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outlook 1

Synthesis

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A Global Assessment of the

Links between Urbanization,

Biodiversity, and Ecosystems

**Revised Draft, 12 February 2012**



**The Urban Challenge**

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. 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 Mongolia, 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 in the coming decades. Without adequate consideration by policy-makers of the implications of the coming urbanization, many of the goals of the Convention on Biological Diversity, as well as the Millennium Development Goals for providing clean water for consumption and sanitation and the UNFCC goals for mitigating and adapting to climate change, are unlikely to be met. A sustainable urbanization will be necessary for achieving goals of a more sustainable planet.

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**Executive Summary**

This first edition of *Cities and Biodiversity Outlook – Synthesis* (*CBO-1 Synthesis*) 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 and urban growth affect biodiversity and ecosystems and presents 10 key messages on the conservation and sustainable use of natural resources. With input from cities, other local authorities, and subnational governments, the synthesis also showcases best practices and lessons learned on urbanization and biodiversity and provides information on how to mainstream (incorporate) these topics into agendas and policies.

**OVERVIEW OF *CBO-1 SYNTHESIS***

**The Charge**

*CBO-1 Synthesis* stems from the decision that 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. Paragraph six of decision X/22 as adopted:

“…*Requests* the Executive Secretary, subject to the availability of resources, to prepare an assessment of the links and opportunities between urbanization and biodiversity for the eleventh meeting of the Conference of the Parties, based on the third edition of the Global Biodiversity Outlook…”

**The Mission**

▸Serve as the first comprehensive global synthesis of how urbanization affects biodiversity and ecosystem dynamics in terrestrial, freshwater, and marine systems.

▸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 urban and peri-urban biodiversity and ecosystems can be used, restored, and created in innovative ways to reduce vulnerability in cities and enhance natural capital and resilience, and how cities can move from being just consumers to also generate multiple ecosystem services and reduce footprints—thus redefining the function of cities.

▸Serve as a first reference for decision- and policy-makers of the CBD and its Parties on the complementary roles of national, subnational, and local authorities for the implementation of the Strategic Plan for Biodiversity 2011–2020 through decision X/22 of COP 10.

**Production**

*CBO-1 Synthesis* has been developed in parallel with *CBO-1 Scientific Foundation*, an in-depth scientific assessment that underpins the synthesis. Both publications are a collaborative effort of the Secretariat of the Convention on Biological Diversity and the Stockholm Resilience Centre of Stockholm University. This linkage of an extensive scientific publication with a policy-making synthesis enables groundbreaking science to support strategic decision-making, and vice-versa.

*CBO-1 Synthesis* draws on multiple sources of information, including national reports, biodiversity indicators, scientific literature, and assessments from inter-governmental and non-governmental bodies. To support content development, accuracy, and global scope, it has relied on an international network of scientists, scientific institutions, United Nations and other organizations, specialists, and decision-makers. More than XX contributors—all recognized authorities in their fields and representing diverse organizations, backgrounds, and geographies—have worked together in a multi-stage and rigorous process 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 not included here; they will be found instead in *CBO-1 Scientific Foundation*.

Just as with its inspiration, the CBD’s flagship publication *Global Biodiversity Outlook* (currently in its third edition), the production of *CBO-1 Synthesis* has been highly inclusive. Two separate drafts were made available for review before publication, and comments from some 240 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.

The first edition of *CBO-1 Synthesis* will be presented at Rio+20 and submitted to the World Cities’ Summit in Singapore in June 2012, and officially launched at the second City Biodiversity Summit parallel to the eleventh meeting of the Conference of the Parties (COP 11) to the CBD in October 2012. A preliminary version of *CBO-1 Scientific Foundation* will be distributed at COP 11, with the final edition published in 2013.

It is hoped that this first edition of *CBO-1 Synthesis*, together with *CBO-1 Scientific Foundation*, will serve asanew and valuable tool for steering urban development onto a sustainable path.

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**SECTION I. INTRODUCTION**

**The Global Reach of Urbanization**

The world is increasingly urban, interconnected, and shifting. The world’s 20 fastest-growing urban regions are in countries such as China, India, and Nigeria, not in Europe or North America. 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. 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 Mongolia, with obvious impacts on natural habitat and the wildlife that depends on it. Over the last few decades there has been increasing recognition that human domination and the rapid development of global urbanism are reshaping the ecology of our entire planet. This rapid urbanization represents major challenges, but also opportunities to ensure basic human welfare and a viable global environment. The opportunities lie in the urban landscapes because these are also the very places where knowledge, innovations, and the human and financial resources for finding solutions to global environmental problems are likely to be found.

Urbanization is a complex and dynamic process playing out over multiple scales of space and time. The emerging urbanizing regions represent probably the most complex mosaic of land cover and multiple land uses of any landscape. Urbanization is both a social phenomenon and a physical transformation now squarely at the forefront of defining humanity’s relationship with the biosphere. While megacities are implicated in this growth, it is the medium-sized cities (population 1–5 million) that will host the fastest rates of urban growth; most of the world’s urban population will live in small cities of less than 1 million people. Urbanization usually entails an increase in the physical size and population of a city over a long period of time. However, this period of expansion is sometimes followed by a period of population decline, leading to complex processes of urbanization–suburbanization/ex-urbanism. It is thus important to recognize the phenomena of “shrinking cities,” where population decline and urban decay—rather than growth—characterize the urban structure.

There has so far not been any global assessment of how urbanization affects biodiversity and ecosystems, or of the many opportunities for sustainable development that urbanization generates. While many studies have examined particular cities or a particular facet of the environment, there has been little attempt to assess the prospects for ecosystem services on an urbanized planet. For example, the 2001–2005 Millennium Ecosystem Assessment—the world’s largest assessment of ecosystems—covered almost every ecosystem in the world but barely mentioned urban systems. The World Bank’s annual World Development Reports, the world’s largest assessments of urbanization, rarely make reference to ecosystems. It is this knowledge gap that this assessment attempts to bridge.

**SECTION II. CONDITIONS AND TRENDS**

**Introduction**

[to come, from lead authors of the scientific foundation]

**Key Message 1:** Unsustainable urbanization is a critical driver behind global biodiversity loss and ecosystem change.

**The Context**

In 1950 less than one third of humans lived in cities, yet by 2050, as the world’s population soars beyond 9 billion, over two-thirds of us will be urbanites. In the next 4 decades, urban capacity will expand by as much as it has over the last 4 millennia.

Such growth is and will continue to be especially pronounced in the developing world, where massive infrastructure investments are required to keep pace with burgeoning urban populations. In many countries, projected urban growth will be predominantly informal and increasingly in risk-prone areas.

The well-being of humans is sustained by flows of energy, material goods (including food, water, fuel, fibre and medicine), and non-material services (including waste absorption). Approximately 3 percent of Earth’s land surface is urban, yet cities account for 75 percent of global resource consumption and generate massive amounts of waste, inflicting heavy impacts on near and distant ecosystems. A city’s ecological footprint - the biologically productive area required to supply a city with resources and assimilate its waste - can be hundreds of times larger than the area of the city itself, in the case of Toronto, over 280 times larger.

As cities expand, they encroach onto agricultural and natural land, drawing closer to protected areas and intensifying the conflicts between unsustainable urban development and biodiversity conservation. In poor cities, inequity, lack of secure tenure and inadequate access to safe energy, food, clean water and sanitation are at the core of environmental challenges. In emerging economies, the rise of the middle class and associated consumption and production culture is placing additional pressures on the environment. Urban planning, design, function and infrastructure lock cities into specific patterns of consumption that are difficult to adjust. Thus choices made today will determine the sustainability of future cities and the quality of life therein as well as the health of ecosystems far beyond physical urban limits.

**The Challenge: Direct Alteration of the Bio-Physical Environment**

Urbanization directly transforms the bio-physical environment by supplanting vegetated surfaces that provide shade, evaporative cooling, storm-water interception, and infiltration functions with impervious built surfaces.

Impervious surfaces

Significant changes in wind speed and direction, incident sunlight exposure, humidity, precipitation, water routing, and soil characteristics are evident in cities. Motorized vehicles create noise pollution, while electric lighting creates light pollution. Urbanization also modifies biochemical cycles by elevating atmospheric concentrations of carbon dioxide, methane, and ozone, while increasing the deposition of acid and nitrogen. Phosphorus, nitrogen, and metals tend to accumulate in cities, and infiltrate nearby groundwater and surface water bodies which are themselves fundamentally altered by soil sealing and rerouting of waterways.

Urban ambient air temperatures are often 2° to 5°C higher than in surrounding rural areas, a phenomenon known as the urban heat island (UHI) effect. A difference of 2.1°C was recorded in London as early as 1810. However, with global average temperatures predicted to rise by 1.5° to 6.1°C during the course of the twenty-first century, climate change is likely to exacerbate the UHI.

Such dramatic changes favor the growth of certain species over others. Only a subset of native species is able to cope, and consequently, urban ecosystems do not always resemble or function like the native ecosystems they replace.

**Urbanization Contributes To:**

1. *Habitat loss and fragmentation*

Throughout history, water supply has been a decisive factor in the search for adequate locations for human settlement. Hence most of the world’s cities are located on river banks, lakesides, flood plains, estuaries and coastlines. Such areas are naturally rich in biodiversity. Clearing vegetation and draining wetlands to make way for urban infrastructure can destroy extensive natural habitats and undermine the integrity of ecosystems and the services they render to humans. Indeed, the severe floods that devastated the City of New Orleans in 2005 have been largely attributed to the destruction of wetlands and floodplains in the region and the resulting loss of absorptive capacity.

Urban infrastructure also fragments natural areas, thereby obstructing the movement of organisms, diminishing the size and quality of their habitats, and spurring their demise towards local extirpation. Subpopulations of wild species can be isolated and impeded from accessing important feeding, breeding, brooding and nursery grounds, essential for their survival. For certain species, the severance of such important ecological linkages is exacerbated by unfavourable increases in the proportion of edge habitat which may, inter alia, heighten the risk of predation.

Urbanisation also supplants agricultural land, thereby increasing pressure to cultivate new land elsewhere or to intensify production in existing farmland. Either way the impacts on biodiversity are typically negative.

As natural habitats shrink, fragment and degrade, so do their capacities to generate ecosystem services such as pollution regulation, nutrient recycling, and organic waste decomposition.

1. *Pollution*

Pollution arises in many forms and can poison the water, soil, and atmosphere. Transport, industry, construction, power generation, agriculture, solid waste accumulation, waste water treatment works and forestry generate pollutants that may adversely affect biodiversity directly or, by unbalancing the chemical constituents of ecosystems, indirectly. As centers of human activity and drivers of demand, cities generate considerable quantities of pollution (e.g. landfill seepage, acid rain, sulphate and nitrate deposition, particulate matter, noise pollution etc.) that if improperly managed, can inflict heavy damage on terrestrial, marine, and aquatic biodiversity and impair groundwater quality.

Urban runoff containing nutrient pollution from organic sewage, vehicle effluent, and plant fertiliser can enter waterways and lead to eutrophication, creating dead-zones void of normal sea-life. The Palmones River Estuary in Spain is surrounded by densely-populated urban and industrial land and has incurred eutrophication over several decades owing to the high input of phosphorous-rich urban runoff.

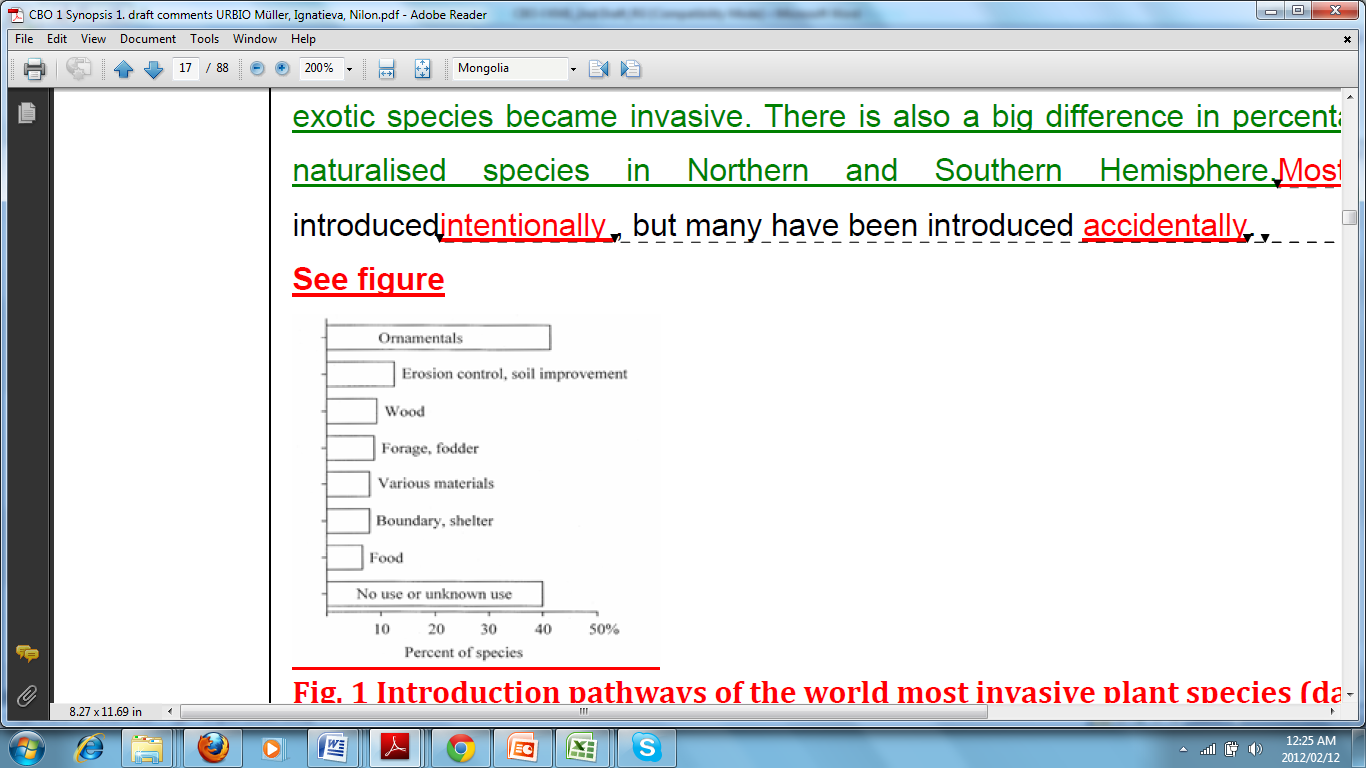
Salt spreading on roads is another such example. Salt penetrates the vascular systems of plants, preventing them from absorbing sufficient water and minerals. In Paris, nearly 3000 trees died in this manner during the great snow-clearing of 1986-1987.

