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Values and Conservation of Honghe Hani Rice Terraces System as a GIAHS Site

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Abstract: Agri-cultural Heritage Systems (AHS) have not only various values but also important enlightening roles for modern agriculture. With agro-scientific and technological progress, the traditional agriculture that has lasted for thousands of years is declining gradually, thus is attached the importance of exploring and protecting our AHS. As a traditional agricultural system for 1300 years, the Honghe Hani Rice Terraces System (HHRTS) has many significant characteristics such as beautiful landscapes, distinctive rice varieties, ecologically clean agricultural production systems, systematic methods of managing water and soil and special ethnic culture. It was designated successively as a Globally Important Agricultural Heritage System (GIAHS) in 2010 and as a World Heritage (WH) in 2013. In this paper, taking HHRTS as an example, we analyzed the economic, ecological, aesthetic, cultural, and social values, as well as the research values, of the GIAHS. We conclude that the restrictions on increasing peasant earnings and improving their living standards are difficult with the low efficiency of traditional planting patterns and the single-industry structure of farming in rugged terrain. However, these restrictive factors are beneficial for developing some industries like green agriculture, organic agriculture or ecological food production because of the clean farmland environment. In the end, we propose the basic approaches to protect the Hani terraces agriculture system should include the local governments to encourage the development of ecotourism, organic agriculture and featuring agriculture by multi-mode economic compensation. It is very important for protecting terraces to coordinate benefits among corporations, governments and villagers by making reasonable policies of compensation.

Key words: Honghe Hani Rice Terraces System; Globally Important Agricultural Heritage Systems (GIAHS); cultural landscape; multiple values; eco-cultural compensation

1 Introduction

Under the impetus of science and technology, traditional agriculture is being replaced by petroleum agriculture with mechanization, automation and chemicalization (Dwivedi 2003; Singh 2005), causing many negative effects such as biodiversity loss, water and soil contamination, food unsafety and so forth (Pham et al, 2011; Liu et al, 2013). With a high demand for their life quality, the public are increas-

ingly paid attention to food quality and security, and begin to re-think the values of existing traditional agriculture systems. For example, bio-dynamic agriculture was proposed in the 1920s, and then organic agriculture was defined and given relevant standards in America in the 1980s (Ma and Joachim, 2006). The Food and Agriculture Organization (FAO) launched the Globally Important Agricultural Heritage System (GIAHS) initiative in 2002. Ministry of Agriculture (MoA) of

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China started Nationally Important Agricultural Heritage System (China-NIAHS) programme in 2012 for conserving agricultural systems with outstanding historical, cultural, ecological and economic values (Min, 2006). With increases of different classes of Agri-cultural Heritage Systems (AHS), how to effectively protect benign agriculture has become an important problem that must be solved because there are precedents in failing to conserve heritages well. For example, Ifugao Rice Terrace was inscribed in the List of World Heritage in Danger in 2001 by United Nations Educational, Scientific and Cultural Organization (UNESCO) due to failing to get effective conservation (SITMo, 2008). Thus, the conservation study for GIAHS sites is a significant topic in GIAHS work.

AHS is a harmonious agri-cultural system comprising humanity getting along with nature, which is formed in the interactive process of human production and land care. In addition to producing safe food, it also produces outstanding landscapes. Moreover it has many significant functions, including conserving agricultural biodiversity which has world-wide significance, maintaining restorable ecosystem and inheriting traditional knowledge and cultural activities. AHS sites usually are found in relatively backward areas, and most people in the regions still live following traditional life habits and old planting patterns. However, because of the growth of inter-regional communication, many people became dissatisfied with their low living standard and began to leave their hometown for jobs that could earn much more incomes. At the same time, local people gradually began to use modern science and technology products for improving production efficiency. Furthermore, some elements of AHS like traditional agricultural ecosystems, folk costumes, traditional customs, carefully kept agricultural landscapes and traditional villages are disappearing little by little (Min, 2006). Therefore, protection of AHS is extremely urgent and has important implications due to its many values and practices.

