CiTieS ANd BiodiverSiTY

outlook

action and policy

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A Global Assessment of the Links between

Urbanization, Biodiversity, and Ecosystem Services

**Second Draft, 17 July 2012**

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**Foreword by the United Nations Secretary-General** [Draft; awaiting sign-off][Insert photo of Ban Ki-moon]

By 2050, given current trends in growth and urbanization, an estimated 3 billion additional people will inhabit the world’s cities, and the world will have undergone the largest and fastest period of urban expansion in all of human history. A recent estimate reveals that the area directly affected by new urban infrastructure within the next 40 years will cover an area roughly the size of Western Europe, with obvious impacts on natural habitat and the wildlife that depends on it. Consequently, urban growth will affect the provision of many ecosystem services and the benefits humans derive from nature, and the demands of cities will reshape most rural landscapes. Without adequate consideration by policy-makers of the implications of the coming urbanization, many of the Millennium Development Goals, the Aichi Targets of the Convention on Biological Diversity, and other goals of related conventions and organizations are unlikely to be met.

While rapid urbanization represents major challenges, it also offers opportunities. As centers of diversity, creativity, and innovation, cities are the very places where knowledge, innovations, and the human and financial resources for finding solutions to environmental problems are likely to be found.Cities must move beyond being just *consumers* of ecosystem services—they must also generate ecosystem services, reduce unsustainable consumption of ecosystem services, and offer better stewardship of the rural ecosystems on which they are so dependent. By redefining their roles, cities can create environments that are socially just, ecologically sustainable, economically productive, politically participatory, and culturally vibrant.

[Add signature]

Ban Ki-moon

Secretary-General, United Nations

**Message from the Executive Director of UNEP**

[Insert photo of Achim Steiner]

Cities give rise to a diversity of views and emotions, from places of pollution and social divisions to centres of ancient and popular culture and crossroads of innovation and new ideas. Today they are also emerging as significant havens for biodiversity and are providing key opportunities for making the transition to an inclusive green economy in both the developing and developed world.

This is among the key points of this new report. *Cities and Biodiversity Outlook* brings into sharp focus not only the extraordinary wealth of urban biodiversity but its role in generating ecosystem services upon which large and small urban populations and communities rely for their food, water, and health.

It makes a strong argument for greater attention to be paid by urban planners and managers to the natural or nature-based assets within their metropolitan boundaries as one way toward realizing a range of targets and aims established both pre- and post-Rio+20.

In partnering with cities, the CBD has also recognized its potential for assisting in meeting the 20 strategic Aichi Targets by 2020 that were agreed upon by governments at the 2010 meeting of the Convention in Nagoya, Japan.

Among the many fascinating findings here are the range of species found in cities of all kinds and complexion. Brussels, for example, contains more than 50 percent of the floral species found in Belgium. Cape Town is host to 50 percent of South Africa’s critically endangered vegetation types and approximately 3,000 indigenous vascular plant species.

*Cities and Biodiversity* *Outlook* also underlines the health benefits of urban biodiversity. Studies in the United States, for example, show that cities with more trees have lower rates of asthma among young children.

It also showcases how policymaking by local government can bring food and health security to citizens, citing Kampala, Uganda, where regulations have allowed close to 50 percent of households to produce safe, quality produce within the city’s limits.

By 2030, well over half the global population will reside in cities. Cities represent major opportunities for delivering a low-carbon, far more resource-efficient world. This report brings to the fore their increasing relevance with respect to biodiversity and the natural systems that underpin the wealth of all nations.

[Add signature]

*Achim Steiner*

*United Nations Under-Secretary General*

*and Executive Director, United Nations Environment Programme*

**Preface by the Executive Secretary of the CBD**

[Insert photo of Braulio F. de Souza Dias]

*Cities and Biodiversity Outlook – Action and Policy* stems from Decision X/22 requesting the Executive Secretary of the CBD to prepare an assessment of the links and opportunities between urbanization and biodiversity, based on the concept of our flagship publication *Global Biodiversity Outlook*. The same decision endorsed a CBD Plan of Action on Sub-National Governments, Cities and Other Local Authorities for Biodiversity (2011–2020) at COP 10 in Nagoya, Japan, in October 2010. The primary goals of this publication are to:

* Serve as the first comprehensive global synthesis of researched scientific material on how urbanization affects biodiversity and ecosystem dynamics.
* Provide an overview, analysis, and response to knowledge gaps in our understanding of urbanization processes and their multiple effects on social-ecological systems.
* Address how biodiversity and ecosystems can be managed and restored in innovative ways to reduce vulnerability in cities.
* Serve as a reference for decision- and policy-makers of the CBD and its Parties on the complementary roles of national, subnational, and local authorities for implementation of the Strategic Plan for Biodiversity 2011–2020 and the associated Aichi Targets.

Ours is an increasingly urban world today, and key decision-makers also work in cities. The 20 ambitious targets set by the CBD for 2020 simply cannot be achieved without coherent governance at global, regional, national, subnational, and local levels. The ways and habits of urban dwellers will largely determine the health of our ecosystems and the survival of biodiversity. As the pages that follow make abundantly clear, sustainable urbanization will be necessary for achieving a more sustainable planet. Cities—their inhabitants and governments—can, and must, take the lead in fostering a more sustainable stewardship of our planet’s living resources. Many already are, in ways that are innovative, exciting, and inspiring—but so much more remains to be done. This publication isanew and valuable tool for steering urban development onto a sustainable path. I hope you will read it, share it, and together with others, take action to save life on Earth.

[Add signature]

*Braulio F. de Souza Dias*

*Assistant Secretary-General*

*and Executive Secretary*

*Convention on Biological Diversity*

**OVERVIEW OF *Cities and Biodiversity Outlook – Action and Policy***

*Cities and Biodiversity Outlook – Action and Policy* provides a global assessment of the links between urbanization, biodiversity, and ecosystem services. Drawing on contributions from scientists and policy-makers from around the world, it summarizes how urbanization affects biodiversity and ecosystem services in chapter 1, and presents, in chapter 2, 10 key messages for strengthening conservation and sustainable use of natural resources in an urban context. Along with the messages, it also showcases best practices and lessons learned and provides information on how to incorporate the topics of biodiversity and ecosystem services into urban agendas and policies. Chapter 3 then presents a list of institutions, projects and initiatives readers can use and apply to their specific needs. The Aichi Targets highlighted throughout the key messages reinforce the mission of the CBD’s Strategic Plan to “take effective and urgent action to halt the loss of biodiversity.”

This volume was developed in parallel with *Global Urbanization, Biodiversity, and Ecosystems – Challenges and Opportunities: Scientific Analyses and Assessments.* Both publications are a collaborative effort of the Secretariat of the Convention on Biological Diversity (CBD) and the Stockholm Resilience Centre of Stockholm University, with significant input from Local Governments for Sustainability (ICLEI).

*Action and Policy* draws on multiple sources of information and an international network of scientists, scientific institutions, United Nations and other organizations, specialists, and decision-maker. More than 200 contributors—all recognized authorities in their fields and representing diverse organizations, backgrounds, and geographies—have worked together to summarize the latest data on status and trends of biodiversity and draw conclusions for future strategies. The material they have reviewed is evidence-based, tested, and in the public domain. For ease of readability, references are limited. A more complete list of references to primary literature and sources will be found in *Scientific Analyses and Assessments*.

Just as with its inspiration, the CBD’s flagship publication *Global Biodiversity Outlook* (currently in its third edition), production of *CBO* *Action and Policy* has been highly inclusive. Two separate drafts were made available for review before publication, and comments from some 50 reviewers were considered. An Interagency Task Force and an Advisory Group, as well as the Global Partnership on Local and Sub-National Action for Biodiversity, have provided valuable oversight of the entire process.

*Action and Policy* will be officially launched at the second City Biodiversity Summit parallel to the eleventh meeting of the Conference of the Parties to the CBD in October 2012. The scientific publication, *Global Urbanization, Biodiversity, and Ecosystems – Challenges and Opportunities: Scientific Analyses and Assessments,* will be available online in October 2012.

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**Evolution of the CBD’s Cities and Biodiversity initiative**

Although responsibility for implementing the 1992 Convention on Biological Diversity rests primarily with subscribing national governments, Parties have always been aware of the need to coordinate plans and actions with sub-national and local governments. That need has grown increasingly urgent with the recognition that more than half the world's population, and a significantly higher percentage of top decision-makers, now live in cities.

The CBD’s initiative on cities and biodiversity has evolved in three phases.

**I. Leading Cities and Pioneers (2006–2008)**

The journey toward a city and biodiversity initiative began in 2006 in Cape Town, when 300 local authorities at the ICLEI General Assembly called for the establishment of a pilot project on Local Action for Biodiversity (now a full-scale programme; see p. XXX). It continued in March 2007, at the initiative of then mayor of Curitiba, Beto Richa, who convened the Curitiba Meeting on Cities and Biodiversity. The Curitiba Declaration, adopted at that meeting, stated that biodiversity issues are addressed most efficiently through local actions, and that urbanization can contribute positively to human development as cities offer many social and economic opportunities. The declaration called for a global partnership of cities, national governments, development agencies, private-sector partners, non-governmental organizations, knowledge and research institutions, and multilateral organizations.

Acting on the recommendations of the Curitiba Declaration, in 2008 ICLEI and IUCN—supported by the Secretariat of the CBD and many participating cities and agencies—launched the Global Partnership on Sub-national and Local Action for Biodiversity at IUCN’s World Conservation Congress in Barcelona. A few months later, at COP 9 in Bonn, a Mayor’s Conference was organized on the issue of cities and biodiversity and contributed to the adoption of the CBD’s first decision on the issue (IX/28). A scientific meeting of the Urban Biodiversity and Design (URBIO) Network was convened in Erfurt, Germany, just prior to the COP and also contributed to the deliberations. Also at COP 9, Singapore’s Minister Mah Bow Tan announced the creation of an index to assess local implementation of the CBD, subsequently called the City Biodiversity Index (see p. XXX). Later the mayors of Curitiba, Bonn, Nagoya, and Montreal, respectively hosts of COPs 8, 9, and 10 and the Secretariat itself, formed an Advisory Committee of Cities under the Global Partnership. This committee, later expanded to include Montpellier, Mexico City, and Hyderabad, has addressed every subsequent COP.

**II. The CBD Plan of Action for Sub-national Governments, Cities and Other Local Authorities (2008–2012)**

Although Decision IX/28 proposed some voluntary activities for Parties and sub-national governments, it was clear that a more systematic and expanded approach would be needed to mobilize all levels of government in implementing the CBD. Several Parties and the Global Partnership proposed the formulation of a global Plan of Action in preparation for COP 10 in Nagoya in 2010. More than 600 local and sub-national government officers met at the City Biodiversity Summit parallel to COP 10 to indicate support for the CBD and their potential to help implement it. On 29 October 2010, the Plan of Action on Sub-national Governments, Cities, and other Local Authorities for Biodiversity was endorsed by 193 CBD Parties through Decision X/22.

The plan provides suggestions on how to mobilize and coordinate local actions on biodiversity, take CBD issues to urban residents, and bring national strategies and plans into the urban context. It also presents objectives, monitoring and reporting guidelines, suggested activities for implementation, and an institutional framework for optimizing synergies among Parties, UN and development agencies, NGOs, and cities.

Sub-national governments responded to the global challenge by establishing, at the 2011 General Assembly of their Network of Regional Governments for Sustainable Development (nrg4SD), a Working Group on Biodiversity.

**III. The Road Ahead**

This third phase focuses on efforts to scale up, at global and regional levels, the successful experiences of the Global Partnership. One of the core instruments for Parties to implement the CBD is their National Biodiversity Strategies and Action Plans (NBSAPs). In January 2011 the city of Montpellier, France, hosted a meeting with national focal points for CBD Parties and regional and local authorities, with an innovative approach to integrate these tools with sub-national/municipal strategies and plans, taking the Mediterranean basin as a target. As a consequence, a network of Mediterranean cities on biodiversity, called MEDIVERCITIES, was proposed and will be further defined in future meetings. The Montpellier meeting also produced a portfolio of projects such as city exhibitions and cooperation platforms for sub-national networks of protected areas. The concept of local and sub-national government networks will be expanded to other regions (such as the Amazon or the Caribbean) and themes (such as marine and coastal biodiversity).

Based on the successful ICLEI LAB programme and IUCN’s Countdown 2010 campaign, and considering the potential expansion of the CBD initiative to the world’s 1 million local authorities, ICLEI partnered with the Secretariat of the CBD to launch, at its World Congress in Belo Horizonte, Brazil, in June 2012, an open and simplified access platform for cities to support the Global Partnership called the Urban Biosphere Project (URBIS; see p. XXX). In the same line, ICLEI and its partners are setting up a project to address biodiversity in conservation hotspots (areas with very high and threatened biodiversity levels).

To further support Parties in implementing the Plan of Action, for COP 11 the Global Partnership is proposing the development of four specific Implementation Plans for the major categories of players, through their representative organizations (cities with ICLEI, sub-national governments with nrg4SD, scientists with URBIO, and international organizations with UNEP). The Implementation Plans will be launched at the Cities for Life Summit parallel to COP 11 in Hyderabad, India, in October 2012.

Building on the example of the Advisory Committee of Cities and further consolidating the Global Partnership, the Brazilian State of Parana, in collaboration with the CBD Secretariat and nrg4SD, hosted a meeting in April 2012 to establish the CBD Advisory Committee of Sub-National Governments. With the objectives of advising Parties in partnering with their sub-national governments, addressing landscape-level connectivity of natural spaces, and promoting decentralized cooperation on biodiversity, the committee will have a geographically balanced structure that includes host sub-national governments of COPs as well as representatives from Africa, Asia, the Americas, Europe, Oceania, the Secretariat of the CBD, and nrg4SD. The meeting also created an open-for-signature protocol for decentralized cooperation among states, discussed a roadmap of events and activities leading to the sub-national component of the Cities for Life Summit in Hyderabad, and adopted the Paran**á** Declaration on Sub-national Governments and Biodiversity.

**SECTION I**

**Summary of *Global Urbanization, Biodiversity, and Ecosystem Services – Challenges and Opportunities***

The following is a summary of the CBO scientific assessment, edited by Thomas Elmqvist, Michail Fragkias, Peter Marcotullio, Robert MacDonald, Susan Parnell, Karen Seto, and Cathy Wilkinson. Chapter references below refer to corresponding peer-reviewed chapters in the assessment, which will be available in October 2012 with full references at [www.cbd.int/cbo](http://www.cbd.int/cbo).

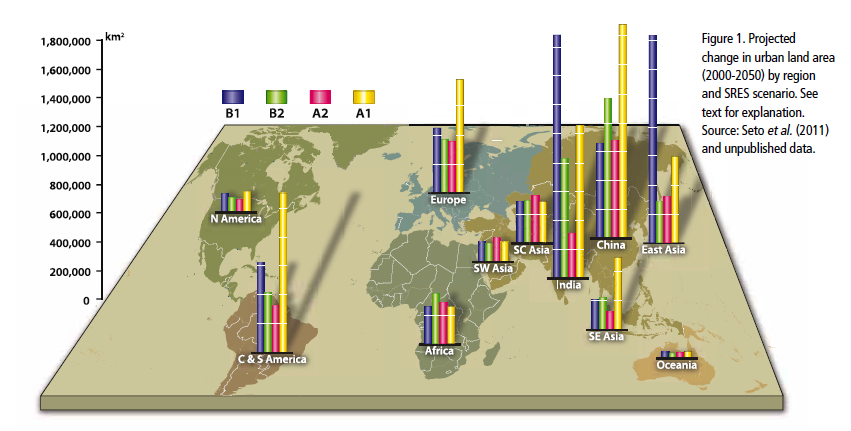
**Urban Expansion**

The world is increasingly urban, interconnected, and shifting. By 2050 almost 3 billion additional people will inhabit the world’s cities, and the world will have undergone the largest and fastest period of urban expansion in all of human history (Chapter 7). Given that most of the urban growth is expected to take place in small and medium-sized cities of 1 million or fewer, this means that the world will add approximately one new city of 1 million people every 10 days for the next 90 years.

Over the last several decades it has become clear that human domination and the rapid development of global urbanism are reshaping the ecology of the entire planet (Chapter 1). Urban infrastructures, which act as huge and complex “meta-logistical” systems, interconnect cities in diverse systems of food, water, waste, energy, and mobility. Anthropogenic-induced carbon emissions, mainly from urban areas, result in a rapidly changing climate. These, in combination with accelerating urban consumption of resources, are dramatically reshaping the ecological context in which cities are attempting to secure their long-term social, economic, and ecological sustainability. Urban areas are therefore facing numerous and severe challenges. among them (i) natural resource shortages, including water; (ii) climate change, as manifested by increases in temperature and variation in precipitation and frequencies and severity of natural disasters—floods, droughts, storms, heat waves, and gradual sea level rise; (iii) demographic and social changes, particularly aging and in many areas increasing social inequity; and (iv) a necessary transition to a fossil-fuel-free future, reducing large carbon footprints.

Particularly in South and East Asia, the next two decades will represent challenges, as the combined urban population in China and India grows by more than 700 million. China’s urban population is expected to increase by 400 million, and India’s urban population will nearly double from today’s 350 million. During this same period, China will create at least 30 new cities of 1 million; India is expected to add 26 cities of this size. Put into a global context, by 2030 nearly two-thirds of the world’s urban inhabitants will live in China or India (Chapter 7).

Four trends in the urbanization process have implications for biodiversity and ecosystems. First, the total urban area is expected to quadruple over the next 30 years while urban populations at national levels double—in other words, urban areas are expanding faster than urban populations (Chapter 7) (see Figure 1). Second, urban land expansion will often consume prime agricultural land, with knock-on effects on biodiversity and ecosystems elsewhere (Chapter 9). Third, rates of urban land expansion near protected areas are as high as in other regions and will challenge conservation strategies (Chapter 7). Fourth, urban expansion is occurring faster in low-elevation, biodiversity-rich coastal zones than in other areas. This likely will put millions of people at risk of climate change impacts such as storm surges and sea level rise (Chapter 8).



**Figure 1.** Projected change in urban land area (2000–2050) by region and SRES scenario. (Source: M. Fragkias and K. C. Seto. The rise and rise of urban expansion. *Global Change* 78, March 2012; designer Hilarie Cutler.)

Challenges related to climate change are particularly complex, and despite the fact that the world is increasingly urban, the ways in which cities influence and are influenced by climate change have been considerably less explored than other areas of research on global warming (Chapter 8). The situation is particularly alarming for Africa, where greater temperature increases than the global average are expected. This will have adverse effects on human well being, particularly in cities, through dramatic changes in such areas as water availability, health, and sanitation.

This rapid urbanization represents major challenges but also many opportunities to ensure basic human welfare and a viable global environment (Chapter 1). The opportunities lie in that urban landscapes also are the very places where knowledge, innovations, and human and financial resources for finding solutions to the global challenge of maintaining biodiversity and ecosystem services are likely to be found.

**Urbanization and Effects on Biodiversity**

Urbanization is today viewed to endanger more species than any other human activity. There are at least three ways in which urbanization is affecting biodiversity (Chapters 2 and 3).

***1. Urban sprawl and habitat fragmentation***

Many of the world’s cities are located in biodiversity-rich areas such as floodplains, estuaries, and coastlines. Urban sprawl and habitat fragmentation are rapidly transforming critical habitats of global biodiversity value—so called hot spots—among them the Atlantic Forest Region of Brazil, the Cape of South Africa, and coastal Central America. The direct impacts of urban growth will clearly affect biodiversity in many biomes; about 10 percent of terrestrial vertebrates are in ecoregions that are heavily affected by urbanization (Chapter 2). Mediterranean habitat types are particularly affected by urban growth because they support a large concentration of cities as well as many range-restricted endemic species. If current trends in population density continue, by 2030 urban land cover will expand between 800,000 and 3.3 million square kilometers, representing a two- to fivefold increase from 2000. This would result in considerable loss of habitats in key biodiversity hotspots, including the Guinean forests of West Africa, tropical Andes, Western Ghats, and Sri Lanka (Chapter 7).

Urban expansion will also affect freshwater biodiversity. A study that quantitatively modeled the effect of global urban demographic growth and climate change on water availability (Chapter 2) predicts that freshwater biodiversity effects would be largest in places with large urban water demands relative to water availability, as well as where there is high freshwater endemism. Of particular conservation concern is the Western Ghats of India, which will have 81 million people with insufficient water by 2050 but also has 293 fish species, 29 percent of which are endemic to this ecoregion—that is, occur nowhere else in the world (Chapter 2).

Many cities contain sites of special importance for nature conservation because they protect threatened species (both spontaneous and cultivated) and habitats. Many are pristine remnants of native vegetation that survived because their topography, soil, and other characteristics are unsuitable for residential or commercial development. Other sites remain protected because their ownership or their use and management have remained unchanged for decades (sometimes centuries), or they are important sites of cultural heritage or have remained unused for a long time. Remarkable examples of pristine remnants in cities include, the remnant forests of the Mata Atlantica in Rio de Janeiro, Brazil; the evergreen forests of the Botanical Garden in Singapore; the National Park El Avila with its rock faces in Caracas, Venezuela; various remnants of bushland in Perth, Sydney, and Brisbane, Australia); remnants of natural forests in York, Canada, and Portland, USA; Sonoran desert parks in Tucson and Phoenix, USA; the Ridge Forest in New Delhi and the semi-evergreen forest of Sanjay Gandhi National Park in Mumbai, India; and rock faces and outcrops in Edinburgh, Scotland (Chapter 3).

***Urban biodiversity*** *is “the variety and richness of living organisms (including genetic variation) and habitat diversity found in and on the edge of human settlements.” This biodiversity ranges from the rural fringe to the urban core. At the landscape and habitat level it includes:*

*• Remnants of pristine natural landscapes (e. g., leftovers of primeval forests, rock faces).*

*• Traditional agricultural landscapes (e. g., meadows, areas of arable land).*

*• Urban–industrial landscapes (e. g., city centers, residential areas, industrial parks, railway areas, formal parks and gardens, brownfields).*

*Patterns of diversity of plants and animals in the urban landscape show some interesting specific urban patterns:*

*1. The number of plant species in urban areas often correlates with human population size—more so than it does with the size of the city area.*

*2. The age of the city affects species richness; large, older cities have more plant species than large, younger cities.*

*3. Diversity may correlate with economic wealth. For example, in Phoenix, USA, plant and avian diversity in urban neighborhoods and parks show a significant positive correlation with median family income.*

***2.******Loss of fertile agricultural land***

Urbanization often consumes fertile agricultural land, thereby increasing pressure to cultivate new land elsewhere and having large-scale negative effects on biodiversity [to be expanded…..]

***3.******Spread of invasive alien species and biotic homogenization***

Urbanization increases the number and extent of non-native invasive species by increasing the rate of introduction events and creating areas of disturbed habitat for non-native species to become established in cities (Chapter 2). There is a suite of “cosmopolitan” species, skilled generalists that are present in most cities around the world. At the same time, urbanization often leads to the loss of “sensitive” species dependent on larger, more natural blocks of habitat. The net result is sometimes termed “biotic homogenization.” Nevertheless, it is remarkable that the number of native species, especially in cities of the Northern Hemisphere, is relatively high. Studies across many taxonomic groups have shown that 50 percent or more of the regional or even national species assemblage is found in cities. For instance, more than 50 percent of the flora of Belgium can be found in Brussels, and 50 percent of vertebrates and 65 percent of birds in Poland occur in Warsaw (Chapter 3). While some cosmopolitan urban species are indeed found worldwide, concerns about overall biotic homogenization may be somewhat unfounded. A recent global analysis of flora from 112 cities and avifauna from 54 cities found that on average two-thirds of plant species occurring spontaneously in urban areas tend to be native to the region of each city; the proportion of native bird species is considerably higher, at 95 percent (Chapter 3). Clearly, many cities continue to retain a significant proportion of native biodiversity.

