



Nature in and across cities: metropolitan approaches for biodiversity conservation

metropolis ●



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The opportunity for biodiversity found in our metropolises to connect communities has never been more obvious than now given the scale of the dual climate and biodiversity crises we face, and as the world looks to build back better from the COVID-19 pandemic.

In our dense urban landscapes, the desire for an equitable green recovery as the world re-opens, will only be realised if we continue to work locally on global challenges. It is at the metropolitan scale we see real opportunities to scale up the innovation shown in response to COVID-19, for community and ecological resilience. Metropolitan governments, or the sum of the metropolis parts, can and will continue to innovate and disrupt, to connect and coordinate – let's use this momentum to allow more nature in our cities for people to thrive, and for human ingenuity to allow nature to thrive too.

The release of this publication coincides with the lead up to the 15th Conference of Parties for the Convention on Biological Diversity (CBD COP15) in Kunming China, where the opportunity to recognise metropolitan governance in a post 2020 Framework for Biodiversity is front and centre. This critical meeting will set priorities for biodiversity conservation and restoration in a global 2050 Vision for Biodiversity. Local and regional governments are highlighting the benefits, amongst the challenges, of an ever-urbanising world for nature. Here we present an analysis of the critical role that governments operating in metropolitan territories can play to reduce further biodiversity losses.

In this new Metropolis publication, Ariana Dickey, Cathy Oke, Judy Bush and Amy Hahs from University of Melbourne, along with colleagues at ICLEI Cities Biodiversity Centre, Metropolis and The Nature Conservancy examine nature in metropolitan contexts using the IPBES framework of Nature for Nature, Nature for Society and Nature for Culture; under five key themes - Urban Nature (Biodiversity, Threatened Species); Human Health and Wellbeing related to nature; Climate Change; Food Security; and Diverse Urban Forms and their influence.

This research synthesis shows that while local or regional governments alone can and do make an impact to their residents and for biodiversity through investment in nature, multilevel collaboration across metropolitan territories would only boost global action at the scale the biodiversity extinction crisis requires. We say to all involved in generating a new framework for nature, that there is a real opportunity and hope for biodiversity conservation in engaging enhanced metropolitan scale approaches.



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In addition to the immense health, social, and economic impacts of COVID-19, the pandemic caused substantial ecological impacts as well (Bang and Khadakkar, 2020). This comparative study responds to calls for a green and resilient recovery from COVID-19 (OECD, 2020) by providing case studies on and targeted actions for enhancing urban biodiversity as cities consider how to rebuild in a post-pandemic world and as multilateral actors in metropolitan spaces continue to cooperate, expand and grow in number.

Five chapters comprise this paper – Urban Nature, Human Health and Well-Being, Climate Change and Urban Resilience, Food Security, and Diverse Urban Forms and their Influence – each of which examines biodiversity and ecosystem conservation through the lens of the chapter theme and addresses the three dimensions of the conceptual framework set out by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES): Nature for Nature, Nature for Society, and Nature for Culture (Diaz et al., 2015).

'Nature for Nature' refers to accommodating and caring for nature for the sake of nature in recognition of its intrinsic value. 'Nature for Society' takes an anthropocentric and utilitarian understanding of nature, which frames nature through its benefits to humanity, for example in the form of ecosystem services. 'Nature for Culture' refers to the value humans derive from and the connections they feel towards nature. Local Traditional Cultural perspectives are emphasised in the Nature for Culture perspectives; however it is increasingly recognised that First Nations and Indigenous peoples bring deep knowledges to all three dimensions of the IPBES framework (Hill et al., 2020).

The chapters proceed to a 'Policy and Action' section, which discusses and provides examples of the various policy mechanisms local and regional governments can use globally to encourage and implement urban nature based on the chapter theme. The following section of each chapter, 'Governance,' raises governance challenges and examples of success related to the chapter theme, bringing perspectives from metropolitan spaces around the world once again. Finally, the chapters each close with a case study, selected for how it exemplifies the chapter theme.

Throughout the report, some key terms are used. The list of terms below provides the definition by which we refer to each:

- *City* – a unit of analysis used to refer to a large human settlement that is functionally, administratively, politically and spatially connected (UN-Habitat, 2020)
- *Governance* – how interactions between urban actors across public, private, and civil society operate in different urban contexts with varying social, political, and economic circumstances (Lukas, 2019: 3). The governing of metropolitan regions can be accomplished by a variety of mechanisms, ranging from a comprehensive metropolitan "government" to a variety of forms of cooperation among the numerous jurisdictions in a metropolitan area, which will be termed "governance" here
- *Green infrastructure* – constructed ecosystem-based installations, often for water runoff management and other ecosystem functions (Cohen-Shacham et al., 2016: 21)
- *Nature-based solutions* – actions to protect, sustainably manage, and restore ecosystems that address societal challenges, such as climate change, food and water security or natural disasters, while simultaneously providing human well-being and biodiversity benefits (Cohen-Schaham et al., 2016: xii)
- *Urban nature* – flora and fauna found in metropolitan spaces

In an increasingly urbanising world, biodiversity and cities are typically framed as antithetical to one another: either biodiversity suffers as cities encroach upon wilderness, or cities must constrain themselves to conserve nature. Human activities impact biodiversity directly through habitat loss, fragmentation, and introduction of new species as well as indirectly by altering climate, soil, hydrology, and chemical conditions (Kowarik, 2011). However, with 70% of the global population projected to be living in cities by 2050 (United Nations, 2018) and an estimated half of the world's GDP reliant on biodiversity and its services (Alshaye & Oudah, 2020), there is a need for urban areas to be reimagined as contributors to biodiversity conservation and habitat provision and for recognition of the multiple co-benefits that biodiversity and nature in metropolitan spaces can bring to climate change, human health and well-being, and sustainable development (Bulkeley et al., 2021; San Gil León et al., 2020).

Further, while biodiversity targets are typically aimed at the national scale, it is at the city scale that infrastructure, development and land use decisions are made and where the bulk of unsustainable resource consumption and polluting economic activities take place – all of which directly and indirectly impact biodiversity (Bulkeley et al., 2021; San Gil León et al., 2020). As such, reframing cities as part of the solution to the biodiversity crisis by incorporating nature into urban agendas through, for example, the implementation of nature-based solutions to address sustainability and climate change goals, can slow the rate at which biodiversity is currently being lost, and contribute to the global efforts to restore and expand habitat – an approach that is particularly significant as cities expand to reach metropolitan scales.

Nature for nature

Metropolitan areas can provide habitat for threatened species, and in some instances are the only remaining habitat for them. For example, one study found that 30% of Australia's threatened species are found in cities (Ives et

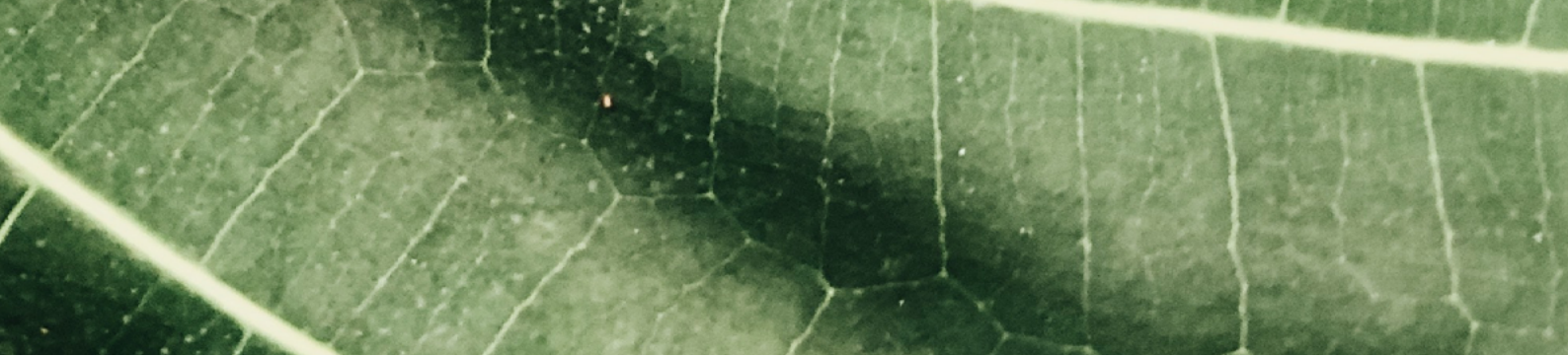
al., 2017), with 39 of those species are restricted to only one or two cities (Soanes & Lentini, 2019). Cities have also been known to expand the ranges of species, such as fruit-eating bats and nectar feeding birds (Xu et al., 2019). In fact, cities with their urban gardens provide vital nectar refuges for pollinators whose flowering food sources and habitats have been replaced by increasingly homogenised and non-flowering agricultural crops in rural areas (Tew et al., 2021). Green infrastructure has been shown to significantly improve biodiversity, including amphibians, reptiles, fish, invertebrates, birds, and bats in addition to plants. This is particularly true for bioswales and green roofs (Filazzola et al., 2019). Finally, small urban spaces provide a substantial yet oft neglected contribution to supporting native species populations and the persistence of local populations as well as enhancing regional diversity (Wintle et al., 2019).

Nature for society

Urban nature enhances climate resilience while also contributing to disaster risk reduction, job creation and revenue in local communities, increasing land value, and improving equity in vulnerable communities (Bulkeley et al., 2021). It also contributes to human health and well-being (see Chapter 2), climate adaptation, mitigation, and resilience (see Chapter 3), and food security (see Chapter 4). Finally, biodiversity underpins sustainable development, as noted by the IPBES, IPCC, and FAO (Tsioumani, 2019).

