Empirical Study of Urban Environmentally Livable Index for China

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Abstract: While the environments of more and more Chinese cities are becoming less polluted following successful introduction of pollution control and environment renovation measures in recent years, more attention is now being given to the livability of cities. However, these successes are often not quantifiable and are not universally recognized. Based on a survey of globally-recognized urban livability indices and their monitoring systems, the paper is to develop and agree with the government counterparts on a verifiable and measurable environmental livability index system targeting the PRC cities, and find a suitable approach for investment assessments in reaching the benchmarks, i.e. the costs of producing changes in environmental livability. With the Chinese Environmental Liveability Index System developed in the paper, environmental performance of 33 Chinese cities were ranked and the environmental challenges of these cities are identified with the further Pressure-State-Response analysis and trend analysis. With a comprehensive analysis with the trends of long-term environmental livability and the pollution control investment of Chinese cities, more effective and aim-oriented incentives and investment policies for urban environmental livability improvement are put forward in this paper.

Key words: Environmentally Livable Index, Analytical Hierarchy Process, Pressure-State -Response Analysis, Investment

1. Introduction

In china, while the environments of more and more cities are becoming less polluted following successful introduction of pollution control and environment renovation measures in recent years, more attention is now being given to the livability of cities. However, these successes are often not quantifiable and are not universally recognized.

Most of the developed countries have established indexing of environmental livability of its cities, a popular tool to rate the respective progress of countries and cities, and to identify the shortcomings. Environmental livability, a crucial element of the quality of life, is a quality of an area as perceived by residents, employees, customers and visitors. Increasing environmental livability is closely linked to efforts to prevent pollution and reduce waste, conserve natural resources and wildlife habitat, protect endangered species, and reduce our ecological "footprint". Efforts to define, quantify, and monitor urban environmental livability assist in achieving the overall goal of urban sustainability.

The presence of a well defined and comprehensive indexing of urban environmental sustainability, the respective monitoring system, and city ranking for the PRC will be a major contribution towards strengthening the scientific basis for policy making and implementation for environmentally sustainable development through (i) promoting environmental agenda between PRC policy makers, urban managers, and the general public; (ii) understanding present and future gaps; and (iii) creating a scientific methodology of environmental investments and evaluating impacts of long-term environmental investments.

Based on a survey of globally- recognized urban livability indices and their monitoring systems, we exerted to develop and agree with the government counterparts on a verifiable and measurable environmental livability index system targeting the PRC cities, and find a suitable approach for investment assessments in reaching the benchmarks, i.e. the costs of producing changes in environmental livability. With a comprehensive analysis with the trends of long-term environmental livability and the pollution control investment of Chinese cities, more effective and aim-oriented incentives and investment policies for urban environmental livability improvement

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are put forward in this paper.

2. International experience

According to the UN, the proportion of people living in urban areas has risen to fifty percent and will continue to grow to two-thirds, or 6 billion people, by 2050. With this in mind, it is essential that urban areas are planned and managed effectively. Developing specific indicator systems for urban areas is becoming increasingly important. There are a number of globally recognized urban environmental indicator initiatives. These include: (i) the United Nations Centre for Human Settlements (UNCHS) Indicators Programme; (ii) the World Bank's (WB) Global Urban Observatory (GUO)[1]; (iii) Agenda 21 initiatives[2]; and (iv) the UNDP indexes[3]. These international indicator initiatives fall into three separate conceptual approaches: (i) the systems approach; (ii) thematic / index approach; and (iii) the policy approach.

A desk-survey has been conducted of globally recognized urban livability indices and their monitoring systems. Analysis of the collected material has included evaluation of their efficacy towards: (i) promotion of environmental agenda between policy makers, urban managers and the general public and understanding present and future gaps; (ii) creating a scientific methodology of environmental investments; (iii) evaluating impacts of long-term environmental investments; and (iv) applicability to the development of PRC indices.

Whilst a number of frameworks have been developed, there has been a general consensus in the international community that different countries should develop their own indicators in order to reflect their individual political and cultural environments[4,5]. The recommended framework for developing the Environmental Livability Index System (ELIS) in PRC is a combination of the systems approach, using the PSR model, and the thematic approach. The combination of the two frameworks allows the concept of livability to be incorporated into the system. Specific elements of what makes up livability can then be defined and identified, such as air quality and livability. The PSR model will then be used to analyze the issues identified.

3. Development of Environmentally Livable Index for Chinese cities

3.1Construction of indicator system

This paper seeks to develop the Environmental Livability Index (ELI), an index for tracking, evaluating and reporting on a city's environmental livability (EL) and its improvement. The index will also provide a support tool for policy analysis and decision making of pollution control investment. The Environmental Livability Index System (ELIS) will be a system consisting of ELI as well as all the indicators and sub-indices for deriving ELI. The ELIS will also integrate impacts of social and economic activities on the environment, as shown in Figure 1.

