1 Introduction and Overview

Cities around the world are facing increasing environmental, economic, and social challenges. Population growth, climate change, and associated natural disasters, food shortages, waste and water management, biodiversity and ecosystem loss, resource inefficiency, social segregation, and urban vulnerability are some of these challenges. More than 50 per cent of the world's population lives in urban areas, which is projected to increase to 70 per cent by 2050 (UN, 2018). Rapid urbanisation in many parts of the world is having a direct impact on social inequalities and human well-being, as many cities struggle to provide sufficient shelter and services for their populations. In established cities, patterns of economic, social, gender, and racial inequality are persisting. The rapidly growing urban population is exacerbating demands on natural resources, both in terms of material consumption and increasing land needs. This has stark implications for our already vulnerable ecosystems and declining biodiversity. At the same time, urban centres concentrate activities

that produce greenhouse gas emissions contributing to climate change and they are also vulnerable to the impacts of a changing climate.

The twin crises of biodiversity loss and climate change have created a critical need to rethink the relationship between cities and nature. At a global level, the key policy processes trying to address these crises are seeking the active commitment of cities to contribute to biodiversity goals (UN Convention on Biological Diversity) and shifting towards the use of urban nature for reaching climate adaptation and mitigation objectives (UN Framework Convention on Climate Change). Cities and nature are therefore at the heart of the intersection between the biodiversity and climate regimes and at the core of reshaping approaches to urban sustainability. Yet despite growing recognition of these interconnected challenges and the potential for synergistic solutions, policy-makers and practitioners continue to largely rely on traditional approaches of governance, finance, and engineering, which often take siloed approaches to address these profoundly interconnected sustainability challenges. Considering cities as 'dense networks of interwoven socio-spatial processes that are simultaneously local and global, human and physical, cultural and organic' (Swyngedouw & Heynen, 2003, p. 899) opens the door for more integrated measures, which are coordinated through a systemic approach (Brink et al., 2016).

Urban nature holds great potential to address the web of challenges that cities are facing and support transitions to a more sustainable future (see Box 1.1). Cities are working with nature in a diversity of ways, such as by using blue and green infrastructure. Blue infrastructure includes, for example, lakes, ponds, drains, and wetlands. These features can regulate storm water flows, reduce pressure on the urban drainage system, and create sponge cities that lower flooding risks while reducing heat island effects, enhancing biodiversity, and providing recreational opportunities. Green infrastructure can include, for example, urban forests, green roofs and walls, multifunctional parks, and river embankments. These areas can improve air quality and energy efficiency, reduce heat island effects, and contribute to human health and well-being, among other benefits. Furthermore, urban gardens can increase access to food and employment, while enhancing physical and mental health and social integration.

The term 'urban nature' can be understood from a general perspective to refer to the blue and green areas present in cities. The emerging concept of nature-based solutions is more specific than urban nature, and focuses on what we have come to know as green and blue infrastructure – an urban nature that has purposefully been created, maintained, or managed to provide multiple benefits for humans and the environment alike. These benefits include addressing key urban challenges like biodiversity loss, health and well-being of urban populations, and a changing climate. In this textbook, both the terms urban nature and nature-based solutions are utilised and explored in the broader context of cities and nature and are

Box 1.1 Recognising the benefits of nature in cities

Grey infrastructure – from roads and pipes to car parks and electricity substations, among many others – plays a dominant role in urban development. Nevertheless, blue and green infrastructure, capturing the natural properties of ecosystems, are also present in cities as established urban nature. Increasingly, these natural areas are being reconceptualised as nature-based solutions to limit the impacts of climate change, enhance biodiversity, and improve resilience, while also generating positive wider economic and social benefits.

- **Climate action for adaptation:** contributions to flood protection, shadow effects and reducing high temperatures (urban heat island) in summer.
- **Coastal resilience:** contributions to reducing flooding for cities located in coastal areas.
- **Cultural heritage and diversity:** contributions to the beauty and the cultural meanings of industrial, military, and other forms of heritage.
- **Economic development:** contributions to employment, nature-related sectors of the economy, and public finances through overall service provision.
- **Green space and biodiversity:** contributions to the availability and accessibility of green space, and animal and plant species.
- **Environmental quality:** contributions to the air quality and beauty of the living environment for urbanites.
- **Health and well-being:** contributions to mental and physical well-being through access to outdoor activities and enjoying the experience of nature.
- **Inclusive governance:** contributions to the accessibility of nature and feelings of safety among urbanites.
- **Regeneration and land use:** contributions to the greening of urban areas that have been or are to be regenerated.
- **Social justice and cohesion:** contributions to the equitable distribution of nature's benefits across urban areas and to social encounters.
- **Sustainable consumption:** contributions to providing local produce and to the pollination of food plants.
- **Water management:** contributions to storing water and reducing the pressure on sewerage systems.

demonstrated through a multitude of cases. The textbook provides an introductory account of how innovation with nature in cities can help to address climate change and biodiversity loss, while supporting the sustainable transformation of urban areas.

