Green Deal, the park presents a system of integrated solutions for regulating water, regenerating the environmental system and enhancing the social fabric towards the desired pact between man and nature to achieve a new productive landscape.

14.2 Landscape Architecture at Diverse Design and Management Scale

As planning processes are becoming increasingly complex, the landscape architect is stepping into the role of moderator in transformation and regeneration, especially if we start from the idea that everything is landscape, the built as well as the unbuilt. With a multidisciplinary approach able to coordinate and act both locally and globally, within one's own team and towards the outside world, we can inclusively catalyse the development. Landscape architecture thus becomes a fundamental discipline both in established contexts such as Europe and developing countries. Because the landscape is already here. We just need to make it visible and usable and bring it back to its original vocation.

To manage a GBI design, it is necessary to listen. Our ability to observe and listen lies at the heart of any project that starts from the landscape itself. Therefore, we are continually flooding our skills from more technical and interdisciplinary disciplines to more social and moderating skills between the private and the public, individual citizens and the community, and the environmental challenges now tangible in the evidence of climate change and solutions that know how to put nature at its core.

14.3 Management Issues

Tackling land-related problems linked to major environmental, social and energy changes cannot be separated from listening to the needs of the local population through transparent and active participation. This aims to establish a dialogue between users and institutions, public and private, architecture and nature. We are well aware that landscape design is an atypical discipline, where the pace of realisation is slower than the ever-faster pace of construction. Still, it is precisely this that allows us to fit in at various scales, especially with the 'meanwhile uses' that will enable us to show how nature guides the temporary use of the changing city. The landscape anticipates the timing of the ongoing transformation, helps create a sense of community, integrates with design and opens up new perspectives on the future. Thus, a greener and more resilient future is based on incorporating nature into the various aspects of our lives.

14.4 Biodiversity and Sustainability in Regeneration Projects of the Contemporary Cities

One example that can illustrate our approach well is the Biodiversity Corridor project in Montréal, Canada. It consists of a green, blue and social infrastructure that aims to reconnect people with nature. It is based on a multidisciplinary and multidimensional approach, as it takes into account both the neighbourhood and the territorial scale.

The current fragmentation of natural elements symbolises the fragmentation of the human experience, now segregated into monofunctional sectors that result from a non-systemic conception of urban life. To increase biodiversity and make it sustainable, we have created new and heterogeneous conditions integrated into one large project. The first element we focused on is the basis of all the different habitats: the soil. The heterogeneity of the rhythm and the relationship between horizontal and vertical elements are both research topics and operational design tools. It generates the design strategy of the masterplan, where variety is introduced into today's monotonous landscape, hosting diverse habitats such as forests, wasteland

and wetlands and promoting the spread of different life forms compatible with the human presence in a resilient and productive urban environment. We thus offer an open-air and living laboratory for constructing a new type of urban landscape that, by its very nature, becomes a productive landscape again.

Chapter 15
Integration of Biodiversity in the Urban Project Approach. Interview with Magali Volkwein and Sébastien Roussel (Agence Devillers et Associés, Paris)

Benedetta Giudice, Gilles Novarina, and Angioletta Voghera

Abstract Founded in 1991 by Christian Devillers, the D&A studio specialises in urban projects with the ambition of managing the city, from the vast territory to the kerb. Composed of architects, urban planners and landscape architects, engineers and sociologists, the studio has gradually diversified its fields of action and works on metropolitan strategies, eco-districts or urban renewal projects, the insertion of mobility infrastructures into the landscape and the creation of parks or gardens. Magali Volkwein has been president of the studio since 2021, and Sébastien Roussel has been a landscape architect associated since 2021. The interview focused on the gradual inclusion of biodiversity issues in the urban project approach and the importance of ecology in producing the city.

Keywords Urban project · Nature en ville · Biodiversity · Eco-districts

15.1 A Pioneering Studio in the Urban Project

15.1.1 Magali Volkwein

Christian Devillers can be considered one of the founders of the "urban project", an approach that gradually asserted itself from the early 1980s in France, where the decentralisation reform shook up the relationships between the stakeholders in planning. While teaching at the École Nationale des Ponts-et-Chaussées, Christian

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Devillers published a series of articles in which he set out the principles of this new approach, with a particular interest in the issue of permanence of street layouts throughout the history of cities.