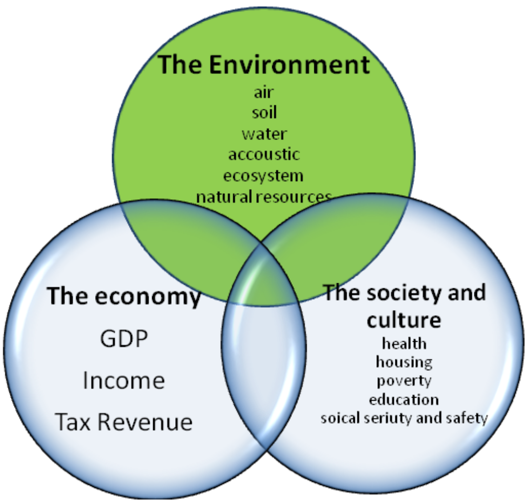


Figure 1. Scope of the Indicators

The ELI system consists of three levels, an aggregated ELI, a sub-index and indicators. Sub-indices are proposed based on the analysis of China's urban environmental issues above. Seven indices for addressing the above major urban issues are included in the urban livability index as water environment, water resource, air environment, solid waste, acoustic environment, ecological environment, domestic liveability and environmental management.

Under each sub-index, indicators are selected according to the PSR model and various criteria for section. The four key criteria – representative, measurability, analytical soundness and data availability- are suggested based on these previous works. Following the above criteria, 8 indicators are selected for water environment, 3 indicators for water resource, 11 indicators for air environment, 6 indicators for solid waste, 1 indicator for acoustic environment, 4 indicators for ecological environment, 4 indicators for domestic livability, and 4 indicators for environmental management. This makes a total of 41 indicators, among which 13 indicators reflecting the environmental state and pollution control efficiency are selected to calculate the Environmental State Index (ESI), and 13 pressure indicators to calculate the Environmental Pressure Index (EPI) and 15 indicators to calculate the Environmental Response Index (ERI). In addition, the Environmental Investment Index (EII) was also calculated. ESI is the weighted mean of atmospheric environmental quality, water environmental quality, water resource status quo, acoustic environment and environmental livability status quo indices; EPI is the weighted mean of pollutants emission intensity indices in atmospheric environment, water environment and solid waste and ecological environmental pressure index; ERI is the weighted mean of treatment rates/removal rate of different wastes and management indices as staff working for environmental protection etc; and EII is the standardized index of proportion of environmental protection investment to GDP.

The reason of decomposing indicators into three purposes of index is for better explain of the relationship and links of pressure, state and efforts made for the mitigation of environmental pressure and improvement of environmental livability.

3.2 Developing weights

The Analytical Hierarchy Process (AHP), a systematic method allowing comparison between a list of objectives or alternatives using a framework that structures a problem, represents and quantifies its elements, relates those elements to goals, and facilitates evaluation of alternative solutions. It is a special type of the Analytic Network Process which allows both interaction and feedback within clusters of elements (inner dependence) and between clusters (outer dependence). Such feedback best captures the complex effects of interplay in human society, especially when risk and uncertainty are involved. It is used globally in a wide variety of decision-making situations in fields such as government, business, industry, healthcare, and education[6].

There are three steps when using the process to derive weights for indicators under the environmental liveability index:

- *Structure the issues* within a hierarchy. Typically an AHP hierarchy consists of an overall goal at the top, a group of options or alternatives for reaching the goal at the bottom, and a group of criteria that relate the alternatives to the goal in the middle. In this report, the APH is used to weigh sub-indices and indicators**.**
- To derive the weights, *evaluate the importance of various criteria* in the hierarchy by introducing pairwise comparisons. The sub-indices will be compared to how important they are to decision makers.
- *Derive weights* for each indicator based on these *judgments*, and then test the system.

In terms of the sub-indices, the weight of the atmospheric environment is the highest, 0.17, domestic livability comes second with 0.16, water environment and water resource are both in third place with 0.14, then environmental management and Ecological environment follow with weights of 0.13 and 0.10, and acoustic environment is the lowest, at only 0.07.

4. Application of Environmentally Livable Index

4.1 How to use ELI

The Environmental Livability Index can be used for environmental performance, identification of environmental issues; city comparison, and financial and investment policy analysis. Testing application includes the following steps: ***a. Select pilot cities*****:** 33 cities are selected for city comparison analysis and around 5 cities for detailed trend analysis; ***b. Determine benchmarks/targets of indicators*****:** For the most of indicators describing “state” such as air, water quality indicators, environmental quality standards can be used as benchmarks, and the targets for policy relevant indicators or indicators for representing society responses are normally set up in various environmental, social and economic development plan; regards some indicators that may not have any standards or targets, some standardization approaches may be used, for example, by using average level of all the targeted cities or international average level as benchmarks; ***c. Analysis and Presentation*****:** The analysis will include comparison and trend analysis. ***d. Planning***

and investment policy implication: This step will discuss how to use the analytical results by applying the index for environmental strategy planning and investment prioritization. *e.* ***Verification*:** Officials from some of the selected cities will be invited to discuss and verify the application of the index. The index system may be modified based on the comments from those city representatives.

