Chapter 2
Conceptual Framework

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A conceptual approach for greener cities must always be based on recognized actual and expected challenges. A first reaction is to develop strategies to deal with these challenges. These strategies have to be conceptualized in clear, targeted concepts. This is the main idea of this chapter and of the book as a whole. To do this for two very different countries, different in size, population, and urbanization level (Sect. 2.3), is a challenge of its own. The need to come to positive results may be much more challenging in China than in Germany. But the strategies can be readily compared, and the two sides can learn from each other about the efficiency of strategies and concepts.

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2.1 Challenges Developing Greener Cities in China and Germany

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Two countries, China and Germany, different in population, size, and culture, share comparable challenges from urbanization. Also, these challenges are different in their dimensions but not very different in their main aspects (Table 2.1). The focus here should not be on challenges which are either very specific to only one country, like urban shrinkage in several German cities or handling of de-industrialization, or very regional within one of the countries, but rather on those which are common to both countries. This includes also the public, planning and administrative reaction to those challenges and the methods used to overcome them.

Concentrating more than 50% of the world's population on less than 3% of the Earth's surface, urban areas provide tremendous opportunities for sustainable land use (Box 2.1). The development of urban areas, including growing infrastructure, economic development, and quality of life, is to be brought into harmony with the protection of nature and the environment. Many municipalities and initiatives worldwide are pursuing 'green' urban development (Fig. 2.1). The concepts that serve as a basis for this are diverse. Transparent, indicator-based evaluation systems are necessary to ensure that planning and action do indeed lead to increased sustainability and to a higher quality of life of the population in cities (Box 2.2).

Box 2.1 More individual living space forces urban growth and resource consumption in Germany and China

In ***Germany*** the trend to bigger apartment sizes per capita is increasing. Between 1998 and 2013 the consumption of apartment space increased from 39 to 46.3 m^2, with pollution constant or even decreasing. The reasons are economic welfare imposing more individual household structures (one- or two-person apartments) and the increasing demand for individual space in apartments (BiB 2013).

Some 50 million of ***China***'s 230 million urban households still live in substandard quarters in crowded conditions. It is estimated that China will need to build 10 million apartments a year until 2030 (Orlik and Fung 2012). Currently, China's average per capita living space is already 32.9 m^2; in Shanghai it is 24.2 m^2 (GBtimes 2015). This trend in individual space resource consumption results in higher CO_2 emissions, more traffic, more pollution, more energy and material use, and many other important factors relevant for sustainable urban development.

Table 2.1 Different conditions of urbanization and ecological urban development (simplified overview)

	Germany	China
Urbanization rate	75% (2014)	54% (2014)
Economic growth rate	Low economic growth, tendency decreasing	High economic growth, tendency decreasing
Urban growth	Slow urban growth through changes of internal urban structures, but still growing urban sprawl and urban land consumption of rural land	Extreme urban growth with big regional differences and the target to reach the urbanization degree of developed countries, and a ban (statutory, but patchily enforced) on converting agricultural land into built-up area
Management of urbanization	Locally, regionally but also nationally steered urban development (e.g. national/regional/local strategies for different challenges like sustainability, climate change, loss of biodiversity, brownfield development), decisions based on competition for economic resources and governmental moderation. Competition between cities and surrounding communities	Centrally steered urban development policy, competition for centrally distributed financial support, local and regional economic competition. Building of new cities and changing of old cities by radical transformation and building of new urban structures (infrastructure, housing stock, open spaces, industry, etc.), but also conservation of cultural treasures. Recently, this phenomenon has slowed down
Ecological principles of urban development	At the urban district level with involvement of citizens and NGOs, good examples have been realized based on urban ecological knowledge for decision-making and urban design	Centrally managed strategy of building new cities as eco-cities without involvement of citizens, based only on fragmented urban ecological knowledge for urban design. But this is now changing with the central and/or local government's efforts to input sound ecological knowledge into decision making as well as urban planning and design
Green policy	Different approaches for green space development policies in cities: national (e.g. 'Whitebook Urban Green', national strategies), regional (e.g. regional plans), local (e.g. landscape, master plans for green, green/biodiversity strategies), supporting programs, etc.	Powerful green space development policies and urban green extension in many cities based on high financial input in land, construction and management. Urban ecological space construction and environmental protection are more economically and administratively oriented, as opposed to ecological orientation

(continued)

Table 2.1 (continued)

	Germany	China
Development of urban nature	Protection of existing urban nature, especially urban forests and wetlands for recreation and biodiversity. Partly development of new urban nature on brownfields (urban wilderness), in urban reconstruction processes. Development of green networks to connect green spaces and biotopes in the city	Development of new urban nature, especially planting urban forests and new design of urban wetlands for recreation and biodiversity

Fig. 2.1 Green can be integrated into urban patterns: **a** Urban green in a residential area in Beijing, **b** Urban green in a residential area in Dresden, **c** Roads without green cover and air pollution in Beijing, **d** Green street/parking place in Beijing. © Jürgen Breuste

Box 2.2 Ten challenges to develop greener cities in China and Germany (cf. Breuste et al. 2016)

1 … Growing urban land consumption

The use of land for building activities and the resource utilization in and around agglomeration centers are increasing. This is connected with increasing resource consumption of mostly fertile agricultural land and other nature resources.