The Honghe Hani Rice Terrace System (hereinafter referred to as HHRTS) is a GIAHS and a famous world cultural heritage site, and also very typical in agro-cultural heritage sites (Min, 2007). Therefore, it has generated considerable interest among researchers in various subject areas. Many studies were conducted in HHRTS. Some studies indicated that population structure change with urbanization and agricultural industrialization has led to lose of traditional knowledge (TK) (Yuan et al, 2014) and labour shortage for the cultivation and maintenance of the rice terraces (Gu et al, 2012). And some showed the soil organic matter decreased and soil erosion became heavy in Hani terrace regions with the paddy field being changed into dryland (Li, et al, 2015; Tarolli et al, 2014). However, the research on protection for HHRTS is still very limited, especially, what to protect for HHRTS and how to protect them were hardly studied. Taking the Hani terraces as a case, this paper will propose a protection measure of economic

propose a protection measure of economic compensation for AHS through analyzing its multiple values and the relationship between conservation and development, hoping to provide a reference for the protection of other AHS systems.

2 Multiple values of HHRTS

HHRTS is a comprehensive system that includes not only natural elements like landforms, and natural organisms, hydrology, climate, but also man-made landscapes such as terraces and water canals (Lasanta et al, 2001; Liu, 2013), as well as intangible cultural elements which refer to agricultural cropping system practices, village customs, local rules and regulations, economy, religion, politics and rural organizations and so on (Xu et al. 2009). The Hani terraces are largely distributed on hillside areas within an elevation from 1300 to 1700 m, which have been built through thousands of years by the Hani Ethnic Minority who are only found in Yunnan Province. In addition, the Hani people created a unique eco-agriculture system and cultural life based on the terraces. HHRTS includes the terrace and its culture which is complex and diverse (He et al, 2012, Fuller and Min, 2014). Therefore, it has multi-values that include economic, ecological, aesthetic, cultural and societal value, as well as scientific research value, and these values are a best display of its comprehensiveness.

2.1 Economic value

HHRTS can produce economic earning for farmers in a variety of ways. Under the rugged landform and complex climate conditions, the Hani people have created a compound agricultural system containing three-dimensions such as different cropping system of rice in different altitude (Table 1), rice-fish patterns, and a rice-duck combination. All these systems can produce diverse agricultural products including a variety of rice, fishes, ducks and birds eggs, aquatic animals such as spiral shellfish, rice-field eels and loaches, aquatic plants like aquatic taro and lotus roots, wild herbal plants grown in farmland ridges containing aquatic celery, plantain herbs and *houltuynia cordata* etc. Moreover, the forests on the top of the mountains can also produce fruits and mushrooms. Because chemical fertilizer has hardly been used on the farmland, clean water, air and soil environment in the Hani terraces gives it many advantages to develop organic agriculture. For example, it needs a shorter conversion period than other areas. With increasing attentions paid to food safety, the suitable conditions for developing organic production will bring large benefits for local farmers. The characteristic rice varieties also raise income for local farmer in that they have higher prices than conventional rice varieties. In addition, the HHRTS landscape with "flowing beauty" derived from seasonal vegetation changes and quick weather shifts in a day is an extremely attractive tourism resource. Tourism will also enhance economic benefit for farmers if developed carefully.

Table 1 Three-dimensional distribution of HHRTS

Terrace types	Altitude and extent of location	Cropping system
Terrace in North tropical river valley	South slope < 800 m; North slope < 700 m	Double cropping rice
Terrace in south sub-tropical middle mountain	South slope 800-1200 m; North slope 700-1200 m; North slope 450-1200 m	Double cropping rice
Terrace in middle sub-tropical middle mountain	1200-1500 m	Single cropping rice
Terrace in north sub-tropical middle mountain	1500-1800 m	Single cropping rice
Terrace in south temperate mountainous area	1800-2000 m	Single cropping rice