I met Christian Devillers in 2008 when we collaborated on an emblematic project, the ViaSilva 2040 ÉcoCité, in the centre of the Rennes Metropolis. The idea was to plan a piece of the city over thirty years, and, amongst the slogans used to justify the project, we wrote, "in thirty years, everything changes except the geography". And geography is not only the physical morphology (nature of the soils and the underground), the topography and the remarkable landscapes but also the layout of major infrastructures. The name of the project, ViaSilva, refers to the presence of an ancient Roman road on the site. For thousands of years, this Roman road has remained embedded in the plot of land on which a new Ecocité was to be built.

The issue of permanence and substitution is, therefore, at the heart of this thinking on the urban project and can be summarised as follows: the urban layouts must be thought of as permanent, and they are the basis of a grid of public spaces which constitutes the foundation of the urban project. Based on this grid, the land must be divided, and a plot of land must be organised, which is naturally mutable and can accommodate changes in use over time. The mutability of programmes over time is essential as it corresponds to the mutability of society and how it has been organised throughout history.

This discovery of the necessary distinction between permanence and mutability also originated from a critique of large social housing complexes. The first interventions to requalify these neighbourhoods, in which the studio was involved, made it possible to understand that we were essentially dealing with large architectural projects in which the distinction between a mutable plot of land and layouts endowed with a certain permanence was not taken into account. This absence of land division is still evident today in the neighbourhoods that are the subject of what is known in France as the "*politique de la ville*". The actions carried out often aim to clarify land division between public spaces to be given back to local authorities and private spaces that will host new housing programmes. In this respect, the work carried out at the time by Nicolas Soulier, an architect and urban planner, who campaigned to make the street a fundamental space for city life, is particularly interesting. Indeed, he imagined the mutation of building blocks, stairwell by stairwell, by imposing a land division a posteriori.

Christian Devillers also worked at the time on renewal projects of social housing or residential districts: the Plaine Saint-Denis project, a competition in which Christian Devillers and his collaborators won, aimed to clarify the structure of the grid of public spaces and extend it. This grid, in turn, made it possible to determine the structure of blocks on which new real estate programmes would be built. This project was, in a way, the origin of the creation, some thirty years ago, of the studio, or more precisely of two agencies, Christian Devillers architect and a society specialising in urban planning and landscape, the latter working on the project management of major infrastructures and, more broadly, on public space. Therefore, the creation of the studio corresponds to a desire to control the design of public spaces by affirming the importance of the permanence of the streets in the organisation of the city.

15.2 The Emergency of *Nature en Ville* in the Concerns of the Studio

Subsequently, D&A has tried to translate the principles of permanence and substitution into practical projects for restructuring existing neighbourhoods or creating new ones. A first experience was the Caserne de Bonne eco-district in Grenoble, which won the national Grand Prix for eco-districts awarded by the Ministry of Ecology and Sustainable Development in 2009. The aim was to reintegrate the enclave of a former military barracks into the city by conceiving a network of public spaces to open a large area to the city. This new district, which until then had functioned as a lock, had to be made a pivotal point in the new organisation of the city.

The work on the grid was accompanied by the intention to remove waterproofing and green the land. The structure of the project is provided by the establishment, in the central part of the new neighbourhood, of a large park, made up of two parts separated by the former barracks building (transformed into an aparthotel): a park and a forecourt laid out as a natural space (Fig. 15.1). There are several interesting things about the Caserne de Bonne project. The programming of activities combined housing for sale and rent, shops, facilities and services. Another idea defended on this occasion, which still inspires the studio, was the desire to articulate the organisation of proximity and the right to centrality by trying to ensure the comfort of pedestrian and cycle mobility on the one hand and the *mixité* of the programmes on the other hand. Therefore, the aim was to create a real neighbourhood that was both pleasant

Fig. 15.1 Forecourt of eco-district de Bonne. Courtesy of Devillers et associés

to live in and integrated into the overall fabric of the city, a neighbourhood that could both accept future changes and extend to a larger scale.

Finally, when we imagined the elements for the constitution of a new centrality, there was, first of all, a commercial programme, which was one of the reasons why I believe the studio won the competition. Christian Devillers took part in the competition with a letter of intent from a commercial operator, an unusual thing at the time because local authorities were not already used to partnerships with private actors. The park also played an important role in terms of centrality, designed as a place to bring people together. The natural spaces provided both a breathing function in the city and the reinforcement of biodiversity. However, this dimension was perhaps at the time secondary to the desire to create a public space that gathers people in an egalitarian manner and allows young and old, poor and not so poor, to meet and thus share real moments of citizenship. This is how public spaces were conceived at the time, and in this respect, the park of Caserne de Bonne played its role perfectly.