2 … Low-density urban expansion
The improving personal living conditions and the individualization in cities entail a preference for low-density housing and more individual space. The demand is high in Germany and growing in China.
3 … Unhealthy urban living conditions due to air and water pollution and noise
Most unhealthy urban living conditions are caused by air and water pollution, too little green space and noise. Especially urban dwellers in China suffer under these conditions.
4 … Climate change
Climate change will aggravate the thermal conditions in urban areas and will be a health risk for sensitive and exposed urban dwellers.
5 … Uneven distribution of urban green
In most of the cities the urban green is not equally distributed and accessible for all to benefit from it.
6 … Exclusion of people from decision-making about their neighborhoods
Only accepted local decision-making is sustainable. Most people want to participate in decision-making about their surroundings. They know best which urban green is missing and where. In many ways ordinary people are, especially in China, still not integrated in the decision-making.
7 … Unused existing scientific and practical knowledge
Many new development projects are failing to integrate the highest standards of available ecological knowledge on buildings and green space organization. Especially in China with its huge urban development everywhere, the ecological standards for building and for open spaces are mostly still not implemented.
8 … Reduced public budget for local tasks
In many communities, reduced budgets do not allow for the development of green spaces with high follow-up maintenance costs. This is the case especially in Germany, but China is also faced with this.
9 … Urban dwellers lost contact with nature
Contact with nature is necessary for health, for a general understanding of nature, and for benefiting from nature. Most urban dwellers have already lost close contact with nature but would like to develop it again.
10 … Existing cities are not sustainable
The current urban form, internal spatial quality, energetic performance, traffic organization, etc. are not sustainable and resilient against future challenges.

Most of the challenges cannot be met by technical solutions alone. These must be accompanied by a reduction of resource-consuming behavior, a long-term process of acceptance and education. The potentials of ecosystems, often called ‘nature-based solutions’, can be used in support. The problems for which urban nature can contribute to a ‘solution’ have to be identified carefully, without

overestimating urban nature's capacities, but also not underestimating and ignoring them. In many cases all three aspects, technical, behavioral, and nature-based, will have to be included in order to best meet the contemporary and future challenges to building resilient cities and towns.

There are several scientific challenges for sustainable urban development integrating urban nature:

- Urban nature and its role in providing ecosystem services is intensively being discussed internationally (Breuste et al. 2013; Kabisch et al. 2015; Von Döhren and Haase 2015; Hansen and Pauleit 2014; Hansen et al. 2015). The analysis and assessment of urban ecosystem services and of urban biodiversity needs to be scientifically sound and practice-oriented. There is an urgent need to integrate the concept of urban nature into urban planning and management (Pauleit et al. 2011; Hansen and Pauleit 2014; Hansen et al. 2015).
- The contribution of the different green and blue spaces which are part of the urban green infrastructure needs to be evaluated with respect to their contribution to people, biodiversity, and climate change adaptation (Gill et al. 2007; Fryd et al. 2011; Breuste and Artmann 2014; Loibl et al. 2014).
- There can be trade-offs between urban ecosystem services and biodiversity. There is a need to investigate how they are mutually dependent within different urban contexts (Breuste et al. 2013; Wang et al. 2016).
- The scales of investigation and implementation are a special problem of analysis and assessment (Andersson et al. 2015). The local-level provision of ecosystem services is important but needs to be embedded into strategic frameworks for developing green infrastructure at urban and regional scales (Pauleit et al. 2011).
- Development of better relationships between urban and rural areas is crucially important in both the European and the Chinese context (Spiekermann et al. 2013). Scale mismatches between service-providing units and units of decision-making require particular attention (Borgström et al. 2006).
- Urban waters are important parts of the urban green-blue infrastructure. Their protection and reestablishment in order to let people profit from urban nature is currently ongoing in many cities (Sect. 3.3.2).
- Soil sealing reduction is a general target in many cities. Several methods to improve this are being discussed (Pauleit and Breuste 2011; Artmann 2014).

2.2 Strategies and Concepts

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In this study, the 'green city' as one concept for urban development refers to a city which fosters urban biodiversity to form green infrastructure, which might provide ecosystem services based on nature-based solutions to tackle urban challenges.

Strategic and conceptual approaches can help to define the aims for urban development and the future spatial structure of a city (Yu et al. 2011). If such approaches for the development of entire urban open space systems are in place, they can serve as a firm base for decision-making (Hansen and Pauleit 2014) and can thereby foster the development of 'green cities'.

To tackle the above-mentioned challenges (Sect. 2.1) and to counteract the problems connected with them, a series of policies, concepts, and strategies referring to different planning levels exist: national, regional, and local (entire city level and neighborhood level).

Concepts on the one hand provide ideas for the urban structure and on the other hand contribute to achieving a concrete aim, the implementation of 'green cities'. For the implementation of policies, models, and concepts, generally strategic planning or strategic approaches are required. Bryson (2004) defines strategic planning in general as "a disciplined effort to produce fundamental decisions and actions that shape and guide what an organization (or other entity) is, what it does, and why it does it." It consists of a set of concepts, methods, and instruments. Bryson (2004) further emphasizes that strategic planning is a tool that supports thinking, acting, and learning in a holistic and organizational context. Strategies can be seen as informal planning instruments. Strategic approaches can aim at the spatial structure of a city, at the quality and function of urban green space systems and at the implementation process.

In this chapter, the following main approaches to foster the development of a 'green city' will be introduced: policies and political strategies (Sect. 2.2.1), concepts for cities (Sect. 2.2.2) and municipal green strategies (Sect. 2.2.3).

2.2.1 Political Strategies

Political strategies try to advance political ideas (Schröder 2000). Currently the concept of a 'green city' is being promoted quite prominently through a number of political strategies on different spatial and political levels.

Global strategies

The 17 Sustainable Development Goals (SDGs) adopted in 2015 are set to take into account all aspects of sustainable development—the ecological, economic, and social dimension—more than has hitherto been the case. For example, one of the core elements of Goal 11 refers to universal access to safe, inclusive and accessible, green and public spaces in particular for women and children, older persons, and persons with disabilities (UN 2015). Since 1978, UN-Habitat has been specifically setting the focus on urban spaces, aiming at promoting the development of socially and ecologically sustainable settlements (UN-Habitat 2012). At the Habitat III Conference in October 2016, the New Urban Agenda was passed, which is meant to serve as a political guideline for urban development over the next two decades. Ecological sustainability is one issue among manifold other goals for urban

settlements. It should be ensured *inter alia* by protecting, conserving, restoring, and promoting ecosystems and biodiversity to allow healthy lifestyles in harmony with nature, urban resilience, and mitigation of and adaptation to climate change. Besides, also safe, inclusive, accessible, and green public spaces in the form of multifunctional areas should be promoted (UN 2016).

