Urban Sustainable Development: Measuring Capacity Outweighs Measuring Development Level

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With the accumulation of problems within the economy, society, resources and environment during the rapid development of China in recent decades, the issue of sustainable development has gained more and more attention. Meanwhile, policy-makers do need evaluation tools to guide the key improvement points effectively. However, most evaluation tools still focus on the assessment of urban development level (namely, the results of development) and a simple comparison of the total score (meaning the simplicity of the comparison purpose). There has been a lack of research on development capacity (namely, the factors which lead to the results), the coordination within various factors and urban biodiversity. The following science digest provides policy-makers with discussions on "urban sustainability" and the evaluation tools. Due to the concentration and the integrity of the city, it is a good case object. However, the application of evaluation methods and tools is not limited to the city scale.

Introduction & Scopes

There is great similarity between the meaning of "urban sustainability" and "sustainable urban development". What "sustainability" emphasizes is an ideal state or a set of conditions from the beginning to the end. It is actually a guideline and a series of constraints on human society. Such guidelines indicate how human beings should handle the relationship with Nature, how mankind should coexist with each other and how human beings should be responsible for their offspring (Baumgärtner et al. 2010). While "sustainable development" describes a process from the initial state to achieving sustainability in the system. The emphasis is on one direction rather than a final state (Joe 2000). Thus, we can see that the "urban sustainable development" is the process to achieve "urban sustainability", and "urban sustainability" is the ultimate goal of "sustainable urban development" (Maclarence 1996). In addition, another difference between "urban sustainability" and "sustainable urban development" is that the former must consider the impact cities have on local, regional and global environment on spatial scales (Alberti 1996).

"Urban sustainability" can basically be defined as a probability of a particular system being able to restrict its degree of development, coordination and continuity within the threshold of sustainable development during the specified target and preset stages of its development, namely, an ability a specific system has to successfully achieve the goals of sustainable development. From the basic concept, sustainable development can be considered as not only a basic measurement of the degree of success of implementing the strategy of sustainable development, but also the sum of the drivers (including physical ability and mental ability) in the process of implementing the strategy of sustainable development.

Hansen and Jones (1996) defined "sustainability" directly as a system's ability to achieve the state of sustainable development. "Sustainability Science", a paper jointly written by 23 world-renowned scientists and published by *Science* in 2001, defines sustainability as: the essence of sustainability is to maintain a regional life support system to ensure survival and meet the basic needs of human beings. The Sustainable Development Strategy Research Team of Chinese Academy of Sciences summed up three essential characteristics of sustainable development: "Development", "Coordination ", "Continuity".

Scientific Debates

Within the academic community there are still debates on the measurement and comparison of urban sustainability because it involves urban biodiversity and value judgment. Firstly, the city is a complex system within which a variety of factors influence each other. It is difficult to define the causal relationships between factors easily and simply. Therefore, there are debates sometimes on how to build an index system to evaluate urban sustainability and on whether the selected indicators reflect aspect of the development level or the capacity (namely, the development results or the factors which lead to the results) (Liu Jianfeng 2003). Secondly, it is a difficult to set the value of the assessment indicators and it is also difficult to make comparison between cities. On the one hand, the data used to make qualitative judgment of cities are often not a definite demarcation point but an data range or a relative reference; on the other hand, the methodology has been questioned which evaluates and compares cities just by a single number generated from integrating a variety of indicators. Actually there are different limitations and application of mathematical methods (Su Weihua 2000), while the city comparison should be multi-dimensional. Thirdly, assessment and

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comparison of cities are often perplexed by urban scale, urban biodiversity and development values, which often become the focal debating issues (Liu Jianfeng 2007).

Expected Outcomes

Supported by the National Science and Technology Support Program (2013BAJ04B00), "Key technology research and demonstration on urban sustainability evaluation and information management" is studying, evaluating and verifying the urban sustainability evaluation indicators which are different but can be set up, proved and assessed. The research has generated some initial results so far. The following outcomes will be delivered continuously:

*** Methods**

1) Establish urban sustainability evaluation theory and method, highlighting the innovation: from assessing development level to evaluating capacity; from aggregate score comparison to coordinative analysis; from single judgment to multi-scenarios distinction; from objective statistical data to combination of subjective and objective evaluation; from static assessment to dynamic evaluation.
2) Sort out various urban sustainable development targets using the cases of National Sustainable Development Experimental Zone.
3) Set up various indicators and weights for urban sustainability evaluation in line with different development expectations.

*** Case Studies**

Test, analyze and report cases of urban sustainable development to provide support regarding methodology and conclusions for other countries and regions.

*** Publications**

Evaluation Report on Chinese Urban Sustainability

*** Workshops and Events**

1) Invite international experts to participate in the evaluation of domestic cities in the project.
2) Disseminate internationally the research findings, such as toolkits, case cities evaluation, etc. through The World Urban Forum and Global Forum on Human Settlements.