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

As a symptom of globalisation, cities worldwide are tending towards similar architecture, landscaping styles, construction materials, and vegetation (derived from nurseries with common plant species). The dramatic changes induced by urbanisation can exceed the adaptive capacities of native species, while simultaneously enabling globally-common, urban-adapted, exotic (or alien), faunal and plant species to flourish. As hubs of horticulture, tourism and trade, cities function as nodes for the introduction of alien species, many of which become invasive and constitute a major threat to biodiversity worldwide.

Such species, can dominate natural ecosystems and competitively exclude native species.. Invasive alien species may prey on native species or modify and usurp habitats resulting in the degradation of biodiversity and alteration ecosystem functioning.

Invasive alien species are usually introduced accidentally, but many have been introduced intentionally (see figure 1). Indeed, in Victorian gardens, it was the height of fashion to use exotic ornamental species, many of which have become invasive.



**Figure 1.** Introduction pathways of the world’s most invasive plant species. Based on 774 species (from Weber 2003).

In the City of Berlin, Germany, 54% of plant species are exotic in the city center, 25% in the suburbs, and only 6% in the surrounding areas. Similarly, in Polish villages, 30% of species are exotic, whereas in Polish towns, this proportion rises is 40-50%, and in Polish cities, 50-70%. Over 120 years, the City of Plzen, Czech Republic, lost 368 native species (c. 31%) and gained 238 exotic species. The influx of exotic species and concurrent extirpation of native species, induced by urbanisation, can in some instances enhance local species richness, while degrading global species richness. Urbanization can therefore be considered as a force for biotic homogenization.

Alien species may actually enhance specific ecosystem services in cities, such as soil mineralization, climate change adaptation and mitigation, and cultural and aesthetic benefits. However, those that become pests and spread into the wild have many negative impacts. Invasive alien species are responsible for multibillion dollar losses in the fishing, forestry, and agriculture sectors. Japanese Knotweed, which originates in Japan, was introduced to Britain as an ornamental plant in the early 19th Century. Thriving in disturbed soil and growing up to 10 cm per day, each plant comprises a rhizome network that can extend up to 3m underground and damage construction foundations, drainage systems, and underground services. Problems such as this are expected to worsen, in line with escalating climate change, global trade, and tourism.

1. *Overexploitation of natural resources*

Biodiversity is exploited for construction materials, industrial products, food, the pet trade, fashion, and traditional medicines in order to meet the demands of city-dwellers. When people migrate from rural to urban areas, their consumption habits normally adjust considerably, thereby reshaping their ecological footprints. Nowhere is this more evident than in China where relatively affluent coastal urban dwellers enjoy far higher purchasing power parity and consume more resources per capita, than their rural counterparts in the west of the country. This is especially reflected in dietary discrepancies with urban dwellers consuming less grain and demanding more meat, dairy and fish products.

Although exploitation of natural resources usually entails the selective removal of a single species from an ecosystem, other species may also be harmed, as is the case with fishing bycatches. Overexploitation of natural resources leads to the exhaustion of those resources, as history can testify.

Cities also have an impact on biodiversity by competing for mutually desired natural resources such as water. Hydrological systems that have been altered to serve urban areas may deprive entire ecosystems (such as freshwater wetlands) of adequate water supply.

1. *Climate change*

Anthropogenic climate change constitutes a profound threat to biodiversity. Cities account for over 70% of greenhouse gas emissions. Sea-level rise and ocean acidification, changing precipitation patterns, rising global average temperatures, and increases in the frequency of extreme weather events will affect the abundance and distribution of species. Indeed, a growing body of evidence suggests that such impacts are already occurring. As climatic bands shift poleward, habitats and the species they harbor may struggle to keep pace, especially across geographical barriers. Habitat fragmentation resulting both directly and indirectly from urbanisation, will hinder the response of species; many will be deprived of the niches to which they are adapted and will be at risk of extinction.

Urban ecosystems are already experiencing certain environmental pressures that are projected to occur in rural areas as a result of climate change. These include elevations in temperature and concentrations of atmospheric carbon dioxide, inorganic reactive nitrogen, and ozone. The rural-urban gradient therefore serves as an insightful model for scientists to better understand species’ responses to climate change and forecast future environmental changes with a view to anticipate and mitigate adverse impacts.

**The Bright Side**

Although urbanization gives rise to an array of environmental pressures, the degree of consequent biodiversity loss and ecosystem change depends largely on the design of cities, the policies enforced therein, and the mindset of citizens, which in turn is driven largely by mass media and education. By upholding the integrity of natural areas within and adjacent to urban areas, adopting smart spatial planning practices, and integrating green infrastructure into urban design (sustainable green infrastructure is based on using natural processes and predominantly native species), the ecological impacts of urbanization can be significantly ameliorated. So too by adopting appropriate procurement policies and managing bio-regional systems in a holistic, cooperative manner, cities can minimize their impacts on biodiversity beyond urban boundaries.

Cities are conducive to human innovation and are usually the birthplaces of resource-efficient technologies and ecological solutions. Ideas and trends spread quickly in cities, and so there is remarkable potential to influence consumption habits of urban residents on a grand scale. In fact, humans have never communicated so intensely and diversely before the urban age and the information revolution (see message 9). In New Zealand, Low Impact Urban Design and Development (LIUDD) has emerged as an approach to urban development that has been widely implemented to reduce the ecological footprints of constructions and maximise their environmental benefits.

Cities have relatively short chains of command and can implement and enforce policies efficiently and rapidly. In South Korea, where over 80% of the populace live in urban areas, cities are recognised as critical agents in implementing the nation’s Green Growth Strategy. As such, specific actions targeting urban areas and binding provisions for city governments are prominently stipulated within the Strategy.

Fertility rates in cities are often lower than in rural areas because of reduced need for farm labour, higher living costs, and increased access to education and family planning. This dampening of human population growth may have considerable indirect benefits for nature.

It can be argued that cities require fewer resources per capita than rural counterparts. In compact settlements, transport distances are minimal and key infrastructure and services can be delivered more efficiently. However, this conjecture must be tempered with the acknowledgement that urban dwellers tend to have higher purchasing power parity and therefore the means to consume more.

**Concluding Remarks**

Unsustainable urbanization, which compromises the atmospheric, aquatic and terrestrial spheres, impedes the attainment of Aichi Targets embedded in the Strategic Plan for Biodiversity (2011–2020), as adopted by Parties to the Convention on Biological Diversity in 2010. In particular, the Aichi Targets listed under Strategic Goal B—“address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society”—and under Strategic Goal C—“to improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity”—are undermined. Similarly, attempts to achieve certain Millennium Development Goals (MDGs) are jeopardized, particularly MDG 7, to “ensure environmental sustainability,” with its Target 7A, to mainstream principles of sustainable development into policy making and reverse the loss of natural resources; and Target 7D, to improve the lives of slum-dwellers.

In the face of explosive urbanization and global environmental change, the challenge for planners, engineers, architects, policy-makers, politicians, and citizens alike is to lock cities into sustainable growth patterns that minimize ecological footprints, while maximizing native biodiversity and safeguarding ecosystem services. This will require enabling policy frameworks that advance integrating biodiversity-rich green spaces into urban design, mainstreaming biodiversity considerations into municipal services, perceiving ecosystems as natural infrastructure, reinforcing the protected area system, incentivizing resource-efficient lifestyles, fostering sustainable procurement and resource extraction, and promoting the management of ecosystems at appropriate scales.

**Recommended Case Studies**

**Mangroves in Mumbai**

The population of the Indian coastal city, Mumbai, will rise from 20 million inhabitants today to 33 million by 2025. Seven islands of Mumbai were adjoined through land reclamation, destroying important mangroves in the process. Mangroves generate a wealth of ecosystem services for coastal communities in terms of fishing, tourism, storm and flood defense, and erosion control. In the last decade, the city has lost more than 10,000 hectares (40%) of its mangrove ecosystem because of land reclamation for housing and the encroachment of slums. Sewage and rubbish dumping have further assaulted the ecological integrity of the mangroves thereby stifling the generation of ecosystem services. This is a particular concern for Mumbai because it is a low-lying coastal city and is vulnerable to the ill effects of projected sea-level rise. Without its mangroves, Mumbai loses its natural buffer against coastal storm surges and flooding.

**Riparian Ecosystem Change in Phoenix, USA**

Urbanization has significantly changed the riparian ecosystems in the desert city of Phoenix, USA. The UHI poses a particular challenge to trees and people. High summer temperatures impair the growth of native trees and compel people to use more water to mitigate their discomfort. Elevated temperatures most adversely affect the poorest residents, whose neighborhoods have the least vegetation and plant diversity. Major hydrological modifications, rerouting of waterways, and the resulting availability of cheap water for irrigation have increased the coverage of plants growing across the city but in doing so have deprived pre-settlement riparian ecosystems of adequate water supply. Since 1938, the region’s major river has supported stream-flow only during floods.

**Destruction of Wetlands in New Orleans**

**The Urban Footprint–Water and Waste (case study forthcoming, drawing from Naan Van Rooijen’s work)**

**Footprints of Cities in Catalonia, Spain**

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

**Rich biodiversity can exist in cities.**

Cities and rich biodiversity are often considered to be incompatible, but in fact urban areas can be surprisingly diverse. Many cities around the world contain high levels of biodiversity, for example, Bonn, Brussels, Cape Town, Curitiba, Edmonton, Mexico, Nagoya, Sao Paulo, Singapore, and Stockholm, to name but a few. This very often has a historical root, as communities settled in areas withparticularly rich and diverse landscapes. Urban biodiversity is defined as “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, satoyama)
* Managed and industrial landscapes (e. g. city centers, residential areas, industrial parks, railway areas, formal parks and gardens, brownfields)
* Landscapes that have been restored to close to their original state.

Urban biodiversity can contain significant species and habitats and provide essential ecosystem services. Remnant ecosystems, the last remaining patches for native biodiversity, typically contain the highest biodiversity, provide the greatest array of ecosystem services, and are the most important for supporting global biodiversity. Examples of native biodiversity include forests, montane habitats, grasslands, savannas, chaparral, peat swamps, mangroves, freshwater systems, rocky shores, coastal habitats, dunes, seagrass meadows, inter-tidal mudflats, etc., which can be found in cities all round the world.

The City of Cape Town, South Africa, provides a well-known example of urban biodiversity richness. With a population of just under 3.7 million people and a land area of 2,500 square kilometers, which is 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 3000 indigenous vascular plant species. Cape Town falls within the globally recognised biodiversity hotspot, Cape Floristic Region, and of the 18 vegetation types within 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 found nowhere else on Earth. Many cities actually contain protected areas within their borders, which provide an important contribution to global biodiversity. The City of Cape Town is one such example, as Table Mountain National Park is entirely surrounded by the municipality, which makes this iconic landmark that is extraordinarily rich in unique fauna and flora, a unique phenomenon.

Another well-known example of a city rich in urban biodiversity, São Paulo City, Brazil, is the most populous city in the southern hemisphere and the third largest city in the world with over 11,000,000 inhabitants. Besides its size, this mega-city still contains important biodiversity from the Brazilian Atlantic Rainforest, another globally recognised 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. 1909 plant species and 435 faunal species have been recorded in the city, with 73 of the faunal species endemic to the Brazilian Atlantic Rainforest, 25 species endangered and 14 probably endangered.

Less than 45% of the City of Bonn, Germany, is developed, and despite its small size of only 141.22 km2, it still exhibits a high level of species and habitat diversity by central European standards. Even intensively used inner-city areas have large numbers of species. The undeveloped city areas consist of about 50 % forest, 30 % open land, and 10% parks and green areas (10 %) and other types of areas.

**Urban Biodiversity Patterns**

Characteristically, biodiversity in cities in the Global South (or developing countries) is largely contributed by remnant ecosystems that are relatively intact, whereas biodiversity in cities of the Global North (developed countries) is found mostly in ecosystems that have experienced extensive human impact and activities and is therefore altered from its original state. This is largely due to the historical factors that a have influenced the development of each city, as well as the physical factors that drive the biodiversity patterns and processes, such as climate and geology.