Through an interdisciplinary approach and drawing on knowledge from case studies from North America, Europe, Asia, Africa, and South America, this textbook provides insights into key challenges and opportunities for urban nature and nature-based solutions (see Box 1.2). Additionally, a number of thought-provoking

Box 1.2 Presenting the structure of the textbook

This textbook is divided into three sections and 10 chapters, the first of which is this overview chapter. It has been designed to engage you in a journey of discovery and learning. The chapters in the textbook are illustrated with figures, images, and text boxes, and also contain follow-up questions and resource materials. Each chapter includes two boxes with key case studies from cities around the world, providing you with insights into urban nature through a focus on sustainability opportunities and challenges.

Throughout the chapters and parts of the textbook, there are a range of boxes that introduce supplementary insights about urban nature and nature-based solutions. The 10 boxes that appear throughout the textbook on 'Cultivating Urban Nature – Key Lessons' provide you with specific suggestions on how to understand, expand, and develop urban nature in your city. These boxes appear throughout the textbook and connect to the themes of different chapters, namely:

1. **Develop Connections:** the converging challenges of urban sustainability demand solutions, like urban nature, that connect multiple issues (Chapter 1).
2. **Tend Creativity:** urban nature can feed our imaginations and our soul (Chapter 2).
3. **Recognise Trade-Offs:** urban nature involves trade-offs that need to be explicitly recognised (Chapter 3).
4. **Make Space:** urban nature needs space to grow (Chapter 4).
5. **Grow Collaboration:** collaboration comes in all shapes and sizes, and greater diversity and flexibility is needed for activities on urban nature (Chapter 5).
6. **Value Experimentation:** seeing is believing – experiments allow actors to try things out without losing too much (Chapter 6).
7. **Foster Investment:** urban nature requires investment of all kinds – financial, political, and cultural (Chapter 7).
8. **Embrace Diversity:** there is no one-size-fits-all for urban nature – beauty is in the eye of the beholder (Chapter 8).
9. **Ensure Equity:** too often, the benefits that urban nature provides are unevenly distributed across communities in cities (Chapter 9).
10. **Nurture Intermediaries:** new relationships and trust are needed to expand urban nature (Chapter 10).

questions and resource materials are provided to support independent and deeper learning (see Table 1.1). This approach provides learners with an overview of the conceptualisation of nature in cities and innovation, and with scientific and empirical evidence as well as an improved understanding of sustainable transformations and ways of reimagining new directions for urban futures (see Box 1.3).

Table 1.1 Overview of learning exercises in the textbook

Activity	Description
Individual reflection	This is a task carried out individually and focuses on understanding and reflecting. For example: Think of what constitutes nature in a city for you. How would you define it in your words? In your opinion, are we (humans) part of this nature or are we outside of it?
Peer discussion	This is a task carried out in groups with peers and focuses on discussion and critical thinking. For example: Discuss with your peers how the concept of 'urban nature' relates to other key concepts and fields of study discussed in this chapter: 'urban ecology', 'urban metabolism', and 'urban political ecology', for example. Relate this discussion to how the perspectives on nature in the city have evolved over time and across various disciplines.
Explore examples	This is a task carried out individually or in groups and involves exploring examples and contexts. For example: Explain what 'nature-based solutions' are and provide three examples of nature-based solutions. Which nature-based solutions can you identify from the case studies of Melbourne and Tianjin? Why do you consider these to be nature-based solutions? Explain why and how these nature-based solutions can be considered multi-functional.

Box 1.3 Cultivating urban nature – key lessons

Develop Connections: the challenges associated with achieving urban sustainability demand solutions – such as urban nature – that can connect multiple issues and provide diverse benefits.

Nature-based solutions are often heralded as being synergistic, able to simultaneously meet a range of environmental, economic, and social challenges. Yet the delivery of these benefits does not necessarily happen automatically and instead needs to be prioritised from the design stage of nature-based solutions projects through to their implementation and maintenance. Many nature-based solutions are currently being implemented without tapping their potential to provide wider benefits beyond their primary objectives, or to support action across multiple municipal policy agendas as well as address the key concerns of private and community-based actors. Recognising this potential and aligning with sectoral agendas can provide additional momentum and resources to fund and choose nature-based solutions alongside or instead of traditional grey infrastructure solutions. Finding these synergies requires bringing diverse actors around the table at an early stage of project design and using decision-support tools that allow the multiple benefits of nature-based solutions to be recognised and considered simultaneously. Looking for the root causes of unsustainability in the city – from water availability to health and inequality – can also provide a means for establishing nature-based solutions that can tackle multiple challenges simultaneously.