We must recognise that in the case of the Bonne eco-district, environmental concerns were limited to actions to control energy consumption. Indeed, we were undergoing the ADEME reform and at the beginning of the labelling policy of the eco-district, so it is not surprising that a large part of the efforts was focused on this issue. The Bonne eco-district was even considered a pioneer in this field, which is why it was ahead of the European programmes, especially the Concerto one.

15.3 The Complex Issue of Water in the City

Since the end of the 2000s, the treatment of environmental concerns was no longer limited to energy. The studio became involved in various national and European research programmes and thus capitalised on elements of reflection, which were the subject of an initial application in the context of the Luciline Rives de Seine eco-district (2008) in Rouen (Fig. 15.2). This project, developed by a European Interreg 4B research programme, which made it possible to mobilise additional funds, highlighted a theme which occupied the studio significantly for five or six years, namely the question of water and water landscapes in public spaces. In the context of this project, the studio sought to deal with the recovery of water in public spaces and provided for a large central valley and systems of rainwater recovery alleys. Such a system was considered a particularly effective way of combating heat islands.

What was interesting in Luciline was the idea of bringing to light a river which came down from the slopes, flowed into the Seine and had been channelled. Thus, we had to bring to light the water to fight against heat islands and protect ourselves from floods by taking into account the rainfall and the flow of water along the slopes, which led us to rediscover the importance of topography. At the same time, we were working on integrating major transport infrastructures into the landscape, and D&A sought to control the levelling of soils, a subject usually dealt with by consultancies specialising in drainage and developing a technical approach to the “pipe” type. The path of water means controlling topography, and to do this, in Luciline, we had to

Fig. 15.2 Central valley in Luciline. Courtesy of Devillers et associés

find a natural flow of water by bringing the river back to light along its course and by creating storage basins in certain places. Finally, we tried to link the issues of water and energy by thinking about installing a tempered water circular system to reduce the heating costs of the houses (even though we have later learned that heating constitutes the smallest part of a building's energy expenditure).

To move away from a technical vision of water management in the city, D&A developed partnerships with a network of small engineering firms specialising in hydraulics (Sogreah). These engineering consultancies have then gathered into a large group called ARTÉLIA. This partnership, which took shape during the Luciline project in Rouen and the Danube eco-district in Strasbourg (2012), has gradually enabled the studio to acquire an engineering culture and dialogue on an equal level with the technical engineering offices.

15.4 Biodiversity in Eco-Districts Projects

The masterplan for the Danube eco-district (Fig. 15.3) resembles that of Luciline, particularly in terms of the layout of public spaces, since both projects include a large central garden in which rainwater is collected. In Strasbourg, it was the first time the studio had worked with a botanist to design public spaces. Until then, D&A had worked with landscape architects (notably Jacqueline Osty at the Caserne de Bonne), but the latter had an aesthetic rather than biological approach to nature in the city. In the Danube eco-district (which won the Grand Prix de la Mobilité), there is a whole reflection on implementing meeting zones to ensure the safety of children. Furthermore, we chose to emphasise biodiversity by working with Philippe Obliger, head of collections at the Strasbourg Botanical Garden and an artist who has grown more than 650 unusual plants (notably blue bananas) in his garden in Schwabwiller. With him, we worked on considering the functioning of local ecosystems in the management of public spaces.

In Strasbourg, the aim was to find ecosystems that were not in competition with each other, and that required the least possible maintenance because, in 2012, we were beginning to think about the management of public spaces, and more particularly green spaces, based on the notion of the total cost (integrating investment and management). Two ecosystems were identified: the Ried ecosystem, made up of a group of wetlands created by the movement of the course of the Rhine throughout time, and the ruderal ecosystem, made up of small plants that progressively colonise uncultivated areas occupied by rubble. However, on the territory occupied by the

Fig. 15.3 Aerial view of the project eco-district Danube. Courtesy of Devillers et associés

future Danube eco-district, there was a former gas factory with large, slightly broken concrete slabs, in the interstices of which a ruderal plant, the white broth, a rather exuberant plant, grew spontaneously. These two local ecosystems could coexist if their concurrence were organised within the framework of the urban project.