4.2 Ranking and PSR analysis of ELI

4.2.1Composite urban environmental livability index

Figure 2, which ranks 33 major Chinese cities according to their environmental livability indices, demonstrates that the ELI is generally higher in southern China, eastern coastal cities and economically developed regions and lower in the north, northwest and less-developed regions. For example, Ningbo, Beijing, Qingdao, and Dalian score better than Taiyuan, Lanzhou, and Harbin. The index is also higher in cities with good natural conditions or large environmental capacity such as Kunming, Xiamen and Hangzhou. Of China's megacities, Beijing has a higher ELI than Shanghai and Guangzhou.

4.2.2Pressure-State-Response Analysis of Urban Water ELI in China

Figure 4 demonstrates the pressure-state-response of different cities. It shows for example that Lanzhou has the highest water environmental pressure and Qingdao the lowest; Ningbo has the best water environmental state and Shenzhen the worst; Zhengzhou has the best water environmental response and Xining the worst.

There is a positive correlation between water environmental condition and response, with cities suffering poor water quality showing a stronger response than those with good water quality. Urban water environmental pressure is affected by upstream pressure as well as local discharge, so the pressure index does not correlate well with the state and response indices.

The water environmental state in cities with low pressure is better in those with high pressure. Cities with poor water environmental state, such as Qingdao, Shenyang and Hefei, have a high response rate, indicating that they attach great importance to protection and treatment of water. Some cities that earned average ratings for environmental pressure and response are rated relatively strongly for environmental state thanks to their naturally high water environmental capacity. Examples include Shanghai and Haikou.

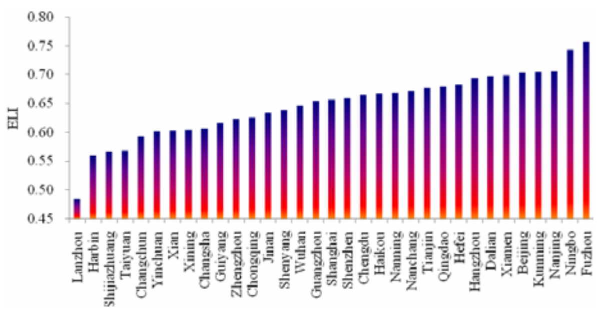


Figure 2 Urban ELI in China

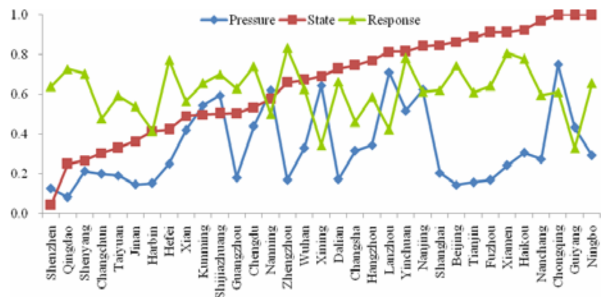


Figure 3 PSR Analysis of urban water ELI in China

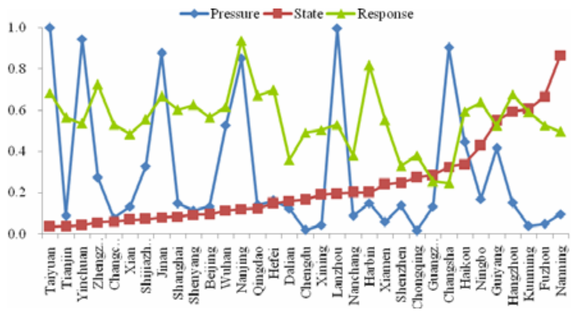
4.2.3 PSR analysis of urban water resource ELI in China

Figure 4 demonstrates the pressure-state-response data for urban water resources. It shows that Taiyuan has the highest water resource environmental pressure and Chongqing the lowest; Nanning has the best water resource environmental state and Taiyuan worst; Nanjing has the best water resource environmental response and Changsha the worst. Of China's megacities, Beijing, Shanghai and Guangzhou all have high water resource pressure. Guangzhou's response is lower than that of Beijing and Shanghai but its state is higher.

In general, pressure and state are positively correlated. This is exemplified by cities such as Taiyuan, Yinchuan, Jinan and Nanjing. Water resource response and state are also positively correlated, as exemplified by Nanning and Fuzhou.

