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Jingzhu Zhao

Towards Sustainable Cities in China Analysis and Assessment of Some Chinese Cities in 2008

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Analysis and Assessment of Some Chinese Cities in 2008

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Preface

The year of 2008 is of special importance in human history, when for the first time the world's urban population exceeded the rural population (United Nations Population Fund 2008), and marking the breakthrough of humankind into an urban-dominated society. In a moment of such importance, it is necessary for us to review, research, and assess the urban development process and development model evolution.

The birth of the world's earliest city is generally deemed to have occurred around 3500 BC. For various reasons, the early urbanization process was quite slow for a long period, and by 1800 the world's urban population only accounted for about 10% of the total population, with this proportion increasing to about 15% in 1900. Along with city generation and development, people have kept asking the question: following which theory or model should the cities be built and developed? Especially, in the last 100 years, along with the accelerating urbanization process and its emerging issues, many people have put forward a variety of urbanization development theories or models from different angles, and the Sustainable City is one that has achieved a profound influence.

People have made quite a few interpretations of Sustainable City from different perspectives. It is generally considered that Sustainable City refers to urban life quality improvement in terms of ecology, culture, politics, mechanism, society, and economy, while leaving no burden to future generations. In short, a sustainable city is one that can provide and ensure sustainable welfare for its residents with the capacity of maintaining and improving its ecosystem services.

Since the policy of reform and opening up in early 1980s, China's urbanization has developed rapidly, with the urbanization rate increasing from 17.4% in 1978 to 44.9% in 2008. The constant urban expansion has led to a number of economic, social, urban construction and management issues, and the conflict between the environment and development has become increasingly conspicuous. The environmental problems experienced in developed countries in the last century have now collectively occurred in China during the last 30 years of rapid economic growth. The severe reality and potential future problems tell us that the construction of sustainable cities is more important and urgent in China than anywhere else in the world.

To promote China's sustainable city construction and development, this book has preliminarily constructed the assessment indicator system and development index of a sustainable city, based on a summary and analysis of the existing Sustainable City theories and practices both at home and aboard. Meanwhile, mainly based on the data from 2008, this book has made a tentative assessment of the development level of Sustainable City in some major Chinese cities in 2008.

Assessment and research on sustainable city construction are work of great significance. With the support, help and encouragement of many colleagues and friends, we have completed this book after more than 2 years' study. Although our work is far from perfect, we hope this book will arouse concerns from all social circles and receive guidance and help from more experts, scholars, and administrators, because Sustainable City construction theories and practices can only be constantly improved through their wide participations and joint efforts.

During the research and preparation process of this book, a number of experts, scholars, colleagues, and friends have provided many constructive comments and suggestions, and we would like to express our sincere gratitude here. Meanwhile, gratitude is also extended to the authors of the references. The research for this book has gained financial support from the One Hundred Talents Project of the Chinese Academy of Sciences, Academy-Locality Cooperation Project of the Chinese Academy of Sciences, CAS/SAFEA International Partnership Program for Creative Research Teams, and other relevant projects, and we express our thanks here. Sincere thanks also go to the support and help of Science Press in the process of editing and publishing.

Finally, it should be noted that the construction or development of sustainable cities includes many different aspects and sustainable city assessment involves theoretical system, indicator system, data acquisition, data processing, calculation methods, and other issues. Thus, it is a difficult job to carry out an assessment of the development level of Sustainable City. Therefore, there are inevitably omissions and errors in this book, and your criticism and correction will be highly appreciated.

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Chapter 1
Brief Review of Sustainable City

1.1 Characteristics of the Sustainable City Concept

The most significant worldwide social change that has occurred in the last 200 years has been the large-scale agglomeration of the world's population in urban areas. During 2008, the proportion of the world's population who lived in urban areas reached 50% for the first time in history, symbolizing the beginning of the era of an urban-dominated society.

Cities, the political, economic, and cultural centers of countries and regions, have played a crucial role in world development. As a result of the accumulation of rich resources and abundant technology and the creation of unparalleled wealth and prosperity surpassing rural areas, cities are continuing to undergo a rapid expansion that has caused severe economic, social, city construction and management issues, which especially threaten the preservation mechanism of the regional ecosystem's structure, functions, processes, and security. Human society has, therefore, been making efforts to pursue an ideal urban development pattern or direction (see Box 1.1). Sustainable City concept has been proved to be an effective approach for key research and practical implementation in pursuit of global sustainability.

After a joint worldwide facility, "The Sustainable Cities Programme (SCP)" was put forward and carried out by UN-HABITAT/UNEP in 1991, and some international organizations, countries, and regions have worked extensively to implement the construction of sustainable cities and to facilitate deep and wide scientific research covering the theoretical studies and approaches of Sustainable City. A series of valuable ideas and views from experts and scholars are now contained in an extensive literature on aspects including economic development (Cedric 1999), ecological environment (Cedric 1999; Gu et al. 2001; Lee and Huang 2007), social progress (Camagni et al. 1998), human welfare (Lewis 2006) along with other valuable viewpoints from different aspects (Haughton and Hunter 1994; Nijkamp and Pepping 1998; Ola and Ahmad 2008). At the Second United Nations Conference on Human Settlements (Habitat II) in 1996, it was proposed that "a sustainable city is a city where achievements in social, economic, and

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physical development are made to last. A sustainable city has a lasting supply of the natural resources on which its development depends (using them only at a level of sustainable yield). A sustainable city maintains a lasting security from environmental hazards which may threaten development achievements (allowing only for acceptable risk)." This Sustainable City concept was then adopted by UN-HABITAT/UNEP "SCP."

The Urban 21 Conference held in Berlin in 2000 suggested that being a sustainable city means "improving the quality of life in a city, including ecological, cultural, political, institutional, social, and economic components without leaving a burden on future generations" (Antrop 2006). World Watch Institute considered that a city moving toward sustainability should improve public health and well-being, lower its environmental impacts, increasingly recycle its materials, and use energy with growing efficiency (World Watch Institute 2007).

Zhao indicated that a sustainable city is one that can provide and ensure sustainable welfare for its residents with the capacity of maintaining and improving its ecosystem services (Zhao et al. 2009). The urban ecosystem service can be generally defined as processes and conditions offered for people's survival and development by cities as social–economic–natural complex ecosystem. In addition, welfare has a relatively extensive connotation and generally encompasses a number of features including economy, society, and environment. A sustainable city requires that a city provides its residents with sustainable welfare, i.e., the total amount of welfare benefit and per capita welfare will not decrease as time goes by.

Box 1.1 Characteristics of the Sustainable City Concept (1)

We say that a sustainable city is one in which the community has agreed on a set of sustainability principles and has further agreed to pursue their attainment. These principles should provide the citizenry with a good quality of life, in a livable city, with affordable education, healthcare, housing, and transportation (Munier 2007).

A sustainable city can broadly be defined as "one that has put in place action plans and policies that aim to ensure adequate resource availability and (re)utilization, social comfort and equity and economic development, and prosperity for future generations" (The Regional Environmental Center for Central and Eastern Europe 2009).

A sustainable city is one that relates its use of resources and its generation and disposal of wastes to the limits imposed on such activities by the planet and its organisms (Chi et al. 2006).

(continued)

Box 1.1 (continued)

The basic feature of a sustainable city can be characterized as: facilitating economical uses of resources by technological and environmental improvements, targeting economic development, wealth building, social progress, and ecological security, maintaining a balance among resources, environment, information, interflow of material of the inner–outer urban system, meeting a city's future needs based on a correct assessment, and satisfying the needs of urban development in the present (Zheng 2005).

Sources

Chi Y, Walsh E, Wang T, Shi H, Babakina O, Pennock A, Graedel TE. 2006. Case studies in quantitative urban sustainability. Technology in Society, 28(1/2): 105–123.

Munier N. 2007. Handbook on urban sustainability. Dordrecht: Springer

Regional Environmental Center for Central and Eastern Europe. Sustainable cities: Environmentally sustainable urban development [2009-11-12]. http://archive.rec.org/REC/programs/SustainableCities/

Zheng F. 2005. Theory and practices of sustainable cities. Beijing: Renmin Press (in Chinese).

Box 1.2 Characteristics of the Sustainable City Concept (2)

A sustainable city is one that can provide and ensure sustainable welfare for its residents with the capacity of maintaining and improving its ecosystem services. The urban ecosystem service can be generally defined as processes and conditions offered for people's survival and development by cities as social–economic–natural complex ecosystem. Welfare refers to the utility of wealth and income to humans, i.e., the extent to which human needs are met. As the society develops and people's understanding deepens, "income" and "wealth" are constantly endowed with new connotations ranging from a relatively narrow understanding of the term of welfare concentrated on economic aspects, to, at comprehensive and broadscale, economic, social, and environmental aspects. A sustainable city is required to provide its residents with sustainable welfare, i.e., the total amount of welfare benefit and per capita welfare will not decrease as time goes by. That is

$$W(t) \leq W(t+\Delta t),$$

$$W(t)/N(t) \leq W(t+\Delta t)/N(t+\Delta t),$$

(continued)

Box 1.2 (continued)

where, $W(t)$ and $N(t)$ are the total amount of welfare benefit and total population, respectively; $\Delta t(\geq 0)$ refers to time increment (Zhao et al. 2009).

Source

Zhao JZ, Cui SH, Yan CZ, Guo QH. 2009. Theoretical Thinking in Sustainable City Construction of China. Environmental Science, 30(4): 1244–1248 (in Chinese).

All the definitions analyzed above propel forward the rich notion of Sustainable City, in which the inscape features range from natural and social aspects to physical and spiritual factors. The Sustainable City concept is a comprehensive reflection forged through complex interrelations, interactions, and coupling mechanisms among the dimensions of society, economy, population, resources, environment, science and technology, and education. The state or construction level of a sustainable city depends not only on its state or level of singular dimensions but also on its proportion, structure, and coupling mechanisms.

The connotation of Sustainable City goes far beyond the definition of traditional urban development, environmental protection, and ecological construction, but is in fact an innovative paradigm, framework, and mechanism shift to a new mode for urban development and construction. The construction of sustainable city is characterized by systemic, holistic, and dynamic development processes that aims to sustain an efficient distribution of resources and optimal restructuring at a fixed temporal–spatial scale and to improve the quality of cites and the level of modernization. This would enable us to meet the needs of the present urban development without compromising the ability of the future city to meet their own development needs.

1.2 Related Theories to Sustainable City

As a new paradigm for urban development, the theoretical system of Sustainable City is still being evolved, optimized, and concluded. In its early stages, theoretical studies of Sustainable City stemmed from the urban planning and design fields. Since the concept of "sustainable development" developed in the report "Our Common Future," a steady and fervent move toward sustainable urban planning has begun, and a series of writings drawing upon theoretical insights into urban form, the urban–rural relationship, scales and density, transportation principles, and land use models have emerged.

Since the 1990s, the focus of theoretical research has transited from the holistic urban system scale to the local community, covering broader dimensions of urban development ranging from physical components (urban form, system structure, function, and metabolism) to abstract connotations including environment, economy, society, culture, political institutions, social equity, etc.

The fundamental orientations of Sustainable City theoretical research included many disciplines, such as system science, urbanology, economics, sociology, management, geoscience, resources science, high and frontline science and technology. Some of the fundamental disciplines or orientations associated with Sustainable City theory, including urban multiobjective coordination, urban PRED (Population, Resources, Environment, Development) system, urban ecology, urban development and control, urban metabolism, urban form, etc., are listed below with detailed viewpoints and concepts (see Table 1.1)

Table 1.1 Related theories and main views on sustainable city

Selected theories	Main views
Multiobjective Coordination Theory	• The system of urban sustainable development is a multiobjective hierarchy, multiobjective mode to reconcile the pursuit of economic development, social progress, sustain the environment and resources, and build capacity for sustainable development • Attention should be paid to the influence, interactions, and restrictions among multiobjectives • The characteristics of urban sustainable development have an eco-sustainable objective as a foundation, economic sustainability as a guidance, and social development as a goal
Urban PRED System Theory	• A city is a complex social–economic–natural macrosystem consisting of population (the system core), resources, and environment–development interactions. Regional PRED system coordinated development serves as the precondition of macro-connotation "urban sustainable development" which is the ultimate goal • The interactions between system and environment are extrinsic conditions for sustaining the dissipative structure of the urban PRED system • The hierarchical forming process of the urban PRED system can gain inner momentum from synergy, which controls the features and laws of the urban system phase transition to realize a self-organized urban system
Urban Ecology Theory	• A city is a human-centered open typical social–economic–natural complex ecosystem • Ecological principles and rules lay the foundation of urban sustainable development. The urban metabolism is sustained by dynamic and sustainable material, energy, and information flows • Fundamental principles of ecology including ecosystem theory, econiche theory, law of the minimum and ecological footprint theory are included in urban eco-sustainability theory

(continued)

Table 1.1 (continued)

Selected theories	Main views
Urban Development and Control Theory	• The dynamic process of urban development, which humans play a crucial part in managing, is controllable • Information, the most active and basic element in the process of urban development is an efficient tool for the regulation of urban sustainable development. To achieve various forms of progress in urban development, therefore, requires information in different forms and carriers • Information feedback is a fundamental approach to realize the control of urban development, which aims at steering urban development to orderly, stable and balanced sustainability
Urban Metabolism Theory	• Cities exhibit dynamic, comprehensive, and complicated metabolic processes. The urban ecosystem transforms external materials and energy inputs through internal technological, economic and social processes into different services and products to provide cities and residents with necessary supports. At the same time, the urban system is also influenced by products and waste outputs transformed • Urban metabolism focuses on the quantity and quality of inputs and outputs of material and energy flows, combined with the influence they exert on the ecological environment. Therefore, studies of urban metabolism have correlated primarily with material and energy metabolism • Efficient urban metabolism serves as one of characteristics of a sustainable city. Urban metabolism efficiency refers to the supply efficiency of the amount of social services realized through the processes of material cycling, energy flow, and information transfer
Urban Form Theory	• The term "urban form" refers to the holistic urban entity components or physical environment, spatial configuration, and establishment of various activities, a comprehensive reflection of city's aggregative formation, growth, form, structure, function, and development • Urban form depends on elements including natural conditions, such as the urban scale and topography of urban land use, and other conditions including the function and structure of urban land use, and road network structure • A compact or decentralized urban form influences the structure and function of the urban system. Therefore, advocating compact transport, living styles, and high density energy efficiency will meet the basic requirements of sustainable city construction

Sources

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Cui SH, Li FY, Yu YX, Lin JY. 2010. Theoretical thinking on urbanization and sustainable urbanization. Urban Studies, 17 (3): 23–27 (in Chinese).

Li SZ, Dong G Z. 2006. On the theory of urban sustainable development and its guidance to the planning practice. Urban Problems, (7): 14–20 (in Chinese).

Wu YQ, Yan MC, Xu LF. 2009. Review on the research of energy-based urban metabolism. Ecology and Environment, l8 (3): 1139–1145 (in Chinese).

A multiobjective coordination theory, which illustrates the complexity of the system and reconciliation of multiple objectives, has enabled the setting of concrete objectives and measures for sustainable city development with a clear guiding ideology and set of principles. For the development of a sustainable city, urban PRED system theory seeks to offer people guidance to adopt the methodology of system science to establish plans and to analyze the coordination mechanisms of urban population, resources, environment, and development. The theory of urban development and control leads to the development of control principles and methods to provide sustainable city development with strong supportive technology and control measures. Furthermore, urban ecology principles reveal the necessity for sustainable city development to adhere to both economic and ecological laws. The urban form theory helps to understand interactions between the forming processes of urban structure and cultural, social, economic, and political power and to understand the close association between urban form and planning in both theoretical analysis and planning practices, whereby fundamental principles of urban planning can be deeper and integrated by systematic studies of the urban form. Intrinsic requirements of a sustainable city that have typically been stressed include increasing urban metabolism efficiency through probing into the efficiency per se and the environmental impacts of urban metabolism, the analysis of material and energy metabolism of the urban system and its coupling processes and mechanism with urban development.

It should be noted that the above theories complementally integrate together with the common study objects, providing a good basis for the establishment of a theoretical system for Sustainable City.

1.3 Sustainable City and Related Urban Development Models and Actions

A great deal of thought about urban development modes, with a variety of features and concerns about the directions of future urban development occurred early before the Sustainable City concept. Those urban development paradigms examined the influence on urban development from different aspects and elements, and featured the economy, environment, society, the relationship between human and the environment, urban organism, urban function, and urban competitiveness.

The classical theories of “Eutopia” and “Garden City” portrayed a livable urban life and natural rural life, which symbolized the idealism of a city with a brighter future, and both laid a good foundation for the following variety of urban development modes. Theories of New Urbanism, Broad-acre City, and organic decentralism addressed decentralizing urban development to maintain a low spatial density with a lifestyle returning to nature, while Cities of To-morrow was dedicated to centralizing

urban development and put emphasis on a good walking environment, efficient public transport and compact form, and scales for people's communication.

After these early theories, evolving researches led to new modes of urban construction such as Eco-city, Livable City, and Healthy City paradigms. With principles including strategies for ecological protection, ecological infrastructure, living standards of residents, protection for culture and history, integrating nature, and the city, Eco-city addresses the integration of the urban natural ecosystem, society and economy, and the protection, restoration, and preservation of the holistic ecosystem.

Livable City has as its basic concept the living environment: safety, health, convenience, and amenity intersect with concerns about residential living quality, comprehensive factors affecting dwelling districts and reconciling disharmony between the living space and its environment. Healthy City stresses the processes of health promotion and sees promoting the preservation of nature and human society as basic principles. In general, urban development needs to rationally integrate local ecological characteristics with historic and cultural factors, to minimize impacts affecting the environment, and to esteem esthetics and cultural content.

Analysis of the sustainability of the key factors of urban environment, livability and health dimensions are kept on surface for their different paradigms and focuses. The traditional way of urban construction can no longer satisfy the practical needs of urban development. Sustainable City, another new concept of future city, will be an inevitable pursuit of humankind as a result of the increasingly complicated, pluralistic and interregional nature of ecological environment problems. It is a new paradigm based on studies and practices of the former urban construction modes, a heritage and a development of conceptions and ideas in different periods, and also an integration and an improvement of a variety of urban development modes (Table 1.2).

Since its inception in 1991, the UN SCP has promoted international organizations, countries, and cities to implement related initiatives and practices. Statistics indicate that "sustainable development committees" or similar institutions consisting of representatives from government, research institutes, private sectors, and community organizations have been established in more than 70 countries worldwide. Those committees aim to pay close attention to the long-term sustainable development agendas and making policies to enhance country-level reconciliation and policy integration. In 1994, the European sustainable cities and towns campaign launched by the European Union initiated a large-scale movement toward "sustainable communities" in many international organizations and countries. The "SustainableCitiesNet.com" set up by the University of Melbourne, Australia, intends to speed up the transformation of cities around the world by embracing information interchange, staff, and programs. Until now, this network has conferred 27 "Sustainable Cities" awards in Europe, Oceania, and North America.