*** Toolkits and Website**

1) Develop toolkits containing multivariate data acquisition, which can integrate subjective and objective evaluation information so as to collect different information on judging urban sustainability from different stakeholders.
2) Develop evaluation models and software targeting urban sustainability under different development scenarios.
3) Design a website on urban sustainability management based on the Administrative Center for China's Agenda 21, the Administrative Office for National Sustainable Communities and Chinese Society for Sustainable Development.

*** Win-win strategies and Action plans**

1) Guide governments at all levels to determine the key improvement points effectively and to optimize the institutional design for cross-sector cooperation and actions according to the evaluation results.
2) Promote the role of third parties including international agencies in evaluating urban sustainability.
3) According to the evaluation results, continuously optimize evaluation methodology, upgrade toolkits and provide continuous evaluation results to guide the governments to work effectively.

The Global Predominant Evaluation Indicators for Sustainable Development

There are two trends in the global predominant evaluation indicators for sustainable development. Most of these indicators focus on development level, that is, the current development status a city has reached. On the other hand, indicators focus on sustainability pay more attention to the driving force in ensuring the implementation of sustainable development strategy in the course of development.

▲ Indicators evaluating urban sustainability put forward by this research

Example: The proportion of tertiary educated population (evaluating urban sustainability):

It is one of the most important methods to judge and deduce regional development potential and trend. It is a core indicator in measuring the level of higher education. Meanwhile, it is an important indicator measuring the region's attractiveness to talents. The higher the indicator, the higher the proportion of high-quality people who can conduct R&D, social service and consumption in the region's demography and the higher the innovative capacity for future urban development.

○ Indicators currently used to evaluate the urban sustainable development level

Example: Number of Invention Patents per 10,000 people (evaluating urban sustainable development level):

It is a general indicator measuring knowledge output in innovative activities and a direct reflection of knowledge-based achievement. It is related to a region's strength and competitiveness. It can exert a profound impact on the region's economic security. The indicator illustrates that the region can acquire market competiveness and profit though patents by taking advantage of its economic, scientific and technological strength.

■ Development
▣ Coordination
▢ Continuous

Index	Variable	Sustainability
Resource		
Land○	Farmland per capita○	■ ▢
	Construction land area per capita○	■ ▢
Water▲	water availability per capita▲	■ ▢
Energy▲	Dependence on external energy○	■ ▣ ▢
	The proportion of non-fossil energy consumption▲	■ ▣ ▢
Social		
Public Service○	Average Years of Education▲	▢
	Financial dependency ratio of the population○	▢
	Number of beds in medical institutions per 10,000 people○	▢
Infrastructure○	Town gas penetration○	■
	Urban water supply capability○	■
	Urban and rural drinking water compliance rate○	■
Transport▲	Road network density○	■
	The proportion of public transport▲	▣
Housing▲	Town housing area per capita○	▣
	Rate on housing price and income in town▲	▣
Social Justice▲	Urban and rural per capita income ratio▲	▣
	Urban and rural Engel coefficient ratio○	▣
Social Security○	annual number of criminal case per 10,000 people○	▣
	The registered urban unemployment rate○	▣
Environment		
Environmental Conditions▲	The total value of ecosystem services○	▢
	The number of sudden environmental pollution incidents○	▢
	Greenhouse gas emissions intensity▲	▢
	Wastewater emissions intensity○	▢
	Solid Waste emissions intensity○	▢
Ecological Protection▲	Main urban public green area per capita○	▣ ▢
	Environmental investment accounted for the proportion of fiscal expenditure▲	▣ ▢
Environmental Governance○	Effluent compliance rate○	▣ ▢
	Comprehensive utilization rate of industrial solid waste○	▣ ▢
	Number of air quality standard Day▲	▢

Index	Variable	Sustainability
Economics		
Market Efficiency▲	GDP per capita○	■
	General budget revenue per capita○	■
	Top industry location quotient▲	▣
Labor Efficiency▲	Labor productivity of the whole society○	▣
	Employment rate▲	■ ▣ ▢
	Labor allocation efficiency○	▣ ▢
Production Efficiency○	Energy consumption per 10,000 Yuan GDP○	■ ▢
	Greenhouse gas emissions equivalent per 10,000 Yuan GDP○	■ ▢
	water consumption per 10,000 Yuan GDP○	■ ▢
	City compactness○	▣ ▢
	Value of construction land in urban○	■ ▢
Innovation		
Education & Training▲	The proportion of tertiary educated population▲	▣ ▢
	number of professional and technical personnel per 10,000 people▲	▣ ▢
Science & Technology Cooperation▲	The proportion of R & D investment of the whole society○	■ ▢
	Proportion of R & D institutions in above-scale enterprises ▲	■ ▢
Technological achievements ○	Number of invention patents per 10,000 people○	■
	Professional and technical personnel per capita technical market turnover○	■
	Proportion of high-tech industrial output value in whole industrial output value○	■

Source: Authors' compilation.

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