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# The impacts of farmers' livelihood endowments on their participation in eco-compensation policies: Globally important agricultural heritage systems case studies from China

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ABSTRACT

Eco-compensation should be given to farmers in order to promote the Globally Important Agricultural Heritage Systems (GIAHS) for a higher level of eco-services. However, differences in farmer's livelihood endowments and strategies can directly affect the initiatives of their participation in compensation policies, resulting in different effects of these incentive policies. In order to improve the efficiency of eco-compensation policies, this paper takes Zhejiang Qingtian Rice-fish Culture System (RF) and Yunnan Yuanyang Hani Rice Terraces System (RT) as examples and adopts the canonical correlation mode to analyze, from the perspective of the heterogeneity of livelihood endowments, the impacts of farmers' livelihood endowments on their participation in eco-compensation policies. The results showed that: (1) Cash compensation of the GIAHS eco-compensation program is a more popular method among farmers. The higher the comprehensive quality of the farmers is, the more acceptable the compensation polices will become and the higher their initiatives will be to participate in GIAHS conservation and agricultural production; (2) Land capital is a key positive factor influencing the satisfaction of the compensation policies of non-agricultural households and households with concurrent business. Human capital, on the other hand, is a negative factor influencing the initiatives of farmers' participation in the GIAHS conservation. (3) The material capital in the R-F will improve farmers' policy satisfaction, while financial capital and social capital can best affect the farmers' initiatives to participate in the GIAHS conservation. (4) The land capital and material capital in the R-T affect farmers' policy satisfaction. Material capital is also a positive factor influencing the initiatives of agricultural conservation.

## 1. Introduction

In today's world, farmland ecosystems provide not only functions for production, but also significant ecosystem services for human survival and development (Costanza et al., 1997; Li, 2001). However, many external economic benefits of these ecosystem services are not often reflected in the market, so it is difficult to incentivize farmers to adopt environmentally sound agricultural practices (Abbona et al., 2007; Rist et al., 2007). Therefore, the eco-compensation mechanism, as a type of public institutional arrangements that internalizes the economic externalities of ecological protection, is one of the important ways to protect farmland ecosystem (Liu et al., 2014).

Western industrialized countries were among the firsts to facilitate farmland eco-compensation policies, such as the Permanent Prairie Cover Recovery Program (PPCRP) of Canada, the Conservation Reserve Pro-gram (CRP) and the Environmental Quality Incentive Program (EQIP) of the United States, the Common Agriculture Policy (CAP) of European Union, etc. These programs, considered as successful practices, have been learned and widely promoted in countries such as Australia and Japan.

An effective incentive is needed to motivate farmers to implement conservation measures on farmlands, which depends on whether the farmers are satisfied with the implementation of the policies and whether they are incentivized as expected (White, 2001; Erdogan et al., 2007). Therefore, the participation of farmers, as one of the important indicators of the effectiveness of the implementation of the eco-compensation policies, has gained extensive attention. For example, Mishra and Khanal, (2013) in the United States found that the main factors affecting farmers' participation in agricultural environmental programs (such as conservation and reserve programs as well as environmental quality incentives) were liquidity and solvency. Home et al. (2014), from the perspective of individual and regional characteristics of

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farmers, have studied and found that different identities and policy expectations in Swiss directly affect the farmers' satisfaction of the compensation policies for arable land protection. Hounsome et al. (2006) analyzed the influencing factors of farmers' participation in the rural environment project in Wales, and revealed that mental health has demonstrated positive effects from project participation. Defrancesco et al. (2008) argues that the initiatives of farmers to participate in agricultural and environmental projects can be affected by factors such as household income, individual attitudes and beliefs. In addition, from the perspective of the participation of farmers, Chinese researchers accessed the implementation effectiveness, barriers and efficiency deviation of the farmland protection and compensation practices in Chengdu, China (Yang et al.,2016). The study shows that the incentive measures of the compensation policy can mobilize the initiatives of the farmers to some extent, and can help promote grain production and raise the farmers' income. Of course, there are many other socio-cultural and political factors that influence the incentives of farmers, which deserve further studies.

However, farmers' various livelihood strategies lead to significant differences in individual perception and effectiveness of incentives of the eco-compensation policies (Hagmann and Chuma, 2002; Söderqvist, 2003). Different livelihood endowments and strategies can directly affect the initiatives of farmers' participation in and response to the compensation policies. It is a pity that although studying the livelihood or participation of farmers is gaining popularity, there is few studies about the relationship between farmers' livelihood endowments and eco-compensation policies. Therefore, based on related studies and research data of Zhejiang Qingtian Rice-fish Culture System (R-F) and Yunnan Yuanyang Hani Rice Terraces System (R-T) in 2015, from the perspective of the heterogeneity of livelihood endowments, this paper accessed the impacts of farmers' livelihood endowments on their participation in eco-compensation policies and aimed to improve the efficiency of eco-compensation policies.

