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Quantitative study of eco-city in Northwest China

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Abstract

This paper responds to challenges made by city issues. A sustainable city is one that relates social ,environment and economic. Based on the three areas of social progress, environmental protection and economic development, the paper gives the compound system model of eco-city construction. Methods of Factor Analysis are used to establish a evaluation system of comprehensive developmental level of eco-city construction level in china and measure the level of eco-city construction level in china. Thus conclusions were drawn:(1) most cities in China are improving in the eco-city construction level with time, but the spatial differences is still exist , especially Central and Eastern is better than Western. (2) Xi'an ranking the first in 2005 to 2007, second in 2008, showed a slight decrease in the overall state; Lanzhou ranking third in 2005 and2006, ranking the final in 2007and 2008, State of the overall downward; Xining ranking the final in2005, fourth in 2006 and 2007, third in 2008, the overall condition was improving; Yinchuan ranking second from 2005 to 2007,first in 2008, the overall condition was improving; Wulumuqi ranking in fourth 2005 and 2008, the final in 2006, second in 2007, the overall state was fluctuating.

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Key words: Sustainability; Eco-city; Social progress; environment protection; economic development ; Regional differences

1. Introduction

The sheer numbers of people and diversity of activities in the world's cities means that we are in evitably major consumers of environmental resources and producers of massive waste streams. It is generally agreed (e.g. [1]) that there are not enough resources and not enough space for all the world's citizens to live like those in today's developed countries. However, it is also believed (e.g. [2]) that a better quality of life for those in the developing world is a necessary condition for sustainability. In

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today's world, with the increasing realization of environmental challenges and limits to the availability of resources, a new goal for urban design is emerging—that of the 'sustainable city'. Cities are an increasing focus of sustainability. They are many things to many people, and may ultimately be regarded as the best environmental choice for human settlement [3].

Urban research concerning so-called 'ecological cities' has introduced several definitions—e.g. 'eco-city' and 'ecopolis'—for urban areas that aim to cause minimum human disturbance to the natural environment (e.g. in Finland, see [4]; [5]). The term 'eco-city' is relatively new, but is based upon concepts that have existed for a long time. In 1975, Richard Register and a few friends in Berkeley, CA, founded Urban Ecology as a nonprofit organization to "rebuild cities in balance with nature". Since then, the organization has participated with others in Berkeley to build a 'Slow Street,' to bring back part of a creek culverted and covered 80 years earlier, to plant and harvest fruit trees on streets, to design and build solar greenhouses, to pass energy ordinances, to establish a bus line, to promote bicycle and pedestrian alternatives to automobiles, to delay and possibly stop construction of a local freeway, and to hold conferences on these and other subjects[6].

China has been experiencing large scale and high speed development of urbanization and industrialization since 1978 with annual GDP increase rate of 9.67% and urban population ratio from 18% in 1978 to 45.7% in 2008. The pace, depth, and magnitude of this transition, while beneficial to local people, has placed severe human ecological stresses on both local and regional life-support ecosystems. China is basically an inland country with more than two thirds of its territory as mountain or hilly areas and densely populated with one fourth of the world population. To survive from the marginal environment, people have to understand and efficiently use the eco-complex and take the strategy of accordance with rather than against nature[7]. There is a great concern that if China is going to develop in the same way as it did in the last two decades, could China's economic prosperity be sustainable? What the implications would be to China's natural resources and environment? Might this development lead China to a disastrous ecological consequence and eventually social instability? To answer these strategic questions, there is a need to systematically investigate the relationships between economy, environment and society in China in the last two decades. In particular there is a need to examine the environmental and social costs China has sacrificed to its economic growth in the past. Based on these studies, our fundamental objective is to identify whether there is a path way that will lead China to a more sustainable development track[8].

To summarize, sustainability requires maintaining an adequate per capita stock of social, environmental and economic assets for use by future generations and avoiding irreversible damage to any single significant asset.

2. Study area

Gansu is located in China's geographical center, at the juncture of the Loess Plateau, Inner Mongolia Plateau, and the Qinghai Tibet Plateau. Shanxi Province is to the East; Qinghai is to the Southwest, respectively. The Xinjiang Uyghur Autonomous Region is Northwest; The Ningxia Hui Autonomous Region border it on the Northeast[9]. In order to facilitate comparison with other cities, the paper selected 33 cities, including 31 capital cities, municipalities and autonomous regions district government, the other two as Shenzhen and Qingdao (Fig. 1).