Also at the international level, the Convention on Biological Diversity (CBD) is seen as a key instrument for fostering and protecting biological diversity (Harrop and Pritchard 2011). So far, 196 Contracting Parties (as of September 2016, CBD 2016), including China and Germany, have ratified this convention.

Strategies for Europe and Germany

Apart from these global strategies, the diverse ecological characteristics of a country and its specific social, political, and economic factors involved in the protection and sustainable exploitation of biological resources require national and subnational responses (Harrop and Pritchard 2011). The CBD serves as a conceptual framework for respective national strategies. In Germany, the 'National Strategy on Biological Diversity' adopted in 2007 (BMU 2007) meets these requirements by demonstrating the German contribution to the conservation of biodiversity at the national and international level, providing guidance for different actors (Stiehr 2009). One of its concrete visions relates to urban landscapes and aims *inter alia* at increasing green spaces in settlements, e.g., through unsealing or ecological upgrading of residential districts.

The German 'Greenbook on Urban Green' summarizes the state of knowledge on urban green development (BMUB 2015). Based on this, a 'Whitebook' has been released in May 2017, which presents concrete recommendations for action and implementation in terms of ten actions fields (BMUB 2017). Since 2011, the 'EU Biodiversity Strategy to 2020' aims at reversing biodiversity loss and accelerating the EU's transition towards a resource-efficient, environmentally friendly economy (EU COM 2011). Against the background of a highly fragmented landscape, the 'EU Green Infrastructure Strategy' published in 2013 serves to promote an EU-wide green infrastructure. Establishing a green infrastructure should foster the preservation and improvement of ecosystems and the services they provide (EU COM 2011). Furthermore, green infrastructure is perceived as an opportunity to integrate biodiversity issues into other policy sectors (EU COM 2013).

The development of urban green spaces is strongly related to issues of urban land use. The National Sustainability Development Strategy of Germany claims to reduce the land take for settlements and traffic infrastructure to less than 30 ha per day by the year 2030 (Die Bundesregierung 2016). This aim is to be reached *inter alia* by avoiding urban sprawl and fostering compact cities (see Table 2.3). The latter goal, which is mainly addressed by infill development in existing urban structures, has an influence on the provision of green spaces in cities. To deal with this conflict, the approach of so-called 'dual inner development' has been introduced to ensure high-quality green space concurrent with building activities in urban areas (Kühnau et al. 2016).

Strategies for China

In the case of China, after it ratified the Convention on Biological Diversity in 1992, the national government released the China Biodiversity Conservation Action Plan in 1994 and updated it to the China National Biodiversity Conservation Strategy and Action Plan (2011–2030) in 2010 to guide conservation and protection work at the national level.[1] To address the importance of biodiversity and green space in urban areas, the State Standard for Garden Cities[2] released by the Ministry of Environmental Protection (MEP) in 2000 and the Notice on Enhancing the Work on Protecting Urban Biodiversity[3] by the Ministry of Housing and Urban-Rural Development (MoHURD) in 2002 set clear indicators and targets to evaluate biodiversity and the condition of green spaces, in order to better preserve and restore them for ecological and cultural services and socioeconomic benefits.

Most recently, China's 13th Five-Year Plan (2016–2020) on National Ecological Protection,[4] a national legislative document to set the direction, principles, baselines, and targets and map out the strategies for ecological conservation and protection in China for the next 5 years, mentioned protecting urban biodiversity and restoring urban green space as key complementary factors to expand ecological services. In addition, the document National Planning of Urban Ecological Protection and Construction (2015–2020)[5] jointly published by MoHURD and MEP in December 2016 proposed to improve the living environment, strengthen urban biodiversity protection, and restore urban eco-environments. In order to implement the targets set in the national plan, provinces and cities usually make their own Five-Year Plans, listing specific targets including the urban park area per capita, etc.

China's Plan for National Economic and Social Development, also called the Five-Year Plan, is the leading plan of national economic and social development in a certain period. It plays a leading role, in contrast to a specific implementation plan. Since 1953, China has adopted 13 Five-Year plans, which covered economic and social development, industry, IT, ecological and environmental protection, etc. Regarding green space development the plans mainly act as steering wheel and set the aggregate indicators on national scale.

'Ecological civilization' is one of the new government strategies in the 13th Five-Year Plan. The core and essence of ecological civilization is to maintain the natural ecological balance and realize harmony between human beings and nature. The specific framework includes: strengthening ecological development, regulating land use, developing main functional zones, strengthening the construction of ecological society, promoting citizens' awareness of ecological development, establishing an ecological civilization system, and setting up a system of national parks.

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[1] https://www.cbd.int/doc/world/cn/cn-nbsap-v2-en.pdf.

[2] http://www.mohurd.gov.cn/lswj/tz/201012502.doc.

[3] http://www.mohurd.gov.cn/zcfg/jsbwj_0/jsbwjcsjs/200611/t20061101_157066.html.

[4] http://www.gov.cn/zhengce/content/2016-12/05/content_5143290.htm.

[5] http://www.mohurd.gov.cn/wjfb/201612/t20161222_230049.html.

Environmental protection and ecological control program at the national level is a generic term for a series of plans that play an active role in promoting green space development. This category of plans further extends and refines the relevant provisions of green space development and environmental protection in the Plan for National Economy and Social Development, so as to provide ideas and guidance for green space development. These plans and outlines are mainly issued by the State Council, the Ministry of Environmental Protection, the Ministry of Housing and Urban-Rural Development, the State Forestry Administration, etc. Some environmental protection and ecological control programs issued in recent years that take an active part in promoting green space development are listed in Table 2.2. Nevertheless, China has not yet issued a special plan with the theme of green space or green infrastructure systems at the national level.

2.2.2 *Urban Concepts*

The communication and finally agreement of different stakeholders on one vision of urban green space development might support the coordination of different interests and the implementation of concrete measures of urban development (Becker 2010; WBGU 2016).

