



The evaluation of environmental capacity: Evidence in Hunan province of China



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ABSTRACT

Environmental capacity paves the foundation for sustainable economic development. As the vital growth pole in the Rise Strategy of Central China, the environmental and economic construction of Hunan province proves to have enormous demonstration effect. In order to better understand the environmental condition in Hunan province, this study combines the information entropy theory and ecological comprehensive index to measure the environmental capacity of 14 administration divisions in Hunan province and 30 provinces across China in 2013. The results indicate that, first of all, the average environmental capacity of 14 administration divisions in Hunan province is relatively lower, i.e., 0.39. Second, Chang-Zhu-Tan city cluster in Hunan province exerts limited radiative and guiding effect on its surroundings; in particular, Xiangtan possesses a notably lower environmental capacity than other two cities, which hampers the integration process. Third, among the four types of environmental capacities concerned, i.e., population capacity, land capacity, resource capacity and waste assimilative capacity, waste assimilative capacity takes up the biggest weight, i.e., 0.31, indicating the most important role in environmental improvement. Finally, the environmental capacity of Hunan province ranks the 24th among the 30 provinces in China and the last in central China. Hunan should pay special attention to the expansion of waste assimilate capacity, so as to promote the overall environmental capacity.

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1. Introduction

Environmental protection is one of the dominant themes of nowadays development across the world, and a permanent topic closely related to the survival of mankind. Facilitating the establishment of ecological civilization, improving the supervision system of ecological environment and strengthening the pollution control capabilities are atop the agenda of China's transition and sustainable development, as well as crucial measures to accommodate the "New Normal" proposed by the new political leaders in China. With China's economy stepping into the "New Normal" phase, China will still be in the stage of accelerating development of industrialization and urbanization in a relatively long time,¹ which may lead to huge amount of energy consumption and related CO₂ emissions as well (Zhang et al., 2014; Wang et al., 2014). As a result, the current rough economic development mode, which is at the

expense of environment quality, may impede China's transition to green, cycle and low-carbon development. Therefore, China should give uppermost priority currently to enhance the energy conservation and emission reduction, accelerate the ecological civilization construction, improve the environmental regulation mechanisms and promote the economic transition.²

Hunan province is located in the south of China's mainland and the middle of Yangtze River field (see Fig. 1), which acts as a bridge between the east coast and west inland provinces. Due to the distinctive location advantage, Hunan province has become one of the key regions to implement the Rise Strategy of Central China proposed by China's central government in 2004.³ In 2007, China's central government entrusted Hunan province the important mission to explore the resource-saving and environment-friendly development pattern, as well as to drive the economic transition in central China.

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¹ http://www.nea.gov.cn/2015-03/05/c_134039005.htm

² <http://sc.cqn.com.cn/huanbao/339325.html>

³ http://www.legaldaily.com.cn/locality/content/2014-03/12/content_5355096.htm?node=31243

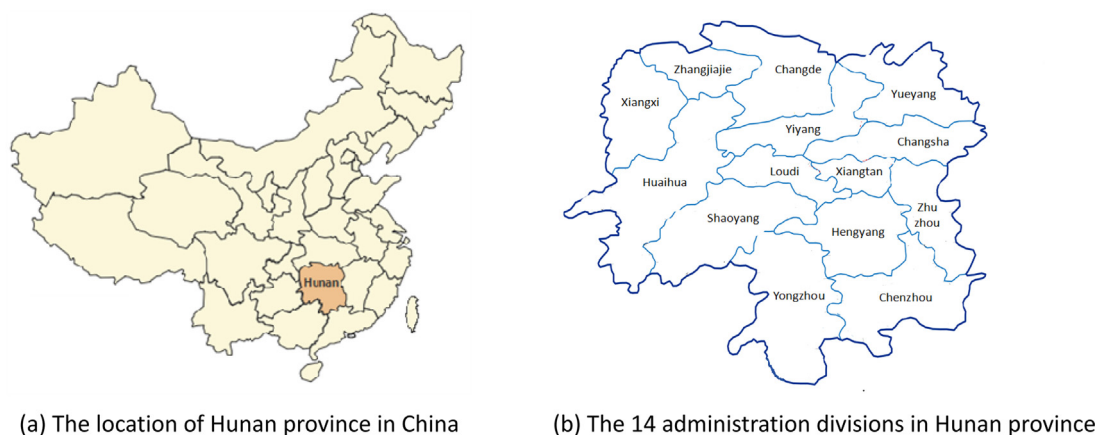


Fig. 1. The location and administration divisions of Hunan province.

