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Sustainable livelihoods and rural sustainability in China: Ecologically secure, economically efficient or socially equitable?

Heyuan You[a], Xiaoling Zhang[b,*]

[a] School of public administration, Zhejiang University of Finance and Economics, Hangzhou, China
[b] Department of Public Policy, City University of Hong Kong, Hong Kong, China; City University of Hong Kong, Shenzhen Research Institute, Shenzhen, PRC

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ABSTRACT

Sustainable production and consumption in the rural regions remains a barely tried yet important issue for contributing to rural sustainability these days. In particular, the sustainable livelihood of rural farmers has not been fully investigated for those in rural areas with high agricultural pollution emissions and a poor ecological quality of agricultural production in China. Also affected are farmers with a low living standard and output, or suffer from social inequity. The sustainable livelihood security (SLS) index therefore provides a useful means of identifying the existence of the conditions necessary for sustainable livelihood or sustainable development. Using the fuzzy comprehensive method, this paper aims to assess the level of sustainable livelihood security of China's provincial farmers and its three components of ecological security, economic efficiency and social equity. A SLS index is established and the entropy weight method used to determine the weight of the indices and analyze spatial distribution. The results indicate that the sustainable livelihood security index and its components vary between provincial regions, with the western provinces being most adversely affected, sustainable livelihood, economic efficiency and social equity being the least secure (or relatively insecure) in the western provinces while economic efficiency is most secure (or relatively secure) in the eastern and middle provinces, and social equity most secure in the eastern provinces. Concluding remarks suggest policies designed to improve the sustainable livelihood security of farmers according to local regional circumstances.

1. Introduction

China's 600+ million rural farming community occupies a relatively lowly position compared to urban dwellers, with low incomes from agricultural production because of land fragmentation (Nguyen et al., 1996). In addition, many farmers suffer from exposure to ecological risks such as drought, soil erosion, environmental pollution and land degradation, especially in the north and northeast provinces (Chen et al., 2014; Ongley et al., 2010; Zhang et al., 2014; Xu et al., 2014). Farmers in different districts adopt different livelihood strategies such as pluriactivity and rural livelihood diversity for survival (Kinsella et al., 2000; Ellis, 1999; Cofie et al., 2010).

Since the Brundtland Commission on Environment and Development, sustainable livelihood – being able to make a living in an economically, ecologically and socially sustainable manner – is now regarded as providing the broad goal for such breadline communities (Bull, 2015). However, achieving a sustainable livelihood is not a deterministic issue (Scoones, 2009) and strategies aimed at improving livelihoods are always limited by unsustainable rural resources, high population growth rate, a vulnerable agricultural environment and significant social inequity, such as in the disparate distribution of wealth and allocation of land rights (Qu et al., 2011; Shaw and Kristjanson, 2014; Ouyang et al., 2014; Dai and Dien, 2013; Wu, 2004). Consequently, although immense changes have occurred in rural areas since China's *Reform and Opening Up* in 1978 (Rozelle, 1996; Gao et al., 2014; De Brauw et al., 2002), the sustainable livelihoods of farmers have yet to be fully realized.

The UK Department for International Development has developed a sustainable livelihood framework to analyze the factors that affect sustainable livelihoods (Scoones, 1998). Similarly, the Cooperative for Assistance and Relief Everywhere (CARE) USA's program uses a household livelihood security framework to understand the relationship between households and society (McCaston, 2005). Household livelihood security covers six security areas: food, health, economics, education, shelter and community participation and emphasizes the multi-dimensional dynamics of the factors

* Corresponding author.
E-mail addresses: youheyuan@gmail.com (H. You), xiaoling.zhang@cityu.edu.hk (X. Zhang).

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causing poverty (Ghanim, 2000). When combined with rapid and participatory rural appraisal, the household livelihood security approach can be used to measure the livelihood security of farmers at the family and community level (Lindenberg, 2002).

Saleth and Swaminathan (1993) have proposed a sustainable livelihood security (SLS) index as a means of identifying the necessary conditions for sustainable livelihoods or sustainable development in a given region (Moser, 1996). SLS has, for example, been applied to evaluate the livelihood security of farmers in highland and lowland communities of the Kali-Khola agricultural watershed in western Nepal (Bhandari and Grant, 2007). It can reveal the impact of livelihood strategies on sustainable rural livelihoods, such as the dramatic improvement of sustainable rural livelihoods in the rapidly developing and transforming areas in China after the implementation of new agricultural practices (Tang et al., 2013). The SLS index has also been used to solve both macro- and micro-level problems, and easily generalizes to different contexts, such as farmers in a village, villages in a district and states in a country (Singh and Hiremath, 2010; Hatai and Sen, 2008; Sajjad et al., 2014; Uma, 1993). This makes the index eminently suited to assessing the SLS of farmers in China.