To regulate this concurrence, we faced a series of new issues, such as the functioning of natural areas that can only be watered when the rainwater retention basins are full and in summer are dried up. We also had to consider the effects of wind (also known as urban ventilation) on the vegetation of the linear park. Ruderal plants grow, for example, in large open spaces where there is a lot of sunlight. Therefore, we tried to find, inside a high-density neighbourhood, south-facing plots of at least 100 m^2, so they could grow. We also wondered about limiting the growth of invasive plants, which could jeopardise the maintenance of the two local ecosystems. We also had to draw up botanical regulations for developers and co-ownerships concerning the proper maintenance of private natural areas. Gradually, the idea of shared space came to enrich the dichotomy that had previously existed between public and private spaces.

15.5 Biodiversity at the Territorial Scale

At the same time, D&A worked on another scale: the eco-districts in Strasbourg and Rouen covered six and eight hectares, respectively, while the ViaSilva project, which I mentioned at the beginning, considered the medium-term development of 600 ha. This led us to link the development of public spaces and the strategy of reconstituting a *Trame Verte et Bleue* (thus, GBI) on a completely different scale, which is that of the metropolis, or even of the *Schéma de cohérence territoriale*. The ViaSilva 2040 project was part of the future investment programme launched by Nicolas Sarkozy, which aimed to create eco-cities in which large French companies could test innovations (primarily technical ones) relating, for example, to heat recovery from water loops or wastewater recycling on superblocks level.

ViaSilva (Fig. 15.4) was the opportunity for D&A to raise the issue of nature in the city on a territory that remained essentially agricultural, located inside the ring road and destined to be served by a future metro line. This area was controlled by the Rennes Metropolitan Authority, which has long pursued an ambitious land acquisition policy. While waiting for future urbanisation, this land is rented to farmers. The inquiries prior to the project focused, on the one hand, on topography and, on the other hand, on hydrography. Wetlands were identified, and it was decided to extend their surface to transform them into vast parks, destined to become places of centrality. More generally, the choice was made to base the project on geography and the creation of a GBI with the idea of linking two ecosystems, that of the Rennes forest to the north of the site and that of the river (the Vilaine) to the south, and to make them meet through ecological corridors. Large areas of ecological compensation were set up before starting minor works, and the renaturation of a territory formerly agricultural and heavily subjected to chemical inputs is now very visible on

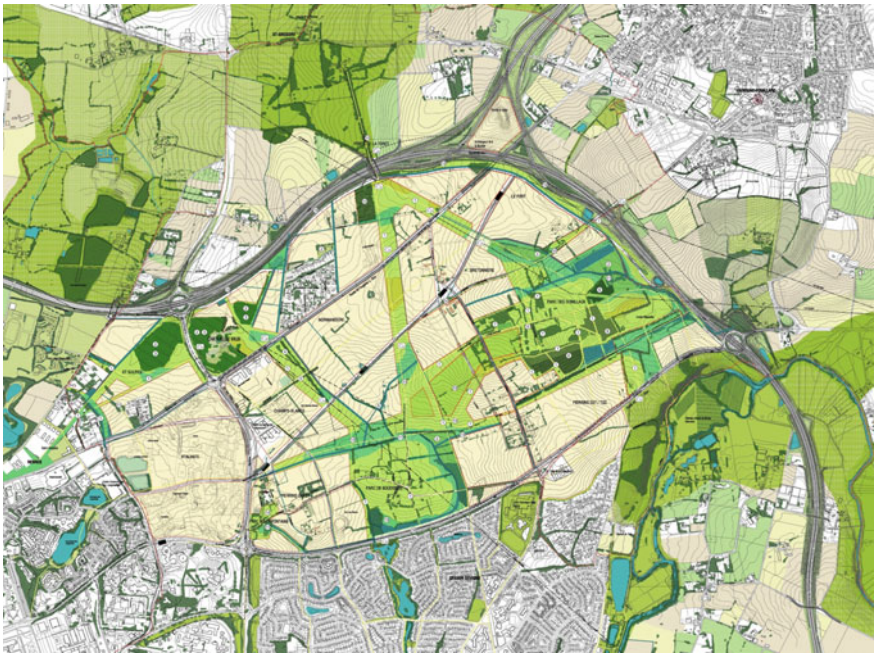

Fig. 15.4 Landscape masterplan of ViaSilva 2040. Courtesy of Devillers et associés

the site: the newts have returned; birds are more numerous than before the project; a stream was rewatered, and wetlands requalified. Therefore, priority was given to the creation of a public green network. On that occasion, a new slogan was invented to summarise the project: "the city (and therefore the network) is a garden".