Nature for culture

Urban nature provides many cultural benefits, including religious and spiritual fulfilment, and recreation. It also contributes to place identity and develops neighbourhood pride (Bulkeley et al., 2021). Urban green spaces that hold religious and cultural significance are often also rich oases of biodiversity, for example in the temples, mosques, churches, and cemeteries in Bengaluru, India (Jaganmohan et al. 2020). And yet, the spiritual and cultural role of nature in cities extends beyond religious spaces to be also spiritually significant



in itself. For First Nations peoples, the connection with land that underpins Indigenous cultures, identities, knowledges, and practices and contributes to health and well-being can be fostered by urban nature, such as that found in public parks, home gardens, and even the presence of trees (Landry et al., 2019). Further, if lands managed by Indigenous peoples globally have suffered less biodiversity loss (IPBES, 2019), there is a real opportunity for metropolitan planning processes to engaging Indigenous peoples and their sustained relationship with nature, in designing resilient cities of the future (Mata et al., 2020). Care must be taken, however, not to romanticise Indigenous people and their relationship with nature, as doing so can result in disempowerment (Irvine et al., 2019).

Policy and action

Taking a nature-based solutions (NBS) approach is one method cities have used to enhance biodiversity. Framing biodiversity through NBS connects the value of biodiversity to a suite of benefits related to climate mitigation and adaptation, disaster risk reduction, and societal well-being (Bulkeley et al., 2020). In Spain, for example, the Àrea Metropolitana de Barcelona supported the construction of semi-fixed sand dunes to provide coastal defence against sea level rise in the area around the Llobregat Delta, which includes four coastal cities within the metropolitan territory. An important feature of the project was the stakeholder mapping conducted in order to understand how to rectify recreational use of the beach with dune protection. The stakeholder mapping exercise proved useful for highlighting the cultural ecosystem service provided by the dunes and created a common understanding between city administrators and citizens. And by taking a NBS approach, the four cities were able to work together to consolidate the beach as a hotspot for recreation and economic activity with climate adaptation management under a single conceptual umbrella (NetworkNature, n.d.(a)).

















Another example of a NBS approach is the Sponge City Programme initiated in cities across China, including Beijing, Wuhan and Shenzhen,

to build water-sensitive, resilient cities that can manage urban flooding in an ecologically sustainable way (Dai et al., 2017; Xia, 2020). To do so, the Sponge City Programme emphasises the use of nature as a means to absorb (like a sponge), store, and purify water, for example through the installation of green walls and green roofs, while also enhancing biodiversity, relieving urban heat island effect.

Monitoring urban biodiversity is also an essential method for tracking biodiversity conservation efforts over time. Singapore pioneered the City Biodiversity Index, which represented the first method for benchmarking cities' biodiversity conservation efforts (CBD, 2013). More recently, Los Angeles, USA created an index specifically suited to its own context. Unique to Los Angeles' index are the 'ecotopes' that partition the metropolitan area into discreet spatial units designed to combine landform, microclimate, and biotic characteristics and allow the city to target action within each ecological subregion. The index seeks to enhance urban habitat conservation and improve equitable access to nature with indicators designed to inspire stewardship and biodiversity action across city employees, policy-makers, community members, and educators, measuring, for example habitat quality and threats to biodiversity as well as education, governance, and community action. (LASAN, 2020).

Biodiversity, while important for its own sake, can more readily muster action through its framing as a co-benefit of other urban agendas, such as climate change, economic growth, sustainable development, and even cultural heritage. Therefore, policy that mainstreams biodiversity by clearly linking it to these agendas has transformative potential (Bulkeley et al., 2021; San Gil León et al., 2020). Amman, Jordan, for example, is developing a system to mainstream biodiversity through a cultural and world heritage lens by developing and expanding a Natural Heritage System that includes categories related to its natural ecosystems. Doing so provides leverage by directly linking the social identity of the city with its natural ecosystems and assets (San Gil León et al., 2020).

Table 1. Biodiversity underpins human and societal well-being. As it currently stands, most of the Aichi Biodiversity Targets are not on track and therefore threaten to compromise the SDGs (adapted from Tsioumani, 2019; CBD, 2017).

SDG	Connection to biodiversity
 No poverty	Ecosystems and biodiversity, which exists within ecosystems, are essential to life itself. They provide the resources that support economic activities, including agriculture, forestry, fisheries, and tourism.
 Zero hunger	Biodiversity is key for food security and nutrition, providing needed genetic diversity to enhance resilience of crops and livestock to pests and changing climatic and environmental conditions. Food systems are dependent upon the ecosystem services that support agricultural productivity, water quality and supply and soil fertility.
 Good health and well-being	Healthy ecosystems and the services they provide mitigate air, water, and soil pollution. Nature is also the source of both modern and traditional medicines.
 Quality education	Cultural ecosystem services contribute to education and opportunities for social and community cohesion
 Gender equality	Women and men have differentiated use and knowledge of ecosystems and environmental management. Reversing biodiversity and ecosystem loss contributes to equal access to the benefits of nature.
 Clean water and sanitation	The supply and quantity of clean water rely on the health and functionality of ecosystems. Ecosystems can also mitigate water-related disasters.
 Affordable and clean energy	Healthy ecosystems provide key sources of renewable energy.
 Decent work and economic growth	Biodiversity underpins many industries based on nature, including agriculture and forestry, and can continue to provide opportunities for employment and economic growth, particularly in new sectors such as nature-based tourism and nature-based solutions.
 Industry, innovation, and infrastructure	Healthy ecosystems can provide reliable and cost-effective natural infrastructure, for example bioswales that reduce stormwater run-off and mangroves that protect and buffer coastlines.
 Reduced inequalities	Recognising Indigenous peoples', local communities', and women's rights to sustainably manage natural resources and implementing equitable benefit-sharing of ecosystems can improve socioeconomic and political inequality among countries and social groups.
 Sustainable cities and communities	Healthy ecosystems provide basic services to cities, and nature-based solutions contribute to addressing challenges related to sustainability and urban well-being.
 Responsible consumption and production	Waste and unsustainable consumption and production undermine biodiversity and healthy ecosystems.
 Climate action	Ecosystems contribute to climate mitigation and adaptation.
 Life below water	Ecosystems and biodiversity are at the heart of this goal
 Life on land	Ecosystems and biodiversity are at the heart of this goal
 Peace, justice, & strong institutions	Illegal wildlife trade, fishing, and timber trade undermines biodiversity.

Governance

Historically, global commitments to enhancing biodiversity were met through national action in the form of National Biodiversity Strategies and Action Plans (NBSAP), with local and regional governments contributing by aligning their Local Biodiversity Strategies and Action Plans (LBSAP) accordingly. However, the plans often relied heavily on specialist knowledge, making them difficult to implement for urban planners lacking the knowledge and/or resources to translate the plans into actions, thereby reinforcing the need for multi-disciplinary and collaborative approaches (Xie & Bulkeley, 2020).

Further, a government-led approach can narrow urban action to focus on restricting biodiversity damage without considering how to enrich urban biodiversity (Bulkeley et al., 2021). The governance of urban biodiversity therefore requires a transformation from a reliance solely on regulation and planning regimes to a biodiversity governance approach that includes non-state and sub-national actors, inclusion of other policy mechanisms such as incentives, strengthening local stewardship, and enhancing First Nations and Traditional Owners' roles in planning and decision-making. Indeed, the landscape of transnational biodiversity governance formed of non-state and sub-national actors seeking to stop biodiversity loss has widened (Pattberg et al., 2019). Notably, however, a study of the CLEVER Cities project, conducted by Horizon 2020 in Hamburg, Germany, Milan, Italy, and London, England aimed at implementing NBS in European cities, demonstrates that despite the intent to adopt a co-creation and governance approach, challenges still remain when seeking to bring a wide range of urban actors into NBS planning and implementation processes (Mahmoud & Morello, 2021).

Initiatives such as CitieswithNature, created by ICLEI, IUCN, and The Nature Conservancy, and the Horizon 2020 Sustainable Cities and Communities programme have emerged as important capacity-building and knowledge sharing resources, where cities can share and learn from one another. And indeed, community-led 'civic ecology' actions have made significant contributions not only to nature, but also to social justice (Krasny & Tidball, 2012). This shift from government to governance is also significant, as it demonstrates an evolution towards a whole-of-society approach that can address both the direct and indirect drivers of biodiversity loss and respond to local context (Bulkeley et al., 2021).

Global-to-local governance of urban biodiversity (adapted from Wilkinson et al., 2013)

Primary commitments

- Cities and Biodiversity Outlook
- Bonn Call for Action
- Durban Commitment
- Plan of Action on Sub-National Governments, Cities, and Other Local Authorities for Biodiversity
- Aichi Targets

Institutional actors









- Stockholm Resilience Centre
- UN-Habitat
- ICLEI
- CitiesWithNature
- IUCN
- The Nature Conservancy
- Regions4Sustainable Development
- UNU-IAS
- URBIO Network
- UNESCO

Major initiatives

- Cities with Nature
- Horizon 2020 Sustainable Cities and Communities
- Advisory Committee on Sub-National Governments and Biodiversity
- Advisory Committee on Cities and Biodiversity
- City Biodiversity Index
- TEEB for Cities

Accelerating action

Table 2. Actions to enhance urban biodiversity, which is intimately linked to climate change and sustainable development (adapted from Alshaye & Oudah, 2020; Bulkeley et al., 2020; Kopsieker et al., 2021; LASAN, 2020; Oke et al., 2020; Pattberg et al., 2019; San Gil León et al., 2020; Soanes et al., 2019; Xie & Bulkeley, 2020)