In the Global North intensive development has taken place over a much longer period of time, typically commencing at the time of the industrial revolution around the 1800s as the population expanded, and increased urban infrastructure was needed to cater for this. In the Global South this population expansion and urban development has previously been slower and less intensive, although this is currently changing. For example while the global statistics show that over 50% of the world’s population live in cities, in Africa (a continent which predominantly consists of countries that are classified as the Global South) the urban population is closer to 80%. Therefore cities in the Global North contain higher proportions of urban biodiversity that have been impacted and influenced by human activity. On the other hand, cities in the Global South still contain a high proportion of biodiversity that is largely intact due to historically lower development rates.

As urbanisation accelerates in the Global South, this high proportion of remnant ecosystems within city boundaries comes increasingly under threat as development expands, uncurbed and unmanaged. While this is a challenge, it also presents an opportunity for cities to incorporate biodiversity into city plans and management processes from the outset, and in this way create a sustainable city that is better equipped and resilient to impacts like climate change.

Urban expansion and development needs to focus on integrated planning and management that take biodiversity and ecosystem services into account. Urban biodiversity is determined 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 the human population. The conservation of native ecosystems in urban areas is therefore of increasing importance, especially given the current rate of urbanization. As natural areas previously outside urban boundaries are incorporated into cites, the displacement of existing biodiversity and ecosystems becomes increasingly problematic worldwide. These and other natural areas should be integrated into city planning and management, as planning processes and policies play a significant role in the variation between cities’ biodiversity.

For cities with biodiversity that is less rich due to historical reasons, local interventions can result in increasing native biodiversity. For example, cities can identify the habitats that used to exist locally and recreate or enhance these habitats. Gradual enrichment or re-introduction of plant and animal species will increase the complexity of the ecosystems, and thus the ecosystem services they provide. By planting native plant species in parks, road-sides, gardens, vertical and roof-top gardens, etc., this will diversify the environment to support other native species such as mammals, birds, reptiles, amphibians, butterflies and dragonflies.

**Local Biodiversity Contributes to Global Sustainability**

Cities contain biodiversity and ecosystem services that are important on a local scale, but also on a regional, national and even global level. The implementation of activities within cities contributes collectively to achieving Millennium Development Goals (MDGs), as well as the Convention on Biological Diversity (CBD) Strategic Plan for Biodiversity (2011-2020) and the Aichi Targets. It is at the local level where policies and plans are actually implemented and protected areas secured and biodiversity loss reduced. Cities play a crucial role in assisting national governments to achieve national objectives through their local mandates and activities. For example cities can support national processes, such as the National Biodiversity Strategies and Actions Plans (NBSAPs) through alignment with the local equivalent, Local Biodiversity Strategies and Actions Plans (LBSAPs), which therefore also assist in national reporting to the CBD.

As an example of the powerful role of cities, of the 35 biodiversity hotspots identified globally, all contain cities and urban areas, many of which are significant in size and population and therefore have a large impact on the hotspot. Biodiversity hotspots are defined by exceptional levels of plant endemism as well as severe habitat loss, and as such many of the hotspots are located in areas where there is high population growth and urban expansion, which significantly threatens natural ecosystems. Cities in biodiversity hotspots therefore have a vital role to play in the conservation of these critically threatened ecosystems, for better or for worse.

**The Sustainability and Livability of Cities Depends on Biodiversity**

Biodiversity refers to both the threatened and rare species, but also the common and ordinary, and biodiversity does not have to be rare to be valuable. Biodiversity, even in cities, in all its forms, provides goods and services, known as ecosystem services, that all of humankind relies on for survival and quality of life. Ecosystem services may be delivered even by ecosystems that are degraded, or that contain low biodiversity. While pristine ecosystems have been shown to provide a greater number of ecosystem services than those that are degraded or altered, many ecosystems that are significantly different from their pristine state can still provide useful goods and services.

At the same time, introduced species can provide a false impression about the biodiversity of a city. Most cities have high numbers of introduced species, many of which are invasive species that actually threaten native biodiversity as they compete with, or in some cases prey upon, native species. Many introduced species can also have a more benign impact and coexist with native species, and can contribute to ecosystems that are uniquely adapted to this new urban environment.

While cities rely on biodiversity outside of their boundaries to provide for local needs, many ecosystem services that are crucial to the sustainability and liveability of cities must be provided locally by biodiversity within the city. These include i) provision of drinking water, ii) improvement of local climate conditions and air quality regulation, iii) carbon sequestration and storage, iv) moderation of extreme events like flooding, storms, tsunamis, landslides, droughts, etc., v) waste water treatment, vi) prevention of soil erosion and maintenance of soil fertility, vii) pollination and dispersal, viii) biological control of pest species, ix) habitats for species, x) maintenance of gene pool diversity, xi) perpetuation of cultural practices and inspiration for creative art and design, xii) recreation, m) maintenance of physical and psychological well-being and health, xiii) tourism attractions, xiv) educational and scientific uses, and xv) industrial applications based on biodiversity.

By conserving biodiversity to provide the above ecosystem services within the city, this reduces the need for the ecosystem services to be transported into the city or for the city dwellers to travel outside of the city to benefit from the ecosystem services, resulting in less energy and resources being consumed.

In this age of globalisation, biodiversity contributes to economic development both directly and indirectly. Direct economic gain can be seem through the provision of ecosystem services that are often more cost-effective that “hard engineering” methods, and that can contribute to local livelihoods. Indirectly, as cities vie to be more liveable, biodiversity can accord them a competitive edge over other cities as liveable cities attract more and better talents and hence, make them more economically viable. Studies in the United States have shown that shoppers have a tendency to spend more in commercial areas with trees. It is quite well documented that property values of homes that are landscaped with trees are higher than those without trees. People are more likely to walk in tree-lined areas, hence resulting in decreased stress, lower blood pressure, and lower obesity rates. This would inevitably lead to lower health cost. Community bonding also benefits from urban forestry as people spend more time outside interacting with their neighbours when trees are present.

**Connecting Natural Ecosystems in Cities Optimises Their Ecosystem Services and Ensures Their Long-Term Survival**

Natural areas in cities tend to be fragmented due to sporadic growth over time, and the pressures of development. By connecting the fragmented ecosystems, this is likely to result in an increase in ecological functionality as a whole, and will therefore maximise the ecosystem services offered.

There are diverse and innovative ways to connect natural ecosystems. For example, planting trees with overarching canopies could assist small mammals, bird and insects to cross roads. Road-side planting that emulates the multi-layering of forests, i.e., a composite of tall trees, medium size trees, shrubs and under storey vegetation, can cater to a diversity of faunal users. Ecolinks like underground tunnels or vegetated overhead linkages can assist in connecting natural areas. All of these areas will supplement and complement the important roles played by protected areas within cities.

**Policy Recommendations**

1. Because the only biodiversity that many urban dwellers experience is that within their immediate urban environment, urban biodiversity is also an important link to connect people emotionally with nature. Studies have shown that when people are physically separated from nature, their understanding of its importance is lower and it is harder to interest them in nature conservation. As the majority of the world’s population (more than 50 percent) now lives in cities, it is critical that we use urban biodiversity to raise awareness about humankind’s dependence on biodiversity and establish education and knowledge transfer facilities, such as schools and universities, reserves, parks, botanical gardens, zoos, etc.
2. Many tools exist to help cities manage their biodiversity. As has often been said, however, we cannot manage what we do not measure. Taking stock of urban biodiversity is thus an essential step in conserving it. Monitoring is an essential component of biodiversity conservation, and activities should be monitored for their effectiveness in achieving the objectives that they are designed for. One tool that can assist with this is the City Biodiversity Index (CBI; see page XX), also known as the Singapore Index on Biodiversity, which is the only biodiversity index designed specifically for cities. The CBI is a self-assessment tool, and allows cities to track changes in local biodiversity over time and suggests how to incorporate this information into decision-making as a diagnostic tool. Guided by the User’s Manual for the City Biodiversity Index, cities around the world have applied the CBI, and the results have been shown to be useful (www.cbd.int/ authorities/gettinginvolved/cbi.shtml). This and many other initiatives can help cities conserve and manage their urban biodiversity.

**Recommended Case Studies**

**Hyde Park, London**

Having officially opened to the public around 1630, Hyde Park is the largest and arguably the best known of the four central London Royal Parks, which connect Buckingham Palace and Kensington Palace. A Royal Parks study demonstrated that Hyde Park is the most popular of the Royal Parks, with an increase of visitors from 4.7 million in 1995 to 7.1 million in 2007, of which 37 percent are Londoners.

The United Kingdom National Ecosystem Assessment includes economic valuation of ecosystem services and has declared that the health benefits of simply living near a green space are worth up to £300 per person per year. The introduction of more than 1,800 square metres of new reed beds in 2009 supports London’s priority habitat for conservation, as part of London’s Biodiversity Action Plan. These areas provide shelter, nest sites, and food for wildlife, in addition to purifying water bodies.

Hyde Park’s wildflower meadow was recently extended to include species such as red campion, aquilegia, and harebells, all of which provide valuable nectar sources for bees and breeding grounds for butterflies. Hyde Park’s Serpentine Lake attracts many insects, thus providing feeding ground for bats, many species of which are endangered.

With the opening of Hyde Park’s new environmental education centre in 2011, the park has even more opportunities to expand its reach to primary and secondary schoolchildren, community groups, and adult learners while simultaneously encouraging the (London) Mayor’s Biodiversity Strategy, aiming to “facilitate information exchange on best practice in enhancing the biodiversity value and promoting sustainable management in parks and green spaces in London.”

**Other case study ideas**

**Singapore**: Rich in biodiversity, but also with a heavy responsibility on the city to conserve and even enhance it, e.g. Tropical lowland forests in the Singapore Botanic Gardens, Bukit Timah Nature Reserve and the Central Catchment Nature Reserves are found less than 15 kilometres from the busiest shopping area of Singapore.

**Stockholm**: a temperate city that has done much to enhance and green its infrastructure

**Rio de Janeiro**: The Tijuca Forest is an excellent example of a successful replanted urban forest.

**Mexico City**: The city has remarkable levels of biodiversity, and has some very integrated city-wide plans to improve the city’s overall sustainability.

**Hanoi**

**Mount Royal, Montreal**

**Cape Town**

Ideas for photos or illustrations:

Photos of biodiversity in those cities mentioned in the text, i.e., Cape Town, Sao Paulo, and Bonn.

**Key Message 3:** Urban and rural ecosystems generate multiple benefits essential to human well-being.

**Key Message 3:** Ecosystems within and beyond cities generate multiple benefits essential to the well-being of city-dwellers.

Human beings, including city-dwellers, are integral components of biodiversity and ecosystems. We interact, directly and indirectly, with various other components and we rely on the many goods and services provided by ecosystems for our survival and well-being, including such profoundly essential basics as food and clean water and air. Appropriately, “eco” is from the Greek *oîkos* meaning “habitat” or “house”, and the broader ecosystem that is planet Earth is indeed our one and only home.

The broadly understood concept of an ecosystem is something of a contrast to that of the built environment. However, relatively natural ecosystems do exist within city boundaries and the city itself is a kind of ecosystem. Moreover, cities and city residents are as dependent on the goods and services that nature provides—“ecosystem services”—as are people who live in closer contact with nature. In fact, because city-dwellers are, on average, financially wealthier and consume more resources per capita than their rural counterparts, they collectively impose a greater ecological impact and demand (75% of global resources); and because of their higher numbers and denser concentrations, city-dwellers are collectively more reliant on a greater quantity of ecosystem services. One might imagine the city as an octopus, drawing resources from far and wide towards it!

The ecosystem services relied on by city-dwellers originate mostly from outside the built environment, but often still within the jurisdiction of the local governments that govern cities. Some are produced nearby, whereas others are delivered, in one way or another, from distant parts of the world. For example, a single supermarket—or even a single product—may contain ingredients from every one of the continents. Our furniture may be made from the trees of distant forests; our food may be harvested (or its domesticated components descended) from distant waters and fields that are pollinated by wild insects and maintained by healthy soils; and many of our medicines are derived from organisms we may never have heard of. In this time of globalization this phenomenon is even more pronounced.

Ecosystems in cities are often extensions of surrounding ecosystems. Take, for example, a river valley corridor that runs through a city. If well maintained, such a “blue corridor” may provide the only means for some organisms to disperse beyond the urban barrier to ensure the persistence of their species. It is true that the scale of ecosystem services provided within cities is typically smaller than outside cities, but there are some that are particularly prominent and important within the built environment. Furthermore, the fact that these “urban ecosystem services” are regularly accessible to large numbers of people means they are arguably of even greater value than their non-urban counterparts. For example a 5-hectare city park that is visited by a million people a year, has a per-unit-of-area usage 2,000 times greater than a 100-square-kilometer national park visited by the same number of people over the same period of time. The consequence is greater equity of benefit sharing through ease of access and lower costs and distances associated with travelling to these natural areas. Likewise, a city’s ecological footprint, especially in terms of carbon, could be substantially reduced through, for example, enhanced energy efficiency and growing and producing a proportion of food locally.

The 2005 Millennium Ecosystem Assessment study divided ecosystem services of importance to human society, in 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. The relevance of each category, specifically in the *city context,* is explored here:

**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 ecology of catchment areas is critical to the flow of water to cities. The conservation of wetlands (including rivers) and their biodiversity enables these natural reservoirs or channels to store and provide water. These services are provided free of charge by nature in exchange only for appropriate management, and they cut down tremendously on costs that local or regional governments would otherwise have to bear. 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. Agricultural systems typically have a negative effect on biodiversity by replacing it. In the city, however, there are opportunities for agriculture to take the place, not of natural ecosystems, but of under-used urban land that has already been altered, and thereby make a contribution to both communities and biodiversity.

