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Investigation of public's perception towards rural sustainable development based on a two-level expert system

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ABSTRACT

Sustainable development is of great significance in rural areas of China, which are under coupled pressures of poverty reduction, environmental protection and economic development. In these areas, agriculture is the primary sector in supporting their economies, where a number of the relevant production and processing practices cause many adverse impacts on environment and ecosystem. This poses many challenges for decision makers in formulating sustainable development strategies without invoking potential controversies or objections from the public. In this study, a two-level expert system (TES) for facilitating the investigation of public's perception towards sustainable development in rural areas was developed. Interactive relationships among objectives of socio-economic development and environmental protection, as well as the related policy implications and public responses, were comprehensively examined and incorporated within TES. A two-level system was particularly adopted for facilitating participation of various stakeholders, including decision makers and farmers. The Yongxin County of the Shanjianghu Region in Jiangxi Province, China was selected to demonstrate the applicability of the developed TES. A series of questionnaire surveys were conducted both for acquiring knowledge about the interrelationships among sustainable development, agricultural production, poverty reduction and environmental protection. Public's perception towards various system components of rural sustainable development were efficiently acquired and analyzed. The results indicated that sustainable development would be very significant on rural areas in China. Also, public awareness to the concept and profile of rural sustainable development was still at a low level, especially for farmers. The developed TES can be not only used for acquiring knowledge of sustainable development, but also providing basic information for the formulation of relevant policies and strategies in rural areas of China.

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1. Introduction

As the foundation for sustaining our daily life, agriculture is one of the most crucial sectors in supporting regional and national economies (Ambroise, Barnaud, Manchon, & Vedel, 1998; Doussan, Thannberger-gaillarde, & Thie'baut, 2000; Kim, Euan, & Luisa Isla, 2002; Landais, 1998; Lange, Hehl-Lange, & Brewer, 2008; Legg & Viatte, 2001; Marsh, 1997; Sartorius & Kirsten, 2007). Over the past decades, decision makers in many developing countries have been facing with the twin challenges of spurring agricultural productions to feed a rapidly growing population and finding an economic engine to stimulate economic growth and reduce social poverty. In addition, they have had to confront the third urgent issue, i.e., the depleting natural resources and the degrading environmental qual-

ity. Undoubtedly, human beings cannot afford to abandon goals of growth and poverty-alleviation for the sake of sustainability; unless resources are managed in sustainable ways, current and future generations will find their welfare threatened (Harmancioglu, Fedra, & Barbaros, 2008; Huang, Huang, Hu, Maqsood, & Chakma, 2005; Murdiyarto, van Noordwijk, Puntodewo, Widayati, & Lusiana, 2008; Nader, Abi Salloum, & Karam, 2008). Thus, identify sustainable patterns for resources allocation, environmental protection and economic development in agricultural sector of rural areas is desired.

Recently, many modes of sustainable development were examined in China to mitigate intensive conflicts between economic development and environmental protection (Huang, Huang, Hu, Maqsood, & Chakma, 2005). Over the past two decades, the environment in China has been seriously impaired along with economic development. The accelerating economic development in this country has been resulting in a series of potential threats to the deteriorating ecosystem if there is lacking of effective

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management strategies for protecting the environment. Numerous events and studies have proved that the destruction of natural resources and the deterioration of environment could be disastrous to current and future socio-economic development. Particularly, sustainable development is critical in the efforts to achieve coordination of social, economic, environmental goals in rural areas of China, which are more backward compared with prosperous cities in the country. However, in order to customize developing modes according to site-specific characteristics, many challenges are facing by decision makers at multiple jurisdictions in rural areas, where up-to-date information and technologies, as well as sufficient economic resources are normally unavailable. Also, for pursuing aims of sustainable development in rural areas, various stakeholders (e.g., decision makers, residents, managers and third-party members) need to systematically consider many factors and processes, such as targets of regional sustainability, consensus in local region for economic development and environmental protection, tradeoffs between eco-environmental preservation and socio-economic development. This poses a major obstacle for decision makers in formulating schemes of sustainable development without incurring potential controversies or objections from the public. Therefore, it is desired to develop effective tools for aiding in acquiring and analyzing public's perception towards local sustainable development and promoting the involvement of various stakeholders in rural areas of China, which can also be easily used by decision makers at multiple spatial scales.