So-called 'Leitbilder' concerning visions, guiding principles, overall concepts or objectives for urban development are used in different contexts (Rößler 2010) to transport ideas for the 'city of the future' in reaction to changes of society, environment, and economy (Kuder 2008). Related to their different origins, the rationales, scope, relevance, and contents differ (Fürst et al. 1999). Three main types can be distinguished (Sieverts 1998):

- 'Urban Utopias' are characterized by symbolic dimensions defining ideal urban frameworks, integrating spatial, societal, and socioeconomic aspects (e.g., Garden City, Howard 1898);
- 'Structural models' focus on urban form, physical structures, land use, and the spatial form (e.g., polycentric urbanization models, compact city, green rings, Sect. 4.2);
- 'Slogans' with a strategic orientation, mottos and catchwords, reproduce more complex and manifold ideas and visions. They are often used for marketing purposes or in competitions (e.g., Vancouver 'Greenest City'; 'Golden/Garden city Wenjiang', Sect. 4.3.7).

Most urban strategies combine selected aspects of more than one of these types to form general but also individual urban strategies.

Green spaces have been addressed explicitly in some of these approaches. Since the beginning of the twentieth century, particularly social, health, and economic functions of urban green spaces have been considered (e.g., Garden City, Howard

1898; organic decentralism, Zhao 2011). Currently, green spaces and their different functions (ecosystem services) are a central and natural element in urban concepts (Breuste et al. 2013; Sondermann and Rößler 2016).

Table 2.2 Plans and programs for promoting green space development at the national level in China

Plans	Departments	Planning Period	Requirements for Green Space Development
Plan for Promoting 'Ecological Civilization' development	State Forestry Administration	2013–2020	It proposes specific requirements of urban forestry and aesthetic rural development
National Main Function Zones Planning	State Council; Central People's Government	Issued in 2010 and planned to be realized in 2020	National territory is designated in zones of so-called 'optimization development', 'key development', 'limited development', and 'prohibited development'. The plan emphasizes that green space protection is a vital requirement of sustainable territorial development
National Ecological Protection and Construction Planning	National Development and Reform Commission, and other 12 departments	2013–2020	It proposes specific suggestions for improving urban ecology, including: urban green system planning, urban forest and country park construction, urban heat island control, urban water quality management, urban vertical greening and low elevation greenbelt construction
National Forestation Program	State Forestry Administration	2011–2020	It puts forward requirements and measures on urban and rural afforestation, green channel and green network construction, restoration of post-mining areas
Ecological Function Area Planning	Ministry of Environmental Protection; Chinese Academy of Sciences	From 2015	According to the natural conditions and ecosystem services potential, so-called 'ecological function areas' at a national scale can be categorized into 3 major classes (ecological regulation, product provision, and human security); there are 242 such areas in China

The variety of different concepts and the speed with which new, additional or even contradictory ones are being developed are continuously increasing. The different approaches "… often appear to be used interchangeably by policy makers, planners and developers" (De Jong et al. 2015). Nevertheless, each of them has conceptual cores and perspectives which make them distinguishable, though also partly overlapping.

The most widespread (and by now mainstream) concept is the 'sustainable city'. Originally, sustainable development was defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission 1987). In 1991 the United Nations Centre for Human Settlements (UNCHS) defined a sustainable city as one "where achievements in social, economic and physical development are made to last" (UN-Habitat 2002). As this definition has been considered too general, particularly lacking ecological aspects (Rees 1992), there has been an intense debate about its aims since the early 1990s (DESA 2013). Subsequently, the Rio Declaration on Environment and Development (UN 1992) integrated the economic, social, environmental, and governability dimensions of sustainability. For the European context it has been stated in the so-called 'Leipzig Charter' that "all dimensions of sustainable development should be taken into account at the same time and with the same weight. These include economic prosperity, social balance and a healthy environment. At the same time attention should be paid to cultural and health aspects" (EU 2007). Concepts and practices of 'sustainable urbanism' have gained growing international popularity since the early 2000s and entered mainstream policy as a consequence of the forceful combination of global climate change concerns and a rapidly urbanizing world population (Huang et al. 2015). Meanwhile this term is accompanied, specified or even replaced by numerous 'sister terms' as for example 'eco-city', 'green city', 'low-carbon city', 'resilient city' or 'compact city' (Joss 2015; de Jong et al. 2015; Table 2.3).

The idea of the 'eco-city', i.e., an 'ecological city', developed in the mid-1970s, with the aim of (re)constructing cities in balance with nature (de Jong et al. 2015). It was defined as a city "one built according to the principles of living within the means of the environment" (Register 1973). The approach of focusing on ecological principles of urban development also followed the ideas of UNESCO's Man and Biosphere (MAB) Program (Zhao 2011). Over time, a broad understanding and a variety of meanings and interpretations has been developed "of which the ecological may be the main, but certainly not the only, one" (de Jong et al. 2015). The term 'eco-city' is increasingly used to describe sustainable urban development, focusing on ecological aspects such as resource efficiency, low-carbon development or waste reduction. Concrete projects to build eco-cities are initiatives that variably promote and pursue sustainable development in relation to urban infrastructure, services, and community at district, town, or metropolitan levels (Joss 2015). In China, more than 500 'ecological cities (counties)' and demonstration projects are under construction. Flagship eco-city projects such as the Sino-Singapore Tianjin

Table 2.3 Overview of concepts related to 'eco-city' (Joss et al. 2011)