Now there are 14 administration divisions in Hunan province, as shown in Fig. 1, which are Changsha, Zhuzhou, Xiangtan, Hengyang, Shaoyang, Yueyang, Changde, Zhangjiajie, Yiyang, Chenzhou, Yongzhou, Huaihua, Loudi and Xiangxi cities. In particular, the three neighboring cities, i.e., Changsha, Zhuzhou and Xiangtan, are called Chang-Zhu-Tan city cluster, which is the key region to facilitate the economic upgrade and sustainable growth of Hunan province. Meanwhile, the Chang-Zhu-Tan city cluster has been devised as the national comprehensive reform pilot. For instance, in April 2015, the “Development Plan for City Clusters along the Middle Reaches of the Yangtze River” was approved by China’s State Council, which covers the urban clusters around Chang-Zhu-Tan city cluster and in a move to create a new economic growth engine and promote the new urbanization in China.⁴

Overall, the new mission and position for Hunan province means both great opportunities and challenges. On the one hand, it provides a historical opportunity for Hunan province to advance reforms in realizing the win–win of economic development and environmental protection during the new economic transition. On the other hand, the current overall extensive and high-carbon economic development pattern makes sustainable development difficult for Hunan province in face of a series of problems, such as the severity of environmental pollution, the restriction of coal and electricity scarcity, the absence of oil and gas resources.⁵

In order to address the cumulative impact of economic development on environmental changes or ecosystem, GESAMP (1986) defines environmental capacity as “a property of the environment and its ability to accommodate a particular activity or rate of an activity...without unacceptable impact”, which is central to the promotion of sustainable development. Compared with carrying capacity, which is on the basis of natural resources (Arrow et al., 1995), environmental capacity stresses both the utilization of resources, human activities and environmental sustainability, which proves a more suitable index for environment. In addition, environmental capacity provides basic support for environmental regulation making, pollutant control, environmental planning, and the evaluation of economic transition advance. Currently, in order to continue exploring the resource-saving and environment-friendly development pattern, and to construct the new Hunan with prosperous economy, fine ecology and harmonious society, it is imperative to evaluate the environmental capacity of Hunan province, which aims at optimizing the economic growth with

environmental protection and forcing the economic transition by environmental regulation.

In fact, many studies have been conducted on environmental capacity, whereas most studies mainly focus on the environmental capacity of water, airborne and tourism. Particularly, there are enormous studies about water environmental capacity with various pollutants. For example, Han et al. (2010) utilize the eco-hydrodynamic model to assess the environmental capacity of dissolved inorganic nitrogen and phosphorus in Jiaozhou Bay, with the purpose of easing the serious environmental problems. Wang et al. (2012a) choose chemical oxygen demand (COD) as the index to calculate the water environmental capacity in the Central Shaanxi of the Wei River, and find that the seasonal pollutant load distribution and total quantity control are beneficial to effective usage of the water resource. Li et al. (2010) explore the water environmental capacity in Zhangweinan canal sub-basin, and the results indicate that 90% and 50% of the hydro-logical guarantee flow rates are suitable to be the design flow rates for rainy and dry seasons, respectively, which can ameliorate the water problems to some extent. In addition, some developed countries have explored many years for building the pollutant emission trading market, which proves to be an effective way to reduce the emissions. Then, there are also some scholars wondering that if this similar trading mechanism can be applied in terms of water environmental management. A case in point is the study of Huang et al. (2014), they suggest that water environmental capacity should be the constraint of pollutant emissions, and then present an example to verify the allocation validity of this multi-object evolutionary algorithm under the restriction of finite capacity. In brief, water environmental capacity is an important component of the regional environmental regulations and programs as well, and the uncertainty analysis of capacity can offer practical suggestions for relevant decision makers (Liu et al., 2012), which can also solve some crucial problems, such as water shortage, water pollution and low utilization, and reflect the positive effect of environmental capacity upon the environmental construction.

Moreover, Lapade (1963) firstly proposes the concept of tourism environmental capacity, and then some scholars gradually expand and improve the concept (Tony, 2001; Perdue et al., 1990; Papageorgiou and Brotherton, 1999). For instance, Alexis (2000) defines the volume of tourism as the environmental capacity of Ayia Napa, a resort on Cyprus’ east coast, and argues that as time goes by, the volume of tourism can be manipulated by management techniques and controls. Fernando et al. (2004) estimate the environmental capacity of Hengisbury Head in the British coastal area using the LAC model, and the results show that the capacity is influenced by many factors, such as economy and social culture.

⁴ <http://news.sohu.com/20150405/n410842536.shtml>

⁵ <http://www.lxshjs.com/Infor/News/Show.asp?id=10905>

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