Although some alien species become invasive, dominating entire ecosystems and causing significant economic loss, other introduced species actually may enhance specific ecosystem services in cities, such as soil mineralization, climate-change adaptation and mitigation, and cultural/aesthetic benefits.

***How Urbanization Affects Evolution and Adaptation***

*Urbanization directly transforms the local biophysical environment and changes the conditions for organisms living there, generating new selection pressures and adaptations.*

*The main changes are:*

*1. Changes in incident sunlight exposure, humidity, precipitation, wind speed and direction, water routing, and soil characteristics.*

*2. Changes in the rate of succession and disturbance regimes.*

*3. Increases in urban ambient air temperatures, which are often 2–5°C higher than in surrounding rural areas—a phenomenon known as the urban heat island (UHI) effect, which in the future will be exacerbated by climate change.*

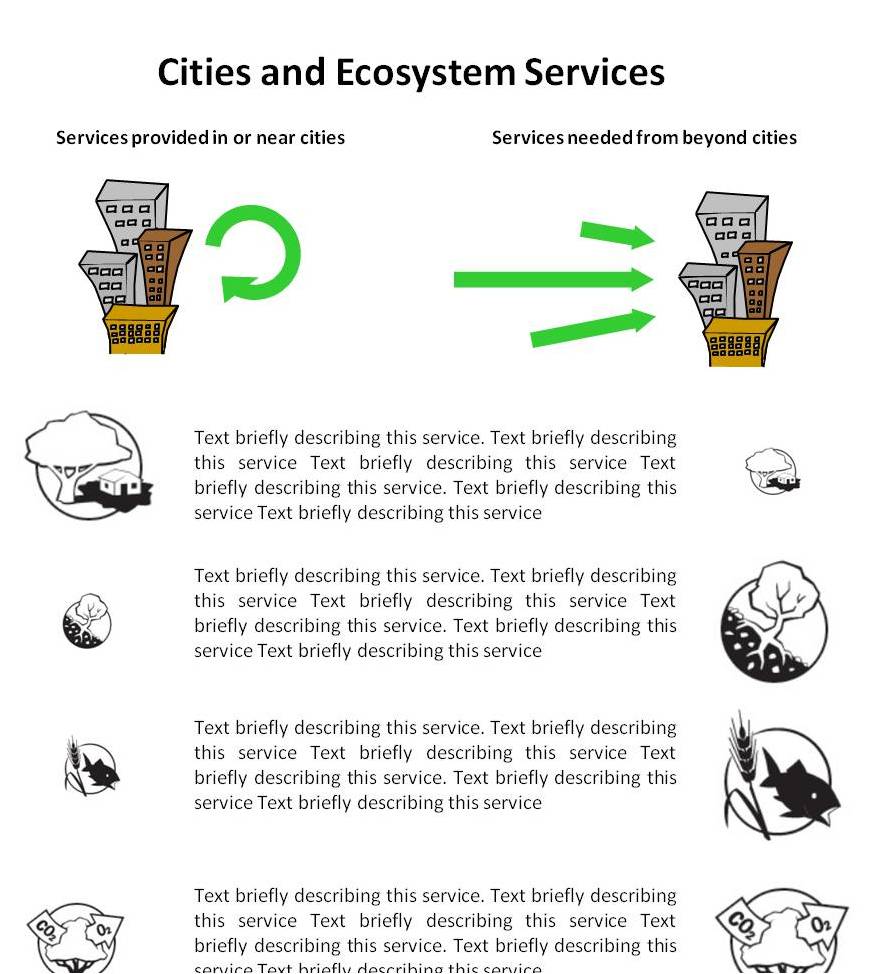
*4. Elevations in atmospheric concentrations of carbon dioxide, methane, and ozone and in nitrogen deposition. Cities accumulate phosphorus, nitrogen, and metals, which can infiltrate surface water and groundwater bodies. Urban runoff containing nutrient pollution from organic sewage, vehicle effluent, and plant fertilizer can enter waterways and lead to eutrophication.*

*Organisms that have survived such changed conditions in urban areas have been able to do so for at least two reasons: (1) they evolved rapidly or (2) they were largely preadapted to this environment. There are several documented cases of rapid evolution in urban areas, involving, for example, tolerance to toxic substances and heavy metals in plants, such as lead tolerance in urban roadside* Plantago lanceolata*. Among insects there are many cases of rapid evolution in urban areas. One of the most notable is the case of industrial melanism among Lepidoptera in the UK, a phenomenon also documented in the USA, Canada, and elsewhere in Europe. Also of interest is that specific urban and rural races have been identified within well-studied* Drosophila *species.*

**Urbanization and Ecosystem Services**

Ecosystem services are the direct and indirect contributions of ecosystems to human well-being. Cities depend on ecosystems both within and beyond the urban environment for a wide variety of goods and services that are essential for economic, social, and environmental sustainability (Chapter 4). Healthy natural systems regulate our climate, protect against hazards, meet energy needs, prevent soil erosion, and offer opportunities for recreation, cultural inspiration, and spiritual fulfillment ([www.teebweb.org](http://www.teebweb.org)).

The 2005 Millennium Ecosystem Assessment study divided ecosystem services of importance to human society into four categories: (1) provisioning services such as food, water, timber, and fiber; (2) regulating services that affect climate, floods, disease, wastes, and water quality; (3) supporting services such as habitat maintenance, soil formation, photosynthesis, and nutrient cycling; and (4) cultural services that provide recreational, aesthetic, and spiritual benefits (see Figure 2).



**Figure 2.** Caption to come when figure is finalized.

***Provisioning services***

The supply of water from catchment areas, often located just beyond or even within city boundaries, is a good example of a localized provisioning service. The conservation of wetlands (including rivers) and their biodiversity enables natural reservoirs or channels to store and provide water. The management of habitats on Mount Kenya, for example, is estimated to save the Kenyan economy more than US$ 20 million a year by protecting the water catchment area of two of Kenya’s main river systems and ensuring a regular supply of water. Another example of a provisioning service is that of urban and peri-urban agriculture, which can augment food security and generate income for vulnerable urban households.

***Regulating services***

Ecosystems regulate not only the supply but also the quality of water, air, and soil. Urban parks and vegetation reduce the urban heat island effect. There is additional potential for lowering urban temperatures when building envelopes are covered with vegetation such as green roofs and green walls. Data from Manchester, UK, show that a 10 percent increase in tree canopy cover may result in a 3–4°C decrease in ambient temperatureand save large amounts of energy used in air conditioning. Urban green spaces can contribute to climate regulation by reflecting and absorbing solar radiation, filtering dust, storing CO2, serving as windbreaks, improving air quality (by oxygen emission and moistening), and enhancing cooling by evaporation, shading, and the generation of air convection.

Increasing areas of impermeable surfaces in urban areas result in large volumes of surface water runoff and increased urban vulnerability to climate-change effects such as increased amplitude in precipitation. Interception of rainfall by trees, other vegetation, and permeable soils in urban areas can therefore be critical in reducing the pressure on the drainage system and lowering the risk of surface-water flooding. Urban landscapes with 50–90 percent impervious ground cover can lose 40–83 percent of incoming rainfall to surface runoff, whereas forested landscapes lose only about 13 percent of rainfall input from similar precipitation events. Urban mangroves and other wetlands also serve as biofiltration systems for treatment of sewage and help reduce downstream pollution.

***Supporting services***

Serving as habitats for species and as storehouses for genetic biodiversity are examples of supporting services that ecosystems offer. Supporting services make other ecosystem services possible—and they can be surprisingly prolific in cities.

***Cultural services***

Biodiversity in cities exposes people to nature and thereby facilitates an appreciation of nature. It also provides opportunities for recreation, health and relaxation, and community cohesion. Green-area accessibility has been linked to reduced mortality and improved perceived and actual general health. It has been shown that the psychological benefits of green space increase with biodiversity, and that a “green view” from a window increases job satisfaction and reduces job stress. This can have a strongly positive effect on economic productivity and hence regional prosperity. The distribution and accessibility of green space to different socioeconomic groups, however, often reveals large inequities in cities, contributing to inequity in both physical and mental health among socioeconomic groups. Several studies have shown that property values (as measured by hedonic pricing) increase with greater proximity to green areas.

Natural elements in urban areas may also be important in providing design features that can be used in the context of eco-design and bio-mimicry in architecture and urban planning.

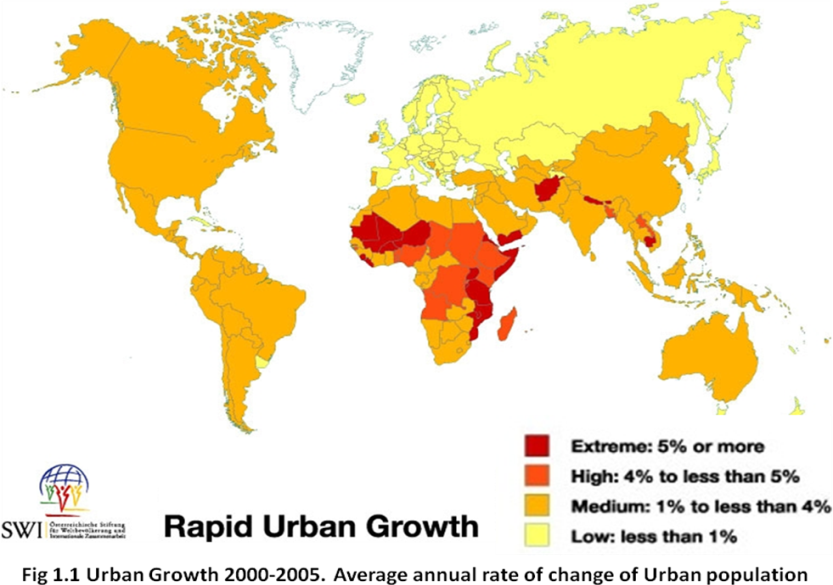
Impacts on natural ecosystems that are due to urban demands can have unforeseen effects on the health and well-being of city-dwellers. Understanding how ecosystems deliver services, who benefits from them, and what happens when an ecosystem changes can provide a key framework for developing sustainable cities within a wider landscape context.

**Regional analysis**

The rate and ways in which the planet urbanizes varies across the regions, and for each specific country and region. Over the next pages, some general and actionable trends are highlighted for the main UN regions.

1. **Africa**

Africa is urbanizing faster than any other continent on the planet (see Figure 3). The population is expected to more than double from 300 million in 2000 to 750 million in 2030. At the same time, the rate of increase in urban land cover in Africa is predicted to be the highest in any region in the world: 700 percent over the period 2000–2030.



**Figure 3.** Average annual rate of change in urban populations, 2000–2005.

Expansion is expected to be focused in five main areas: the Nile River, the Guinean coast, the northern shores of Lakes Victoria and Tanganyika, the Kano region in northern Nigeria, and greater Addis Ababa, Ethiopia. In many respects, the way urbanization is taking place in Africa is along the lines of past and current patterns elsewhere in the world, but in some respects it is unique. As in other areas of the globe, urbanization in Africa has seen the depopulation of rural areas, the rapid expansion of urban slums, and sprawling development and land conversion with an associated loss of biodiversity. Characteristic to Africa, however, is a more even pattern of urban growth, with less emphasis on growth of megacities and urbanization being most rapid in small to medium-sized cities. Based on current projections for 2010–2020, 74.2 percent of the total population growth on the content will occur in cities of less than 1 million people. Also characteristic, and challenging, is the high level of urban poverty: more than 43 percent of Africa’s urban populations live below the poverty line, higher than in any other continent.

The effects of urbanization on land cover in Africa also appear to differ from those in other regions. In the neotropics and southeast Asia, urbanization and agricultural export markets are currently the strongest drivers of deforestation. In contrast, in much of sub-Saharan Africa, old patterns of forest loss still prevail: subsistence or smallholder agriculture and extraction of wood fuel, timber, and charcoal for domestic use. However, there are significant variations within this large continent. For example, in several West African countries, recent rapid population growth in cities has increased incentives for farmers to convert forests into fields for crops to sell in urban markets.

While the rate of urbanization is higher in Africa than in Asia and the neotropics, the rate of deforestation is substantially lower (see Figure 4). This suggests that urbanization in Africa, as yet, has a lower impact on forest ecosystems and loss of biodiversity than it does in other tropical regions. At the same time, however, hunting pressures on larger wildlife species remain quite high due to the market for bushmeat, which may increase with urbanization. Some aspects of biodiversity may therefore decline despite lower rates of deforestation. It has been argued that in Africa, increased rates of rural–urban migration would relieve sources of pressure on old growth forests and allow marginal agricultural lands to return to forest, but this view has been heavily criticized.



**Figure 4.** Percent forest loss versus percent annual urban growth. (From DeFries et al. 2010.)

It is likely that a converging pattern will emerge over time whereby increased affluence among urban populations in Africa may drive rapid deforestation, and increased demand for biofuels and other cash crops may result in a new export-driven mode of deforestation, just as in Asia and the neotropics. The present may nonetheless represent a window of opportunity unique to Africa. If simultaneous efforts could be taken to (1) increase yields in non-forested lands to satisfy urban demands for agricultural products and (2) protect existing forested areas in order to maintain carbon stocks for mitigating climate change (a strategy known as REDD, Reducing Emissions from Deforestation and Degradation), there would be multiple benefits for biodiversity and ecosystem services. Additional challenges, however, may be presented by the widespread water stress that African river basins are projected to encounter as a result of climate change.

What emerges in many African cities, and is unique, is a cyclical pattern of rural and urban migration. While a foothold in the rural environment is retained, the shift to urban livelihoods means that rural land-use patterns no longer retain the same degree of focus on production, but become instead landscapes infused with cultural and familial significance. While this trend is apparent, the opportunities to reflect on African urbanization are still limited compared with other parts of the globe. However, it is apparent that even with urbanization, there is a diverse and often high level of dependency on the provision of ecosystem services from areas within cities as well as natural areas in the immediate vicinity of cities. In adjacent rural areas, biodiversity resource harvesting feeds into an extensive rural economy focused on supplying cities. The question remains as to how Africa will take up the opportunity to learn from previous urbanization processes elsewhere, to avoid a retrofitting of past, and frequently problematic, experiences.

1. **Asian Urbanization – Challenges and Opportunities in India and China**

The Asian continent contains 60 percent of the world’s population and exhibits great diversity in ecology, society, culture, and economy. Although Asia is still predominantly rural, a massive transition is developing with high rates of urbanization. Overall patterns of change are dominated by two regional giants: India and China. Recent analyses indicate that nearly half of the increase in urban land across the world is predicted to occur in Asia, with the largest increases in China and India (Chapter 7).

***India***

India, currently about 30 percent urban, is expected to become 50 percent urban by about 2044, which will have significant implications for the country’s environment, ecology, and sustainability. India contains 3 of the world’s 10 largest cities—Delhi, Mumbai, and Calcutta—as well as 3 of the world’s 10 fastest growing cities—Ghaziabad, Surat, and Faridabad. Urbanization in India is unevenly distributed, with about half of the country’s urban population liveing in smaller urban agglomerations with populations under 100,000. These small to medium-sized cities pose special challenges for urbanization. They are typically characterized by poor infrastructure and high levels of poverty, yet they also provide important links between larger cities, creating networks of urban corridors that provide opportunities for mega-urban city–regions to emerge. These urban corridors constitute a new type of urban spatial structure that can lead to expanded human footprints. One of the largest examples of this is the developing Mumbai–Delhi industrial corridor, which is more than 1500 kilometers long and connects two of the country’s mega-cities.

Although significant economic growth has been achieved because of urbanization in India, Indian cities have not sufficiently addressed issues of urban environment and ecology, or put into place adequate plans to deal with emerging challenges such as climate change. These challenges are faced disproportionately by the urban poor, and urban inequality has increased in Indian cities over time. Rapid urbanization affects natural ecosystems, biodiversity, microclimates, air, soil, and surface and ground water. Loss of agricultural land to urbanization places a severe constraint on future food security for India’s growing population. Thus, urbanization constitutes a process with great potential but also significant challenges for India. It is essential and urgent that India find ways to balance economic growth with reducing the pressure on ecosystems, the environment, and natural resources in order to ensure a secure, equitable, and sustainable future.

Climate change will have a major impact on Indian cities in the decades to come, accelerating desertification, reducing agricultural productivity, leading to increased scarcity of fresh water supplies, and leaving cities to cope with increasing numbers of climate refugees. The worst affected are the urban poor, living in slums and informal settlements with poor infrastructure and facilities. Yet even the wealthy cannot be insulated from these effects. India is in a position to better address its formidable challenges of sustainable urban development based on innovative collaborations between municipal governments, civil society groups, community groups, researchers, and other sectors of society. Such approaches are being tried in several large cities, including Bangalore, Delhi, and Chennai, as well as in several smaller and growing cities such as Surat and Indore.

Recent amendments to India’s constitution provide scope for greater involvement by civil society, community organizations, and the urban poor in urban governance. For instance, in Pune, municipal authorities have adopted participatory budgeting exercises at the ward level to involve local residents. In cities such as Bangalore, Pune, and Delhi, pressure from media and civil society groups, as well as a number of interventions from Indian Courts, have also been influential in making municipal authorities more responsive to concerns of environmental and ecological protection. Community groups and social entrepreneurs have been influential in improving solid-waste management in cities such as Chennai and Surat. While such initiatives are few and have a long way to go, they provide opportunities for urban growth to shape more socially inclusive and ecologically sustainable paths.

Urban expansion in India is accompanied by complex effects on local and regional biodiversity, ecosystems, and forest cover because of a combination of socio-demographic and lifestyle changes in urban areas (FIGURE IN HERE). Urban growth, especially in areas adjacent to forest land and protected areas, increases pressures on these ecosystems through forest encroachment, habitat fragmentation, poorly regulated development and recreation, and spillover of air and water pollution. At the same time, lifestyle changes due to urbanization may decrease pressures on some forest resources such as fuelwood and charcoal. Urbanization has promoted a transition in household energy use for cooking, from fuelwood to liquefied petroleum gas (LPG). Between 1993 and 2005, urban fuelwood demand declined from 30 to 22 percent of households, despite significant population growth in urban areas, whereas rural fuelwood demand only dropped from 78 to 75 percent. Overall, forest cover remained unchanged or increased slightly in conjunction with this climb up the energy ladder in urban households. While forest cover does decline with urban development, the effects are not homogeneous. For example, relatively unregulated housing and industrial development has significantly diminished mangrove forests in Mumbai. Yet just across the Thane Creek in Navi (New) Mumbai, where urban development was a planned process starting in the 1980s, mangrove forests have shown a remarkable recovery in the past two decades. They now provide important habitat for a variety of species, as well as recreational and educational opportunities for people who like to walk through the mangroves on boardwalks. This recovery likely occurred at least in part because of a shift from the earlier rural use of mangrove as firewood to other sources of fuel in the new city.

There is an increase in incidence of human–wildlife conflicts throughout India, with many recent cases of leopards, elephants, and other large mammals encountering and sometimes being killed by people in the expanding urban fringes. Traditional cultural and religious practices have not only tolerated but often encouraged wildlife such as primates to inhabit towns and cities, but changing lifestyles have turned this into a point of conflict. At the same time, highly adaptable species such as the leopard show a remarkable ability to persist in urban habitats despite the high risk of frequent encounters with humans. Other, rarer species continue to colonize habitats in urban areas, such as the sizeable population (10,000–13,000) of Lesser Flamingos that since the mid-1990s have been using Thane Creek as a wintering ground.

These examples represent both a challenge in finding ways to minimize conflicts with some species and improve habitats for others, and an opportunity to engage the public in understanding and managing local biodiversity. Even the largest Indian cities retain a high proportion of native plants, birds, butterflies, and other taxa, especially in parks and forest fragments that are either protected or as yet undeveloped. Calcutta, one of the mega-cities of the world, provides habitat for 273 bird species, all of them native to the region. However, 77 percent of the tree species in Bangalore’s urban parks are non-natives. The discrepancy between birds and trees illustrates the role of agency in determining urban biodiversity patterns: trees in parks are planted by human agents and therefore reflect our preferences, which may not reflect native biodiversity. Birds, by contrast, occupy cities of their own accord and are thus good indicators of how well a city’s habitats support native species. A greater understanding of the mechanisms determining urban biodiversity requires a careful teasing apart of anthropogenic factors from ecological ones, and relies on good data that can often be most efficiently collected with the participation of urban residents. Examples of this include the growing number of citizen-science projects to monitor birds and butterflies in cities. A growing interest in nature among urban dwellers, as evidenced by the recent increase in popularity of activities such as bird and butterfly watching and wildlife photography, as well as wildlife-based television shows, suggests a growing constituency for biodiversity conservation that can be harnessed to improve urban governance toward positive outcomes for human life and biodiversity in cities.

***China***

By 2030 the urban population of China is expected to exceed 900 million, an increase of more than 300 million. While there are uncertainties around this estimate, there is even greater uncertainty about the location and amount of future urban expansion. China has been urbanizing rapidly since the early 1980s. This is manifested by large rural–urban population migrations and by the expansion of urban areas and the built environment. One consequence of urban expansion has been the loss of fertile agricultural land. Another, less noticed, has been the urban expansion within biodiversity hotspots. Throughout the country, urban areas are now increasingly encroaching on protected areas. Especially along the coast, many ecosystems have been destroyed as a result of continuous building and development. Urban expansion is predicted to create an 1,800-kilometer coastal urban corridor from Hangzhou to Shenyang. As urbanization progresses toward the western regions of the country, more of the biodiversity hotspots are likely to be affected by development and urban land conversion.

Of the 34 hotpots identified around the world, four are partially within China’s borders: Himalaya, Indo-Burma, Mountains of Central Asia, and Mountains of Southwest China (see Figure 5). In 2000 about 13 percent of the total urban land in China—a little over 10,000 square kilometers—was located within these hotspots ([Güneralp and Seto 2012](#_ENREF_4)). Importantly, the urban land in the Indo-Burma hotspot constitutes 92 percent of the total urban land across all four biodiversity hotspots. This hotspot extends across Guangdong province, which accounts for more than two-thirds of the urban land in this hotspot (see Figure 5) and the most urban land in any biodiversity hotspot across China. Neighboring Guangxi and neighboring Yunnan provinces have southern portions of their land in the Indo-Burma hotspot. Xinjiang province in northwest China has considerable urban land (about 500 km2) in the hotspot Mountains of Central Asia; it equals about one-fifth of the total urban land in the autonomous region (see Figure 5).