Sustainable city	Synonymous with 'eco-city/town'. The UN-Habitat Sustainable Cities Programme has been promoting this concept since the early 1990s
Sustainable community	Synonymous with 'eco-community'
Smart city	Used to emphasize hi-tech aspects of development—smart energy grids, IT networks, and related efficiencies in utility and service provision
Slim city	World Economic Forum knowledge transfer initiative to encourage cities to increase efficiency across a variety of sectors, e.g. energy, transport, construction work
Compact city	Use of this term typically implies an opposition to urban sprawl. It is an influential urban design concept whose guiding principles include high residential density and the discouragement of private car use
Zero energy city/zero net energy city	Uses no more energy than it is able to generate locally. This is achieved through a combination of measures to reduce power consumption and the introduction of new renewable energy sources
Low-carbon city	The reference to carbon (in this and the following two terms) may reflect national aspirations to create 'low-carbon economies'—often as part of policies designed to mitigate climate change. The focus is on the physical aspects of cities: energy, transportation, infrastructure and buildings. 'Carbon' is sometimes used as shorthand for all greenhouse gases
Carbon-neutral city/net zero city	Similar to 'low-carbon city'—except defined more strictly as a city which offsets carbon/greenhouse gas emissions such that its net emissions are zero
Zero-carbon city	More specifically still, a city which produces no greenhouse gases and is run exclusively on energy from renewable sources
Solar city	May have a relatively narrow focus on replacing fossil fuels with solar energy, and is in some cases limited in its ambitions. The Indian government's Solar Cities program aims to reduce conventional energy use by 10%, with solar energy being part of a mix of renewable energy sources to be promoted
Oekostadt/Ökostadt	As well as being a direct German translation of the term 'eco-city', 'Ökostadt' also refers more specifically to a series of Austrian, German and Swiss towns and cities which declared their intention to introduce principles of sound environmental management and sustainable development in the 1990s—often as part of an Agenda 21 program
Transition town	The 'Transition Town' movement, which originated in the UK and Ireland, is a growing international phenomenon. Transition Town activities are typically organized at grass-roots level rather than embedded in policies. The aim is to build up local communities' social and environmental resilience to the effects of climate change and fossil fuel shortages—both of which are assumed to be inevitable in the future
Eco-municipality	The label 'eco-municipality' describes a local authority which has adopted a particular series of values related to environmental and social sustainability, to guide policy making. The movement is most strongly associated with Sweden (where it has its roots in the 1980s), but has also recently gained ground in the USA

project were established (Shepard 2015). Meanwhile, 'eco-city' works as an "umbrella term encapsulating a variety of concepts, models and practices which aim to further urban sustainability at neighborhood, city or city-regional levels" (Joss et al. 2011, Table 2.3).

Currently the concepts of 'eco-cities' and 'green cities' (Beatley 2012) as starting points for sustainable development are emerging and spreading. Nevertheless, the UN points out that it is "… important to understand cities' sustainability as a broader concept which integrates social development, economic development, environmental management and urban governance, which refers to the management and investment decisions taken by municipal authorities in coordination with national authorities and institutions" (DESA 2013). Following the Sustainable Development Goals of the UN, the 'New Urban Agenda', adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in 2016 (Sect. 2.2.1) formulates a broad concept of future cities and human settlements (Habitat III 2016). One issue, besides others, is that cities should "protect, restore, and promote their ecosystems, water, natural habitats and biodiversity, minimize their environmental impact, and change to sustainable consumption and production patterns".

In this book, we use the term 'green city' to refer to a city which focuses on green spaces, nature, and biodiversity as crucial elements of a sustainable city (Sect. 1.2).

2.2.3 Municipal Strategies for Urban Green Spaces and Biodiversity

Even though urban green spaces and urban nature, due to manifold challenges (see above), are of higher relevance than ever, land use decisions in cities are often made against them (Kowarik et al. 2016). Against this background, strategic approaches on the municipal level are useful tools to strengthen the position of urban green spaces and biodiversity and can help to improve urban green space systems by defining overall aims, providing spatial frames, and serving as firm bases for decision-making (Yu et al. 2011; Hansen and Pauleit 2014).

Municipal Green Space Strategies

"An Urban Green Space Strategy is a strategic document with a long-term perspective that should fall within the compass of a city's development policies and integrate well with other policies. It deals with all urban green spaces, regardless of type or ownership. To be most effective and for the greatest efficiency the strategy should be integrated into the planning system of the city. Such a strategy confronts the present situation of green spaces (with all problems, conflicts, potentials and needs) and the future collective vision and goals. It covers all aspects and subjects

dealing with green spaces management and development. As a result it provides basic and enduring development proposals, tasks and actions for implementation that are needed to assure the realization of set visions and goals" (GreenKeys Team 2008). By addressing all types of green spaces or biotopes, urban green space strategies have the potential to provide a basis for the protection and promotion of biodiversity (habitats and species). Urban green space strategies can address all aspects of the internal and external interactions that are important in the context of green spaces. They can address

- the quantity (minimum green standard values and benchmarks, e.g., m^2 green spaces per capita, Sect. 3.7),
- the spatial structure of a city and the green space system (density, land use patterns: e.g., green rings like in Leipzig, Cologne and also in Chinese cities or the vision "Dresden as a compact city in an ecological network" (Sect. 4.4.6); green fingers; connecting built-up with green and open spaces; accessibility of green: e.g., distance from residential area),
- the quality and function of urban green space systems (e.g., priority areas, green space types, aims for biodiversity and ecosystem services, green spaces for play and sports , Sect. 4.2),
- the implementation process (e.g., planning, building, management of urban green spaces, public participation, formal and informal instruments, programs, e.g., for greening of walls, roofs, backyards , Sect. 5.1 and 5.2) and
- the monitoring, e.g., an evaluation of implementation processes (success and failures).

