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Sustainable development of eco-industrial parks in China: effects of managers' environmental awareness on the relationships between practice and performance

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ABSTRACT

As an important means of achieving sustainable development, eco-industrial parks have been given great significance at every level of Chinese governments, and as a result, they have made great strides in China. The increasing pressures of resource constraints and the need for environmental protection have made the achievement of optimal sustainable development performance crucial. Managers of eco-industrial park administrative committees, as decision makers and executors, have a pivotal role in the design, plan, and organization for the sustainable development of eco-industrial parks. Furthermore managers' environmental awareness is important when organizing environmental practices in their eco-industrial parks. This paper seeks to establish the value of the effects of managers' environmental awareness on the relationships between environmental practices and sustainable development performance by presenting an analysis of Chinese eco-industrial park projects. Using an empirical study, this paper first identifies the key environmental practices, directed by managers, which impact the sustainable development performance of Chinese eco-industrial parks. The moderating effect of managers' environmental awareness on the relationships between environmental practices and sustainable development performance is then developed. Our results show that instituting environmental norms for eco-industrial park enterprises, building industrial symbiosis, and providing guidance to key enterprises play significant roles in producing sustainable development performance for eco-industrial parks. Managers' environmental awareness is helpful in driving and transforming environmental practices into sustainable development performance. Our results also provide assistance for designing and implementing environmental practices for sustainable development, recruiting managers with higher environmental awareness, and training managers to improve their environmental awareness so that eco-industrial parks can achieve sustainable development performance.

1. Introduction

Increasing resource and environmental pressures have impeded China's efforts to rapidly improve the people's life quality, while also protecting its natural environment (Geng et al., 2007). In addressing this complex development problem, industrial ecology (IE) is viewed as one of the solutions, as it aims at optimizing the use of materials and energy in products, processes, industrial sectors and economies by systematically mimicking natural systems in an industrial institution (Geng and Cote, 2004; Geng et al., 2007). As one of the main aspects of IE, eco-industrial development (EID), which is an application of the IE framework for industrial development, was 'first proposed in China in the early 1980s and became popular in the late 1990s' (Geng et al., 2007, p. 122). With the development of EID, eco-industrial parks (EIPs) were initiated in China in 2001 (Geng and Cote, 2004). Since then, the Chinese central government has played a pivotal role in EIPs.

As the national agency on environmental protection, the State Environmental Protection Administration (SEPA) led the first EIP project in Guigang, Guangxi Zhuang Autonomous Region in 2000 (Geng et al., 2007). The Guigang EIP has developed into one of the

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most typical and successful EIPs by establishing industrial symbiosis among the existing enterprises, including a sugar factory, an alcohol plant, a fertilizer plant, a pulp plant, a paper mill, a cement mill and sugarcane farmers in the region, with the goal being to reduce pollution and disposal costs and to generate more revenue (Zhu and Cote, 2004; Duan, 2001). With the success of the Guigang EIP, as well as the pressure of environmental protection, many industrial parks, such as Tianjin Economic Development Area (TEDA), Dalian Economic and Technological Development Zone (DETDZ), and Suzhou Industrial Park, have been transformed into EIPs with direction and support from SEPA. By April 18, 2014, there were 85 national-level EIPs, and among them, 26 passed the acceptance check and 59 were under construction (MEPC, 2014). There are also many provincial and municipal EIPs in China (Suo, 2012). The majority of those 85 national-level EIPs are located in the eastern coastal part of China, with 22 in Jiangsu province, 10 in Shandong, 8 in Shanghai, 7 in Zhejing, 5 in Guangdong and 4 in Liaoning. Their geographical distribution is shown in Fig. 1.

To promote the development of EIP projects, China also released national circular economy industrial park standards and national EIP standards, which outline the performance required of an EIP. An EIP should meet the four groups of indicators of economic development, ecological industry, ecological environment and green management (Geng and Zhao, 2009; Geng et al., 2009, 2012). In addition, in 2009, the Ministry of Environmental Protection (MEP) of China also released a national initiative to encourage national EIPs to incorporate low carbon development principles to respond to climate change (Dong et al., 2013). After more than a decade of experience, China is in a leading position in the world in the design and operation of EIPs (Shi et al., 2012).