Table 1.2 Comparison of some-related urban development modes

City notion	Year	Originator	Mainstream conception	Related literature, events, and initiatives
Garden City	1898	Ebenezer Howard	A concentric pattern with open spaces, public parks, and radial boulevards, the garden city would be self-sufficient when it reached full population	Formulated by Ebenezer Howard in his book: "To-morrow: A Peaceful Path to Real Reform," 1898 Creation of the first Garden City called Letchworth (England), 1903. The second garden city Welwyn (England) built, 1921
Livable City	1961	WHO	The basic concept of living environment: safety, health, convenience, and amenity	The Habitat Scroll of Honour award launched by the United Nations Human Settlements Programme in 1989 The LivCom Awards, the International Awards for Livable Communities, were launched by International Federation of Park and Recreation Administration (IFPRA), 1997 and endorsed by the United Nations Environment Programme
Eco-city	1971	Man and Biosphere UNESCO	Five principles for the ecological city planning: ecological protection strategy (including protection for nature, animals, plants, resources, and pollution prevention and cure); basic ecological facilities (the capacity of permanent support of natural landscape and hinterland for city); living standard of residents; protection of culture and history; and the	First thoroughly integrated eco-city effort Arcosanti (Arizona) founded, 1970 Publication of Eco-city Berkeley: Building Cities for a Healthy Future, 1987. First International Eco-city Conference held in Berkeley, 1990

(continued)

Table 1.2 (continued)

City notion	Year	Originator	Mainstream conception	Related literature, events, and initiatives
			integration of nature and city (The MAB report, 1984)	
Healthy City	1984	A Conference entitled "Beyond Health Care" launched by WHO in Toronto, Canada	A healthy city is one that is continually creating and improving the physical and social environments, and expanding the community resources that enable people to mutually support each other in performing all the functions of life and in developing to their maximum potential. It is defined by a process, not an outcome	First International Conference on Health Promotion held by WHO in Ottawa, Ottawa Charter for Health Promotion was produced, 1986 Healthy Cities Project launched by WHO Regional Office for Europe, 1987
Sustainable City	1991	UN Commission on Human Settlement Sustainable Cities Programme	A sustainable city is a city where achievements in social, economic, and physical development are made to last. A sustainable city has a lasting supply of the natural resources on which its development depends (using them only at a level of sustainable yield). A sustainable city maintains a lasting security from environmental hazards which may threaten development achievements (allowing only for acceptable risk)	The Sustainable Cities and Towns Campaign (ESCTC) held in Aalborg, 1994 Second United Nations Conference on Human Settlements, Habitat II held in Istanbul, 1996

Box 1.3 Brief Introduction to the UN SCP

SCP is a joint UN-HABITAT/UNEP facility established in 1991 to build capacities in urban environmental planning and management (EPM). The program, founded on broad-based stakeholder participatory approaches, is a long-term initiative aimed at strengthening the institutional capacity of city and local authorities and their partners in the area of urban EPM. Targeting urban local authorities and their partners, the program serves as an effective combination tool through supporting demonstration projects to promote "Agenda 21" (launched in 1992) implementation on city level. After 5 years, SCP put its strategy and implications of the "Environmental Guidelines for Settlements Planning and Management" written by UN-HABITAT/UNEP into reality, and Dar es Salaam became the first SCP Demonstration City. Currently, SCP and its sister program, Localizing Agenda 21 (LA21), operate in over 30 countries worldwide including China, Chile, Egypt, Kenya, India, Guiana, Poland, Cuba, Brazil, Nigeria, Morocco, Philippines, Russia, Senegal, Sri Lanka, Tanzania, and so on (UN-Habitat 2001).

The EPM approach of SCP addresses the urban challenge by promoting the sustainability of cities. The EPM approach is based on and supports the efforts that cities make in developing their environments by improving their environmental information and expertise, strategies and decision making, and implementation. With improved EPM capacity and policy application processes, municipal authorities are able to better address priority local environmental issues:

City level
City demonstrations are the focus of the work (3–5 years, $1–2 million each)·help local practitioners and decision makers identify priority issues involve stakeholders, develop strategies, agree on action plans implement priority projects, and institutionalize the process.

National level
Currently countries such as Egypt, Chile, Nigeria, and Tanzania, with others in preparation respond nationally to issues identified locally replicate lessons in other urban centers.

Regional level
City networks in regions such as Africa, Asia, and the Arab States share information and lessons learned pool expertise and other technical resources.

Global level
Core team with partners at city, national, regional, and global levels backstop activities at city, country, and regional levels compile lessons of experience and best practice develop reusable tools and procedures (UNCHS and UNEP 2000).

Sources

UN-Habitat. 2001. Sustainable Cities Programme 1990–2000: A Decade of United Nations Support for Broad-based participatory management of Urban Development.
UNCHS and UNEP. 2000. Sustainable Cities and Local Governance.

Box 1.4 Brief Introduction to Sustainable Cities Construction in the EU

To meet the mandate established for the local level in Chap. 28 of the Agenda 21 document, the European Union set related legislation and fostered charters on sustainability, aiming to translate to the European level the outcomes of the Rio World Summit in 1992. The Sustainable Cities and Towns Campaign (ESCTC) was held against this background in Aalborg in 1994. To mainstream local sustainability throughout Europe, the Campaign also fosters the implementation of the "Aalborg Commitments," which represents the sustainable cities and towns movement in the European Union. The Aalborg Commitments are a set of shared commitments to be jointly implemented by local governments across Europe. A practical toolkit is provided to support local authorities with the implementation of the Aalborg Commitments and important policy guidelines are set for local sustainability. Tools are listed under the Commitments entitled Governance, Local Management toward Sustainability, Natural Common Goods, Responsible Consumption and Lifestyle Choices, Planning and Design, Better Mobility, Local Action for Health, Vibrant and Sustainable Local Economy, Social Equity and Justice, Local to Global. New emerging approaches such as Eco-BUDGET, eco-taxes, DISPLAY-Energy Efficiency Labeling for Public Buildings, and forest certification are also included.

In 1996, the second occasion of the Sustainable City Awards was held in Lisbon. The conference provided the opportunity to further translate the principles of the Aalborg Charter into action by setting out practical measures and resulted in the adoption of the Lisbon Action Plan: From Charter to Action.

Until the present time, the awards have been held on four occasions in 1996, 1997, 1999, and 2003, giving international recognition to European local authorities for their efforts made toward sustainable urban development and have proven to be successful in encouraging cities and towns all over Europe in their "sustainability activities" (Europe Union 2008).

Source

Europe Union. The European Sustainable Cities and Towns Campaign. [2008-07-15]. http://www.sustainable-cities.eu/.

Sustainable city practices embrace ecological, economic, and social dimensions. Specifically, actions related to ecology include: climate change, energy efficiency, renewable energy, and resources, Transit-Oriented Development, nature preservation, water management, waste management, environmental policy tools (such as eco-budget and environmental audit), and so on, while actions in social and economic fields place extra-emphasis on mobility, education, rendering services for disadvantaged groups, employment, improving actions by local government and

institutions, cooperation with the private investment sector, regulations, the global and local economy, and so on. By comparing the international cities construction modes mentioned above, it is not difficult to find that the early initiatives often start from demonstration cities and that the paradigm of sustainable city construction has penetrated every local dimension, from policy guarantees made by official institutions to practical actions at the community level.

Chapter 2
Exploration and Practices of China's Urban Development Models

2.1 Evolution of China's Urban Development Model During the Last 30 Years

Since the 1980s, the Chinese government or related sectors and management institutions have discussed and explored many aspects of urban construction, including the "civilized city" which emphasized social culture, "environmental protection model city," "garden city," "ecological garden city," and "eco-city" which focused on protecting the urban ecological environment, "hygienic city" and "healthy city" which stressed caring for residents' health, as well as the "livable city" focusing on residents' living comfort. Various urban models have their own implementation focuses and the establishment goals continue to evolve and innovate along with the national urbanization process to ensure, promote, and adapt to the healthy and rapid development of China's urbanization.

The National Civilized City is an integrated honorable title reflecting the overall degree of urban civilization and harmony. It was created with the goal of achieving coordinated development among material, political, and spiritual civilization while at the same time achieving economic growth, so as to enhance the overall citizen's ideological quality.

The National Hygienic City title aims to raise the level of urban hygiene, improve urban hygienic appearance, enhance people's health, and thus enable people to enjoy a clean, beautiful, tidy, and comfortable living and working environment.

A "healthy city" is also an embodiment of an improved healthy urban environment and aims to improve environmental and sanitary conditions to provide a better health service, thus achieving health status improvements through the uses of a variety of resources.

The National Garden City represents the enhancement of urban greening and environmental awareness, taking the core idea of garden greening to stimulate all aspects involved in urban construction. The fundamental goal is to promote the overall perfection of urban function, to effectively improve the living environment, and to promote sustainable urban development.

The Ecological Garden City further focuses on using ecological principles in urban and urban greenland system planning, construction and management,

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effectively controlling and reducing various pollutants and wastes, implementing clean production, green transportation, and buildings, with the goal of promoting harmony between human and nature in cities, thus making the environment cleaner, safer, more beautiful, and more comfortable.

The National Environmental Protection Model City is a concrete embodiment of implementing an urban sustainable development strategy and aims to establish a number of environmental protection demonstration cities with coordinated environmental, social, and economic development, thereby achieving coordination between economic growth and ecological environment and promoting sustainable development of both the socioeconomic system and the natural ecosystem.

The Ecological Demonstration Zone and Ecological City, based on the requirements of ecological concepts and sustainable development, are the in-depth embodiment of the ecological environmental campaign. Its focus is on the coordinated development of the urban economy, society, and natural complex ecosystem to realize the rational exploitation of natural resources and ecological environmental improvement, while at the same time ensuring socioeconomic development and meeting increasing mass material and cultural life needs.

The title of Livable City, proposed in the twenty-first century, focuses on overall urban development and a people-oriented philosophy. Its comprehensive target is to build a livable city with fresh air, a beautiful environment, and healthy ecology and to realize the suitability of a natural living and cultural environment, reflecting the fundamental essence of urban planning and construction.

From the perspective of urban construction development, proposals for the urban development and construction model have been influenced by a number of aspects. The theoretical preparation is the foundation. Firstly, the urban development model must be based on the relevant theories or disciplines which are comparatively mature (such as the eco-city theory proposal and the development of the human settlement environment discipline); secondly, the government's guidance of urban development orientation and effective solutions to problems faced with urban development in different historical periods, put forward a corresponding urban development orientation and policy control system.

Box 2.1 National Civilized City

【Creation Date】 1980

【Implementation Department】 Spiritual Civilization Development Steering Commission

【Target】 National Civilized City refers to the cities which are at the new development stage of building a moderately prosperous society accelerating the development of socialist modernization. They persist under the guidance of the theories of Deng Xiaoping and the "Three Represents" by thoroughly implementing the scientific concepts of development, making

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Box 2.1 (continued)

comprehensive progress of economic, political, and cultural construction and notable achievements in spiritual civilization, finally realizing a high citizen's ideological quality and a high degree of social civilization. National Civilized City is a comprehensive honorary title reflecting overall urban civilization and degree of harmony, targeted at achieving coordinated development of material, political, and spiritual civilization to enhance the overall citizen's ideological quality at the same time as ensuring economic growth.

【Background】 Activities which aimed to build National Civilized City started from 1980 (People.com 2005). After the reform and opening-up, strengthening the building of a socialist spiritual civilization was gradually put on the Party and country's main agenda, steadily promoting the construction activities from "civilized window" and "civilized service" to "civilized city" (Shanghang County Government Website 2008). In 1996, the Party's fourth session of the Sixth Plenary Session issued the "the Resolution of Several Big Issues regarding Strengthening the Socialist Spiritual Civilization Construction," and explicitly proposed to carry out the civilized cities construction activity and building a batch of demonstration model civilized cities and districts by targeting improvements in citizen's ideological quality and degree of urban civilization. In May 1997, the Central Spiritual Civilization Steering Committee was established, which was an important measure taken by the Party in comprehensively strengthening socialist spiritual civilization. The criteria, application and assessment scope, guidance, and supervision methods of the National Civilized City were not confirmed until the Central Civilization Committee issued the "Provisional Measures on Selecting and Praising National Civilized City, Civilized Town and Village, and Civilized Unit" in August 2003. The Central Civilization Committee (2003) Document No. 9 stipulated that the National Civilized City would be evaluated and praised every 3 years. In September 2005, the Spiritual Civilization Development Steering Commission publicized the candidate list of the first batch of National Civilized Cities, Towns and Villages, and Civilized Units, including ten National Civilization Cities (Xiamen, Qingdao, Dalian, Ningbo, Shenzhen, Baotou, Zhongshan, Yantai, Langfang, and Zhangjiagang), three National Civilized Districts (Tianjin Heping District, Shanghai Pudong New District, and Beijing Xicheng District), and in the same year the "National Civilized City Assessment System" officially came into effect. In 2008, the honorary title of the first batch of civilized cities was retained after the reexamination by the Spiritual Civilization Development Steering Commission. In December 2008, the proposed list of second batch of National Civilized Cities (or Districts) was publicized on major central news websites. In January 2009, Chengdu,

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Box 2.1 (continued)

Nanjing, Nanning, Huizhou, Nantong, Dongguan, Maanshan, Suzhou, Daqing, Beijing Dongcheng District, Shanghai Jing'an District, Chongqing Yubei District, Xinjiang Kuerle (county-level city), and Inner Mongolia Manzhouli (county-level cities) were awarded the title of Civilized Cities (or Districts) (Xinhua.net 2009).

【Assessment System】 The "National Civilized City Assessment System," published in 2005, is the first national indicator system to evaluate and assess the effect of mass spiritual civilization building activities and was revised in 2008. The 2008 version had 111 indicators, targeting at provincial capital/subprovincial cities, prefecture-level cities, county-level cities and districts. It comprehensively surveys the development level of economy, politics, culture, and social construction as well as the level of spiritual and material civilization construction. The assessment system mainly uses six data acquisition methods, namely, report hearing, material review, questionnaire, online survey, field visiting, and overall observation and puts forward concrete requirements and assessment criteria in five categories, including the level of economic development, public infrastructure and public transport, medical and public sanitation, population and life quality, and social security, mainly composed of two parts: "basic indicators" and "characteristics indicators." The basic indicators reflect the basic conditions of civilized city building, including seven assessment items, namely a clean and efficient administrative environment, a fair and just legal environment, a normative and trustworthy market environment, a healthy vigorous human environment, a comfortable living environment, a sustainable ecological environment, and solid and effective building activities. The characteristic indicators reflect the working characteristics of urban spiritual civilization building and the overall city or district image, including focused publicity of building work, honorary titles, hosting of large-scale activities, and overall city image (Qingshanghu Administrative Information net 2008).

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Box 2.2 National Hygienic City

【Creation Time】 1990

【Implementation Department】 National Patriotic Health Campaign Committee

【Target】 In the very beginning, the objective of the National Hygienic City assessment was to strengthen patriotic health work and to improve the urban hygienic environment. During the urbanization process, the criteria of hygienic city assessment have gradually shifted to the concerns about the influence of urbanization on urban hygiene, highlighting sociability and public participation. It stresses the establishment of a long-term effective management mechanism while focusing on infrastructure construction and considering the governance of weak links such as the urban villages in cities, the urban and rural fringe, trade markets, and the "five smalls" (small restaurants, small beauty salons, small dancing halls, small shower rooms, and small hotels) to solve the hygienic problems closely related to residents' living. Building a hygienic city aims at improving the urban hygiene level to provide the residents with a clean, beautiful, tidy, and comfortable living and working environment. Creating a hygienic city is a necessary to strengthen the socialist spiritual civilization and material civilization and is also an important work by which all levels of government benefit residents, by placing great significance on persisting in reform and opening up, promoting stability and unity, developing production, economic prosperity, and protecting people's health (People.com 2009).

【Background】 To fully integrate the "Decision on Strengthening the National Patriotic Health Work" issued by State Council and the spirit of eighth enlarged committee meeting of National Patriotic Health Campaign Committee, to improve urban health conditions and enhance people's health, the Patriotic Health Campaign Committee issued a "Notice on Carrying out Building National Hygienic City Activity," and at the end of the year issued the "Trial Draft of Building Hygienic City Criteria" to organize hygienic city selecting and praising nationwide for the first time. In June 1990, Weihai, a city in Shandong Province, won the first title of National Hygienic City [WAWF (1990) No. 30 document]. Until July 2009, the National Patriotic Health Campaign Committee had named 108 National Hygienic Cities, 28 National Hygienic Districts, and 377 National Hygienic Counties or Towns, accounting for about 1/6 of Chinese cities (Xinhua.net 2009).

【Assessment System】 In 1999, the relevant sectors and experts of the National Patriotic Health Campaign Committee Office revised the "National Urban Health Standards" and "National Hygienic City Assessment and Naming Methods." Later, the "National Urban Health Standards" were amended in 2005 and 2009. On January 1, 2009, the revised "National Hygienic City Assessment and Naming, Supervision and Management Methods" was implemented. The assessment criteria have gradually included livelihood-related

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Box 2.2 (continued)

aspects in urban and peri-urbanization areas including health, hygiene, environmental protection, and disease prevention and control, mainly in the following nine aspects: (1) patriotic health organization and management, (2) health education, (3) urban appearance and environmental sanitation, (4) environmental protection, (5) public and domestic drinking water sanitation, (6) food hygiene, (7) infectious disease prevention and control, (8) control of four urban pests, and (9) unit and residential zone sanitation (National Patriotic Health Campaign Committee Office Website 2008).

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Box 2.3 National Garden City and Ecological Garden City

【Creation Time】 1992 (National Garden City); 2004 (Ecological Garden City)

【Implementation Department】 Ministry of Housing and Urban–Rural Development

【Target】 The original intention of building garden cities was to change the dirty and disorderly urban environment. As the urbanization process continues, higher objectives continue to be set. Today, building National Garden Cities has become an effective pathway of building an urban ecological civilization; its focus is not just on garden greening, but taking it as the core idea to drive all aspects involved in urban construction, including urban environmental sanitation, road transport, housing security, ecological environment, and urban management. From the start of building a National Garden City, the aim is to improve overall urban functioning, enhance the comprehensive quality, and effectively improve the living environment and promote urban sustainable development.

In 2004, based on a review of carrying out garden city building activities, the Ministry of Construction proposed the new target of building "Ecological Garden Cities," which aimed to use ecological principles in urban planning,

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Box 2.3 (continued)

construction, and management to further improve the system of urban green areas, effectively control and reduce air pollution, water pollution, soil pollution, noise pollution, and various wastes, implement clean production, green transportation, and green buildings, and promote harmony between humans and nature in cities, thus, making the environment cleaner, safer, more beautiful, and more comfortable (Ministry of Housing and Urban–Rural Development 2004a).

【Background】 In 1992, the former Ministry of Construction began to select and praise the National Garden Cities (or Districts) nationwide every 2 years. Beijing, Hefei, and Zhuhai received the title of the first batch of National Garden Cities. By the end of 2009, the Ministry of Construction had named 11 batches of National Garden Cities (or Districts), including 139 National Garden Cities and 7 National Garden Districts. These cities and districts have provided a good model and played a leading role in city garden greening nationwide.

To promote the building of the Ecological Garden Cities, the Ministry of Construction in June 2004 announced the "Notice on the Issuance of Building "Ecological Garden City" Implementation Opinions" and proposed the provisional guidelines, assessment methods, and standards for building an ecological garden city: the assessment of the Ecological Garden City will be held once a year; the applicant must be a city that has already held the title of National Garden City; the construction should adhere to five principles, including being people-oriented, prioritizing environmental aspects, systematic, engineering projects driving and adapting to local conditions. In addition, feasible targets and plans for building an Ecological Garden City should be prepared according to the different levels of urban socioeconomic development, so as to promote coordinated economic, social, and environmental development. The assessment would be made by means of cities' voluntary application, recommendation by the provincial construction administrative departments, consultation with the experts invited by the Ministry of Construction, and checking and approval by the department executive council (Ministry of Housing and Urban–Rural Development 2004b). In June 2007, the Ministry of Construction formally confirmed 11 cities as National Ecological Garden Pilot Cities, including Qingdao, Nanjing, Hangzhou, Weihai, Yangzhou, Suzhou, Shaoxing, Guilin, Changshu, Kunshan, and Zhangjiagang (Ministry of Housing and Urban–Rural Development 2007).