To achieve such an objective, we had to reverse the urban organisation model used in the studio's previous projects by creating a minimal but highly hierarchical road structure, with major urban boulevards encircling the site and then secondary streets delimiting superblocks, which were operational units subdivided into blocks, each of which had its own private garden. These gardens were directly connected to the public parks, which allowed them to set up alternative paths for pedestrians and cyclists. The idea behind the project was to create a garden city.

15.6 The Tree in the City

In 2012, the hedgerow, a very classic figure of the agricultural landscape in Brittany, grew in importance inside D&A: the tree must be considered an element of a landscape system. We, therefore, proposed the creation of a "*mega-bocage*" which would bring together existing hedges and where the wood could be used productively. This vision remained at the level of intention due to the absence of support from local

authorities. Since 2018, we listened to the botanists with whom we had been working for years, in particular Pierre Bazin of the Aubépine firm, and we understood that the durability of the plantations depended on the protection of the roots of the trees. This led us in the operational phase of ViaSilva to modify the division of the lots, the location of the buildings and the layout of the paths.

This reflection, which began in Rennes, was then developed within the studio, and the topic of the tree in the city was applied to several projects; in particular, projects for the requalification of social housing neighbourhoods carried out on the initiative of the National Urban Renewal Agency (ANRU). These neighbourhoods, created seventy years ago, have seen their buildings deteriorate but have a plant heritage that has reached maturity. However, in the first ANRU projects, in the logic of embellishment, there was significant funding for demolishing and requalifying public space without considering the tree's importance. In 2019, following the arrival of Sébastien Roussel at the studio as a landscape architect and specialist in historical gardens, we proposed to the contracting authority for the ANRU project in Nantes Bellevue to include in the technical specifications an additional task on planting. And it sometimes takes years for these missions to be taken into account in the regulations.

15.6.1 Sébastien Roussel

What finally triggered, this additional task was the initiative of the director of green spaces, Romaric Perrocheau, who launched a canopy plan based on a census of all the trees in Nantes. A meeting was held between the botanist and the designer to set up a rating grid that made it possible to consider both the sanitary state and the heritage value of different tree species. I understood the historical development of plantations better and analysed the conditions that needed to be fulfilled for them to flourish. This blossoming of trees is, indeed, linked to the absence of frequent trampling by pedestrians or light vehicles. This diagnosis has made it possible to evolve urban forms and to constitute a planting strategy ensuring "natural" protection: planting on hillsides, at a minimum distance from frequent passages, by increasing the volume of plantation pits.

15.6.2 Magali Volkwein

The importance of trees in the city also responds to new concerns of citizens. In most consultation meetings, the sentence that repeatedly comes up is, "are you planning a tree in front of my window"? Faced with this request, the studio has had to deal with this question rigorously by developing, for example, an action-research partnership with the National Research Institute for Agriculture, Food and the Environment (INRAE) in Clermont-Ferrand Metropolis in an attempt to identify the tree species that better resist to global warming.

Fig. 15.5 Metropolitan park in Clermont-Ferrand. Courtesy of Devillers et associés

15.6.3 Sébastien Roussel

In Clermont Saint-Jacques, the aim was to create, inside a social housing district, a new park on a basaltic plateau that links up with the Limagne plain (Fig. 15.5). Our starting premise was to accept that we do not know which tree to plant in the face of accelerating climate change and the presence of a subsoil without water reserves. This ongoing work will show how different tree species groups could withstand long-term water stress and thermal amplitude. This data collection is fundamental to understanding how the landscapes will evolve and anticipate the trees' adaptation to the urban environment in order to constitute future canopies.

15.7 Soils and Their Renaturation

The issue of trees is intimately linked to the question of soil. In 2016, the studio was entrusted with a mission to requalify the Micheville site, located within the Alzette-Belval Opération d'Intérêt National perimeter. The developer is a public agency under the authority of the State. Since the 1980s, this cross-border territory between Lorraine and Luxembourg was occupied by large iron and steel platforms, and now it is abandoned. Today, the landscape is an immense green space with small villages. But, this "green" is composed of both agricultural land and former wasteland that has been reclaimed by vegetation. But, in the latter case, the subsoil is not only cluttered with underground industrial installations but also highly polluted with heavy metals. The State became involved in this area because it wanted to make it a demonstrator of a strategy for the renaturation of industrial land and urban requalification. Anticipating the current policy of Zero Net Artificialisation, the Opération d'Intérêt National provided for a requalification strategy in a challenging economic context, with clean-up and redevelopment costs of €120/m^2, while the housing market is almost non-existent, which makes it impossible to balance the projects financially. The studio