2.2 Ecological value

The Hani rice terraces have unique landscape characteristics which composed of forests, villages, rice terraces and water system, called the four elements of the system. The flow process of substance and energy of the structure is as follows: natural precipitation → overland runoff/water storage → forest → village → terraced farmland → river. The level terrain and field ridges make soil, sewage and excrement in overland runoff flow into each step of terrace field by reducing runoff speed. Eventually the water flowing into the river is purer. The measured data indicated that N and P content in the water from villages is higher than other places (Fig. 1). Therefore, the Hani terraces have the function of purifying water quality (Zhang et al, 2010). Moreover, this function can utilize the fertilizer from villages for crop growth (Cui et al, 2010). The complete cycle system of the Hani terraces not only improves efficiency of resource utilization while maintaining a clean environment of farmland (Table 2), but also prevents soil erosion for village safety. Besides, it also has more advantage in defending extreme drought than other agroecosystems (Bai et al, 2013). In sum, the landscape characteristics of the Hani terraces have the effect of maintaining the stability of the whole terrace system.

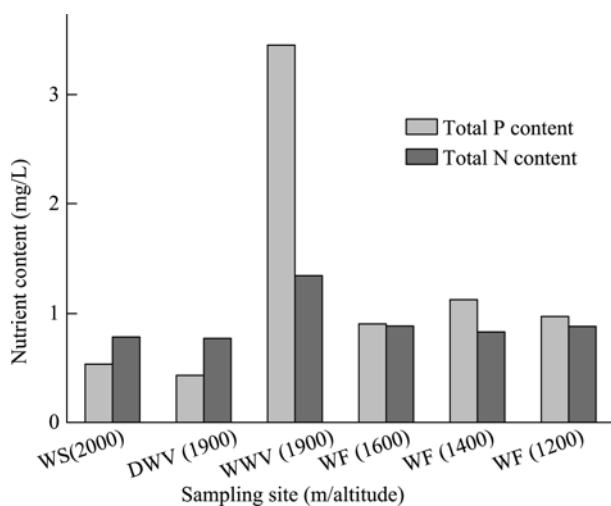


Fig.1 Contents of TN and TP in water from different elevations in the Hani terraces system
 Note: WS is "Water Source"; DWV is "Drinking Water in the Village"; WWV is "Waste Water from the Village"; WF is "Water Field"

Table 2 Comparison between contents of soil nutrition in the Hani terraces and environmental quality national standards of pollution-free food

Nutrient types	Mean value of soil of rice field in Hani terraces	Environmental quality standard on national green food producing area (NY/T391-2000)	
		Grade	Content
Organic matter (g/kg)	25.09	I	>25
		II	20~25
		III	<20
Total N (g/kg)	1.25	I	>1.2
		II	1.0~1.2
		III	<1.0
Available P	15.48	I	>15
		II	10~15
		III	<10
Rapidly available K	120.16	I	>100
		II	50~100
		III	<50

The Hani terraces system has many other ecosystem service functions, such as conserving germplasm resources (48 of local rice breeds (He et al, 2012)), maintaining biodiversity (more than 200 paddy weeds, a great many invertebrates, as well as cranes and ibises), regulating micro-climates and carbon sequestration (Mi et al, 2012). Especially, diversity of rice varieties can improve the power of crops resisting diseases and insects according to the research finding published by Zhu et al (2000) in the journal "Nature".

2.3 Aesthetic values

The Hani terraces are considered to have great beauty. The landscape in which mountains encircled the narrow and long terraces following the contours like silk ribbons make people experience appreciative shock and a sense of mystery (Zhang, 2005). Green, thick forests draped on the top of the mountains (Fig. 2a), traditional structures in villages-"mushroom in the middle of mountains" (Fig. 2b), layer on layer of terraces extending from villages to valley bottoms, are all elements that form a beautiful picture. The pictures are regularly changing with the seasons. The landscape of shining water surface and linear terrace ridges sometimes covered by a layer of mist in Winter and Spring



Fig. 2 landscapes of Hani terraces

is like a quietly elegant wash drawing (Fig. 2c). When Summer is coming, the terraces are dressed with a green coat (Fig. 2d). The coat is replaced by golden yellow clothes in Autumn. The dynamic beauty is readily shown by the color changes of the Hani rice terraces.

The labor scene is another point of beauty in the Hani terraces. Farmers transplanting rice seedlings and harvesting the rice in Autumn, picking mushrooms in the forest, cattle or horses being loaded with the grains and walking on the narrow terrace ridge to home, these labor scenes show human diligence and dignity. Enthusiasm and hospitality of the Hani people suggest a peaceful mind. Delicate and magnificent costumes made by these people indicate the wisdom and skill of the Hani people.