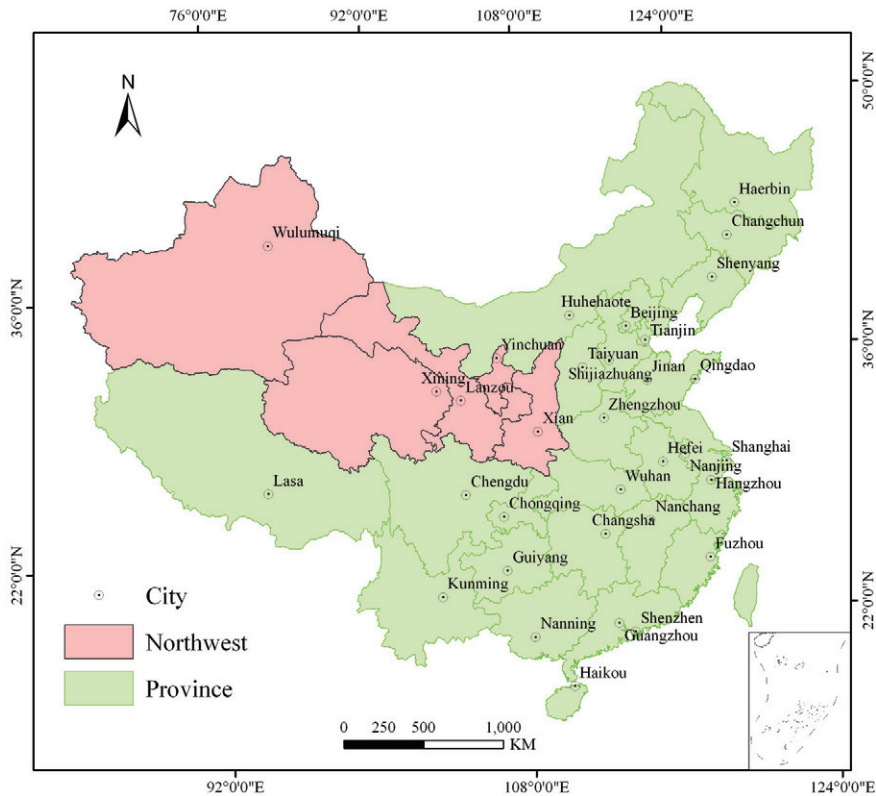


Fig. 1. The location of 33 chosen local areas in China.

3. Study methods and data

Factor analysis (FA) and principal-components analysis (PCA) are two important multivariate statistical analysis methods. The two methods are often used together for data reduction by structuring many variables into a much smaller number of components or factors. The techniques are particularly useful for eliminating variable collinearity and uncovering latent variables[10]. Factor analysis refers to a variety of statistical techniques whose common objective is to represent a set of variables in terms of a smaller number of hypothetical variables [11]. Factor analysis of the core is that less factor independent of each other reflected most of the information in the original variables. Urban ecosystem is a large system, including the factors are many, and it can not be exhaustive evaluation of the ecology, we must choose in which a number of factors as evaluation index. The principle of selection of indicators should be noted that factors of comprehensive, representative, hierarchy, rationality and reality. China promulgated Ecological County, Ecocity, Eco-province Construction Index (Trial) in 2003, eco-city construction is given indicators, the specific provisions on economic development, environmental protection and social progress of three categories of indicators, issued in 2007 years of Ecological County, Ecocity, Eco-province Construction Index (Revised) Construction of ecological indicators of the city have been adjusted and revised. Based on our understanding of the meaning of ecological city and to fully take into account the statistical analysis of the data can be collected, we selected a total of 16 indicators to measure eco-city construction in China situation in Table 1.

Tab.1. Evaluation index system for cities in china

Social progress	Environmental Protection	Economic Development
Population density (persons / sq km)	waste water discharge of industrial (million tons)	GDP (billion yuan)
Library collection every hundred (volumes)	sulfur dioxide emissions of industrial (tons)	per capita GDP (yuan)
per million college students (people)	soot emissions of industrial (tonnes)	the proportion of tertiary industry in GDP (%)
per capita power consumption (kWh / person)	per capita green area (square meter)	Investment in real estate development accounted for the total social fixed asset investment share (%)
expenditure of food (yuan)	sewage treatment rate of urban (%)	
	harmless treatment rate of domestic garbage (%)	
	The Built-up area green coverage (%)	

The data sources were mainly collected from Yearbook of Chinese Cities in 2006 – 2009, Yearbook of Chinese cities (towns) life and price in 2006 – 2009 and Statistical Yearbook of China's regional economy in 2006 – 2009 published by China Statistics Press.

4. Conclusion and discussion

Using statistical software SPSS16.0, we analysis the index data in construction of ecological city of china respectively with factor analysis and with principal component extraction of common factors and the sub-composite score, and sort the total score (Fig 2, Fig 3, Fig 4, Fig 5).