Actions	Outcomes	Target
Mainstream biodiversity objectives and systematically incorporate into urban planning and policy through framing as co-beneficial with other social, environmental and economic agendas, including sustainable development and climate action	<ul style="list-style-type: none"> Achieve biodiversity objectives while also achieving other social, environmental and economic goals 	  
Adopt a biodiversity governance approach and build capacity to include partnerships, public engagement, and giving local actors the resources and tools to implement nature in their communities	<ul style="list-style-type: none"> Harness creativity, resources, and networks of non-state and sub-national actors to support ambitious biodiversity action Fosters participation and sense of stewardship within communities 	
Identify, monitor, and report on ecological subregions with similar landform, microclimate, and biotic features across metropolitan and regional area	<ul style="list-style-type: none"> Retain ecological connectivity, ecosystem integrity and biodiversity 	
Recognise small spaces and unconventional habitats as important for biodiversity and ecological connectivity, such as cemeteries, golf courses, infrastructure cavities, and urban street trees	<ul style="list-style-type: none"> Protect and enhance local biodiversity and ecosystem integrity 	
Foreground Indigenous people's knowledge and stewardship for collaborative approaches to restoring nature in cities	<ul style="list-style-type: none"> Acknowledge Indigenous peoples' unique relationship with the land Increase engagement with and stewardship of nature in the city 	
Develop monitoring and evaluation measures for state and non-state actors to report and demonstrate contribution towards biodiversity efforts	<ul style="list-style-type: none"> Create positive competition between cities and accountability for promised biodiversity action 	

 Nature
  Society
  Culture

Resources

CitiesWithNature
www.citieswithnature.org

Naturvation
www.naturvation.eu

IUCN: Business and Biodiversity
www.iucn.org/theme/business-and-biodiversity

Science-Based Targets Network
www.sciencebasedtargetsnetwork.org

Nature Conservancy Greenprint Resource Hub
www.conservationgateway.org/ConservationPractices/PeopleConservation/greenprints/Pages/default.aspx

WWF One Planet Cities
wwf.panda.org/projects/one_planet_cities

WRI Cities4Forests
www.wri.org/our-work/project/cities4forests

Case study: Durban, South Africa



Image 1. A sign indicating an area designated for conservation as part of the Durban Metropolitan Open Space System (Image Source: Boon, 2019).

Durban is considered to be a global biodiversity hotspot and is home to a threatened savanna ecosystem, the KwaZulu-Natal Sandstone Sourveld. As the metropolitan area has grown, development priorities have consistently superseded environmental and biodiversity concerns. In order to preserve the remaining ecosystem, Durban has taken a series of coordinated actions, including urban planning tools and strategies, biodiversity stewardship, protection initiatives, management, and decision support. With regards to planning mechanisms, any planning applications submitted for sites within or adjacent to Durban's Metropolitan Open Space System, a network of spaces with high biodiversity value, must undergo a biodiversity impact assessment by the Environmental Planning and Climate Protection Department (EPCPD). Durban also has a Biodiversity Stewardship Programme that focuses on building partnerships and incorporating 'technical and traditional knowledge systems to empower, guide and incentivise landowners to manage environmental assets on their properties' (Boon et al., 2017: 9).

Through the stewardship programme, local government is running pilots to better understand conservation challenges in areas with traditional governance systems and also collaborating with Ezemvelo KZN Wildlife, the provincial government's wildlife authority, to proclaim municipal nature reserves that enjoy greater legal protection. The EPCPD has also initiated local Working on Fire and Working for Ecosystems programmes that manage and restore savanna landscapes and have the additional social co-benefit of alleviating poverty and developing the skills of the people employed through the programmes. Finally, ecological knowledge is generally limited in local government, so to address this, Durban developed the Durban Research Action Partnership between the municipality and the University of KwaZulu-Natal. The transdisciplinary research partnership connects science, policy, and practice and builds knowledge, skills, and capacity around biodiversity, environmental management, and climate change adaptation within local government (Boon et al., 2017).

Biodiversity provides direct health benefits, such as food and medicine, as well as indirect health benefits resulting from its role underpinning the ecosystem services that are essential to life on earth, including heat mitigation, air quality, flood risk reduction, space for physical recreation, contribution to mental health, and beyond (WHO & CBD, 2015). How earth's resources are managed plays an integral role in determining the health status of a community, and in fact, stewardship of the environment can contribute to securing livelihoods and enhancing the resilience of communities, while conversely, the loss of natural resources and ecosystems can lead to morbidity and mortality (WHO & CBD, 2015). Urbanisation and modern living habits, including more time spent indoors and on screens, are reducing people's direct experiences of nature (Bratman et al., 2019). Therefore, conserving, restoring, and enhancing urban biodiversity has unique implications for human health and well-being as people increasingly experience 'nature' and ecosystem services within an urban context (Bratman et al., 2019; Kowarik, 2011). With metropolitan areas expanding and threatening habitats, the imperative to make space for ecosystems to thrive in cities is acute in order to safeguard human health and well-being.

Nature for nature

Urban contribution to biodiversity conservation depends on environmental quality and ecosystem integrity within metropolitan spaces as well as regional surroundings. Metropolitan areas should protect habitats from pollution, such as fertiliser run-off, and provide the conditions for healthy, thriving biodiversity, including ecological connectivity and retention of natural habitat. Indeed, metropolitan areas located in regions with high levels of landscape degradation can play a significant role in contributing to regional biodiversity and should thus prioritise conserving and restoring urban nature (Kowarik, 2011).

Nature for society

The range of health and well-being benefits that nature provides could not have been more overstated via responses of city dwellers to COVID-19 lock downs (Pouso et al., 2021). Beyond the wellbeing benefits of spending time in natural environments, nature contributes to nearly 30% of all marketed drugs and biodiversity provides the necessary genetic diversity for future vaccine and drug development (Lindley et al., 2019). Urban nature also improves air and water quality, encourages physical activity, and dampens noise (Stagno et al., 2020). Trees capture

particulate pollutants while also providing shade, lowering temperatures, and slowing the production of ozone that causes smog that can be damaging to human tissue (Lindley et al., 2019; Stagno et al., 2020). Tree canopy cover is also associated with improved pregnancy outcomes (Braubach et al., 2017). Meanwhile, parks serve as oases with better air quality that can reduce exposure to pollutants (Kopsieker et al., 2021). The pathways shaded by trees and open spaces that parks provide have positive correlations with local residents' physical activity patterns as a result of encouraging active transport and providing space for recreation (Lindley et al., 2019). Blue spaces, such as rivers, lakes, and coasts, are also associated with better health outcomes and increased physical activity (Bratman et al., 2019). Studies have shown that humans prefer the sounds produced in and by urban nature to human-made sounds (Stagno et al., 2020). And urban nature has been shown to positively impact both quality and quantity of sleep (Shin et al., 2020).

In addition to the positive physical health benefits of urban nature, ecosystems also contribute to positive mental health. Access to natural space is associated with lower levels of depression, anxiety, and stress (Beyer et al., 2014) in addition to improved cognitive function of those experiencing depression (Berman et al., 2012). Interestingly, more biodiverse open spaces in particular are associated with psychological restoration than those that are less biodiverse (Wood et al., 2018). Positive associations have also been identified between parks and reductions in crime as well as increased perceptions of safety (Kopsieker et al., 2021), although some have raised concerns about crime and safety in parks and near dense vegetation (Escobedo et al., 2018). Further, urban nature can mitigate climate impacts, such as heat waves and flooding, that would otherwise result in increased morbidity and mortality (Lindley et al., 2019). And notably, the health benefits associated with urban nature are shown to be particularly beneficial for disadvantaged and vulnerable communities, indicating that supporting ecosystems holds potential for increasing equity and reducing health inequality (Braubach et al., 2017).

A lack of access to urban nature can result in physical and mental health disorders, such as vitamin D deficiency, asthma, anxiety, and depression (Stagno et al., 2020). Further, a homogenous diet reduces contact with sources of symbiotic microbiota and limit supply of micro-nutrients that contribute to human health – both of which can be linked directly to ecological biodiversity (Lindley et al., 2019; WHO & CBD, 2015).

Nature for culture

Urban nature provides opportunity for increasing social capital and cohesion (Oke et al., 2020). Nature also makes significant contributions to well-being by generating a sense of fulfillment of immaterial and non-consumptive needs (Stagno et al., 2020). And reciprocally, spirituality can foster respect and action in favour of biodiversity (Irvine et al., 2019). In Greater Hyderabad, India, traditional religious belief and health systems rely on biodiversity. The traditional health system, Unani, makes use of over 400 plant species, while Ayurveda, another traditional healing system practiced in the metropolitan area deals with about 600 plant species, with many urban households raising these medicinal plants at home (GHMC, 2012). For many Indigenous people, including those living in cities, health and well-being are intimately connected to the land and Indigenous health practitioners often bear their knowledge from their connection with nature (Figuroa Huencho et al., 2020). This relationship with nature extends beyond physical and mental health to include emotional and spiritual as well (Hatala et al., 2020). For Indigenous youth in Canada, for example, experiencing nature, including the sight of as well as the sound of nature, is perceived to reduce stress, distract from pain, and deepen connection with loved ones while also providing and calming and positive state of being (Hatala et al., 2020). Nature in an urban context and witnessing the changing of seasons offers a guiding force 'like an Elder' that can support Indigenous youth to cope with the stresses of city life (Hatala et al., 2020: 8). Meanwhile, the ecological commitments stemming from commonly held Indigenous belief that all life is equal and connected often results in the preservation of nature as simply a matter of maintaining personal health (Irvine et al., 2019).

Policy and action

The connection between health and nature is widely recognised, including by multilateral agencies such as the World Health Organisation (2016), regional authorities such as the European Commission (2016), national agencies such as the United States Department of Agriculture and Forest Service (2018), down to the sub-national, such as metropolitan Quito in Ecuador (Secretaría de Ambiente Quito, 2021), and municipal level, such as the City of Melbourne (2017) in Australia. And yet despite the need for better coordination between environmental and health policies, policy makers at present struggle to integrate these agendas and scale them while remaining attendant to local conditions and community needs (Lauwers et al., 2020).

Barriers preventing metropolitan spaces from embracing urban nature include lack of knowledge about the benefits of urban nature; public concerns about falling tree limbs; disciplinary and knowledge silos; and lack of financial resources (McDonald et al., 2017). To overcome these barriers, finance streams should be linked, for example between health and forestry stakeholders. There are diverse finance mechanisms available to local and regional governments, including public revenue and municipal codes and policies, as well as appealing to health-focused philanthropies and higher levels of government for health-related grants to fund urban nature (McDonald et al., 2017). Further, enhancing urban nature for health can be integrated as solutions into existing planning processes via numerous entry points, including sustainability plans, heat action plans, and water planning (McDonald et al., 2017). Guangzhou, China, for example, has developed a network of greenways that promote healthy lifestyles and encourage modal shift from car use to cycling and walking while simultaneously preserving green belts for nature conservation (Horn and Xu, 2017).