Furthermore, the Hani terraces system occupies ecological beauty. In addition to creating a benign cycling landscape structure, Hani people form a round of ecological culture to maintain harmonious coexistence between humans and nature (Gu et al, 2012). Examples are “running fertilizer to farmland by waterpower” and life facilities that waterpower drives such as waterpower grinder, waterpower roller, which can reduce polluting energy to use. Other aspects also demonstrate ecological characteristics of the Hani terraces culture. For example, water management institutions which regulate responsibilities of each household to repair trenches, water assignment methods, terrace exploitation and maintenance also have explicit standards. The culture of worshipping and banning hacking forest presents that Hani people emphasize ecological environment since ancient times. In

HHRTS, forest lands provide water for villages and terraces, and then terraces supply water to forests below, and then the water flows into more terraces (Liu et al, 2012). The model of “forest cultivating fields and fields fostering forest” also shows inner ecological beauty of the Hani terraces system.

2.4 Social-cultural values

In the process of agricultural production over the long term, Hani people have created lots of cultural habits based on the rice terraces. The terraces are foundation of Hani people identifying each other belonged to the same people. Where Hani people live there are undoubtedly terraces. Terraces are the defining characteristic of Hani culture. “Four seasonal production melodies” is an easily understandable song of the Hani people, which is a most important medium for passing agricultural knowledge from generation to generation for the minority group. The song contains agricultural production processes, customs, agricultural technology, and refers to a calendar that marks the dates of seasonal change. Many polyphonic folk songs of the Hani ethnic minority closely connect to rice labor. Their content usually refers to praising labor, eulogizing love and admiring beautiful scenes of farmland, of which “mountainous song of sowing rice seedling” is the most representative. Therefore, understanding terrace culture can help people understand terrace agriculture.

Due to the closed mountainous environment, Hani people have formed cultural characteristics of dependence each other and a mental structure of following traditional customs,

and therefore they have strong ethnic consciousness and ethnic sense of honor (Bai, 1989). The population management institution in Hani people is an important cultural phenomenon. When the terrace and water in an area is not sufficient to meet the demand of growing population, the village separation strategy is to deal with the resource limitation. Generally, young men in a family remove from original village to a new place to create a sub-village for dwelling. Another significant cultural phenomenon in Hani people is the water allocation institution, which makes all the families in a village, or between different villages share the water equally by intricate ditches (Hua and Zhou, 2015). These features ensure the social stability of the Hani people.

2.5 Scientific research value

The HHRTS has scientific value for researchers in various disciplines. Vocal culture passed down from generation to generation by Hani people has high values for language researchers and historians. For example, the song “Hani apeichungpopo” that has been written down about immigrant history over a long period has important values for social science researchers because they can understand ancient cultural evolution through studying it (Minc, 1986). The matter and energy cycles of the Hani terraces is a demonstration of sustainable use of land that could be of use in other mountainous areas. Diversity of rice breeds can provide conditions of breeding new rice varieties plant breeders. Wild medicinal plants utilized by Hani people are important raw materials for many medicines and their use knowledge

has enlightenment role for modern medicine research. Meanwhile, these wild plants and their relevant knowledge also belong to research scope of ethnobotany, thus they have important research values to Medicine Ethnobotany (Ghorbani et al, 2011). In addition, HHRTS is significant for research in art, ethnology, sociology and anthropology.

3 Conservation countermeasures for HHRTS

3.1 Protecting the content and solving key problems of HHRTS

3.1.1 Protecting content

The five values of HHRTS above are, indeed, attached to the three components of HHRTS which are landscapes, ecosystems and the traditionally characteristic culture of Hani people. Therefore, if the five values are maintained sostenuto, the three components must be conversed well through many measures. The three components of HHRTS cover plenty of elements (see Fig. 3). Terrace landscapes include macro terrace landscape, labor landscape in terraces and cultural landscape of the Hani people. Ecosystem of terraces refers to farmland biodiversity, crop germplasm diversity, soil and water conservation and the farmland environment which includes soil quality, water quality and air quality. Key points of the cultural protection are celebrations, custom, religious faith, native costume, folk management institution of agricultural production, and oral culture. In fact, all the elements of the three components are closely linked together. As a result, the HHRTS must be conserved as a whole.