Part I

Understanding Perspectives

Urban nature and nature-based solutions, such as urban forests, have the potential to provide multiple benefits to a range of sustainability challenges facing cities (see Box P1.1). They can help to limit the impacts of climate change, enhance biodiversity and improve environmental quality while contributing to economic prosperity and social well-being. But how should we understand urban nature and nature-based solutions?

Box P1.1 Spotlight on implementation – urban forests

Urban forests are an emerging concept which not only incorporate trees, but also include other vegetation in streets, parks, plazas, river embankments, wetlands, railway corridors, community gardens, and on buildings, as well as the soil and water that supports them. Urban forests have been around for generations but have only recently been valued for more than their aesthetics and recreational value. This shift comes as a result of population growth, densification, and climate extremes and recognition of the potential environmental, economic, cultural, and political benefits they can offer. Urban forests are increasingly recognised as a tool to persuade and engage local actors to work with and expand urban vegetation. They can create resilient and sustainable urban landscapes that provide healthy and enjoyable places for people to live and work but this requires rethinking the role of green spaces in cities. Like other nature-based solutions, they must draw on strong visions and strategic target-oriented planning, coupled with new governing modes and partnerships, often reallocating and sharing responsibilities with private actors.

Urban forests represent a key approach to expanding nature-based solutions in cities.

Box P1.2 Understanding the value of nature in cities

Assessing the value and potential of urban nature and nature-based solutions requires an approach that takes account of the multiple benefits they can provide and the different criteria against which they can be evaluated. This necessitates utilising different kinds of knowledge and assessing the value of nature in the city in relation to urban sustainability goals.

Biophysical and ecological: nature-based solutions and urban nature can provide ecosystem services for cities, such as providing resources, regulating environments, creating habitats, and generating social and cultural activities. The extent and scope of these services varies with the conditions in which nature-based solutions are introduced, how they are designed, and the ways in which they are maintained over time.

Economic and financial: nature-based solutions and urban nature can bring a variety of benefits to cities. Understanding the economic and financial value of these benefits is important if they are to be taken into account in decision-making processes as an alternative or complement to traditional forms of infrastructure and urban development.

Social and cultural: the benefits of nature-based solutions and urban nature can also be social and cultural, from providing spaces for social interaction to recreational opportunities. At the same time, nature is seen to have values that are difficult to account for in economic terms but which are nonetheless important to society, such as contributing to human well-being as well as being inherently valued in their own right.

Part I explores how urban nature and nature-based solutions are conceptualised through different approaches and different ways of valuing nature, and the ways in which nature is being created for cities (see Box P1.2).

Conceptualising: This chapter outlines different conceptual frameworks that can be used to better understand the evolving role nature has played in cities. It distinguishes between socioecological systems and urban political ecology, each of which influence how nature has been regarded and treated in different time periods and urban settings. It seeks to provide an overview of these concepts and explain their implications for how urban nature and nature-based solutions are constructed and viewed today as an urban policy issue.

Key contents:

- Presenting different approaches to understanding urban nature, nature-based solutions, and the relationship between nature and cities.
- Discussing the emergence of nature-based solutions as a response to urban sustainability challenges.
- Case studies: Urban Forest Strategy (Melbourne, Australia) and the Eco-Valley of Tianjin Eco-City (Tianjin, China).

Valuing: This chapter provides an insight into the different kinds of values that nature has, how this plays out in the urban arena, and what this means about how it can and should be assessed. Through a detailed account of values and benefits as well as potential assessment techniques and their limitations, this chapter also presents how techniques capture the values of diverse stakeholders and discusses the implications when stakeholders attribute different and sometimes conflicting values and benefits.

Key contents:
- Exploring our understanding of the value of nature and highlighting the challenge of conflicting values and benefits with urban nature and nature-based solutions.
- Reviewing assessment techniques, including their limitations and potential approaches for further improvement.
- Case studies: Cape Town Environmental Education Trust (Cape Town, South Africa) and Beekeeping at Audi Hungaria (Győr, Hungary).

Developing:
This chapter investigates the technical and biophysical properties of nature-based solutions by presenting eight types of urban ecological domains that are illustrated with practical examples. In addition, the ecosystem services associated with different types of nature-based solutions, like urban forests, are outlined, including provisioning services, regulating services, habitat and supporting services, and cultural services.

Key contents:
- Presenting how urban nature is being developed in our cities in different ways and combinations – in particular through the concept of nature-based solutions.
- Outlining eight types of urban ecological domains and the ecosystem services associated with different types of nature-based solutions.
- Case studies: BiodiverCity (Malmö, Sweden) and the Tolka Valley Park (Dublin, Ireland).