4.2.4 PSR analysis of urban atmospheric ELI in China

Figure 5 shows that Xining has the highest atmospheric pressure and Haikou the lowest. Haikou, however, has the highest atmospheric environmental state, and Urumchi the lowest. Lanzhou scores highest in terms of response and Haikou scores lowest. Of China’s megacities, Shanghai has a lower atmospheric response than Beijing and Guangzhou. Cities such as Haikou, and Fuzhou with low pressure rank well in terms of environmental state but poorly in terms of response. Those under high pressure, such as Shijiazhuang, Taiyuan and Chongqing, tend to rank poorly in terms of atmospheric state. Some cities where pressure is relatively low (such as Chengdu and Changsha) nonetheless rank poorly with regard to atmospheric quality because of their weak response.



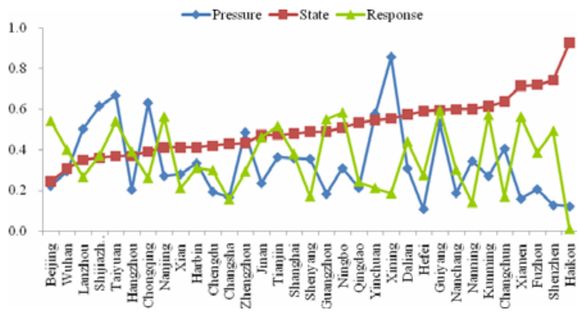
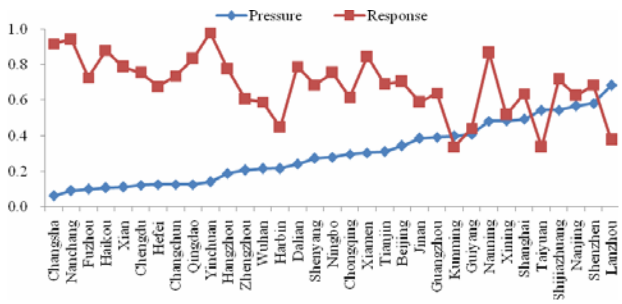


Figure 4 PSR analysis of urban water resource ELI **Figure 5 PSR Analysis of urban atmospheric ELI**

4.2.5 PR analysis of Livability Index in urban solid waste in China

According to Figure 6, Lanzhou has the highest solid waste discharge pressure and Changsha the lowest. Changsha has the strongest disposal response and Kunming and Taiyuan the weakest. Of China’s megacities, Beijing’s discharge pressure is higher than Shanghai’s or Guangzhou’s but its response is also higher.

In general, as discharge pressure increases, environmental response capacity decreases. Some cities such as Lanzhou have substantial solid waste pressures but very weak response capacities. These cities must enhance their ability to use, treat and dispose of urban solid waste to improve their environmental livability index.



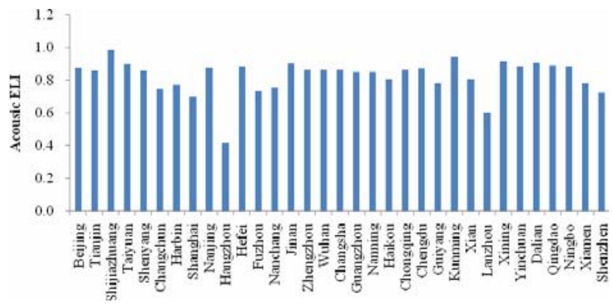


Figure 6 PR analysis of urban solid waste ELI **Figure 7 Ranking of urban noise ELI**

4.2.6 Urban Noise Environmental Livability Indices in China

Figure 7 ranks noise levels for the cities studied. Shijiazhuang ranks the highest and Hangzhou the lowest. Of China’s megacities, Beijing has a higher noise environmental livability index than Guangzhou or Shanghai. In general, compared with the other environmental indices discussed in this report, urban acoustic environmental livability in China is high, with the index mostly above 0.6, indicating reasonably good livability in most cities.

4.2.7 Comparative Performance Review of other Environmental Livability Indices in China

Due to the page space limits, the paper cannot list all figures for the evaluation results of Urban ecological environment index, Urban domestic livability and Environmental Management Index. The main comparative performance review conclusions are as follows：

- *Ecological environmental livability indices*: Nanjing is ranked highest and Shijiazhuang lowest. Of megacities, Guangzhou and Beijing rank higher than Shanghai. Ecological environmental problems are serious in Xi'an because of its high population density and ground water depletion.
- *Domestic livability indices*: Nanjing is ranked the highest and Harbin the lowest. Of megacities, Shanghai and Beijing have a higher domestic livability index than Guangzhou. In general, urban domestic livability in the economically developed southern regions (such as Nanjing and Hangzhou) is higher than in northern cities (such as Harbin and Lanzhou).
- *Environmental management livability indices*: Nanjing has the highest livability index in China and Changsha the lowest. Of megacities, Shanghai and Beijing rank more highly than Guangzhou. In general, economically developed regions, such as Nanjing, Beijing, Tianjin, and Chongqing, rank relatively well, indicating that they invest in environmental protection and attach importance to urban environmental management. Some cities (Qingdao and Haikou for example) that rank highly with regard to environmental livability rank poorly for environmental management. Such cities should increase investment in environmental protection and strengthen environmental management in order to raise overall urban environmental livability.