【Assessment System】 In 1997, the Ministry of Construction named the fourth batch of National Garden City while at the same time putting forward 12 standards for National Garden City Assessment. The assessment indicators were mainly based on answering the questions of how to build a garden city; the major concerns included urban landscape and greening, parks, ecological environment, and municipal infrastructure (Wenming.cn 2008).

After 2000, with the increasing number of applicant cities and to regulate the building of the Garden Cities, the Ministry of Construction developed the "Implementation Plan of Building National Garden City" and "National

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Box 2.3 (continued)

Garden City Standard" to put forward normative requirements on application scope and procedures, and this standard was later revised in 2005. The new standard is composed of qualitative and quantitative criteria, and the assessment indicators include: organizational leadership, management system, landscape protection, green construction, park construction, ecological environment, and municipal facilities. The application scope for the Garden City District has extended, and the people's government in all cities can apply for the National Garden City and the municipality people's government can apply for the National Garden District. The applicants must fulfill the following criteria: (1) the city government has proposed the plan of building a National Garden City and has been implemented for 3 years; (2) the people's government of the city deems that it has meet the national garden city standards after organizing a self-examination; (3) Provincial Garden City building activities have been carried out and the title of Provincial Garden City has been awarded. In addition, a review of the named "National Garden Cities (or Districts)" is conducted every 5 years.

In 2004, the provisional "National Ecological Garden City Assessment Standard" was proposed based on the building of National Garden City; it is composed of qualitative and quantitative criteria. The qualitative criteria mainly include the compilation of the scientific planning for the urban green space system which is integrated into the comprehensive plan for the city; coordinated urban and regional development, with a good city-wide ecological environment; keeping the city terrain features; inheriting historical culture; having formed a unique urban natural and cultural landscape; complete and efficient urban infrastructure facilities; effective disposal of industrial and domestic pollutants, clean and safe urban environment; complete public sanitary facilities, high level of pollution control and the establishment of corresponding crisis disposal management; a variety of cultural and sports recreational and leisure facilities, complete residential community functions, a high degree of residents' satisfaction with the urban living environment; and so on. There are three quantitative criteria, namely, an urban ecological environment indicator, an urban living environment indicator, and an urban infrastructure indicator. The urban ecological environmental indicator includes a comprehensive species index, an index of local plants, the proportion of water permeable area in roads and squares in built-up areas, urban heat island effect level, built-up area green coverage, and per capita public greenland and greenland rate. The urban environment indicator involves five aspects: air pollution, urban water environment, water quality in drinking water distribution system, environmental noise, and degree of public satisfaction with the ecological environment. The infrastructure indicator considers livelihood issues such as the complete rate of infrastructure, percentage of households with access to

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Box 2.3 (continued)

tap water, urban sewage treatment rate, utilization rate of recycled water, innocuous treatment rate of domestic garbage, hospital beds per 10,000 people, average speed on primary and secondary roads, and so on.

The construction of an ecological garden city requires higher standards and wider scopes than that of a garden city. It focuses city's green environment and infrastructure and inherits the central idea of the Garden City on urban greening, ecological landscape, and infrastructure building. However, it is not a simple assessment indicator upgrade, but is an enrichment and expansion of the connotation of garden city and involves innovations in urban planning, construction, and management system. In all, it is one of the stages of building an ecological city (Nanyang.net 2009).

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Box 2.4 Healthy City

【Creation Time】 1994

【Implementation Department】 National Patriotic Health Campaign Committee

【Target】 The goal of building a Healthy City is to form an effective environmental support and health service, so as to improve the environment and health status of citizens. The principle of the Healthy City project is to fully activate the local government in public sanitation and health and encourage local government to fulfill the policy proceeding from public health objectives. It aims to achieve the objective of health improvement through raising people's awareness, mobilizing the cooperation between citizens and local government as well as social institutions, to form an effective supporting environment and

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Box 2.4 (continued)

provide a better health service. It uses a variety of resources to improve environmental and sanitary conditions by enhancing residents' awareness of participation and mobilizing them to participate in various health activities (Yuan et al. 2008, Xinhua.net 2005, Zhou et al. 2000).

【Background】 In 1978, the World Health Organization (WHO) held the International Conference on Primary Health Care in Alma-Ata and proposed the global strategic objective of "Health for All by the Year 2000," launching a grand public health campaign. To achieve this strategy, in October 1984, WHO held the first Global Health Conference in Ottawa, Canada, putting forward the concept of the Healthy City. The "Ottawa Health Promotion Charter" developed in the conference explained the five health promotion strategies in detail, including: building healthy public policy, creating supportive environments, strengthening community actions, developing personal skills, and reorienting health services. In the same year, WHO held a meeting in Lisbon, formally launching the Healthy City Project. The participating city must follow the formal application process and be accepted as a network member by the WHO European headquarters. In 1993, WHO convened the First International Healthy Cities Conference in San Francisco, and then offices of the Healthy City Project were set up in many parts of the world. By 2007, more than 4,000 cities had joined in the Healthy City Project, including 100 cities in developing countries (WHO/Europe 2005).

China's Healthy City Project began in August 1994, when WHO cooperated with the Ministry of Health and took Dongcheng District of Beijing and Jiading District of Shanghai as pilot districts to pioneer the building of healthy cities. Jiading District focused on waste disposal, including environmental hygiene, environmental protection, health education, disease prevention, urban health services, health guidance, etc., while Dongcheng District focused on health education, sewage treatment, city greening, etc. By 1996, there were seven WHO Healthy City Projects including the newly added Chongqing Yuzhong District, Suzhou, Haikou, Baoding, and Dalian, of which Suzhou has become one of the steering committee cities of the WHO Alliance for Healthy Cities in Western Pacific Region. In 1997, the Ministry of Health jointly decided with the National Patriotic Health Campaign Committee to coordinate the building of the Healthy City and National Hygienic City. With the growing healthy city building work, cities such as Suzhou, Zhangjiagang, and Shanghai successively proposed to build healthy cities and started implementation with local government commitment. After receiving the title of National Hygienic City in 1998, Suzhou actively carried out the building of a healthy city. In 2001, the National Patriotic Health Campaign Committee Office made a formal declaration to WHO Western Pacific Region by taking Suzhou as the Pilot Healthy City. In 2003, Shanghai launched comprehensive healthy city building, becoming the first mega city proposing the building of a healthy city. In October 2006, the

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Box 2.4 (continued)

Second General Assembly and Conference of Alliance for Healthy Cities (AFHC) was held in Suzhou and 16 cities and two individuals were awarded for their efforts in healthy cities movement, in which Suzhou won the Award for Progress of Healthy Cities with Good Performance, Changshu won the Award for Progress of Healthy Cities with Great Potential, and Wujiang won the Award for Good Practices of Healthy Cities. Kunshan, Jiangsu won the Good Practice of Healthy Cities Awards for its gender-based violation reduction and improving the quality of care through mother-friendly hospital initiative in WHO Awards for Healthy Cities 2006. At the end of 2007, based on the national hygienic city building and achievements made by WHO Healthy City in recent years, the National Patriotic Health Campaign Committee Office (PHCCO) officially launched the nationwide construction of Healthy Cities, Healthy Districts (or Towns) activities and approved the pilot work of Shanghai, Hangzhou in Zhejiang Province, Dalian in Liaoning Province, Suzhou in Jiangsu Province, Zhangjiagang, Kelamayi in Xinjiang Uygur Autonomous Region, Dongcheng District and Xicheng District of Beijing, Qibao town in Minhang District, and Zhangyan Town in Jinshan District, Shanghai (Qiao 2010).

【**Assessment System**】The WHO Healthy City is defined as follows: A healthy city is defined by a process, not an outcome; not one that has achieved a particular health status; one that is continually creating and improving the physical and social environments and expanding the community resources that enable people to mutually support each other in performing all the functions of life and in developing to their maximum potential. It is conscious of health and striving to improve it. Therefore, any city, regardless of its current health status, can be a "healthy" city. What is required is a commitment to health and a process and structure to achieve it. The indicators differ in regions: for example, there are 32 healthy cities indicators for the WHO European Region, involving health indicators, healthy service indicators, environmental and socioeconomic indicators, focusing on the health of residents as well as the basic conditions of health services. The medium-term indicators of WHO Regional Office for the Western Pacific Healthy Cities address health literacy, social action and influence, healthy public policy and organizational practices, healthy lifestyles, healthy environments, and effective health services. The preparation of China's healthy city standard system and assessment system started in April 2009 and is currently in the preassessment phase (Health Department of Zhejiang Province 2004).

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Box 2.5 National Model City for Environmental Protection

【Creation Time】 1997

【Implementation Department】 Ministry of Environmental Protection

【Target】 National Model City for Environmental Protection is the concrete embodiment of implementing a urban sustainable development strategy. It takes sustainable urban development as the principle to set up models of coordinating social and economic development with good environment quality, complete urban infrastructure, clean urban appearance, and ecological virtuous for steering cities to route of sustainable urban development. It symbolizes a social civilization and prosperity, rapid economic growth, good environmental quality, rational resources utilization, an ecological virtuous circle, a beautiful and clean city, complete infrastructure, and a comfortable and convenient lifestyle (Liaoning Provincial Environmental Protection Department 2009, China's Ministry of Environmental Protection 2009).

【Background】 In May 1997, to implement the objective of "Setting up a Number of Model Cities with Rapid Economic Growth, Clean and Beautiful Environment and Virtuous Ecological Circle in Urban Environmental Protection," proposed by the "National 'Ninth 5-Year' Plan for Environmental Protection and the Outline of the Long-Term Target for the Year 2010," the State Environmental Protection Administration (now the Ministry of Environmental Protection) decided to carry out nationwide National Model Cities for Environmental Protection building activities. Through these activities, a number of National Model Cities for Environmental Protection were established with coordinated environmental, social, and economic development, to promote the national environmental protection process. In November 1997, the Medal Awarding Meeting of the National Model Cities for Environmental Protection convened in the Great Hall of the People and granted medals to six cities, namely, Zhangjiagang, Shenzhen, Dalian, Xiamen, Weihai, and Zhuhai. By the end of 2008, 67 cities and 5 municipality districts have been awarded the title of National Model Cities (or Districts) for Environmental Protection, and 128 cities have been actively carrying out "model

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Box 2.5 (continued)

creation" activities. After 10 years efforts, "model creation" has become an important carrier and driving force for governments at all levels to implement scientific development concepts and green political performance, making a new path of urban environmental protection with Chinese characteristics. Through "model creation," urban environmental protection work has been upgraded comprehensively and the environmental quality has also been significantly improved. "Blue sky, clear water, green space, serenity, and cleanliness" have become important symbols for model cities (China's Ministry of Environmental Protection 1997).

【**Assessment System**】In 1997, the assessment indicators and creation activities for the National Model Cities for Environmental Protection were proposed simultaneously, aiming to reflect the contents of urban sustainable development and competitiveness, socioeconomic development level, and the degree of coordination with environmental protection. Before the implementation of the latest revised version of the "'Eleventh 5-Year' National Model Cities for Environmental Protection Assessment Indicator and Implementing Detailed Rules (Revised)" on January 1, 2010, four amendments were made in 1998, 2002, 2006, and 2008, respectively. In that revised version, the assessment indicator system was composed of basic conditions and specific assessment indicators, among which the basic conditions include the following three indicators: the quantitative examination of environmental comprehensive treatment ranks in the national or provincial leading position in 3 consecutive years; the National Hygienic Cities assessment has been passed and accepted; and the environmental protection investment indicator is greater than 1.5%. One of the basic conditions of the National Environmental Protection Model Cities is to pass the assessment of the National Hygienic Cities. However, besides the important socioeconomic aspect, the urban assessment indicator lays greater emphasis on environmental quality, construction, and management. Specific assessment indicators include 26 indicators which carry out assessment on four aspects, namely, economy and society, environmental quality, environmental construction, and environmental management, covering key environmental protection work aspects such as total emission reduction, water, air, noise, solid waste pollution prevention and control, environmental impact assessment, urban environmental infrastructure construction, and environmental protection capability building (China's Ministry of Environmental Protection 2008).

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Box 2.6 Ecological Demonstration Zone and Ecological City

【Creation Time】 1994 (Ecological Demonstration Zone); 2003 (Ecological City)

【Implementation Department】 Ministry of Environmental Protection

【Target】 The construction of Ecological Demonstration Zones and Ecological Cities(Counties and Zones) is a major revolution in promoting regional sustainable development of the social economy. The fundamental objective is to rationally organize and actively promote the coordinated development of the regional social economy and environmental protection, thus setting up a virtuous circle of the economic–social–natural complex ecosystem to achieve rational exploitation of natural resources and improvements of the ecological environment at the same time as ensuring socioeconomic development and meeting the growing material and cultural needs of the people.

【Background】 The construction of National Ecological Demonstration Zones generally went through three stages, from pilot projects to the current situation:

1. Early preparation. In 1994, the State Environmental Protection Administration formulated the "National Ecological Demonstration Zone Construction Planning," and in March 1995, a workshop of ecological demonstration zones in some provinces, cities, and counties was held in Beijing. Later, the "National Ecological Demonstration Zone Construction Planning Outlines" was published, which defined the objectives and tasks of building ecological demonstration zones and proposed relevant goals in the "Ninth 5-Year" environmental protection plan.
2. Pilot organization. From 1996 to 1999, the country carried out 154 National Ecological Demonstration Zone Pilot Projects in four batches, among which were 2 Ecological Provinces (Hainan Province and Jilin Province), 16 Ecological Regions and Ecological Cities, 129 Ecological Counties (or County-level cities), and 7 others. At the same time, Sichuan,

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Henan, Zhejiang, Jiangsu, Heilongjiang, Liaoning, Hebei, Inner Mongolia, Fujian, and Guangdong provinces (or regions) also carried out Provincial Ecological Demonstration Zones Pilot Projects.

3. The first batch of accepted cities. At the implementation of the Ecological Demonstration Zone, many pilot units began from a high starting point and acted decisively to ensure the smooth progress of pilot work. Therefore, in 1998, the State Environmental Protection Administration decided to organize the acceptance of ecological demonstration zones in advance, and in 1999, the acceptance of 33 pilot units was completed. By June 2004, the State Environmental Protection Administration has approved nine batches of National Ecological Demonstration Pilot Zones, with a total of 528. There are thus 528 regions and units which have carried out ecological demonstration zone construction, and 166 of them have been accepted and officially named as National Ecological Demonstration Zones.

The construction of national ecological demonstration zones has developed rapidly due to the concerns of party committees and governments at all levels, having a good influence on the surrounding areas and making ecological demonstration zone construction become an ideal carrier and form of regional social organization and sustainable economic development. In May 2003, to further deepen the construction of ecological demonstration zones and to promote the realization of the strategic task and objective of building a well-off society in an All-round Way, the State Environmental Protection Administration issued the "Construction Indicators of Ecological County, Municipality, and Province (Trial Implementation)." In 2006, national ecological city building achieved interim progress when Zhangjiagang, Changshu, Kunshan, Jiangyin, Shanghai Minhang District, and Anji County in Zhejiang Province were the first batch named as National Ecological Cities, Districts, or Counties. In 2007, Liaoning convened a mobilization meeting for building an ecological province, and Shanxi started to work toward building an ecological province. So far, there are 14 provinces which have carried out ecological province construction, namely, Hainan, Jilin, Heilongjiang, Fujian, Zhejiang, Shandong, Anhui, Jiangsu, Hebei, Tianjin, Sichuan, Guangxi, Liaoning, and Shanxi (People and ecology net 2010).

【**Assessment System**】In 2003, the State Environmental Protection Administration issued the Construction indicators of Ecological County, Municipality, and Province, strengthening its relevance and pointing and fine-tuning part of the indicators. The State Environmental Protection Administration also issued "Guiding Opinions on Strengthening the Ecological Demonstration Construction Work" in the beginning of 2007. On December 26, 2007, the Ministry of Environmental Protection enacted "Construction indicators of Ecological County, Municipality, and Province (Revised)" to further investigate economic, social, and population growth and degree of public satisfaction, at the same time

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as investigating traditional ecological problems such as water, air, noise, and waste, and the integrity of ecological structure and function.

The construction indicators of the Ecological County, Municipality, and Province are composed of economic growth indicators, ecological environment protection indicators, and social progress indicators. Targeting the assessment indicators differing applicability in various regions, the indicator system was divided into constraining indicators and reference indicators, and refining the indicators requirements in different regions. The basic requirements of ecological city (including the municipal administrative area) construction indicators are as follows:

1. The development of "Ecological City Construction Planning" has been deliberated, promulgated, and implemented with the approval of the Municipal People's Congress. The relevant state laws, regulations, and institutions of environmental protection, as well as various local environmental regulations and institutions, have been effectively implemented.
2. Governments above and including the county level (including various economic development zones) have independent environmental protection institutions. Environmental protection work shall be included in the performance assessment contents of the Party committee and governmental leadership, and a corresponding assessment mechanism has been set up.
3. Have completed the tasks of energy saving and emission reduction assigned by the upper-level government. Without major environmental incidents in 3 years, various environmental problems put forward by residents have been effectively solved. There is no significant effect on the ecological environment caused by invasive alien species.
4. The ecological environmental quality assessment indicator ranks in the leading position in the province.
5. At least 80% of the counties in the city (including county-level cities) meet the requirements of the National Ecological County construction indicators and win the honorary title; the central city shall pass the assessment of the National Environmental Protection Model Cities and win the honorary title (Tao 2008).

Sources

People and ecology net. Ecological Demonstration Zone Construction [2010-02-02]. http://loess.geodata.cn/html/kepu/docc/wenmingbrow.asp-id=1548&classid=61.html

Tao KF. 2008. New Ecological Construction Indicator Promotes Energy-saving and Emission Reduction – Interpretation of "the Construction Indicator of Ecological County, Municipality and Province" (revised). Environmental Education, (2):33–35. (in Chinese)

Box 2.7 Livable City

【Creation Time】 2005

【Implementation Department】 Ministry of Housing and Urban–Rural Development

【Target】 To build livable cities with fresh air, beautiful environment, and healthy ecology.

【Background】 Since the 1990s, with the continuation of reform and open-up policy, the enhancement of the urbanization level and achievements made toward building a well-off society have meant that the requirements which urban residents make on livability have gradually increased. In 1989, the United Nations Habitat Center set up the "Habitat Scroll of Honour Awards" and China strengthened international cooperation in human habitation. In June 1991, the UN-Habitat Beijing Information Office was established, and some domestic cities participated in the UN-Habitat Best Practices and won awards. In 1997, the International Federation of Park and Recreation Administration (IFPRA) launched an international nonprofit "International Awards for Livable Communities." In 2001, China's Ministry of Construction (now Ministry of Housing and Urban–Rural Development) set up its own livable settlement awards, "China Habitat Award" and "China's Model City For Livable Environment," to enable urban development in China to be in line with international standards. The award-winning cities of Zhuhai, Dalian, Zhongshan, Xiamen, Qingdao, and Weihai have become stars and models in Chinese cities, being regarded as the most livable cities by the public and provoking people to think about and pursue the concept of livability. In 2005, in the "Overall Beijing Urban Plan" approved by the State Council, the concept of "livable city" appeared for the first time. Later, in many national urban working sessions, building a livable city became an important part of urban planning (Dong and Yang 2008).