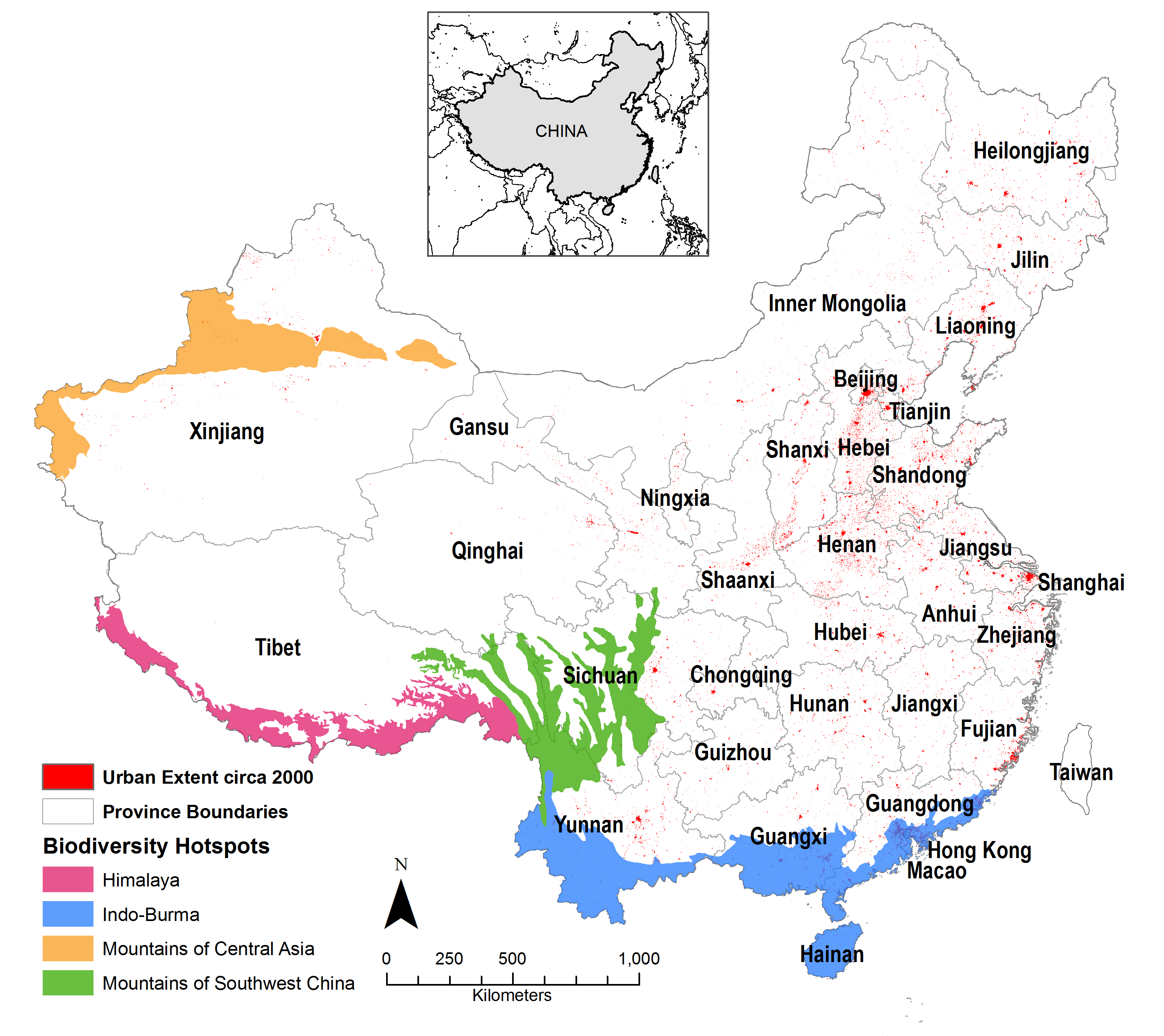
Based on the IPCC scenarios and projected urban expansion rates, the urban land in biodiversity hotspots is projected to increase from about 10,000 square kilometers in 2000 to 40,000–77,000 square kilometers by 2030. Of the four hotspots, Indo-Burma, which had by far the most urban land (more than 9,000 square kilometers) in 2000, is projected to have more than 35,000–70,000 square kilometers of urban land by 2030.

The threats to biodiversity hotspots come from direct land-cover changes that cause habitat loss and degradation of ecosystem functioning, as well as from indirect effects of urban encroachment. One indirect effect is the increased incidence of colonization by introduced species as urban areas expand into these hotspots.

Going beyond the physical expansion of urban areas in or near the biodiversity hotspots, the consumption patterns of urban inhabitants in general can adversely affect biodiversity and ecosystems in these sensitive areas, even if they are not located in close proximity to urban areas. In particular, the reduction in household size with increasing urbanization has been shown to have large impacts on resource consumption and biodiversity. Moreover, urban expansion and population growth in one location may have knock-on effects, leading to land-change cascades that can extend well into the more sensitive parts of biodiversity hotspots—both in the same country and across continents. Such challenges cannot be met by local-level solutions only; they require policy responses at a much larger scale and thus call for strategies with sufficient breadth to be developed at the national and international levels.

In addition to the preliminary forecasts reported here, a recent literature review identified China as having 2,541 nature reserves, covering more than 15 percent of the country’s territory. The proximity of urban areas to these reserves will increase dramatically by 2030. Therefore there is a critical window of opportunity in the next few decades for China to implement more proactive approaches to guiding urban expansion in ways that least negatively affect biodiversity and ecosystems.

Minimizing habitat and biodiversity loss and limiting degradation of ecosystem services will require appropriate urban planning and reformation of the current land market system. Yet the proximity of urban inhabitants to areas that are particularly biodiverse or that are critical to provisioning of various ecosystem services also presents opportunities. Such proximity may make it easier to increase awareness among these urbanites through education campaigns that can include visits to these sites ([Miller and Hobbs 2002](#_ENREF_10)).



**Figure 5.** Biodiversity hotspots and urban extent in China circa 2000.

1. **Latin America and the Caribbean**

[Text to come]

1. **Europe, CEE and North America**

[Text to come]

1. **Oceania**

[Text to come]

**Conclusion**

The broad global picture presented in this section suffices to show that global patterns of urbanization have and will have significant implications for biodiversity. In particular, urbanization is one of the major drivers of habitat conversion. Habitat conversion driven by urbanization will be particularly important for coastal and island systems, as well as biomes that are disproportionately urbanized, such as Mediterranean habitats. Without addressing urbanization impacts in such places, Aichi Target 11 is unlikely to be met.

Addressing urbanization and biodiversity challenges in developing regions such as in Africa will require governance responses across the continent. Particularly at the city level, lack of financial and human resources, and consequently technical capacity, can prevent biodiversity and environmental issues from being recognized or addressed. In many instances, biodiversity concerns are seen as independent of and less important than other urban pressures such as poverty, unemployment, and access to food, water, sanitation, and housing. This perception needs to change in recognition of the ways in which biodiversity interacts and often underlies all of the other urban problems, and may also hold the key to their solutions. Barriers to integrating the environment with other issues often involve, in addition to lack of resources and capacity, a disconnect between scales of government, with lack of effective communication between local and national levels; disenfranchisement or mismanagement of local government by higher levels of government; and failure of national policy to be applied and implemented properly on the local scale. Fiscal decentralization needs to match political decentralization, municipal boundaries may need to be extended for greater control over land-use change in peri-urban areas, and accompanying management tools must have area-wide (i.e., metropolitan or even regional) reach. Ultimately, how biodiversity is managed or integrated into cities will depend on whether it is positioned institutionally and topically as a priority in governance agendas, and whether the co-benefits provided by ecosystems are integrally recognized across general policy and action.

**AICHI TARGETS**

The Aichi Targets listed below are 20 ambitious but achievable goals that make up part of the CBD’s Strategic Plan for Biodiversity 2011–2020, adopted in Nagoya, Japan, in 2010. The Aichi Targets provide a framework for action by all stakeholders—*including cities*—to save biodiversity and enhance its benefits for people. Many of the targets are referenced in the Key Messages in Section II. The CBD is preparing a set of informal “Quick Guides” to all of the targets, available at www.cbd.int/nbsap/training/quick-guides.

**Target 1:** By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

**Target 2:** By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

**Target 3:** By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.

**Target 4:** By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

**Target 5:** By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

**Target 6:** By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

**Target 7:** By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

**Target 8:** By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

**Target 9:** By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

**Target 10:** By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

**Target 11:** By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

**Target 12:** By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

**Target 13:** By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

**Target 14:** By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

**Target 15:** By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

**Target 16:** By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

**Target 17:** By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

**Target 18:** By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

**Target 19:** By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

**Target 20**: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

**SECTION II**

**KEY MESSAGES**

**Key Message 1:** Urbanization is both a challenge and an opportunity to manage humanity’s ecological footprint.

As described in Section I, the continuous increase in the number and size of urban regions, and the ensuing transformation of landscapes on different scales, pose great challenges for reducing the rate of loss of biodiversity and for ensuring human well-being. In the following Key Messages we highlight how, in the face of explosive urbanization and global environmental change, planners, engineers, architects, policy-makers, politicians, and citizens alike can take on the challenges and build on multiple opportunities to facilitate sustainable growth patterns, while managing native biodiversity and safeguarding ecosystem services. Although many of these actions are local and will have local effects, cities are embedded in the biosphere and increasingly influence sustainability on the planetary scale, far beyond the limits of individual cities.

Humanity is now using nature’s services 52 percent faster than Earth can renew them—meaning our collective ecological footprint is unsustainable. The Ecological Footprint analysis, conceived in 1990 by scientists at the University of British Columbia, is a method for measuring the human demand on nature. The ecological footprint is the amount of land necessary to sustain each citizen’s life style, considering not only food but also materials, energy, and water and other natural resources. It compares per capita footprint (the equivalent, in hectares, of the area needed to produce all the resources consumed per capita) and biological capacity (the average equivalent productive area available per capita). The method began at the national level and has only recently been explored for analyses by economic sector, demand category, and subnational area or socioeconomic group. An interesting emerging area is the attempt to develop the ecological footprint concept as a component of the planetary boundary concept and make it possible to, at least for some of the variables, to identify regional boundaries.

Urbanization has been identified as a key factor in the growth of the global footprint over the last 30 years. Increasing affluence and consumption in urban regions increase footprints, while urban economies of scale and technology for waste recycling, energy efficiency, and emission reductions reduce per capita footprints. According to data from the Global Footprint Network, in 2008 the world required an average of 2.7 hectares of land per person to produce its goods but had only 1.8 hectares available. The situation varies dramatically between high- and low-income countries. Citizens in the Congo and Gabon, for example, use less than 10 percent of their biocapacity, whereas citizens in France and Germany use 200 percent of their biocapacity. Regionally, biocapacity differences can be marked: the average U.S. citizen consumes 7.2 hectares per year but has only 3.9 available, resulting in a net loss of 3.3 hectares; the average Canadian consumes slightly less (6.4 hectares) but has an amazing biocapacity of 14.9 hectares, resulting in a net gain of 8.5 hectares.

While the methodology of calculating urban footprints has advanced, and includes necessary estimates of biodiversity change in biocapacity calculations, the application of the concept and the management of footprints remain intensely challenging. How do the various sectors involved assign responsibilities and share costs? What are the specific contribution and roles of each player (private sector, government agencies, NGOs and major groups, international organizations, and multilateral agreements)? It is relatively easy to measure footprints at the local level, but it is very difficult to address and manage them unless actors are involved at the landscape level whose mandate goes beyond the city boundaries.

Since urbanization represents large opportunities for reducing footprints, more than 100 cities or regions have so far used the Ecological Footprint analysis to help develop policies. In 1995, statistics showed London’s footprint to be 125 times the size of the city—requiring an area the size of the UK’s entire productive land surface to provide needed resources. In 2000 the city commissioned a report on London’s footprint and later engaged in a project called “Toward Sustainable London: Reducing the Capital’s Ecological Footprint” (see [www.citylimitslondon.com](http://www.citylimitslondon.com) and www.londonremade.com).

It is important to point out, however, that while actions at the city level capture important opportunities and end up contributing to the reduction of footprints, actions by a consortium of municipalities or state governments operating at larger scales are likely to accomplish even more.

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[More to come]

For a complete bibliography, see www.xxx.

**CASE STUDY**

**Measuring a Regional Footprint: Catalonia, Spain**

In 2009 the autonomous community of Catalonia, Spain, commissioned an extensive report on its footprint in preparation for its own biodiversity law. The report is framed within the Convention on Biological Diversity and its related European directives. It speaks not only of footprints but of international “anti-cooperation” and ecological debt, the negative consequences of trade, and exchanges with its partners. As Catalonia’s economy is 44 percent industrial, the study examines the effects of imports of oil, minerals, and biofuels in originating countries and also refers to the impacts of timber, meat, fish, and grain imports. Between 1990 and 2004, importation of materials into Catalonia grew from 11.8 tons per capita to 16.9 tons, or 56 percent. In 2006, every citizen had an ecological footprint of 8.39 hectares beyond availability. The report estimates the effects of overseas direct investment of Catalonian companies on biodiversity (23 percent of its volume affects Latin American conservation hotspots) and considers the landscape impacts of resort development by Catalonian hospitality groups in the region and elsewhere. [Insert an appropriate image from Catalonia.]

**Key Message 2:** Rich biodiversity can exist in cities.

It is commonly assumed that cities and rich biodiversity are incompatible, whereas the fact is that many cities are biodiversity rich and several are even located within globally recognized “biodiversity hotspots.” Some notable examples of cities with rich biodiversity are Berlin, Bonn, Brussels, Calcutta, Cape Town, Chicago, Curitiba, Edmonton, Frankfurt, Freiburg, Hamilton (New Zealand), Helsinki, Mexico City (see Figure 2.1), Montreal, Mumbai, Nagoya, New York City, Portland (Oregon), Seattle, São Paulo, Singapore, Stockholm, and Vienna, to name but a few. This often has historical roots; areas with rich and diverse ecosystems are also rich in natural resources and therefore have long been magnets for human settlement and commerce. [Insert boxcar on Biodiversity Hotspots (below) near this paragraph.]

Urban habitats can be surprisingly diverse. Forests, montane habitats, grasslands and shrublands, savannas, peat swamps, mangroves, rivers, lakes, rocky shores, coastal habitats, dunes, seagrass meadows, intertidal mudflats, and coral reefs are all examples of habitats found in cities. Such richness of habitats also results in the generation of multiple ecosystem services, which can contribute significantly to enhanced human well-being (see also Key Messages 4 and 6).

While intact natural ecosystems harbor the richest biodiversity, remnants of pristine natural landscapes (e.g., relicts of primeval forests), traditional agricultural landscapes (e.g., meadows and satoyama), restored landscapes, and managed and industrial landscapes (e.g., industrial parks, railway tracks, residential and city centers, parks, gardens, and brownfields) are increasingly becoming refugia for biodiversity in cities.

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| [Insert photo of biodiversity in Mexico City.] |
| **Figure 2.1** Mexico City has as an area of 1,479 square kilometers—41 percent urban and 59 percent rural area under conservation status. One of the largest cities in the world, it has 8.8 million inhabitants in the city proper and about 22 million in the metropolitan area. Mexico City supports about 2 percent of all the known species in the world: 3,000 species of plants, 350 species of mammals, 316 species of birds, and many species of aquatic plants and animals. |

***Several factors influence urban biodiversity***

Urban biodiversity is influenced by the status of the original surrounding ecosystems and by the planning, design, and management of the built environment, which in turn are influenced by the economic, social, and cultural values and dynamics of human populations. Conserving native ecosystems in urban areas is increasingly important, especially given the current rate of urbanization. Brussels, for example, contains more than 50 percent of the floral species found in Belgium. As natural areas previously outside urban boundaries are incorporated into cites, the displacement of existing biodiversity and ecosystems becomes increasingly problematic worldwide.

Small and medium-sized cities can also exhibit high levels of species and habitat diversity. Two examples are Vienna, Austria, and Berlin, Germany. Fifty-four percent of Vienna is under nature protection, containing 10 species important to global biodiversity. Berlin has 22 habitats with global importance.

Many cities contain protected areas within or just outside their borders that provide important contributions to global biodiversity. In Cape Town, Table Mountain National Park, an iconic landmark extraordinarily rich in endemic plants and animals, is entirely surrounded by the municipality. In Mumbai, Sanjay Gandhi National Park—known for its dense semi-evergreen forests, 280-plus species of birds, 150 species of butterflies, and 40 species of mammals, including a small population of leopards—protects 100 square kilometers entirely within a megacity. In Stockholm, the National Urban Park is a 2,700-hectare protected area with high biodiversity, right in the city center. In Kenya, Nairobi National Park (see Figure 2.2), just 7 kilometers from the center of Nairobi, is home to lions, cheetah, rhinos, buffalo, and more than 400 species of birds. In the western U.S., Saguaro National Park lies just outside the City of Tucson and protects about 40,000 hectares of the unique Sonoran Desert ecosystem.

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| [Insert image of Nairobi National Park.] |
| **Figure 2.2** Nairobi National Park, 7 kilometers from the center of Nairobi, is renowned for its wildlife. More than 100 species of mammals and 400 species of birds occur in the park. |

These examples show that with proper planning and management, it is possible for substantial components of native biodiversity to remain in cities.

***Biodiversity includes common species too***

Biodiversity does not have to be rare to be valuable—it refers to common and widespread species as well as those that are threatened and rare. Monitoring the status of common species is important because fluctuations in their populations can indicate potential environmental problems. A case in point is the quintessentially urban House Sparrow (*Passer domesticus*) whose populations have recently declined drastically in Eurasian cities throughout its native range, for reasons that are not entirely clear. Understanding the ecology of common species may help us improve habitats for them as well as for rarer species. Furthermore, ecosystem services may be delivered even by ecosystems that are degraded or that contain low biodiversity. While pristine ecosystems typically provide a greater number of ecosystem services than those that are degraded or altered, many ecosystems that are significantly altered from their pristine state can still provide useful goods and services.

**Urban Nature Facts**

•Even backyard gardens can harbour significant biodiversity: a study of 61 gardens in the city of Sheffield, UK, found 4,000 species of invertebrates, 80 species of lichen, and more than 1,000 species of plants.

•Cities can be important habitats for a diverse bee fauna. Bees in urban and suburban settings have a richer, healthier diet than bees in modern intensive farmland settings.

***Connecting natural ecosystems can improve ecosystem services***

Connecting fragmented ecosystems is likely to increase ecological functionality as a whole and therefore to maximize the ecosystem services offered. There are diverse and innovative ways to connect natural ecosystems. Planting trees with overarching canopies can help small mammals, birds, and insects cross roads and highways (see Figure 2.3). Roadside planting that emulates the multilayering of forests—for example, a composite of tall trees, medium-sized trees, shrubs, and understory vegetation—can cater to a diversity of animal users. Ecolinks such as underground tunnels and vegetated overhead linkages can help connect natural areas. All of these efforts can complement the important roles played by protected areas in cities. Of course, linkages can also provide pathways for invasive non-native species to spread into the native ecosystems, so care must be taken to minimize such adverse impacts.

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| [Insert image of Rua Gonçalo de Carvalho in Porto Algre.] |
| **Figure 2.3** Rua Gonçalo de Carvalho in Porto Algre, Brazil, is a stunning example of a natural urban ecolink. When this tree-lined street was threatened by development, local residents and environmental groups mobilized to protect it. In June 2012, Porto Alegre passed a law protecting this and more than 70 other “Green Tunnels” in the city, recognizing them as sites of ecological, cultural, tourist, and aesthetic value. Although the trees occasionally cause power outages when it rains (because electrical wires pass through the canopy), residents value the many benefits they provide. In addition to serving as an ecolink, the trees help reduce the urban heat island effect, improve air quality, minimize rain impact and flooding, and increase property values. |

**Aichi Target 5:** By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

*Cities can help preserve forests and wetlands of critical biodiversity by ensuring the connectivity of existing and future protected areas. Managing footprints (best done at the provincial, state, or regional level) can also make a difference.*

***Cities can enhance their native biodiversity***

With the growing awareness of the value of biodiversity and ecosystem services, cities with high native biodiversity should ensure that their biodiversity is conserved. Cities with less rich biodiversity should pursue enrichment, enhancement, restoration, and reintroduction efforts to increase native biodiversity. Biodiversity can thrive in cities if (1) appropriate land-use planning is enforced, (2) ecosystems are valued and conserved, and (3) monitoring of biodiversity is undertaken.

In just about any city, local interventions can increase native biodiversity. For example, cities can identify the habitats that used to exist locally and create or enhance these habitats. Gradual enrichment or reintroduction of plant and animal species will increase the complexity of ecosystems and the services they provide. Planting native plants in parks, roadsides, gardens, vertical and rooftop gardens, and other such areas will diversify the environment to support native mammals, birds, reptiles, amphibians, bees, butterflies, and dragonflies. Recent studies highlight the importance of even small urban gardens in providing habitat for native pollinators such as bees, which have declined alarmingly in recent years. Two often-used strategies are the creation of biosphere reserves or green belts around cities, and the “green” reengineering of major highways and infrastructure projects.

**Aichi Target 12:** By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

*Campaigns by scientific institutions, zoos, museums, and aquaria—where city and regional authorities often have a managing interest—can raise critical attention and funds and provide technical assistance for the conservation of threatened species even, across the globe.*

***Monitoring biodiversity conservation efforts is important***

It is often said that we cannot manage what we do not measure. Many tools exist to help cities manage their biodiversity. Taking stock of urban biodiversity is thus an essential step in conserving it. One tool that can assist with this is the City Biodiversity Index. This and many other initiatives (see “Resources and Initiatives,” p. XXX) can help cities conserve and manage their urban biodiversity.

With concerted efforts, the proliferation of biophilic cities can become a worldwide phenomenon, making city living a wondrous experience connected with biodiversity.

***Select References***

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For a complete bibliography, see [www.xxx](http://www.xxx)

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**Biodiversity Hotspots**

Conservation International defines a biodiversity hotspot as having at least 1,500 endemic plant species and having lost at least 70 percent of its original habitat area. Of the 34 biodiversity hotspots identified globally, all contain urban areas—many of them significant in size and population. “The amount of biodiversity contained in the hotspots is extremely high,” says Conservation International. Cities in biodiversity hotspots therefore have a vital role to play in the conservation of these critically threatened ecosystems. [Insert image of Global Biodiversity Hotspots, preferably one that shows cities on it]

**CASE STUDIES**

**Cape Town**

With a population of just under 3.7 million people and a land area of 2,500 square kilometers (0.2 percent of South Africa’s total land area), Cape Town supports 50 percent of South Africa’s critically endangered vegetation types and about 3,000 indigenous vascular plant species. Cape Town falls within the globally recognized biodiversity hotspot known as the Cape Floristic Region; of the 18 vegetation types in the city, 11 are critically endangered and 3 are endangered. Although this statistic in part reflects severe land-use pressure, it also disproves the common assumption that cities cannot have high levels of biodiversity. What’s more, many of the plant species found in metropolitan Cape Town are endemic—found nowhere else on Earth. [Insert image of a well-known Cape Town plant]

**São Paulo**

São Paulo is the most populous city in the Southern Hemisphere and the third largest city in the world, with more than 11 million inhabitants. This megacity contains important biodiversity from the Brazilian Atlantic Rainforest, a globally recognized biodiversity hotspot. Twenty-one percent of the city is covered by dense forest in various stages of ecological succession, but these remnants are under severe threat from the unrestrained occupation of both low-income housing and luxury condominiums. An impressive 1,909 plant species and 435 animal species have been recorded in the city, with 73 of the animal species endemic to the Brazilian Atlantic Rainforest. The city’s Green Belt Biosphere Reserve, part of UNESCO’s Mata Atlantic Biosphere Reserve, protects important remnants of this rainforest as well as associated ecosystems. [Insert image of an example of São Paulo biodiversity.]

