



Identification and assessment of ecosystem services for protected area planning: A case in rural communities of Wuyishan national park pilot

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ABSTRACT

It is important to integrate local residents' awareness and perception of ecosystem services (ES) into the ES assessment for the planning of protected areas (PAs). Using data collected from the newly designated Wuyishan national park pilot, we assessed communities' identification and perceptions of a broad range of ESs. We examined the factors that affected the preference and assessment across communities and found a PA-enclave effect: preference towards the ES categories diverge between residents inside and outside of current protected areas resulted from previous PA management. While provisioning services were recognised and closely bonded with livelihood when communities acquired them as demanders, cultural services were also recognised when communities saw themselves as providers. The recognition and assessment of regulating services were generally low as local people were more sensitive to ecological outcomes than processes. The results underline the importance of the cultural landscape history in shaping communities' mind and the security of livelihood as a baseline to facilitate regional conservation planning. Since communities are diverse in perceptions to ESs even in the relatively homogeneous national park pilot, the management must consider a strategic planning in regulation to address the diversity in demand to achieve the conservation goal in the whole region.

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1. Introduction

Ecosystems provide a variety of benefits to society commonly known as ecosystem services, which are conditions, processes, and components of the natural environment that sustain human well-being (MA, 2005; Daily, 1997). The ecosystem services (ES) concept is gaining increasing attention of academics, researchers and policy makers in China to inform and support decision making on biodiversity conservation and terrestrial spatial planning (Ouyang et al., 2016; Xu et al., 2017). Most studies have focused either on the assessment of the biophysical capacity of certain types of ecosystem to deliver services or on the economic evaluation of ecosystem services at a certain scale (D'Amato et al., 2016; Yang and Yang, 2014; Niu et al., 2012; Ouyang et al., 2003; Zhao et al., 2003; Xie et al., 2000). Few studies, however, have addressed the social-cultural preferences of ecosystem services from the perspective of a non-economic value approach. Values associated with

ecosystem services result from the day-to-day interaction of people with their environment. As people perceive the environment based on their social-cultural background, different ecosystem services beneficiaries perceive, appreciate, use and manage ecosystem services differently. Therefore, understanding the demand priorities for ecosystem services and managing trade-offs among them is a challenge (Bennett et al., 2009). Then the concept of ecosystem services bundles emerges to incorporate socio-cultural dimensions of ecosystem services into decision making through social preference of ecosystem services (Mensah et al., 2017; Wei et al., 2017; Cebrián-Piqueras et al., 2017; Bagstad et al., 2016; Martín-López et al., 2012; Castro et al., 2011).

During the 20th century, protected areas (PA) have become an essential part of conservation strategies to minimise the influence of humans on biodiversity (Pyke, 2007). The progress in China is also significant, as the country has already had more than 15% of the terrestrial area under the protection of different titles (Xu et al., 2017). However, for areas where human settlement has long been existing, a major concern is how to regulate frequent and consistent human activities to comply with conservation targets in

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and around a designated protected area (Xu et al., 2017), because conflicts between biodiversity conservation and livelihood is a major concern when conducting new management for protected areas both in China and other regions (e.g. Jiang et al., 2017; Infield & Namara, 2001; Zhou & Grumbine, 2011). As a major resource user group, local communities in the rural area have created a cultural landscape where nature and society have interacted for decades or centuries. Therefore, local perspectives on ecosystem services are needed to assess the importance of ecosystem services for local people. Identifying the motivation and reasons behind the preference is helpful to understand which services are relevant for local people and which trade-offs need to be addressed to make decisions regarding the regulation of local activity for conservation targets in a protected area (Paudyal et al., 2016; Wandersee et al., 2012; Wang and Yamamoto, 2009). Furthermore, the assessment of ecosystem services by local people influences their acceptance of policy on natural resources management, and the implementation of rules and regulations as part of the institutional components of a social-ecological system affects the stability of the system (Castro et al., 2016; Palomo et al., 2013; Martín-López et al., 2012; Castro et al., 2011; MA, 2005).