In China, following the guidance of national laws, local governments, at both the provincial and city level, usually set up the regulations on urban greenery, wildlife protection, and historical areas, etc., to carry out urban green and biodiversity works; meanwhile, many cities have made or are making specific urban biodiversity protection plans under their own urban green system planning and are actively participating in the national initiatives to build a 'Garden City', which regards urban biodiversity as a crucial factor for its development. Since 1992, almost half of all Chinese cities (310 cities) and 212 counties have been nominated by MoHURD as 'Garden Cities' or 'Garden Counties'.[6]

However, cities take different approaches to improve their green space and strengthen local biodiversity; some of them are more focused on protecting the existing species and green spaces, some highlight the importance of enriching the species and restoring the environment; some are only about the plants, some also include animals (Hu 2011). In order to further evaluate the efforts and accelerate the progress on urban ecological protection and restoration, the document Standards on Classification of National Eco-Garden Cities was published by MoHURD with a

[6]http://www.mohurd.gov.cn/zxydt/201602/t20160201_226501.html.

comprehensive evaluation index system and multidimensional performance assessment methodology. The index system covers several aspects with clear and ambitious targets such as local species ratio in urban green areas, resident satisfaction percentage, storm water recollection ratio, etc., and the performance assessment methodology includes local engagement, expert field studies, and third-party verification. On 29 January 2016, MoHURD designated seven cities as 'National Eco-Garden Cities', Xuzhou, Suzhou, Kunshan, Shouguang, Zhuhai, Nanning and Baoji, to recognize their achievements: For example, to restore the urban ecosystem and improve urban ecosystem services, Baoji City has carried out exemplary projects to renovate urban mountain environments, such as Beipo and Nanyuan; Nanning City has successfully recovered the urban water systems, such as Keli River and Liangqing River, etc.; Shouguang City has systematically restored the urban mining areas; to build up the urban greenery system and coordinate regional development, Kunshan City has formed a new urban system with integration of water, road and green; Zhuhai also has built 298 community parks to ensure that the citizens can walk to a park within 10 minutes; and Shuzhou city has established a well-connected ecological network.[7]

Municipal Biodiversity Strategies

For effective and efficient protection and development of local biodiversity, it is essential to proceed strategically. For this reason, a number of German municipalities are planning or developing or have even already passed biodiversity strategies. Through these strategies it is possible to systematically record, describe, and negotiate objectives and activities to promote urban nature with respect to legal, economic, planning, and ecological aspects. Municipal biodiversity strategies do not replace instruments like environmental reports, landscape plans, species protection programs or action plans, but rather place them in a common context. The resulting benefit is not only a document, but also the process of elaboration and implementation, providing the chance to develop common ideas for local nature and biodiversity together with citizens, nature conservation organizations and other stakeholders. This contributes to a better understanding and appreciation of biodiversity by residents. By having such a strategy approved by the city council, a high level of political commitment and support can be ensured (Herbst 2014). At present (year 2016), 12 German municipalities have a biodiversity strategy.

In China, all provinces (23) have biodiversity strategies. There are three municipalities which have biodiversity strategies, namely Shanghai, Tianjin, and Chongqing (Chinese versions available under http://www.doc88.com/p-5843925970015.html (Shanghai), http://www.doc88.com/p-7846250170700.html (Tianjin), http://www.doc88.com/p-5317308281162.html (Chongqing)). Also some prefecture-level cities like Kunming and Haikou and some county-level cities like Dujiangyan have biodiversity strategies.

[7] http://www.mohurd.gov.cn/zxydt/201602/t20160201_226501.html.

2.3 Aspects of City Characteristics in China and Germany

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Cities differ in many ways, from age and architecture to climate, ecology, economy, and culture (Liu et al. 2016). It should be noted that Chinese and German cities can be compared physically (Tables 2.4 and 2.5), but regarding the sociocultural conditions and values this is very difficult. The frame for the following explorative case study was selected with consideration of data availability and own experiences of the author team.

Ongoing trend towards urbanization and re-densification

Cities are growing worldwide—in their spatial extent, concerning their total population and with respect to their general and actual macroeconomic significance. At the same time, cities are changing rapidly, in the technology sector, regarding mobility, energy or working environments but also in connection with ecological trends and requirements.

Table 2.4 The capitals in comparison (Beijing Statistical Yearbook; Grunewald et al. 2016)

	Beijing (2012/2014)	Berlin (2014)
Inhabitants (millions)	20.7	3.5
Administrative area (km^2)	16,400	892
Population density (Inh./km^2)	1260	3900
Green area[a] (%)	73	44
m^2 green space per capita	1	1
Nature conservation area (ha/%)	137,880/8.4	2061/2.3
Number of species (plants)	2708	2179

[a]Forests, public green, waters, agricultural land

Table 2.5 City development in Germany and China (Sources: German Federal Statistical Office and National Bureau of Statistics of China)

City size (million inhabitants)	Number of cities in Germany			Number of cities in China		
	1950	1980	2010	1953[a]	1982[b]	2010[c]
>10	–	–	–	–	–	3[d]
>1	2	3	4	9	38	187
>0.5	3	11	10	16	47	274
>0.1	48	58	63	78	137	180

[a]According to the first national population census
[b]According to the third national population census
[c]CSB (2012). China City Statistical Yearbook. Chinese Statistics Press, Beijing (National Bureau of Statistics of China)
[d]In 2014 already 6 megacities (UN 2014)

China faced a rapid urbanization process in the last three decades. It is expected that around 70% of the Chinese population will live in growing or new cities in 2025. The total urban population will then amount to 900 million people, nearly 250 million more than today (Johnson 2013).

As evidenced in Fig. 2.3, it is apparent that the greatest population density of the Chinese population is in the east. It is estimated that over 90% of the Chinese population inhabit 40% of the land mass of China. China has a long history of city development, but with the policy reform and the opening since the early 1980s, urbanization has increased rapidly (e.g., Zhao 2011; Bai et al. 2014). This manifests in large rural–urban population migrations and in the expansion of urban areas and the built environment. The scale of urbanization in China has so far been extraordinary, and there is a clear indication that it will remain so in the coming decades. Thus, the impact of the country's urban growth on biodiversity and ecosystems may surpass the extent of impacts we have witnessed across the world so far (Güneralp and Seto 2013).

China's urbanization is unique in terms of its speed, scale, and government-driven nature (Ye and Wu 2014), and the process has a low level of sustainability (Xu et al. 2016). In March 2014 the National New-type Urbanization Plan (2014–2020) has been realized (Fang 2014). One of its five main aims is for China's urban population fraction to rise by 1% per year to reach 60% by 2020 (Ye and Wu 2014). However, the observed imbalance that urban land is growing faster than population growth poses a problem (Box 2.3).

Box 2.3

Growth through state-subsidized residential construction? In China there is a risk of increasing investment ruins in the form of empty ghost towns (Fig. 2.2).