【Assessment System】 In April 2006, the Ministry of Housing and Urban–Rural Development listed the "Livable City Evaluation Indicator System of Scientific Research" as a research project of 2006. In April 2007, the "Livable City Scientific Evaluation Standards" was accepted by the Ministry of Housing and Urban–Rural Development's Science and Technology Department. It has a detailed classification with a larger concept extension compared with traditional livable cities, further innovating the concept, management mode of China's urban planning and construction and urban spatial layout and morphology. This orientation standard uses scientific assessment criteria and implements a hundred-mark (100 points) system. Following the inspection of task group experts, cities with a livable index cumulative score being equal to or greater than 80, and without negative conditions, can be identified as a "Livable City" by the Livable City task group of the Chinese Society for Urban Studies (CSUS). Cities with a livable index between 60 and 80 are recognized as a "moderately livable city"; cities

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Box 2.7 (continued)

with the livable index below 60 or with the livable index above 80 but with two negative conditions are listed as "early warned livable cities." In the text of the "Scientific Assessment Standards of Livable City," the urban livable degree is evaluated in six aspects, namely, social civilization level, economic prosperity level, level of beautiful environment, resource load level, life convenience level, and public security level, and each aspect includes a number of subitems and indicators. At present, only the "Livable City Scientific Evaluation Standards" is used for scientific guidance of "Livable City" planning, building, and management, and each city can choose to apply it voluntarily (CNKI 2007).

Sources

CNKI. "Livable City Scientific Evaluation Standards" Is Formally Issued in Beijing. [2007-07-18]. http://www.ccpd.cnki.net/news_view-id1802-lmid144-wenjian3.html

Dong XF, Yang BJ. 2008.The Advancement of Construction and Research on Livable City in China. Earth Science, 23(3):323–326 (in Chinese).

China's urban construction model is to promote, in a generally top-down manner, the implementation of a procedure of "practice–assessment–naming–reviewing" or "create an assessment system on a trial basis–practice–amendment–naming–reviewing." In recent years, a bottom-up approach has also been adopted, which stresses the broad participation of the public and the incorporation of the degree of public satisfaction, gradually guiding and encouraging citizens and social organizations to join in urban construction. When compared with the building modes which focus on good results, the building of healthy city takes the WHO Healthy City Project as its starting point and focuses on the implementation process and concept of healthy urban capacity building. It prepares related healthy city planning and indicators for adjusting measures to local conditions, according to different situations and characteristics of cities and districts.

2.2 Practices of China's Sustainable Cities

In the twenty-first century, cities in China will inevitably encounter great environmental and development challenges, including the pressure of three population peaks (total population, total employed population, and total elderly population), excessive utilization of natural resources, deteriorating ecological environment, rapid advances in industrialization, urbanization and modernization, aggravating unbalanced regional development, and so on, which will become bottleneck constraints to urban development in future. In 1986, pilot and experimental

demonstration works of "National Sustainable Communities" were launched through the guidance and support of the State Science and Technology Commission (now Ministry of Science and Technology) in conjunction with other government agencies. This initiative intended to actively explore the operating mechanisms and a new model to coordinate economic development with population, resources, and environmental development during the industrialization and urbanization of medium-sized cities and small towns, to research measures to address the bottleneck of economical and social sustainable development. Through specific guidance and planned project implementation of the Ministry of Science and the local technology sector, significant progress has been made in the sustainable development awareness of government and public, the positioning of local sustainable development, people's living, life and overall ideological quality, effective protection and utilization of ecological environment and natural resources, and so on and has formed the initial sustainable development construction modes with various characteristics.

Proceeding from the certainty of the world's future development trend and profound analysis of China's national conditions, and in view of the grand background of general trends in domestic and international development, in June 1992 the Chinese government solemnly signed the Rio Declaration on Environment and Development at the United Nations Conference on Environment and Development held in Brazil; in March 1994 the Chinese government led in developing "China's Agenda 21 – White Paper on China's Population, Environment, and Development in the twenty-first Century," which set out that the objectives for the development of human settlements are: to formulate and enforce policies, laws, regulations, development strategies, long-term plans, and action programs by appropriate government agencies and legislative bodies; to mobilize all social communities and people for taking an active part in the construction of human settlements, which should be rationally laid out with comprehensive facilities, which are convenient for working and living, and which have clean, quiet, and comfortable environments. It formulated an action program suitable for national development and took these as guidance for implementing sustainable development. In 1996, the Chinese government officially made sustainable development the country's basic development strategy, and in 2003, the "comprehensive, coordinated and sustainable" scientific outlook on development was proposed, giving rise to a huge sensation in the international community.

Subsequently, some large cities have made continuous efforts to implement "China's Agenda 21." In 1997, Shenyang and Wuhan joined the SCP project. In January 2005, approved by the Ministry of Science and Technology, the administrative Center for China's Agenda 21and UN-Habitat signed a cooperation agreement to jointly promote and implement "UN-Habitat Sustainable City Program (SCP II)" in China. Guiyang, Panzhihua, and Hailin became the second batch of SCP pilot cities. In Guiyang, the SCP II lasted 2 years, and the implementation strengthened the scientific basis and feasibility of the "Overall Construction Plan for a Pro-Ecology City," while also promoting government, enterprises and citizens to change their views on urban development and environmental protection.

Box 2.8 Introduction to Shenyang Sustainable City Project

In 1994, the State Environmental Protection Administration Bureau recommended that the Shenyang Municipal Government sign the "Letter of Intent of Sustainable Cities Project Pilot Cooperation" with the UN Habitat Commission and UNEP. With the support of relevant UN institutions, Shenyang then began to explore how to achieve coordinated socioeconomic and environmental sustainable development. In May 1997, Shenyang municipal government signed the "Sustainable Shenyang Project" jointly with UNDP and China International Economic and Technical Exchange Center, and Shenyang was officially included in the list of the world's "Sustainable Cities Project" pilot cities. According to the project document provisions, the implementation of Shenyang's sustainable development is mainly composed of three phases, and each phase is established on the basis of previous stage (Shenyang Environmental Protection Bureau 2005).

Phase I: Project start-up phase. Strengthen the awareness and participation of relevant departments; carry out seminars and training activities; prepare an environmental program; define major urban environment problems and main related departments of urban environmental management; convene city consultation meeting; and identify priority urban environmental issues as well as major solutions.

Phase II: Prepare action plan. Set up "Working Group on Environmental Issues" as the main action. The working group fully analyzes, discusses, evaluates, and consults to address major environmental issues identified by a city consultation meeting and implants the specific environmental management strategy into a detailed action plan; the organizations and institutions responsible for improving environmental quality take charge of implementation to put the urban environmental management and action plan into practice.

Phase III: Open-style follow-up consolidation phase. A series of suggestions on investment and technical assistance projects are produced through strategic and action plans and discuss with related institutions. With the support of China's Agenda 21 Center, the experience of Shenyang will be further summarized and promoted.

The Sustainable Shenyang Project is actually a capacity building project. Project implementation cannot immediately solve a number of Shenyang's environmental problems; however, the project emphasizes the interaction between environment and development and brings environmental problems concerns into the urban development strategic planning and decision-making process. Project implementation provides a framework for urban environmental planning and management to facilitate a cross-sectoral decision-making mechanism, enhance information exchange, and cooperation between the major-related departments, and thus make the relevant department change its former approach of dealing with specific issue that focuses only on the interest

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Box 2.8 (continued)

of inner department. It also proposes solutions from a global perspective and further institutionalizes the principals of broad participation, democratic decision making and issues settlement priority in implementation. As these practices gradually expand to other areas, the efficiency of various departments and the overall management of Shenyang will thereby be enhanced (UN-Habitat 2009).

Sources

Shenyang Environmental Protection Bureau. Sustainable Shenyang Programme. [2005-03-17]. http://www.acca21.org/local/dl/download/unscp050317/susshenyang.pdf

UN-Habitat: United Nations Human Settlements Programme. Sustainable Cities Programme 1990–2000: A Decade of United Nations Support for Broad-based participatory management of Urban Development. [2009-04-01]. http://ww2.unhabitat.org/programmes/sustainablecities/documents/scp1990-2000.pdf

Box 2.9 Introduction of Wuhan Sustainable City Project

In 1995, following a recommendation by the State Environmental Protection Administration, Wuhan participated in the global "Sustainable Cities Project." In May 1997, the tripartite "Wuhan Sustainable Development Management Projects" (SWP) file was signed by the UNDP China Office, China International Center for Economic and Technical Exchanges, and Wuhan Municipal People's Government. In the same period, the Wuhan Environmental Protection Bureau established the SWP office, organized broad local stakeholder participation, and invited international and domestic experts for consultation and guidance. They identified four priority environmental issues, namely, city ground surface water environmental protection and treatment, atmospheric environmental protection and treatment, urban solid waste management, and urban transport comprehensive treatment. In December 1999, under the guidance of UN experts, nine governmental departments and scientific research institutions of Wuhan jointly prepared and completed the "Wuhan Environmental Management Strategic Outline" (Wuhan Environmental Protection Bureau 2005).

Under the guidance of the "Wuhan Environmental Management Strategic Outline," Wuhan has attached great importance to coordinating urban economic, social, and environmental development and included environmental management into various national economic and social development plans, especially in the "Tenth 5-Year" plan and management objectives of governments. It has implemented a people-oriented social development policy, focused on promoting disaster reduction and prevention, human habitat condition improvement, and poverty reduction by utilizing comprehensive

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Box 2.9 (continued)

environmental management. The "Clean Wuhan, Beautiful Home" activity carried out by Wuhan was a key environmental comprehensive treatment and community building program.

The "Sustainable Wuhan Project" has played a significant role in promoting Wuhan's sustainable development. Through project implementation, governmental strategic planning and environmental management capacity have been improved, a series of urban environmental protection and construction projects have been implemented, social environmental consciousness and residents' awareness of participation have been strengthened, and international exchanges and cooperation in the field of environmental protection have been promoted. Under the guidance of sustainable development, the economy, society, and environment of Wuhan have enjoyed coordinated development, people's lives have been improved, and the city has a brand new appearance (UN-Habitat 2009).

Sources

UN-Habitat: United Nations Human Settlements Programme. Sustainable Cities Programme 1990–2000: A Decade of United Nations Support for Broad-based participatory management of Urban Development. [2009-04-01]. http://ww2.unhabitat.org/programmes/sustainablecities/documents/scp1990-2000.pdf

Wuhan Environmental Protection Bureau. Sustainable Wuhan Programme. [2005-03-17]. http://www.acca21.org/local/dl/download/unscp050317/suswuhan.pdf

China participated actively in the "Rio Declaration," "United Nations Framework Convention on Climate Change," "Local Agenda 21," and a series of international conventions and related action plans, which have laid a good foundation for sustainable cities construction. However, given the complex background of urbanization, the urban ecological environment, population, economy, society, culture, and politics will inevitably be changed and sustainable cities construction will face many challenges. On one hand, the management mode and mechanism of the sustainable cities still need reform and innovation in various forms, which can be realized through the combination of top-down political guarantee and bottom-up public participation. On the other hand, further revealing the relationships between urban systematic structure, function, metabolism, and processes, as well as constructing a sound and effective assessment indicator system, will be the crucial point of scientific construction of the sustainable cities, enabling the objective of sustainable cities construction to be finally achieved.

Chapter 3
An Assessment Indicator System and a Comprehensive Index for Sustainable City

3.1 Functions of Assessment Indicator System for Sustainable City

3.1.1 Significance and Functions of Sustainable City Assessment

1. Significance of sustainable city assessment
   Apart from qualitative description, the most important method we used to analyze and assess the development level toward a sustainable city was quantitative analysis (Sustainable Development Strategy Study Group 2003). The quantitative analysis seeks and sets up a set of measures that can quantify the development level toward a sustainable city and answer the questions that people are generally concerned about. For example: What is the level and trend of sustainable city construction of this specific city? How can the city's ranking be defined compared with the sustainable city construction level of other cities? What are the weak points and key issues in the sustainable city construction processes of this specific city? What are the prioritized areas and paths to enhance or improve the sustainable city construction level of this specific city? (Kuik and Verbruggen 1991; Opschoor 1992). We measured or assessed the sustainable city construction level precisely to answer questions.
   The construction or development of a sustainable city is a dynamic process with broad meanings and continuity. Measuring and assessing city's construction or development level in the sense of Sustainable City will cover many aspects including the economy, society, ecology, and environment. Therefore, it is necessary to establish an assessment indicator system, instead of one or few indicators, to analyze and assess a city's development level toward a sustainable city.
2. Function of assessment for a sustainable city
   The assessment indicator system for a sustainable city has multiple attributes and multiple hierarchies. It is not present in one isolated set of indicators or simple collection of a set of indicators, but is present in a complex by dynamic integration

J. Zhao, *Towards Sustainable Cities in China*, SpringerBriefs in Environmental Science 1,
DOI 10.1007/978-1-4419-8243-8_3,

of measurement indicators in many areas. This system exhibits the sustainable cities construction and development processes of assessed cities in a simple but comprehensive way, with the following six primary functions.

(a) Determination of the assessment indicator system for a sustainable city: the candidate city should be systematically analyzed and identified the further determine key issues for this city to resolve. In fact, the issues judged and measured by the indicators in this system are exactly the primary focuses for the construction or development of a sustainable city, and the indicator system demonstrates the holistic development status of the candidate city through its overall effect.
(b) The assessment indicator system for a sustainable city enables decision makers to focus on key issues and prioritized areas related to sustainable city development and to follow up the status and progresses of such issues.
(c) The assessment indicator system for a sustainable city can instruct policy- and decision makers to know the framework for sustainable city development clearly during policy- and decision-making process and to ensure that all policies are coordinated with each other and do not deviate from the construction direction.
(d) The assessment indicator system for a sustainable city can simplify and improve the understanding of sustainable city development from all the groups of society, promoting their understanding of related plans and actions and taking active measures and actions in a cooperative manner.
(e) The assessment indicator system for a sustainable city can show the status and executive effect of policies on sustainable city construction development and enable people to know the development progress at any time. Feedback from the above information can help policy- and decision makers carry out early evaluation of the appropriateness and effectiveness of policies and make necessary improvements and adjustments.
(f) The assessment indicator system for a sustainable city is a control tool and precautionary method used by decision makers and managers. Through time series analysis of the indicator system, city decision makers and managers can forecast and know the city's development status and future trends and carry out specific adjustments to policy control or system structure.

Box 3.1 Sustainable Seattle: Indicators of Sustainable Community

The comprehensive plan "*Towards A Sustainable Seattle*: A Plan for Managing Growth, 1994–2014" was adopted by the City Council in the summer of 1994, following 4 years of extensive citizen involvement as thousands of people discussed, debated, and expressed their opinions about how Seattle should grow in the years ahead. From these discussions, the following four

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Box 3.1 (continued)

core values emerged, which were Community, Environmental Stewardship, Economic Opportunity, and Social Equity (Sustainable Seattle 2010). Five indicator aspects were:

Environment: Wild salmon, Ecological health, Soil erosion, Air quality, Pedestrian-and bicycle-friendly streets, Open space near urban villages, and Impervious surfaces.

Population and Resources: Population, Water consumption, Solid waste generated and recycled, Pollution prevention, Local farm production, Vehicle miles traveled and fuel consumption, and Renewable and nonrenewable energy use.

Economy: Energy use per dollar of income, Employment concentration, Unemployment, Distribution of personal income, Health care expenditures, Work required for basic needs, Housing affordability, Children living in poverty, Emergency room use for non-ER purposes, and Community reinvestment.

Youth and Education: High school graduation, Ethnic diversity of teachers, Arts instruction, Volunteer involvement in schools, Juvenile crime, Youth involvement in community service, Equity in justice, and Adult literacy.

Health and Community: Low birthweight infants, Asthma hospitalizations for children, Voter participation, Library and community center usage, Public participation in the arts, Gardening activity, Neighborliness, and Perceived quality of life.

Source

Sustainable Seattle. About Us. [2010-02-02]. http://www.sustainableseattle.org/About

Box 3.2 A Sustainable City Plan: Santa Monica, USA

On September 20, 1994, Santa Monica's City Council adopted the city's first Sustainable City Program to ensure that Santa Monica can continue to meet its current environmental, economic, and social needs without compromising the ability of future generations to do the same. The program has evolved in 14 years since its adoption and has been responsible for many positive changes in the community. In 2003, the City Council adopted an expanded version of the program called the Sustainable City Plan (SCP), which was developed by a diverse group of community stakeholders and lays out far reaching sustainability goals for the community (Office of Sustainability and the Environment 2010).

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Box 3.2 (continued)

Resource Conservation: Decrease consumption of nonlocal, nonrenewable, nonrecyclable energy, water, materials, and fuels/Promote renewable resource use.

Environmental and Public Health: Minimize or eliminate the use of hazardous and toxic materials and the levels of pollutants entering the air, soil, and water.

Transportation: Maximize mobility and access/Reduce traffic and pollution associated with transportation.

Economic Development: Nurture a diverse, stable local economy that supports the basic needs of community members/Increase sustainable business practices.

Open Space and Land Use: Develop and maintain a diverse open space system that supports the community and the natural environment/Create mixed-use urban villages.

Housing: Provide a mix of affordable, livable, and green housing types for people of all socioeconomic, cultural, and household groups.

Community Education and Civic Participation: Community members participate actively and effectively in civic affairs and community improvement efforts.

Human Dignity: All community members are able to meet their needs, have adequate access to housing, health care, education, employment, and are empowered to enhance the quality of their lives.

Source

Office of Sustainability and the Environment. Santa Monica Sustainable City Plan. [2010-02-02]. http://www.smgov.net/Departments/OSE/Categories/Sustainability/Sustainable_City_Plan.aspx

Box 3.3 Indicators in Handbook on Urban Sustainability

The Handbook on Urban Sustainability was written by worldwide specialists from Canada, India, Italy, Palestine, Peru, Spain, and the Netherlands and is a guide to establishing a city on a sustainable path (Munier 2007). It addresses sustainable urban planning issues by breaking the city down to its main components. The authors analyzed and discussed these topics referring to the following indicators:

1. Economic aspects: Economic growth, Jobs opportunities, Unemployment, Cost of living, Taxes, Average disposable income, Ratio of household

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Box 3.3 (continued)

income to rental/mortgage, Increase/decrease in housing prices, Industrial diversity, Industrial resilience, Specialization, Number of centers for community participation, Emergency preparedness, and Percentage of the top five industries responsible for the 80% of income (measured in amount of wages paid per annum).

2. Social aspects: Social climate, Cultural diversity, Perceived discrimination, Social strata, Number of hospitals, Number of dispensaries, Existence of slums, Crime rate, Drug use, Child labor, Violence in schools, Number of homeless people, Housing plans for low-income people, Average ratio of teachers to students, Average ratio of students to floor space in schools, Average ratio of people to floor space in dwellings, AIDS in the city, and Quality of services in hospitals and health centers.
3. Environmental aspects: Reduction in energy consumption by City Hall activities, Percentage of domestic water reused, Reduction in energy consumption in the household, Percentage of industrial water reused, Reduction in energy consumption in industry, Percentage of sludge recovery from wastewater treatment plans, Tons of minerals (Phosphorous, Potassium) recovered from wastewater treatment plants, Average BOD_5 content in effluent discharged by industries into the river, Percentage of plastic recycled, Percentage of paper and cardboard recycled, Percentage of tires recycled, Decrease in the use of plastic bags in supermarkets, Kg/capita of waste on the streets, Content of CO_2 in the city monitoring stations, Content of SO_x in the city monitoring stations, Square meter of green space per inhabitants, Kilometer of bikeways, and Increase in urban forests.
4. Institutional aspects: Ratio of City Hall personnel to 1,000 inhabitants, Advance on plans for emergency preparedness, Surveys held on urban issues, Annual number of meetings between City Hall and citizens, Percentage of measures suggested by citizens and implemented, and Percentage of the city budget managed by citizens.
5. Infrastructure: Percentage of households connected to municipal sewer, Percentage of households with cesspools, Percentage of crude wastewater discharged into a river, Drinking water quality, Water per capita, Average travel time, Connectivity, Number of times the city was flooded by rainfall, Landfill hectares per 1,000 people, Reduction of cars on the streets, Carpool policy, Percentage of wind energy, Percentage of biomass energy, Use of fuel-cells in transportation, and Use of stream network for domestic heating.