It can be seen from Figure 2, Figure 3, Figure 4 and Figure 5: With time, most cities in China are improving in the eco-city construction level, but the spatial differences is still exist , especially Central and Eastern is better than Western.

It can be seen from Fig 6 :

- (1)Xi'an ranking the first in 2005 to 2007, second in 2008, showed a slight decrease in the overall state;
- (2)Lanzhou ranking third in 2005 and 2006, ranking the final in 2007 and 2008, State of the overall downward;
- (3)Xining ranking the final in 2005, fourth in 2006 and 2007, third in 2008, the overall condition was improving;
- (4) Yinchuan ranking second from 2005 to 2007, first in 2008, the overall condition was improving;
- (5)Wulumuqi ranking in fourth 2005 and 2008, the final in 2006, second in 2007, the overall state was fluctuating.

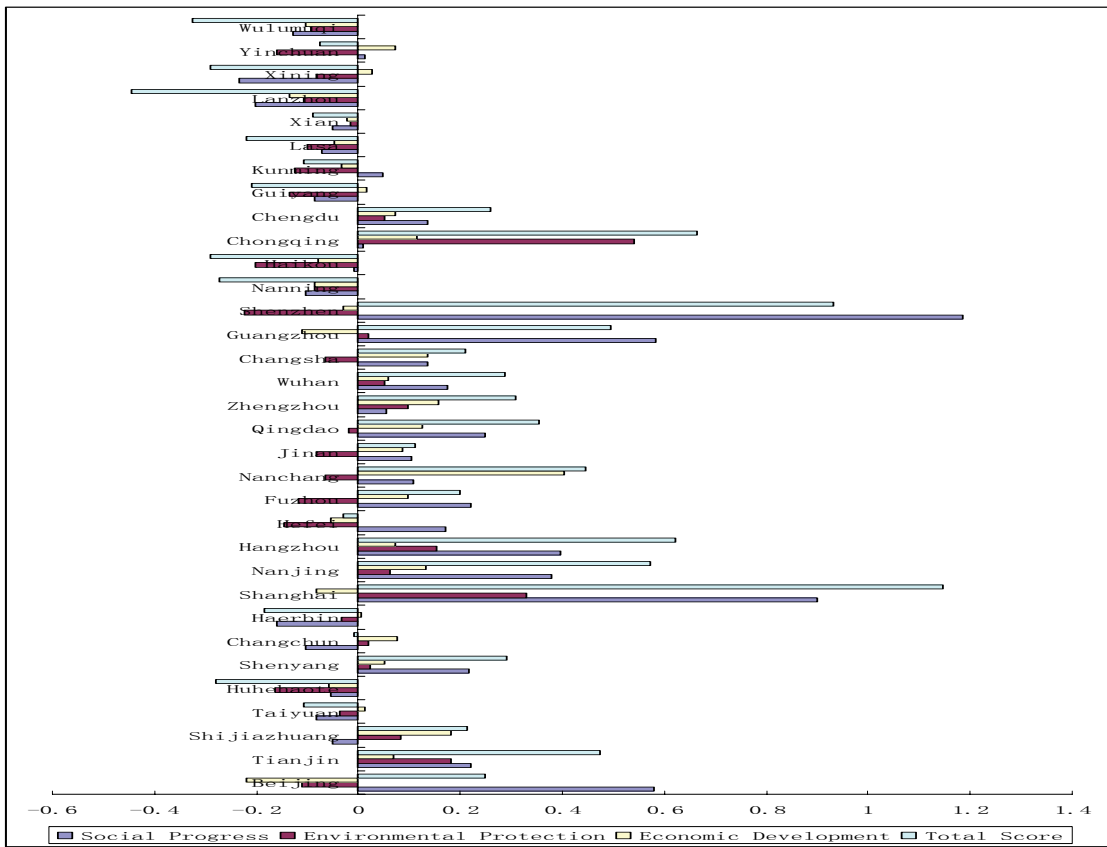


Fig.2. Every factor and total scores of ecological city construction level in 2008