In the past decade, the urban land has grown by 78.5%, whereas the urban population has only grown by 46%. Many houses in urban areas are vacant. Cities and municipalities designated 3500 new building areas for the development of new residential areas and industrial parks, particularly in small- and medium-sized towns (Li 2016).

China's high speed urbanization boosted the economic growth and social progress, which greatly improved Chinese people's living standards and human well-being. Rapid urbanization, however, also resulted in a series of problems such as environmental pollution and ecological degradation. The current environmental pollutant emissions are undoubtedly influencing ecosystem functions and services, public health and even urban sustainability in China. China now has 690 million people living in urban areas where the environmental conditions are deteriorating, including through air pollution, especially the high PM2.5 concentrations in many megacities like Beijing, Tianjin, Nanjing, Shanghai, Hangzhou, Guangzhou, etc. (Fig. 2.1c; Sect. 3.3.3). How to control the ever-increasing environmental pollution and make cities livable for urban dwellers is a great challenge.

Fig. 2.2 The ghost city of Kangbashi, Inner Mongolia. © Wei Hou

Against this background, the general idea in the Integrated Reform Plan for Promoting Ecological Progress issued in 2015 is respecting, protecting, and staying in tune with nature. Conserving resources and protecting the environment have come to be the fundamental state policy and were given high priority (Box 2.4).

Box. 2.4 Chinese environmental and urban ecological scientists have paid much attention to the current urban environmental and ecological issues and focused on the following topics

… Urban dynamics and its impacts on urban ecosystem services, such as mitigation effects of urban green and blue infrastructure on the urban climate (Kong et al. 2014; Kuang et al. 2015; Sun and Chen 2012; Zhang et al. 2010; Zhou et al. 2014).
… Ecosystem services assessment and evaluation, urbanization impacts on urban biodiversity (Zhao et al. 2006), urban biodiversity investigation and assessment. But how to integrate these concepts and research findings into urban planning and management practices is still a challenge in China (Liu 2010).
… Ecological and environmental consequences associated with urbanization processes in China, such as urban thermal environmental mitigation (Li et al. 2011; Peng et al. 2015), air pollution reduction Sect. 3.3.3 and the impact of urban expansion on ecosystem services (Lin et al. 2013).
… Urban planning and management theories and practices to promote urban sustainable development and ecological progress.

According to the administrative divisions of China, there are three levels of cities: municipalities, prefecture-level cities, and county-level cities (Zhou et al. 2013). Municipalities and prefecture-level cities are each not a 'city' in the strictest sense of the term, but instead an administrative unit comprising, typically, both an urban core (a city in the strict sense) and surrounding rural or less urbanized areas, usually many times the size of the central, built-up core. Prefecture-level cities nearly always contain multiple counties, county-level cities, and other such subdivisions. To distinguish a prefecture-level city from its actual urban area (city in the strict sense), the term 'urban area' or 'built-up area' can be used. However, even this term encompasses large suburban regions often greater than 3000 km^2. For comparison: The administrative area of Chongqing (Table 2.6) is almost as large as the territory of Austria, and the area of Beijing is 18 times greater than the Berlin administrative area. Comparability is more likely given with respect to metropolitan regions in Germany such as the Rhine-Ruhr region with about 10 million inhabitants and 7000 km^2.

In China, the municipality is a political designation defining regions under control of a municipal government. The population of the official Chinese urban areas is listed in Table 2.6 for the five biggest cities (based on administrative area). The city of Xuzhou is added because it is an important example of structural change regarding green space implementation (Chap. 4).

We are focusing in particular on four case studies in China: Beijing, Shanghai, Chengdu and Xuzhou (Fig. 2.3, Table 2.6), because they are well distributed, they represent relevant problems, and data and case studies are available.

Germany has an established urban structure and is highly urbanized (Fig. 2.4; Table 2.7). In 2013, the share of settlement and transport area in the total area was 13.6% (StaBA 2015). 75% of the German population live in cities currently; however, two-thirds of them in small- and medium-sized cities. Only the Rhine-Ruhr metropolitan region with over 11 million inhabitants (2014) and 7110 km^2 has dimensions comparable to those of the biggest Chinese cities (Table 2.6).

Table 2.6 Population characteristics of the five biggest Chinese cities (by administrative area) and selected case study cities (Source: National Bureau of Statistics of China and Xuzhou Statistical Yearbook)

	Thousand inhabitants in 2010		Area (km^2)		Population density (inh./km^2)	
	Admin. area	Urban area	Admin. area	Urban area	Admin. area	Urban area
Chongqing	28,846	15,693	82,402	26,025	350	603
Shanghai	23,019	22,315	6340	5155	3630	4329
Beijing	19,612	18,827	16,408	12,187	1195	1545
Chengdu	14,048	7416	12,121	2064	1159	3593
Tianjin	12,938	11,091	1946	7418	1083	1495
Xuzhou	8577	1967	11,259	3037	762	647