**Regulating Services**

Ecosystems regulate not only the supply, but also the quality, of water, air, and soil. Catchments, parts of which are often directly adjacent to cities and managed by their local governments, intercept and absorb more runoff if their ecosystems are healthy than if they are degraded. This allows them to recharge groundwater sources and reduce the risk of flooding downstream. Similarly, vegetation alongside and within river courses regulates the flow of water. Disaster limitation like this is even more important in coastal areas where ecosystems can mediate the impact of stormy seas and tidal surges. The planting of appropriate tree species can reduce some of the effects of road-traffic noise in cities whilst also contributing to carbon storage and climate regulation and contributing to biodiversity and ecosystem functioning. Wetlands can play an important role in regulating pollutants and the treatment of urban waste water, such as in the vicinity of Kampala, Uganda\*. The presence of urban heat islands, together with high levels of pollution from transport and commercial and residential heating, means that the avoidance of climate stress and the ecosystem-derived benefits of clean air, water, and soil are extremely pertinent in cities. 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.

**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. In her 741-square-meter suburban garden in Leicestershire, England, Jennifer Owen spent 30 years studying species richness and in the process recorded 1,782 species of animals and 422 species of plants, some described to science for the first time. Cities are also “sinks” for nutrients, through their disproportionate production of waste. Reduction, re-use, and recycling are means of reducing the impact of this waste production on biodiversity wherever products are produced; and wherever waste is eventually discharged. It is also in cities that people can most efficiently be mobilized to engage in such activities.

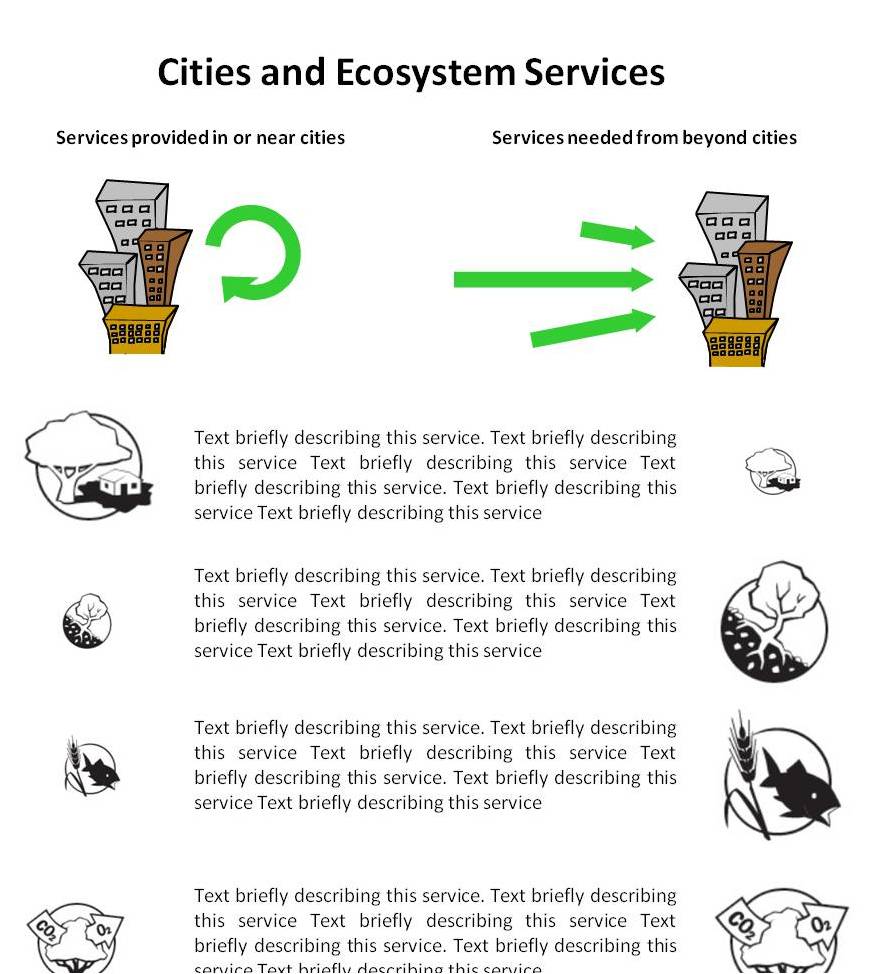
**Health and Cultural Services**

Biodiversity in cities exposes people to nature and thereby facilitates an appreciation of nature in an environment where nature is easy to ignore. Through appreciation comes support, so this kind of awareness has the potential to affect attitudes and behavior and to influence policy-making, thereby contributing towards more sustainable and resilient cities. They also provide opportunities for recreation and relaxation, and community cohesion. The more dense the human population, the more important these services can be. They are provided by culturally valued landscapes and waterscapes, such as parks and woodlands, playing fields, and nature reserves, as well by as the many smaller open areas found throughout urban environments. Urban parks and gardens provide highly valued recreation to large numbers of people, as evidenced by the number of people who congregate in them, especially on weekends and in good weather. Green areas also significantly increase urban property values through the aesthetic improvement of neighborhoods. This is reflected in real estate value. For example in the city of Montreal, residential property increased by 20% if less than 50 meters away from a park. Greening of business districts has been shown to improve customers’ perceptions of those districts, thereby enhancing business activities. Green civic areas can help attract tourists to an area, bringing associated economic benefits. Ecosystems contribute to good physical and mental health. For example studies showed that levels of aggression and violence in apartment blocks facing concrete and asphalt were higher than in buildings with views of green areas\*; reduces job stress\*; and improve rates of recovery from surgery\*. Contact with animals improves health for heart-attack survivors, reduces the incidence of minor health problems, and improves the health of isolated and elderly individuals. Increased job satisfaction, reduced work pressure, and increased productivity are benefits for employees with physical and visual access to green spaces. Exposure to nature provides inspiration for creative thinking by providing a tranquil environment; but also more directly by, for example, providing ideas for many of man’s inventions from the influence of bird flight on early aviation; to the barbs on seeds inspiring velcro; termite mounds influencing the design of passive air conditioning; bat’s eco-location and radar; and countless others with more being looked into continuously.

**In Conclusion**

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. Healthy ecosystems and biodiversity are thus vital for cities to function properly. Impacts on natural ecosystems due to urban demands can have unforeseen effects on the health and well-being of city-dwellers. Cities need to recognize that their ecological footprint affects a far wider geographical area than their own surface and contributes significantly to the loss of biodiversity both locally and globally. Recognizing this, cities can engage in many initiatives to use and conserve ecosystems efficiently. The long-term health not only of ecosystems—but of cities and city-dwellers—will depend on this. Understanding how ecosystems deliver services, who benefits from them, and what happens when an ecosystem changes, provides a key framework for developing sustainable cities within a wider landscape context.

[One more paragraph may be added, to address MDGs and Aichi Targets.]



**Recommended Case Studies**

**The “Healthy Parks, Healthy People” Approach**

The “Healthy Parks, Healthy People”(HPHP)approach was launched in 2000 by the park management agency Parks Victoria, State Government of Victoria, Australia. 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. Over time, various other parks around the world have embraced similar approaches.

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| Photo: Parks Victoria |

In 2002, Parks Victoria commissioned Deakin University in Melbourne, Australia, to do an extensive literature review on the health benefits of contact with nature. Evidence from fields as diverse as ecology, biology, environmental psychology, and psychiatry shows that “access to nature plays a vital role in human health, wellbeing and development,” the report stated. The research, updated in 2008, also indicates that “humans are…dependent on nature for psychological, emotional and spiritual needs that are difficult to satisfy by any other means.”

The first International Healthy Parks, Healthy People Congress was held in Melbourne, Australia, in 2010 and attracted more than 1,200 attendees from 38 countries. The Congress and the summary document that emerged from it, the Melbourne Communiqué, outlined the many benefits of reconnecting people to nature—from improving human health to conserving healthy ecosystems, promoting economic growth, and fostering more vibrant and cohesive societies. To cite but one example, the communiqué noted that “Globally, 36 million premature deaths per year can be averted by action addressing chronic diseases like heart disease, stroke and diabetes. The community costs could be dramatically reduced if a small proportion of health budgets were invested in preventative programs in parks.”

Declaring that parks are “integral to healthy people and a healthy environment” and that “human health depends on healthy ecosystems,” the Melbourne Communiqué called on all sectors to “work together for the benefits of humanity and the environment.” For more information, visit [www.hphpcentral.com](http://www.hphpcentral.com).

**Other case study suggestions**

**Bangalore, India:** biodiversity and slums.

**Cape Town:** Thomas to suggest an author.

**SECTION III. SCENARIOS**

**Introduction**

[to come, from lead authors of the scientific foundation]

**Key Message 4:** Biodiversity and ecosystem services should be valued so that they are treated appropriately as critical natural capital.

The fact that ecosystems and biodiversity provide goods and services essential to humankind inherently means they have value. The value of ecosystems can be estimated in terms of actual monetary costs (for example, by determining the costs of replacing the ecosystem services that regulate water quality with a water-purification facility) or through various non-monetary means (some quantitative and others qualitative). Owing to the political and financial systems on which our societies are based, humankind typically measures the value of commodities using a single “currency”: money. Policy and planning decisions are driven by trade-offs and utility, which are predominantly expressed in economic terms. As such, decisions that involve making a trade-off between different policy goals or land uses are often to the detriment of non-market valued ecosystem services. The identification, recognition and capturing of ecosystem services in economic terms is therefore an essential conservation approach. This approach has been aptly described in the global study, The Economics of Ecosystems and Biodiversity (TEEB).

Using the “TEEB approach” 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 people whose homes are protected against landslides, or the number of crops that depend on natural pollination – or in monetary terms. For monetary valuation, several methods exist including: direct market price; replacement cost; damage cost avoided; production function (value added); hedonic price (extra amount paid for higher environmental quality); travel cost (cost of visiting a site); preference tests (e.g. willingness-to-pay surveys and choice experiments); participatory environmental valuation; and benefits transfer (inferring a value based on results of other appraisals). Choice of method must depend on the characteristics of the concerned ecosystem service, the desired accuracy of valuation, and the availability of time, resources and expertise.

Almost any given ecosystem generates a “bundle” of ecosystem services but not all of these services are amenable to quantitative appraisal. 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. It enables them to highlight the importance of ecosystems and their biodiversity to the various local government sectors that affect biodiversity, and this in turn underscores the importance of treating ecosystems as natural capital - an extension of the economic notion of ‘capital’ to ecosystem services. The UK government agency, Natural England, determined a subgroup of natural capital termed Critical Natural Capital (CNC) which comprises environmental assets that are: i) essential for human health and/or for the functioning of life support systems; and ii) irreplaceable or practically unsubstitutable. The UK Government uses this classification system to inform policy-making and ensure that CNC is afforded the strictest protection.

By illustrating that natural capital contributes to job creation, saves costs, 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 schemes can be established which offer incentives to landowners and farmers to manage their land sustainably. For example, the City of New York has made substantial payments to upstream actors in the Catskill/Delaware watershed, to improve land use practices and thereby uphold 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. Conversely, ignoring the value of ecosystems can have considerable consequences for citizens’ livelihoods, such as losing opportunities to do business, improve local economy and welfare, and in the short, medium, and long term, reduce expenses. 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.

Valuation is also highly relevant and has a high profile at the international level. The Parties to the Convention on Biological Diversity agreed to the adoption of the Strategic Plan for Biodiversity (2011–2020) and associated Aichi Targets as an international guide for biodiversity planning at the national level. The first 2 of these 20 targets directly address valuation. In particular, Target 2 encapsulates both international coordination as well as the critical integration discussed above: “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.”

By providing basic services, healthy ecosystems clearly contribute to local livelihoods, well-being, and economic development—and thus to alleviating poverty and to attaining the Millennium Development Goals (MDGs). More specifically, providing clear indicators and baselines, valuation tools and exercises can facilitates the monitoring of progress of MDG Goal 7 to “ensure environmental sustainability,” particularly its Target 7.B which aims to “reduce biodiversity loss.”

In promoting the economic value of ecosystem services, it is important not to lose sight of the ecological and ethical arguments for biodiversity conservation. Economic arguments are very effective in winning political support to protect and enhance biodiversity, but there may still be cases when it is more economically advantageous to convert natural areas for alternative land-use. In such instances, ethical considerations become especially important.

**Recommended Case Studies**

**Nakivubo Swamps, Uganda**

The Nakivubo Swamps are situated adjacent to the Ugandan capital city, Kampala. The local government had proposed draining the swamps to make way for agriculture. However, a study revealed that this wetland ecosystem was providing a valuable service by filtering organic waste and other effluent derived from Kampala. 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 per annum to maintain. The local government promptly dropped the proposal to drain the Nakivubo Swamps, in recognition of the ecosystem services they render. In this particular case, the land conversion for agriculture could be judged in terms of sewage-treatment capacity lost; direct investment to maintain the wetland was a cost-effective measure to uphold the purification service. This case study demonstrates how detailed information and cost estimates can better inform planning decisions.

**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.

**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.

**Other case study suggestions**

•A case of application of Natural Capital with UK-based Natural England •Application of CBI in Lisbon, Portugal

**Key Message 5:** The importance of ecosystems must be reflected in policy and planning.

Biodiversity and ecosystems affect virtually every activity in which urban and regional practitioners and policy-makers are engaged. Conversely, virtually every department of local government is engaged in activities that affect biodiversity. However, it is typically only those with the specific mandate of biodiversity conservation that are aware of these facts, and the importance of cross-sectoral integration of ecological considerations is seldom given the necessary focus by urban and regional administrations. Local and regional administrators responsible for biodiversity management typically have too many goals to achieve single-handedly, even when resources allow for substantial teams of people. Furthermore, their goals may conflict with those of other local government departments, for example those in charge of land-use and territorial planning, transportation, and housing—all the more so when the administrators work in isolation from those departments. This lack of coordination and cooperation can lead to uninformed actions and negative impacts on the environment. Conversely, when time and effort are invested in implementing mechanisms to ensure that all departments consider or incorporate ecological considerations into their work, the workload can be shared and multiple goals can be met. These investments can take the “softer” form of raising awareness of the importance and benefits of considering biodiversity, as well as the “harder” approach of integrating biodiversity considerations into municipal policy and planning.