4.3Trend analysis in major cities

From 2000 to 2007, environmental livability in Beijing, Shanghai, Guangzhou, Wuhan and Shenyang rose consistently, as shown in Figure 8. Table 1 compares the five cities, showing their index values and rankings for the years 2000, 2003, 2005 and 2007. Guangzhou recorded the highest improvement rate (45.4%). Over the period, environmental livability in Guangzhou, Beijing and Wuhan rose significantly. Growth in Shanghai and Shenyang was slower.

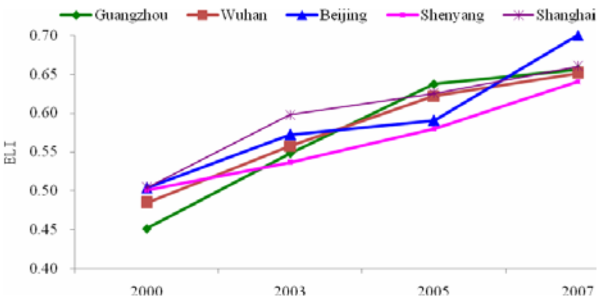


Figure 8 Trend analysis of ELI of major cities

Table 1 Ranking comparison of ELI of major cities

City	2000		2003		2005		2007		Increment Rate (2000 to 2007)/ %
	Index	Ranking	Index	Ranking	Index	Ranking	Index	Ranking	
Guangzhou	0.45	5	0.55	4	0.64	1	0.66	3	45.4
Wuhan	0.48	4	0.56	3	0.62	3	0.65	4	34.4
Beijing	0.50	2	0.57	2	0.59	4	0.70	1	32.9
Shenyang	0.50	3	0.54	5	0.58	5	0.64	5	27.8
Shanghai	0.50	1	0.60	1	0.63	2	0.66	2	24.3

4.3.1Beijing

Figure 9a shows that in 2000 the main environmental problems in Beijing were in the areas of water environment, water resources, air quality and solid waste. By 2007 (Figure 9b) its water environment index had risen from 0.43 to 0.82, water resources from 0.32 to 0.49, air quality from 0.23 to 0.52 and solid waste from 0.42 to 0.68, rising by 91.2%, 51.8%, 125.3% and 62.4% respectively. Despite these improvements, water resource and air quality indicators remain poor because Beijing has low per capita water resources, high concentrations of nitrogen oxide and limited ability to remove these. To tackle such problems, Beijing should strengthen water resource management and air quality controls.

4.3.2Shanghai

Figure 10a shows that Shanghai's major environmental problems in 2000 related to water resources and environment, and air quality. All had improved markedly by 2007, as shown in Figure 10b. However, water resource and air quality remained weak when compared to other indicators because of Shanghai's low per capita water resource base, heavy sulfur dioxide pollution and limited ability to remove pollutants at source. Solid waste and ecological indices during the seven-year period fell by 15.7% and 24.6% respectively as urban domestic waste production increased but treatment capacity lagged behind. Shanghai must therefore focus attention on water resources, air quality, and the management of solid waste.

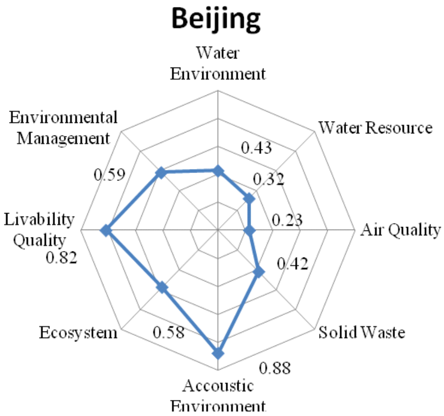


Figure a

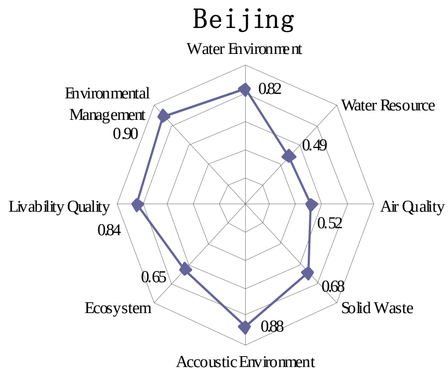
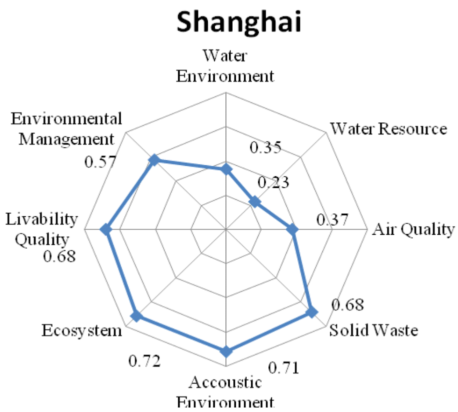