Studies have shown that spending two hours experiencing nature per week, either as one long, continuous experience or accumulated sessions over the course of the week, substantially improves health and well-being (White et al., 2019). Significantly, however, proximity and accessibility to open spaces alone does not necessarily induce people to use them. In South Asia, open spaces must be able to accommodate walking trails to encourage people to use them, for example, and sanitation facilities that are secure for women to safely use (Adhikari et al., 2020). This gendered perspective is important to consider, as women and men experience urban nature differently, and the health benefits provided by outdoor spaces may not be realised by women who perceive that their needs related to personal safety are not attended to (MacBride-Stewart et al., 2016). Further, women tend to place greater value on the aesthetic quality of a space and will (or will not) use an open space based on its aesthetic appeal (MacBride-Stewart et al., 2016). Therefore, in addition to proximity and accessibility, urban nature that is designed to be aesthetically, culturally, and spiritually appropriate and tailored to local values are needed to reap the associated health benefits (Adhikari et al., 2020; Bratman et al., 2019).









Governance


Interagency and intergovernmental collaboration and partnership with local organisations are important for governing urban nature. Cooperative planning processes that enable communication between city parks, forestry, and public health departments, for example, can mobilise resources across a wider group of urban stakeholders (McDonald et al., 2017). Local and regional governments should also support transdisciplinary research between ecology and health that can lead to cost-effective and tailored solutions to enhance health and reduce health inequalities (Shanahan et al., 2015). Finally, as discussed in the previous section, how urban residents experience nature impacts the degree to which they benefit from nature, and therefore, diverse stakeholders must be involved in the design, planning, and implementation of urban nature to maximise health and well-being benefits.

An illustrative example of governing an urban nature project for health is the Doncaster Community Dementia Garden in the United Kingdom (Naturvation, n.d.). The garden was created by a consortium of charities, organisations, and a social enterprise with funding from local council, the National Health Service, and local organisations. It responded to national- and local-level strategies around creating dementia-friendly environments and aimed to create a ‘stimulating, relaxing, and safe environment for people living with dementia, as well as their carers, to enjoy’ (Naturvation, n.d.). This case demonstrates how agencies across government and government levels can come together with local organisations to implement urban nature specifically targeted at health.

Accelerating action

Table 3. Actions to increase urban nature for human health and well-being (adapted from Adhikari et al., 2020; Bratman et al., 2019; McDonald et al., 2017; Shanahan et al., 2015)

Actions	Outcomes	Target
Prevent pollution and produce conditions for diverse and thriving ecosystems, including urban wetlands, grasslands, and forests	<ul style="list-style-type: none"> Biodiversity is conserved and enhanced Avoid over-reliance on trees as forms of urban nature 	
Design aesthetically, culturally, and spiritually appropriate urban nature, including according to the needs of Indigenous people and women	<ul style="list-style-type: none"> City residents are incentivised to use urban nature to improve mental, spiritual and physical health and well-being 	 
Establish connections and link finance streams between health, planning, and environmental management/forestry stakeholders	<ul style="list-style-type: none"> Increase resources directed towards bringing nature into cities 	 
Support policies that integrate health and nature agendas and explore funding from health-focused philanthropies	<ul style="list-style-type: none"> Expand resourcing for urban nature by tapping into health resource streams 	 
Support transdisciplinary health and ecology research	<ul style="list-style-type: none"> Increase the evidence base supporting nature for health and well-being outcomes 	

 Nature  Society  Culture

Resources

InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs)

www.naturalcapitalproject.stanford.edu/software/invest

Urban InVEST

www.naturalcapitalproject.stanford.edu/software/invest-models/development-urban-invest

Case study: Louisville, USA



Image 2. Community greening intervention as part of the Green Heart project in Louisville (Image source: © The Nature Conservancy/Devan King)

Louisville ranks amongst the worst in the state of Kentucky for air quality, having received an F from the American Lung Association for annual ozone days since 2012. In response, Louisville Metro Government's Office of Advanced Planning and Sustainability has undertaken a number of projects that intend to clarify the connection between investing in urban nature strategies and quantifiable health impacts, such as Green for Good and Green Heart Louisville (Louisville Metro Government, n.d.). Green for Good uses vegetation as a means to reduce traffic-related pollutants, while Green Heart Louisville is designed to tackle air pollution and chronic disease in disadvantaged neighbourhoods by taking a nature-based approach where 'trees are the medicine' (Green Heart Louisville, n.d.(a); Louisville Metro Government, n.d.). Louisville Metro Government executes both projects in partnership with a range of collaborators, including universities, the U.S. Forest Service, and a design and engineering

consultancy, the Nature Conservancy and the National Institutes for Health (Green Heart Louisville, n.d.(b); Louisville Metro Government, n.d. (a)). Slated to run until 2023, Green Heart Louisville seeks to scientifically assess the impact of trees on air quality and health by taking baseline health measurements prior to planting trees around the target neighbourhoods and then comparing health, pollution, and social cohesion from before the planting to two years after. Researchers aim to discover new relationships between nature and health, find new ways to prevent heart disease, diabetes, and obesity without the use of medications, and develop a scientifically validated 'greenprint' for bringing nature into cities that can serve as a model to be replicated across the Louisville metropolitan area, and in indeed in metropolitan areas around the world to impact the lives of thousands, and potentially millions or billions, of urban residents (Green Heart Louisville, n.d.(a); n.d.(c)).

Cities disproportionately contribute to climate change while also being highly vulnerable to its impacts (Frantzeskaki et al., 2019; Gomez-Baggethun et al., 2013). In addition to their contribution to urban biodiversity, nature-based solutions are increasingly recognised as one way to address climate change through mitigation and adaptation measures (Frantzeskaki et al., 2019; Kabisch et al., 2016). NBS also enhance resilience, here defined as the adaptive capacity, flexibility, and systems redundancy that enables a city to function and evolve after a disruption, such as a severe weather event (Ahern, 2011; Alshaye & Oudah, 2020; Leichenko, 2011). The biodiversity extinction crisis and climate crisis are inextricable, and yet there are only 123 Local Biodiversity Strategies and Action Plans in 31 countries that address the Aichi targets as compared to the several thousand climate action plans documented by the Global Covenant of Mayors (Bulkeley et al., 2021: 23). Encouraging an integrated, multilateral metropolitan scale approach to urban nature, as part of the new global framework for nature, holds real promise for addressing climate change, resilience and biodiversity extinction simultaneously. There are promising examples of metropolitan actors collaborating across the metropolitan scale, such as the Living Melbourne strategy in Metropolitan Melbourne, Australia, however there remains challenges of implementation if collaborating actors lack consensus on their roles of or indeed the goals for nature (Fastenrath et al 2020).

Nature for nature

With regards to mitigation, NBS sequester carbon by acting as natural carbon sinks while simultaneously providing habitat for urban nature (Oke et al., 2020). From an adaptation perspective, metropolitan areas can make space for environmental change due to climate change while simultaneously enabling conservation and biodiversity enhancement by taking an 'ecological renovation' approach by, for example, planting drought tolerant species in an increasingly dry landscape (Prober et al., 2019). Finally, to support the resilience of urban nature, incorporating a diverse, interconnected network of habitats can increase ecological niches for species, particularly as climate change shifts habitat conditions (Colding, 2007; Walsworth et al., 2019).

Nature for society

When natural processes are disrupted, hazards can be triggered or amplified. NBS, however, can restore and stabilise these processes and decrease disaster risk and intensity (Kopsiek-

er et al., 2021). Ecosystems can also help vulnerable communities better adapt and become more resilient to adverse climate impacts (Cohen-Shacham et al., 2016). Blue infrastructure buffers temperature extremes through absorbing extra heat in summer and releasing in winter, while green infrastructure provides shade, absorbs heat through evapotranspiration, and reflects solar radiation (Gomez-Baggethun et al., 2013). While some tree species can compound air pollution issues through the production of volatile organic compounds, NBS also remove pollution, including ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter (Calfapietra et al., 2013; Gomez-Baggethun et al., 2013; Nemitz et al., 2020). Other societal benefits NBS provide include enhancing urban renewal processes and regenerating neglected and degraded areas, which improve city livability (Horn & Xu, 2017). Additionally, unlike grey infrastructure, NBS are multifunctional and the direct and indirect benefits generated by them are likely to exceed implementation and maintenance costs once accounted for, making it more cost effective than traditional engineering approaches (Horn & Xu, 2017; Kopsieker et al., 2021).

Nature for culture

NBS increase social encounters, for example in parks and open spaces, while also improving mental and physical well-being (Alshaye & Oudah, 2020). They also contribute 'spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience' and support 'knowledge systems, social relations, and aesthetic values' (Gomez-Baggethun et al., 2013: 178). Urban resilience, including disaster recovery, is underpinned by social capital and strong community relationships, thus indicating the significance of urban nature's contribution to social cohesion, community connection, and participation during a crisis like that of COVID-19 (Bensley-Nettheim, 2020).

Despite being widely recognised as one of the groups most vulnerable to climate change, Indigenous people and their perspectives on climate change are typically undervalued and marginalised (Makondo & Thomas, 2018; Nursey-Bray et al., 2019). This is perhaps surprising in light of the fact that Indigenous peoples have observed and reported changes to the environment that corroborate Western scientific accounts of climate change and have adapted to climate changes over millenia, albeit over longer time scales than current changes resulting from anthropogenic emissions, while also demonstrating extraordinary adaptability in the face of colonisation and

displacement (Nursesey-Bray et al., 2019). In addition to biophysical impacts, climate change also affects traditional sites, knowledge and culture, including the destruction of cultural sites as a result of flooding, for example, and negatively impacting culturally significant species affected by rising temperatures, such as green turtles and medicinal plants (Choy et al., 2016; Nursesey-Bray et al., 2019; Lynn et al., 2013). Further, despite the diverse cultures and living environments of Indigenous peoples globally, many Indigenous worldviews take a relationship-based perspective, emphasising the relations between humans, land, sky, water, animals, plants, spirit and beyond (Cochran et al., 2013).