Local and regional administrations tend to have an abundance of sector- or program-specific plans and policies. In cases where they have enough resources to have staff dedicated to biodiversity, a Local Biodiversity Strategy and Action Plan (LBSAP) is a worthwhile basis to guide the actions of such individuals—although it is unlikely to be sufficiently considered by other sectors. One “action,” therefore, should be to influence the work of other sectors. Specific sectors may merit particular focus and offer long-lasting mechanisms to support the work being done for biodiversity conservation. Land-use planning is perhaps the most obvious example, but engagement with other sectors may be equally effective. For example, by influencing the way procurement is practiced, “green” products and services can be favored, creating incentives for service providers to compete toward enhanced sustainability. Local governments also have a degree of control over the goods that transit through their boundaries—not only those that are consumed within them. They can also 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. 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.

Although influencing such sectors is crucial, convincing them separately to write biodiversity considerations into their sector-specific plans may not be as effective, or efficient, as to aim at overarching city-wide plans. Although their directives may be less tangible than those of more specific plans and policies, city-wide plans are more visible and are designed to trickle down and inform each of the sector-specific plans that fall beneath them. The city of Edmonton, Canada, has taken this approach. One of Edmonton’s six overarching city-wide plans, “The Way We Green,” has the advantage of already being environmentally oriented, and the city’s biodiversity department has ensured that biodiversity-specific goals are well covered. Furthermore, Edmonton’s overarching plan is aligned with the internationally relevant Aichi Targets and the Strategic Plan of the Convention on Biological Diversity (CBD). This highlights the importance of convincing decision-makers of the importance of biodiversity. Once biodiversity is written into such plans, biodiversity practitioners can expect increased involvement in projects and programs of other sectors, and at least partly rely on the budget allocations of those sectors. Furthermore, as long as municipal policy is adhered to, compliance with these overarching policies is automatic.

The Strategic Plan for Biodiversity (2011–2020) of the CBD and several decisions of the CBD Conference of the Parties mandate that Parties to the Convention achieve biodiversity conservation targets or face penalties. Local governments, in turn, are obliged by their national governments to contribute to achieving these goals. Yet it is often the case that local and national objectives are misaligned. LBSAPs aligned with the respective sub-national and national strategies and action plans (NBSAPs) present an opportunity to rectify such misalignment and better coordinate local and national objectives.

Depending on local needs and priorities, and political and administrative contexts, a range of instruments and tools can be used by local authorities to integrate biodiversity in their strategies and plans. Examples include legal, planning, and regulatory instruments; zoning and land-use laws; municipal bylaws; conservation easements and management agreements with local organizations or private individuals; urban planning and design; economic and financial measures, including tax incentives, subsidies, and grants; market-based incentives such as procurement policies and payments for ecosystem services; certification and labeling programs; and standards, codes of conduct, guidelines, and information on good practices.

“Mainstreaming” refers to the integration of the conservation and sustainable use of biodiversity into existing or new sectoral and cross-sectoral plans and processes (rather than creating parallel and artificial processesand systems). By demonstrating the value of ecosystems and integrating measures such as subsidies or bylaws to promote and preserve biodiversity, local governments can bring different departments together to enhance service delivery to residents. For example, incentive measures related to green infrastructure could 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. 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. Green infrastructure can also boost municipal tax revenues by stimulating green economic activity, attracting high-caliber professionals and businesses, and increasing real-estate value.

Cities that can profile themselves as green cities and that communicate the positive impacts of their environmental and biodiversity policies and plans can create an enabling environment and facilitate the alignment of capacities for biodiversity conservation within their administrations. Oftentimes, leading individuals will take the initiative to make biodiversity highly visible and present it as a strategic goal. They will encourage the participation of their cities in international events, create task forces, committees, or working groups, organize regular cross-sectoral events, meetings, and even field trips, encourage the development of a biodiversity strategy and action plan, and make existing mainstreaming tools available to every department. Such actions have a direct influence on the involvement and interest of key actors in an administration.

Integrating biodiversity into policies and plans can make a substantial contribution toward attaining the Aichi Targets embedded in the Strategic Plan for Biodiversity (2011–2020), as adopted by parties to the CBD. Aichi Targets 1 through 4 under Strategic Goal A—“Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society”—are especially pertinent. Similarly, under the Millennium Development Goals (MDGs), Target 7.A calls for integrating principles of sustainable development into country policies and programs and reversing the loss of environmental resources.

Such integration cannot be achieved by local authorities alone, however. Cities will have to work with a wide range of stakeholders, including the private sector and civil society, and with different levels of authorities such as regional, subnational, national, and even international, within their own country and also from other countries, in order to effectively implement their biodiversity plans. The capacity of a city to implement policies and influence policy-making processes depends largely on the quality of the interaction among city departments and between cities and other actors.

**Recommended Case Studies**

**Melbourne: Growth Corridor Plans**

**Curitiba** (good cases of governance: BIOCITY programme led to parkways and doubling of green spaces).

**Durban**:.

**Key Message 6:** In an increasingly urbanized world, food and nutrition security will depend on more local and biodiversity-based food systems.

Many city-dwellers and decision-makers have long assumed that because food is readily available in grocery stores and along the streets, it will always be there. This assumption was upended in 2007–2008, when food prices soared and cities in more than 20 countries around the world experienced food riots. Due to their complexity and logistics, the collapse of food production and distribution chains will by necessity be more acute in cities. To an extent previously unseen, food and nutrition security entered global and urban political agendas.

Conflicts, climate change, increases in extreme weather events and disasters, economic and social turmoil, and loss of biodiversity have all elevated the volatility of our food supplies and prices and put millions of people at risk, particularly the poorest. In cities everywhere around the world, people are experiencing increases in hunger, poverty, and non-communicable diseases such as obesity. The world community has acknowledged that the human right to food must be progressively realized despite the enormous challenges and inequities that exist in the food systems of both rich and poor countries.

**At stake is the contribution of biodiversity to a food-based approach 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. Local and biodiversity-based food systems will play a key role in building more resilient food systems.

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, plants and trees, livestock, fisheries, and aquaculture.
* Promote a common understanding of the challenges that urbanization brings, at local and global levels, to the issues of biodiversity with regard to food and nutrition security, agriculture, and natural-resources management, and identify how cities and urban consumers can become drivers of agro-biodiversity at different geographical scales.
* 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 food system is a continuum from rural to urban**. We need to consider the urban, peri-urban, and rural components of food systems together, as well as their links with global markets. We also need to take into account every phase from food production (including local biodiversity and indigenous species) to food storage, processing, marketing, and consumption. Strong synergies can result from dialogue, planning, and action led by local authorities and stakeholders across the urban–rural continuum. A key task for ensuring food and nutrition security is for people at global and local levels to collaborate in taking on both the rural and urban dimensions of an *integrated* food system, connecting producers and consumers in a framework of sustainable ecosystem management.

In addition to promoting more sustainable food systems, increased food security, and sustainable diets, urban–rural linkages yield many other benefits: promoting environmental resilience and economic vitality in both the urban and rural sectors while highlighting the fundamental challenges of conserving biodiversity, improving land use, and adapting to climate change. All of these issues are mutually reinforcing. A holistic approach to their management can result in solutions that are both broad and deep.

**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 new approach seeks to build diverse supplies of food geographically close to population centers—not to constrain the global supply chains that contribute to food security for many countries, but to improve local decision-making and management of food systems linking local and global productions and food supply. 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. It also recognizes that in their daily food-consumption choices and habits, all humans contribute to either the loss or preservation of biodiversity, at the local or global level.

Building such food systems need to be done holistically, combining multi-level, multi-sector, and multi-stakeholder approaches. For local authorities, among the most challenging socioeconomic and health factors related to food systems are poverty and livelihoods, hunger, malnutrition, shifting diets and health, food safety, waste reduction and energy management, and the migration of people and labor from rural to urban areas. If solutions to these challenges are linked, these and other components of the food system can contribute significantly to greening the economy—a major goal for many cities and national governments for whom resilience has become an urgent concern.

**Such an integrated approach of food-system resilience is described by** **four dimensions**:

1. a people-centered and social-development-policy dimension,
2. a natural-resource-management dimension,
3. a multi-level governance dimension, and
4. a territorial-planning dimension across the urban–rural continuum.

These four dimensions are mutually reinforcing for 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 economic development, biodiversity conservation, and climate-change adaptation can become more integrated.

Addressing food and agriculture biodiversity related to cities contributes to most of the Aichi Targets, in particular:

* Strategic Goal A: “Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society”—by forging a strong link with livelihoods and poverty-reduction strategies.
* Strategic Goal B: “Reduce the direct pressures on biodiversity and promote sustainable use”—by contributing to sustainable management of agriculture, aquaculture, and forestry.
* Strategic Goal D: “Enhance the benefits to all from biodiversity and ecosystem services”—by developing urban lead ecosystem services.
* Strategic Goal E: “Enhance implementation through participatory planning, knowledge management and capacity building”—by mobilizing urban dwellers, who make up more than half the world’s population.

**Focus on Solutions**

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

* Key roles of local 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.

**In Summary**

Too often, food systems have been neglected when designing, planning, and managing cities. This must change, especially as the world becomes more urbanized and as human populations increase. We must grapple with questions such as: How does biodiversity contribute to the universal right to food of the world population in urban and rural areas? What do we have to do to produce enough diversified and nutritious food for urban dwellers? How can cities and urban consumers be drivers of agro-biodiversity at local and regional levels? How can cities preserve the surrounding ecosystems on which much of our food production depends? Only by working together across all sectors of society can we understand and address the challenges that link biodiversity, food and nutrition security, agriculture, and urbanization.

**Recommended Case Studies**

**Rome, Italy**

**Havana, Cuba**

**Food procurement choices by Brazilian city governments**

**Kampala, Uganda:** Urban Agriculture Health Project.

**Rooftop gardening and agriculture:** Multiple cities.

**SECTION IV. Responses: Governance, Institutions, and Learning**

**Introduction**

[to come, from lead authors of the scientific foundation]

**Key Message 7:** Urban planning and design that incorporate biodiversity and ecosystems can help reduce carbon emissions and enhance urban adaptation to climate change.

The Intergovernmental Panel on Climate Change (IPCC) warns that at current greenhouse gas emission rates, average global temperatures are likely to 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: 70 percent of all emissions, by some estimates. At the same time, cities often achieve *lower* per-capita CO2 emissions than nonurban areas.

Cities are frequently located in or near prime biodiversity sites, and avail themselves of their associated ecosystem services: watersheds supply fresh water, wetlands offer storm-protection and water-purification functions, and forests provide carbon-capture and air-purification capacity. 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 have profoundly disruptive effects on the functioning of city systems. With many species living in or commuting through cities, their fate is often linked with that of urbanization.

Urbanization can pose a threat to ecosystems too, with land-use conversion often directly degrading habitats that support biodiversity. The culprit, however, is not urbanization per se, but rather *unsustainable forms* of urbanization that treat the wider environment as an externality. Cities can support biodiversity while *at the same time* reducing carbon emission 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 the above, however. Cities—particularly the least capacitated—are growing fast at the same time as they struggle to reduce emissions and build resilience to the effects of climate change. So cities in developing countries—whose environmental protections are often the weakest and whose poor populations are often the most vulnerable—are already poised to suffer the most. At the same time, many of the same cities will have to pioneer innovative solutions for reducing per-capita emissions that can reduce further climate change.

Fortunately, cities have enormous potential for working with the biodiversity located in, around, and flowing through them. 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 measuring and 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.

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. 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.

Mosaic planning can also incentivize transport strategies to connect cities within regions through 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, as 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 a variety of useful climate change–related functions: they serve as “green lungs,” absorbing a city’s CO2 and other ambient pollutants; they can significantly reduce the urban “heat island” effect, a vicious cycle caused by the tendency of built areas and paved surfaces to absorb and magnify increased ambient heat; and they remind the public of the critical role that ecosystems play in mitigation and adaptation functions, which can further increase support for such measures.

Urban “waste” spaces such as wetlands, drosscapes, and brownfields may have even more innovative roles to play. 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.

In pursuit of the above possibilities, local governments can employ several policy-relevant solutions. At the broadest scale, they can form agreements of cooperation with their regional governments and the governments of adjacent local jurisdictions. As a result, regional intiatives such as intercity transportation and industrial development outside a particular jurisdiction can take into account the wider health of watersheds, for example, which deliver benefits to many cities. At the city scale, local authorities can use The Economics of Ecosystems and Biodiversity (TEEB; see page XX) to better recognize, demonstrate, and capture the value of ecosystems in cities and urban systems. 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 circular building technologies such as green roofs.

Many of the above initiatives will also help achieve the Millennium Development Goals (MDGs) on Environmental Sustainability. The MDGs aim, in part, to reduce deforestation and take action on climate change (Target 7.A) and to protect key habitats for threatened species (Target 7.B) by 2015. In parallel, the Aichi Targets aim by 2020 to promote awareness of the value of biodiversity and its sustainable use (Target 1), integrate biodiversity into local development and poverty-reduction strategies (Target 2), halve the rate of loss of natural habitats and reduce habitat degradation and fragmentation (Target 5), safeguard ecosystem services, especially those that support vulnerable populations (Target 14), and enhance ecosystem resilience and biodiversity’s contribution to climate-change mitigation and adaptation (Target 15).