**Stockholm**

Stockholm, the most populous city in Scandinavia, comprises 216 square kilometres and includes 160 kilometres of waterfront and 14 islands. More than 14 percent of the city consists of aquatic environments. Among terrestrial environments, lush parks and residential areas with old, densely vegetated gardens complement protected areas and remnant patches of trees and grassland. Although the twentieth century saw a significant homogenization of Stockholm’s hinterlands, the city still supports a rich and diverse flora and fauna. More than 1,000 species of vascular plants have been recorded. Of 69 species of mammals known to breed in Sweden, 43 reproduce in or near Stockholm, including, somewhat controversially, wolves (*Canis lupus*) only a few tens of kilometres from the city. This rich biodiversity can be attributed in part to the city’s radial layout of infrastructure, which has left several green wedges connecting Stockholm to its hinterlands, and to a history of environmental efforts that date back to the late 1800s. More than 40 percent of the city’s land area still consists of green spaces. [Insert image of an example of Stockholm biodiversity.]

**Singapore**

By virtue of its geographical location, Singapore has a rich natural heritage. More than 10 ecosystems are found in this highly urbanized city–state of 5 million people. Although much of its biodiversity disappeared during the British colonization, Singapore still has a wealth of flora and fauna. Among the native species recorded are 2,145 vascular plants, 52 mammals, 364 birds, 301 butterflies, 127 dragonflies, 103 reptiles, 400 spiders, 66 freshwater fishes, and 255 hard corals. Between 2000 and 2010, intensive surveys found more than 500 species of plants and animals new to Singapore, of which more than 100 were new to science. Nestled in the heart of Singapore and not more than 15 kilometers from the busiest shopping areas are the Central Catchment Nature Reserve and Bukit Timah Nature Reserve. A network of parks and park connectors permeate the island, allowing easy access to varied habitats rich in plant and animal life. [Insert image of an example of Singapore biodiversity.]

**THEME BOX**

**City Biodiversity Index**

The City Biodiversity Index (CBI), also known as the Singapore Index on Cities’ Biodiversity, is a self-assessment tool that encourages cities to monitor and evaluate their progress in conserving and enhancing biodiversity (see p. XXX). More than 50 cities around the world are in various stages of testing the CBI and providing data for it. It currently comprises 23 indicators in three components: native biodiversity in the city, ecosystem services provided by biodiversity in the city, and governance and management of biodiversity in the city. Stakeholders such as universities and civil society can assist in providing some of the data. A platform for cities to share their experiences in applying the index has been particularly useful to cities considering using the CBI.

Other applications for the CBI have also surfaced. For example, information from it can be used in the decision-making and master planning of cities; it can assist policy- and decision-makers in allocating resources and prioritizing projects; good practices can be made into case studies for sustainable development; and some of the indicators can form the basis for calculating the economic value of biodiversity and ecosystem services. The CBI is also a useful public communication tool for city authorities. With ongoing refinement and improvement, it is becoming more valuable all the time.

**Key Message 3:** Biodiversity and ecosystem services represent critical natural capital.

“Natural capital” can be defined as the stock of goods and services that are provided by ecosystems and are essential to humankind. Quantifying the value of ecosystems in both monetary and non-monetary terms and/or attaching qualitative values are important tools for mainstreaming ecological considerations into the management of a city. Unfortunately, the value of natural capital is not often appreciated by society, and until recently, few attempts have been made to quantify it. One of the earliest attempts was made in the UK, where the government agency Natural England determined a subgroup of natural capital termed Critical Natural Capital (CNC). CNC comprises environmental assets that are (1) essential for human health or the functioning of life support systems and (2) irreplaceable or practically un-substitutable. The UK Government uses this classification system to inform policy-making and to ensure that CNC is afforded the strictest protection.

**Achi Target 2:** By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

*Mainstreaming of biodiversity needs to be done at national as well as sub-national and local levels to be effective. Biodiversity values are different for each level of “vertical” (i.e., national, provincial, and local) and “horizontal” (i.e., divisions such as environment, planning, transportation, education, finance, and nutrition) government.*

***Ecosystem services can be captured in economic terms***

Since policy and planning decisions are driven by trade-offs and utility, predominantly expressed in economic terms, decisions on land uses are often made to the detriment of non-market-valued ecosystem services. The identification, recognition, and capturing of ecosystem services in economic terms is therefore an essential approach. This approach has been aptly described in the global study “The Economics of Ecosystems and Biodiversity” (TEEB). [Place TEEB theme box (below) near this paragraph.]

If we fail to incorporate both monetary and non-monetary values of ecosystems into urban planning, then the conventional market alone will dictate the allocation of resources. The result of “business as usual” is environmental degradation and erosion of natural capital, incurring economic costs to either recover the natural capital or provide artificial alternatives.

Using the ecosystem valuation approach (including both monetary and non-monetary valuation) requires good background understanding and careful handling, in part because the complexities of ecosystems far exceed those of accounting systems. Ecosystem services that can be identified and quantitatively valued may be expressed in non-monetary terms—for example, the number of crops that depend on natural pollination—or in monetary terms. For monetary valuation, several methods exist: direct market price; replacement cost; damage cost avoided; production function (value added); hedonic price (extra amount paid for higher environmental quality); and travel cost (cost of visiting a site and willingness-to-pay surveys). Non-monetary valuation methods include preference values, scenic beauty models, studies to determine preferred choices, and visitor numbers. Choice of method depends on the characteristics of the concerned ecosystem service, the characteristics of the relevant management structure, the desired accuracy of valuation, and the availability of time, resources, and expertise.

***Valuating ecosystem services facilitates good decision-making***

Almost any ecosystem generates a “bundle” of ecosystem services, but not all of these services can be translated into numbers. Hence it is notoriously difficult to attach a comprehensive economic value to an entire ecosystem. Attaching monetary values to ecosystem services can nevertheless be enormously useful to those concerned with biodiversity management. The City of Cape Town, South Africa, for example, recently calculated that for every dollar the municipality spends on the environment, almost $8.30 of ecosystems goods and services is generated. This kind of knowledge underscores the importance of treating ecosystems as natural capital and is very useful in making the argument for spending on ecosystem management.

**Urban Nature Facts**

•In the U.S., city parks increase the value of nearby residential properties by an average of 5 percent; excellent parks can provide a 15 percent increase.

•In 2006, Washington, D.C.’s parks were estimated to increase total property values in the city by just under $1.2 billion and resulted in an additional $7 million in property taxes.

•In 2007, park-derived tourist spending in San Diego, California, amounted to $144.3 million—$40,033,000 of which was estimated to profit the local economy.

•The park system in Philadelphia provided a stormwater retention value of $5,949,000 in 2007.

By illustrating that natural capital contributes to job creation, saves money, and complements services already provided by municipalities such as disaster-risk management, municipal leaders can be encouraged to make decisions that favor the environment rather than harm it. At the same time, such efforts can gain broad public support for conservation, and even attract public and private investments. Payments for Ecosystem Services (PES) schemes can be established which offer incentives to landowners and farmers to manage their land sustainably. The City of New York, for example, has made substantial payments to upstream land managers in the Catskill/Delaware watershed to improve land-use practices and thereby ensure the provision of high-quality drinking water and avert the need to build costly water-purification facilities. Thus citizens can enjoy the direct benefits provided by nature and avoid paying to restore or replace degraded ecosystems.

By highlighting costs and benefits related to biodiversity preservation, valuation exercises also facilitate decision-making processes, for example regarding infrastructure development and planning proposals. Ignoring the value of ecosystems runs the risk of permanently losing the benefits that nature provides us, taking them away from the hands of future generations.

[Look for a TEEB graph or image to insert in this KM.]

***Select References***

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For a complete bibliography, see [www.xxx](http://www.xxx)

**CASE STUDIES**

**Water Purification through Wetlands: Nakivubo Swamps, Uganda**

The Nakivubo Swamps are adjacent to Uganda’s capital city, Kampala. The local government had proposed draining the swamps to make way for agriculture, but when a study revealed that this ecosystem was providing a valuable service by filtering organic waste and other effluent derived from Kampala, the proposal was promptly dropped. The study indicated that a water-purification facility capable of performing the same service would cost several million US dollars to construct and US$ 2 million a year to maintain. In this case, the value of converting land for agriculture would be offset by the cost of lost sewage-treatment capacity; direct investment to maintain the wetland was a cost-effective measure to uphold the purification service. This example demonstrates how detailed information and cost estimates can better inform planning decisions. [Insert photo of Nakivubo Swamps]

**The Value of Restoring Biodiversity: Mayesbrook Park, London**

An innovative partnership of public and private organizations in a densely urban area of East London has transformed a formerly rundown 45-hectare park into a showcase of how public green space can help a community cope with the risks from climate change, such as increased flooding and higher summer temperatures, while also providing socioeconomic uplift. The project involved rehabilitating the Mayes Brook, creating a new floodplain to naturally and safely store floodwater, planting new shrubs and trees to provide shade and enhanced habitats for wildlife, and adding new footpaths and signage so the public can better use the park. A 2011 assessment of the economic benefits of the project demonstrated that an investment of £3.84 million in restoring degraded habitats and enhancing the green infrastructure will yield a lifetime benefit-to-cost ratio of approximately 7:1. The gross annual benefit delivered by the ecosystem services is estimated at approximately £880,000. The cultural services—including recreation, social relations, and education—return a gross annual value of approximately £820,000, demonstrating how the restoration of biodiversity can provide economically robust climate-change mitigation and adaptation and also enhance the well-being of city-dwellers. [Insert image of the park.]

**Wetlands and Floodplains Protect Coastal Cities: New Orleans**

Flooding has always been hazardous for the City of New Orleans. Extensive levees were built to mitigate flood risk, and surrounding wetlands were drained to combat disease such as mosquito-borne yellow fever and to open the way for further urbanization. In losing water, peaty soils compressed, subsided, and steadily sank below sea level. The levees prevented sediment-rich waters of the Mississippi River from adequately replenishing the floodplains and wetlands. Today more than 3,000 kilometers of levees line southern Louisiana’s waterways, and intensive engineering has rerouted vast volumes of water. Numerous upstream dams trap sediment, further depriving the delta of silt. This rapid disappearance of coastal wetlands has undermined the region’s capacity to absorb storm flow. In 2005, residents of New Orleans paid dearly for this spectacular loss of green infrastructure when the city was devastated by Hurricane Katrina and the disastrous flooding it wrought. One of the few positive outcomes of that tragedy is a growing realization that restoration of green infrastructure is necessary to counter future storms, especially in the face of projected sea-level rise. [Insert image showing Hurricane Katrina destruction.]

**Tree Planting in Canberra**

In the Australian city of Canberra, local authorities plant trees to generate a wealth of benefits. More than 400,000 trees can be found within the city limits. This urban forest helps mitigate the urban heat island effect, thereby reducing the need for energy-intensive air-conditioning and ventilation. The trees also improve air quality, intercept and absorb storm water, and sequester carbon. In terms of value generated or savings incurred to the city, these services were valued at approximately US$ 20–67 million for the period 2008–2012. The valuation has helped inform planning and budget allocations. [Insert photo of trees in Canberra]

**Ecosystem Valuation in Cape Town**

The City of Cape Town, South Africa, recently undertook an intensive assessment of the value of ecosystem services generated by natural areas in the city. These areas include nature reserves, coastal areas, wetlands, and rivers. Using valuation methods such as “willingness to pay,” the study estimated the net present value of the city’s natural assets as US$ 5.13–9.78 billion. The study has helped leverage funding for the environment from across departments by revealing the considerable contribution of ecosystem services to human welfare and underscoring the need to account and pay for their maintenance.

**THEME BOX**

**TEEB – The Economics of Ecosystems and Biodiversity**

**TEEB (**[www.teebweb.org](http://www.teebweb.org)**)** is a major international initiative to **integrate the valuation of ecosystem services and biodiversity—appropriately referred to as “natural capital”—into governance and management, including at the city level. TEEB** draws attention to the global economic benefits of biodiversity, highlights the growing costs of its loss and of ecosystem degradation, and draws together expertise from science, economics, and policy to enable practical actions moving forward.

The impetus for TEEB came from the growing recognition that the benefits of nature mostly bypass markets, thus escaping pricing and defying valuation—and that this lack of valuation is an underlying cause for the degradation of ecosystems and loss of biodiversity. TEEB has made a compelling economic case for the conservation of natural capital. Its many reports evaluate the costs of the loss of biodiversity worldwide and compare them with the costs of effective conservation and sustainable use.

TEEB’s “Local and Regional Policy Makers Report”illustrates how dependent municipalities are on nature, and that nature has cost-effective solutions to local problems such as drinking-water supply and air-pollution control. “TEEB Manual for Cities” helps urban and regional policy-makers and planners assess the value of natural systems and consider opportunities and trade-offs of their policy and planning options. Other TEEB reports with a focus on the business sector, national government, and citizens are available for download at the TEEB website.

TEEB for Citizens is a multimedia effort to draw on information from the various TEEB reports and present them in a compelling way for consumers and citizens. This effort, TEEB4me ([www.teeb4me.com](http://www.teeb4me.com)), focuses on creating awareness and understanding of the value of nature. TEEB4me uses tools such as Facebook, Twitter, and Vimeo to create a global conversation with a large and growing network of people interested in reflecting the value of biodiversity in their daily lives and decisions.

**Key Message 4:** Well-managed urban biodiversity benefits human health.

Biodiversity is a foundation of human health. The health benefits that we derive from direct contact with nature range from improving immune function, mood, and concentration to reducing stress levels and enhancing the benefits of physical exercise.

There is a unique opportunity to make nature accessible and beneficial to people everyday through effective planning, policies, and health promotion in cities, rather than city residents travelling to experience biodiversity in rural areas or not benefiting from biodiversity at all when it is separate from their daily lives. Inter-linkages between human health and our environment extend beyond the mere absence of disease or infirmity, but require a holistic view of health that incorporates mental, physical, and social well-being, as defined by the World Health Organization (WHO).

***Cities play a major role in human health***

As urban populations and related consumption continue to expand, so do the pressures on the natural systems that sustain them. In the absence of proper safeguards and integrated urban planning, this can have devastating implications for the environment and for human health. Cities play a major role in providing built facilities, tackling inequities, and managing natural environments that help determine human health. With proper planning and adequate resources, several urban health concerns can be addressed to achieve mutual benefits for human and environmental health.

Non-communicable diseases (NCDs), specifically heart disease, diabetes, cancer, and chronic respiratory illnesses, are now a global health epidemic. More than 36 million people die every year from NCDs. Based on WHO estimates, this number is projected to be 44 million by 2020. Urbanization can increase exposure to common risk factors for NCDs, such as changes in physical activity and diets. Urbanization is also generally accompanied by increased air pollution, which causes significant mortality every year as a result of cardiovascular and respiratory disease. The consequences of NCDs are especially hard felt among vulnerable and economically disadvantaged populations; almost 80 percent of current NCD deaths occur in low- and middle-income countries.

Current evidence strongly suggests that NCDs can be largely prevented by lifestyle decisions, and some of these can bring benefits to biodiversity in cities. Urban risk factors can be limited by developing urban spaces that improve air quality, promote active living, and facilitate good nutrition and dietary diversity. For example, better public-transport practices and bicycle/pedestrian pathway systems can lead to increased physical activity and reduced greenhouse gas emissions (see Figure 4.1). Urban agriculture systems can promote dietary diversity and improve nutrition and food security, while supporting agricultural species conservation and indirectly benefiting rural and natural areas by limiting the urban food-supply “footprint.” Cities can also play a significant role in promoting awareness of the health value of dietary diversity and healthy diets based on local sources. This can encourage more sustainable agricultural production while improving urban diets and decreasing obesity and cardiovascular disease. Organic urban agriculture also increases local biodiversity and provides habitat for plants, birds, and other species that may otherwise be adversely affected by urban development.

The management of biodiversity in cities has also been shown to help reduce childhood asthma and other air-pollution-related diseases, and to provide settings that enhance health benefits from physical activities.

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| Insert photo of Bogota case study from Cristina Romaneli |
| **Figure 4.1** In Bogota, Colombia, physical activity has increased significantly and greenhouse gases have been curtailed by closing 97 kilometers of a major road to traffic on Sundays and during holidays, improving the bus transit system, using cleaner buses, and creating a 334-kilometer bicycle path around the city. |

Understanding the complex interactions between urban populations and infectious disease is also paramount, particularly since approximately 1 billion people currently live in squalid, slumlike conditions. Cholera, influenza, dysentery, and malaria are but a few common diseases that are tightly intertwined with ecological processes. Infectious diseases such as these can often be curbed with a combination of measures, including adequate sanitation and sewage systems, as well as the conservation and restoration of local environments to encourage resilient, biologically diverse adjacent mangrove, lake, and river ecosystems (see Figure 4.2). Micronutrient deficiencies are a contributing factor that makes people more vulnerable to infectious diseases by decreasing immune and non-immune host defenses. Urban agriculture can lower the pressure for food supplies from surrounding forested and rural regions, and this in turn can conserve natural ecosystems and support their ability to regulate wildlife-related infectious diseases. High species diversity has been found to reduce the risk of disease transmission to human beings by diluting pathogens among a large number and type of potential hosts. However, frequent interactions between humans and wildlife may lead to increased spread of pathogens, and this risk also needs to be incorporated in urban planning.

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| Insert photo of Dar es Salaam Participatory Resource Planning case study from Cristina Romaneli |
| **Figure 4.2** The Sustainable Cities Programme in Dar es Salaam, Tanzania, uses a participatory bottom-up planning approach to manage fecal waste discharged into the environment. This programme aims to reduce serious health risks posed by wastewater and to support the coastal habitats on which coastal cities depend for their natural resources. |

***Biodiversity can benefit mental health too***

Another heath challenge that cities are well placed to consider is that of mental illness. WHO estimates that mental illness affects more than 450 million people worldwide. Mental illness is often associated with rapid social change, stressful work and living conditions, an unhealthy lifestyle, physical illness, and more recently, changes in the urban environment. Adopting biodiversity as a priority for development policies can provide mental health benefits for people such as reduced stress, better resilience in times of adversity, improved mental concentration, and increased self-confidence, while also providing vital exploratory opportunities for urban children and youth. Some researchers argue that ecosystem services, such as food production and air quality, play an important role in mental health too.

**Aichi Target 14:** By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

*Management of ecosystems for health, water, food safety, and flood protection, among others, is a key mandate for city authorities.*

***Integrated urban planning is essential for achieving healthy cities***

Cities can offer greater access to health care, education, and public transport as well as better water-supply systems and overall infrastructure—a reality that has fueled the belief that urban dwellers have an “urban health advantage” over their rural counterparts. However, as noted above, several health issues are associated with cities, and as the number of people living in cities continues to rise, so will the challenges associated with achieving healthy cities. In this light, integrating urban biodiversity planning with public education and the work of health experts is essential. This can be achieved with urban policy and initiatives such as urban reforestation; the establishment of urban parks and outdoor gyms, paths, and trails; the promotion of urban agriculture; the development of sanitation and water infrastructure; and the design and location of community facilities that use the benefits of nature as a setting for other activities, such as healing and wellness (hospitals, elderly, or disabled care) and learning (schools and childcare facilities).

**Urban Nature Fact**

•In Sacramento, California, city residents who exercise in parks tend to have lower medical costs; in 2007, the average medical cost difference between active park users and inactive users was $250 for adults under age 65 and $500 for adults 65 and older.

The so-called urban advantage must not overshadow the complexities of urbanization. It can be helpful to consider urban health issues in two diametrically opposed categories: those linked with poverty and those linked with affluence. Both frequently coexist in the same city. As noted in the joint WHO and UN-HABITAT report “Hidden Cities,” the least affluent members of society are also those most likely to be struck by the double burden of communicable and non-communicable diseases. Consequently, it can be concluded that the urban advantage is the result of a variety of socioeconomic, cultural, behavioral, environmental, and health-service factors, which must be actively planned for and incorporated into policy measures at all levels of governance.

Local governments are usually well placed to achieve human health and biodiversity co-benefits, given their understanding and proximity to local conditions. While they sometimes lack resources and infrastructure, they generally have better knowledge of and more immediate access to stakeholders and potential partners within their constituencies, and are often better placed to mobilize and adjust resources necessary for local circumstances.

The application of our knowledge of the determinants of human health and their inter-linkages continues to expand in city policies and programmes. For example, the worldwide Healthy Cities movement has existed for more than 25 years and has spread to all regions. Although each city and situation clearly requires the development of specific solutions, the following examples highlight some of the urban human health and biodiversity inter-linkages that planning and initiatives consider:

1. Land use change, urban food production, food security, nutrition, and dietary diversity;
2. Water quality, wastewater management, sanitation, and disease;
3. Physical activity, preventative actions to address NCDs, and environmental benefits from lifestyle choices;
4. Local knowledge, traditional knowledge and medicines, poverty reduction, and development; and
5. Energy consumption, public transportation, and climate change adaptation, including the urban heat island effect.

The increasing number and diversity of urban policies and programmes on human health and biodiversity inter-linkages are providing a rich source of knowledge for cities to use and build on (see Figure 4.3). Over time, this understanding will help with the development of more robust predictions of how different approaches to ecosystem management in cities affect human health. Given the unique position of cities at the implementation interface between people and biodiversity, we must widely share our understanding, predictions, and lessons learned through local, regional, and global collaboration networks. By looking at biodiversity through the lens of health *and* also looking at health with an eye for biodiversity, we can achieve mutual health benefits for cities and biodiversity.

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| Insert photo of Belo Horizonte Food Security Program from Cristina Romanelli |
| **Figure 4.3** In Brazil, the Belo Horizonte Food Security Program, hailed as one of the most comprehensive policies to tackle hunger and secure a healthy food supply for the future, was very successful in improving nutrition and reducing poverty and mortality. It won the Future Policy Award in 2009. |

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For a complete bibliography, see [www.xxx](http://www.xxx).