Institutional fit often creates barriers for Indigenous climate change adaptation initiatives to be upscaled and mainstreamed in urban policy (Choy et al., 2016; Nursesey-Bray et al., 2019). In Australia, for example, Indigenous adaptation initiatives do not cleanly align with existing colonial governance frameworks and are therefore excluded from funding opportunities and institutionalisation, even in instances when Indigenous communities were consulted (Choy et al., 2016; Nursesey-Bray et al., 2019). Partnering with Indigenous peoples to bring nature into the city thus presents an opportunity to reinvigorate Indigenous connections to land in an urban context and bring together multiple forms of knowledge

to address and respond to climate change in a way that does not undermine urban Indigenous cultural identity (Choy et al., 2016). And yet it is important to be cognizant that the pressure to share 'Traditional Ecological Knowledge' (TEK) and the romanticisation of "Indigenous resilience to climate change" can create anxiety for urban Indigenous people, fearing a sense of lost credibility if TEK is revealed to be fragmented as a result of the fracture and loss of knowledge caused by colonisation (Nursesey-Brey et al., 2019). Therefore, efforts must be made to acknowledge urban Indigenous people as engaged citizens with cultural rights (Nursesey-Brey et al., 2019).

Policy and action

Anticipated climate impacts include more frequent and intense weather events, sea level rise, species loss and extinction, as well as 'climate-related risks to health, livelihood, food security, water supply, human security, and economic growth' (IPCC, 2018: 9). Explicitly drawing the connection between the biodiversity crisis and climate change presents an opportunity for cities to address both simultaneously while also enhancing urban resilience (Alshaye & Oudah, 2020; Bulkeley et al., 2021).

Table 4. Sample of NBS that increase urban resilience and adaptive capacity (adapted from Gomez-Baggethun et al., 2013; Horn & Xu, 2017)

Climate risk	Urban impact	NBS	Outcome
Heavy rainfall	<ul style="list-style-type: none"> ▪ Flooding and stormwater runoff ▪ Landslides 	<ul style="list-style-type: none"> ▪ Green roofs, riparian forest systems, flood plains, rain gardens, bioretention swales, natural and constructed wetlands ▪ Afforestation, maintaining vegetative cover 	<ul style="list-style-type: none"> ▪ Reduced pressure on urban drainage systems ▪ Waste treatment and purification of runoff ▪ Stabilises soil and reduces risk of landslides
Increased temperatures	Urban heat island effect and heat waves	Green infrastructure, open spaces	Cooler buildings, lower energy costs, reduced urban heat island effect
Rising sea levels and storms, hurricanes, and tsunamis	Coastal flooding and erosion	Wetlands, marshes, mangroves, oyster reefs, coral reefs, deltas	<ul style="list-style-type: none"> ▪ Minimise erosion ▪ Buffer cities and reduce infrastructure damage caused by flooding

Implementing NBS to address climate change and enhance urban biodiversity can yield significant social benefits, such as an ecosystem-based adaptation project conducted in Bogotá that involved restoring creeks that connected urban and peri-urban areas with the Andean highlands that surround the city. By replanting native vegetation, removing invasive vegetation, and engaging the community in the restoration efforts, Bogotá, Colombia was able to reduce flooding vulnerability and strain on the sewage system while also providing clean water and reducing violent crime by employing young men as part of the restoration effort and as tour guides for the area (IUCN, 2020). Similarly, the Reforestation Program run in Rio de Janeiro, Brazil involves reforesting hillsides to prevent erosion and landslides during heavy rainfall events, which often impact the poorest and most vulnerable communities in the cities. In addition to preventing landslides, benefits of the program include carbon sequestration, enhanced biodiversity, microclimate regulation, and reduction of flood risk as well as professional training, environmental awareness, and additional income for residents of informal settlements (Alshaye & Oudah, 2020).

Cities have also taken novel approaches to enhance urban nature through regulation. One such example is Stuttgart, Germany, which has required all new buildings to have green roofs since 1993 (Horn & Xu, 2017). The approach has recently been adapted by City of Melbourne to increase the integration of greening in new developments (Bush et al 2021). Meanwhile, Amman, Jordan requires developers to conduct environmental impact assessments to regulate the relationship between development and environmental protection and incentivises high floor-to-area ratios by providing discounts on construction fees and taxes (Alshaye & Oudah, 2020). Implementing NBS can also encourage behaviour changes that contribute positively to climate action. Montréal, Canada, for example, turned Papineau Avenue, the city's longest north-south street and formerly a car-dominated avenue, into a green boulevard flanked by plantings of native vegetation to control stormwater runoff, reduce urban heat island effect, and increase biodiversity. The plant beds cordoned off a new pedestrian pathway, which encourages active transport (Metropolis, 2020).

Governance












The governance of NBS is typically characterised by involvement of multiple and diverse stakeholders (Dorst et al., 2019). For example, in a survey conducted by Metropolis of 15 metropolitan areas across Africa, Asia-Pacific, Europe, Latin America and the Caribbean, and North America, 14 respondents noted close partnerships with the private sector and 13 with academia, civil society organisations, and individual citizens, highlighting the need for on-going collaborative governance of NBS (Metropolis, 2020). There is a need to include ecologists, horticulturists, and landscape planners in order to better integrate NBS for urban resilience and to better articulate the many values NBS provide for cities (Bush & Doyon, 2019). Local and regional governments must act to centre women in developing climate change and biodiversity plans, as they are known to be more vulnerable to climate impacts, particularly in the Global South (Pearse, 2017). This is not because of women's intrinsic vulnerability but rather due to the socioeconomic and cultural contexts within which gendered climate action is produced (Pearse, 2017). As such, these diverse stakeholders should be included in the planning, design, and development of NBS. A key benefit

of this mode of participatory governance is that it ensures knowledge is integrated across sectors, levels of government, institutions, and communities, and it minimises duplicated efforts (Alshaye & Oudah, 2020). Taking a collaborative approach also ensures that NBS addresses local context and increases resilience as a result of incorporating a diversity of inputs and participation in planning and decision-making (Frantzeskaki, 2019).

One illustrative example is the case of Montréal, Canada. When developing the green corridors along Papineau Avenue, involving experts while also establishing a sense of co-ownership between citizens and politicians resulted in creating increased demand for green corridors throughout the city (Metropolis, 2020). Similarly, Rotterdam in the Netherlands brought together diverse stakeholders for the planning, design, and implementation of a riverbank renewal project by linking their interests to climate change. By doing so, the city was able to engage a broader group of stakeholders than would have been possible if a 'technical solution' to addressing climate impacts, such as an engineered flood protection system, been implemented (Alshaye & Oudah, 2020).

Accelerating action

Table 5. Strategies for integrating climate action and urban biodiversity agendas (adapted from Alshayeh & Oudah, 2020; Barber et al., 2020; Bush & Doyon, 2019; Cohen-Shacham et al 2016; Frantzeskaki, 2019; Horn & Xu, 2017; Nursey-Bray et al., 2019; Pearse, 2017; Prober et al., 2019)

Actions	Outcomes	Target
Adopt an 'ecological renovation' approach to implementing nature in the city	<ul style="list-style-type: none"> Enhance adaptive capacity by acknowledging the changing conditions associated with climate change 	 
Conserve, restore, and sustainably manage ecosystems, including forests and marine and coastal ecosystems	<ul style="list-style-type: none"> Healthy ecosystems and provision of ecosystem services Sequester carbon and prevent release of CO2 into atmosphere Conservation and protection of biodiversity and ecosystems 	 
Promote processes that make space to address conflicts and create opportunities for diverse stakeholders with different forms of knowledge to contribute to climate and biodiversity action	<ul style="list-style-type: none"> Climate and biodiversity action promote social equity 	 
Strengthen multi-sectoral and multi-level collaborative governance	<ul style="list-style-type: none"> Support for NBS enhanced through participation NBS tailored to local needs 	
Support Indigenous climate adaptation by building agency and partnerships and supporting Indigenous-led initiatives	<ul style="list-style-type: none"> Culturally-sensitive adaptation initiatives are acknowledged and institutionalised 	 
Promote novel and sustainable forms of financing for NBS, including green bonds, taxes, and public-private partnerships	<ul style="list-style-type: none"> Ensure NBS can be funded both now and into the future 	
Support research-practice partnerships for developing and implementing NBS	<ul style="list-style-type: none"> Lessons for implementing NBS are integrated into future applications and supports policy learning Research outputs are attuned to the needs of practitioners 	

 Nature
  Society
  Culture

Resources

Secretariat of the Convention on Biological Diversity – Voluntary guidelines for the design and effective implementation of Ecosystem-based Approaches to Climate Change Adaptation and Disaster Risk Reduction
www.cbd.int/doc/publications/cbd-ts-93-primer-en.pdf

iTree - tools to quantify and communicate the value of urban trees
www.itreetools.org

Case study: Greater Manchester, United Kingdom



Image 3. An example of a green infrastructure installation in Greater Manchester (Image Source: Salford City Council, 2018).

The IGNITION project, conducted by the Greater Manchester Combined Authority (GMCA), is a science-driven NBS project aimed at increasing green infrastructure to improve climate resilience. The project, which is slated to run through April 2022, has involved conducting a climate change risk assessment in order to identify the city's vulnerabilities, such as to the increased risks of heat waves and flooding. Based on the assessment's findings and through scientific modelling, the city established the target of increasing green infrastructure by 10% from a 2018 baseline by 2038 in order to keep temperatures at a 2000 level.