**Recommended Case Studies**

**Mayesbrook Climate Change Park**

Mayesbrook Park lies in a densely urban area of East London in the Borough of Barking and Dagenham. The borough is one of the 20 most deprived in the UK, being characterized by relatively high unemployment, low household incomes, and high rates of cancer, heart disease, and teen pregnancy. The Mayes Brook that runs through the park was severely degraded, suffering from poor water quality and impoverished biodiversity and placing several residential and commercial properties at risk from flooding. Modeling suggests that with a changing climate, the risk from flooding will increase.

The restoration scheme for the park and the brook has transformed a 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 for the local community. The Mayesbrook Climate Change Park is being delivered by an innovative partnership of public, private, and voluntary organisations, including the Thames Rivers Restoration Trust, London Borough of Barking and Dagenham, Environment Agency, Greater London Authority, London Wildlife Trust, Natural England, Design for London, RSA insurance company, and the SITA Trust.

The first phase of the work rehabilitated the Mayes Brook in 2011 and created a new 1-hectare floodplain to naturally and safely store the increased floodwater expected in the area in future. New tree and shrub plantings covered an area equivalent to three football pitches, providing shade that cools the area and enhanced habitats for wildlife. New footpaths, entranceways, and signage have allowed the public to better use the park.

Future phases of the project will include a café surrounded by a climate-change garden of drought-resistant plants. A display in the café will explain how the park improvements help facilitate adaptation to climate change. The display will also show people how they can change their own lives to better cope with climate change impacts. Two polluted lakes in the park will be restored and replanted to help with stabilizing and cooling the microclimate as well as delivering recreational benefits.

A 2XXX assessment of the economic benefits associated with the restoration project demonstrated that an investment of £3.84m in restoration of degraded habitats and an enhancement of the green infrastructure will yield a lifetime benefit-to-cost ratio of approximately 7:1. The gross annual benefit delivered through the range of ecosystem services has been estimated at approximately £880,000. Of this, the regulating services—including reduction of flood risk and climate regulation—yields a gross annual return of approximately £28,000. However, 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 substantially human well-being in the urban environment.

**Mexico City Actions on Climate Change**

The effects of climate change have been manifest in Mexico City, in particular the changes in the intensity and timing of rainfall, increases in annual average temperatures, and greater frequency of extreme weather events. In order to combat climate change, a range of projects and actions have been implemented by various departments and organizations of the Government of Mexico City in concert with civil society, academic institutions, private initiatives, and international agencies.

Mexico City was the first city in Latin America to implement a Climate Action Program. In its first two years, 2008–2010, the program resulted in a reduction of almost 1.4 million metric tons of CO2 equivalent, or approximately 4 percent of the city’s greenhouse gas emissions. Three of the key elements in the overall program place biodiversity at their core, namely: the Green Roof Program; the Recovery of the Rivers Magdalene and Eslava; and the Program of Restoration of Ecosystems and Compensation for Maintaining Environmental Services.

The Green Roof Program has put in place regulations and incentives to encourage and promote the use of green roofs. The target is the creation of 10,000square meters of new green roofs per year, to assist in improving air quality, regulating humidity, creating enhanced microclimates, and providing new biodiversity resources across the city. By increasing the environmental awareness of citizens, the program also plays an important educational role.

Focusing on pollution risks not just in the rivers but also in the wider watershed of two important tributaries, the Recovery of the Rivers Magdalene and Eslava program is improving environmental conditions both within the watercourse and in the riparian neighbourhoods. By June 2010, more than 2.3 kilometers of river had been cleaned up and ecologically restored, helping to secure a water supply for the city and reducing the energy and economic costs associated with traditional water treatment.

Almost 60 percent of Mexico City is represented by Land for Conservation. This area of natural and seminatural habitats lies in the southern part of the city and provides environmental goods and services that are essential to everyone in the city—among them capturing CO2, regulating climate, replenishing groundwater, preserving species and habitats, and providing sites for recreation, research, and education. 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 participate more actively in protecting and restoring natural ecosystems. Between 2007 and 2009, 5.4 million trees and shrubs were planted and 566 hectares of land were converted from intensive agriculture into agro-forestry and seminatural ecosystems.

**Yokohama – Measures against Global Warming**

In 2007, almost 20 million tons of CO2 were emitted in the administrative district of Yokohama. Aiming to become a low-carbon city, the city set a goal to reduce per person CO2 emissions by at least 60 percent, relative to the 2004 level, by 2050.

The City of Yokohama has a population of 3,680,000, which year after year has been degrading and converting its mountain forests and farmland. In order to protect biodiverse areas, the city has introduced a new tax system and a mechanism to use the revenue to conserve privately owned green areas, and it has encouraged citizens, corporations, and developers to take part. An essential element behind these efforts is the recognition that increasing urban development has produced a demonstrable impact on the city’s microclimate, above that associated with the impacts of global climate change, resulting in a “heat island” effect.

The increase in buildings and paved surfaces across the city has enhanced the heat-absorption capacity of the land surface and consequentially increased the reflective heat, resulting in raised temperatures. Conversely, the decrease in the area of forests and farmland has resulted in reductions in evapotranspiration, slowing the cooling of the land surface.

As a response, the city has recognised the importance of biodiversity in stabilising the local climate and decided to expand green areas with rooftop and wall greening. In parallel, it is working with citizens to reduce residential CO2 emissions. In order to improve the warming microclimate and stabilize the temperature environment in a city, a minimum target for effective evapotranspiration from green areas has been set at 30 percent of the total city land area.

**Other case study recommendations**

**São Paulo:** watersheds protecting against mudslides and floods; islands of heat. **Urban “eco-areas”:** Multiple examples from Europe, UK, South Korea, and UAE.

**Key Message 8:** UN agencies, national and local governments, traditional leaders, businesses, and citizens must collaborate in managing the urban landscape.

Writing in *Science* in 1999 about new insights into managing common resources, Elinor Ostrom and 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.

The solutions to many pressing global environmental problems, including the loss of biodiversity and ecosystem services, ultimately rely on the local outcomes delivered by local actors. The good will and commitments at the global and national levels can be translated into practical results only if locals are able to respond. At the same time, local demands should be addressed by national and global processes to generate trust and ongoing cooperation, which are fundamental to long-term goals such as implementation of the Convention on Biological Diversity. No single actor has a monopoly on decisions related to biodiversity if we are aiming at sustainable solutions. 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 levels of decision-making, from national and local governments to UN and other international organizations, citizen groups, NGOs, and businesses both large and small.

Good governance is the process of steering or guiding societies toward collective outcomes that benefit all levels of society. Governance implies the interaction of multiple actors who are semi-independent of a central power and operate at different levels of decision-making. Supporting biodiversity in cities is like solving a puzzle; it will never be completed if one or more pieces are missing. 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.

Local policies for tackling the same issues targeted by international environmental agreements existed in many countries before ratification of those agreements. For centuries, countries have been protecting biodiversity for different reasons. Natural parks and reserves already existed in many countries—including developing ones—when the applicable conventions came into force. This underscores the extent to which effective implementation of international environmental agreements depends on the national and subnational policies already in place; implementation is largely dependent on local political situations. However, the emergence of political demands at higher levels can change the balance of political and economic forces at the local level, which can facilitate—or in some cases, hinder—local implementation.

New governance structures for the land management of biodiversity have emerged that do not rely solely on traditional market and government interventions, but on institutional arrangements. Often, local citizens make these arrangements themselves, and they involve both private and public land. 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.

Nevertheless, there is a need to create governance mechanisms that facilitate the dynamic exchange of knowledge and resources. Such exchanges can generate innovative solutions for urban biodiversity at both the local and global levels. 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.

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 interacting between the relevant stakeholders within and beyond the city. This can be done in three steps:

* First, decisions should be based on transparency, accountability, and inclusiveness, in order to create trust among the different stakeholder groups and a collaborative environment.
* Second, local authorities should create the institutional rules and organizational capacity to make collaboration effective and efficient. Many collaborations stop in the middle, and stakeholders lose interest in continuing long term. A contact person (or department/organization) for each action can help determine responsibilities and flow of information.
* Third, collaboration should reflect results 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 and other indicators, are also necessary.

[Note: One or two paragraphs will be added that address what is at stake; challenges; opportunities; and MDGs and Aichi Targets.]

**Recommended Case Studies**

•The Global Partnership; example of collaboration between UN agencies and local governments.

•National Park of Tijuca in Rio de Janeiro, Brazil; example of collaboration among different levels to manage biodiversity.

•Kanazawa, Japan (linking culture and biodiversity: local businesses using local biodiversity)

•Durban (collaboration between the local authority and local communities for generating green jobs in biodiversity); examples of collaboration among different local groups.

•Indigenous people: Multiple cities.

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

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

**Key Issues**

The dense concentration of people in urban areas and the merging of cities into larger urban landscapes provide stimulating opportunities for learning and innovation in terms of policy, planning, scientific advancement, and social and cultural interactions. Enhancing these opportunities through education, knowledge networking and creation of new partnerships for urban resilience and sustainability will promote more efficient use of natural resources, sustainable consumption and production patterns, reduced consumption of water and energy, and sustainable and equitable management of biodiversity.

Education is a key determinant of opportunity equality in the urban setting and a powerful instigator/driver of urban attitude and lifestyle changes. Insufficient knowledge and understanding of biodiversity and ecosystem services significantly hampers attempts to mainstream biodiversity considerations into integrated urban planning. It is urgent, therefore, that attention and allocation of resources focus on biodiversity education and awareness-raising programs, especially for the most disadvantaged and vulnerable citizens. It should be noted, however, that inadequate awareness is not a problem limited to citizens. In many cases, decision-makers and even professionals are not fully aware of the merits of biodiversity preservation. Awareness among *all* stakeholders needs to be increased to ensure the critical political support which is needed to mainstream biodiversity concerns into urban planning and policies.

The low level of awareness is closely connected to the lack of training and education of public officials and personnel, extending to both the importance of biodiversity for human well-being and the ability to identify or create opportunities to protect or enhance it.

**Opportunities**

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 and learning are 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. At the same time, the capacity to live sustainably in urban settings is not acquired and developed only within the walls of formal educational establishments; it is also generated through a wide range of non-formal and 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.

Over the last few decades, the number and diversity of urban environmental education programs have grown significantly, with the aim—among other things—of raising awareness about the benefits provided by biodiversity in general and urban 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.”

According to UNESCO, ESD in the urban context 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: it promotes mainstreaming biodiversity and ecosystem services into all forms of learning as a critical contribution to sustainable development actions, including organizing thoughtful consumption and production behaviors that are sustainable from local to global levels.

Considering that by 2030 urban dwellers will account for 70 percent of the world’s population, and that a similar proportion of these urban residents will be under age 18, ESD should be envisaged 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, e.g. pupils, students, communities, practitioners, policy makers, their principal components should encompass:

* *An integrative, innovative, and holistic vision of education and lifelong learning* encompassing various forms of training, information, awareness-raising, and learning for all ages. Biodiversity education with special focus on urban biodiversity can be provided in formal (schools and universities), non-formal (adult literacy classes and various educational institutions, including zoos and aquariums which have an important role to play in public education and awareness raising), and informal (family, community, and everyday life) settings.
* *A cross-disciplinary and systemic approach* that is particularly effective in promoting 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. Developed skills include reflective learning, critical thinking, the use of holistic approaches, interdisciplinary methods, and investigatory learning such as field studies***.***
* *A cooperative process based on networks and partnerships* promoting broad, concerted commitment and a full response to biodiversity challenges in the context of sustainable urban development. This entails involving stakeholders—including urban dwellers, teachers, decision-makers, civil society, the private sector, the media, and all cultural communities—at the community, national, and international level.

**Recommended Actions**

1. *Improve access to and retention in quality basic education* by addressing the issue of biodiversity in the context of sustainable urbanization. The key requirement is providing universal access to education to all urban citizens, including the marginalized and the vulnerable. Education policies in cities typically must serve highly diverse populations, which require effective public services and the collaboration of numerous partners. Teaching and learning must be learner-centred, developed in light of individual aspirations and daily experiences, leading the student to discuss and understand the values and challenges of biodiversity. The learning environmentitself, including school design and management practices, should reflect urban citizenship by forming a democratic forum for integration, dialogue, and respect for the environment and biodiversity.
2. *Reorient existing educational programs to address biodiversity in the framework of sustainable urbanization.* The issue of values and benefits of urban biodiversity should be incorporated in curricula and educational materials, as well as in the learning outcomes, which must not only include academic performance but also the full development of human potential and building of abilities and know-how to enable pupils to make decisions and develop attitudes conducive to preservation of urban biodiversity and sustainable urban development.
3. *Incorporate* principles of urban ESD strategies into existing programmes and structures at the local level (e.g. Community Learning Centres, distance learning models and mobile learning units).
4. *Provide training to:*
5. *decision-makers at all levels*, on principles, strategies, and methods for effective mainstreaming of biodiversity considerations in urban policies and governance;
6. *urban professionals* (architects, landscape architects and urban planners, lawyers, urban development and planning experts, economists, geographers, and engineers), on establishing and developing joint management systems for urban development, adequate housing, and access to basic amenities and public transport for all city dwellers that would reduce the negative impacts on biodiversity inside and outside cities;
7. *NGOs and community and local organizations*, on principles, strategies, and methods for influencing public policies on social and environmental management in urban settings, while communicating to public bodies the needs of all urban dwellers;
8. *media and communication professionals,* on disseminating messages and contentthat promote the understanding of the role and benefits of biodiversity in the urban context;
9. *industries and enterprises,* on the impact of industrial and commercial activities on biodiversity, and ways and means of reducing those impacts;
10. *universities and research centres*, on the need for knowledge and innovation for sustainable urban development and the role of urban biodiversity, notably through exchange among professional associations (e.g., International Union of Architects, International Federation of Landscape Architects, and International Society of City and Regional Planners) and local authorities, to provide a joint support framework and know-how transfer.