Source

Munier N. 2007. Handbook on urban sustainability. Dordrecht: Springer

Box 3.4 An Assessment Indicator System for Sustainable Community in Beijing

First-level indicators	Second-level indicators	Third-level indicators
Social comprehensive development level	Community population	Net immigration and emigration
	Poverty elimination	Percentage of people under the minimum income line
	People with disabilities	Universal design for all people
	Education	Percentage of reeducation for community adults
		Enrollment radius for children of the right age
	Culture and entertainment	Space quality for outdoor activities
		Variety and integrity of facilities in outdoor space
	Medical treatment	Health service level and variety provided by community
		Vaccination for children under 5 years
	Housing condition	Living area per capita and different combination of spatial functions
		Use of green building materials and energy conservation design
		Percentage of electricity use for artificial climate built
	Transportation	Different means of transportation chosen by citizens
		Relationship between ambulation and vehicular circulation
	Community safety	Safety of walking alone in neighborhood
		Sound insulation and privacy assurance
	Facilitating service	Most important facilitating service citizens actually use
	Human resource	Acquaintance with neighbors
Economic development level	Income and consumption	Engel's coefficient (the food consumption ratio)
	Community economy self-support capability	Different financing modes for community construction
	Community employment	Employment in the community
Natural environment	Community landscape	Natural water condition
		Percentage of local species in green space
	Environmental pollution	Proportion of nonbiodegradable housing waste from total waste
	Sustainable use	Water use according to classification degree
		Percentage of renovation and reuse of old housing stock
	Resource consumption	Mode of heating and temperature adjustment ability
Organization and management	Community organization	Satisfaction degree for different kinds of manager
	Property management	Property management option ascription
	Third-party organization	Quantity of spontaneous organization and volunteers

Source: Li DH, Fang WL, Tan L, Wu J. 2003. Several key issues on urban sustainable community development building. Complex Ecology and Circular Economy – the First National Symposium on Industrial Ecology and Circular Economy Technology. (in Chinese)

Box 3.5 A Sustainable City Assessment Indicator System of Ji'nan, China

First-level indicator	Second-level indicator	Third-level indicator
Urban-integrated sustainable development ability	Economic development	GDP per capita (Yuan)
		Revenue per capita (Yuan)
		Net annual income of farmers per capita (Yuan)
		Disposable annual income of urban residents per capita (Yuan)
		Percentage of tertiary industry in GDP (%)
		Unit GDP energy consumption (tons of standard coal/million Yuan)
		Unit GDP water consumption (m^3/million Yuan)
		Percentage of large-scale enterprises with ISO 14000 certification (%)
		Land GDP output rate (Yuan/km^2)
		Environmental investment ratio in GDP (%)
	Ecological construction	Forest coverage (%)
		Protected area in total homeland (%)
		Recovery of degraded land (%)
		Urban public green area per capita (m^2)
		City life system intact rate (%)
		Green coverage in urban built-up area (%)
		Mining eco-environmental recovery rate (%)
		Wetland area (%)
		Percentage of ecological counties quantity (%)
	Environmental protection	Air quality (better than or equal to second standard level days/year)
		Quality attainment rate for urban water function zones (%)
		SO_2 emission intensity (kg/10^4 yuan GDP)
		COD emission intensity (kg/10^4 yuan GDP)
		Quality attainment rate of centralized drinking water (%)
		Centralized treatment rate of urban sewage (%)
		Recycling rate of industrial water (%)
		Attainment rate of rural sewage discharge (%)
		Noise attainment rate (%)
		Urban treatment rate for domestic garbage (%)
		Comprehensive utilization rate of industrial solid waste (%)
		Environmental quality attainment rate in tourism area (%)
		Intensity of fertilizer application (kg/hm^2)
		Large-scale integrated livestock and poultry breeding farm manure utilization (%)
		Attainment rate of industrial wastewater discharge (%)
	Social development	Level of urbanization (%)
		Urban gas coverage rate (%)
		Engel's coefficient (%)
		Gini coefficient
		Higher education enrollment rate (%)
		Environmental publicity and education coverage rate (%)
		Rate of public satisfaction with environment (%)
		Years of schooling per capita (years)
		Secondary technical and higher experience per 10^4 people (people)
		Average life expectancy (years)

Source: Li F, Liu XS, Hu D, Wang RS. 2007. Evaluation method and its application for urban sustainable development. Acta Ecologica Sinica, 27 (11): 4793–4802. (in Chinese)

3.1.2 Principles of Designing the Assessment Indicator System for Sustainable City

Establishing a feasible assessment indicator system for a sustainable city should firstly define the design principles, then design the frame structure and indicator contents of this system, and finally determine concrete indicator calculation and data acquisition methods according to the determined frame structure and indicator contents.

The assessment indicator system for a sustainable city is designed basically in compliance with the following principles (Sustainable Development Strategy Study Group 2003):

1. The assessment indicator system for a sustainable city should cover and place equal values on economic, social, ecological, and environment areas, or it would not be an effective assessment indicator system.
2. The assessment indicator system for a sustainable city should adequately reflect and show the denotative meanings of a sustainable city and comprehend the essence of Sustainable City in a scientific, systematic, and accurate manner.
3. The assessment indicator system for a sustainable city should be as complete as possible to reflect the primary aspects or characteristics of sustainable city development as a whole.
4. The assessment indicator system for a sustainable city should have an appropriate number of indicators, which has been compressed as far as possible for the sake of easy operation without influencing its completeness. Too many indicators may result in operation and utilization difficulties.
5. The indicators of the assessment indicator system for a sustainable city should be made unrelated to each other. In this way, the indicator system is able to maintain a clear structure and appropriate number of indicators.
6. The assessment indicator system for a sustainable city should have measurable and comparable indicators, and certain numeric methods for qualitative indicators. In addition, the calculation methods of such indicators should be straightforward, and data for calculation should be easily accessible from reliable sources.

3.1.3 Issues to be Considered in Establishing an Assessment Indicator System for Sustainable City

There are many issues which exist in the process of establishing an effective and feasible assessment indicator system for a sustainable city, and a key and difficult task for future work is to resolve the following issues:

1. The scientific foundation
   The current level of science and technology makes us fail to understand every aspect of sustainable city development completely, accurately, and clearly.

We may even fail to find some issues, meaning that some indicators were either not put forward and set up or not put forward and set up on a solid scientific foundation. Therefore, we should seek to fully comprehend the relationship between the urban environment and socioeconomic development.

2. Computational methods
   The influence of subjective factors on the selection of computational methods, such as indicator standardization, indicator weighing, and comprehensive assessment index, should be reduced as much as possible. Selection of more applicable, transparent, and accurate assessment methods can guarantee the data quality and weighing mechanism.
3. Compromise between perfection and practical demand
   While it may be expected that a scientific, complete, and feasible assessment indicator system for a sustainable city can be established, in fact it is impossible to set up a complete indicator system once and for all, and we have no choice but to make certain choices or compromises between the system completeness and practical need. In other words, we could only set up a relatively feasible assessment indicator system for a sustainable city as soon as possible to satisfy the timely need, while seeking to improve the indicator system by incorporating further theoretical and practical advances.

3.2 Establishment of an Assessment Indicator System for Sustainable City

3.2.1 An Assessment Indicator System for Sustainable City

Establishment of an assessment indicator system for a sustainable city is one of the central and critical procedures to assess a city's construction or development level in the sense of Sustainable City. The full coverage and clear structure of the indicator system directly decides the assessment effect and quality. Taking into consideration, the availability of the required data, the practical status of the current basic data for Chinese cities shows that it is difficult to calculate and assess the sustainable city development level from the perspectives of ecosystem services and welfare.

According to the exiting situation, and taking into account China's specific conditions and the availability of required data, this book is based on the principles of designing an assessment indicator system for Sustainable City, related sustainable urban assessments within China and abroad. The identified 12 indicators that constitute the assessment indicator system for Sustainable City are average life expectancy, proportion of educational expenditure to GDP in urban districts, GDP per capita in urban districts, urbanization rate, proportion of added value of nonagricultural industry, treatment rate of domestic sewage, treatment rate of domestic

Table 3.1 A sustainable city assessment indicator system of China

Variable symbol	Indicator explanation	Attribute	Unit
X_1	Average life expectancy	Positive[a]	Years
X_2	Proportion of educational expenditure to GDP in urban districts	Positive	%
X_3	GDP per capita in urban districts	Positive	Yuan per capita
X_4	Urbanization rate	Positive	%
X_5	Proportion of added value of nonagricultural industry	Positive	%
X_6	Treatment rate of domestic sewage	Positive	%
X_7	Treatment rate of domestic garbage	Positive	%
X_8	Comprehensive utilization rate of industrial solid waste	Positive	%
X_9	Attainment rate of industrial wastewater discharge	Positive	%
X_{10}	SO_2 emissions per unit of industrial output value	Negative[b]	Tons/million Yuan
X_{11}	Soot emissions per unit of industrial output value	Negative	Tons/million Yuan
X_{12}	Percentage of green coverage in built-up area	Positive	%

[a]Positive means the larger values represent more sustainable
[b]Negative means the smaller values represent more sustainable

garbage, comprehensive utilization rate of industrial solid waste, attainment rate of industrial wastewater discharge, SO_2 emissions per unit of industrial output value, dust emissions per unit of industrial output value, and percentage of green coverage in built-up area. The indicator system includes the contents of the specific indicators in Table 3.1, and the definition of these indicators can be found in Appendix.

3.2.2 A Comprehensive Assessment Index for Sustainable City and Its Calculation Method

The indicators of an assessment indicator system of Sustainable City (Table 3.1) could reflect and describe different aspects of sustainable city construction. However, it is difficult to get a general understanding of the sustainable city development level, as the system has many indicators, and especially to make overall comparisons between cities. It, therefore, is necessary to establish (or propose) an integrated index or comprehensive index to assess the overall development level of Sustainable City. We have designed a comprehensive index for Sustainable City assessment, which is called City Development Position (CDP), to quantify development level of Sustainable City.

As each indicator has a different unit of measurement, it is necessary to conduct the nondimensionalization or normalization treatment of the actual data. The min–max

normalization method was used in this book to realize the standardized data processing. Suppose there are m cities that participate in the assessment and n indicators constitute the assessment indicator system for Sustainable City, for the ith city, the value of jth indicator at year t will be $X_{ij}(t)$.

$$X_j(t)_{\min} = \min\{X_{1j}(t),\ X_{2j}(t),\ \ldots,\ X_{mj}(t)\},$$

$$X_j(t)_{\max} = \max\{X_{1j}(t),\ X_{2j}(t),\ \ldots,\ X_{mj}(t)\}.$$

With the consideration about actual states of the selected cities and the two assessment scenarios in the next chapter, a linear normalization method can be used to convert $X_{ij}(t)$ to $X'_{ij}(t)$ with a value ranging from 55 to 95. The possibly best city (or cities) can obtain up to 100 points after receiving a maximum of five points bonus under the bonus scenario. Even the worst city (or cities) can get at least 55 points as all the cities evaluated in this research are among some nicer ones in China. The calculation method for positive-value indicators is

$$X'_{ij}(t) = 55 + \frac{X_{ij}(t) - X_j(t)_{\min}}{X_j(t)_{\max} - X_j(t)_{\min}} \times 40. \tag{3.1}$$

The calculation method for negative-value indicators is

$$X'_{ij}(t) = 55 + \frac{X_j(t)_{\max} - X_{ij}(t)}{X_j(t)_{\max} - X_j(t)_{\min}} \times 40. \tag{3.2}$$

The negative-value indicators include SO_2 emissions per unit of industrial output value and dust emissions per unit of industrial output value.

Furthermore, we set W_j as the weight of indicator j, the CDP for city i in the year t could be calculated as follows:

$$\mathrm{CDP}_i(t) = \sum_{j=1}^{n} \left(X'_{ij}(t) \times W_j\right). \tag{3.3}$$

Taking into account data availability, calculation convenience, and sustainable assessment features and see also each city's own characteristics and regional differences between multiple cities, this book makes no distinction in the importance of the 12 indicators. That is, it gives the same weight to each indicator, which means that the coefficient of W_j is a constant 1/12.

Chapter 4
Calculation and Ranking of Sustainable City Development Level for Some Cities in China

4.1 City Selection for Assessment

Taking into account, the availability of required data, the basic comparability between cities, city size and level of urbanization, and other factors, the book selected 26 provincial or autonomous region capital cities (due to lack of data, Lhasa City and Taipei City were not included), four municipalities and five cities with independent planning, resulting in a total of 35 cities for the analysis and assessment of sustainable city in China in 2008. Selected cities include (in alphabetical order):

1. Provincial or autonomous region capital cities
   Changchun, Changsha, Chengdu, Fuzhou, Guangzhou, Guiyang, Haerbin (Harbin), Haikou, Hangzhou, Hefei, Huhehaote (Hohhot), Ji'nan, Kunming, Lanzhou, Nanchang, Nanjing, Nanning, Shenyang, Shijiazhuang, Taiyuan, Wuhan, Wulumuqi (Urumqi), Xi'an, Xining, Yinchuan, and Zhengzhou.
2. Municipalities (municipality directly under the Central Government)
   Beijing, Chongqing, Shanghai, and Tianjin.
3. Cities specifically designated in the state plan
   Dalian, Ningbo, Qingdao, Shenzhen, and Xiamen.
   For convenience, the above 35 cities participated in the assessment in accordance with the following number code in alphabetical order:

   ① Beijing, ② Changchun, ③ Changsha, ④ Chengdu, ⑤ Chongqing, ⑥ Dalian, ⑦ Fuzhou, ⑧ Guangzhou, ⑨ Guiyang, ⑩ Haerbin (Harbin), ⑪ Haikou, ⑫ Hangzhou, ⑬ Hefei, ⑭ Huhehaote (Hohhot), ⑮ Ji'nan, ⑯ Kunming, ⑰ Lanzhou, ⑱ Nanchang, ⑲ Nanjing, ⑳ Nanning, ㉑ Ningbo, ㉒ Qingdao, ㉓ Shanghai, ㉔ Shenyang, ㉕ Shenzhen, ㉖ Shijiazhuang, ㉗ Taiyuan, ㉘ Tianjin, ㉙ Wuhan, ㉚ Wulumuqi (Urumqi), ㉛ Xiamen, ㉜ Xi'an, ㉝ Xining, ㉞ Yinchuan, and ㉟ Zhengzhou. The geographical location of each city is shown in Fig. 4.1.

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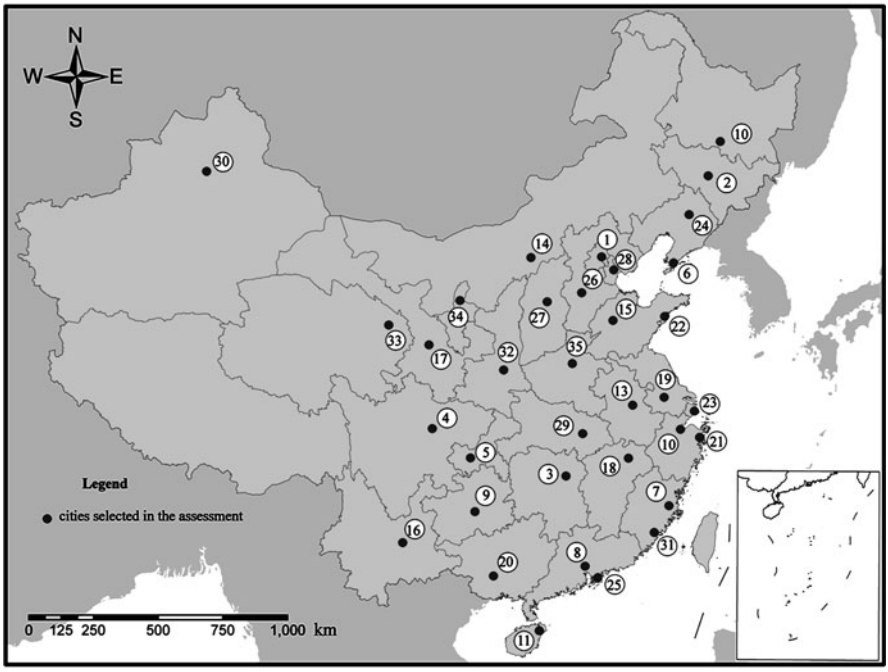

Fig. 4.1 Locations of cities selected in the assessment

Box 4.1 City Specifically Designated in the State Plan

"City specifically designated in the state plan" is a category of Administrative Region of the People's Republic of China. In the 1980s, this plan intended to give some major cities a special position in national plans, and granted them provincial level economic management authority, but not provincial level administrative authority. The 14 cities specifically designated in the state plan before 1993 were Shenyang, Dalian, Changchun, Haerbin, Nanjing, Ningbo, Xiamen, Qingdao, Wuhan, Guangzhou, Shenzhen, Chengdu, Chongqing, and Xi'an. Then, the provincial capital cities (Shenyang, Changchun, Haerbin, Nanjing, Wuhan, Guangzhou, Chengdu, and Xi'an) were excluded, so the number of remaining cities was decreased to 6. In the same year, the State Commission Office for Public Sector Reform announced that all the original 14 cities specifically designated in the state plan, and also Hangzhou and Ji'nan, were to have subprovincial administrative authority level, including the ten subprovincial capital cities and the six other cities specifically designated in the state plan. After Chongqing was promoted to the level of municipality (i.e., directly under

(continued)

Box 4.1 (continued)

the Central Government), the number of cities specifically designated in the state plan was decreased to 5 (Shenzhen, Ningbo, Qingdao, Xiamen, and Dalian).

Source

Baidu Encyclopedia. City Specifically Designated in the State Plan. [2010-03-27]. http://baike.baidu.com/view/112105.htm

4.2 Calculation Results of Comprehensive Assessment for Sustainable City and Ranking the Selected Cities

4.2.1 Data Sources for Assessment and Calculation

Data collection and processing are important for the assessment process of sustainable cities. Our analysis of sustainable city development requires not only theoretical and qualitative research, but also, more importantly, conducting empirical research through analysis of large amounts of data. To have a clear understanding of the real level of urban development in China, it is vital for empirical studies to get accurate and reliable data. The indicator data used in this book were all from the governmental statistical yearbook, published or reported.

This book intends to assess the level of sustainable city development of some cities in China in 2008, but the relevant figures for average life expectancy (X_1) are not available, so the data for average life expectancy (X_1) were obtained from "Report on China's urban living quality No.1" compiled by Beijing International Institute on City Development (Lian 2006). Tianjin's percentage of green coverage in built-up area, and Guangzhou's comprehensive utilization of industrial solid waste, centralized sewage treatment rate, innocuous treatment rate of domestic garbage, SO_2 emissions per unit of industrial output value, and soot emission per unit of industrial output value were from the "China City Statistical Yearbook 2008" (Department of Urban Social Economic Survey of National Bureau of Statistics of China 2009) (data from 2007). The urbanization rate indicators of Ji'nan and Qingdao were calculated referring to the "Shandong Statistical Yearbook 2009" (Shandong Statistics Bureau 2009)

The rest of the data for the indicators were all from "China City Statistical Yearbook 2009" compiled by the National Bureau of Statistics (Department of Urban Social Economic Survey of National Bureau of Statistics of China 2010). The data released by "China City Statistical Yearbook 2009" were actually for the year 2008.

This book summarizes these basic data in Tables 4.1 and 4.2.