**CASE STUDIES**

**Healthy People and Parks**

Parks Victoria, a park management agency of the State Government of Victoria, Australia, launched the “Healthy Parks, Healthy People” (HPHP; [www.hphpcentral.com](http://www.hphpcentral.com)) approach in 2000. The goal was to emphasize the value of visiting parks and natural open spaces for the benefits they provide as healthy places for body, mind, and soul. Similar approaches have now developed around the world, including in Canada, the United Kingdom, and the United States. The Melbourne initiative that emerged from the first International HPHP Congress declared that parks are “integral to healthy people and a healthy environment” and that “human health depends on healthy ecosystems.” The Congress was also the springboard to a partnership with a national health insurance provider, which is now funding public preventative health activities and establishing a network of health professionals to encourage people to increase their physical activity by engaging in activities in parks. [Insert Parks Victoria photo of walkers in park, from Kathryn Campbell]

**“Healthy People, Healthy Parks” Nepal**

The “Healthy Parks, Healthy People” concept is also being adapted to developing countries, beginning with HPHP Nepal, a partnership involving the International Union for Conservation of Nature, Parks Victoria, and the Nepalese government. A 2010 workshop in Kathmandu highlighted that HPHP and resulting lessons learned could indeed be applied in countries with different socioeconomic contexts. As Dr. Chhatra Amatya, chairman of Chhahari Nepal for Mental Health, explained, “HPHP is all the more needed in a country like Nepal. Our children do not have space to play a game in a city.” [Insert photo of children in Nepal by Jo Hopkins]

**Curitiba’s Innovative Approach to Waste Management**

Curitiba’s population exploded from 120,000 to more than 2 million between 1942 and 1997, challenging the city to provide food, water, and sanitation services to its residents. By the early 1970s, poverty, waste, and disease were rampant in the city’s slums. Today, with 14 forests, 16 parks, and some 1,000 public green spaces, Curitiba is known as “Brazil’s green capital” and is hailed as a prime example of a green economy in a developing country. Among its innovations is the Green Exchange Programme, which encourages slum dwellers to clean up their surroundings and improves public health by offering fresh fruit and vegetables and bus tickets in exchange for garbage and waste brought to neighborhood centers. Local markets also accept bus tokens in exchange for food. Since 1991 the poorest neighborhoods have exchanged some 11,000 tons of garbage for almost 1 million bus tokens and 1,200 tons of food, and more than 70 percent of Curitiba households have participated in the program. The initiative also allows children to exchange recyclables for school supplies; in one 3-year period, more than 100 schools reportedly traded 200 tons of garbage for almost 2 million notebooks. [Insert photo from Cristina Romanelli]

**Greenery in Slums: A Valuable Source of Traditional Medicine**

In many slums, the presence of trees and plants that heal is extremely crucial, as traditional medicine is typically the most economical, trusted, and readily available form of health care in such settlements. In Bangalore, one of India’s fastest growing cities, an estimated 30–40 percent of the population lives in 550-plus slums. Surveyed slums in Bangalore have an average of 11 trees per hectare, versus 28 per hectare in other residential areas. The species that dominate are of high medicinal and nutritional value to the residents and are sources of primary health care. The trees also offer many socio-cultural services. Daily chores such as cooking, washing dishes and clothes, and maintaining personal hygiene are carried out under tree cover. Trees act as pillars of support in such settlements—figuratively and literally by bearing tents, clotheslines, wires, and so on. The variety of roles that plants play in slums is extremely critical to people’s health and well-being. [Insert photo of tree in Bangalore slums, from Divya Gopal]

**More Trees, Less Childhood Asthma: New York City**

Rates of childhood asthma in the United States increased by 50 percent between 1980 and 2000, with the highest rates reported in poor urban communities. In New York City, where asthma is the leading cause of hospitalization among children under age 15, researchers at Columbia University undertook a study of the correlation between numbers of trees on residential streets and incidences of childhood asthma. They found that as the number of trees rose, the prevalence of childhood asthma tended to fall, even after data were adjusted for sociodemographics, population density, and proximity to pollution sources. How might trees reduce the risk for asthma? One explanation is that they help remove pollutants from the air. Another is that trees may be more abundant in neighborhoods that are well maintained in other ways, leading to lower exposure to allergens that trigger asthma. Yet another is that leafy neighborhoods encourage children to play outdoors, where they are exposed to microorganisms that help their immune systems develop properly. Further studies will provide a clearer picture of whether street trees really do make for healthier children: New York City is currently in the midst of planting a million new trees by 2017. [Insert image of a tree-lined street in NYC.]

**The Many Benefits of Urban Agriculture**

Growing local crops can increase knowledge and awareness of and interest in the biophysical and food-growing processes, empower citizens to influence sources of food production, strengthen links to natural food chains, and encourage healthier lifestyle choices. Greater food self-reliance, cheaper food prices, greater accessibility to fresh produce, and poverty alleviation are all key benefits that can arise from urban agriculture with sound decision-making and planning of the cities’ ecosystems. The advantages of urban agriculture have also been noted in the World Health Organization’s Healthy Cities Programme, which appeals to local governments around the world to include urban agriculture in their urban plans.

**Key Message 5:** Incorporating biodiversity and ecosystems in urban planning and design helps reduce carbon emissions and enhance adaptation to climate change.

The Intergovernmental Panel on Climate Change warns that at current greenhouse gas emission rates, average global temperatures will likely increase by 4°C by 2030, the catastrophic effects of which are beyond our ability to predict. Efforts to mitigate CO2 emissions are urgently required. But even with concerted action, the planet will still experience more frequent and intense heat waves, drought, storms and flooding, and sea-level rise. Cities are poised to bear the brunt of these effects, as they concentrate more than half of humanity in some of Earth’s most vulnerable locations along coasts and rivers. Of course, production and consumption activities heavily concentrated in cities have contributed to climate change in the first place through emissions. At the same time, cities often achieve *lower* per-capita CO2 emissions than nonurban areas.

***Climate change is affecting ecosystem functioning***

All cities benefit from their associated ecosystems: watersheds supply fresh water, wetlands offer storm-protection and water-purification functions, and forests help purify the air. These serve as critical inputs into production systems as well as a basis of livelihoods for many cities’ poorest residents. Climate change, however, is affecting ecosystem functioning—and even minor shifts in the ability of ecosystems to provide services can profoundly disrupt city systems. With many species living in or commuting through cities, their fate is often linked with that of urbanization.

**Aichi Target 10:** By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

*The majority of people in the Coral Triangle, and along the Mesoamerican Reef and the Great Barrier Reef, live in coastal cities, and their consumption and pollution contribute significantly to coral stress. Since cities are responsible for up to 75 percent of all transportation emissions, they have a key role to play in reducing emissions and ocean acidification.*

Cities can support biodiversity while *at the same time* reducing carbon emissions and enhancing adaptation to climate change. The key is strategic planning that aligns production, distribution, and consumption systems with the carrying, regeneration, and assimilation capacities of natural systems. Urban-based mitigation against the effects of further climate change creates a virtuous cycle that benefits humans and nonhuman species alike. There are significant challenges to achieving this, however. Cities—particularly in developing countries—are growing quickly at the same time as they struggle to reduce emissions and build resilience to the effects of climate change. Cities in developing countries—whose environmental protections are often the weakest, and whose poor populations are often the most vulnerable—are poised to suffer the most.

Fortunately, cities have enormous potential for working with the biodiversity located in, around, and flowing through them (see Figure 5.1). The more compact a city is, the smaller its spatial footprint. This means that larger outlying green areas can be preserved intact. More green space, particularly when it supports functional ecosystems, generally means more vegetation that can act as a carbon sink for offsetting urban emissions. Even more importantly, when key points of ecosystem functioning are identified and strategically prioritized, biodiversity hotspots can be incorporated into larger ecosystem mosaics. Such mosaics permit the movement of species, water, and other resources by mitigating landscape fragmentation. Functional watersheds can ensure reliable access to safe drinking water, which is especially critical given climate change–related disruption of precipitation cycles and of historical river flows and groundwater levels.

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| [Insert PPT image from Thomas of creative greening in Fukuoka, Japan.] |
| **Figure 5.1** Caption to come. |

At the city–region scale, landscape mosaic planning prioritizes green corridors—including those along rivers and other vital watercourses and migratory paths—that connect larger green patches (see Figure 5.2). Other types of connective mechanisms, such as road bridges and tunnels and connecting tree canopies, can stitch together green fragments in an urban landscape depending on the functional needs of the targeted species. The overall impact is that humans and nonhumans alike are able to optimally access key urban and ecological nodes—commuting between settlements and green patches—with minimal mobility requirements. Ecosystems that provide connectivity between natural spaces allow species greater access to resources and to genetic exchange, which are especially important in building resilience to the effects of climate change.

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| [Insert image of Atlantic Forest Biosphere Reserve] |
| **Figure 5.2** The Atlantic Forest Biosphere Reserve stretches along 3,000 kilometers of the Atlantic Coast and covers approximately 94,000 square kilometers in 14 different Brazilian states. The reserve is important for both its biological and socio-cultural diversity, as it includes large urban centers—among them, Rio de Janeiro, Florianopolis, and São Paulo—as well as many small traditional communities of peasants, small-scale fishermen, and forest extractive groups. |

***Urban planning can incentivize strategies to mitigate climate change***

Mosaic planning can also incentivize transport strategies to connect regional cities via low-emission public transit. As urban regions consider the impact of cutting across and fragmenting functional ecosystems, they can bundle transit lines and prioritize mass transit modes. To this end, compact urban settlements support landscape mosaics *and* most viably support public transit. This is because urban density can sustain critical masses of people around the necessarily concentrated nodes of train and bus stations. The impact of CO2 mitigation is massive: replacing a car commute with one by a train, bus, or bicycle can reduce per-capita carbon emissions from 2 1/2 to 13 times.

Urban planning can also expand the green spaces and parks in cities. Beyond providing a refuge for wildlife and space for human recreation, urban green spaces perform many useful climate change–related functions. Firstly, they reduce pollutants and sequester carbon. Secondly, they remind the public of the critical role that ecosystems play in mitigation and adaptation functions, which can further increase support for such measures. Thirdly, they can significantly reduce the urban heat island (UHI) effect (see Figure 5.3), a vicious cycle caused by the tendency of built areas and paved surfaces to absorb and magnify ambient heat; this magnified heat frequently prompts greater energy expenditure for air conditioning, increasing greenhouse gas release and thereby further increasing the UHI effect.

**Urban Nature Fact**

•In 2005, the trees of Washington, D.C., removed 244 tons of carbon dioxide, nitrogen dioxide, ozone, particulate matter, and sulphur dioxide, at a savings value of $1,130,000.

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| [Insert image of São Paulo’s Green Belt Biosphere Reserve.] |
| **Figure 5.3** São Paulo’s Green Belt Biosphere Reserve, established in 1994, helps counteract the urban heat island effect by reducing the ambient temperatures of adjacent areas by up to 10°C. |

Urban “waste” spaces such as brownfields—formerly used for industrial processes—may have even more innovative roles to play in cities. Permitted to revert to natural habitat with minimal human interference, these spaces perform a variety of critical climate-change-adaptation functions, such as handling extreme influxes of storm water without expensive infrastructure or evacuation. Urban brownfields may also represent a nearly one-for-one (re-) conversion of greenhouse gas (GHG)-emitting to GHG-absorbing surface area. Preserving rather than draining and paving over wetlands can allow for the absorption of excess rainfall and buffer against coastal flooding. As the effects of climate change intensify—putting unprecedented pressure on urban infrastructure such as storm drainage, seawalls, and levees—ecosystem-based adaptation is worth far more than the nominal cost of ecosystem preservation.

At the city scale, local authorities can use The Economics of Ecosystems and Biodiversity (TEEB; see p. XXX) to better capture the value of ecosystems. And at the neighborhood scale, cities can establish land-use and building regulations that require minimum per-capita green space, sustainable redevelopment of brownfields, and building technologies such as green roofs (see Figure 5.4). Once established, a green roof can significantly reduce both peak flow rates and total runoff volume of rainwater by storing it in plants and substrate and releasing it back into the atmosphere through evapotranspiration. Such roofs can retain 70–80 percent of rainfall in summer and 10–35 percent in winter, depending on their build-up. By providing a mosiac of urban microhabitats that help mitigate habitat loss and fragmentation, green roofs also provide many direct benefits that enhance local biodiversity.

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| [Insert image of a green roof.] |
| **Figure 5.4** Green roofs can be used not only to enhance targeted ecosystem services, such as storm-water retention and food production, but also to improve biodiversity in general. For example, using local seed mixes and substrates can mitigate habitat loss and fragmentation and also enhance habitat provision and connectivity, when placement and height of the green roofs complement and support existing ecological communities in the surrounding landscape. Wildflower meadows (Salt Lake City, USA), nesting sites for birds (Basil, Switzerland), and invertebrate-rich “brownfields”—well-drained, nutrient-poor environments on previously developed lots (London)—are just a few examples of ecological environments created by green roofs. Large-scale rooftop agriculture initiatives already exist in many cities around the world, among them New York, Chicago, Singapore, and Montreal (see p. XXX). Shown here is a wildflower meadow on the roof of The Church of Jesus Christ of Latter-day Saints Conference Center in Salt Lake City, Utah. |

***Aichi Target 15:*** *By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.*

*No other level of government does as much restoration as local governments. Many “brown” and transition (ex-industrial) areas under city governments are either in the process of being restored or could be. City governments can also promote the use of green infrastructure and roofing.*

***Select References***

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For a complete bibliography, see [www.xxx](http://www.xxx)

**CASE STUDIES**

**Mexico City’s Actions on Climate Change**

Mexico City was the first Latin America city to implement a Climate Action Program. Three components of the overall program place biodiversity at their core: (1) The Green Roof Program aims to create 10,000square meters of new green roofs annually, to improve air quality, regulate humidity, reduce temperatures, and provide new biodiversity resources across the city. By increasing environmental awareness among citizens, the program also plays an important educational role. (2) Focusing on pollution risks, the Recovery of the Rivers Magdalene and Eslava program is improving environmental conditions in two important tributaries and their surrounding neighborhoods. Additional funding in 2011–2012 has helped secure a water supply for the city and reduce the energy and economic costs associated with traditional water treatment. (3) Almost 60 percent of Mexico City is represented by Land for Conservation, which provides environmental goods and services essential to the entire city. The two-pronged Program of Restoration of Ecosystems and Compensation for Maintaining Environmental Services rewards landowners in this area both for protecting essential natural resources and for restoring degraded habitats. It also encourages communities to actively protect and restore natural ecosystems. [Insert appropriate image from Mexico City.]

**Yokohama, Japan – Mitigating Local Climate Change**

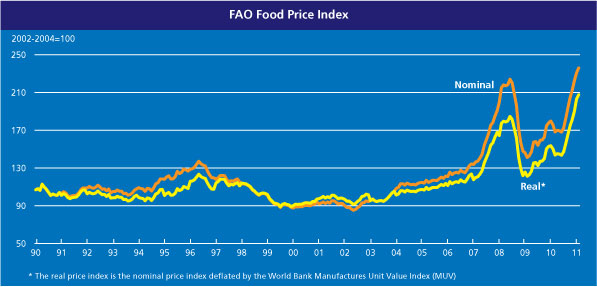
In 2007 the administrative district of Yokohama emitted almost 20 million tons of CO2. Aiming to become a low-carbon city, it set a goal to reduce per person CO2 emissions by at least 60 percent, relative to the 2004 level, by 2050. With a population of almost 3.7 million, Yokohama has been continuously degrading and converting its forests and farmland. The consequence has been a demonstrable impact on the city’s microclimate, above that associated with global climate change, resulting in an urban heat island effect. The increase in buildings and paved surfaces has enhanced the city’s heat-absorption capacity and increased its reflective heat, thereby raising temperatures. At the same time, the decrease in forests and farmland has reduced evapotranspiration, thereby slowing cooling. Recognizing the importance of biodiversity in stabilizing the local climate, the city introduced a new tax system and a mechanism to use the revenue to conserve privately owned green areas. It also decided to expand green areas with rooftop and wall greening and to work with citizens to reduce residential CO2 emissions. It set a minimum target for effective evapotranspiration from green areas at 30 percent of the total city land area. [Insert appropriate image from Yokohama.]

**Key Message 6:** Food and nutrition security depend on local and biodiversity-based food systems.

[This message is currently being revised, with input from Arthur Getz.]

The conservation and sustainable use of biodiversity for food and agriculture play a critical role in the fight against hunger. Yet the rapid growth of cities is challenging the provisioning capabilities of agriculture and modifying food systems at local and global levels. Conflicts, economic and social turmoil, rising energy prices, climate change, increases in extreme weather events and disasters, and scarce or polluted water supplies are among the factors that further elevate the volatility of food supplies and prices and put millions of people at risk, particularly the poorest. At the same time, a shift in urban diets to less diverse and more processed foods has increased the incidence of non-communicable diseases such as obesity and diabetes.

In cities everywhere around the world, people are experiencing increases in hunger and poverty. Food and nutrition security entered global and urban political agendas to an extent previously unseen in 2007–2008, when food prices soared and cities in more than 20 countries around the world experienced food riots. Current food prices have once again reached 2008 levels (see Figure 6.1).



**Figure 6.1.** The FAO Food Price Index is released monthly and is a measure of the monthly change in international prices of a basket of food commodities.

***Biodiversity contributes to food and nutrition security***

Feeding the world’s growing population requires a comprehensive approach that considers ecological, social, and economic dimensions. Agriculture and food biodiversity is a key component of sustainable diets that are nutritious, culturally acceptable, and contribute to long-term ecosystem management and economic vitality. Sustainable agriculture is dependent on healthy soil and water and on biological diversity. Furthermore, traditional crops used in many local diets around the world have high nutrient content. Local and biodiversity-based food systems will play a key role in building more resilient food systems.

How can cities and urban consumers be drivers of agro-biodiversity at local and city–region levels? How can cities preserve the surrounding ecosystems on which much of the food production depends? Critical needs and challenges are to:

* Recognize the importance of biodiversity for sustainable and healthy diets and enhance the preservation of local agro-biodiversity, with particular attention to traditional foods and eating habits, local plants and trees, livestock, fisheries, and aquaculture.
* Identify priorities for improving urban–rural linkages, governance,and partnerships that provide for better management of local biodiversity as well as soil and land uses, water, and other natural resources.
* Facilitate efforts among stakeholdersat all levels to embrace the challenges of conserving biodiversity, including agro-biodiversity, within city–region planning strategies.

***The opportunities***

A new approach is emerging for local, biodiversity-based food-system planning that recognizes the importance of urban–rural linkages within a city–region planning strategy. This cross-sectoral approach seeks to build diverse supplies of food close to population centers—not to constrain the global supply chains that contribute to food and nutrition security for many countries, but to improve local decision-making and management of food systems. Within the local context, such a food system considers all aspects of the capacity of urban, peri-urban, and rural areas for food self-reliance, including land and water resources, production practices, transport, access, consumption patterns, and political feasibility.

At the local level, building such food systems needs to be done holistically, combining multi-level, multi-sector, and multi-stakeholder approaches. Strong synergies can result from dialogue, planning, and action led by local authorities and stakeholders across the urban–rural continuum in a given city–region. It must first be recognized that in their daily food-consumption choices, all humans contribute to either the loss or preservation of biodiversity, at the local or global level. Sustainable food systems also need to link food production (including local biodiversity and indigenous species) to food storage, processing, marketing, and consumption. The access to the major processing and distribution networks is difficult for small farmers; however, improving their access to local markets, for examples through public procurements programmes, could result in the development of local food processing industries, which would create employment and benefit the poor by improving access to fresh food.

***An integrated approach***

An integrated approach to resilient food system has four dimensions, each of which should consider biodiversity issues.

**1. A people-centered and social-development-policy dimension, associated with the Right to Food**

It is important to ensure the inclusion of vulnerable groups, with special attention to gender, youth, and migrant workers, in the design and implementation of food and biodiversity policies. Citizens and consumers are able through their daily food purchases to influence the food system and support biodiversity. Local governments and agencies can do the same through their procurement policies. In 2010, the city of Rome adopted a Green Procurement Policy for food and canteens with more than 144,000 meals (70 percent of which include organic food) served daily in 550 nursery, primary, and secondary schools, with a consideration for biodiversity.

**2. A multi-level governance dimension**

Urban–rural food systems run across existing political boundaries; encompass various urban centres/municipalities; and have a complex mix of jurisdictions spreading across district, state, and national governments which bear on regional land use and marketing, and which receive different pots of money from the central government. There is thus a need for planning and investment across institutional boundaries. The integration of agriculture, biodiversity, and food systems at the various levels of government needs to be supported by urban, metropolitan, and regional/national management, incentives, and governance measures. Special attention needs to be paid to health control, storage and processing, land legislation, land tenure systems, use of vacant land, and access to water.

**3. A territorial-planning dimension across the urban–rural continuum**

Development of and territorial planning for urban–rural food systems needs to be considered at various scales: the neighbourhood level, the city level, and the city–region level. A recent example of this thinking is the Kenyan government’s new Ministry of Nairobi Metropolitan Development, which is charged with development of the Nairobi Metropolitan Region, including the city as well as surrounding peri-urban and rural areas. The ministry aims to ensure integrated spatial growth and strategic programmes for the provision of social, economic, and infrastructural services, including protection of the region’s agricultural and natural support base, throughrestricting urban growth and addressing issues of food security. However, strategies for accomplishing these goals have yet to be defined and are urgently needed. Use of appropriate policy instruments such as (environmental) legislation, training, financial support or economic incentives, or others should be defined to enhance specific agriculture production systems in specific urban, peri-urban, and rural areas of the region. As long as this is not done, the promotion of a more sustainable urban food system in the Nairobi Metropolitan Region remains on paper only.

**4. An ecosystem and disaster risk reduction dimension**

Natural resources management essential to agricultural production includes soil and water conservation, energy inputs, wastes generated, and the potential for recycling and closing of loops in flows of energy and nutrients. Many cities and their surrounding areas face increasing water shortages. In Kathmandu, Nepal, for example, the Rainwater Harvesting Promotion Programme promotes rainwater harvesting to combat problems of water supply for drinking and irrigation.

These four dimensions are can mutually reinforce stronger urban–rural linkages at the city–region level. They can be encompassed within action plans or operating frameworks for sustainable development related to social, environmental, and economic goals. Moreover, the role of food systems in the context of planning for resilience and sustainability, across all levels of government, can directly contribute to preserving local biodiversity. As awareness and capacity for food-system planning increase at all levels, policy and programs linking food and nutrition security with biodiversity conservation, economic development and climate-change adaptation can become more integrated.

***Focus on solutions***

Creating more biodiversity and local-based food systems will demand approaches in governance and new planning tools. For example:

* Complementary roles of local, subnational (state/province/region), and national governments, collaborating with civil society and the private sector, need to be acknowledged and formally engaged.
* Education and empowerment of consumers regarding the importance and consequence of their food-consumption choices for biodiversity need to be developed.
* Improvements are needed in the technical competencies of partners to address challenges of biodiversity to food and nutrition security and to provide training and policy guidance to decision-makers and planners at all levels.
* Collaborative strategies for implementing technical and policy support, particularly related to biodiversity and natural-resource management, need to be developed in greater detail.
* At local levels, dialogue should begin with a multi-stakeholder assessment of key problems and issues related to agro-biodiversity, identification of possible strategies for solutions and actions, clear demarcation of actors and their implementation roles, and harnessing of resources and institutional capacities, with monitoring and evaluation throughout the process.

**Aichi Target 6:** By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

*City and provincial authorities are often centrally involved in aquaculture promotion as development policy, and often regulate no-take fishery zones. They can also play a role by making urban consumers aware of restrictions on capture and consumption of threatened or endangered species.*

**Aichi Target 7:** By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

*City and sub-national governments, through development strategies and regulations (as well as enforcement of rules), influence aquaculture, agribusiness, and forestry—not only in harvest and production but also in design, planning, and promotion of sustainable consumption.*

**Aichi Target** 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

*Urban consumption of traditional food (based on local varieties and breeds) creates markets for local agrobiodiversity. Sustainable public procurement at the city or state level (e.g., for school/institutional food service and catering) has been proven to encourage small-scale and locally managed sustainable farming and animal husbandry.*

**Urban Nature Facts**

•Urban demands for specialized foodstuffs such as tuna and shrimp can affect fish stocks halfway around the globe.

•Urban agriculture can contribute to soil conservation, urban hydrology, microclimate improvement, and urban biodiversity.

•One acre of urban agriculture, using urban waste as an input, can save more than 5 acres of rural marginal agricultural land of rainforest.

***Select References***

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For a complete bibliography, see [www.xxx](http://www.xxx)

**CASE STUDIES**

**Guiding Healthy Urban Agriculture in Kampala**

Uganda’s largest city is well suited to agriculture: it has a tropical climate, good soils, water, and abundant rainfall. Although the city is growing rapidly, agriculture remains highly visible, even in densely populated areas. In 2002, 49 percent of households were farming within city boundaries—the vast majority of them for food security or survival, not commercially. About half were raising livestock as well as crops. The recognition that urban agriculture was so widespread generated serious health concerns among Kampala’s City Council. In many cases, people were farming in hazardous or unsuitable places—roadsides, wetlands, and contaminated sites. When an extended research project started on urban farming and public health, the city joined the effort. Between 2002 and 2005, the project researched the benefits and risks of urban agriculture in Kampala. As a result of this and other research, Kampala changed how it regulates urban food production. In December 2006 it passed five new ordinances defining how urban agriculture can be carried out in the city. The effort—among the first serious legislative reforms to support urban agriculture—was designed to encourage self-reliance among urban dwellers and safe and healthy food production while also ensuring public health. [Insert photo of urban agriculture in Kampala.]