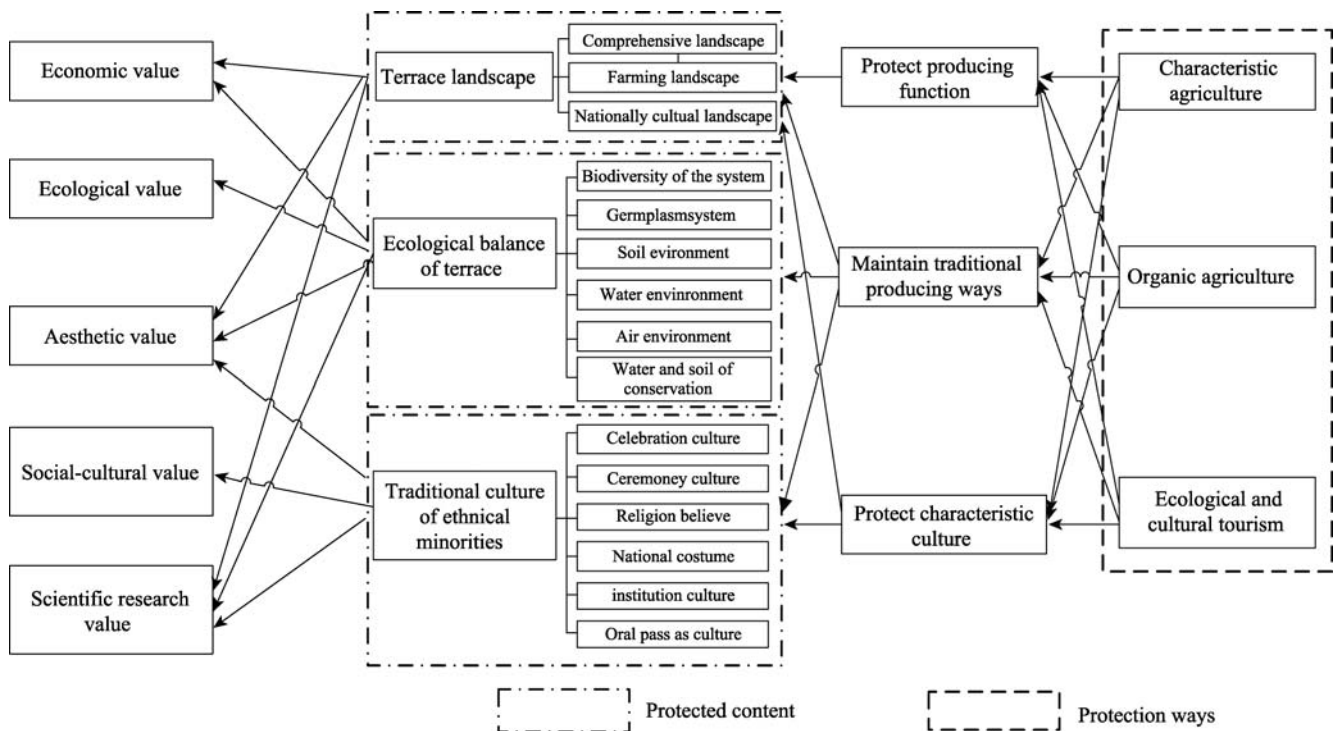


Fig.3 the contents of protection and the approaches to protection of the Hani terraces system

3.1.2 The characteristics of AHS and solving key problems of HHRTS

AHS is different from other types of heritage. First, it is living because crops, livestock and agricultural activities are important parts of it. Then, dynamic nature is another characteristic of it, namely, AHS is changing with modern technology development. Besides, AHS is an integrated system, which it is a comprehensive body constituted by landscape and intangible cultural elements (Min, 2009; Fuller and Min, 2013). As to HHRTS, the terrace landscapes, the traditional rice varieties and folk culture in HHRTS mainly relied on continual terrace production function to exist. If the paddy fields are deserted, the landscapes and present ecosystems will disappear or change and the traditional culture system will be broken. Therefore, to ensure that Hani people can continue planting crops through ecologically traditional ways is the core of the protection challenge. The conservation of AHS and its development are, indeed, to promote mutual development. Thus, an effective approach to HHRTS protection is to establish a balanced orientation for rising economic income of farmers in terraces by new and old ways.