The IGNITION project focuses on four tasks to achieve this goal: mapping opportunities for green infrastructure implementation in a publicly accessible database, progressing green infrastructure investment through the Greater Manchester Environment Fund, developing business plans for implementation, and strengthening partnerships with stakeholders including NGOs, housing developers, climate agencies, and the airport focused on delivering green infrastructure. The project also delivers targeted communication, education, and campaign activities to keep the public engaged (Metropolis, 2020).

Urban and agricultural land uses are expanding to meet the demands of the world's growing population, which can have devastating impacts on habitats and cause significant biodiversity loss when approached through our current business-as-usual models with their focus on large-scale, land-clearing, monocultural cropping and intense use of pesticides and fertilisers (Clucas et al., 2018; Maxwell et al., 2016). These trends are expected to intensify over time and are particularly acute in the Global South, where a considerable proportion of the world's biodiversity exists (Hanspach et al., 2017). Because the food-biodiversity nexus is often approached from a food production perspective, food security and biodiversity are typically perceived to be in conflict with one another (Glamann et al., 2017; Wittman et al. 2017). However, food production represents only one dimension of food security, with people's ability to access food, genetic diversity of food sources, stability of food availability, and food utilisation (diet and nutrition) comprising the other dimensions (FAO, IFAD & WFP, 2014; Wittman et al., 2017). Urban agriculture thus provides a viable alternative to industrial agriculture by providing multifunctional benefits, with increased potential for creating and maintaining diverse habitats for biodiversity while also providing more readily accessible food sources. Coordinating at the metropolitan scale allows for better integration of food, agriculture, and water systems, creating a more functional and inclusive territory through strengthened urban-rural linkages.

Nature for nature

Urban agriculture is highly managed, and therefore tends to exhibit greater biodiversity and variation in vegetation cover and structure than other open spaces. Further, urban agriculture can enhance biodiversity not only within sites where agricultural activities are taking place but also in the surrounding areas due to the "spill over" of energy, resources, and organisms across habitats – an important process for enabling wildlife to persist in urban contexts (Lin et al., 2015).

Nature for society

Biodiversity and vegetation associated with urban agriculture can yield more and higher quality ecosystem services, including pest control, pollination, and climate resilience (Lin et al., 2015). Supporting this diversity is important because the primary ecosystem service provider today may not thrive in a future with changed environmental conditions resulting from climate change. For this reason, having multiple species contrib-

ute the same ecosystem service is essential for the resilience of urban ecosystems (Elmqvist et al., 2003; Jansson & Polasky, 2010), including urban food systems. In a food context, supporting diverse edible plant sources supports continuing access to food if a shock, such as a pest, afflicts one variety, therefore increasing the resilience of the food system overall.

Due to their reliance on accessing food at markets rather than growing it themselves, urban residents (and particularly the urban poor) are highly vulnerable to disruptions to food systems – a vulnerability exacerbated by climate change (Dubbeling et al., 2019). Urban agriculture can ameliorate this vulnerability by providing ready access to food in cities while also yielding greater profit margins associated with shorter supply chains (Nicholls et al., 2020; Zezza & Tasciotti, 2010).

Nature for culture

Urban agriculture has been shown to be immensely valued by urban residents for exercise, social cohesion, connection to nature, and for some, satisfying yearnings for rural life (Nicholls et al., 2020; Xie et al., 2020). It also offers an opportunity for urban residents to come together around a shared food identity, culture, and tradition (Lopes et al., 2020; Xiong and Brownlee, 2018).

Indigenous peoples' respect for the natural world and the sustainable use of its resources, aims to ensure that both current and future generations can access food without damaging ecosystems (Moeke-Pickering et al., 2015). Food security is therefore intimately tied to cultural values that connect food, land, and past, present and future generations, and the ability to produce food in cities becomes significant for both sustenance and ceremony. Because lands managed by Indigenous peoples are widely recognised to be more biodiverse (IPBES, 2018), fostering urban agricultural spaces specifically for urban Indigenous peoples can address both cultural food needs and contribute to urban biodiversity. One way to do so in a culturally conscious way is through recognising Indigenous peoples' use of plants for food and other resources, rebuilding a culture of Indigenous food and supporting Indigenous food sovereignty. Urban and inner-city organisations in Winnipeg, Canada, for example, have acted as facilitators to consciously support re-learning and re-skilling programs to celebrate Indigenous food traditions and connect younger generations with older ones in cities (Cidro et al., 2015). Engaging with Indigenous peoples and supporting Indigenous land trusts

are also important actions for cities to take, as the gardening and gathering activities that can take place in urban agricultural space acts as a medium for sharing and passing down traditional knowledge and practice while also reviving interactions with land and food (Moeke-Pickering et al., 2015). Urban agriculture can also play an integral role in fostering social cohesion in multicultural and linguistically diverse communities and providing rural-urban migrants a connection to the countryside while also contributing to food security and biodiversity. In Melbourne, Australia, for example, community gardens are associated as safe spaces and spaces for community interactions that contribute to overall well-being, particularly for English as a Second Language (ESL) and immigrant gardeners, for whom gardening also contributes to acculturation and place attachment (Egerer et al, 2019), and skills development and job opportunities (Bush & Doyon, 2017). Likewise, in Beijing, China, urban agricultural parks are highly valued for the ways in which they foster connections for urban residents to rural landscapes, particularly for those who migrated to the city (Xie et al., 2020).

Policy and action

Urban agriculture can address food security concerns by providing fresh and nutritious produce that is physically and economically accessible to urban residents while also limiting biodiversity loss by reducing the need to expand agriculture into natural landscapes and enhancing biodiversity within cities (Clucas et al., 2018; Lopes et al., 2020).

One method for incorporating urban agriculture into city policies is to integrate urban agriculture into environmental management and climate change strategies. An initiative to reduce urban heat island effect in Bobo-Dioulasso in Burkina Faso, for example, promotes the planting of fruit-bearing trees, which also provides space for recreation (Dubbeling et al., 2019).

Urban agriculture has also been framed through an equity lens, with cities using land use planning to accommodate urban agriculture to bolster food security for urban residents, particularly the urban poor and disadvantaged. In Durban, South Africa, local government established an Urban Management Zone to regenerate inner-city spaces, grow produce, and host schools and garden clubs (Lopes et al., 2020). Belo Horizonte, Brazil conducts an Urban Agroforestry project, which involves planting native trees and agriculture crops that provide food security for socially vulnerable communities while also increasing local biodiversity (Metropolis, 2020). Finally, Rosario, Argentina developed an Urban Agriculture Programme that emphasised participatory processes to improve the city's food supply and targeted women, seniors, and youth, as they faced the highest levels of unemployment across the city. Participatory workshops were held to develop and agree upon instruments for giving residents land tenure for urban agriculture, resulting in the inclusion of urban agriculture in the city's urban development plan and social housing schemes, exempting landowners from property tax, and establishing a land bank (MUSE, n.d.).

Governance

The governance of urban food systems requires vertical, horizontal, and territorial collaboration. Multilateral organisations, such as the Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), and the World Food Programme (WFP), and city-networks, such as ICLEI and C40, can provide coordinating support, technical guidance, and leverageable international frameworks to achieve food security and biodiversity goals. Meanwhile,

national governments can provide financial support to sub-national governments seeking to implement urban agriculture initiatives. Urban and rural linkages must be made in order to build inclusive metropolitan spaces and regions. Local and regional governments should therefore partner with rural surroundings to promote harmonised action that integrates food, agriculture

Sample of types of urban agriculture

Some examples of the many forms of urban agriculture that city policies can support include:

- home gardens
- allotments and community gardens
- rooftop gardens
- vertical agriculture
- edible landscaping
- easement/nature strip gardening
- community-supported agriculture (CSA)
- informal urban agriculture

and water systems while also opening channels for knowledge sharing and capacity building between urban and rural farmers. Equally as important as networking between cities and regions, is networking between urban agricultural sites within a metropolitan area in order to share urban agricultural management methods and to enhance local governance capacity. Stakeholders involved at the local level might include civil society organisations, NGOs, and research and academic institutions. Likewise, participatory methods are essential in order to make use of local knowledge, promote action that supports biodiversity amongst citizens, and build an urban agriculture system that meets community needs while addressing metropolitan-wide concerns (Lopes et al., 2020).

Global-to-local governance of biodiversity and food security (adapted from Wittman et al., 2017: 1294)

Global

- **Bio-physical:** global climate change, environmental change
- **Socio-institutional:** trade agreements, environmental agreements, certification systems, social movements, research systems, multinational corporations, financial regimes

Regional

- **Bio-physical:** regional climate change, environmental change
- **Socio-institutional:** government policy, NGO programs, civic engagement, equity, political stability, migration, food storage and distribution systems, food imports and exports, corporate behavior

Landscape









- **Bio-physical:** microclimate, soil types, topography, pests and diseases, soil erosion, water availability, amount of natural vegetation
- **Socio-institutional:** land tenure system and land availability, capital assets, market structure, infrastructure, agricultural inputs and knowledge




Household

- **Bio-physical:** soil fertility, pests and diseases
- **Socio-institutional:** political agency and rights, demographics, education, social networks, gender equality, capital assets, affluence, livelihood strategies

Accelerating action

Table 6. Strategies for enhancing biodiversity and ecosystem services in urban agriculture (adapted from Dubbeling et al., 2019; Lopes et al., 2020; Nicholls et al., 2020).

Actions	Outcomes	Target
Stratify plantings to create more complex landscapes	<ul style="list-style-type: none"> Increased insect and mammalian diversity and abundance Improved aesthetic function 	 
Increase native plantings and diverse seed sources used for urban agriculture	<ul style="list-style-type: none"> Genetic diversity improves connectivity of threatened and rare species and increases resilience of food systems Increased pollinator diversity Protect Indigenous Biocultural Knowledge of traditional food sources Encourage participation by small to medium enterprises in acting as a source for seeds 	  
Integrate urban agriculture into land use and development planning, including social housing and settlement upgrading	<ul style="list-style-type: none"> Communities can secure tenure for urban agricultural initiatives, reducing the threat to food security associated with eviction Improved food security for vulnerable communities 	
Establish land trusts for Indigenous people	<ul style="list-style-type: none"> Strengthen connection to land and food Enhance traditional knowledge and knowledge sharing 	
Strengthen urban-rural connections	<ul style="list-style-type: none"> Food and water systems are integrated spatially Knowledge sharing and capacity building is enhanced 	

 Nature  Society  Culture

Resources

ICLEI CITYFOOD Network
https://iclei.org/en/CITYFOOD_Network.html

FAO City Region Food System Toolkit
<http://www.fao.org/in-action/food-for-cities-programme/toolkit/introduction/en/>

Case study: Rio de Janeiro, Brazil



Image 4. Half of the food produced by the Hortas Cariocas project is distributed to residents living in neighbourhoods near the urban farms (Image Source: Rio de Janeiro Prefeitura, n.d.)