**Urban Agriculture in Cuba**

Since 1987 Cuba has focused on urban and suburban agriculture to counter its crisis of lack of imports as well as malnutrition and iron deficiency in the population. More than 54,000 hectares are currently dedicated for urban agriculture, including vegetables, fruits, apiculture, and livestock. Havana alone supports one of the most extensive urban agriculture networks in the world: 4 million tons of vegetables are grown each year in more than 200 urban organic farms, known as *organiponicos*. Urban agriculture produces 90 percent of Havana’s fruits and vegetables while reducing the city’s carbon footprint by trading the produce in local markets. Biodiversity is considered a key element for sustainable production, and a priority is placed on improving the gene bank in the country. More than 650 species are grown in Cuba, including more than 100 livestock breeds. Compost, biopesticides, and seeds are produced by cooperative producers, who receive technical support from a national organization. The products are then made available to urban farmers through local kiosks. Recent research is focused on improved soil and plant management, developing new vegetable varieties, greenhouse production, and small agro-industry development to increase resilience in the face of climate change.

[Insert photo from <http://www.flickr.com/photos/melody_breaker/7178705946>. Caption: Urban organic agriculture in Havana. Photo by Melody Breaker.]

**Urbanization Encourages Food Biodiversity in Northern Vietnam**

The urbanization rate is still low (30 percent) in Vietnam compared with other South-East Asian countries, but it is growing steadily. Cities increasingly offer a significant market for food products. Traditionally, food in Vietnam has been distributed through street vendors and fixed market retailers, but in the last 10 years modern distribution has developed in the form of supermarkets and shops. Urban consumers are concerned with the origin and quality of food, and they readily establish a relationship between a specific place of production and specific taste features, which are due to soil and climate characteristics as well as traditional production methods. Although these specificities of consumption help maintain food biodiversity, biodiversity is jeopardized because retailers commonly mix products of different origins and the traceability of food is not always ensured. Thanks to various farmer organizations, as well as public and international research organizations, several protocols have been developed to stabilize production of the traditional *hoa vang* sticky rice and to have it labeled and packaged so it can fetch a premium price. Similar experiences relate to Thanh Ha litchi fruit, Bac Kan seedless persimmon, the *dai hoang* variety of banana, H’mong beef, and various indigenous vegetables. [Insert photo of farming in northern Vietnam or of a speciality food mentioned here.]

**Rooftop Gardening in Montreal**

Rooftop gardening is catching on all over the world. In Montreal, where local fruits and vegetables can be hard to find except during the brief summer growing season, a 31,000-square-foot greenhouse known as Lufa Farm sits atop an office building. It grows more than 25 varieties of vegetables year-round, and it does so without using any artificial pesticides, fungicides, or herbicides. The use of controlled-environment agriculture enables the operation to yield as much as a conventional farm 10 times its size. Mohamed Hage, Lufa’s founder, hopes that someday Montreal will be full of rooftop gardens. As he explains on the farm’s website, rooftop gardens do “more than grow vegetables.” They allow land previously lost to development to be farmed again; minimize the distance, time, and handling of food between grower and consumer; allow for the production of highly nutritious foods “instead of only semi-tasteless varieties that ship and store well”; and directly involve consumers with local farmers. Rooftop gardens also keep buildings cooler, save energy, improve air quality, and help mitigate the urban heat island effect. Lufa Farm distributes its produce at more than 30 drop-off points around Montreal. It also provides products from several local Quebec farms. [Insert photo of Lufa Farm in Montreal.]

**Key Message 7:** Ecosystem functions must be integrated in urban policy and planning.

To integrate urban biodiversity and ecosystem services into local governance, the key elements of a Local Biodiversity Strategy and Action Plan (LBSAP; see p. XXX) can be incorporated into overarching city-wide plans. Such city-wide plans are visible and can trickle down to guide each of the sector-specific plans that fall beneath them (see Figure 7.1). The “trickle-down” model of integrating biodiversity consideration is potentially applicable to any city-wide plan. Depending on local needs and priorities, and political and administrative contexts, a range of instruments and tools can be used by urban and regional practitioners and policy-makers to mainstream biodiversity.

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| [Insert image of Edmonton.] |
| **Figure 7.1** The city of Edmonton, Canada, has taken the “trickle-down” approach with its city-wide plan “The Way We Green,” which ensures that biodiversity is considered at all municipal levels. |

The Strategic Plan for Biodiversity of the Convention on Biological Diversity (CBD) and associated Aichi Targets provide a basis upon which to establish this alignment. By adopting the Strategic Plan for Biodiversity and Aichi Targets, all 193 Parties to the CBD committed themselves to achieving a set of biodiversity goals by 2020. If local governments align their objectives with those of their national governments, the potential for collaboration, support, and attainment of those objectives is increased.

***Aichi Target 17:*** *By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.*

*Cities are encouraged to develop local strategies and action plans on biodiversity in support of national strategies.*

A compelling example of integration combining top-down and bottom-up approaches is that of London. The creation of the London Biodiversity Partnership in 1996 brought key public and private stakeholders to agree on a set of objectives aligned with the UK government strategies and action plans. Together they came up with London’s Biodiversity Action Plan, which identifies priority actions regarding important wildlife habitats and several key species. The success of this strategy, which is also aligned with international objectives, has depended on ensuring its acceptance as a normal part of the planning process. Another good example is the launch in April 2012 of Bioclima Paraná (see Figure 7.2), the Brazilian state of Paraná’s biodiversity strategy and action plan, developed in support of the Brazilian national biodiversity and action plan and the global Aichi Biodiversity Targets adopted at COP 10, in Nagoya, Japan. Bioclima proposes climate change mitigation and adaptation measures through new mechanisms of environmental management and financial incentives, including payment for ecosystem services (PES). One of the modalities of PES will be the Biocredit, a set of public and private financial resources intended to compensate landowners who have preserved forest areas beyond the requirements determined by existing national and state environmental laws. Bioclima’s stakeholders include NGOs, scientific and technical institutions, the private sector, and multilevel government implementation agencies.

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| Insert image of Paraná’s Bioclime program |
| **Figure 7.2** Bioclima Paraná aims to conserve biodiversity and restore ecosystems. |

***Local governments can help turn policy into practice***

By identifying strategic entry points, local governments can have a significant effect on the way business is done. For example, by influencing the way procurement is practiced, municipalities can promote “green” products and services and create incentives for service providers to work toward enhanced sustainability. Local governments also have some control over the goods that transit through their boundaries, and they can develop and enforce legislation and control over these goods in an ecologically appropriate manner. For example, the city of São Paulo, Brazil, is the center through which great quantities of timber harvested in the region pass en route to various parts of the world (see Figure 7.3). The city has had a substantial positive impact by ensuring that only legally harvested timber trade is permitted within city boundaries. Illegal merchants find this difficult to circumvent because São Paulo remains the region’s most efficient trade route.

***Aichi Target 3:*** *By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.*

*City authorities have key mandates on this target. Strategies include facilitating licensing of green businesses, enforcing environmental regulations, providing incentives for new (and greener) technologies (such as tax breaks or free land/infrastructure), promoting and attracting green investors, and mainstreaming of “payment for ecosystems services” mechanisms.*

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| [Insert image of timber trade transiting through São Paulo.] |
| **Figure 7.3** Caption to come. |

By demonstrating the value of ecosystems and integrating measures such as subsidies, bylaws, certification programs, and codes of conduct to promote and preserve biodiversity, local governments can bring different departments together to harmonize their policies and ultimately enhance service delivery to residents. For example, incentive measures related to green infrastructure can bring together departments in charge of housing, roads, parks, water, and even finance to realize gains for the city as whole. By constructing and preserving eco-corridors, eco-bridges, pocket wetlands, permeable pavements, urban forests, green parks, connections between urban and rural areas, and green walls and roofs, cities can significantly reduce the costs of delivering certain services such as storm-water management. Green infrastructure can also boost municipal tax revenues by stimulating green economic activity, attracting high-caliber professionals and businesses, and increasing real-estate value. According to a literature review completed by the City of Montreal in 2010, proximity to parks generally increases property value. The increase varies from 5 to 20 percent, depending on park and neighborhood characteristics. Owing to the multifunctional characteristics of green infrastructure, local government and residents can also benefit from, among other things, reduced soil erosion, improved soil fertility, increased aesthetic values, and lower heating, ventilation, and air-conditioning requirements.

***Aichi Target 11:*** *By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.*

*In the U.S., out of $81 billion invested in biodiversity (most of it in the design, establishment, and operation of protected areas) in 2007–2008, $61 billion came from local authorities. Parkways, corridors, and municipal and provincial parks (public and private) arguably can make the difference in reaching this target.*

***Select References***

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For a complete bibliography, see [www.xxx](http://www.xxx)

**CASE STUDIES**

**Growth Corridor Plans in Melbourne**

Melbourne is Australia’s second-largest city, with a current population of more than 4 million. It is growing rapidly and expected to reach 6 million over the next 30 years. In response to this growth, a metropolitan planning strategy is being prepared that will not only manage growth but ensure that Melbourne sustains its broadly valued infrastructure, services, art and cultural attractions, and diverse natural settings such as bays, waterways, parks, and gardens. The city’s Growth Area Authority—an independent body that works in partnership with local councils, developers, and the Victorian Government to help create sustainable, well-serviced communities—is developing four Growth Corridor Plans. Each plan will create new communities planned around housing, jobs, transportation, town centres, open spaces, and key infrastructure, taking into account impacts on biodiversity and how to plan for better integration of nature and people. New communities will benefit from an integrated plan that provides for a distinctive character and amenities and that preserves and enhances existing biodiversity values. By guiding development in a sustainable manner, the plans aim to reduce carbon and other footprints. [Insert photo of Melbourne. Caption to read: “Melbourne’s growing suburb of Toolern, where a new park is being established along the creek.” Photo by James Lauritz]

**Durban’s Metropolitan Open Space System – D’MOSS**

Durban is located in a global biodiversity hotspot (see p. XXX) and has been committed to sustainable development for decades. The Durban Metropolitan Open Space System (D’MOSS) is a plan that identifies key areas that support biodiversity and supply ecosystem services. Although D’MOSS was initiated in the 1970s and has appeared in strategic plans since the early 1990s, Durban’s town planning schemes were developed with little environmental input and often conflict with strategic plans, environmental policy, and law. To address this problem, D’MOSS was included in the schemes in 2010 as a controlled development layer, a first for a South African city. Despite the underlying zoning, development may not occur within D’MOSS without first obtaining environmental authorization or support from the municipality, which may or may not be given. Where it is given, it is likely to be subject to significant controls to ensure that biodiversity and ecosystem services are not degraded. This effort has been seen by some as curtailing property rights, but others see positive spin-offs—for example, the city’s Treasury and Real Estates Departments can now consider potential environmental restrictions when property taxes are calculated on vacant land. [Insert photo of Krantzkloof Nature Reserve, from Errol Douwes. Caption: Krantzkloof Nature Reserve, part of D’MOSS. Open-space planning in Durban has provided an important vehicle for protecting biodiversity in the city and mainstreaming conservation issues in its planning and decision-making processes]

**How Accra Benefits from Its Wetlands**

Accra is Ghana’s largest city and economic center. It has three major wetlands, and according to the Ghana Environmental Protection Agency, they provide residents with “unimaginable benefits”—among them erosion and flood control, clean water, and a greenbelt that regulates the city’s microclimate. As important sites for eco-tourism and as scenic spots for the city’s hotels and beach resorts, the wetlands support commerce and employment. They also support the city’s poorest residents, who use the wetlands for fishing, crabbing, the provision of raw materials such as raffia and salt for cottage industries, traditional medicines, and dry-season vegetable farming. As Accra has grown, however, its wetlands have been threatened by encroaching development, pollution, overexploitation, siltation, and loss of biodiversity and aesthetic values. The city has managed these problems by instituting integrated management strategies that recognize the value of wetlands and ensure enforcement of building regulations and pollution control. The approach has included the designation of two RAMSAR sites; management systems on the sites; development of Coastal Sensitivity Mapping; delineation of greenbelts to stop urban sprawl; and the creation of awareness programs to encourage residents to help conserve the wetlands. [Insert photo of Accra wetlands from Samuel Anku]

**Curitiba’s Biocity Program**

Combining public and private initiatives, Curitiba’s Biocity Program is a leading example of urban planning integrated with biodiversity conservation. The program has brought together multiple departments and stakeholders in an effort to reduce local biodiversity loss and thus contribute to global biodiversity conservation targets. Biocity concentrates its actions in five main areas: (1) planting ornamental indigenous plant species in the city, to promote knowledge and familiarity with the region’s indigenous flora; (2) establishing protected areas; (3) preserving water resources, through a plan for revitalizing the Barigui River basin; (4) planting indigenous tree species in the city; and (5) improving both air quality *and* transportation, through the Green Line Project, a major transportation corridor with special lanes for bicycles and pedestrians as well as a linear park. Since its launch in 2007, the Biocity Program has improved the city’s green spaces and green infrastructure and thus the quality of life for residents. Currently, Curitiba counts 300,000 trees, 77.7 million square meters of protected areas, and more than 380 public parks and gardens, for a total of 51.5 square meters of green area per inhabitant. [Insert image from Curitiba.]

**Key Message 8:** Successful management of biodiversity and ecosystem services includes all levels and all sectors.

Cities are both centers of ecosystem-service demand as well as sources of environmental impact. They thus have an important role in global environmental governance. Good management of the urban landscape for biodiversity can only be achieved with the collaboration of multiple jurisdictions and a large number of public and private actors. These actors need to come from all sectors and levels of decision-making and to synchronize and harmonize their actions “vertically” (i.e., at national, sub-national, and local levels) and “horizontally” (i.e., across divisions such as environment, planning, transportation, education, finance and nutrition). Government sectors and levels need to cooperate with other actors such as citizen groups, scientists, NGOs, businesses, and UN and other international organizations. Different actors are sources of different knowledge and management capacity.

There is significant diversity in the way Parties can approach vertical and horizontal governance of biodiversity and ecosystem services. Federally managed governments such as the UK decentralize many of the mandates on biodiversity governance to their national and sub-national authorities through, and these in turn commission much of the implementation at lower government levels. This is also the case in Germany and Canada. Other states, such as Japan, South Africa, Mexico, and Brazil, provide guidelines for biodiversity governance and encourage their sub-national and local governments to develop strategies and action plans in line with their national ones. In the case of small island states and more centrally managed nations, communication is more direct, and responsibility for local implementation is shared at all levels of governance.

***Good governance benefits from a diversity of approaches***

Good governance is the process of steering or guiding societies toward collective outcomes that benefit all levels of society. Processes of decision-making need to balance a mix of centralized and decentralized structures, which in turn need to adapt and change with prevailing circumstances. Having nested institutions cooperating from the local to the global scale can contribute to a better foundation for governance. However, there is no “silver bullet” for best governance. Good environmental governance in cities is likely to benefit from a diversity of approaches. Patterns of good governance at the global level are beginning to emerge, but we still need to understand how to assess their effectiveness.

Writing in *Science* in 1999 about new insights into managing common resources, the American political economist and Nobel laureate Elinor Ostrom and her colleagues concluded that “Institutional diversity may be as important as biological diversity for our long-term survival.” They may well be right, but there is little understanding of this diversity and how it can lead to patterns of good governance that cut across scales—from local to global—in different ecosystems, including the urban. Thus there is a need for experimenting, fostering a diversity of institutions and approaches as well as generating more knowledge about governance of biodiversity and urban ecosystem services.

**Aichi Target 18:** By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

*At least 40 percent of the world’s indigenous peoples now live in cities. Traditional knowledge and the importance it bestows to biodiversity therefore need to be integrated into urban planning. Cities in Panama, Guatemala, Bolivia, Venezuela, Fiji, Samoa, and Indonesia, among many others, possess significant indigenous populations that should be engaged in sustainable urbanization and city management.*

New governance structures for land management for biodiversity have emerged that do not rely solely on traditional market and government interventions, but on other institutional arrangements. Often, local citizens make these arrangements themselves, and they involve private, common, and public land to protect ecosystem services that cannot always be assessed by monetary values. These are governance mechanisms that can provide new forms of thinking about spatial planning and interventions from different perspectives. They are particularly useful for understanding the role of different actors. They can also address concerns that local populations may be losing control of their landscape to higher levels of governance. Giving local people more voice and control is one step toward finding sustainable solutions to managing their resources.

***Many solutions for preserving biodiversity emerge at the local level***

There is an urgent need to create governance mechanisms that facilitate the dynamic exchange of knowledge and resources. Such exchanges can generate innovative solutions for urban biodiversity from the local to the global level. They are also necessary for building local capacities that can scale up innovations. As many of the solutions to global concerns such as biodiversity emerge at the local level, we need local *and* global efforts to create the capacity to innovate locally and diffuse those innovations globally to those who need them. Local groups have to be able to adopt the best solutions for their local needs, absorb new practices, and be able to create the institutional mechanisms to scale up their benefits.

**Urban Nature Facts**

•Individual initiatives count! Voluntary approaches, for example to set standards and targets for decreasing emissions, are usually introduced before governments resort to regulations.

Local authorities should map the possibilities of collaboration. Initially they should try to align their work on biodiversity with other formal and informal local processes that can affect biodiversity positively or negatively. In so doing, local governments must create a forum for interaction among the relevant stakeholders within and beyond the city. This can be done in three steps:

1. Decisions should be based on transparency, accountability, and inclusiveness, in order to create trust among the stakeholder groups and a collaborative environment.
2. Local authorities should create the rules and organizational capacity to make collaboration effective and efficient. Many collaborations stop midstream, and stakeholders lose interest in continuing. A contact person (or department/organization) for each action can help determine responsibilities and flow of information.
3. Collaboration should reflect realities on the ground, in both biodiversity and social dimensions. Clear mechanisms of assessing the direction in which local biodiversity is moving, such as the City Biodiversity Index (see p. XXX) and other indicators, are also necessary.

**Aichi Target 4:** By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

*Means of production and modes of consumption are dictated by norms, regulations, and negotiations happening in cities. City governments, by their business licensing and law-enforcement mandates, close relations with large corporations, and landscape management tools they have at close range, are arguably THE level of government that can achieve this target.*

***Subnational governments can play a critical role in protecting biodiversity***

Subnational governments—be they provincial, state, or regional—have a critical role to play in helping cities protect biodiversity. Local governance of biodiversity typically requires landscape-level coordination and thus can benefit greatly from the cooperation of subnational governments. This is particularly true when (a) urbanization has happened through smaller cities, where economies of scale apply; (b) coordinated efforts are needed to protect watersheds and other ecosystem features; and (c) there is a need to quantify the footprint of urbanization beyond city borders. Subnational governments also hold critical mandates in terms of tax and infrastructure-investment distribution to cities that are essential for any green municipal budget to work.

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For a complete bibliography, see [www.xxx](http://www.xxx)]

**CASE STUDIES**

**Biodiversity Recovery in Greater Sudbury**

Greater Sudbury, the most populated city in northern Ontario, is an important mining center and home to one of the largest nickel ore bodies in the world. Past smelting activities contributed to high levels of atmospheric sulphur dioxide and resulted in the disappearance of most of the area’s vegetation: by the 1960s, an estimated 84,000 hectares were considered barren or semi-barren. In 1978 the city initiated a regreening program. Based on a partnership among community groups, citizens, government ministries and agencies, educational institutions, and the local mining companies, Vale and Xstrata Nickel, the program has resulted in the planting of millions of trees and shrubs on tens of thousands of hectares. Together with the mining companies, the city also developed a Biodiversity Action Plan. This long-term commitment to ecological recovery and biodiversity (available at [www.greatersudbury.ca/biodiversity](http://www.greatersudbury.ca/biodiversity)) was developed with considerable community input. The plan outlines the actions needed for ecological recovery, highlights the need for education and citizen engagement, and also addresses issues such as watershed protection, food biodiversity, climate change, and at-risk species. With these efforts, the City of Greater Sudbury and its partners continue to showcase the extent to which a community can transform itself through ecological recovery. [Insert before and after photos of Greater Sudbury from Nicole Marzok.]

**Generating Green Jobs in Durban**

Durban’s Buffelsdraai Landfill Site Community Reforestation Project was initiated in 2008 in anticipation of creating a carbon sink to help offset the CO2 emissions associated with Durban’s hosting of several World Cup soccer matches in 2010. The project involves “reforestation” of a 757-hectare buffer zone of a municipal landfill site. Indigenous trees are grown by “Treepreneurs,” local community members who establish small-scale indigenous tree nurseries at their homes. Tree seedlings are exchanged for credit notes, which can be traded for food and other basic goods, or even used to pay school fees. To date, the project has engaged nearly 600 Treepreneurs—75 percent of them women and 19 percent of them youth—who have planted more than 276,000 trees on 240 hectares. The project has created more than 300 jobs for community members, demonstrating that reforestation can provide direct socioeconomic benefits to communities as well as enhance biodiversity and ecosystem functioning. In 2011 the Buffelsdraai Landfill Site Community Reforestation Project was recognized by the United Nations as one of ten “lighthouse projects”—projects in developing countries that help put the world on a more climate-resilient and low-carbon path while also improving people’s lives. [Insert photo of “treepreneurs” from Errol Douwes.]

**Kanazawa – Linking Biodiversity and Traditional Crafts**

Kanazawa is famous for its gardens, old architecture, literature, cuisine, and traditional crafts. The city was designated a UNESCO City of Crafts and Folk Art in 2009 and hosted the global launch of the UN Decade on Biodiversity in 2011. Local businesses have traditionally been linked to the city’s ecosystems. In recent years, city policies, community involvement, and local entrepreneurship have reinforced this cultural and ecological richness through various initiatives. In agriculture, an innovative branding scheme for traditional varieties of local vegetables—Kaga vegetables—has helped preserve agro-biodiversity while incentivizing the local economy, from seed companies to farmers, retailers, and the hospitality industry. These efforts have also revitalized the traditional Kaga cuisine and the locally made porcelain and lacquerware on which it is served. Approximately half of the city’s current vegetable production—valued at more than $16 million USD in 2008—corresponds to the Kaga brand. Kanazawa currently has about 900 manufacturing companies related to traditional craft industries. Its efforts highlight the importance of aligning cultural considerations in the design of local strategies that ensure sustainable use of local biodiversity. [Insert photo of Kaga vegetables from Jose Puppim de Oliveira.]

**A Public-Private Partnership in Iloilo City**

The Iloilo River has played a significant role in the development and economy of Iloilo City, Philippines. By 2000, however, unrestricted development, siltation, overfishing, commercial exploitation, and dumping of waste had brought the river to a critical state. Facing further urbanization and alarming degradation of the river and the biodiversity it supported, in 2003 the city government partnered with the Iloilo Business Club (IBC) to develop a planning process and 10-year master plan for restoring the river. Realizing the need for multisector and integrated approaches, the city and IBC convened consultative groups composed of NGOs, private businesses, academia, religious organizations, villages, and youth groups. A multiagency coordinating body—the Iloilo River Development Council—was established to institutionalize and implement the master plan. The master plan has prevented the destruction of mangroves, stemmed aquatic pollution, and established community watch groups to facilitate environmental protection. It has also resulted in measures to conserve and protect biodiversity. The approach taken in Iloilo demonstrates how multiple stakeholders, including those with commercial interests, can work together to integrate the protection and enhancement of important natural resources into both a sustainable urban master plan and actions on the ground. [Insert photo of Iloilo City.]