*5. Provide platforms and support mechanisms* for sharing best practices and lessons learned and linking experiences of local urban communities to national, regional, and international environmental policies for sustainability.

6. *Improve communication* within the city (both inter-departmental, and between the city and other stakeholders) around biodiversity and ecosystem services, in order to ensure all departments and stakeholders are involved, and that processes are transparent. Integration of biodiversity throughout all city functions relies on a good communication strategy, with tailored approaches for each target audience.

7. *Develop institutional mechanisms for knowledge transfer* and learning between cities. The ‘sister cities’ concept could potentially be leveraged to such ends.

Experience has shown that besides the lack of education and public awareness, another key factor that negatively affects resilience and sustainability and is related to learning and education opportunities is the fragmentation of political and institutional boundaries and mandates in and around cities. 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 and observatories 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 Transboundary Conservation Specialist Group of IUCN WCPA and URBIS.

**Links to Millennium Development Goals and Aichi Targets**

Investment in education and awareness-raising programs on the values and benefits of urban and other types of biodiversity in the context of sustainable urbanization will significantly contribute to achieving Target 1 of the Aichi Targets: “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.” It will also provide the necessary basis for achieving Targets 2 and 4, which deal with integration of biodiversity values in development strategies, and implementation of sustainable consumption and production plans, respectively. Finally, it will contribute to strategic objective E, namely enhancing implementation through participatory planning, knowledge management, and capacity building.

In addition, while investing in universal access to education will contribute to Millennium Development Goal (MDG) 2 on education for all, investment in quality urban education with efficient environmental components will contribute to MDG 7 on environmental sustainability.

**Recommended Case Studies**

**Green Wave** (SCBD – see).

**São Paulo, City Green Belt Biosphere Reserve:** In particular its programme on training and market of eco-jobs for youth.

**Puerto Princesa, Philippines:** Mangrove seeding and restoration.

**Mahe, Seychelles:** Promotion of public gardening.

**Mexico City:** Three zoological gardens and wildlife in situconservation programs.

**Cape Town:** ICLEI and CEPA Evaluation Toolkit.

**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. 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 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 influxes 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.

Innovative 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 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.

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*. 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).

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 while providing yet 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. 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.

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 with 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.

At the broadest scale of governance (often nationally), governments are beginning to eliminate “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 obsolescence of unsustainable industries. However, for green technology and its associated industries to be *socially sustainable*, the most specialized laborers must be appropriately retrained. 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–region* scale 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. With the appropriate participatory planning tools, all urban stakeholders can ensure that their day-to-day needs are inscribed within a practical spatial configuration.

As mentioned in message 6, 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 be a more reliable source. 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.

Undertaking the above can also help fulfill the Millennium Development Goals (MDGs) on Environmental Sustainability, particularly those relating to providing a safe water supply to all humans (Target 7.C) and improving the lives of 100 million slum dwellers (Target 7.D) by 2015. In parallel, they can also help achieve the Aichi Targets that aim to integrate biodiversity values into local development and poverty-reduction strategies (Target 2) and to have stakeholders implement plans for sustainable production and consumption as well as minimize the impact of resource use on the environment (Target 4).

**Recommended Case Studies**

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

The rehabilitation and expansion of the water supply and sewerage network for the city of Cartagena, Colombia, provided an opportunity for the sustainable disposal of the city’s wastewaters and the opportunity to restore the adjacent degrading Ciénaga de La Virgen, an important coastal lagoonal wetland surrounded by mudflats and mangroves.

The approach integrated a range of innovations, including restoration of degraded habitats, improved protection of a legally protected area and an associated Recovery, Conservation and Environmental Management Plan (RCEMP) for the Ciénaga, use of a cumulative environmental impact assessment (the first of its kind in Colombia), and establishment of a multidisciplinary expert panel, comprising technical experts and the private sector, to oversee the entire design and site-selection process.

This project demonstrates the importance of considering biodiversity and the protection and enhancement of important wetland habitats as part of a project’s initial goals. By adopting this integrated approach, perceptions can be changed and landscapes once thought of as degraded or unattractive can become economic, aesthetic, and ecological assets. The holistic and inclusive thinking applied in Cartagena demonstrates how the needs of infrastructure, biodiversity, and local communities can integrated in a mutually beneficial, dependent, and sustainable manner.

**Iloilo River Rehabilitation Project**

The Iloilo River has played a significant role in the development and economic fortune of Iloilo City, Philippines (population XXXX). By 2000, however, unrestricted development, siltation, overfishing, commercial exploitation, and dumping of waste had brought the river to a critical state. Faced with ever increasing urbanisation and alarming degradation of the river and the biodiversity it supported, in 2XXX the city government, in partnership with the Iloilo Business Club (IBC), developed a planning process and 10-year master plan for restoring the river. The innovative public-private approach involved all stakeholders in the important stages of planning and decision-making. The rehabilitation of the Iloilo River was considered essential to the overall objectives for the city. Because of the strategic importance of the river wharf, which brings industrial and agricultural cargo into the city and beyond, the river’s location made it a significant commercial asset, providing vital associated economic services. The city’s relationship with the river also provided opportunities for improving sanitation and human health without compromising the river’s economic potential.

The city government formulated the Iloilo River Rehabilitation Project and the River Development Master Plan, and worked in partnership with the IBC to increase the level and quality of public participation in the environmental decision-making processes. Realizing the need for multisector and integrated approaches, the city and IBC convened multisector consultative groups composed of non-governmental organisations, private businesses, academia, religious organisations, villages, and youth groups. The city ensured that the community was central to all stages of decision-making. Out of this process, a multiagency consultative and coordinating body—the Iloilo River Development Council—was established to institutionalise and implement the River Development Master Plan.

The approach taken in Iloilo demonstrates how the involvement of multiple stakeholders, including those with commercial interests, can work together to recognise the value of important natural resources and seek to integrate their protection and enhancement into a sustainable urban master plan.

**Other case study ideas**

**Mumbai, Gorai Closure Project:** 20-ha dump transformed landscape and people’s lives. Fabiana will write.

**“Supertrees” in Singapore.** Might do simply as a photo with caption.

**Section V. Conclusion**

**Synthesis and Recommendations**

[To come]

[**THEME BOXES:** Presented here in a more extensive version, they will be further summarized and distributed throughout the text, next to the key message they best support. For the purposes of this first draft of the synthesis, they are presented together here, in alphabetical order.]

**CITY BIODIVERSITY INDEX**

The City Biodiversity Index (CBI), also known as the Singapore Index on Cities’ Biodiversity (SI), is a self-assessment tool that allows cities to monitor and evaluate their progress and performance related to conserving and enhancing biodiversity. The index also allows cities to identify areas in which they have done well or can further enhance their performance through, for example, better policies, partnerships, or management.

The CBI is the first tool of its kind to be developed specifically for cities. More than 50 cities from around the globe are in various stages of testing the CBI and providing data for it. With ongoing refinement and improvement, the CBI is becoming more valuable all the time.

**Development of the City Biodiversity Index**

The idea for the CBI was proposed in 2008 by then Minister for National Development of Singapore, Mr. Mah Bow Tan. The index was formulated by the National Parks Board of Singapore in collaboration with the Secretariat of the Convention on Biological Diversity (SCBD), the Global Partnership on Local and Subnational Action for Biodiversity (GPLSAB), and a seven-member task force of international experts.

The first technical expert workshop on the CBI was held in Singapore in February 2009. Key considerations in developing the index were its ease of use by cities, scientific credibility, and objectivity. The draft CBI comprised 25 indicators divided into three components: (i) native biodiversity in the city; (ii) ecosystem services provided by biodiversity in the city; and (iii) governance and management of biodiversity in the city. The rationale for these components was that city officials and the civil society need to know what biodiversity exists in their city and its importance in terms of providing ecosystem services (such as regulation of climate or water) in the city. Governance and management are also an important component of the index, as these are the means by which cities enhance their biodiversity efforts. A quantitative scoring methodology based on a scale of 1 to 4 points per indicator was developed. The first version of the CBI User’s Manual was made available in September 2009 on SCBD’s website, and cities were invited to test the index.

A second technical expert workshop, held in July 2010 in Singapore, reviewed the experience of cities that had tested the index. Participants made key revisions, including streamlining the number of indicators from 25 to 23 and fine-tuning the scoring, and a revised User’s Manual was made available.

A third technical expert workshop was held in October 2011 in Singapore. As data were available from only 14 cities for the seven indicators that require scoring ranges to be determined, participants agreed that a larger sample size was required before an appropriate statistical methodology could be adopted and the scoring ranges determined. The third revision of the CBI is available at www.cbd.int/authorities/doc/User%27s%20Manual-for-the-City-Biodiversity-Index27Sept2010.pdf.

[Note: Updated paragraph to be added here if scoring ranges are further developed.]

**Lessons Learned and Applications of the CBI**

In developing the CBI, it has been important to bear in mind its primary purpose, which is to assist cities in monitoring their biodiversity conservation efforts over time and to support the integration of biodiversity considerations in developing and managing the city. The enormous diversity of cities in terms of geography, economic development, and human-resource capacity was an important consideration in developing an index that is relevant to cities around the world.

It is proposed that the CBI’s current 23 indicators be seen as core indicators. Optional indicators can be developed as necessary and can be tailored to specific monitoring needs of individual cities. Some suggestions include indicators on the ecological footprint of the city, on promoting vertical greenery, on other types of ecosystems, such as Mediterranean and desert ecosystems.

The CBI is flexible enough to accommodate the application by the city depending on its resources and capacity. For example, the index need not be based on new and additional surveys initially; existing data are also welcome.

A platform for cities to share their experiences on applying the index was particularly useful to cities considering using the CBI. The CBI also allows cities to engage their relevant stakeholders such as universities and civil society to assist in providing some of the data. The CBI is also a useful public communication tool for city authorities.

In developing and testing the CBI, other potential applications for it have surfaced. For example, information from the index can be used in the decision-making and master planning of cities. 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 can also assist policy- and decision-makers in allocating resources and prioritizing projects.

**Way Forward**

It is hoped that the CBI will be a useful tool for cities to highlight their contribution to the biodiversity conservation efforts of their respective governments. Parties are encouraged to note their respective cities’ contribution in the regular national reporting to the CBD. In the long term, and with the support of more cities applying the index, the CBI may be developed into a biodiversity certification program for cities to recognize their efforts on promoting biodiversity conservation and management.

To date, 12 cities have provided information on all 23 indicators of the CBI: Auckland, Bandung, Bangkok, Brussels, Curitiba, Edmonton, Hamilton, Lisbon, London, Montreal, Nagoya, and Singapore.

[Note: Authors will add either box stories or a section to highlight some of the cities’ experiences on applying the Index.]

**GREENING IN THE RED ZONE**

The Civic Ecology Lab (CEL) at Cornell University has been collecting and studying stories that are emerging from communities (predominantly urban) around the world of people who turn to greening during the most difficult of times—periods of violent conflict and of collapse of the social and economic fabric of their community, and in the aftermath of earthquakes, hurricanes, and other human-natural disasters. This post-catastrophe, community-based stewardship of nature that serves as a source of social-ecological resilience is referred to as “Greening in the Red Zone.”

CEL has brought together these stories, in a series of short examples and longer case studies, in a book and a related website in an effort to understand why people turn to greening in the face of conflict and disaster. What motivates them, and what are the implications for themselves, their community, and their local environment? CEL has turned to explanations from a growing body of research on the impacts of more passive contact with nature, as well as a smaller literature on the outcomes of the act or active practice of nature stewardship. It is also drawing on a growing network of “resilience scholars”: social and ecological scientists who believe that change is to be expected and planned for, and that identifying sources of resilience in the face of change—including the ability to adapt and to transform—is crucial to the long-term well-being of humans, their communities, and the local environment.

According to resilience scholars Ann Masten and Jelena Obradovic, “It is often argued that all disasters are local, at least in the short term. In the same sense, it could be said that all human resilience is local, emerging from the actions of individuals and small groups of people, in relation to each other and powered by the adaptive systems of human life and development.” Heeding these words, CEL is focused on phenomena that take place at local levels—the small acts of greening that emerge, often spontaneously, following disaster. This is not to say that the questions addressed by CEL are irrelevant for government policy-makers, larger NGOs, and researchers working in the areas of natural resources management and peacemaking. To the contrary, taken as a whole, the theoretical and practical contributions of CEL regarding so called Greening in the Red Zone make an argument for why policy-makers should take into account these local acts of greening or small-scale “sources of resilience.”

How might local greening practices become a source of resilience during difficult times? Although much of our thinking about individuals who have experienced catastrophe focuses on suffering and despair, studies have shown that not only are resilient people buffered from depression by positive emotions, they actually thrive through such emotions. To quote one such research paper, “finding positive meaning may be the most powerful leverage point for cultivating positive emotions during times of crisis.”