Figure b

Figure 9 Trend analysis for Beijing



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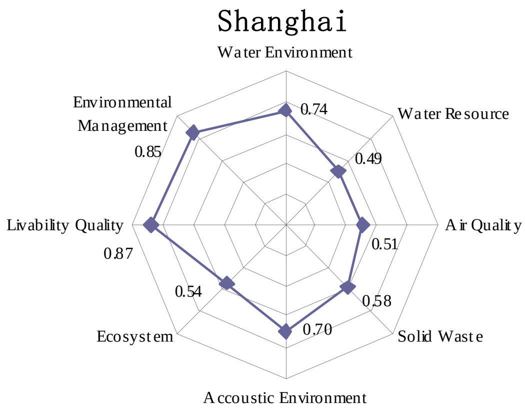

Figure b

Figure 10 Trend analysis for Shanghai

4.3.3Guangzhou

Figure 11a indicates that in 2000 Guangzhou's water environment, water resource, air quality, solid waste and environmental management indices were all low. By 2007, as shown in Figure 28b, many of these indicators had risen substantially: water environment, water resource, air quality, solid waste and environmental management indices had risen by 101.9%, 82.1%, 68%, 58.3% and 82.3% respectively. The city's water resource indicator remains low because Guangzhou has low per capita water resources and low water recycling rates. Further work is needed in this area.

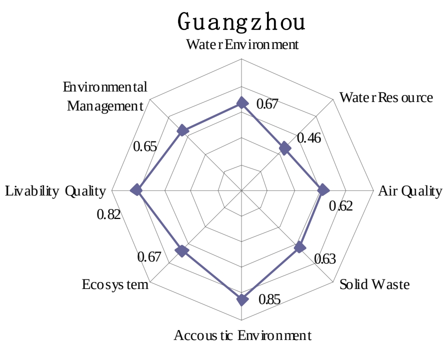

Figure a

Figure b

Figure 11 Trend analysis for Guangzhou

From 2000 to 2007, Guangzhou's ecological environmental livability indicator dropped significantly, showing that the city must also pay more attention to ecological environmental management.

4.3.4Wuhan

Figure 12a demonstrates that Wuhan's key environmental problems in 2000 were related to its water environment, water resources and air quality. By 2007, as shown in Figure 12b, it had recorded significant improvements in all of these areas, most particularly in relation to water environment (where the index climbed by 218%).

Nonetheless, Wuhan's water resource and air quality indicators remain low because of low per capita water resources, heavy sulfur dioxide and particulate pollution, and its limited ability to treat nitrogen oxides. Wuhan must continue to focus on the management of water resources (by advocating for more economical use of water and encouraging improved water circulating utilization rates) and strengthen the treatment of atmospheric pollution.

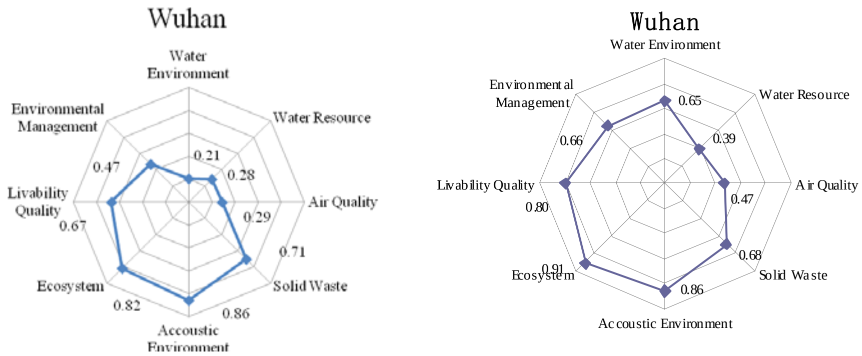

Figure a

Figure b

Figure 12 Trend analysis for Wuhan

4.3.5Shenyang

Figure 13a shows that in 2000 the main environmental problems facing Shenyang related to its water environment, water resources and air quality. By 2007, indicators in all of these areas had improved, with particularly strong growth in water environment (150%). When compared with other cities, however, indicators are weak thanks to Shenyang's poor surface water quality, low per capita water resources, high sulfur dioxide and particulate concentration, and limited ability to remove major atmospheric pollutants.