Fig. 15.6 Masterplan of the two platforms of Micheville. Courtesy of Devillers et associés

has really left its mark on pollution in Micheville by trying not to reduce the problem to its technical dimension. The installation of the iron and steel industries was carried out by levelling the hillsides and, to get rid of the pollution contained in the soil, the idea of the project consisted of recovering the original topography by remodelling the land by recreating the hillsides (Fig. 15.6).

15.8 The City, a Living Milieu

15.8.1 Sébastien Roussel

The issue of nature in the city is often approached through the notion of GBI, but it seems to me that the urgency of dealing with the consequences of climate change should lead us to question this approach. In landscape schools, we learn that the city is an ecosystem. But, this ecosystem is not only human or anthropic; it is ultimately a living environment that man cannot totally control. At the École Nationale Supérieure du Paysage de Versailles, I organised, with Florent Clier and Bjorn Blake, the "Co-habitat" workshop, which looked at how the "human living", could share a territory with "non-human living" (that is wildlife). The notion of control must be combined with that of letting go. This question leads to rethinking the way of doing the project: how can we get out of anthropocentrism and draw spaces and environments for a

human and non-human living? To the notion of control, it is necessary to associate a certain letting go in front of the unknown of the living and its movement. This attitude can be found at all levels of the project, from the land to the sowing of a meadow. However, it should not be concluded that these spaces constitute a kind of Garden of Eden where natural processes would function spontaneously and autonomously. The cohabitation of the human and the non-human must somehow be thought out.

Chapter 16
Future Perspectives and Approaches Towards Operationalisation

Benedetta Giudice, Gilles Novarina, and Angioletta Voghera

Abstract The chapter discusses the innovative contribution of green and blue infrastructure (GBI) in its diverse fields of action: the cultural approach, its ecological application in regional and urban planning and design at different scales. Starting from the French and Italian case studies and the other international best practices, we attempt to redefine topics, methods and tools to operationalise GBI.

Keywords Methods · Tools · Innovative practices · Ecological planning and design

16.1 Approaches

Currently, green (and blue) infrastructure (GBI) is internationally recognised for modifying our cities and territories to favour a sustainable and resilient adaptation. Including GBI in spatial planning and design, from territorial to plot scale, has become increasingly essential. Indeed, the crucial role of GBI is mentioned in international strategies, policies, and regional and local experimentations dealing with planning and design. This paradigm allows for bringing sustainability and resilience into play and redefining the relationship between ecological-environmental, economic, social and health dimensions of a territory. Starting from the construction of broad knowledge frameworks, GBI contributes to responding to the need for adapting to climate change and enhancing the quality of biodiversity, landscape, life and well-being (Norton et al. 2015). Indeed, it constitutes a renewed approach for the city

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of the future based on a different balance between the needs of man and nature to counter all the crises.

GBI is multifaceted and can be interpreted in several manners: as (i) a system of ecosystem services (ES) and nature-based solutions (NBS), (ii) a strategy of conservation and valorisation of natural and semi-natural landscapes that penetrates the urban tissue, and (iii) a spatial strategy. All three interpretations also rely on the "blue" elements, including waterways, rivers, and streams.

The first interpretation embraces the vast topics of ES and NBS (Raymond et al. 2017). This interpretation of GBI stems from studies in landscape ecology (Forman and Godron 1986), dealing with the necessity to connect all the different natural habitats. In this field, GBI structures the natural environment necessary for ecosystem functioning[1] and networking to mediate the relationship between GBI and health (Coutts and Hahn 2015) of man and nature. Thus, it opens the path to the recognition and design of ecological networks, integrating and reinforcing the innovative role of vast scale strategies and punctual actions. Within this interpretation, the ecological network links natural protected areas (nodes and site biodiversity conservation areas) to urban parks, green areas, and local facilities for play, sport, and leisure,[2] acting as stepping stones in the urban context.