An object with many properties needs many aspects to be considered when evaluating how good it is (Liu, 2008). In addition, decisions made in complicated systems need the comprehensive consideration of many relevant factors (Qin, 2012; Vahabzadeh et al., 2015). To do this involves a comprehensive holistic evaluation (Koplovitz et al., 2011). In uncertain situations, fuzzy set theory, first introduced by Zadeh (1965) to solve problems involving vague or imprecise data, has been widely used in combination with comprehensive evaluations. The fuzzy comprehensive method – a reliable decision-making methodology based on fuzzy set theory – has been applied in the quantitative description of socioeconomic status and ecological characteristics (Feng and Xu, 1999; Meng et al., 2009). For example, it has been successfully used in describing complex nature interactions that occur during oil spill management (Liu and Wirtz, 2007) and evaluating the water quality of Lake Honghu in China (Li et al., 2009). The procedures involved in the fuzzy comprehensive method are: (1) selecting parameters and the classification threshold values; (2) formulating the membership functions; (3) calculating the weights matrix; and (4) computing the membership degrees and obtaining the assessment result. With the SLS index, multi-index evaluation is needed to assess the relevant indices that indicate the condition of impact factors. It is also difficult to determine the classification threshold values of criteria to grade the SLS of farmers strictly due to the imprecise relationship between impact factors and the SLS (Su et al., 2010). This makes the fuzzy comprehensive method an obvious candidate for dealing with the fuzziness in the index when evaluating SLS and is therefore adopted in this study.

Although sustainable livelihoods of farmers have been receiving increasing attention in China, little progress has been made in practice. An understanding is urgently needed of the impact of ecological security, economic efficiency and social equity. This paper integrates the SLS index and fuzzy comprehensive method to determine the extent to which the necessary conditions for sustainable livelihoods or sustainable development exist for farmers in China. The findings can help formulate specific policies for improving the SLS of farmers. The remainder of the paper is organized as follows. The next section presents entropy weighting and the fuzzy comprehensive method and discusses the SLS index. A case study is then described in which the degree of SLS membership of provincial farmers and the spatial distribution of SLS are determined. The results indicate that the SLS index and its components varies between provincial regions, with the western provinces being most adversely affected, sustainable livelihood, economic efficiency and social equity being most insecure in the western provinces, while economic efficiency is most secure in the eastern and middle provinces and social equity most secure in the eastern provinces. Finally, specific policies designed to improve the SLS of farmers are proposed according to the local circumstances of different provincial regions of China.

2. The concept of SLS and its indicators

Sustainable livelihood has been defined as the means of living against further poverty which require necessary capabilities, assets and activities to maintain an economically, ecologically, and socially sustainable manner (Chambers and Conway, 1992). The SLS has emerged in response to the desire to check the extent to which peasant households have adequate and sustainable access to a sustainable livelihood (Saleth and Swaminathan, 1993). Swaminathan (1991) also proposes that the concept of SLS is focused on the three pillars of ecologically secure, economically efficient and socially equitable; underscoring ecology, economics and social dimensions.

Many of the studies of the measurement of SLS are driven by a desire to understand why the gap between the rich and the poor is widening (Swaminathan, 2000). These include the search for a simple and flexible analytical framework of SLS to access long-term livelihood security (Singh and Hiremath, 2010). SLS measurement is sensitive to inter-relationships among the indicators. However, no widely accepted method is available to quantify such inter-relationships, given the absence of standard for describing the good or bad degree of SLS (Kumar et al., 2014; Sajjad et al., 2014).

There are also many common concerns about SLS and the obvious differences in its attributes identified in the literature. Singh and Hiremath (2010), for example, consider ecological security, economic efficiency and social equity to be the vital factors that determine SLS and Chambers and Conway (1992) emphasize that sustainable livelihood depends on whether a livelihood is sustainable environmentally and socially. Some studies argue that difficult access to land and an insecure land tenure system have a key impact on SLS, as they strongly influence the everyday choices and prospects of poor rural people (Clover and Eriksen, 2009). Other scholars report that the rapid population growth is strongly associated with the insecurity of SLS in one region since it can lead to resource scarcity, a direct driver of economic decline and poverty (Gecho et al., 2014). Therefore at present the multi-index comprehensive evaluation is widely accepted to measure SLS.

For many studies, a great effort has been made to identify the appropriate indicators for assessing SLS. In the context of mining, these indicators capture changes in economic, socio-cultural, health, political and environmental conditions (Horsley et al., 2015). An improved Livelihood Sustainability Index (LSI) has been established to assess the vulnerability of livelihoods in environmentally fragile areas of southern China (Wang et al., 2016). The genuine saving indicator (GSI) is developed for the purpose of preventing decline in capital stock, comprising produced, human and natural capital (Hamilton et al., 1997). In addition, the sustainable net benefit index (SNBI) is an integrated index of economic development in order to describe a clearer picture of welfare (Pulselli et al., 2006). Many of the indicators have also been developed with respect to SLS security analysis. The SLS is not as easy to explain since it should fully integrate ecological, economic and social dimensions (Swaminathan, 1991). Due to differences in natural, social and economic conditions, the indicators should be selected according to local circumstances (Uma, 1993; de Sherbinin et al., 2008).

There is a common understanding for assessing SL Moser (1996), for instance, concludes that economic efficiency, ecological security, solidarity and technical feasibility are essential for SLS and eradication of poverty; Sajjad et al. (2014) propose an SLS index that