**Theme Box**

**Indigenous Peoples in Urban Areas**

According to an estimate in a 2010 UN-HABITAT report, at least 40 percent of the world’s indigenous peoples now live in urban areas. For example, an estimated 40 percent of Latin America’s indigenous peoples, 54 percent of Canada’s aboriginal peoples, and 84 percent of New Zealand’s Maori population live in cities. In Chile almost 65 percent of the indigenous population resides in cities, and in Tanzania 90 percent of Masai men have migrated to the city. Several factors have prompted such migrations: land dispossession, displacement, military conflict, natural disasters, the overall deterioration of traditional livelihoods coupled with the absence of viable economic alternatives, and the prospect of better economic opportunities in cities. For many indigenous peoples, migrating for work—both within and beyond national borders—is perceived as a way out of poverty.

Despite finding a few benefits, such as proximity to social facilities, many indigenous peoples encounter substantial difficulties in urban areas. Lack of employment and income-generating opportunities, racism and other forms of discrimination, limited access to education and health services, and inadequate housing are the main challenges they face. In general, disrespect for a wide range of human rights is often the main underlying cause for persisting poverty among urban indigenous communities. In most cases, indigenous communities try to organize themselves to better cope with their new economic and social conditions, which are often characterized by hostility and discrimination.

There are, however, examples where urban indigenous peoples have opportunities to improve their lives and to contribute to the sustainable development of cities. The increasing efforts of many local authorities to preserve biodiversity and local culture have revealed unique opportunities to integrate indigenous traditional knowledge into cities’ biodiversity conservation strategies and action plans. As indigenous peoples often have profound natural, spiritual, economic, and cultural connections to the land and the goods and services it provides, cities can benefit by engaging indigenous peoples in urban planning and policy. Traditional knowledge can help cities reduce project costs—for example, by improving resources management—and thus contribute to the conservation and sustainable use of natural resources. [Insert photo of indigenous people in Edmonton. Caption: In response to a growing awareness of the needs and aspirations of aboriginal peoples residing in Edmonton, in 2005 the City Council adopted the declaration “Strengthening Relationships between the City of Edmonton and Urban Aboriginal People.” Later that year it also developed the Edmonton Urban Aboriginal Accord, and two years later it created an Aboriginal Relations Office. As a result of these efforts, Edmonton is bringing aboriginal perspectives to city projects, among them land-use review of a portion of Whitemud Park, the redesign of Walterdale Bridge in Rossdale, and the Boyle Street redevelopment plans.]

[Insert photo of indigenous people in Auckland. Caption: Auckland, the largest city in New Zealand, has a sense of place that has been shaped by the shared experiences of Maori and European peoples. Maori see themselves as belonging to the land, as opposed to the land belonging to them, and the natural environment plays a significant role in defining the Maori sense of place. With the participation by Maori in local government decision-making, the Auckland City Council developed the urban design framework, in which its goal number one is to reflect the city’s *tangata whenua*—Maori, Pacific, and multicultural identity—and to be visibly recognized as a place of the South Pacific. The use of Maori values in urban design and development is entirely consistent with low-impact urban design and development.]

**Key Message 9:** Cities offer unique opportunities for learning and education about a resilient and sustainable future.

As important hubs for diversity, creativity, and innovation, cities are a testing ground of our capacity to live together and create environments that are socially just, ecologically sustainable, economically productive, politically participatory, and culturally vibrant. Education is vital to the task of acquiring that capacity. Schools are an important means of establishing the connection between local life and global issues, including the challenges posed by the loss of biodiversity. Local authorities can play a crucial—and growing—role in integrating biodiversity into the urban educational agenda (see Figure 9.1). At the same time, the capacity to live sustainably in urban settings is not acquired only within the walls of formal educational establishments; it is also generated through a wide range of informal modalities of learning. Cities are themselves the sites of continuous exchanges of practical, traditional, and scientific knowledge and information through which people’s thinking, understanding, and perceptions are transformed. Such transformations may ultimately lead to corresponding changes in urban planning and policies.

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| Insert photo of bird survey in Nagoya. |
| **Figure 9.1** The City of Nagoya founded Nagoya Biodiversity Center in September 2011 to accumulate information on local organisms. Working with citizens and local community groups, the center carries out activities such as field surveys of plants and animals, control of invasive alien species, and exchange of information among relevant organizations. Here, a group surveys the birds of Shonai Green as part of a citywide bird survey. Photo by Nagoya Biodiversity Center. |

***Education for Sustainable Development (ESD) is a key strategy***

Over the last few decades the variety of urban environmental education programs has grown significantly, with the aim—among other things—of raising awareness about the benefits provided by ecosystem services in general and biodiversity in particular. Approaches range from outdoor-adventure programs to programs focused on environmental action; while some seek to teach ecological science through hands-on inquiry or research activities, others integrate art, green jobs, or social justice. Recently, increased attention has been given to programs that take place within the context of communities, including in cities, so as to better foster learning about social as well as ecological processes. Prominent examples are programs that are nested within and linked to community-based stewardship or civic ecology practices, such as community forestry, streamside restoration, and community gardening. Incorporation of traditional knowledge and practices is critical for the success of such community-based initiatives. These and similar educational approaches are part of the UN-promoted Education for Sustainable Development (ESD), which seeks to “encourage changes in behavior that will create a more sustainable future in terms of environmental integrity, economic viability, and a just society for present and future generations.” [Place ESD boxcar (below) near this paragraph]

***Aichi Target 1:*** *By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.*

*No level of government can reach citizens for education, communication, and awareness-raising as regularly, clearly, and effectively as city officers. National governments need to help cities achieve this target.*

Considering that by 2030 urban dwellers will account for 70 percent of the world’s population, and that a similar percentage of these urban residents will be under age 18, ESD should be viewed as a key strategy for enabling individuals to make informed decisions at all levels of urban life while promoting lifestyle changes that integrate the multiple values of biodiversity. While urban ESD strategies need to be adapted for different learners—for example, students, communities, practitioners, and policy-makers—their principal components should encompass:

* *An innovative and holistic vision of education and lifelong learning* that encompasses various forms of training, information, awareness-raising, and learning for all ages.
* *A cross-disciplinary approach* that promotes urban biodiversity and sustainable urban development and that allows the environmental, social, economic, and cultural dimensions of biodiversity to be addressed in a comprehensive manner.
* *Values and a vision of the future* to guide individuals toward an attitude of respect, social cohesion, sharing, solidarity, and intergenerational responsibility.
* *A dynamic and participatory pedagogical framework* thatisadapted to localcontexts and places individuals at the heart of education for urban citizenship and respect for the values of biodiversity.
* *A cooperative process* that involves multiple stakeholders—including students, teachers, decision-makers, civil society, the private sector, the media, and all cultural communities—at the community, national, and international level.

The application of the UNESCO Biosphere Reserve concept developed under the Man and the Biosphere Programme is particularly relevant here as it can help bridge city, municipal, and regional boundaries, thereby creating platforms for politically neutral collaboration for enhanced resilience and sustainability. This can facilitate learning and education by providing “one-stop” integrated learning platforms based on the participation of all relevant learning and education stakeholders (e.g., schools, universities, research institutions, etc.) as well as other key stakeholders (e.g., local communities, authorities, private sector, NGOs, etc.). Other examples include the Transboundary Conservation Specialist Group ([www.tbpa.net](http://www.tbpa.net)) of the IUCN World Commission on Protected Areas (WCPA) and URBIS (see p. XXX).

***Select References***

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For a complete bibliography, see [www.xxx](http://www.xxx)

**Boxcar**

**UNESCO’s Education for Sustainable Development – ESD**

ESD aims to enhance cities’ roles as places for good governance, proper planning and landscape considerations, multicultural expression, and social inclusion. It focuses on creating a quality learning and educational environment for sustainability, promoting lifelong learning opportunities in cities, teaching tolerance and mutual understanding in urban societies, enabling children and youth to learn to participate in urban life, enhancing learning to create inclusive societies in inclusive cities, and developing learning in all its diverse forms. Biodiversity education is an integral part of ESD, which promotes mainstreaming biodiversity and ecosystem services into all forms of learning as a critical contribution to sustainable development, including organizing thoughtful consumption and production behaviors that are sustainable from local to global levels.

**Case Studies**

**Biodiversity Education in Mexico City’s Zoological Parks**

Mexico City operates three zoological parks: Chapultepec Zoo, San Juan de Aragón Zoo, and Los Coyotes Zoo. In recent decades these parks have evolved from recreational facilities to modern conservation centers of local, national, and exotic wildlife species. Considering education as an essential task for biodiversity conservation, the parks have developed a wide array of innovative educational programs and activities, among them rotating exhibits, interactive educational activities, summer educational courses, educational training for docents, and educational tours for schools. Activities may focus on a specific species and its recovery, or they may be directed toward biodiversity-related themes such as climate change, water conservation, or habitat protection. The great majority of the 9 million people who visit these parks every year live in cities and have limited exposure to nature. Through their educational programs, Mexico City’s zoological parks thus have the opportunity to heighten public awareness of the importance of conserving biodiversity for a resilient and sustainable future. [Insert image of one of Mexico City’s zoological parks]

**Five Million Trees in Five Years: The Harare Greening Project**

The Harare Greening Project is an ambitious effort to reverse deforestation, help mitigate the effects of climate change, and beautify Harare’s roadways. The project began in 2010 when a few Harare residents convened a stakeholders meeting. Among the key players they invited were NGOs working in sustainable development and climate change, government workers with responsibility for trees, tree nursery owners, and municipal representatives. The group set a target of planting 5 million trees over a 5-year period. They encouraged participation at many levels and invited supporters to plant trees on their own land or on public land, or to buy trees for others to plant. Half a million trees were reportedly planted in the first year. Although the project has encountered several challenges, it has continued to expand. What’s more, the concept has been adopted on a larger scale: a partnership of companies that formed an organization called Friends of the Environment Trust is championing a nationwide effort to plant 500 million trees in Zimbabwe. [Insert image of tree planting in Harare]

**Restoring a River and Empowering Youth: New York City**

Year-round, the nonprofit organization Rocking the Boat (<http://rockingtheboat.org>) in New York City offers opportunities for severely disadvantaged local youth to learn about the natural and social history of the Bronx River and to work on projects to restore it. Here, a group of students monitors the effects of habitat restoration. Planting *Spartina* grasses, mapping the riverbed’s topography, building and installing tree swallow boxes along the riverbank, taking field notes and collecting data, and learning to identify plants, birds, fish, and other wildlife are just a few of the activities students do. Getting out on the river in a fleet of hand-built wooden boats, the students also learn about water safety, teamwork, and how to row a boat. As Rocking the Boat says on its website, this hands-on environmental education program gives urban youngsters “the chance to learn about their own community, their own river, and their own possibilities for the future.” Photo by Alex Kudryavtsev. [Insert image of kids in river, from Alex Kudryavtsev]

**THEME BOX**

**Greening in the Red Zone**

Stories are emerging from communities around the world of people who turn to greening during the most difficult of times—periods of violent conflict and collapse of the social and economic fabric of their community, and in the aftermath of earthquakes, hurricanes, and other disasters. They range from post-apartheid actions in South Africa to re-green symbolically poignant landscapes to community involvement in revisioning open space after a massive earthquake in Haiti and after an earthquake and tsunami in Japan. These examples of post-catastrophe, community-based stewardship of nature serve as sources of social-ecological resilience and are referred to as “Greening in the Red Zone.”

The Civic Ecology Lab (CEL) at Cornell University has collected such stories in a book and a related website (http://greeningintheredzone.blogspot.com) in an effort to understand how local greening practices can become a source of resilience during difficult times. Because of the rapid growth of cities globally and their ever looming importance as sites of conflict and disaster, many of the case studies are from urban settings (e.g., the Berlin Wall, New Orleans post-Katrina, Monrovia after the Liberian civil war), although more rural examples (Korean village groves, community-based wildlife and park management in Kenya and Afghanistan) and region-wide examples (e.g., Cyprus Red Line, Korean Demilitarized Zone) also are of interest. [Insert image of a Greening in the Red Zone project; Keith Tidball to provide]

**Key Message 10:** Cities have a large potential to generate innovations and governance tools and therefore can—and must—take the lead in sustainable development.

Cities are stimulating centers of diversity, productivity, and innovation. Time and again their development has overlapped with unprecedented scientific and technological progress. This is because urban agglomeration concentrates financial and human capital to drive the global economy. But in an increasingly globalized world, competition has generated losers as well as winners. The decisions so often made in cities have dramatic consequences for seemingly distant people and places. Jobs are repeatedly outsourced, creating a wake of unemployed workers in multiple countries. Scarce resources are extracted and toxic wastes disposed of wherever environmental regulations are weakest. And, of course, cities can experience these effects within their own boundaries too.

Accelerating demographic pressures—including growth that is due to natural increase as well as rural migration—have made it more difficult than ever for cities to grow sustainably. In fact, for many of the fastest-growing cities, the situation is quite the opposite: they are struggling to cope with rapid population growth in the context of dwindling resource and capacity bases. Yet thoughtful planning in such cities can transform so-called diseconomies of agglomeration—and their resulting sprawl, segregation, and congestion—into compact, integrated, and connected settlement patterns that maximize access to services and resources at the same time as they minimize environmental degradation (see Figure 10.1).

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| [Insert photo of the sustainable Chinese city Suqian] |
| **Figure 10.1.** The Chinese city of Suqian, established in 1996, covers 8,555 square kilometers and has a population of 5.55 million. Rivers and wetlands make up 27 percent of the city. Throughout every step of its fast-growing economic and social development, Suqian has given priority to environmental protection. It has done this by focusing on four key measures: planning; ecological construction and protection; resource use; and environmental protection, especially in the fields of water resources protection, afforestation, (planting of forests where they previously did not exist), and ecological tourism. Seqian’s aggregate investment for environmental protection has reached RMB 17.08 billion. |

***A major opportunity lies in the transition to a “green economy”***

Innovative and integrated urban planning, management, and governance *can* harness the advantages of agglomeration for greater equity and sustainability. A major opportunity lies in the transition to a “green economy,” which promotes cities harnessing their potential to generate higher levels of economic competitiveness and human well-being at relatively lower and more sustainable rates of resource use and emissions intensity. (Economists call this “decoupling.”) As the world struggles to recover from a retracted economic crisis, cities will have to harness their ability to deliver continued growth and quality of life in the context of resource constraints.

**Aichi Target 19:** By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

*More and more, science and technology are influenced by local and sub-national authorities. Cities and provinces finance a significant number of scientific and technical organizations and museums and thus have a key role to play in sharing and applying the work of such institutions. Adapting and transferring urban “green” technologies in development, housing, and landscape management is arguably one of the most critical steps for protecting biodiversity.*

Through and beyond the Industrial Era, urban-based production and consumption systems tended toward an increasingly linear metabolism. Resource inputs typically led straight to waste outputs, with associated environmental (and often social) costs ignored as “externalities.” Despite this trajectory, there remains the significant potential—and increasing tendency—for cities to try to make their metabolisms more *circular* (see Figure 10.2). This can be achieved through processes such as rematerialization (the recycling of products and wastes), dematerialization (producing with fewer material inputs), and substitution (producing and/or using energy from alternative, especially renewable, sources).

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| [Insert image of recycling efforts in Nagoya, which has had remarkable success with recycling.] |
| **Figure 10.2** Caption to come. |

Practically speaking, cities can reduce overall resource consumption through shared infrastructure. This permits waste collection and harvesting within areas of dense habitation. By intensifying efforts to “mine” their own waste, cities can close the overall urban metabolic loop by producing usable fertilizers and water for irrigation. They can also provide additional green jobs that may counteract job losses in other unsustainable, declining extraction industries. Shared infrastructure also encourages other efficiency arrangements such as common building envelopes that allow for lower-energy heating and cooling systems.

Cities in more developed countries can make use of the opportunity of greening infrastructure to retrofit old, inefficient infrastructure with solar panels, solar water heaters, and double-paned windows. Although initially costly, this transition can create many new jobs in green industries and is likely to pay high long-term dividends. Cities in developing countries have the added advantage of being able to leapfrog inefficient infrastructures and make an even cheaper, earlier transition by getting their transport and water and sanitation systems right the first time. And greener infrastructural systems may be low technology as well, scrapping the need for expensive imported technology and encouraging more labor-intensive jobs that can employ the bulging youth population in these countries.

Other types of urban infrastructure innovatively blur the distinction between landscape and buildings. Green roofs can absorb excess water, especially in heavily built-up areas where pavement and buildings have replaced permeable ground cover, thus reducing flood risk. They can also help regulate micro-climates and provide habitats for species. Vertical greening—such as growing shrubs and vines on the surfaces of tall buildings—can reduce the urban heat-island effect of buildings and pavement. Not only do green roofs and walls on urban buildings constitute a significant adaptation mechanism, but they also mitigate further climate change by absorbing CO2. Green roofs and walls can help revert and expand the functional green landscape surface typically thought to be lost in the urban built footprint.

At the other end of the scale, cities are working to incorporate entire landscapes and systems of green spaces as part of their functional infrastructure. Whether natural, cultivated, or merely protected regardless of status, such networks provide comprehensive ecosystem services such as the management of storm water, reduction of the urban heat island effect, and carbon sequestration. The innovation lies not so much in employing new infrastructural technologies as in acknowledging and working with systems that have always existed. And the results are often far cheaper and more sustainable.

***Local authorities are often the most effective level of government***

Beyond innovations in urban planning and technology, cities and city–regions may require reformulated governance arrangements to benefit from many of the advantages outlined above. Local authorities must ensure that private-sector innovations are distributed equitably and have the wider health of regional ecosystems in mind. The relatively low position that local authorities hold in the chain of hierarchy often makes them the most effective level of government to deal with the needs of people and the environment on the ground. Concerted policies to provide subsidized housing for the poor, public investments in accessible mass transit, and universal water and sanitation infrastructure are essential.

Local Agenda 21 (LA21), launched in 1992 at the Earth Summit in Rio de Janeiro, attempted to assist local authorities in tackling many of the global sustainability challenges typically considered beyond their control. LA21 emphasized mainstreaming participatory processes in which local stakeholders set their own priorities while at the same time more effectively engaged higher levels of governments. However, in 2005, frustrated by the failure of the US Government to ratify the Kyoto Protocol, more than 140 US cities pledged to meet the protocol’s targets themselves. That same year 18 large cities around the world formed the Large Cities Climate Leadership Group (C40) to address the causes and consequences of climate change where national-level inaction had typically prevailed. Twenty years after the start of LA21 there is a perceptible tension between process and results, with many national governments ignoring local engagement processes when faster results can be obtained.

**Aichi Target 20**: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

*Innovative financing is one of the solutions that will be found at provincial and municipal levels. Most Payment for Ecosystem Services mechanisms (for watersheds or temperature regulation, for example) and examples of tourism revenues accruing to park systems through concessions, for instance, come from sub-national or local governments.*

Nevertheless, at the broadest scale of governance (often nationally), governments are beginning to take action. Some have eliminated “perverse” subsidies that artificially support industries that are neither environmentally friendly nor economically competitive. Shifted subsidies tend to support clean-technology innovation, which is accelerating the demise of unsustainable industries. However, for green technology and its associated industries to be *socially sustainable*, the most specialized laborers must be appropriately retrained for the new skills that this technology requires. The intense interactions that occur in cities among academia, civil society, and the private sector can support clusters of green industry that link training with jobs to ensure that the availability and skills of workers match the shifting demands of the private sector.

Given the multiplicity of stakeholders and sectors involved—and the physical requirements and implications of environmental systems—cities must employ an overarching *spatial* strategy to integrate these governance arrangements. Strategic planning at the city–regionscale is essential. Local authorities must locate affordable housing near job opportunities and amenities and services. This enhances the quality of life for a city’s residents while reducing resource use and emissions—and these benefits are all the greater when city–regions invest heavily in public and nonmotorized transit (see Figure 10.3). With the appropriate participatory planning tools, all urban stakeholders can ensure that their day-to-day needs are inscribed within a practical spatial configuration. Promisingly, city–regions are increasingly using advanced GIS and mapping technologies to study regional connectivity and landscape fragmentation.

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| [Insert image of Curitiba’s famous low-carbon, intermodal transport system.] |
| **Figure 10.3** Curitiba’s efficient public transportation system uses 25 percent less fuel per capita on average than its counterparts in other areas of Brazil, thereby reducing fuel consumption *and* emissions. |

Cities are also increasingly looking at the governance of food systems and incorporating wider biodiversity-related vulnerability reduction measures. Urban and peri-urban agriculture and forestry (UPAF) reduces farm-to-table distance for food products, strengthening food security in the densest areas that need it most. As the effects of climate change imperil agriculture and disrupt supply chains, locally sourced foods raised by farmers more attuned to local conditions can provide a reliable supplement to more distant food sources. Coming full circle, reduced transport distances also reduce fuel consumption and CO2 emissions, and lessen the need for fuel imports and increasingly intensive energy-extraction methods, thereby lowering cities’ ecological footprints across many dimensions.

Lastly, cities can employ specific policy tools to realize many of the above opportunities. Adopting sustainable procurement policies not only ensures transparency and other tenets of good governance, but also ensures that local governments’ purchases and contracts support sustainable environmental and labor practices. Cities can also establish regulations—for example, congestion pricing for private cars driving through dense urban areas—in tandem with incentives—such as subsidized public transit—to guide urban residents to more sustainable behavior. Lastly, cities can establish policies for formalizing the tenure of and extending infrastructure to vulnerable slum dwellers.

***Select References***

[To come]

For a complete bibliography, see [www.xxx](http://www.xxx)

**CASE STUDIES**

**Cartagena – Water Supply, Sewerage, and Environmental Clean-Up**

A 20-year project (2005–2025) to rehabilitate and expand the water supply and sewerage for the city of Cartagena, Colombia, is providing opportunities to sustainably dispose of wastewater, restore an important coastal wetland, and improve sanitary conditions and access to clean water for the city’s poor. The approach integrates several innovations, among them restoration of degraded habitats, improved protection of a legally protected area, use of a cumulative environmental impact assessment (the first of its kind in Colombia), and establishment of a multidisciplinary expert panel to oversee the design and site-selection process. This project demonstrates the importance of considering biodiversity as part of a project’s initial goals. By adopting this approach, the issues surrounding the disposal of 145,000 cubic meters per day of polluted wastewater are being overcome. By integrating the views of local stakeholders, perceptions have been changed and landscapes once thought of as degraded or unattractive are becoming economic, aesthetic, and ecological assets. Not only are sanitary conditions being improved, but the expansion of water-supply services is increasing land values. The holistic thinking applied in Cartagena demonstrates how the needs of infrastructure, biodiversity, and local communities can be integrated in a mutually beneficial and sustainable manner. [Insert photo of Cartagena.]

