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Assessing the influences of ecological restoration on perceptions of cultural ecosystem services by residents of agricultural landscapes of western China

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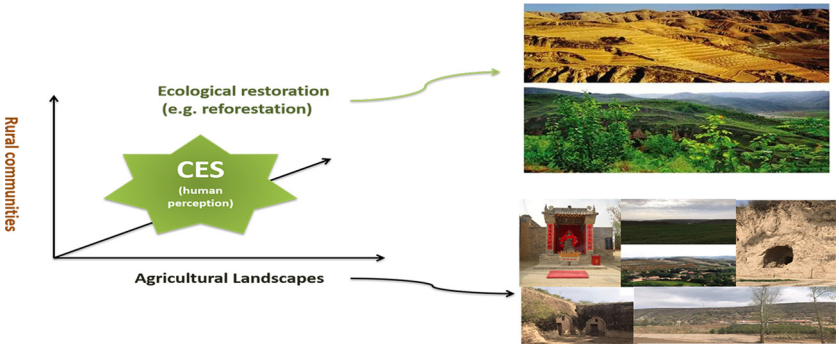
HIGHLIGHTS

- Residents perceive the cultural ecosystem services (CES) of agricultural landscapes.
- CES perceptions changed after implementing the Grain for Green (GFG) program.
- Local customs affected the GFG's influence on CES.
- We quantified the importance of land uses on perceptions of CES provision.

GRAPHICAL ABSTRACT



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ABSTRACT

Landscape change caused by ecological restoration projects has both positive and negative influences on human livelihoods, yet surprisingly little research on the cultural consequences of ecological restoration in agricultural landscapes has taken place. Cultural consequences can be captured in the ecosystem services framework as cultural ecosystem services (CES). However, assessment and valuation of these services to support decision-making for this essential ecosystem is lacking. To help fill this gap, we assessed the opinions of Chinese rural communities about CES and the changes in their perception under the Grain for Green program (GFG), a nationwide program to relieve the pressure on ecosystems (soil erosion and land degradation) by converting cultivated land or barren land on steep slopes into grassland and forests. We used Guyuan City in China's Ningxia Hui Autonomous Region as a case study, using a workshop to identify the CES provided by the agricultural landscape, followed by semi-structured household interviews to quantify perceptions of these CES. We found that all eight CES types identified by the workshop were perceived by the rural communities. Reforestation changed their perceptions of CES directly due to land cover change and indirectly due to the resulting economic changes and migration of mostly young workers in search of better jobs. Cultivated land was perceived as more important than forest for CES provision. In addition, residential areas were perceived as providing significant CES because of local traditions that produce close and highly social neighborhood bonds in agricultural landscapes.

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1. Introduction

Agricultural landscapes are key ecosystems that support human livelihoods and well-being. In addition to their main function of producing food, livestock feed, and fiber, they can—if they are well-managed—also play a role in soil and water conservation (Forouzangohar et al., 2014), climate regulation (Anderson-Teixeira et al., 2012), and habitat provision for many species (Burel and Baudry, 2005; Opdam et al., 2015). Moreover, agricultural landscapes have important socioeconomic significance for their roles in food provision and job creation (Smukler et al., 2012; Chen et al., 2017). These functions are especially indispensable in dry-land ecosystems, where >2 billion people currently live (UN, 2011). The majority of dry agricultural landscapes are located in developing countries, and 10 to 20% of this land is suffering from one or more forms of land degradation (MEA, 2005). Given the significant roles of agricultural landscapes in delivering ecosystem services (ES) and their ongoing degradation of these landscapes (MEA, 2005), provision of these services is an important area of research and implementation, particularly in the context of ecological restoration programs such as reforestation of abandoned farmland (Barral et al., 2015).

The program's goal is to convert agricultural land on steep slopes and other heavily degraded land into forest or grassland, and to restore degraded forest and grassland. This conversion is desirable because the steep slopes make access difficult for agricultural equipment, which can increase the risk of damaging the surface vegetation (e.g., due to slipping of wheels caused by a loss of traction), and because this damage and cultivation of the soil (e.g., tilling) expose the fine-grained soil to erosion by wind and water. The ultimate goal is to prevent soil erosion by increasing vegetation cover and reducing the area of exposed soil (Feng et al., 2005; Rozelle, 2005). The implementation of Grain for Green converted 28.67×10^6 ha of fragile or degraded cropland to forests or grasslands by 2012, thereby significantly changing land cover and land use in many regions. This is especially true in western China, the region that has the largest area of cultivated sloping land, where the loss of grain resulting from this program was expected to reach 50% (Feng et al., 2005; SFA, 2013). Displaced farmers are given an annual allowance of grain to compensate for their lost farm fields, and are paid a small amount for participating in restoration activities such as tree planting and grassland restoration (Guyuan Bureau of Statistics, 2016b). However, these benefits were scheduled to decrease and gradually disappear when the program ended in 2015, and were only extended in some parts of the program areas (Xue and Zhen, 2018).