The second interpretation links natural territories to human communities (Austin 2014), considering them as a socio-ecological integrated landscape system, a "network with patches and corridors" (Hersperger et al. 2021, p. 2340). This network should be integrated into the landscape and spatial planning in order to overcome degradation processes and loss of natural functions (Noss 1987) and restore "functional, viable longleaf ecosystems for ecological, economic, and social benefits […] at a landscape scale" (Allen III 2012, p. 21). Acting at a landscape scale means coordinating different spatial scales, from general policies and strategies to punctual interventions (as in France). Indeed, the GBI paradigm can be used to support the integration of multifunctionality and connectivity into planning at diverse scales.

Returning to the aspect of scale, the third interpretation focuses on GBI as a design paradigm that should fertilise spatial planning and projects at all scales.

Within these interpretations, waterways (the "blue" elements) play a fundamental role for their capacity to innervate territories (from the "big" river to the channelled channels), constituting the proper regeneration design support to redefine marginal territories, open spaces, and urban areas. The "blue" element, in addition to the internationally recognised "green", becomes a "bridging concept" in relation to two aspects. On the one hand, the first aspect is connected to ES within GBI, which can be interpreted as a mediator in making operational biodiversity policies for the society and economy. On the other hand, the second aspect can be related to landscape

[1] GI offers a wide range of ecosystem services: from life-supporting services (soil formation and maintenance of free soil) to those regulating emissions, climate, water, erosion, prevention of hydrogeological disruption, regulation of pollination, habitats for biodiversity, or supplying food, raw materials, fresh water, biological variability, and even cultural services, such as landscape, aesthetic, recreational, educational, spiritual, artistic, and identity values.

[2] In Italy, these facilities are legislatively defined as "urban standards", and they are compulsory quantified in the land use plan.

networking in GBI. The landscape is a mediator between man and nature, cultural approaches, past and future, conservation and use (CoE 2000; Palang and Fry 2003; Castiglioni et al. 2015). Thus, starting from the European Landscape Convention (ELC), the landscape becomes a keystone able to communicate the value of GBI to a wide public of stakeholders and local communities (CoE 2000). The landscape can be the *trait d'union* to realise a systematic GBI project that focuses on enhancing biodiversity and nature in the built and urban environment (Norton et al. 2016; the French policy of "*nature en ville*" well identifies this objective).

The approaches presented here find reference in most of the book's contributions. Diverse methods and approaches characterise the contributions, even though they differ based on geographical, cultural, and institutional frameworks. Since 2010, with the institutionalisation of *Trames Vertes et Bleues* (TVB[3]), the French situation appears consolidated and strictly connected to multiscalar planning and design. The strong attention to the design dimension is evident, as some case studies demonstrate. Indeed (see, for example, Fournier and Bonnefond, Seigneuret chapters and the interview with D&A), many experimentations of TVB have had tangible and visible results (Giudice and Voghera 2021).

On the contrary, the Italian situation is still experimental, focusing mainly on conservative and valorisation action, dealing with the strategic role of landscape planning (Hersperger et al. 2021; Selman 2009). The main outputs can derive from the first approved Regional Landscape Plans[4] (Giudice 2021; Voghera and Giudice 2021). For example, the Regional Landscape Plan of Puglia (approved in 2015) promoted GBI as a structural component of the plan defining a strategic vision for landscape valorisation focused on five territorial projects and thirteen interventions (i.e. regional ecological network, urban and rural pacts, infrastructural scenario for slow mobility connecting inner areas to the sea). The Regional Landscape Plan of Tuscany (2015) developed an ecological network strategy aimed at enhancing the ecosystem quality of the regional landscape. The Regional Landscape Plan of Piedmont (2017) identifies a network of landscape connection, a conceptual model that connects ecological, historical-cultural and recreational aspects in a multifunctional system. Friuli-Venezia Giulia (2018) promotes two integrated strategies for the regional ecological network and a network of cultural heritage and slow mobility. Lazio (2021) is the only plan that does not explicitly promote a strategic vision of GBI but identifies some local areas for multifunctional landscape actions.

The three interpretations help mark some key aspects and values of GBI. First, it is a multifunctional strategy that becomes a "vehicle to embed a strategically planned network designed and managed" to supply several benefits (Natural England 2008). Besides, it is a multiscalar tool for developing planning policies (Albert et al. 2017; Von Haaren et al. 2016) at a large scale as well as local interventions. From a planning

[3] TVB may be identified as the French GBI.

[4] Since 2004 with the promulgation of the National Code of Cultural Heritage and Landscape, Italian Regions must draft a Regional Landscape Plan. To date, only 6 regions have approved the plan.

perspective, GBI, intended as a design tool, helps shape future choices, supporting the identification of strategic areas for the ecological network.