Rio de Janeiro's *Hortas Cariocas* are urban gardens that provide ecological value, access to healthy food, environmental education, and occupational opportunities for some of the city's most vulnerable residents. When identifying locations for the farms, the project, promoted by the Rio de Janeiro Municipality, provides training and material supplies to develop organic agricultural spaces within the city and offers remuneration to residents involved in food production. Of the 42 urban farms, 18 are located in schools. There, they showcase agricultural practices, demonstrate the importance of agroecology to students, and highlight the value of a healthy diet, and the food produced at the schools supplements students' diets during school meals. The remaining 24 gardens are located in vulnerable communities. Half of the food produced in these communities is distributed between residents, public schools, and elderly care centres, while the other half is left for urban farmers to sell to generate income and for purchasing equip-

ment. Overall, the gardens produce about 80 tons of food for more than 20,000 residents annually, while making use of underutilised land, disseminating sustainable agricultural practices, and fostering the agricultural potential of the urban poor (Lopes et al., 2020). "Because it generates a significant amount of organic food that directly benefits local communities, Hortas Cariocas is a reference in food security. The project was awarded in 2019 by the Milan Pact and has been inspiring other cities since then", said Débora de Barros, Undersecretary of Environment of the Rio de Janeiro Municipality. In fact, the municipality has teamed up with the regional government of the State of Rio and the national state-owned Brazilian Agricultural Research Corporation (Embrapa) to develop vegetable gardens in schools and idle urban spaces in other municipalities in metropolitan Rio de Janeiro, including Itaguaí, São Gonçalo and Nova Iguaçu.

By 2030, cities of less than 500,000 residents are expected to absorb over 1 billion people of the forecasted increase in urban population, with the fastest growing cities located in Asia and Africa. These 'intermediary cities' with populations between 20,000 to 500,000 can be characterised by their position as centres of decision-making within a region and serve as important urban-rural linkages (Bolay & Kern, 2019). As they rapidly grow, they hold the potential to implement ecologically-sound and sustainable practices that bypass current and old technologies, with impacts not only at the local level but also regionally and in their rural hinterland (Bolay & Kern, 2019). In fact, many intermediary cities are part of or merging into greater metropolitan areas, thereby playing an integral role in regional biodiversity conservation. Just as intermediary cities are expected to face substantial increases in population, so too is the projected population of informal settlements around the world. Currently, over 1 billion people live in informal settlements, with 80% located in Asia and Sub-Saharan Africa – and that figure is projected to increase to 3 billion by 2030 (UN-DESA, 2019). Informal settlements frequently encroach upon ecologically significant areas, such as flood plains (Douglas, 2018), increasing the vulnerability and risk for residents of informal settlements while also threatening biodiversity. It is therefore crucial that urban biodiversity conservation efforts incorporate policies and actions that are inclusive of diverse urban forms and their contribution to global biodiversity conservation.

Nature for nature

Cities are where the most permanent ecological changes occur and the greatest conservation challenges are at hand (Rupprecht et al., 2015). As intermediary cities and cities with informal settlements rapidly grow, they should centre and embed urban biodiversity conservation principles into development strategies and plans. One method to do so is to adopt a 'protect, restore, connect' strategy to address the drivers of ecosystem degradation and biodiversity loss (Barber et al., 2020). 'Protection' involves protecting ecosystems through legal and management measures; 'restore' involves enacting interventions to renew ecological integrity; and 'connect' refers to retaining ecological connectivity to maximise synergies between halting biodiversity loss, mitigating and adapting to climate change, and promoting sustainable development (Barber et al., 2020).

Nature for society

Low-income urban residents and residents of informal settlements are often highly dependent on ecosystem services, including for food, livelihoods, fuelwood, and water, and as such are vulnerable to changes in extent, quality, or accessibility of green-blue infrastructure. Further, informal settlements are often located in sites exposed to environmental disruptions, such as flooding, that increase their vulnerability to climate impacts. In both instances, nature-based solutions can help mitigate these risks (Satterwaite et al., 2018). In the case of coastal settlements, for example, mangrove forests can serve as critical infrastructure that buffer impacts of hurricanes while also contributing to livelihoods, such as through the provision of nutrition and fuel (Barber et al., 2020). Recognising biodiversity's contribution to human life, particularly those of the most vulnerable and marginalised, is essential for the well-being of society.

Nature for culture

Ecological knowledge is frequently embedded in collective memory, however as nature is disturbed through urbanisation and modernisation, connections to ecological memory can become fractured. This, in turn, damages socio-cultural connection to nature (Andersson & Barthel, 2016). Preserving landscapes can serve to simultaneously preserve ecosystem continuity, place-specific stewardship practices, and socio-cultural connection to nature. Conversely, the degradation of ecosystems and socio-ecological memory can result in mal-adaptive management practices, for example a preference for irrigation-intensive flora in arid cities like Phoenix or Dubai (Andersson & Barthel, 2016).

Localised knowledge is necessary for conservation efforts to appropriately respond to biodiversity challenges (Rupprecht et al., 2015). Further, the failure to look to Indigenous peoples' environmental and biodiversity management practices and perspectives has been linked to failed conservation efforts (Barau et al., 2013). Indigenous systems reflect world and cultural views that create values connected to the environment and therefore can result in informal biodiversity conservation enacted by individuals, for example in Africa, where "myths, mysteries and tales remain part of institutions that determine people's relations with the environment" (Barau et al., 2013: 784).

Policy and action

As cities undergo rapid population growth, particularly in informal settlements and in intermediary cities that already comprise or will be absorbed into metropolitan areas, recognising the needs of an increasingly diverse urban population is necessary. Differentiated citizenship, including based on gender, can impact one's access to health care or water, for example, even within the same community or neighbourhood (Butcher, 2021; Conteh et al., 2021). Although implementing urban nature is often associated with an 'unquestioned planning orthodoxy and moral imperative related to the green, resilient, and sustainable city,' socially differentiated needs coupled with asymmetrical reaping of urban nature's benefits can result in inequitable outcomes (Anguelovski et al., 2020: 1745). To make incorporating urban nature more inclusive and just, cities should adopt intersectional feminist planning approaches that recognise diverse experiences of the city (Shokry & Anguelovski, 2020).

One method of doing so entails reframing urban informality as a productive rather than problematic (Catalytic Communities, 2021). Having high proportions of urban green in informal settlements is frequently not the case, as increasingly dense settlements typically leave less room for open space and vegetation (Satterwaite et al., 2018). And yet in Rio de Janeiro, Brazil, the Gardens and Reforestation Working Group of the Sustainable Favelas Network promotes the implementation of community gardens that produce fresh, pesticide-free produce and shares information within the network on urban agroforestry, thereby contributing to the city's urban biodiversity and demonstrating coordination across the metropolitan area (RFS, 2020).

With regards to the contribution of municipalities other than the main local government in a metropolitan area, 16 municipalities in the Àrea Metropolitana de Barcelona are collaborating around the socio-environmental recovery of the Llobregat River demonstrating the critical role of metropolitan coordination for creating more inclusive and ecologically connected city (Metropolis, 2020). Indeed, the city is famous for its commitment to create a more feminist city (Shokry & Anguelovski, 2020). In the municipality of Courbevoie, a commune of the metropolitan area of Paris, a participatory urban ecology project conducted by provides another illustrative example of the role that the territories comprising metropolitan areas besides the central city can play in enhancing urban nature regionally. The initiative sought to forge links between citizens and nature by encouraging locals to contribute

to shared gardens and citizen science projects, promote the well-being of residents, and build the image of the municipality around a shared identity that prioritises high-quality landscape and environment (CFB, 2016).

Governance

The governing capacity of a city impacts its ability to regulate and enforce biodiversity conservation, which highlights the need for strengthen governance and institutional capacity (Huang et al., 2018). Participatory approaches to urban environmental governance can mediate conflicts between biodiversity conservation priorities and the priorities of urban residents, particularly of those living in settlements that may encroach upon ecologically significant areas (Satterwaite et al., 2018). In a study of three intermediary Latin American cities, Dosquebradas, Colombia, Santa Ana, El Salvador, and Santo Tomé, Argentina, for example, participatory planning processes were used to analyse problems, propose actions, and aid decision-making related to enhancing climate resilience, including through the use of green infrastructure. The cases demonstrate how negotiating competing interests between stakeholders resulted in establishing mutual understanding of the winners and losers of proposed actions, who should be involved that may be forgotten in traditional planning processes, and how the planned actions would be realised. A key outcome of the participatory process included the development of community-government organisational mechanisms that enabled collective monitoring and follow-up on green infrastructure implementation and strengthened government-civil society communication (Satterwaite et al., 2018).