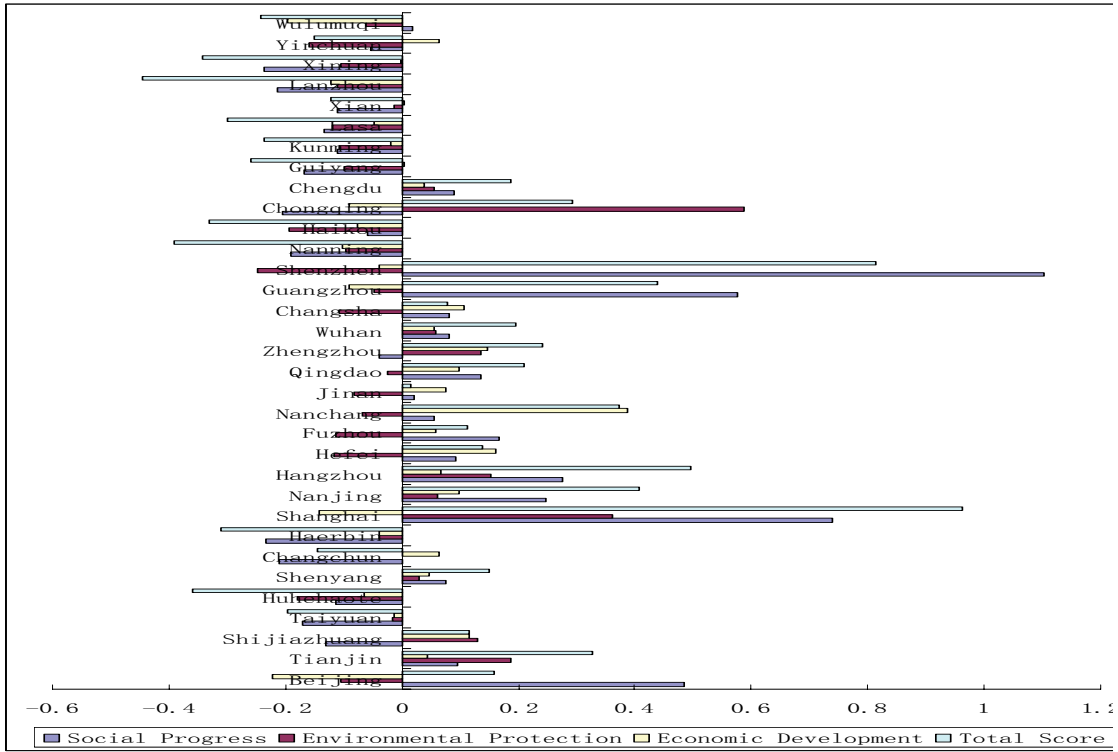


Fig.3. Every factor and total scores of ecological city construction level in 2007