Table 4.1 Basic data in some cities in China (the min and max values are in bold)

City (unit)	Average life expectancy (year)	Proportion of educational expenditure to GDP in municipal districts (%)	GDP per capita in municipal districts (10^4 Yuan)	Urbanization rate (%)	Proportion of added value of nonagricultural sectors (%)	Urban household population (10^4 people)	Resident population in municipal districts (10^4 people)
Beijing	**79.62**	**2.96**	64,936	73.14	98.92	1,158.75	1,590.05
Changchun	73.10	1.41	52,524	44.10	91.50	330.22	359.49
Changsha	75.00	1.22	73,422	36.34	94.26	238.32	251.50
Chengdu	75.84	0.98	40,821	54.41	93.07	510.15	670.83
Chongqing	73.70	1.80	24,516	27.86	88.71	**1,534.50**	1,483.99
Dalian	73.34	1.02	83,541	59.62	92.51	298.31	451.70
Fuzhou	72.55	1.63	40,868	41.34	89.72	186.68	272.00
Guangzhou	76.83	1.12	85,854	89.80	97.96	645.83	880.64
Guiyang	74.30	2.90	31,476	49.85	94.18	216.65	202.27
Haerbin	72.37	1.56	43,351	48.18	86.39	475.13	475.48
Haikou	72.92	2.24	24,420	60.41	92.92	155.82	181.48
Hangzhou	78.50	1.44	89,805	50.29	96.26	424.30	421.91
Hefei	75.50	0.96	60,982	43.14	93.68	203.48	200.94
Huhehaote	69.87	0.89	57,614	47.04	94.29	116.70	158.36
Ji'nan	73.92	1.02	54,726	71.39	94.20	350.23	414.06
Kunming	73.70	0.92	37,074	42.07	93.06	241.41	308.89
Lanzhou	72.10	2.27	31,639	62.56	96.68	209.99	229.62
Nanchang	68.95	1.11	58,543	47.13	93.89	223.09	191.55
Nanjing	73.91	1.56	64,096	82.83	97.54	541.24	537.81
Nanning	71.29	1.52	35,656	**27.32**	**84.56**	263.89	264.03
Ningbo	75.80	1.70	**102,731**	34.94	95.78	220.12	219.16
Qingdao	73.92	1.47	91,362	61.48	94.96	276.25	275.90
Shanghai	78.14	2.35	75,053	87.46	99.18	1321.70	**1,806.78**
Shenyang	73.34	1.39	66,515	64.54	95.24	509.02	509.02
Shenzhen	76.50	1.32	89,814	**100.00**	**99.91**	228.07	869.19

Shijiazhuang	73.00	1.68	47,613	41.21	89.09	240.72	239.22
Taiyuan	77.50	1.56	48,477	72.36	98.57	281.29	264.16
Tianjin	75.95	2.19	59,448	60.72	98.07	793.85	994.07
Wuhan	76.00	1.18	55,469	64.48	96.35	512.42	611.60
Wulumuqi	**67.41**	1.69	**23,908**	73.92	98.25	226.94	421.66
Xiamen	78.23	2.18	62,651	68.28	98.62	173.67	249.00
Xi'an	75.00	1.29	30,064	47.12	95.28	554.73	643.80
Xining	70.17	**0.73**	25,801	52.83	95.45	112.21	112.21
Yinchuan	70.17	1.71	34,635	64.44	94.12	**88.84**	**102.06**
Zhengzhou	74.80	2.46	46,722	41.94	96.85	276.75	273.17

Table 4.2 Basic data in some cities in China (continued) (the min and max values are in bold)

City (unit)	Comprehensive utilization rate of industrial solid waste (%)	Centralized sewage treatment rate (%)	Innocuous treatment rate of domestic garbage (%)	Attainment rate of industrial wastewater discharge (%)	SO_2 emissions per unit of industrial output value (ton/10^8 Yuan)	Soot emission per unit of industrial output value (ton/10^8 Yuan)	Percentage of green coverage in built-up area (%)
Beijing	66.43	74.50	97.71	98.26	5.55	1.92	37.15
Changchun	99.40	74.00	78.01	95.33	15.55	17.41	37.88
Changsha	88.50	70.90	**100.00**	88.06	22.55	14.21	36.29
Chengdu	98.26	84.17	96.51	98.91	26.17	8.77	38.55
Chongqing	80.10	72.00	79.10	93.47	108.97	17.55	68.94
Dalian	95.73	87.20	93.73	97.03	19.91	3.70	44.00
Fuzhou	96.02	68.70	97.30	95.94	26.38	2.27	37.66
Guangzhou	**100.00**	74.20	82.40	95.26	8.69	1.38	35.01
Guiyang	46.29	**32.46**	93.36	93.34	98.42	19.73	42.10
Haerbin	74.76	62.30	85.00	80.37	29.59	32.88	33.71
Haikou	**100.00**	82.03	94.30	**100.00**	**0.65**	0.77	43.41
Hangzhou	95.06	83.20	**100.00**	84.39	9.81	3.96	38.60
Hefei	99.17	75.60	77.83	96.08	13.23	6.11	35.26
Huhehaote	90.34	41.40	72.58	94.12	87.97	17.68	35.14
Ji'nan	94.41	70.20	86.10	98.82	17.49	5.22	36.43
Kunming	**39.70**	82.23	**100.00**	99.55	52.08	5.97	35.93
Lanzhou	78.07	60.96	**49.58**	98.50	52.24	9.52	26.39
Nanchang	90.50	86.80	**100.00**	93.61	12.62	9.09	**70.30**
Nanjing	92.40	86.00	96.90	95.45	21.26	5.24	46.13
Nanning	90.23	46.98	58.35	84.65	68.36	34.47	38.99
Ningbo	85.70	79.70	**100.00**	92.38	15.73	2.41	37.45
Qingdao	98.30	83.50	**100.00**	99.77	10.82	2.65	41.52
Shanghai	95.53	85.81	77.00	93.75	11.86	1.62	40.62
Shenyang	92.29	76.60	**100.00**	91.46	14.43	9.79	41.81
Shenzhen	87.99	75.03	94.17	94.66	2.14	**0.19**	45.01

Shijiazhuang	90.77	77.00	**100.00**	99.23	41.67	9.58	39.26
Taiyuan	47.44	68.60	76.28	97.14	52.12	21.14	34.65
Tianjin	98.21	79.00	93.50	99.90	17.30	4.82	34.90
Wuhan	89.56	80.70	85.99	98.99	21.42	6.43	37.40
Wulumuqi	67.25	48.39	77.81	**79.15**	94.59	25.41	**24.20**
Xiamen	91.20	**96.50**	100.00	99.75	15.42	0.47	38.40
Xi'an	97.80	59.40	74.90	97.59	49.88	10.22	40.29
Xining	73.79	52.35	100.00	83.67	**123.47**	**42.07**	35.61
Yinchuan	88.62	87.61	100.00	99.76	30.84	10.50	36.56
Zhengzhou	78.10	95.80	87.62	99.97	33.12	16.62	34.03

4.2.2 Calculation Results and Ranking

1. Results and city ranking of the Basic Scenario
   Basic data in Tables 4.1 and 4.2 were standardized with (3.1) and (3.2). The $CDP_i(t)$ for each city was computed with (3.3).
   All the calculations in this book were based on the 2008 data. The 35 cities were ranked from high to low according to the CDP values. Table 4.3 lists the CDP results and city ranking.
2. Assessment results and city ranking under Bonus Scenario

Table 4.3 CDP Values in 2008 and city ranking (Basic Scenario)

Ranking	Cities	CDP values
1	Xiamen	86.76
2	Shenzhen	86.26
3	Shanghai	84.54
4	Beijing	83.93
5	Qingdao	85.90
6	Tianjin	85.86
7	Guangzhou	83.80
8	Nanjing	82.34
9	Hangzhou	82.50
10	Ningbo	83.99
11	Haikou	81.80
12	Dalian	82.34
13	Wuhan	80.00
14	Shenyang	80.74
15	Nanchang	80.63
16	Zhengzhou	81.03
17	Chengdu	79.57
18	Ji'nan	80.37
19	Yinchuan	77.85
20	Hefei	79.87
21	Shijiazhuang	76.86
22	Fuzhou	77.70
23	Changsha	78.59
24	Changchun	78.15
25	Taiyuan	76.34
26	Xi'an	76.45
27	Kunming	74.93
28	Lanzhou	74.54
29	Chongqing	73.39
30	Guiyang	72.85
31	Huhehaote	71.23
32	Haerbin	69.76
33	Wulumuqi	67.17
34	Xining	67.87
35	Nanning	65.91

Taking into account, the characteristic process of China's sustainable city construction and development, and based on the indicator system (Table 3.1), this book added a "national honorary title awarded to city" indicator, which includes some awards with comparatively close correlation with China's sustainable city construction (prior to December 31, 2008). The specific awards are shown in Table 4.4.

The Bonus Scenario is achieved by adding extra points to the Basic Scenario. This means that if a city received a title listed in Table 4.4, then the city receives an additional one point for each title.

The 35 participating cities who received a national honorary title are shown in Table 4.5.

Table 4.4 Bonus points related to sustainable city development in 2008

Honorary title awarded to cities	Department bestowing award	Selection for the first time
National Historical and Cultural City	The State Council of the People's Republic of China	1982
National Hygiene City	National Patriotic Health Campaign Committee	1990
National Garden City	Ministry of Housing and Urban–Rural Development	1992
National Model City for Environmental Protection	Ministry of National Environmental Protection	1997
National Civilized City	Spiritual Civilization Development Steering Commission	2005
National Ecological City	Ministry of National Environmental Protection	2006

Table 4.5 Awards of China's National Honorary City Title (year)

Cities	National historical and cultural city	National hygiene city	Environmental protection model city	National garden city	National civilized city	National ecological city
Beijing	1982			1992		
Changchun		2008	2002	2001		
Changsha	1982			2008		
Chengdu	1982	1993	2005	2006		
Chongqing	1986					
Dalian		1993	1997	1997	2005	
Fuzhou	1986	2000	2004	2003		
Guangzhou	1982	2008	2007	2007		
Guiyang				2007		
Haerbin	1994					
Haikou	2007		1999	2001		
Hangzhou	1982	1995	2001	1994		
Hefei				1992		
Huhehaote	1986					
Ji'nan	1986					

(continued)

Table 4.5 (continued)

Cities	National historical and cultural city	National hygiene city	Environmental protection model city	National garden city	National civilized city	National ecological city
Kunming	1982					
Lanzhou						
Nanchang	1986	2006		2007		
Nanjing	1982	2003	2003	1997		
Nanning				1997		
Ningbo	1986	2004	2001	2003	2005	
Qingdao	1994	1996	2000	1999	2005	
Shanghai	1986			2003		
Shenyang	1986		2004	2007		
Shenzhen		1992	1997	1994	2005	
Shijiazhuang				2007		
Taiyuan						
Tianjin	1986		2006			
Wuhan	1986			2005		
Wulumuqi						
Xiamen		1996	1997	1997	2005	
Xi'an	1982	2008				
Xining				2008		
Yinchuan	1986	2007		2007		
Zhengzhou		2006		2005		

Results and ranking following the bonus calculation are listed in Table 4.6.

Table 4.6 CPD Values in 2008 and city ranking (Bonus Scenario)

Ranking	Cities	CDP values	Bonus	Total
1	Xiamen	86.76	4.0	90.76
2	Shenzhen	86.26	4.0	90.26
3	Qingdao	84.54	5.0	89.54
4	Guangzhou	83.93	4.0	87.93
5	Shanghai	85.90	2.0	87.90
6	Beijing	85.86	2.0	87.86
7	Nanjing	83.80	4.0	87.80
8	Ningbo	82.34	5.0	87.34
9	Hangzhou	82.50	4.0	86.50
10	Tianjin	83.99	2.0	85.99
11	Dalian	81.80	4.0	85.80
12	Haikou	82.34	3.0	85.34
13	Chengdu	80.00	4.0	84.00
14	Shenyang	80.74	3.0	83.74
15	Nanchang	80.63	3.0	83.63
16	Wuhan	81.03	2.0	83.03
17	Yinchuan	79.57	3.0	82.57

(continued)

Table 4.6 (continued)

Ranking	Cities	CDP values	Bonus	Total
18	Zhengzhou	80.37	2.0	82.37
19	Fuzhou	77.85	4.0	81.85
20	Ji'nan	79.87	1.0	80.87
21	Changchun	76.86	3.0	79.86
22	Changsha	77.70	2.0	79.70
23	Hefei	78.59	1.0	79.59
24	Shijiazhuang	78.15	1.0	79.15
25	Xi'an	76.34	2.0	78.34
26	Taiyuan	76.45	0.0	76.45
27	Kunming	74.93	1.0	75.93
28	Lanzhou	74.54	0.0	74.54
29	Chongqing	73.39	1.0	74.39
30	Guiyang	72.85	1.0	73.85
31	Huhehaote	71.23	1.0	72.23
32	Haerbin	69.76	1.0	70.76
33	Xining	67.17	1.0	68.17
34	Wulumuqi	67.87	0.0	67.87
35	Nanning	65.91	1.0	66.91

Chapter 5
Comprehensive Analysis of Assessment Results and Ranking of Sustainable Cities in China

For the sake of convenience and integration, the candidate cities were verbally analyzed in accordance with the ranking results of the comprehensive assessment with the awards bonus included, i.e., in the order of the Bonus Scenario shown in Table 4.6. The ranking order described in this chapter refers to the place of each city among the 35 candidate cities.

The supporting information for each candidate city is taken from http://zh.wikipedia.org and http://baike.baidu.com.

1. Xiamen
   Xiamen, known as Amoy in western countries, administered as a subprovincial city and one of five cities specifically designed in the state plan, is one of the first Special Economic Zones which have carried out the opening-up policy. Lying in the southeast coastal area of Fujian Province and looking across the sea to Jinmen Island, Xiamen is an important site for cooperation and exchange with Taiwan. Electronics, engineering, and chemicals are three pillar industries.

   Xiamen takes first place in the Basic Scenario.

   Its innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities, including Yinchuan and Nanchang; the centralized sewage treatment rate (96.50%) is also the highest; soot emission per unit of industrial output value (0.47 tons per 100 million Yuan) and attainment rate of industrial wastewater (99.75%) rank second and sixth, respectively; the average life expectancy (78.23 years) and the proportion of educational expenditure to GDP (2.18%) score highly and rank third and eighth, respectively; and the urbanization rate (68.28%) and proportion of added value of nonagricultural sectors (98.62%) rank ninth and fourth, respectively.

   The comprehensive utilization rate of industrial solid waste (91.20%) and green coverage in built-up area (38.40%) are relatively low and both rank 16th. Xiamen has won four honorary titles including National Hygiene City, National Model City for Environmental Protection, National Garden City, and National Civilized City. Xiamen still takes first place in the Bonus Scenario.

2. Shenzhen
   Shenzhen, also called Roc City, is situated in the eastern bank of the Pearl River Delta in South China and was the first Special Economic Zone in China.

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It is endeavoring to develop its four pillar industries, which are high and new technical industry, modern logistics industry, financial services, and culture industry.

Shenzhen takes second place in the Basic Scenario.

Its urbanization rate (100%) and proportion of added value of nonagricultural sectors (99.91%) score the highest and both rank the highest; GDP per capita in its municipal districts (89,800 Yuan per capita) and average life expectancy (76.50 years) are higher, ranking third and seventh, respectively; among its environment-related indicators, the soot emission per unit of industrial output value (0.19 tons per 100 million Yuan) and SO_2 emission per unit of industrial output value (2.14 tons per 100 million Yuan) are low and rank first and second, respectively, among all candidate cities.

Among the 35 candidate cities, Shenzhen's centralized sewage treatment rate (75.03%) and attainment rate of industrial wastewater (94.66%) rank 19th and 22nd, respectively, and the proportion of educational expenditure to GDP (1.32%) ranks 23rd.

Shenzhen has won four honorary titles, including National Hygiene City, National Model City for Environmental Protection, National Garden City, and National Historical and Cultural City. Shenzhen still takes second place in the Bonus Scenario.

3. Qingdao

Qingdao is located in the southwest of Jiaodong Peninsula in Shandong Province and is a subprovincial city specifically designated in the state plan. It is an important economic and cultural center on China's eastern coast and is an international beach resort. Qingdao is also the central city for national marine scientific research and ocean industry development and is a national key site for modern manufacture and high and new technical industries.

Qingdao takes fifth place in the Basic Scenario.

GDP per capita in its municipal districts (91,400 Yuan per capita) is high, ranking second; all its environment-related indicators gain high scores within the top 10, of which its innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Yinchuan; the attainment rate of industrial wastewater (99.77%) and comprehensive utilization rate of industrial solid waste (98.30%) rank fourth and fifth, respectively. Average life expectancy (73.92 years) ties for 17th place with Ji'nan and proportion of educational expenditure to GDP (1.47%) ranks 19th.

Qingdao has won five honorary titles including National Historical and Cultural City, National Hygiene City, National Model City for Environmental Protection, National Garden City, and National Civilized City. Qingdao still takes third place in the Bonus Scenario.

4. Guangzhou

Guangzhou, commonly abbreviated as *Sui* in Chinese, is one of five central cities in China and is the largest and oldest foreign trading port in Southern China. Located in South Guangdong Province and on the north bank of the

Pearl River Delta, Guangzhou is also the starting point of the Sea Silk Road and is known as the "South Gate of China."

Guangzhou takes seventh place in the Basic Scenario.

Its urbanization rate (89.80%) ranks second, inferior only to Shenzhen; the comprehensive utilization rate of industrial solid waste (100%) ties for first place with Haikou; SO_2 emission per unit of industrial output value (8.69 tons per 100 million Yuan) and soot emission per unit of industrial output value (1.38 tons per 100 million Yuan) are relatively low and both rank fourth.

Its relatively lower proportion of GDP spent on education (1.12%) ranks 27th. The innocuous treatment rate of domestic garbage (82.40%) and green coverage in built-up area (35.01%) rank 25th and 29th, respectively, relatively low in the ranking.

Guangzhou has won four honorary titles including National Historical and Cultural City, National Hygiene City, National Model City for Environmental Protection, and National Garden City. Guangzhou takes the fourth place in the Bonus Scenario.

5. Shanghai

Shanghai, commonly abbreviated as *Hu* in Chinese, is a municipality directly under the Central Government and one of five national central cities. It is located in the middle of China's coastline and at the extreme east of the Yangtze River Delta, looking out to the East China Sea in the east and adjacent to Jiangsu and Zhejiang provinces. Shanghai is the most internationalized city on the Chinese mainland and is an international center for economy, commerce, finance, shipping, culture and design, and also one of the primary tourist destinations in China.

Shanghai takes third place in the Basic Scenario.

Its proportion of added value of nonagricultural sectors (99.18%) is second only to Shenzhen among the 35 cities; its relatively high urbanization rate (87.46%) ranks third; both its average life expectancy (78.14 years) and proportion of educational expenditure to GDP (2.35%) rank fourth.

Its innocuous treatment rate of domestic garbage (77.00%) and attainment rate of industrial wastewater (93.75%) rank 30th and 24th, respectively.

Honorary titles won by Shanghai include National Historical and Cultural City and National Garden City. Shanghai still takes fifth place in the Bonus Scenario.

6. Beijing

Beijing, commonly abbreviated as *Jing* in Chinese, is the national capital and the political, cultural, and international exchange center of China. It is located at the northwest edge of the North China Plain, adjacent to Tianjin and Hebei Province and is the most developed city in terms of its tertiary industry in China, having a great worldwide influence.

Beijing takes fourth place in the Basic Scenario.

Its average life expectancy (79.62 years) and proportion of educational expenditure to GDP (2.96%) score the highest and both rank first; the

proportion of added value of nonagricultural sectors (98.92%) ranks third; of its environment-related indicators, SO_2 emission per unit of industrial output value (5.55 tons per 100 million Yuan) and soot emission per unit of industrial output value (1.92 tons per 100 million Yuan) are higher and rank third and sixth, respectively, among the candidate cities.