3.2 Protection and safeguard mechanism of HHRTS

3.2.1 Protection approaches of HHRTS

Frequent occurrence of the food safety problem and ecological environment deterioration have attracted attention focusing on food health, therefore green food, clean environments and especially traditional culture of ethnical minorities will have wide markets. Reasonable industrial development is an important protection approach. Thus, developing tourism, organic agriculture and local characteristic agriculture are better ways that should be considered.

As far as the type of farming is concerned, choosing organic agricultural production is preferred to conventional agricultural production for HHRTS. On the one hand, HHRTS enjoys a cleaner farmland environment than modern agricultural regions, thus it need not so long period of organic conversion for organic production. On the other hand, without high efficiency of mechanization production, planting rice needs more consumption of labor power for farming in HHRTS than in plain area. This leads to higher production cost of rice in HHRTS than in plain area according to the research by Zhang et al (2015). Therefore, to conduct organic agricultural production will not only improve income of farmers due to higher prices of organic food, but it also will maintain the ecological balance of terrace field with nonuse of pesticides and chemical fertilizers, and also maintain traditional planting ways. In the process of implement organic agriculture, however, governments should make compensation policies such as ecological compensation or product price compensation for reducing operational risk for those farmers whose products is in the period of organic conversion (Zhang et al, 2015).

Ecological tourism and folk culture tourism could be developed for propelling terrace landscape protection for example. Pure air and water, beautiful terrace landscapes and folk culture are attractive tourism resources for urban residents. To develop tourism depending on the advantage of these resources can let local people get new chances to earn money for improving their living. Correspondently, in order to continually keep the benefits from tourism, those local people themselves will have to maintain these terrace landscapes and ecological environments by cleanly farming, and retain their traditional culture such as ceremonies, custom, food, dances, institution and costumes. So, apparently, tourism development can play an important role in conservation of HHRTS, but a reasonable mechanism for interest allocation must be created by local governments.

In addition to organic agriculture and tourism, developing local characteristic agriculture is also an effective means to enhance profit of per unit area for the continuity of planting in the terraces. In HHRTS, red rice, duck eggs, bamboo shoots, loach, medical herbs and so forth are characteristic agricultural products. These products not only have good taste but also high nutritional values. For example, research shows red rice has more significant advantage in trace element contents that are good for human health over white rice (Wang, 2007). These characteristic products usually have a high premium rate and a large blank market, thus farmers can gain more profit from them. At the same time, these characteristic crops in HHRTS and its relevant culture like food culture, farming culture can be passed on from one generation to another.

3.2.2 Economic compensation methods for industrial/economic developments

If the approaches listed above are carried out, it must take some measures to ensure income of farmers as protagonists. However, in fact, enterprise benefits are generally captured by the main body of market of tourism and tourism companies gain most profits. How to deal with the relationship between enterprises and farmers is an important problem. For example, before certificated, organic agriculture has a transfer period that the products cannot be sold as organic products, thus some policies for maintaining benefits of the planters must be provided. As far as local characteristic products are concerned, going into market needs a process, thus local government also should adopt support for stabilizing income of farmers until they are well established. We think that these questions can be solved through three economic compensation methods (Fig. 4).