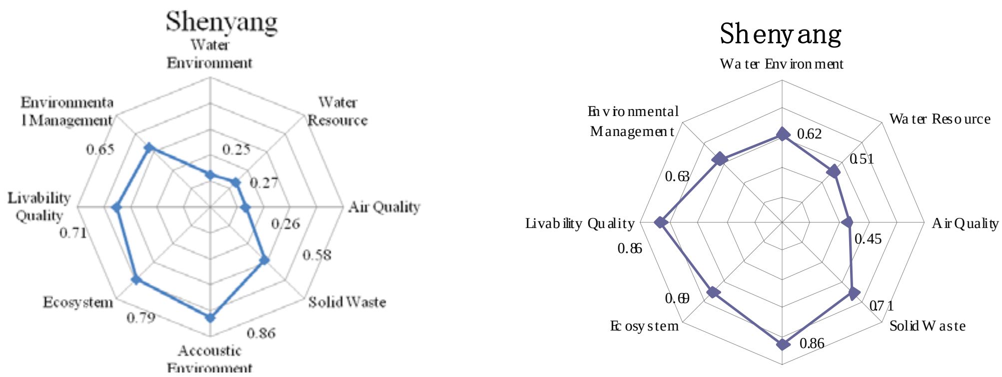

Figure a

Figure b

Figure 13 Trend analysis for Shenyang

Its ecological environment and environmental management indices dropped over the study period by 13.3% and 3.81% respectively due to rising groundwater exploitation and insufficient investment in protection of the urban environment. Shenyang must increase investment in environmental protection and continue to focus on improving its water environment, water resources, air quality controls and ecological environment.

4.4 Effect of urban environmental investment on environmental state

4.4.1Relationship of ESI, EPI and EII in major cities

Urban environmental quality is mainly affected by environmental pressure and the level of environmental pollution control，the paper had an analysis about the relationship among ESI, EPI and EII. As shown in Figure 13, ESI has a positive correlation with EPI and a negative correlation with EII in most cities. Figure 14 shows that the environmental pressure of megacities as Beijing, Shanghai, Tianjin, Guangzhou and Shenzhen are almost equivalent. Although environmental protection investment index in Guangzhou and Shenzhen is lower than that in the other cities, their environmental state is better than Beijing, Shanghai and Tianjin.

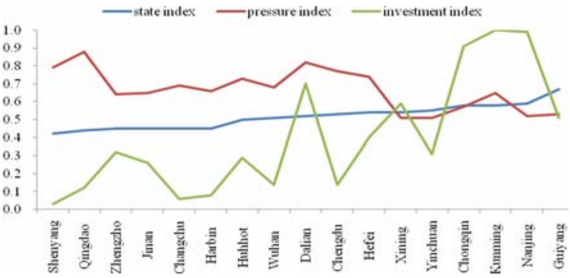

Figure 13 ESI, EPI and EII of major cities

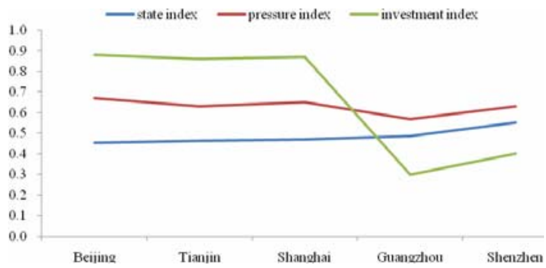

Figure 14 ESI, EPI and EII of megacities

4.4.2 Effect of urban environmental investment

Using the data of 33 cities, urban environmental state index S is dependent variable and urban environmental pressure index P and urban environmental investment index F are independent variable, the following linear model is established:

$$S=0.678F-0.413P+0.549 \quad (1)$$

The test result of the above model shows that R^2 of the model is 40%, indicating that 40% environmental state change can be explained by the variables of environmental pressure and environmental protection investment; both model and coefficient passed the significance test. At the same time, it is known from the residual plot that standardized residual does not have heteroscedasticity and there is not a linear relation between residual and the variable of environmental state, which conforms to the assumption of the model. The model reveals the following conclusion:

- EPI has a negative correlation with with ESI of urban environmental quality. As urban environmental pressure increases, environmental state falls and its marginal influence coefficient is 0.413.
- EII has a positive correlation with ESI of urban environmental quality. As urban environmental protection investment increases, environmental quality rises and its marginal influence coefficient is 0.678.
- It is known from the model that although the absolute value of the variable coefficient of environmental protection investment is greater than that of the variable coefficient of environmental pressure, the absolute value of its standardization coefficient is smaller than that of the environmental pressure coefficient, indicating that the influence of environmental pressure variable on urban environmental state is greater than environmental investment coefficient. Therefore, the emphasis of present urban environmental protection investment should be still put on the reduction of pollution emission, i.e. that mitigating urban environmental pressure and reducing pollution emission are still the priority tasks of most Chinese cities. Invest on the comprehensive

cleaning and beautification of urban environment and further improvement of environmental quality should be on the second place.