Although China has made great progress in EIP development during the past decade, EIPs are facing a development bottleneck in integrating national government principles and environmental management tools into all decision-making related to EIP development (Geng and Zhao, 2009). Although many enterprises are beginning to understand the importance of sustainable development, they may not be certain of how the concept applies to their business activities (Tseng, 2013). In China, managers in EIP Administration Committees (EIP managers) have a pivotal role in designing, planning, and organizing EIPs' development. Because the EIPs in China are primarily developed to reduce the environmental impact caused by industrial agglomeration (Shi et al., 2010), when instituting environmental practices in their EIPs, the environmental awareness of the EIP managers is important to EIP sustainable development. However, little research is available on the role of environmental awareness of EIP managers in EIP sustainable development. Hence, this study focuses on how this awareness might interact with management initiatives related to environmental practices and how this awareness might be helpful in driving the transformation of such initiatives into the sustainable development performance of EIPs.

To complete this investigation, this paper begins with a literature review in Section 2. In Section 3, the conceptual model is constructed and hypotheses are put forward. Methodology, including questionnaire development and data collection, is introduced in Section 4. And Section 5 analyzes the data and shows the results. The discussion and conclusion are presented in Section 6 and Section 7 respectively.

2. Literature review

2.1. Sustainable development performance of EIPs

The concept of sustainable development entails the integration of economic prosperity, environmental protection and social advancement (Benn and Bolton, 2011). The principles of sustainable development are engendered in the conceptualization of EIPs because the latter is underpinned by the notion of IE mimicking natural ecological systems (Gibbs and Deutz, 2007). As a new industrial model, EIPs can reconcile the three dimensions of sustainability: economic, environmental and social sustainability performance (Elabras, Veiga and Magrini, 2009). Jung et al. (2013) also argues that when evaluating the performance of an EIP, all three dimensions of sustainable development performance, economic, environmental and social sustainability performance, need to be taken into account. Takala and Pallab (2000) argue that sustainable development performance includes the economic, environmental and social responsibility aspects and, hence, aims to address all three aspects.

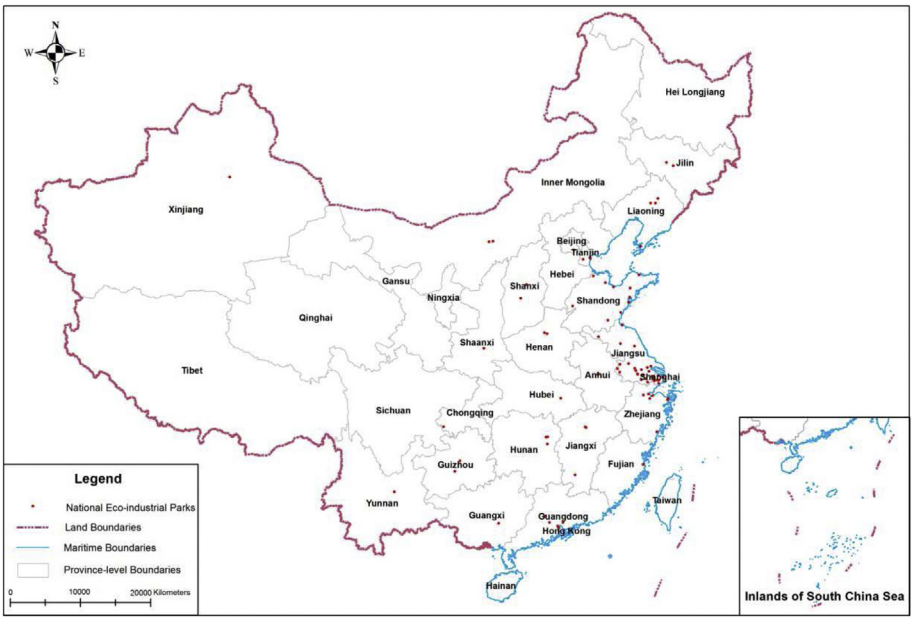

Fig. 1. The geographical distribution of the national EIPs in China.

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