Suggested conservation strategies based on relationship between strength of land governance and the impacts of urban growth on biodiversity (adapted from Huang et al., 2018, p. 47)

Long-term urban conservation strategies

Short-term urban conservation strategies

Strength of urban governing capacity



Diagnose ecosystems and species



Monitor, restore, and reintroduce identified ecosystems and species



Build governance capacity through enhancing political and economic stability and controlling corruption



Coordinate institutions



Adjust land use policy to protect areas



Build governance capacity through public participation, international aid, and development















Coordinate institutions

Impacts of urban expansion on biodiversity

Accelerating action

Table 7. Cities should seize the opportunity to adopt transformative approaches to urban biodiversity conservation and nature-based solution implementation as they rapidly urbanise, thereby bypassing outdated methods of development in order to make substantial ecological and equity gains (adapted from Barber et al., 2020; Huang et al., 2018; Satterwaite et al., 2018; Shokry & Anguelovski, 2020)

Actions	Outcomes	Target
Adopt a 'protect, restore, connect' strategy to urban nature	<ul style="list-style-type: none"> Ecosystems and biodiversity are protected and enhanced 	 
Support community-led efforts to enhance urban biodiversity	<ul style="list-style-type: none"> Locally-tailored initiatives can increase biodiversity while also attending to local needs Acknowledge contribution of Indigenous, traditional, and local knowledge to urban biodiversity conservation, restoration, and enhancement Strengthen urban biodiversity governance 	  
Mainstream gender issues and adopt intersectional approach to urban nature planning	<ul style="list-style-type: none"> Inclusive urban nature spaces that recognise and respond to the widely diverse needs of urban residents 	
Use participatory methods to ensure urban nature responds to the needs of local communities	<ul style="list-style-type: none"> Increase longevity and public acceptance of urban nature 	
Preserve existing landscapes when possible	<ul style="list-style-type: none"> Sustain ecological continuity Retain place-specific stewardship 	 

 Nature  Society  Culture

Resources

Metropolis Observatory: Bringing nature back to the metropolis for all

https://www.metropolis.org/sites/default/files/resources/Observatory_Bringing-nature-back-metropolis-all_Anguelovski-Shokry.pdf

ICLEI Cities and Biodiversity Case Study Series

https://icleicanada.org/wp-content/uploads/2019/07/Cities-and-Biodiversity-Case-Study-Series_english.pdf

Case study: Kathmandu, Nepal



Image 5. Rooftops are being converted into productive spaces for gardening in Kathmandu, Nepal (Image source: Santoshmajhi035/WikimediaCommons)

In the metropolitan area of Kathmandu, rapid and uncontrolled urbanisation has created challenges related to water scarcity, waste management, and food security as the hinterlands around Kathmandu have been degraded (ENPHO, 2014; UNFCCC, 2014). In order to address these challenges, which are expected to intensify with advancing climate change, the Kathmandu Metropolitan City partnered with local non-governmental organisations, a research institute, and various international organisations, including UN-Habitat, to conduct a rooftop farming initiative aimed at contributing to the metropolitan area's climate mitigation and adaptation actions (ENPHO, 2014).

While the NGO was responsible for working with an initial set of trial households to implement rooftop gardens through capacity enhancement and technical support, the research institute monitored the sample households for climate impacts, and metropolitan authorities promoted rooftop gardening and developed a policy paper. The case thus demonstrates how coordinating institutions and building governance capacity through public participation, international aid, and development can contribute to multiple climate-, food security-, sustainable development-, and biodiversity-related goals.

The roadmap to Kunming, Yunnan Province, China and a 2050 Vision of “Living in harmony with nature”

In November 2018, Parties to the Convention on Biological Diversity (CBD) adopted a decision at the 14th Conference of the Parties (COP), held in Sharm El-Sheikh, Egypt, calling for a comprehensive and participatory process for the preparation of the post-2020 global biodiversity framework (GBF).

This decision urged local and subnational governments to actively engage and contribute to the process of developing a robust post-2020 GBF in order to foster strong ownership of the framework to be agreed and strong support for its immediate implementation.

CBD COP 15, to be held in Kunming, Yunnan Province, China in October 2021 will adopt this post-2020 global biodiversity framework as a stepping stone towards achieving the 2050 Vision of “Living in harmony with nature”.

The local and subnational constituency’s ambitions for the post-2020 Global Biodiversity Framework are captured in the Edinburgh Declaration and includes a call for a renewed decision and more ambitious plan of action for the Decade.

If the post-2020 GBF is to be achieved, it will be essential to involve all levels of Government, and society, in its implementation. The Edinburgh Declaration outlines the political commitment of local and subnational governments to continue to act and commit resources to the implementation of the post-2020 GBF.

It also calls for all levels of government to work more effectively, collaboratively and consciously, and to adopt the renewed decision and plan of action, at COP15. If adopted, it will increase the level of engagement by local and subnational governments in supporting the successful implementation of, and reporting on the post-2020 GBF, its 2030 targets and milestones, and the programmes of work under the CBD across seven action areas: the development and implementation of biodiversity strategies and action plans reflecting the involvement of subnational governments; harmonization between levels of government, and mainstreaming; resource mobilization; capacity development; communication, education and public awareness; assessment and improved information for decision-making; and monitoring and reporting.

As this report emphasises, the role for metropolitan governments in mobilising support for global efforts for biodiversity has never been clearer. ICLEI, in collaboration with its partners, the Advisory Committee on Subnational Governments (coordinated by Regions4 and the Government of Québec), Group of Leading Subnational Governments towards the Aichi Biodiversity Targets, European Committee of the Regions, and the Scottish Government, developed a roadmap for mobilising the local and subnational governments’ participation in the post-2020 GBF process. This roadmap has resulted in the creation of a local and subnational advocacy for nature website; regular monthly advocacy webinars; several consultative

events including a session at The Nature of Cities (TNOC) Summit in Paris in June 2019, a 3-day event for metropolitan authorities held in Medellin, Colombia in July 2019, a 3-day event for Brazilian authorities held in São Paulo, Brazil in February 2020, and the Edinburgh Process for Subnational Governments, Cities and Local Authorities on the development of the post-2020 GBF, was an online global engagement and consultation process and provided the most significant opportunity for local and subnational governments to voice their ambitions.

The First Draft of the Post-2020 GBF (released on 12 July 2021) gives stronger recognition to the role and contributions of all levels of subnational government. Globally all levels of subnational governments are showing greater interest in contributing to national and global biodiversity targets. For example, a series of multi-level dialogues on the Edinburgh Process and implications of the post-2020 GBF for local and subnational governments took place between May – July 2021 in Peru, Colombia, Mexico, Canada, China and South Africa. More and more cities are joining CitiesWithNature to share the actions they are taking at local level and a new online platform aimed at regions, Regions WithNature, is under development.



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- Bang, A. and Khadakkar, S.** (2020). Biodiversity conservation during a global crisis: Consequences and the way forward. *PNAS* (117:48), p. 29995-29999.
- Braubach, M., Egorov, A., Mudu, P., Wolf, T., Thompson, C. W., & Martuzzi, M.** (2017). Effects of urban green space on environmental health, equity and resilience. In *Nature-based solutions to climate change adaptation in urban areas* (pp. 187-205). Springer, Cham.
- Bulkeley, H. & Davis, M.** (2020). *Nature-Based Solutions: Harnessing the Potential for Ambitious post-2020 Biodiversity Outcomes* [Whitepaper]. Post-2020 Biodiversity Framework. Retrieved from <https://4post2020bd.net/resources/expertise-7-nature-based-solutions-harnessing-the-potential-for-post-2020-biodiversity/>.
- Bush, J. and Doyon, A.** (2019) 'Building urban resilience with nature-based solutions: How can urban planning contribute?', *Cities*, 95(102483), pp. 1–8. doi: 10.1016/j.cities.2019.102483.
- Cohen-Shacham, E., Walters, G., Janzen, C. & Maginnis, S.** (2016) Nature-based solutions to address global societal challenges, Nature-based solutions to address global societal challenges. Gland, Switzerland. IUCN, 97pp. doi: 10.2305/iucn.ch.2016.13.en.
- Huang, C. W., McDonald, R. I., & Seto, K. C.** (2018). The importance of land governance for biodiversity conservation in an era of global urban expansion. *Landscape and Urban Planning*, 173, 44-50.
- Irvine, K. N., Hoesly, D., Bell-Williams, R., & Warber, S. L.** (2019). Biodiversity and spiritual well-being. In *Biodiversity and Health in the Face of Climate Change* (pp. 213-247). Springer, Cham.
- Lindley, S. J., Cook, P. A., Dennis, M., & Gilchrist, A.** (2019). Biodiversity, physical health and climate change: a synthesis of recent evidence. In *Biodiversity and health in the face of climate change* (pp. 17-46). Springer, Cham.
- Lopes, L., Caus, N., Diniz, B., Montuori, L., Zimmermann, Y., Chamat, O., and Davids, R.** (2020). *Nature Based Urban Solutions: Empowering cities for the development of sustainable food system policies* [Whitepaper]. Urban20. Retrieved from <https://www.urban20.org/resource/empowering-cities-for-the-development-of-sustainable-food-system-policies/>.
- McDonald, R., Aljabar, L., Aubuchon, C., Birnbaum, H., Chandler, C., Toomey, B., Daley, J., Jimenez, W., Trieschman, E., Paque, J., & Zeiper, M.** (2017). *Funding Trees for Health: An Analysis of Finance and Policy Actions to Enable Tree Planting for Public Health* [Whitepaper]. The Nature Conservancy. Retrieved from <https://www.nature.org/en-us/what-we-do/our-insights/perspectives/funding-trees-for-health/>.
- Oke, C., Bekessy, S. A., Frantzeskaki, N., Bush, J., Fitzsimons, J. A., Garrard, G. E., ... & Gawler, S.** (2021). Cities should respond to the biodiversity extinction crisis. *npj Urban Sustainability*, 1(1), 1-4.
- San Gil León, A., Coetzee, I., & Blatch, T.** (2020). *Nature Based Urban Solutions: Towards Transformative Change: Urban Contributions To Achieving The Global Biodiversity Agendas*. [Whitepaper]. Urban20. Retrieved from <https://www.urban20.org/wp-content/uploads/2020/11/Towards-Transformative-Change.pdf>.
- Shokry, G. & Anguelovski, I.** (2020). "Bringing nature back to the metropolis for all." Metropolis Observatory. Retrieved from https://www.metropolis.org/sites/default/files/resources/Observatory_Bringing-nature-back-metropolis-all_Anguelovski-Shokry.pdf.

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