Comprehensive utilization rate of industrial solid waste (66.43%) and centralized sewage treatment rate (74.50%) score relatively low and rank 32nd and 20th, respectively.

Beijing has won two honorary titles including National Historical and Cultural City and National Garden City. Beijing still takes sixth place in the Bonus Scenario.

7. Nanjing

Nanjing, also called Jinling, is a subprovincial city and one of the four historical capitals of China, being the ancient capital of six Dynasties. Located in the downstream of the Yangtze River, it is a key industrial city and economic center in the downstream area of the Yangtze River, an important cultural and educational center and also an important traffic hub of Eastern China.

Nanjing ranks eighth in the Basic Scenario.

Green coverage in built-up area (46.13%) ranks third, only inferior to Nanchang and Chongqing; the urbanization rate (82.83%) ranks fourth; centralized sewage treatment rate (86.00%) and proportion of added value of nonagricultural sectors (97.54%) gain high scores and rank sixth and ninth, respectively; other indicators are medium ranking.

Nanjing has won four honorary titles including National Historical and Cultural City, National Hygiene City, National Model City for Environmental Protection, and National Garden City. Nanjing takes eighth place in the Bonus Scenario.

8. Ningbo

Ningbo, commonly abbreviated as *Yong* in Chinese, is the second largest city in Zhejiang Province. It is located in the southern part of the Yangtze River Delta and covers a total area of 9,365 km, adjacent to Hangzhou Bay in the north, Shaoxing in the west, Taizhou in the south, and facing Zhoushan across the sea. Ningbo, a subprovincial city specifically designated in the state plan, is one of three economic centers of Zhejiang Province and has a long history in shipping and foreign exchange, also being an important gate of the Sea Silk Road.

Ningbo takes tenth place in the Basic Scenario.

GDP per capita in its municipal districts (10,270 Yuan per capita) is the highest among the 35 candidate cities; the innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Yinchuan.

The average life expectancy (75.80 years) and proportion of educational expenditure to GDP (1.70%) both rank 11th; the urbanization rate (34.94%) ranks 33rd, only above Chongqing and Nanning; the comprehensive utilization rate of industrial solid waste (85.70%) and the attainment rate of industrial wastewater (92.38%) ranks 25th and 28th, respectively.

Ningbo has won five honorary titles including National Historical and Cultural City, National Hygiene City, National Model City for Environmental Protection, National Garden City, and National Civilized City. Ningbo takes eighth place in the Bonus Scenario.

9. Hangzhou
Located in the north of Zhejiang Province, Hangzhou is an important central city of the Yangtze River Delta and a traffic terminal in Southeast China. As a national key scenic tourist city, Hangzhou has had a lively diversified economy and advanced cultural education from ancient times. The city features abundant natural resources, energy sources, and good investment settings and has been awarded the title of 'the best commercial city in mainland China' by Forbes Magazine.

   Hangzhou takes ninth place in the Basic Scenario.

   Its innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Yinchuan; average life expectancy (78.50 years) ranks second, only inferior to Beijing; GDP per capita in its municipal districts (89,800 Yuan per capita) takes fourth place; SO_2 emission per unit of industrial output value (9.81 tons per 100 million Yuan) gains a high score and ranks fifth.

   Its proportion of educational expenditure to GDP (1.44%) and urbanization rate (50.29%) are relatively low and both rank 20th; its attainment rate of industrial wastewater (84.39%) is also relatively low and ranks 32nd.

   Hangzhou has won four honorary titles including National Historical and Cultural City, National Hygiene City, National Model City for Environmental Protection, and National Garden City. Hangzhou takes ninth place in the Bonus Scenario.

10. Tianjin
Tianjin, commonly abbreviated as *Jin* in Chinese, is a municipality directly under the Central Government, a National Synthetically Reform Testing District and one of five national central cities. At the center of the Bohai economic circle, it is the largest open coastal city in Northern China. Before the foundation of new China in 1949, Tianjin had been one of the largest cities and the economic and financial center of northern China. With developed and influential industry, commerce and culture, it is also home to universities, railways, aviation, postal service, mining industry, and so on.

   Tianjin takes sixth place in the Basic Scenario.

   Two environment-related indicators, including attainment rate of industrial wastewater (99.90%) and comprehensive utilization rate of industrial solid waste (98.21%) gain high scores and rank third and seventh, respectively; its proportion of educational expenditure to GDP (2.19%) and average life expectancy (75.95 years) are relatively high and rank seventh and ninth, respectively; the proportion of added value of nonagricultural sectors (98.07%) ranks seventh and the urbanization rate (60.72%) ranks 15th.

Its green coverage in built-up area (34.90%) is relatively low and only ranks 30th.

Tianjin has won two honorary titles including National Historical and Cultural City and National Model City for Environmental Protection. Tianjin takes tenth place in the Bonus Scenario.

11. Dalian

Dalian is located in the extreme south of Liaodong Peninsula in Northern China, adjacent to the Bohai Sea in the northwest and looking out to the Yellow River in the southeast. Being a subprovincial city specifically designated in the state plan, Dalian is one of the important coastal port cities of Liaoning Province and also one of the 14 open coastal cities in China. It is a gate for the northeast China to connect to the outside world and also an important center for international shipping, international logistics, and regional finance in Northeast Asia.

Dalian takes 12th place in the Basic Scenario.

Its centralized sewage treatment rate (87.20%), green coverage in built-up area (44.00%), and GDP per capita in its municipal districts (83,500 Yuan per capita) gain higher scores and rank fourth, fifth, and sixth, respectively.

Its proportion of added value of nonagricultural sectors (92.51%) ranks 29th and the proportion of educational expenditure to GDP (1.02%) ties for 29th place with Jinan.

Dalian has won four honorary titles including National Hygiene City, National Model City for Environmental Protection, National Garden City, and National Historical and Cultural City. Dalian takes 11th place in the Bonus Scenario.

12. Haikou

Haikou is located in the northeast of Hainan Province and is the provincial capital. It connects to Guangdong's Leizhou Peninsula across the Qiongzhou Strait, where Nandu River enters the sea and provides train and ferry services.

Haikou takes 11th place in the Basic Scenario.

Its environmental development is sound, especially its comprehensive utilization rate of industrial solid waste (100.0%) which ties for first place with Guangzhou; both the attainment rate of industrial wastewater (100.0%) and SO_2 emission per unit of industrial output value (0.65 tons per 100 million Yuan) take first place among the 35 candidate cities; soot emission per unit of industrial output value (0.77 tons per 100 million Yuan) gains a high score and ranks third.

Its proportion of added value of nonagricultural sectors (92.92%) only takes 28th place; GDP per capita in its municipal districts (24,400 Yuan per capita) takes 34th place, only superior to Urumqi among the 35 candidate cities.

Haikou has won three honorary titles including National Historical and Cultural City, National Model City for Environmental Protection, and National Garden City. Haikou takes 12th place in the Bonus Scenario.

13. Chengdu

Chengdu, historically known as the "Land of Abundance," is located in central Sichuan Province in the hinterland of Chengdu Plain, which is in the west of the

Sichuan Basin. It is a center of logistics and commerce, technology, trade, and finance and a transportation and communication hub for southwest China, an important base of high and new technical industry, modern manufacturing industry, modern service industry, and modern agriculture in China and also a cultural and educational center for the southwest area.

Chengdu takes 17th place in the Basic Scenario.

Its comprehensive utilization rate of industrial solid waste (98.26%) and centralized sewage treatment rate (84.17%) gain high scores and rank fifth and eighth, respectively.

Its proportion of educational expenditure to GDP education (0.98%) and proportion of added value of nonagricultural sectors (93.07%) gain relatively low scores and rank 31st and 26th, respectively. All other indicators are at the medium level.

Chengdu has won four honorary titles including National Historical and Cultural City, National Hygiene City, National Model City for Environmental Protection, and National Garden City. Chengdu rises to 13th place in the Bonus Scenario.

14. Shenyang

Located in the south of Northeast China on the Liaohe Plain of Central Liaoning Province, Shenyang is the largest central city of Northeast China and also the largest city to the north of the Great Wall. It holds an important economic and strategic position and is famous for manufacturing heavy industrial equipment.

Shenyang takes 14th place in the Basic Scenario.

Its innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Yinchuan. The relatively high green coverage in built-up area (41.81%) takes eighth place.

Average life expectancy (73.34 years) ties for 22nd place with Dalian; both the proportion of educational expenditure to GDP (1.39%) and soot emission per unit of industrial output value (9.79 tons per 100 million Yuan) rank 22nd; the attainment rate of industrial wastewater (91.46%) ranks 29th.

Shenyang has won three honorary titles including National Historical and Cultural City, National Model City for Environmental Protection, and National Garden City. Shenyang still takes 14th place in the Bonus Scenario.

15. Nanchang

Nanchang is located in the north of central Jiangxi Province, south of the Yangtze River, near the downstream of Ganjiang River and Fuhe River, adjacent to Jiuling Mountains to the west and close to Poyang Lake to the northeast. As a national comprehensive transportation hub contiguous to the Yangtze River Delta, Pearl River Delta, and southern Fujian triangle, it is a primary location to the interior and a key hinterland for industrial transfer.

Nanchang takes 15th place in the Basic Scenario.

Its green coverage in built-up area (70.30%) takes first place in the ranking; innocuous treatment rate of domestic garbage (100%) ties for first place with nine

other cities including Xiamen and Yinchuan; the centralized sewage treatment rate (86.80%) and SO_2 emission per unit of industrial output value (12.62 tons per 100 million Yuan) gain relatively high scores and rank fifth and eighth, respectively.

Average life expectancy (68.95 years) and proportion of educational expenditure to GDP (1.11%) are close to the lowest values and rank 34th and 29th, respectively.

Nanchang has won three honorary titles including National Historical and Cultural City, National Hygiene City, and National Garden City. Nanchang rises up to 15th place in the Bonus Scenario.

16. Wuhan

Wuhan, the capital of Hubei Province, is the largest city of central China and a megalopolis on the middle and downstream of Yangtze River and also the most important industrial and commercial city in Hubei and central China.

Wuhan takes 13th place in the Basic Scenario.

Average life expectancy (76.00 years) and the attainment rate of industrial wastewater (98.99%) gain high scores and rank eighth and ninth, respectively.

The proportion of educational expenditure to GDP (1.18%) takes 26th place, and all other environment-related indicators are at or below the medium level.

Wuhan has won two honorary titles including National Historical and Cultural City and National Garden City. Wuhan drops down to 16th place in the Bonus Scenario.

17. Yinchuan

Yinchuan, the capital of the Ningxia Hui Autonomous Region, is the political, economic, and cultural center of this region. Located in the center of Yinchuan Plain, it administers three districts, two counties and a city, and one-quarter of its population are of the Hui ethnic group.

Yinchuan takes 19th place in the Basic Scenario.

Its centralized sewage treatment rate (87.61%) and attainment rate of industrial wastewater (99.76%) gain high scores and rank third and fifth, respectively. The innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Nanchang. The proportion of educational expenditure to GDP (1.71%) is higher and ranks tenth.

Average life expectancy (70.17 years) ties for 31st place with Xining; its GDP per capita in the municipal districts (34,600 Yuan per capita) gains a relatively low score and only ranks 28th.

Yinchuan has won three honorary titles including National Historical and Cultural City, National Hygiene City, and National Model City for Environmental Protection. Yinchuan rises up to 17th place in the Bonus Scenario.

18. Zhengzhou

Located in the north of central Henan Province and on the downstream of the Yellow River, Zhengzhou is one of the major cities in the central and western

regions of the mainland. It is the second largest cities in central China, major economic center and one of the most important national railway, highway, and aviation hubs.

Zhengzhou takes 16th place in the Basic Scenario.

Its attainment rate of industrial wastewater (99.97%) ranks second, only inferior to Haikou; its centralized sewage treatment rate (95.80%) is also very high and ranks second, only inferior to Xiamen; the proportion of educational expenditure to GDP (2.46%) ranks third; its proportion of added value of nonagricultural sectors (96.85%) gains a relative high score and ranks tenth.

Its urbanization rate (41.94%) ranks 29th and green coverage in built-up area (34.03%) is also relatively low, ranking in 32nd place.

Zhengzhou has won two honorary titles including National Hygiene City and National Garden City. Zhengzhou rises to 18th place in the Bonus Scenario.

19. Fuzhou

Located on the downstream of the Minjiang River and coastal area of eastern Fujian Province, Fuzhou is the largest city of this province. The Minjiang River is the largest river in Fuzhou and forms the Fuzhou Plain, in the downstream of the Fuzhou Basin.

Fuzhou takes 22nd place in the Basic Scenario.

Its comprehensive utilization rate of industrial solid waste (96.02%) and soot emission per unit of industrial output value (2.27 tons per 100 million Yuan) gain relatively high scores and rank ninth and seventh, respectively.

Its centralized sewage treatment rate (68.70%) and average life expectancy (72.55 years) gain relatively low scores and rank 26th and 27th, respectively; the urbanization rate (41.34%) and proportion of added value of nonagricultural sectors (89.72%) are close to the minimum values and rank 30th and 31st, respectively.

Fuzhou has won four honorary titles including National Historical and Cultural City, National Hygiene City, National Model City for Environmental Protection, and National Garden City. Fuzhou rises up to 19th place in the Bonus Scenario.

20. Jinan

Jinan, adjacent to the Yellow River in the south and Mount Tai in the north, is also known as “City of Springs” because of its 72 famous springs. Major industries in Jinan include electronic information, transportation equipment, household appliances, mechanical manufacture, bioengineering, and garments, and it maintains good momentum of heavy and light industries development.

Jinan takes 18th place in the Basic Scenario.

Its urbanization rate (71.39%) gains a high score and ranks eighth.

Its proportion educational expenditure to GDP (1.02%) gains a relatively low score and ties for 29th place with Dalian; the proportion of added value of nonagricultural sectors (94.20%) is relatively low and ranks 21st. All environment-related indicators are at or below medium level, between 10th and 25th places in the ranking.

Jinan won the honorary title of National Historical and Cultural City in 1986 and drops down to 20th place in the Bonus Scenario.

21. Changchun

Changchun is also known as the "Spring City in Northern China" and is located in the hinterland of the Northeast Plain. It is a natural geographic center of the Northeast China Region and is an important grain-producing area, but its dominant economic strength lies in its industries which are gradually increasing and include automobiles, agricultural, and sideline food processing, photoelectric information, biomedical, energy, building, and material manufacture.

Changchun takes 24th place in the Basic Scenario.

Its comprehensive utilization rate of industrial solid waste (99.40%) ranks third, only inferior to Guangzhou and Haikou.

Its urbanization rate (44.10%) and proportion of added value of nonagricultural sectors (91.50%) are relatively low and rank 26th and 30th, respectively; the innocuous treatment rate of domestic garbage (78.01%) and soot emission per unit of industrial output value (17.41 tons per 100 million Yuan) are relatively low and both rank 27th.

Changchun has won three honorary titles including National Hygiene City, National Model City for Environmental Protection, and National Garden City. Changchun remains in 21st place in the Bonus Scenario.

22. Changsha

Changsha is located in the northeast of Hunan Province and was home to many historical figures and contains many cultural relics. As an important industrial and commercial city in central south China, Changsha is stepping up its efforts to promote new industrialization pathway and is achieving rapid development of many high and new technical industries and large-scale industrial machinery.

Changsha takes 23rd place in the Basic Scenario.

Its innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Yinchuan; GDP per capita in its municipal districts (73,400 Yuan per capita) is relatively high and ranks eighth.

The proportion of educational expenditure to GDP in urban districts (1.22%) ranks 26th; urbanization rate (36.34%) is close to the lowest value and ranks 32nd; attainment rate of industrial wastewater (88.06%) takes 30th place.

Changsha has won two honorary titles including National Historical and Cultural City and National Garden City. Changsha remains in 22nd place in the Bonus Scenario.

23. Hefei

Hefei, anciently known as Luzhou and Luyang, has a superior geographical location between the Yangtze and Huai River, and mainly features plains and mountains. Hefei is one of the first batch of science and education cities in China with rich science and education talent resources. Its superior location

and transportation services facilitate its development of processing, manufacturing, and high and new technical industries.

Hefei takes 20th place in the Basic Scenario.

Two indicators related to industrial pollution including the comprehensive utilization rate of industrial solid waste (99.17%) and SO_2 emission per unit of industrial output value (13.23 tons per 100 million Yuan) gain relatively high scores and rank fourth and ninth, respectively.

Its proportion of educational expenditure to GDP (only 0.96%) takes 32nd place; the innocuous treatment rate of domestic garbage (77.83%) ranks 28th; proportion of added value of nonagricultural sectors (93.68%) is relatively low and ranks 25th.

Hefei won the honorary title of National Garden City in 1992 and drops down to 23rd place in the Bonus Scenario.

24. Shijiazhuang

Shijiazhuang, commonly abbreviated in Chinese as *Shi*, is the political, economic, technology, finance, culture, and information center of Hebei Province, and is an open city approved by the State Council to carry out the coastal and financial opening-up policies. Located in the hinterland of the North China Plain, adjacent to Beijing and Tianjin in the north, Shijiazhuang is an important city along the Beijing–Guangzhou Railway.

Shijiazhuang takes 21st place in the Basic Scenario.

Its innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Yinchuan; the attainment rate of industrial wastewater (99.23%) gains a high score and ranks eighth.

Its relatively low average life expectancy (73.00 years) and SO_2 emission per unit of industrial output value (41.67 tons per 100 million Yuan) both rank in 25th place; urbanization rate (41.21%) and proportion of added value of nonagricultural sectors (89.09%) rank 31st and 32nd, respectively.

Shijiazhuang won the honorary title of National Garden City in 2007 and drops down to 24th place in the Bonus Scenario.

25. Xi'an

Xi'an, anciently called Chang'an, is the geographic center of mainland China and is the main location for scientific research, higher education, defense science and technology, and high and new technical industry in the Central and Western China District. It is also a key center for aviation and aerospace, machinery manufacture, and textile industries.

Xi'an takes 26th place in the Basic Scenario.

Its relatively high comprehensive utilization rate of industrial solid waste (97.80%) ranks eighth.

GDP per capita in its municipal districts (30,100 Yuan per capita) is close to the minimum value and takes 31st place; SO_2 emission per unit of industrial output value (49.88 tons per 100 million Yuan) and centralized sewage treatment rate (59.40%) are relatively low and rank 26th and 30th, respectively.

Xi'an has won two honorary titles including National Historical and Cultural City and National Hygiene City. Xi'an rises to 25th place in the Bonus Scenario.

26. Taiyuan

Taiyuan, known historically as Jinyang, is located in the east of the Loess Plateau and the north of the Taiyuan Basin. Since ancient times, Taiyuan has been an important transportation channel between Beijing and Luoyang.

Taiyuan takes 25th place in the Basic Scenario.

Its proportion of added value of nonagricultural sectors (98.57%) and average life expectancy (77.50 years) gain high scores and both rank fifth; all its environment-related indicators (except for the attainment rate of industrial wastewater (97.14%) at 15th place) rank in the bottom tenth, of which the comprehensive utilization rate of industrial solid waste (47.44%) ranks 33rd.

Taiyuan drops down to 26th place in the Bonus Scenario.

27. Kunming

Kunming, the capital of Yunnan Province, is a well-known tourism city in China. Located in Southwest China on the Central Yunnan-Guizhou Plateau, it is surrounded on three sides by mountains and adjacent to Dian Lake in the south. Kunming features a low-latitude mountain plateau monsoon spring-like climate. In recent years, Kunming has become an international hub linking China and Southeast Asia, and several railways and highways between Kunming and Thailand, Vietnam and Laos are under construction, while sea access from Kunming is also going to be opened.