Previously, public participation/involvement was highly recommended as an effective way for solving public issues such as environmental protection and sustainable development, and to enhance acceptability of the relevant decision-making process (Cai, Xu, & Yang, 2002; Cai, Yang, & Xu, 2003; Cai, Huang, Nie, Li, & Tan, 2007; Cai, Huang, Yang, Lin, Bass, et al., 2008; Cai, Huang, Yang, Lin, & Tan, 2008; Cai, Huang, Yang, & Tan, 2008; Cai, Huang, Lin, Nie, & Tan, 2009; Tran, 2006). It is thus considered as a necessary process to formulate decision alternatives which may have direct or indirect impacts on the public. Over the past decade, there were many studies on public involvement/participation to help facilitate the management of natural resources, environmental quality, as well as the customization of sustainable development modes. For example, Haque, Kolba, Morton, and Quinn (2002) proposed a method for improving the degree of public participation in water resources management, water pollution control, as well as the related decision-making process. Dungumaro and Madulu (2003) made an attempt to incorporate various public participation measures within an integrated water resources management system for effectively identifying decision alternatives with high public acceptability in a watershed of Tanzania. Chopyak and Levesque (2002) examined the past, current, and future trends of the relationship between science, technology, and society, indicating a shift to a raised public-participation level in relevant decision making across the world. In order to examine public's perception toward potable and non-potable water reuse. Hartley (2006) proposed an interdisciplinary and integrative method and applied it to several communities in USA. Tran (2006) carried out a study to investigate public awareness on sustainable development in a small island, suggesting that public's perception and involvement would be a significant factor for developing regional sustainable development schemes. Peterlin, Kontic, and Kross (2005) analyzed public's perception toward environmental quality management in a coastal zone of Slovenia through a number of statistics methods. In China, there were still quite a number of studies on public participation/involvement and its effects upon environmental management, water resources management, ecological engineering, waste management and sustainable development. For instance, Tang, Wong, and Lau (2008) examined current situations/obstacles of public participation when conducting social impact assessment

(SIA) and proposed a case study for public participation in Guangdong Province, indicating that public's perceptions toward results of SIA has received increasing attention from multi-level governments across China. Dumreicher (2008) investigated the process of sustainable development in many villages of China through analyzing public opinions on environmental quality and living space in rural areas. Li, Xiong, and Xu (2008) proposed a series of measures for: (a) improving public access to environmental information, (b) expanding environmental information disclosure among private enterprises, (c) increasing collection and disclosure of environmental information, and (d) investigating and managing environmental information in rural areas.

These studies either proposed various measures for promoting public participation in the process of conducting an individual project related to environmental management, ecological conservation and sustainable development, or merely made a comprehensive review or investigation on the design, implementation and evaluation of public participation. Moreover, a number of methods were proposed for acquiring public's perception towards the management of land use, water resources, and environment, which are merely effective in a specific city and region. There is lacking of studies on public participation in rural areas for supporting sustainable development, especially in developing countries. Also, the majority of the previous studies merely proposed methods for acquiring public's perception towards an individual development project or construction work at a problem-solving level, few of them suggested a universal tool for not only enhancing public participation but also improving effectiveness of decision making in environmental protection and socio-economic development. Furthermore, public participation in most of the studies was limited to one specific group of people, such as local residents, decision makers and enterprise managers. They could hardly handled public publication and acquired public's perception in a broad and general context. There were few studies which could comprehensively and dynamically integrate public participation into sustainable development schemes in rural areas. This would lead to a lack of effective and applicable measures for supporting sustainable development especially in rural areas. Comparatively, expert system is considered as one of the effective tools in supporting decision making related to sustainable development at multiple scales. It can link a combination of decision-support tools (e.g., optimization modeling, and cost-benefit analysis) and various information components into a general decision-making process (Athanasiadis & Mitkas, 2007; Boyle and Baetz, 1998; Carswell, Gardiner, Bertolotto, Rizzini, & Mandrak, 2008; Huang, Batez, & Patry, 1992, 1995a, 1995b; Lewis & Bardon, 1998; Tremblay, Hester, Mcleod, & Huot, 2004; Zeng, Zhang, Liu, & Yang, 2007; Zeng & Trauth, 2005; Yao, Liu, Fan, Yao, & Yang, 2006). With such an effective tool, both the knowledge of agricultural development and eco-environmental preservation, as well as public's perception towards sustainable development can be interactively and dynamically acquired. Thus, a large quantity of data and information can be easily obtained without onerous efforts.

Therefore, the objective of this study is to develop a two-level expert system (TES) for helping acquire public's perception towards sustainable development in rural areas and apply it to the Sanjianghu Region of Jiangxi Province, China. Interactive questionnaire design, visual display options and user interactions will be integrated into such a system, improving its applicability and robustness in dealing with real-world development problems in rural areas. Opinions from various stakeholders and decision makers can thus be successfully identified for supporting the generation of policies and strategies related to sustainable development, highly enhancing their public acceptability of the obtained plans. Practical measures and strategies can thus be properly customized in the study area. Relationships among socio-economy, eco-envi-

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