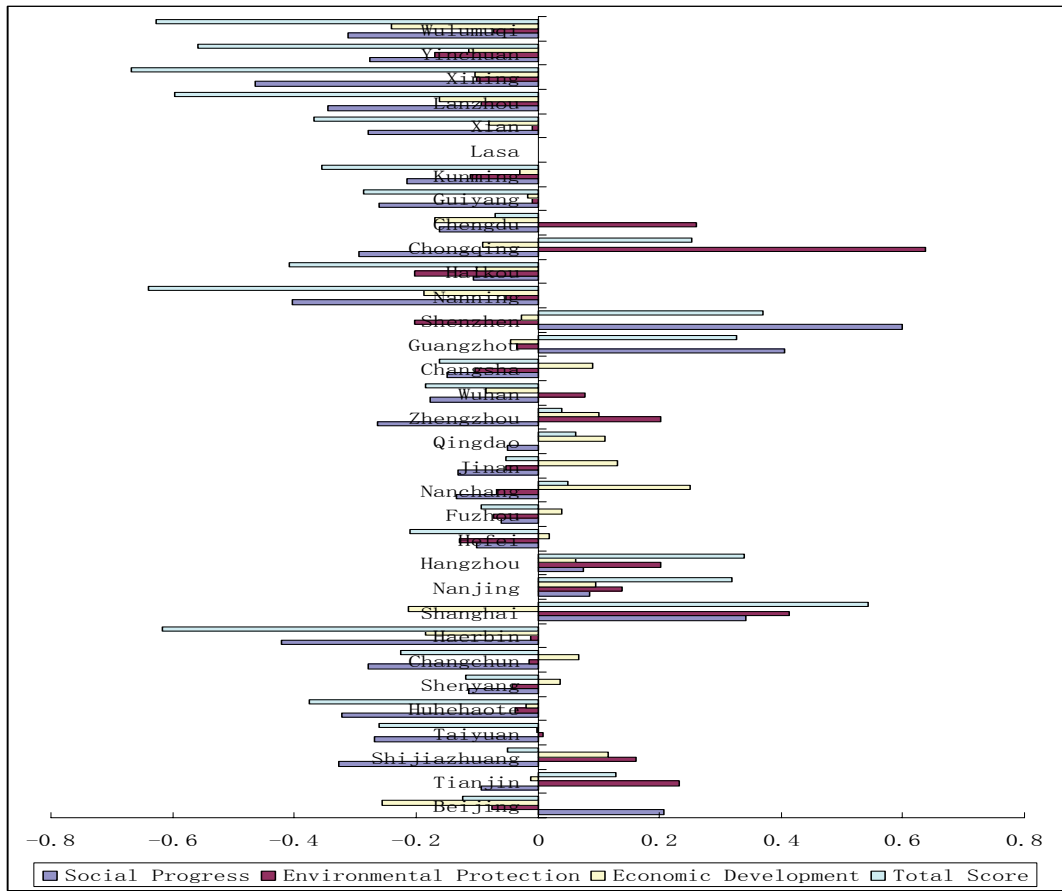


Fig.4. Every factor and total scores of ecological city construction level in 2006

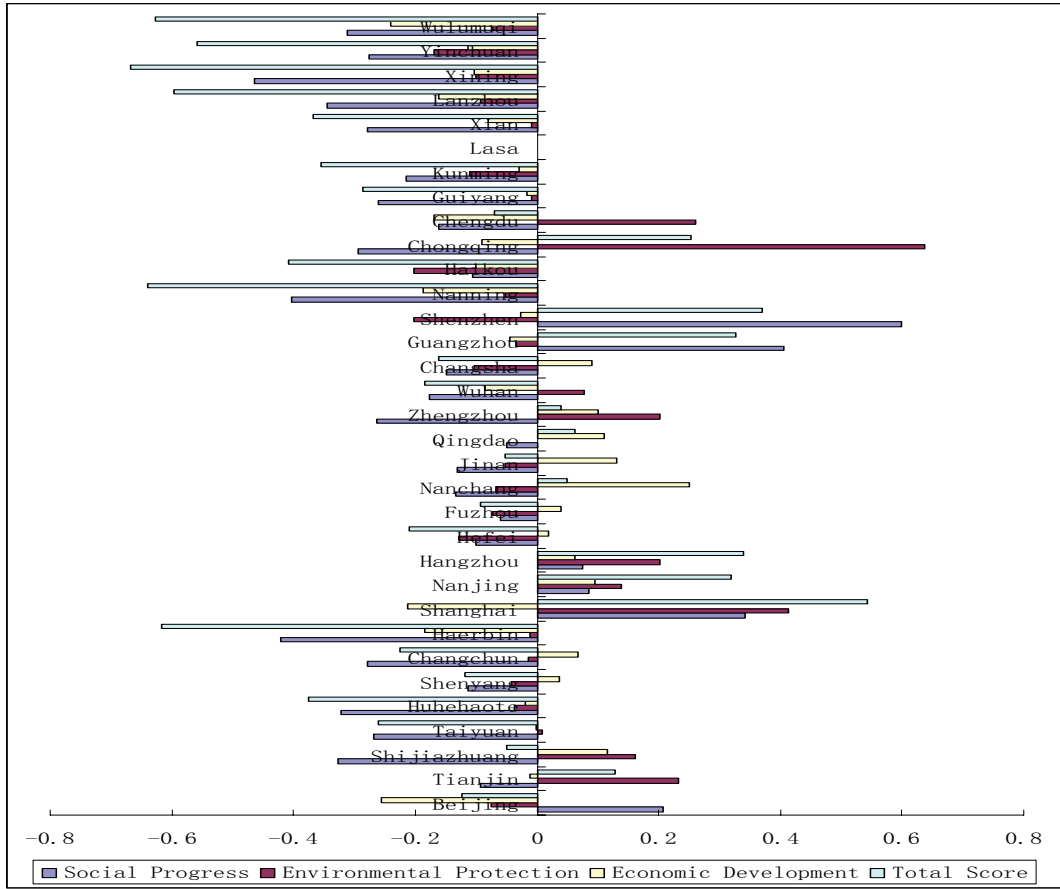


Fig.5. Every factor and total scores of ecological city construction level in 2005

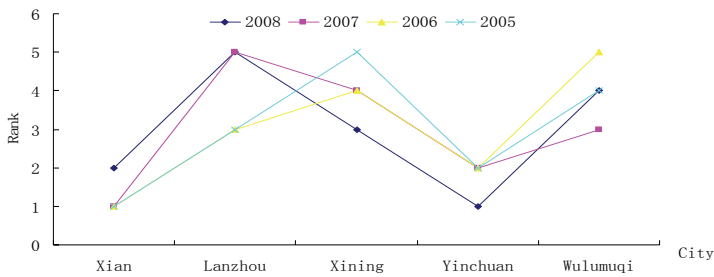


Fig.6. Northwest ranking of capital construction of ecological city

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