## 2. Study areas and methodology

### 2.1. What is GIAHS

Concerned with increasing food insecurity, marginalization and poverty of small-scale family farmers, environmental degradation driven by unsustainable agricultural practices, monoculture, human-induced biodiversity loss and adverse impacts of climate change compounding the vulnerability of agriculture-based communities in developing countries, the conservation and adaptive management of Globally Important Agricultural Heritage Systems (GIAHS) was one among more than 300 initiatives launched at the Johannesburg Summit in 2002. FAO introduced GIAHS as a global initiative to reverse negative trends and become a driving force of change.

Defined as "remarkable land use systems and landscapes that are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development", GIAHS is a holistic approach that aims at empowering communities to draw on their rich agricultural heritage and knowledge systems to sustainably use and manage local resources to strengthen resilience and improve food and nutrition security and livelihoods.

Since its beginnings in 2002, the GIAHS initiative has been a driver in shifting policy and research trends; specifically research initiatives integral to validating traditional knowledge, raising awareness about the scientific soundness of this knowledge and integration of traditional knowledge in policy making. Community-based dynamic conservation embedded in traditional knowledge has emerged at a time when the science of ecology, the various fields of applied ecology and the policy initiatives they guide appear to be going through three conceptual shifts: a shift from narrow reductionism to a holistic systems view of the world, a shift to including humans in the ecosystem, and a shift from an expert-based approach where management plans are drawn up by experts far removed from the communities and ecosystems to participatory conservation and management.

Examples of systems included in GIAHS range from mountain rice terrace agro-ecosystems, multiple cropping/polyculture farming systems, understory farming systems, ancient irrigation and below sea level systems, soil and water management systems, to nomadic and semi-nomadic pastoral systems (Bai et al., 2013). The criteria for selection of the aforementioned system types is that the system must be a socio-ecological landscape, preserved and transmitted over time a body of traditional knowledge systems, with a high degree of biocultural diversity and agrobiodiversity, human-managed systems that over time have developed secondary nature landscapes with aesthetic beauty, systems that go beyond mere production of food and fibers but dynamic ones with socio-cultural functions and diversity.

### 2.2. Study aeras

As one of the first countries participating in the early work of FAO/GIAHS, China already has 15 GIAHS. China has accumulated a great deal of experience in the scientific research and management practice of the dynamic conservation of GIAHS, which provides a useful reference for promoting the GIAHS work of the FAO and other countries.

In 2015, the GIAHS Steering Committee of Chinese Ministry of Agriculture suggested that in order for the GIAHS to "provide different combinations or higher levels of environmental services", it would be necessary to "compensate farmers for the loss of revenue due to the modes of production". Eco-compensation policies can not only encourage farmers to adopt environmentally friendly production methods to give full play to the ecological functions of GIAHS, but also compensate for their increased costs and production losses due to the use of traditional production methods, so that farmers can internalize their external contributions (Min et al., 2016).

According to different levels of economic development and different compensation methods, we selected the Zhejiang Qingtian Rice-fish Culture System (R-F) and Yunnan Yuanyang Hani Rice Terraces System (R-T) as study areas, in which the main agricultural production mode is feed fish in rice field (Table 1). The most prominent example of fisheries as an integral element of agricultural heritage systems is the China rice-fish culture. Often referred to as the prototype of fresh water aquaculture, rice-fish culture has long contributed to the food and nutrition security of China. Nearly 2000 years ago, there was documentation of fish culture in paddy fields. This system is a comprehensive resource use system. Rice feeds and shelters fish and fish help control weeds and pests, loosen soil and fertilize the field. Under this cycling system, chemical use is minimized while biodiversity increased (Zhang et al., 2012; Li et al., 2016). China is currently exploring future potentials of rice-fish culture as a key to food and nutrition security and agri-environmental schemes. According to the State of the World Fisheries and Aquaculture 2012, China is the main producer of rice-fish culture, with an area of about 1.3 million ha of rice fields producing 1.2 million tons of fish and other aquatic animals in 2010. Considering that approximately 16.6 million, an equivalent of 30% of all the employed in the fisheries sectors, were engaged in fish farming in 2010, the systems' contributions to the communities they support are multifold.

Zhejiang Qingtian Rice-fish Culture System is located in Qingtian County of Zhejiang Province along China's southeast coast, and was

**Table 1**
GIAHS for Case Studies.

| | Location | Area /hm$^2$ | Income /Yuan | Compensation method | Compensation standard |
|---|---|---|---|---|---|
| R-F | Zhejiang | $0.7 \times 10^4$ | $1 \times 10^4$ | cash subsidy | 6532 Yuan/hm$^2$ |
| R-T | Yunnan | $2 \times 10^4$ | $0.3 \times 10^4$ | price increase | 9.52 Yuan/kg |