5. Conclusions

The environmental liveability index is a useful tool for assessing liveability, monitoring trends, policy analysis and planning, and communicating to the public, but it can do these things only if it is integrated into China's environmental management framework. However, its practical application still has a long way to go due to the effectiveness of ELI itself and the possible political barriers.

5.1Functions and potential applications

Based on a combination of PSR model and theme based approach, environmental livability indicators are proposed and weights for aggregating these indicators into a composite index are established. Further, the test application of the ELI is carried out for 33 PRC cities including Beijing, Shanghai, Taiyuan and Lanzhou etc. The application demonstrates how the environmental livability indicators and its aggregated index (ELI) can be used for (i) providing a tool for assessing the currently environmental livability status and for identifying priority environmental issues related to city livability; (ii) monitoring environmental pollution control and natural resource management trends, and (iii) hereby providing a basis for analyzing the effectiveness of the past and current environmental policies; (iv) comparing or ranking environmental performance among the selected cities, which may spur pressure on local government for improving the city environmental livability; (v) providing a baseline or advice for policy making or environmental planning such as environmental investment plan; (vi) facilitating public communication.

5.2Shortcomings of the Current ELI system

Although the test application shows that the ELI system can be used as a tool for environmental livability evaluation and policy analysis, but there are many methodological uncertainties regarding establishing ELI and institutional barriers for applying ELI for policy making. The methodological uncertainties include: (i) The aggregated ELI and its indicators are usually constructed in a manageable size by scarifying details. Further some of aspects on environmental livability may not be measurable in a quantitative way. Policy analysis and making are normally required to fully understand the phenomenon or issues, which may require other qualitative and scientific information such as driving forces and natural background for explaining trends or issues, therefore the ELI system should be used as only one of tools, that is, as a tool for helping reveal trends and draw attention to problems that require further analysis and possible actions. (ii) Implicit assumptions in selection of indicators and calculation of weights. These indicators and weights needs to be further tested and verified in the future applications.

The institutional barriers are: (i) data availability and data quality. The data availability and data quality is a critical issue for applying the ELI system. For current testing application, data comes from different sources. Some of data are from research reports, that means these data are not regularly measured, also most of data are not available for medium and small cities. The data availability has made problems in selection of appropriate indicators, which may result in failing to measure important aspects of environmental livability and also it limits the possibility of applying it in small and medium cities. Lack of data availability and data quality will cause problems to give unbiased or complete picture of environmental livability, that may lead to serious problems on policy decision. (ii) benchmarks and targets. Environmental standards and national environmental planning target can be used as benchmarks and targets for some of the indicators, but it is difficult to define a common recognized benchmarks and targets for standardizing some of the indicators such as emission per GDP etc.

5.3Future Directions

International Experience shows that indicators similar to environmental livability indicators are cost-effective and powerful tools for tracking environmental progress, providing policy feedback and measuring environmental performance. Also the testing application shows the potential possibility of applying these indicators for PRC city environmental improvement. However, international experiences and this testing application also shows that development of the ELI is a dynamic process, which means that the ELI requires constant improvement through its future application and within the improvement of the data availability and data quality. Number of future works both technical and institutional are recommended as follow:

- Establishment of monitoring and data collection system. Data availability and data quality are critical for applying the ELI system. It is suggested to set up a designated department for the monitoring and data collection or assigned it to an existing department within current environmental organization, at the national and city levels, in cooperation with other relevant institutions such as economic and statistical institutions. The department at the national level will provide standardized measurement approaches and ensure the collected data are comparable. The local level departments will be responsible for monitoring and collecting data and timely reporting the data to the national level.
- Promotion of its application in PRC cities and continuous improvement of the ELI indicators system. To promote its application, a demonstration and training problem is strongly suggested as a follow up program for demonstrating and training city governments on the application of the ELI system for monitoring, evaluation of environmental livability and improving their policy analysis capability by using the ELI system. The feedback from these demonstration and training program will be used for further improving the ELI system.
- Linking to the five-year plan. Environmental five-year plan is a key tool for national and local environmental protection. In principle ELI can provide methodologies for identifying environmental issues, evaluating the effectiveness of the five year plan and providing indicators to monitor and evaluate the implementation of the five year plan. However further work needs to be done on how the ELI can be used as a tool for environmental five year plan and performance evaluation
- Propose benchmark-linked investment assessments with ELI system. There are three main types of environmental protection investment in China. In: (i) the construction of urban environmental infrastructure; (ii) the treatment of long-standing industrial pollution sources; and (iii) environmental protection of new projects. However, the absence of a unified definition of, or statistical methodology for, environmental protection investment damages data accuracy and creates problems when choosing assessment indicators and methods to measure the effects of this investment. So the presented analysis in section 4.4 is still at elementary and rough stage and more efforts should be exerted both for data gap and analytic methodologies.

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