16.2 A New Ecology-Led Project

The consideration of GBI in urban project approaches is nothing new. In the second half of the XIXth, one of the first landscape architects, Jean-Claude Nicolas Forestier, who worked with Alphonse Alphand, the main collaborator of Baron Haussmann in Paris, wrote *Grande ville et système de parcs* (Forestier 2001), in which he suggested to organise the links between public parks and gardens by creating parkways. Some years after, the garden city experience (see Forget chapter), which started in England and diffused in plenty of countries in Europe, North and South America, based the structuration of new towns upon a large typology of green spaces as central parks, parkways, green alleys, squares, private gardens and green belts (Sadoux et al. 2017). In such approaches, the role of green spaces networking was to offer healthy conditions of life and promote leisure close to residential neighbourhoods.

It was only at the end of the 1990s that ecology-led approaches emerged in the field of urban planning and design. The Bergamo regulatory plan by Bernardo Secchi and Paola Viganò (2000) was one of the first experiences of collaboration between planners and natural science specialists in Italy, which integrated the landscape ecology approaches in planning, emphasising the role of ecological corridors in the structuration of a green system. Such an experience has been gradually integrated into the territorial planning systems of different European countries. In France, as already mentioned in Sect. 16.1, the Grenelle II law (*portant engagement pour l'environnement*—2010) established the identification of the different elements of the TVB by regional, metropolitan, and local plan. In Italy, as declared in Sect. 16.1, Regional Landscape Plans have increasingly integrated ecological networks. Ten years of implementation of this new form of planning shows the crucial role of local plans and operative projects in preserving or restoring biodiversity and ecological networks inside metropolitan or urban contexts.

Local planning and design experiences focused on the importance of small green spaces (riparian forests, green edges of transport infrastructures, agricultural land residues, private gardens, and wastelands) in connecting urban parks with green belts. During the early 2010s, landscape architects and planners developed new forms of parks—based upon Gilles Clément's "*Jardin en movement*" approach (Clément 2017)—by associating different types of plants and organising rainwater collection by small valleys. A new landscape aesthetic was born that explained the success of landscape architects such as Gilles Clément or Michel Desvigne in numerous European countries.

The climate change thread leads architects, landscape architects and planners to modify their project approaches by integrating new ecological parameters at different territorial scales, from the neighbourhood to the metropolitan area. The creation of new pools of water inside public parks cannot be any more separated from the

management of the whole water cycle. Such new management highlights the need to consider the topography in projects, struggle with soil sealing, and protect human settlements against floods. The presence of new blue infrastructures inside the city provides unique opportunities to develop to produce energy and reduce heat islands.

Developing new projects to contrast climate change also leads architects, landscape architects and planners to imagine typologies of plants more adapted to global warming. Trees, such as oaks and plane trees, which are characteristic species of temperate climate countries and are very often used in public parks, are no longer suitable because of climate change. Protection of tree roots systems, preservation of soils' agronomic wealth, and re-establishment of natural flooding of water of streams and rivers provide new topics that must be integrated by project elaboration and during building processes (see Magali Volkwein and Sébastien Roussel and LAND studio interview). The urban ecosystem must be considered a human milieu that is both anthropic and natural. The coexistence of humans and non-humans inside this milieu tends to become one of the issues of the urban project and modifies the design of public and collective spaces.

Next to these "cultural" assets, it is important to accompany the entire process and design action to operationalise it. An example can derive from the introduction of policy indications and rules. In France, many local plans have introduced specific guidelines and abacuses of design solutions (*Orientations d'Amenagement et de Programmation*–OAP). For example, the local plan of Grenoble (PLUi Grenoble Alpes Metropole) identifies a long-term strategy based on (i) landscape and biodiversity, (ii) air quality, and (iii) risks and resilience. These indications can support the GBI project for resilience and sustainability (Voghera and Giudice 2019), integrating green and blue with grey (infrastructure and technological actions), brown (physical, chemical, and biological integrity of soils), and black infrastructure (contrast to the loss of biodiversity due to night-time lighting).

In this perspective, GBI contaminates urban design and architecture with other practices and knowledge by contributing to the conformation of the built environment, landscape, soil, and ecosystems and assuming relevant responsibilities in the challenge of governing global processes of sustainable and resilient regeneration.

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Index

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