This description shows that the program's intensive conversion of agricultural landscapes will affect more than just ecological restoration; it can also undermine the cultural identity of human inhabitants by dramatically affecting the lifestyle of residents and their employment opportunities (Speldewinde et al., 2015; Chen et al., 2017; Cerretelli et al., 2018). Because the residents of areas affected by such programs must believe in the value of the programs before they will be willing to participate, it's necessary for program planners and implementers to understand how these residents perceive these changes. This understanding will help the government to evaluate the influence of the changes and mitigate any unsuspected but serious consequences by exploring the experiences of local communities. This knowledge can improve the planning and implementation of an ecological restoration project that is conducted in regions where established agricultural landscapes will change to new land cover types, thereby affecting the culture and livelihoods of the residents (Chen et al., 2017). Researchers in environmental psychology research have found that people observe and value their surroundings for more than just the spatial quality; they also evaluate the changes over time, forms of maintenance, use for sensory experiences, and use options, among other things (Buchel and Frantzeskaki, 2015; Dou et al., 2017).

To deal with severe problems related to widespread soil erosion and land degradation and to restore or protect the ecological quality of agricultural landscapes, China's central government initiated a nationwide land retirement program called “Grain for Green”, also known as the Sloping Land Conversion Program, in 1999 (Jiao et al., 2005; Xu et al., 2010; Du and Sun, 2011).

Cultural ecosystem services (CES) are strongly associated with the ways in which people interact with and gain benefits from their landscape (De Groot et al., 2002; Chan et al., 2011; Daniel et al., 2012). CES include aesthetic services (Zanten et al., 2016), recreational services (Martin-Lopez et al., 2012), inspirations for art and design (Chen et al., 2017), cultural heritage (Tengberg et al., 2012), spiritual or religious inspiration (Smukler et al., 2012), and education and scientific opportunities (Arnaiz-Schmitz et al., 2017). In developed countries, CES are highly valued for their therapeutic and recreational benefits (Tielbörger et al., 2010). In contrast, societies in developing countries value CES more for their roles in cultural identity and survival (MEA, 2005). However, in contrast to more tangible and commonly used ecosystem services, such as the provisioning of food and drinking water, the intangible and subjective nature of CES makes it challenging to identify and value them (Chan et al., 2012b; Russell et al., 2013; Satz et al., 2013; Fish et al., 2016) The integration of CES into the ecosystem services framework therefore remains a challenge due to the difficulties associated with defining, articulating, and measuring CES (Bryce et al., 2016).

Although a number of studies have proposed CES assessment methods (Chan et al., 2012a; Tengberg et al., 2012; Van Berkel et al., 2014; Dou et al., 2017), the focus has been on factors that can be easily measured, such as tourism revenues or visitor numbers (Satz et al., 2013). The bias towards such easy-to-measure variables may lead to over-valuation of landscapes that attract tourists, and under-valuation of landscapes that form the daily environment of rural communities, such as agricultural landscapes. Some scientists have used more sophisticated techniques to assess CES appraisal, such as contingent valuation and hedonic pricing (Zhen et al., 2014; Chen et al., 2017), but these methods have been criticized both because they can under- or overestimate “willingness to pay” and because assigning monetary values to vulnerable public goods such as (cultural) ecosystem services is inherently risky (Chan et al., 2012b; Pleasant et al., 2014; Fish et al., 2016). This risk arises both because the values are highly subjective and because different socioeconomic groups may have greatly different willingness to pay, or equal willingness but different ability to pay.

In addition, CES have usually been studied in stable ecosystems, and little is known about how CES changes under ecological restoration, especially for large-scale, intensive programs such as Grain for Green (Lü et al., 2012; Liu et al., 2016). Under such programs, the changes of CES may be more directly perceived and experienced by residents of the program area, and their benefits may be appreciated in different ways, particularly for aesthetic services (e.g., appreciation of the beauty of the original or changed landscape), cultural heritage and identity services, spiritual or religious inspiration, and education and scientific opportunities (Langemeyer et al., 2015; La Rosa et al., 2016). Consequently, it is necessary to increase our awareness of and knowledge about the impacts of ecological restoration on the CES of the communities affected by the program to provide support for policy development and decision-making that will mitigate the impacts on these communities.

To help fill the knowledge gap, we designed a study to analyze the influences of Chinese ecological restoration policy on the CES of rural communities. To account for the subjective nature of perceptions of the value of CES, we developed an approach to assess the changes of CES under ecological restoration by identifying how local residents perceive CES and the relationships between these perceptions and the physical changes in their landscape.

2. Data and methods

2.1. Case study area

As a case study of our method, we chose Guyuan City, in the Ningxia Hui Autonomous Region of northern China, as our study area. (Note that