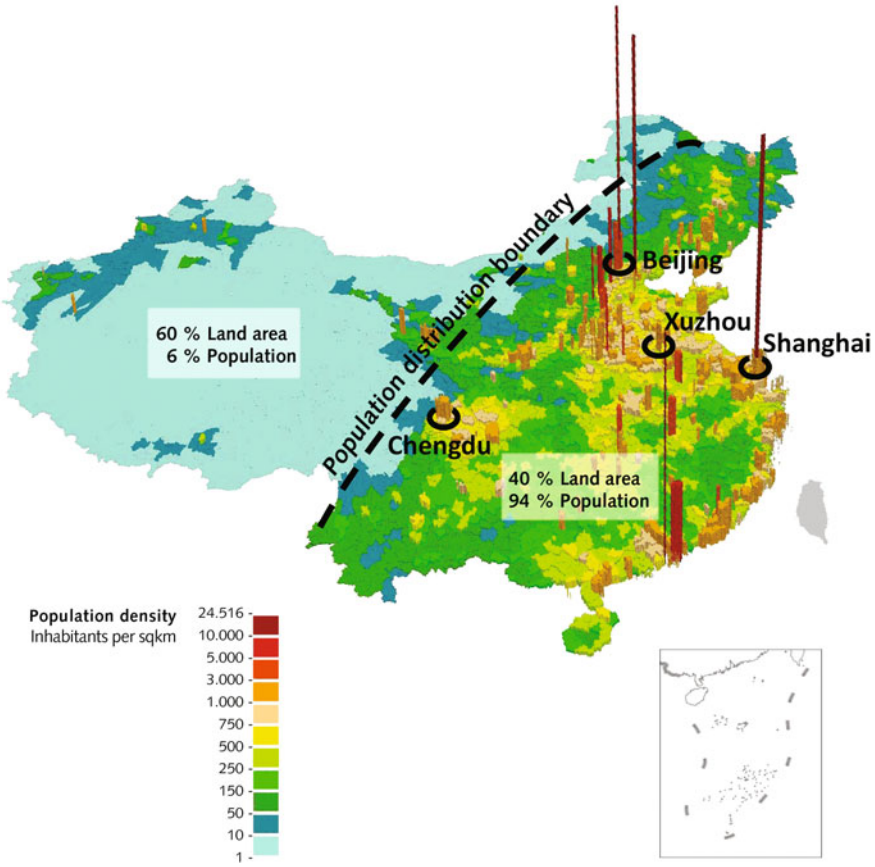

Fig. 2.3 Distribution of population density in China in 2009 and location of case study cities. © Gaodi Xie/CAS

Germany also went through a renewed process of urbanization and re-densification during the last decade (BBSR 2015). Also, in Germany more and more people want to live in the metropolitan areas, as they expect to find education and work there. Immigrants are attracted mainly by the big cities, too. Even in 'shrinking' regions, which are characterized by population decline and economic problems, new housing and transport areas continue to be developed (Haase et al. 2013).

Particularly dynamic growth is observed and predicted in the Greater Munich area, in the Berlin/Potsdam and Frankfurt/Main regions, as well as for Cologne, Hanover, and Bonn. Hamburg and the East German cities of Dresden and Leipzig are also growing, that is, the demand for housing increases, and the pressure on open spaces increases as well. These are also the German cities that were selected for the case studies (Table 2.7; Fig. 2.4; Chap. 4.3).

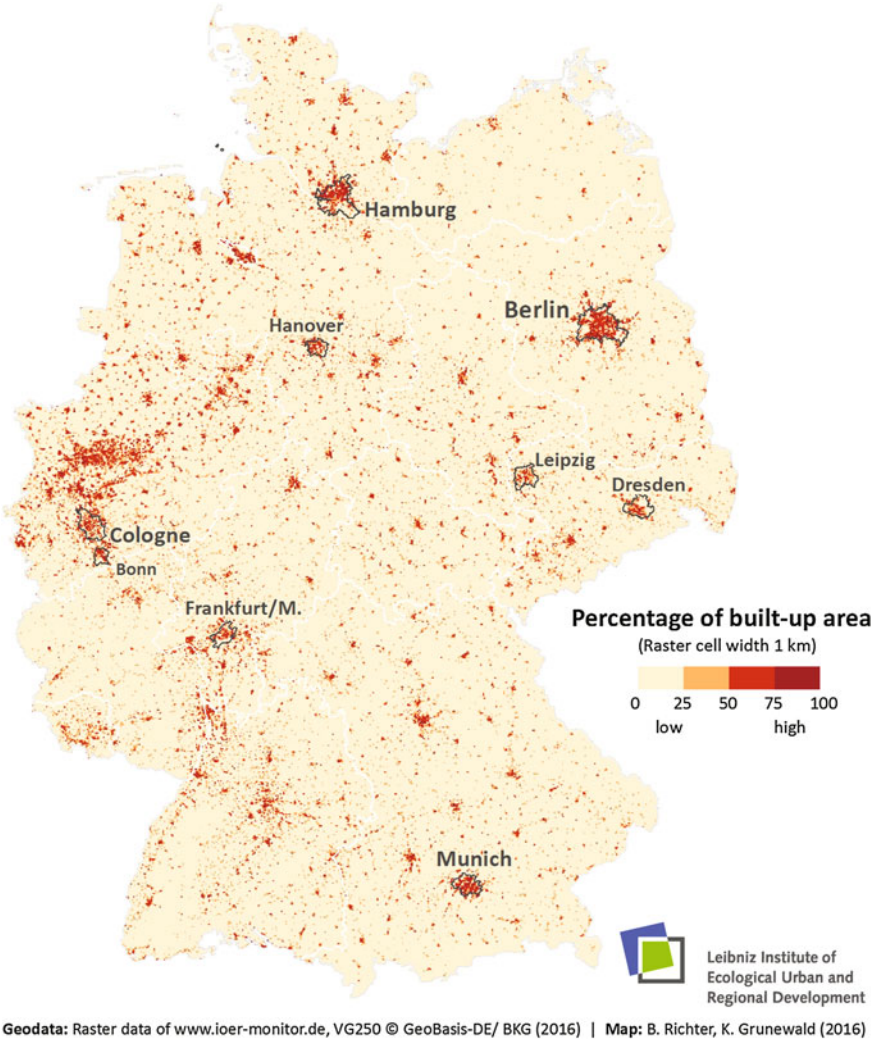

Fig. 2.4 Distribution of big cities and location of case study cities in Germany

Table 2.7 Characteristics of the five biggest German cities and selected case study cities (StaBA 2014)

	Population (rank)	Area (km^2)	Population density (inh./km^2)
Berlin	3,470,000 (1)	891.7	3890
Hamburg	1,763,000 (2)	755.3	2330
Munich	1,430,000 (3)	310.7	4600
Cologne	1,047,000 (4)	405.0	1210
Frankfurt/Main	718,000 (5)	248.3	2580
Leipzig	544,000 (11)	297.4	2430
Dresden	536,000 (12)	328.3	1630
Hanover	524,000 (13)	204.2	2570
Bonn	314,000 (19)	141.1	2230

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