Incorporating local perceptions and assessments of ecosystem services is especially important when China is reforming its protected area system and heading for a new national park system with the principle of “conservation first, public welfare a priority”. One aspect of the principle is that the system aims to eliminate all the activities that could harm ecosystems except for improvements to facilities used by local people in their everyday life, aiming to minimise the possibility of the trade-off between development and conservation. Because achieving welfare is also the target for local people who are part of the public, this reform encourages community co-management that local people actively take part in conservation from which they benefit from the provision of ecosystem services (Translated from Jian Li Guo Jia Gong Yuan Ti Zhi Zong Ti Fang An published by the general offices of the Communist Party of China Central Committee and the State Council). In view of re-arranging protected areas for better conservation, the new national park system is similar with the global movement of setting up transboundary protected areas where different component areas of different conservation level are re-arranged to secure community livelihood and conservation target at a landscape level, such as in Southern Africa and the European Union (Metcalf, 2003; Trillo-Santamaría & Paül, 2016). The difference may be that in China the provincial boundaries are the first “hard edges” other than national boundaries. Therefore, it is good timing to increase local people's awareness and an opportunity for them to participate in conservation planning (Al-assaf et al., 2014; Cerdán et al., 2012; Liu and Xue, 2010; de Groot, 2006; MA, 2005).

Currently, a national park pilot is integrated by spatially overlapping or adjacent protected areas based on the integrity of ecosystems, defined by new boundaries and zonation. Communities are also undergoing changes in relation to the location of these new boundaries as well as to the following new regulations. Identifying their perception of ecosystem services helps to understand how local values are manifested in land-use choice for livelihood (for which people may act illegally according to the laws and regulations of protected areas) and how to mobilise people in behaving compatibly with conservation targets. This is especially important for certain pilots where there is already dynamic institutional change as well as the environmental change that keep shaping a cultural landscape (He et al., 2017). The cultural landscape is actually built in a social-ecological system where people behave under certain institutions to affect resource use and eventually ecosystems (Castonguay et al., 2016). Therefore, understanding local use and awareness of ecosystem services as affected under certain institutions may help to reduce trade-offs and promote

synergies between biodiversity and livelihood practices in resources use through institutional change in China (Li et al., 2013; Xu et al., 2006).

This research focuses on a subtropical forest ecosystem in southeast China. The newly designated Wuyishan national park pilot has consisted of several protected areas managed by different agencies, mainly the national nature reserve and the national scenic area; the community people are either governed by the local government or jointly governed by the national nature reserve agency if living in the nature reserve. Previous studies only focused on the monetary value of certain forest ecosystem services for the nature reserve or the scenic area, paying little attention to the trade-off between stakeholders and local perspective towards ecosystem services (Xu and Zhong, 2007; Wang et al., 2006). Few researchers have conducted comprehensive research concerning the location of communities and their perspective towards ecosystem services, especially in the procedure of management decision making regarding the needs of both the public welfare and community livelihood. However, community context matters a lot in setting up new protected areas when it comes to re-arrangement of land use and access to natural resources. An example is the Limpopo Transfrontier Park where communities with very different backgrounds in natural resource management in Mozambique, South Africa and Zimbabwe adjusted to the new transboundary conservation area (Metcalf, 2003). Similar in Wuyishan, with the new national park pilot under construction, communities outside of the nature reserve are now inside of the national park pilot when the fragmented conservation targets by separated PAs are integrated spatially under an overall national park management.

This research aims to explore preferences and assessment of locally relevant ecosystem services (except supporting services) by local people settling to a certain distance of the national park pilot, in order to explore adaptive ecosystem-based management with regard to the national park management objectives, through perusing a resilient social-ecological system in decision making. Specifically, the paper aims to:

- (1) Identify the preference and importance of forest ESs perceived by the local communities in and around the designated national park pilot. The forest ecosystem services have experienced dynamic changes during the last thirty years; especially that the reform of the collective forest tenure and the ecological forest zoning and compensation policy have affected the varieties and quantities of services. Therefore, the current perception of the meaning of ESs will be the most updated information.
- (2) Identify the variable affecting the assessment of ESs and some social-ecological bundles for the Wuyishan area from the perspective of local communities located in different proximity to the national park pilot. The linkage between social-economic variables and assessment of ESs and bundling procedure reflects the deeper binding between communities and land use history which has transformed to a certain cultural landscape, and provides the up-to-date information for management decision to resolve trade-offs regarding the needs of community livelihood and public benefit.

2. Methods

2.1. Study area

The Wuyi Mountains are a mountain range located in the prefecture of Nanping, in northern Fujian province near the border with Jiangxi Province, Southeast China (Fig. 1). The mountains have been listed as a UNESCO World Heritage Site, for cultural, scenic

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