Kunming takes 27th place in the Basic Scenario.

Its innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Yinchuan; its attainment rate of industrial wastewater (99.55%) ranks seventh.

Among the 35 candidate cities, its proportion GDP spent on education (0.92%) is relatively low and ranks 33rd; the comprehensive utilization rate of industrial solid waste (39.70%) is the lowest.

Kunming won the honorary title of National Historical and Cultural City in 1982 and remains in 27th place in the Bonus Scenario.

28. Lanzhou

Lanzhou, which used to be known as the Golden City, is at the geometric center of China. The city proper is located at the upper reaches of Yellow River and surrounded by majestic mountains in the south and north. It is an important railway hub in China and is crossed by the Baotou–Lanzhou, Lanzhou–Xinjiang, Lanzhou–Qinghai, and Lianyungang–Lanzhou Railways. In recent years, three editions of urban master planning led Lanzhou to implement the strategy of "eastward expansion, westward movement, southward extension, and northward development," and the city has proactively explored a new path to a better city through environment enhancement and characteristic urban construction and has continued to improve its integrated service functions.

Lanzhou takes 28th place in the Basic Scenario.

Its relatively high proportion of educational expenditure to GDP (2.27%) and proportion of added value of nonagricultural sectors (96.68%) rank 5th and 11th, respectively, among the 35 candidate cities.

Among its environment-related indicators, its innocuous treatment rate of domestic garbage (49.58%) and green coverage in built-up area (26.39%) rank 35th and 34th, respectively.

Lanzhou remains in 28th place in the Bonus Scenario.

29. Chongqing

As one of four municipalities directly under the Central Government, Chongqing is located in Southwest China and is a grouped city composed of one megalopolis (Chongqing urban area), two large cities (Wanzhou and Fuling), and four medium cities (Qianjiang, Yongchuan, Jiangjin, and Hechuan). Due to its mountainous geography and naturally foggy conditions, Chongqing is also known as Fog City and Mountain City.

Chongqing takes 29th place in the Basic Scenario.

Its green coverage in built-up area (68.94%) gains a high score and ranks second; the proportion of educational expenditure to GDP (1.80%) ranks ninth among the 35 candidate cities.

GDP per capita in its municipal districts (24,500 Yuan per capita) and proportion of added value of nonagricultural sectors (88.71%) both rank 33rd; the urbanization rate (27.86%) and SO_2 emission per unit of industrial output value (108.97 tons per 100 million Yuan) are close to the minimum value and both rank 34th.

Chongqing won the honorary title of National Historical and Cultural City in 1986 and remains in 29th place in the Bonus Scenario.

30. Guiyang

Guiyang is located on the east slope of the Yunnan-Guizhou Plateau in Southwest China. It is the center and capital of Guizhou Province and has a high altitude and low latitude. In ancient times, Guiyang was abundant in bamboo and many places are named after this plant.

Guiyang takes 30th place in the Basic Scenario.

The very high proportion of educational expenditure to GDP (2.90%) ranks second among the 35 candidate cities, only inferior to Beijing; among all indicators showing the status of environmental development, the green coverage in built-up area (42.10%) gains a high score, ranking seventh.

SO_2 emission per unit of industrial output value (98.42 tons per million Yuan) and comprehensive utilization rate of industrial solid waste (46.29%) are only 33rd and 34th place in the ranking, respectively; the centralized sewage treatment rate (32.46%) is the lowest among all the candidate cities.

Guiyang won the honorary title of National Garden City in 2007 and remains in 30th place in the Bonus Scenario.

31. Huhehaote (Hohhot)
Hohhot, meaning "Blue City" in Mongolian, is the capital of the Inner Mongolia Autonomous Region, adjacent to the Yinshan Mountains in the north, linked to the Yellow River in the south, and encircled by the Tumochuan Plain. It was officially declared the "Dairy Capital of China" by the national government in 2006.

Hohhot takes 31st place in the Basic Scenario.

Both its comprehensive utilization rate of industrial solid waste (90.34%) and proportion of added value of nonagricultural sectors (94.29%) take 19th place among the 35 candidate cities.

Its proportion of educational expenditure to GDP (0.89%) takes 34th place; both average life expectancy (69.87 years) and innocuous treatment rate of domestic garbage (72.58%) take 33rd place.

Hohhot won the honorary title of National Historical and Cultural City in 1986 and remains in 31st place in the Bonus Scenario.

32. Haerbin (Harbin)
Harbin is the capital of Heilongjiang Province and is the most northern provincial capital in China. At the center of Northeast Asia, it is an important hub of the Eurasia Land Bridge and air corridor. Harbin features a continental monsoon climate of middle latitude temperate zone with short cool summers and long cold winters, earning it the nickname of "Ice City." As a newly emerging industrialized city, Harbin has exploited its geographical advantages to open large international economic, trade and technology fairs in recent years, and has become a window and platform for links between China and Russia and regional Northeast Asia cooperation.

Harbin takes 32nd place in the Basic Scenario.

Its proportion of educational expenditure to GDP (1.56%) ties for 15th place with Taiyuan and Nanjing; the urbanization rate (48.18%), SO_2 emission per unit of industrial output value (29.59 tons per million Yuan), and innocuous treatment rate of domestic garbage (85.00%) all rank 22nd.

Both its proportion of added value of nonagricultural sectors (86.39%) and attainment rate of industrial wastewater (80.37%) rank 34th; both its green coverage in built-up area (33.71%) and soot emission per unit of industrial output value (32.88 tons per million Yuan) rank 33rd.

Harbin won the honorary title of National Historical and Cultural City in 1994 and remains in 32nd place in the Bonus Scenario.

33. Xining
As the capital of Qinghai Province, Xining is located in the Yellow River–Huangshui River valley on the Tibetan plateau, in part of the Qilian Mountains. The Huangshui River, a tributary of the Yellow River, runs through its urban area from west to east. Archeological discoveries in Zhujiazhai, Shenna, and Xixingyuan sites in northern urban areas have shown that there were signs of early human activities 4,000 or 5,000 years ago in Xining.

Xining ranks 34th place in the Basic Scenario.

Its innocuous treatment rate of domestic garbage (100%) ties for first place with nine other cities including Xiamen and Yinchuan; its urbanization rate (52.83%) and proportion of added value of nonagricultural sectors (95.45%) rank 19th and 15th, respectively, among the 35 candidate cities.

GDP per capita in its municipal districts (25,800 million Yuan per capita) takes 32nd place; the proportion of educational expenditure to GDP (0.73%), SO_2 emission per unit of industrial output value (123.47 tons per 100 million Yuan) and soot emission per unit of industrial output value (42.07 tons per 100 million Yuan) are the lowest values among the 35 candidate cities.

Xining won the honorary title of National Garden City in 2008 and remains in 33rd place in the Bonus Scenario.

34. Wulumuqi (Urumqi)

Urumqi (meaning "beautiful pasture" in Uygur) is the capital of Xinjiang Uygur Autonomous Region. Located in the center of Xinjiang on the north slope of Tian Shan, it is considered to be the farthest city from the sea in the world. Urumqi is a multiethnic city where 13 ethnic minorities live. In recent years, with the further implementation of the West Development Strategy, China has launched a series of preferential policies to support the development of Xinjiang.

Urumqi takes 33rd place in the Basic Scenario.

Its urbanization rate (73.92%) and proportion of added value of nonagricultural sectors (98.25%) gain very high scores and, respectively, rank in fifth and sixth place; the proportion of educational expenditure to GDP (1.69%) ranks 12th.

Average life expectancy (67.41 years) and GDP per capita in its municipal districts (23,900 Yuan per capita) are the lowest among the 35 candidate cities; all indicators showing the status of environmental development are very low and two indicators, attainment rate of industrial wastewater (79.15%) and green coverage in built-up area (24.20%) are at the bottom of the ranking.

Urumqi remains in 34rd place in the Bonus Scenario.

35. Nanning

Nanning (Namzningz in Zhuang Characters), commonly abbreviated in Chinese as *Yong*, is the capital of Guangxi Zhuang Autonomous Region and boasts a history of more than 1,680 years. Located in the southwest of Guangxi Province close to Guangdong, Hong Kong, and Macao and looking out to Southeast Asia, it is an important hub to link southeast coastal areas and southwest interior and is also a key capital of the Western Area. Nanning is a multiethnic city and has the most ethnic groups in China, including people of the Zhuang, Yao, and Miao minorities, although the Han ethnic group makes up the majority of the population. Nanning's superiority lies in its rich national cultures, and the Zhuang Folk Song Fair is officially recognized as a state-level nonmaterial cultural heritage. Since 1999, Nanning has held the Nanning Festival of International Folksong Arts eight times in succession, creating a new bright spot of the combination of culture and economy for Guangxi, and

Nanning has become an attractive location for folk song lovers. The highly successful Sino-ASEAN Expo has been held in Nanning on four occasions since 2004.

Nanning takes 35th place in the Basic Scenario.

Comprehensive utilization rate of industrial solid waste (90.23%) and green coverage in built-up area (38.99%) gain relatively high scores and rank 20th and 13th, respectively. However, other indicators are relatively low and the urbanization rate (27.32%) and the proportion of added value of nonagricultural sectors (84.56%) are at the bottom of the ranking.

Nanning won the honorary title of National Garden City in 1997 and remains in 35th place in the Bonus Scenario.

Chapter 6
Macromanagement System and Regulation Measures for China's Sustainable City Construction

After nearly 30 years practice, China has made great progress in the field of sustainable city, especially achieving some breakthroughs in theoretical and practical issues. The Chinese economy is experiencing rapid development along with the three-step macro-strategy, and the urbanization process keeps on accelerating, making the task of sustainable construction and development faced by China extremely urgent. It is, therefore, vital for us to put forward and develop the macromanagement system and control measures for China's sustainable city development according to the national conditions so that China's sustainable city construction and development will be further promoted and assured. Sustainable city construction and development involves so many factors, and this book only carries out discussions and explorations on some comprehensive and fundamental factors.

6.1 Strengthening Development Awareness of Sustainable City

What kind of cities do we need? What is the direction of urban development? These are the first core issues faced by urban construction and development, and the answer to the questions depends on people's conception and consciousness of urban development.

The connotation of Sustainable City has exceeded the traditional concepts of urban development, environmental protection, and ecological construction and is an innovation in terms of ideology and institution. The sustainable city is a new urban development model, requiring changes in people's values and behavior, i.e., a corresponding strong awareness of the construction or development of sustainable cities. Development awareness of sustainable cities cannot be generated automatically, as it has to be achieved through wide publicity of relevant issues in various forms, thus enabling policymakers, regulators, and the public to deeply and systematically comprehend the scientific meaning of sustainable cities. Meanwhile, it is important to encourage and guide the public to generally and actively participate in sustainable city construction. Without the wide participation of social

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circles, sustainable city construction is impossible to be realized. On the other hand, the process of practicing sustainable city construction can continuously strengthen and enhance people's development awareness of sustainable cities.

6.2 Carrying Out Theoretical and Methodological Research on the Construction of Sustainable City

Although some international organizations and many experts have carried out in-depth research on the theory of sustainable city construction and made many achievements, these activities are still far from being enough to meet the needs of sustainable city construction. Therefore, it is urgent to organize various experts and managers to further conduct integrated, in-depth and systematic research of sustainable city construction theory to propose and establish a relatively complete theoretical system, particularly to tackle "urban environment research," the core content of sustainable city construction. "Urban environment research" does not only include research on environmental issues in cities, but also the study of the relationship and mechanism between urban development rules and urban ecosystem succession regulation, and then research how to effectively couple these two rules and integrate them into an overall urban development framework to plan and guide sustainable city construction, thus enabling the city to have the capacity to maintain and improve its ecosystem services, as well as providing sustainable welfare to its residents.

The methodology of sustainable city construction is the key to sustainable city construction. The research on the methodology of sustainable city construction shall be carried out in terms of time (different time scales), space (different spatial scales), quantity (the metabolism of various substances, energy, and information), degree (threshold, limit, and boundary), order (the relationship among various processes), and so on, to further study the influence of coupling rules between these factors of sustainable city construction and development, to form a methodological system of "time–space–quantity–degree–order," providing a methodological basis for sustainable city construction.

6.3 Establishing a Scientific and Technological Support System for Sustainable City

With the rapid advances in science and technology in today's world, science and technology has already permeated into all areas of human development and plays an increasingly significant role. The future of humankind and urban development is dependent on the advancement of science and technology more than ever.

The history and reality of urban development show that science and technology plays a crucial role in urban form and development direction. Scientific and technological advancement is the supporting and driving force for sustainable city construction and also the fundamental way to solve major issues in sustainable city construction. There is an urgent need for China's sustainable city construction to set up a comprehensive science and technology support system. In a certain sense, science and technology is the cornerstone of sustainable city construction.

6.4 Improving the Institutional System of Sustainable City Construction

The government is the leading and driving force in sustainable city construction. It can arrange, guide, and inspire social circles to promote sustainable city construction through a series of institutions. Institutional system construction is a dynamic process consisting of developing and implementing the system as well as testing and improving the system in practice, and there is no end to this process in theory. Although there are some systems related to sustainable city construction, they cannot meet the needs of sustainable city construction. To promote a comprehensive transformation from existing urban structure, function, management, and operation to sustainable cities, the corresponding institutional guarantee systems, including the system of laws and regulations, the scientific decision-making process, and wide public participation, should be completed.

6.5 Establishing a Management System for Sustainable City

Establishing an urban management system suitable for sustainable city construction is the important guarantee for the successful implementation of management process for sustainable cities. The construction of a sustainable city is a systematic project, involving all aspects of urban construction. Therefore, a unified functional department under direct government guidance is needed to change the fragmented sectoral settings, strengthen horizontal linkages between institutions, and intensify the role of governmental institutions in policy guidance, planning implementation and macro-control, while transferring the specific operational and service functions related to sectoral economic profits and group interests into society and markets. The goal is to define the functions, power, and responsibilities of various institutions within the urban management system, combine the system's rigidity and environmental flexibility and adaptability, achieve the consistency of integrated planning, assessment feedback, and adjustment, and form a unified, efficient, orderly and coordinated management system, and operating mechanism.

6.6 Improving the Policy System of Sustainable City Construction

The policy system is the most important means for governments at all levels to regulate and control the sustainable city construction and development processes, which is composed of a series of specific policies and policy systems. The construction of sustainable cities requires those systems to be transcendent in terms of time scale, a more comprehensive scope or field and coordination of more consistent goals. The state should consider the policy orientation, focuses and intensity from the perspectives of new ideas, new angles, a wider scope and long-term overall interests, especially to pre-evaluate the possible policy effects and make constant adjustments to the implementation process to ensure the continuity and long-term effectiveness of the policy system for the construction of a sustainable city.

6.7 Building a Performance Assessment System of Sustainable City Construction

The city construction performance is the effect and result produced by urban construction activities, the most important indicator to measure the urban construction level. Sustainable city construction requires the process of urban construction to be comprehensively assessed and examined from a sustainability perspective. According to the implications of the connotation of sustainable cities, setting up a scientific and feasible urban construction performance assessment system for measuring urban planning, construction process, management, and control level is of practical significance to sustainable city construction.

Appendix
Indicator Explanations

1. Average life expectancy
   The average life expectancy is the average survival years of the 0-year age group, and it is a comprehensive reflection of the level of death as well as an important indicator of population health. This is an integrated indicator, reflecting both the social and economic conditions and medical progress and is also a reflection of people's nutritional status and quality of life.

2. Proportion of educational expenditure to GDP in municipal districts
   The proportion of educational expenditure to GDP in municipal districts is equal to the ratio of education expenditure of municipal districts to total GDP. For the sake of convenience, we referred to it as the "proportion of educational expenditure to GDP"

$$\text{Proportion of educational expenditure to GDP in municipal districts} = \frac{\text{Education expenditure of municipal districts}}{\text{Total GDP in municipal districts}} \times 100\%.$$

3. GDP per capita in municipal districts
   GDP per capita in municipal districts refers to the ratio of total GDP in municipal districts to all citizens (resident population) in municipal districts.

$$\text{GDP per capitain municipal districts} = \frac{\text{Total GDP in municipal districts}}{\text{Resident population in municipal districts}}.$$

4. Urbanization rate
   The urbanization rate is equal to the percentage of the total nonagricultural population to total population (registered population).

$$\text{Urbanization rate} = \frac{\text{Nonagricultural population}}{\text{Total registered population}} \times 100\%.$$

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5. Proportion of added value of nonagricultural sectors
The proportion of added value of nonagricultural sectors is equal to the ratio of nonagricultural sectors' added value (secondary and tertiary industry) to total GDP.

$$\text{Proportion of added value of nonagricultural sectors} = \frac{\text{Second industry added value} + \text{Third industry added value}}{\text{Total GDP}} \times 100\%.$$

6. Centralized domestic sewage treatment rate
The centralized sewage treatment rate refers to the rate of urban domestic sewage emission attaining emission standards after secondary or more than secondary processing or other treatment facilities (equivalent to secondary treatment, such as oxidation pond, oxidation ditch, and biogas digester or wetland treatment system) to the total urban sewage emission.

7. Innocuous treatment rate of domestic garbage
Innocuous treatment rate of domestic garbage is the percentage of treated waste through processes such as landfill, incineration, composting, and other recycling, to the total domestic transported waste.

$$\text{Innocuous treatment rate of domestic garbage} = \frac{\text{Treated waste through harmless process}}{\text{Total domestic transported waste}} \times 100\%.$$

8. Comprehensive utilization rate of industrial solid waste
The comprehensive utilization rate of industrial solid waste, used in the study period, is the ratio of the comprehensive utilization of industrial solid waste for main raw materials to the industrial solid waste output volume.

$$\text{Comprehensive utilization rate of industrial solid waste} = \frac{\text{Comprehensive utilization of industrial solid waste}}{\text{Solid waste output volume}} \times 100\%.$$

9. Attainment rate of industrial wastewater discharge
The attainment rate of industrial wastewater discharge refers to the ratio of industrial wastewater volume (including treated and untreated), which fully attained national and local standards, to the total industrial wastewater discharge.

$$\text{Attainment rate of industrial wastewater discharge} = \frac{\text{Wastewater volume up to standards}}{\text{Total industrial wastewater discharge}} \times 100\%.$$

10. SO_2 emission per unit of industrial output value
SO_2 emission per unit of industrial output value is equal to the ratio of a city's industrial SO_2 emission to the city's industrial production value. SO_2 emission from industrial enterprises refers to the total SO_2 emitted to the atmosphere by the factory's production process and fuel combustion.

$$\text{SO}_2 \text{ emission per unit of industrial output value} = \frac{\text{Industrial SO}_2 \text{ emission}}{\text{Industrial production value}}.$$

11. Soot emission per unit of industrial output value
Soot emission per unit of industrial output value is equal to the ratio of a city's soot emission to its industrial production value. Industrial soot emission refers to the amount of soot emitted into the atmosphere from enterprises.

$$\text{Soot emission per unit of industrial output value} = \frac{\text{Industrial soot emission}}{\text{Industrial production value}}.$$

12. Percentage of green coverage in built-up area
The percentage of green coverage in built-up area refers to the ratio of the vertical projection area for green trees, shrubs, and perennial herbs, managed by all units in the region to its total built-up area.

$$\text{Percentage of green coverage in built-up area} = \frac{\text{Vertical projection area of green space}}{\text{Built-up area}} \times 100\%.$$

13. Bonus indicator
The bonus indicator refers to the awards of the National Historical and Cultural City, National Hygiene City, National Garden City, National Model City for Environmental Protection, National Civilized City, and National Ecological City. A city gains one extra point for each award.

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