**The Way of the Future: Urban Eco-Areas**

Some cities are starting to change their ways. They’re taxing wastes, encouraging renewable energies, promoting car sharing, and optimising natural sources of light. The best examples are in urban eco-areas such as Copenhagen’s Vesterbro, London’s Beddington Zero Energy Development, Vauban in Freiburg im Breisgau, and the Eva Lanxmeer quarter in the city of Culemborg in the Netherlands. These areas are designed to be carbon neutral and to promote concepts of eco-citizenship, encouraging people to improve their own well-being by preserving the environment. “Cities of tomorrow” are also beginning to emerge—cities that are ecological and technological at the same time. For example, the energy-independent city of Gwanggyo in South Korea will be a verdant acropolis of organic “hill” structures, with eight buildings that mix housing, offices, entertainment areas, and other facilities, thereby reducing transportation needs while also building a strong sense of community. In Abu Dhabi, the planned city of Masdar will rely entirely on solar energy and other renewable energy sources, with a zero-carbon, zero-waste ecology. This eco-city will eventually comprise 6.5 square kilometers and by 2020 be home to 90,000 inhabitants. Transport will be based only on citizen’s feet, bikes, and for further distances, a rapid electric tramway. [Insert photo of Gwanggyo, South Korea, from Kathryn Campbell.]

**From Open Dump to Greenery: Mumbai’s Gorai Dump Closure Project**

The city of Mumbai generates about 6,500 tons per day of municipal solid waste and about 2,400 tons per day of construction waste. For almost 40 years, all of that waste went to Gorai Dump—a 20-hectare open dumpsite in Mumbai’s western suburbs. Situated next to a creek and close to residential areas, the dump had caused significant environmental damage and long been known as one of the unhealthiest places in Mumbai. Closure of the site in 2009 involved leveling and reforming the heaps of garbage (their average height was 26 meters), covering them with impermeable surfaces, and converting them into a high-quality green area. The next step in the project will be installing a power plant at the site that will run on methane gas from the decomposing garbage—thereby producing electricity as well as reducing greenhouse gas emissions. The project has already yielded many public-health and lifestyle benefits that have completely transformed the lives of local residents. They have a beautiful new green space to enjoy, air and water quality have improved, breeding flies and rodents have been eliminated, and property values in the area have increased fivefold. [Insert photo of Gorai Dump; before and after photos would be great]

**Montreal’s Urban Ecoterritories**

Montreal’s ecoterritories are a network of critical conservation areas. In 2004, to halt the annual loss of 75 hectares of woodlands, Montreal identified 10 areas larger than 15 hectares in which to prioritize the protection and enhancement of natural spaces. These “ecoterritories” comprise core zones (pockets of biodiversity), protective buffers, and ecological corridors (see map) and include a mix of existing protected areas and other natural spaces, in private as well as public hands. The city has engaged in several conservation initiatives in the ecoterritories. Various tools are used (among them, ecological gifts, leases, and acquisitions) to meet the needs of stakeholders. Protected areas are expanded, private and public owners of biodiversity-rich areas are approached to exchange their land with publicly owned brownfields, and incentives are offered, including technical assistance and a permit to develop buildings to a higher construction level elsewhere. The ecoterritories concept is now recognized in several borough chapters of the Montreal Master Plan. [Insert map of ecoterritories from Daniel Hodder’s PPT presentation]

**Green Urban Policies in Montpellier**

Montpellier provides an outstanding example of how green urban policies can attract investments in sustainable development and technologies. Montpellier cares for biodiversity not only within its own borders—it has a “green network” of protected areas that link the city’s ecosystems—but also far beyond. To remind citizens of the relevance of rainforests and the need to conserve them, Montpellier built an Amazonian greenhouse at the Zoological Park, where visitors can see tropical animals and plants. Investing in biodiversity has paid off for the city: in 2011, Montpellier was named the European and French Capital for Biodiversity. This image, in turn, attracts green businesses and even international scientific organizations. Several research institutions, including Bioversity International, CIRAD-Agriculture for Development, the National Institute for Health and Medical Research, and the Institute for Research and Development, work in Montpellier through Agropolis International, a network of researchers in 13 institutions. The city also reaches out for scientific and technical cooperation. Cooperating with cities in the U.S., Germany, Spain, China, Israel, Morocco, and Algeria, Montpellier took the lead in establishing MEDIVERCITIES, a network of cities focused on biodiversity around the Mediterranean Basin. [Insert photo from Montpellier; perhaps of the Amazonian greenhouse?]

**“Supertrees” in Singapore**

[Photo with caption only. Insert photo of supertrees.]

**SECTION III**

**Resources, Initiatives, and Tools**

Biodiversity is still declining rapidly on a worldwide scale, with notable impacts on the well-being of both natural and human societies. As cities are centres of population, consumption, innovation, and decision-making power, their governments can play a critical role in achieving the CBD Strategic Plan for Biodiversity 2011-2020, including the Aichi Biodiversity Targets. Through the design and implementation of land-use planning and zoning management tools, cities execute urban development and infrastructure projects, license businesses, provide a variety of services to residents (e.g., water, sewerage, waste disposal, recreation, and housing), promote investment, and conduct public education and awareness campaigns. All of these activities have direct effects on biodiversity in and beyond city borders.

With local knowledge and close community ties, local authorities are ideally placed to take action at the city level to protect natural resources for present and future generations, and by cooperating with other levels of government and other sectors and major groups, they will ultimately increase and optimize the investment of resources in the implementation of the CBD. Over the years, cities, other levels of sub-national and national governments, academia, and international organizations have developed a vast toolbox of policy instruments, guidelines, projects, and institutions that promote this interaction. This section lists some of the most important ones; it is by no means complete, but opens doors for further contacts and research. For ease of reference, initiatives are listed under four categories:

1. Institutions and Organizations with experience and a track record on the issue
2. Networks of like-minded individuals and governments at all levels
3. Tools and Guidelines
4. Projects and Working Groups

**I. Institutions and Organizations**

**EU CoR – European Union Committee of the Regions**

http://cor.europa.eu/en

A consultative body of the EU that provides regional and local authorities with a voice in EU policy development, including on biodiversity. Its 344 political members, including governors and mayors, work to secure harmonious and sustainable development across all European territorial areas. It has recently concluded a Memorandum of Understanding with UNEP on biodiversity and ecosystem services.

**FAO – Food and Agriculture Organization of the United Nations** <http://km.fao.org/urbanforestry/>; www.fao.org/urbanag/

Founded in 1943 to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations, and contribute to the growth of the world economy, FAO serves as a knowledge network and provides policy expertise and technical know-how and has been active on urban and peri-urban forestry, agriculture, and food safety.

**ICLEI – Local Governments for Sustainability (also see p. XXX)**

[www.iclei.org](http://www.iclei.org)

An international association of local governments and governmental organizations committed to sustainable development. Members come from 70 different countries and represent more than 5.5 million people. ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and help local governments implement sustainable development.

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

[www.iucn.org](http://www.iucn.org)

The world’s oldest and largest global environmental organization, with more than 1,200 government and NGO members and almost 11,000 volunteer experts in some 160 countries. IUCN works on biodiversity, climate change, energy, human livelihoods, and greening the world economy by supporting scientific research, managing field projects all over the world, and bringing together stakeholders from all levels of society to develop policy, laws, and best practices. Cities and sub-national governments are active members of IUCN, and more than 300 cities and regions contributed to the successful Countdown 2010 initiative. The Urban Specialist Group of the IUCN World Commission on Protected Areas works to strengthen the ability of the conservation community to serve the needs of cities and inform urban residents about the benefits of protected areas and nature conservation generally. Information and several excellent publications are available at the group’s website, [www.interenvironment.org/pa](http://www.interenvironment.org/pa).

**Ramsar Convention on Wetlands**

[www.ramsar.org](http://www.ramsar.org)

An intergovernmental treaty (linked to the CBD through the Biodiversity Liaison Group of Multilateral Environmental Agreements, MEAs, which also includes migratory species, international trade in endangered species, and the World Heritage Convention; see www.cbd.int/brc/) that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Adopted in the Iranian city of Ramsar in 1971 and in force since 1975, it is the only global environmental treaty that deals with a particular ecosystem. The Convention has worked in collaboration with UN-HABITAT, CBD, ICLEI, and others, and adopted recommendations to develop principles for the planning and management of urban and peri-urban wetlands. Its member countries cover all geographic regions of the planet.

**Stockholm Resilience Centre**

[www.stockholmresilience.org](http://www.stockholmresilience.org)

A leading research institution that develops innovative approaches on how to govern social-ecological systems and build resilience for long-term sustainability. It aims to understand the complexity and interdependence between people and nature and to enhance our capacity to deal with change. See also “Urban Planet”, below.

**UNEP – WCMC**

**United Nations Environment Programme – World Conservation Monitoring Centre**

www.unep-wcmc.org

A collaboration between UNEP the UK-based WCMC to provide authoritative biodiversity and ecosystem services information to countries, organizations, and companies to use in developing and implementing policies and decisions.An important focus is integrating biodiversity and ecosystem services information into normal business practices, making it more accessible and relevant to the business community.

**UNESCO – United Nations Educational, Scientific, and Cultural Organization**

[www.unesco.org](http://www.unesco.org)

Contributes to the building of peace, eradication of poverty, sustainable development, and intercultural dialogue through education, the sciences, culture, communication, and information. The broad goals of the international community, including the Millennium Development Goals, underpin all of UNESCO’s activities. Its World Heritage Convention, and Man and Biosphere Programme, work regularly with city and regional governments, which are key players in both multilateral agreements.

**UN-HABITAT – United Nations Human Settlements Programme**

www.unhabitat.org

The main UN agency covering human settlements and urban planning, UN-HABITAT promotes socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all. Among the many resources available on its website are a central repository of reference materials and links to online learning programs for local leaders.

**United Nations University – Institute of Advanced Studies (UNU – IAS)**

www.ias.unu.edu/

The Institute conducts research, postgraduate education, and capacity development, both in-house and in cooperation with an interactive network of academic institutions and international organizations. Research focuses on the interaction of social and natural systems and is aimed at developing informed policy-making that addresses global concerns.

**II. Networks**

**German Alliance of Municipalities for Biodiversity**

[www.kommunen-fuer-biologische-vielfalt.de/70.html](http://www.kommunen-fuer-biologische-vielfalt.de/70.html)

Launched as an outcome of the Global Partnership, this new alliance implements nation-wide projects and encourages local authorities to preserve biodiversity. The working language of the alliance is German, so that small municipalities with no English skills can actively participate.

**Global Partnership on Local and Sub-National Action for Biodiversity**

[www.cbd.int/authorities/Gettinginvolved/GlobalPartnership.shtml](http://www.cbd.int/authorities/Gettinginvolved/GlobalPartnership.shtml)

Established in 2008 and facilitated by the Secretariat of the CBD to help sub-national governments and cities sustainably manage their biodiversity resources; implement practices that support national, regional, and international strategies; and learn from existing initiatives. Partners include the UN, national and city governments, NGOs, and academic and research organizations. A separate Advisory Committee on Cities and Biodiversity and an Advisory Committee of Sub-national Governments and Biodiversity have been established, as well as a network of scientists (URBIO; see below) and a Task Force of International Organizations led by UN-HABITAT (see above).

**Network of Associations of Local Authorities of South East Europe (NALAS)**

[www.nalas.eu](http://www.nalas.eu)

A network of associations in South-East Europe that represents roughly 9,000 local authorities. The NALAS Secretariat, based in Skopje, Macedonia, organizes task forces on themes important to local governments. The primary focus is on local finances, urban planning, waste management, institutional development, and energy efficiency.

**nrg4SD – Network of Regional Governments for Sustainable Development**

[www.nrg4sd.org](http://www.nrg4sd.org/); www.cbd.int/authorities/nrg4sd.shtml

Established in 2002 to represent sub-national governments at the global level and help them promote sustainable development. It now totals some 50 sub-national governments from 30 countries and 7 associations of sub-national governments and represents about 600 territories worldwide. The network encourages understanding, partnerships, projects, and expertise exchange among its members and with other major international stakeholders. It focuses on three main areas: climate change, biodiversity, and water resources and sanitation.

**URBIO – International Network in Urban Biodiversity and Design**

[www.fh-erfurt.de/urbio](http://www.fh-erfurt.de/urbio/httpdocs/index.html); www.hss.iitb.ac.in/urbio2012/

A worldwide scientific network for education and research founded in 2008 to promote urban biodiversity through a continuing dialogue with the CBD Global Partnership for Cities and Biodiversity. It represents all disciplines involved in research, planning, design, and management of green urban environments and currently has more than 700 members from more than 50 countries. In order to foster scientific exchange among researchers, practitioners, and stakeholders, URBIO maintains a website, distributes regular newsletters, and is organizing international scientific conferences prior to COP meetings.

**III. Tools and Guidelines**

**CBD Programmes of Work**

www.cbd.int/programmes

The Conference of the Parties of the CBD established seven thematic programmes of work which correspond to some of the major biomes on the planet. Each programme establishes a vision and basic principles to guide future work, and parties periodically review the state of implementation of the programmes. The COP has also initiated work on key cross-cutting issues that provide links between the thematic programmes. All of these efforts contribute to meeting the Aichi Targets.

**CEPA – Biodiversity Communications, Education and Public Awareness**

www.cbd.int/cepa/about.shtml

The goal of CEPA is to communicate the scientific and technical work of the CBD in a language that is accessible to many different groups, integrate biodiversity into education systems in all Parties to the Convention, and raise public awareness of the importance of biodiversity to our lives, as well as its intrinsic value. Bringing this to the local level, ICLEI – Local Governments for Sustainability’s Local Action for Biodiversity (LAB) programme and the City of Cape Town collaborated to produce an “Evaluation Design Toolkit for CEPA” with both qualitative and quantitative indicators, recognizing that CEPA programmes involve complex social systems that cannot be evaluated in the same way that we monitor biophysical systems. This toolkit will assist managers, practitioners, and partners in the design, planning, and evaluation of CEPA programmes. The toolkit has been produced as a CD with the intention that over time, its application will further contribute to its refinement. It can be downloaded at www.iclei.org/biodiversity or www.capetown.gov.za/environment.

**City Biodiversity Index (CBI) or Singapore Index on Cities’ Biodiversity (see p. XXX)**

[www.cbd.int/authorities/gettinginvolved/cbi.shtml](http://www.cbd.int/authorities/gettinginvolved/cbi.shtml)

A tool to help cities manage their biodiversity conservation efforts and integrate biodiversity considerations in urban planning and governance. Also serves as a platform through which cities can share solutions for conserving biodiversity and overcoming problems of urbanization. The user’s manual can be downloaded at www.cbd.int/authorities/doc/User%27s%20Manual-for-the-City-Biodiversity-Index27Sept2010.pdf.

**Global Ecological Footprints**

www.footprintnetwork.org/en/index.php/GFN

An international nonprofit working to advance sustainability through use of the [Ecological Footprint](http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_basics_overview/), a resource accounting tool that measures how much nature we have, how much we use, and who uses what. (See Key Message 1 for a detailed discussion of ecological footprints.)

**International Day for Biological Diversity (IDB) – May 22**

www.cbd.int/idb/

An annual event, established in 1993, to increase awareness of biodiversity issues, promote practical action, and showcase the biodiversity work being done in different countries. IDB celebrates a different theme each year. Also see Green Wave, below.

LBSAPs

**LEED – Leadership in Energy and Environmental Design**

www.usgbc.org

An internationally recognized certification program that provides a framework for implementing practical and measurable green building solutions—from individual buildings and homes to entire neighborhoods and communities. LEED certification provides independent, third-party verification that a building, home, or community was designed and built using strategies aimed at achieving high performance in nine key areas of human and environmental health, among them sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. Developed in 2000 by the nonprofit [U.S. Green Building Council (USGBC)](http://www.usgbc.org/About), LEED continually updates its rating system, ensuring that it promotes state-of-the-art strategies for the built environment. LEED projects are in progress in 120 different countries.

**Plan of Action on Sub-National Governments, Cities and Other Local Authorities on Biodiversity (2011–2020)**

www.cbd.int/authorities/planofaction.shtml

Adopted in 2010 to provide suggestions to Parties to the CBD on how to mobilize local actions on biodiversity, take CBD issues to urban residents, and bring national strategies and plans into the urban context. Includes a set of objectives, monitoring and reporting guidelines, and suggested activities for implementation, as well as an institutional framework for optimizing synergies among Parties, UN and development agencies, NGOs, and networks of cities. Dissemination of best practices helps promote local efforts and facilitates communication among all levels of government.

**Strategic Plan for Biodiversity 2011–2020 and Aichi Targets**

[www.cbd.int/sp/](http://www.cbd.int/sp/); www.cbd.int/sp/targets/

A ten-year framework for action adopted by 193 countries through the Convention on Biological Diversity and by its stakeholders to save biodiversity and enhance its benefits for people. The Plan comprises a vision and mission, implementation guidelines, and 20 ambitious yet achievable Aichi Targets organized under five main goals, with the purpose of inspiring broad-based action in support of biodiversity.

**United Nations Decade on Biodiversity – 2011–2020**

[www.cbd.int/2011-2020](http://www.cbd.int/2011-2020)

Launched in November 2011 to support implementation of the UN’s Strategic Plan for Biodiversity 2011–2020, adopted at COP 10 in Nagoya, Japan, and supported by the UN General Assembly. Promotes an overall vision of living in harmony with nature and aims to mainstream biodiversity at different levels. Website offers information about biodiversity, events around the world, and how everyone can make a difference.

**World Resources Forum**

www.worldresourcesforum.org

A global science-based platform for sharing knowledge about the economic, political, social, and environmental implications of global resource use. WRF promotes innovation for resource productivity by building bridges among researchers, policymakers, business, NGOs, and the public. Its flagship activity is the annual WRF Conference, the scope of which includes full life-cycle analysis of products and services and the promotion of Sustainable Consumption and Production.

**IV. Projects and Working Groups**

**Cities in the Hotspots – ICLEI**

[URL to come]

A programme being developed by ICLEI to secure ecosystem services in biodiversity hotspots—critically threatened areas harbouring a significant portion of global biodiversity—in ways that result in tangible benefits for the people and economies of cities and their regions. The programme aims to mobilize a network of local governments that will reduce biodiversity loss and increase social, economic, and ecological resilience to global change, incidentally contributing to implementation of the CBD Strategic Plan and attainment of the associated Aichi Targets. It will be run in partnership with the CBD Secretariat, IUCN, UN-HABITAT, RAMSAR, and Conservation International. Technical assistance and training will be provided to participating cities with a view to building local capacity for ecosystem management.

**European Capitals of Biodiversity**

[www.capital-biodiversity.eu/2.html](http://www.capital-biodiversity.eu/2.html)

A project to honor and highlight the efforts of European municipalities to protect their biodiversity and to provide healthy and livable communities for current and future generations.

**Green Wave**

http://greenwave.cbd.int/en/home

A global biodiversity campaign to educate children and youth about biodiversity. Each year, The Green Wave will contribute to worldwide celebrations of the [International Day for Biological Diversity (IDB; see above)](http://www.cbd.int/ibd/). In participating schools, students plant a locally important or indigenous tree species in or near their schoolyard on 22 May at exactly 10 AM, thereby creating a figurative “green wave” starting in the far east and traveling west around the world.

**LAB – ICLEI’S Local Action for Biodiversity Project**

www.iclei.org/lab

Local Action for Biodiversity (LAB) is a global urban biodiversity project coordinated by ICLEI Cities Biodiversity Center. The project encourages local governments to integrate biodiversity considerations into urban planning and policy, guiding participating cities in biodiversity and ecosystem management, while developing and refining biodiversity “tool kits” and establishing a global network for the exchange of best practices. LAB includes an assessment, a political pledge at various levels, the preparation of a Local Biodiversity Strategy and Action Plan (LBSAP) that aligns with the national equivalent, and the implementation of three biodiversity projects that operationalize the plan. LAB cities receive support from ICLEI in the form of technical assistance, networking opportunities, participation in specialist training workshops, showcasing of achievements at important international events, and advocacy.

**Natural Capital Project**

www.naturalcapitalproject.org

A joint venture of [Stanford University's Woods Institute for the Environment](http://woods.stanford.edu/), [University of Minnesota's Institute on the Environment](http://environment.umn.edu/), [The Nature Conservancy](http://www.nature.org/), and World Wildlife Fund that develops software for quantifying the values of natural capital. Science–policy interface tools enable users to integrate scientific and economic understanding of natural assets into real land-use and investment decisions. Focused on national and state governments—and working with key policy makers, resource managers, scientists, and other diverse leaders—Natural Capital seeks to transformation how governments and businesses factor the values of nature into policy and decision-making.

**TEEB – The Economics of Ecosystems and Biodiversity (see p. XXX)**

www.teebweb.org

An international initiative that draws attention to the global economic benefits of biodiversity, highlights the growing costs of biodiversity loss and ecosystem degradation, and draws together expertise from the fields of science, economics, and policy to enable practical actions.

**UCEG – Urbanization and Global Environmental Change Project**

www.ugec.org

A core project of the [International Human Dimensions Programme on Global Environmental Change](http://www.ihdp.unu.edu/) (IHDP) that seeks to provide a better understanding of the interactions between global environmental change and urbanization at the local, regional, and global scales. To capture the benefits of urbanization and to mitigate, as well as adapt to, negative environmental and socioeconomic impacts, UGEC facilitates collaboration among academics, political decision-makers, and practitioners.

**Urban Planet**

[www.urbanplanet.org](http://www.urbanplanet.org)

An interdisciplinary, onsite learning environment with interactive data, maps, and innovative solutions for more sustainable urban regions. Initiated by the Stockholm Resilience Centre, Urban Planet emphasizes the close interdependence of social and natural systems and the fundamental role of ecosystem services for human wellbeing. The site is continually updated with new case studies and welcomes suggestions from all over the world.

**URBIS –** **Urban Biosphere Network**

[www.urbis.org](http://www.urbisinitiative.org)

A global open network of scientists, planners, educators, and policy-makers that provides a platform for developing more resilient and equitable urban regions. By reconnecting people with the natural world and with each other, URBIS raises awareness of the need to reduce footprints and adopt sustainable production, consumption, and waste-disposal methods. URBIS addresses three major challenges to sustainable development in a context of rapid urban growth: (1) vulnerabilities of urban regions to global and regional environmental change; (2) the need for regional planning tools that bridge the urban–rural divide; and (3) adoption of a landscape approach to urban planning. URBIS aims to recognize municipal efforts to collaborate on sustainable urban planning and is also creating a database of good-practice case studies and lessons learned. With formal recognition of cities that meet international standards for sustainable planning, URBIS aims to provide yet another incentive for local governments to collaborate for sustainable urbanization. On-going virtual knowledge exchange and discussions among cities and stakeholders will be established and regularly facilitated through new communications tools.

Note: URLs may change between now and September; we’ll update as needed.

***Cities and Biodiversity Outlook* on the Internet**

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**Ten Key Messages**

[For inside back cover or back cover]

1. Unsustainable urbanization is a critical driver behind global biodiversity loss and ecosystem change.

2. Rich biodiversity can exist in cities.

3. Biodiversity and ecosystem services represent critical natural capital.

4. Urban ecosystems significantly improve human health.

5. Incorporating biodiversity and ecosystems in urban planning and design helps reduce carbon emissions and enhance adaptation to climate change.

6. Food and nutrition security depend on local and biodiversity-based food systems.

7. Ecosystem functions must be integrated in urban policy and planning.

8. Successful management of biodiversity and ecosystem services includes all levels and all sectors.

9. Cities offer unique opportunities for learning and education about a resilient and sustainable future.

10. Cities have a large potential to generate innovations and governance tools and therefore can—and must—take the lead in sustainable development.