Scientists at the Civic Ecology Lab argue that we should pay attention to the use of the term “cultivating” in this quote. It makes the connection between cultivating positive emotions and cultivating plants, and suggests that the act of greening integrates both. As these researchers argue, a series of “provocative studies provide an intriguing context and ‘jumping-off’ point for investigating the role not just of viewing or being around trees and green spaces, but also of *cultivating* such spaces. By cultivating, we refer to nurturing plants and animals, people and communities.”

Thus, the evidence accumulated by CEL focuses on community greeners (the people) and community greening (the practice), as well as the community green spaces these people and practices create (the places). CEL is working to answer questions about the role of “greening” people, practices, and places in building and demonstrating resilience in the face of catastrophic change. It is exploring how the act of people coming together around the renewal and stewardship of nature might enhance individual and community resilience, and perhaps even contribute to social-ecological system (SES) resilience, biodiversity conservation, ecosystem services provision, and related sustainability issues, in chaotic post-disaster and post-conflict contexts. Because of the rapid growth of cities globally and their ever looming importance as sites of conflict and disaster, many of CEL’s 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.

For more information on Greening in the Red Zone, visit http://greeningintheredzone.blogspot.com.

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

Local Action for Biodiversity (LAB) Pioneer is a global urban biodiversity project coordinated by ICLEI Cities Biodiversity Center, which in turn is coordinated by the Africa Secretariat of ICLEI – Local Governments for Sustainability.

Local governments are significant frontline managers of global biodiversity as they are tasked with service provision and ensuring that social and economic development proceeds within the carrying capacity of the biological resource base. Local governments thus have considerable potential to affect ecosystems at a range of scales. Recognizing this potential, as well as the imperative to address biodiversity loss in urban areas, LAB Pioneer Project engages with local governments to encourage the integration of biodiversity considerations into urban planning and policy formulation. The project guides participating cities, known as LAB Pioneers, to become international leaders in biodiversity and ecosystem management, while developing and refining biodiversity “tool kits” and establishing a global network for the exchange of best practices. The project also promotes public awareness of urban biodiversity and highlights the efficacy of local actions in addressing biodiversity loss.

The project was proposed by the City of Cape Town at the ICLEI World Congress 2006 and adopted by the ICLEI Council. Its pioneer phase ran from 2006 to 2009, working with a select group of 21 local and regional authorities from around the world that represented more than 54 million citizens. The initiative has since expanded to include many more cities and has branched into thematic streams, including LAB Climate Change and Biodiversity and LAB Biodiversity and CEPA (Communication, Education, and Public Awareness).

LAB Pioneers work through five steps:

1. Compilation of a Biodiversity Assessment Report, which synthesizes available information on local species and habitats and outlines current management practices;
2. Signing of the Durban Commitment, a political recognition of the importance of biodiversity and a pledge to protect it;
3. Preparation of a Local Biodiversity Strategy and Action Plan (LBSAP) that aligns with the national equivalent;
4. Endorsement of LBSAP by the City Council; and
5. Implementation of three biodiversity projects that operationalize the LBSAP, such as the adoption of specific bylaws or ecologically restorative activities.

In undertaking these steps, LAB Pioneers receive support from ICLEI Cities Biodiversity Center, in the form of technical assistance, networking opportunities, participation in specialist training workshops, showcasing of achievements at important international events, and advocacy.

From the adoption of green roofing policies in the City of Seoul, South Korea, to the restoration of waterways around the City of São Paulo, Brazil, the achievements of LAB Pioneers are diverse, geographically widespread, and numerous. LAB Pioneers have also made substantial contributions to global policy processes. For example, they were instrumental in generating the political momentum that was conducive to the adoption of Decision X/22 at the 10th Conference of the Parties to the Convention on Biological Diversity in Nagoya in October 2010. The decision constitutes a formal recognition of the critical role that local governments play in addressing the plight of biodiversity and endorses a Plan of Action that sets out a range of measures that national governments can take to support their local governments in that pursuit.

As new cities continuously join LAB Pioneer and the network grows, best practices and case studies accumulate, management tools are improved, and the scope for knowledge exchange enlarges, thereby enhancing the benefits of participation. For more information, visit [www.iclei.org/lab](http://www.iclei.org/lab).

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

**TEEB** is a major international initiative to draw attention to the global economic benefits of biodiversity, highlight the growing costs of biodiversity loss and ecosystem degradation, and draw together expertise from the fields of science, economics, and policy to enable practical actions moving forward. Established in 2007, TEEB is hosted by the United Nations Environment Programme with financial support from the European Commission, Germany, the United Kingdom, Netherlands, Norway, Sweden, and Japan.

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 has become an underlying cause for the degradation of ecosystems and the loss of biodiversity. With this in mind, TEEB has made a compelling economics case for the conservation of ecosystems and biodiversity. Drawing on expertise from around the world, its many reports evaluate the costs of the loss of biodiversity and the associated decline in ecosystem services worldwide and compare them with the costs of effective conservation and sustainable use. The intent is to sharpen awareness of the value of biodiversity and ecosystem services and facilitate the development of effective policy, as well as engaged business and citizen responses.

Assessing the monetary and non-monetary values of the benefits that citizens derive from ecosystems is a new and challenging way for local actors to think about nature. To undertake this challenge, TEEB first published a “Local and Regional Policy Makers Report,”which illustrates how dependent cities and municipalities are on nature, and that nature has cost-effective solutions to local problems such as drinking-water supply or air-pollution control.

In 2011, TEEB published two more groundbreaking reports. “TEEB Manual for Cities” gathers experiences and case studies from around the world and proposes an approach to help urban and regional policy-makers and planners assess the value of natural systems and consider opportunities and tradeoffs of their policy and planning options. The manual provides an easily understandable introduction to the subject of ecosystem services; how to determine their value; and how to incorporate a consideration of ecosystem services into municipal functioning as a long-term investment to enhance existing municipal management. The focus of the manual is on cities, although the term “cities” is used to represent all forms of local government. The audience is practitioners and policy makers at the local level—including those directly responsible for biodiversity management and those whose work is indirectly related to biodiversity management.

“TEEB in Business and Enterprise” is aimed squarely at the business and enterprise sectors, which also have a huge role to play in how we manage, safeguard, and invest in our natural capital. This report provides practical guidance for a wide array of enterprises and businesses, including mining, oil and gas, agriculture and fisheries, banks and asset managers, insurance and business services, eco-tourism and eco-agriculture, and bio-carbon.

These and other TEEB reports are available for download at the TEEB website, as are presentation tools, a newsletter, information on upcoming TEEB-sponsored workshops and conferences, and information aimed at distinct end-users, among them ecologists and economists, international and national policy-makers, local and regional policy-makers, businesses, and citizens.

Yet another TEEB project is TEEB for Citizens, a multimedia effort to draw on information from the various TEEB reports and present them in a compelling and imaginative way for consumers and citizens. This effort, coined “TEEB4me,” focuses on harnessing the power of the internet and social media to create awareness and understanding of the value of nature. TEEB4me—at [www.teeb4me.com—uses](http://www.teeb4me.com—uses) tools such as Facebook, Twitter, and Vimeo to maximize outreach and 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.

For more information, visit [www.teebweb.org](http://www.teebweb.org).

**URBIS – The Urban Biosphere Network**

*Reconnecting people to nature in an urbanizing world*

**What Is URBIS?**

URBIS is a global 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.

Launched in May 2008 at the Convention on Biological Diversity’s (CBD’s) COP 9 in Bonn and formalized at CBD COP 10 in Nagoya in October 2010, 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 and our incomplete knowledge of linked social and ecological systems functions in an urbanizing world.

URBIS adopted the CBD’s ecosystem approach to urban thinking and planning. The ecosystem approach is one that recognizes the need to protect, wisely use, and equitably share the natural resources and ecosystems that support life on Earth. It connects people and their economic and social needs with our planet’s health in a very immediate way. This is one of the major challenges today, as policy-makers, scientists, and citizens try to reconnect the three pillars of sustainable development: food, energy, and water.

URBIS contributes to the achievement of the Millennium Development Goals (MDGs) at both the regional and local scales. It will also be a useful tool in forging the Sustainable Development Goals (SDGs) expected to emerge from the Rio+20 Conference in June 2012.

Developed through a place-based research partnership between Columbia University and UNESCO, the URBIS initiative has been developed since 2010 by ICLEI, IUCN, UNESCO, the Stockholm Resilience Centre, the Swedish Society for Nature Conservation, Cornell University, United Nations University, the Secretariat of the CBD, and the cities of Montreal and Jerusalem.

**URBIS on the Ground**

In the past 10 years several academic groups and civil-society organizations have been involved in developing and testing the URBIS concept. They include:

* In Shanghai: ecosystem services focusing on water.
* At Tulane University in New Orleans: ecosystem restoration, resilience, and post-disaster recovery.
* At The New School and Cornell University in New York: education related to civic ecology, resilience, and sustainability.
* At Chicago Wilderness in Chicago: urban planning, networking, and collaboration.

Since 2010, three URBIS pioneer cities have adopted the URBIS concept for urban planning at different scales:

* Stockholm: protection of biodiversity and ecosystem functions in “green wedges” in the Stockholm archipelago.
* Montreal: establishment of “eco-territories” to preserve the natural environment and promote public interest, well-being, and economic development.
* Jerusalem: joint management by Arab and Jewish communities of natural, cultural, and social assets for water and sewage treatment.

**URBIS Recognition**

A new initiative is underway to create formal URBIS recognition of municipal efforts to collaborate on sustainable urban planning. Criteria are being developed for this recognition, and the funding, partnerships, and tools needed to make the concept operational are being pursued.

URBIS will recommend that cities work through a voluntary, participatory, site-driven, and tiered-designation approach. This process will help cities make common-sense, cost-effective, and science-based decisions to help guide equitable and sustainable urban social-ecological development.

By the year 2020, URBIS aims to certify 20 URBIS cities that have shown tangible improvements in development practices. With formal recognition of cities that meet international standards for sustainable planning, URBUS aims to provide yet another incentive for municipalities to collaborate for sustainable urbanization.

**What URBIS Offers**

URBIS is a force for change and effective collaboration for sustainable urban planning. A partnership with URBIS offers:

* a unique opportunity to help build a distinguished community of urban centers engaged in highly visible urban sustainability planning.
* an effective networking platform with access to tools, materials, and information sharing.
* increased quality of life for residents and improved performance on environmental indicators.
* enhanced global competitiveness and leadership in the green economy.
* comprehensive tools for adaptation to environmental changes.

**New Communication Tools**

URBIS is in the process of creating a handbook on lessons learned and best practices. On-going virtual collaborations and discussions among cities and stakeholders will be established and regularly facilitated through new communications tools. For more information, visit XXX [need URL].

**RESOURCES AND INITIATIVES**

**8-80 Cities**

[www.8-80cities.org/](http://www.8-80cities.org/)

A Canadian-based nonprofit with an international outlook that works to improve quality of life in cities. It promotes walking and bicycling as activities and urban parks, trails, and other public spaces as great places for all ages. Its goals are to improve the environment, advance economic development, boost and complement transportation systems, make better recreation for all, and enhance personal and public health. The 8-80 team works with decision-makers in the public, corporate, and nonprofit sectors in cities all over the world.

**City Biodiversity Index (CBI) (see page XX)**

[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.  More than 50 cities worldwide are currently using the CBI. A User’s Manual is available for download at www.cbd.int/authorities/doc/User%27s%20Manual-for-the-City-Biodiversity-Index27Sept2010.pdf.

**Climate Alliance**

www.klimabuendnis.org

An organization of more than 1,600 European cities, municipalities, and districts that have partnered with the Indigenous Peoples Organization of the Amazon Basin ([COICA](http://www.coica.org.ec/ingles/bienvenido.htm)) to protect the global climate. The group aims to reduce greenhouse emissions by developing and implementing local climate strategies, especially in the energy and transport sectors. It also works to raise public awareness of the need to protect rainforests and to abstain from municipal procurement of tropical timber derived from destructive logging.

**FAO – Food and Agriculture Organization of the United Nations**

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

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. Serves as a knowledge network and provides policy expertise and technical know-how.

**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 below).

**Green Wave**

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

The Green Wave is 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 below)](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.

**ICLEI – Local Governments for Sustainability (see page XX)**

[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.

**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.

**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.

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).

**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.

**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.

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

[www.nrg4sd.org](http://www.nrg4sd.org/) and 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.

**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.

**Ramsar Convention on Wetlands**

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

An intergovernmental treaty 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 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 ecosystem services 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.

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

www.cbd.int/sp/

A ten-year framework for action by all countries and stakeholders to save biodiversity and enhance its benefits for people. Twenty ambitious yet achievable targets are organized under five main goals, with the purpose of inspiring broad-based action in support of biodiversity.

**TEEB – The Economics of Ecosystems and Biodiversity (see page XX)**

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.

**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.

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

www.unhabitat.org/

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 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. 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.

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

www.ias.unu.edu/

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.

**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.

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

[www.fh-erfurt.de/urbio](http://www.fh-erfurt.de/urbio/httpdocs/index.html)

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.

**URBIS –** **Urban Biosphere Network (see page XX)**

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

A global network of scientists, planners, educators, and policy makers who share ideas for developing more resilient and equitable urban regions by promoting an ecosystem approach to planning and management. Provides access to tools, materials, and information sharing. Several “pioneer” URBIS cities have already undertaken major works in sustainable urban planning.

Note: CBD URLs may change between now and June 12; we’ll update as needed.

**Interactive Visualization of the Assessment on the Web**

[Text to come]

**Key Recommendations**

[Text to come]

**Bibliography**

[Text to come]

**Acknowledgments**

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**Photo Credits**

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