The first method is that tourism enterprises pay fees to relevant farmers. Tourism developments of Hani terrace are dependent on terrace landscapes, their folk culture and good natural environments, therefore farmers engaging in agriculture is of primary importance in maintaining the landscape. In this respect, farmers make huge contributions to

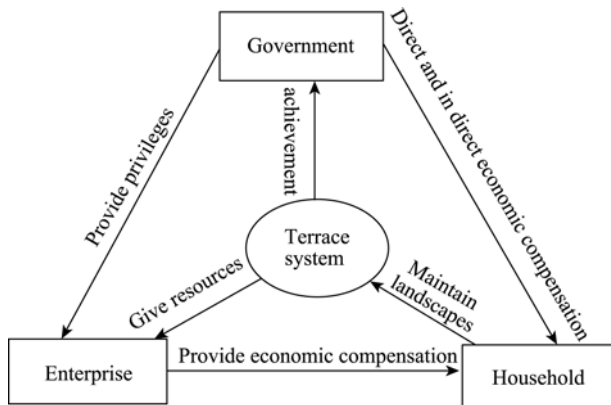


Fig.4 The approaches of economic compensation to peasant households in industrial/economic development process of the Hani terraces

tourism. Observing agricultural production scenes and village life are important tourism resources. Consequently, tourism enterprises should give ample compensation to farmers on the basis of their contribution. Many methods of pay can be considered for encouraging plantation of rice, such as cash payment, dividend policies, or participating in tourism activities.

The second one is that governments compensate farmers by transfer payments. There are two ways to do this in transfer payments by governments. Firstly, local governments pay an amount of money to farmers according to national standards. Secondly, local governments or enterprises compensate the farmers who plant organic agriculture due to the low price of products and little yields in the transfer period. Only if these are provided can organic agriculture grow.

The third one is that indirect compensation propels organic and characteristic agriculture. Government investment or privilege of policy to new transitions is a sustainable and indirect approach. In recent years, organic, green and characteristic products as well as related products for markets are far higher than common agricultural products. The Hani terrace has environmental advantages for developing these agricultures, thus it is advisable and feasible that increasing farm income per unit by developing ecological and characteristic agriculture and processing agricultural products achieves the aim of protecting the terraces.

The three compensation methods can maintain income stability of farmer, from beginning to completed certification of the several types of agriculture. Thereby these agricultures can develop successfully to protect the essential Hani terrace system.

4 Discussion and conclusions

AHS possess multiple values including economic, ecological, aesthetic, socio-cultural and scientific benefits for locals and for society, thus conserving the Hani terraces has important strategic significance. Most AHS are located in poor mountainous areas, and they still persist in using traditional

approaches in agriculture. However, with quickly improving communication and information appliances, the concepts of farmers are changing. As a heritage type, the living state and dynamic nature of AHS are significant characteristics different from other heritages. The two characteristics endow AHS with substantial economic potential. Thus, boosting economic value of AHS is a significant means of propelling its conservation. In response to natural characteristics of HHRTS, developing tourism, characteristic agriculture and ecological agriculture are the best protection approaches for it.

Different from other heritage sites, AHS protection, indeed, has been directly implemented by farmers over many centuries. Today, how to coordinate the tasks and benefits among farmers, enterprises and governments is a key research subject. This paper has put forward several methods at the macro level to encourage special types of agriculture, but micro protection mechanism research is also an important research orientation for agricultural conservation. The mechanism of profit division between enterprises and farmers, economic standards of governments compensating farmers, organization types of agricultural production in heritage sites, are research focuses for HHRTS in the future.

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哈尼梯田农业文化遗产价值分析及保护模式探索

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摘要: 农业文化遗产具有多种重要价值, 对现代农业发展有重要的启示作用, 然而, 随着科学技术不断进步, 延续几千年的传统农业濒临消失, 因此农业文化遗产发掘与保护越来越受到重视。本文以哈尼梯田为典型案例, 总结出哈尼梯田农业文化遗产具有经济价值、生态价值、美学价值、文化价值、科研价值和社会价值等多重价值。分析得出, 哈尼梯田低效的传统种植方式、单一的产业结构和崎岖的地形制约了农民收入提高和生活水平改善, 是导致劳动力外流的根源问题。但是, 从另一方面看, 这些限制却又使其具有发展诸如绿色农业、有机农业和生态农产品加工的优势。通过多模式的经济补偿方式, 鼓励发展生态旅游、推广有机农业和特色农业, 以产业发展促进哈尼梯田的保护是根本的保护途径。

关键词: 红河哈尼稻作梯田系统; 全球重要农业文化遗产; 文化景观; 多重价值; 生态与文化补偿