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journal or publication title	世界遺產学研究
volume	Special Issue
page range	11-16
year	2017
URL	http://doi.org/10.15068/00148443



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■ Abstract

The Hualien District Agricultural Research and Extension Station (HDARES) has actively helped indigenous tribes to build stable, high-quality crop production systems, develop organic farming, and adopt the concept of eco-agriculture. In doing so, the HDARES helps locals to maintain biodiversity, sustain food production, improve their livelihoods, and protect the ecosystem.

To protect indigenous traditional wisdom, HDARES focuses on recovering indigenous and organic farming technology and industry. The community of the Xinshe Tribe recovers and applies its traditional farming skills, making efforts to maintain the cultural customs of the Kavalan ethnic group. The Fushin Eco Farm introduced organic pest control measures to implement the concepts of the Satoyama Initiative. Thus, the work of HDARES is oriented to the recovery of nature-culture linkages in agricultural landscapes for the conservation of biodiversity and cultural traditions.

KEY WORDS: indigenous traditional culture, eco-agriculture, leisure tourism industry

■ 1. Introduction

Agricultural landscapes are expressions of the interrelations between cultural and natural heritage; according to research, the continuation of traditional systems produces higher biological and cultural diversity (Fan et al., 2013; Yen et al. 2016). Eco-agriculture is a system that supports both agricultural production and biodiversity conservation while working in harmony to improve the livelihoods of rural communities (Scherr and McNeely 2002); for example, producing crops with less pollution or damage to the environment. This approach enhances the role of traditional agriculture in food security and ecological conservation, increases the competitiveness in the high-quality agricultural industry, and ensures its sustainable development.

For centuries, many indigenous peoples have developed, maintained, and adapted different types of eco-agriculture systems. Their knowledge, traditions, land use practices, and resource management institutions are essential to the development of their viable eco-agriculture systems; however, due to modernization, migration, and aging population, decreased emphasis has been placed on traditional knowledge, to the point that it is disappearing.

The Hualien District Agricultural Research and Extension Station (HDARES) is responsible for conducting agricultural experiments and research for Hualien and Yilan counties in Eastern Taiwan as well as performing multifunctional operations such as, demonstration and extension, farmers' education and marketing counselling, and

technological and technical collaborations. In addition, HDARES has become a regional center for agricultural research development and extension. The work of HDARES is closely related to farmers' rights and interests as well as to the construction of rural areas. Therefore, the functions of HDARES are crucial for the agricultural development of Eastern Taiwan.

The offices of HDARES are based in the Hualien and Yilan counties of Eastern Taiwan (see Figure 1). These counties cover 6,772 km², of which more than 13% is alpine hillside. Among the 736 km² of arable land (10.9% of the total land area), paddy fields cover only 293 km² (39.8% of arable land) while dry land covers the remaining 443 km² (60.2% of arable land).

The main cultivated crops of Hualien County are rice, maize, tea, pomelo, watermelon, plum, peanut, lily, and sweet potatoes, while that of Yilan County are rice, cabbage, kumquat, orange, pomelo, tea, onions, wax apple, Yin Liu, and garlic.

The area of arable land in Hualien County is mostly covered with calcareous schist alluvial soil, shallow soil and gravel that causes poor soil fertility, while that of Yilan is slate alluvial soil, which causes poor drainage in some areas. This geographical area is characterized by mountainous terrain and steep slopes, short and rapid rivers, and frequent typhoons, earthquakes, and other natural disasters. Among the region's households, 47,188 (15.5% of the total number of households) live from agriculture and 202,000 people (25% of the total population) are farmers (HDARES 2014).

In this context, HDARES has subscribed to the Satoyama Initiative, an international

action plan created by the United Nations University and the Japanese government, which aims to encourage the preservation and utilization of biodiversity. At the core of the initiative is the concept of "socio-ecological production landscapes and seascapes," which encompasses the ecological habitat formed through the long-term interaction between humans and nature as well as the dynamic landscapes utilized by humans. (IPSI 2017) In landscapes and seascapes utilized for ecological production, natural resources may be used, then recycled, and used again. Additionally, the values and importance of traditional culture should be recognized, thus striking a balance among sustainable food production, people's livelihoods, and ecosystem protection. In this way, the Satoyama Initiative promotes the recognition of cultural values in productive landscapes, supporting the interlinkages between nature and culture that contribute to environmental conservation, especially biodiversity conservation.

2. Strategies of HDARES for the conservation of the agricultural landscape in Eastern Taiwan

2.1 Development of ecological farming and conservation of the agricultural landscape

HDARES develops organic production technology and techniques for crops and cultivates this knowledge in farmers, helping Eastern Taiwan to become an organic production hub in Taiwan. In recent years, organic research conducted by the HDARES has further ventured into the field of ecology with studies performed to identify ways to create

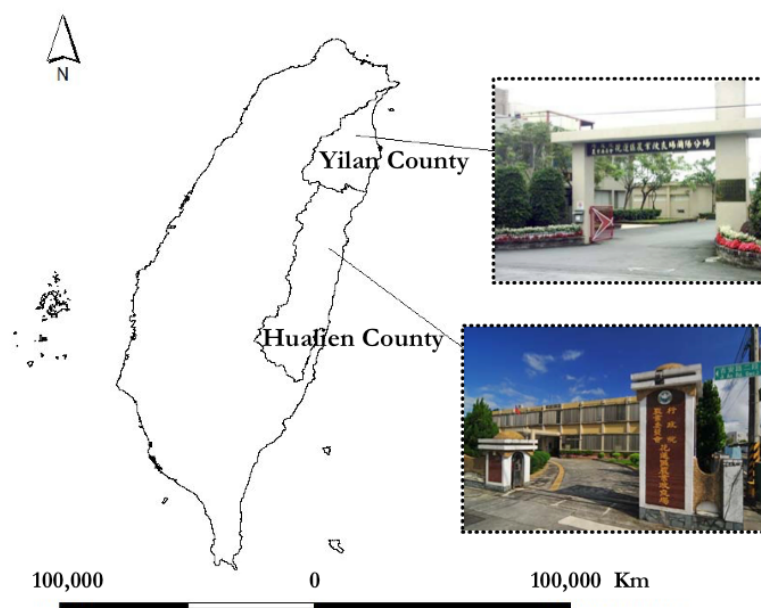


Figure 1. The location of HDARES in Taiwan

diverse biological habitats inside organic farmland, to develop techniques for operating and managing ridge vegetation, and to teach farmers to use the principles of ecological balance for pest control. These efforts have reduced the costs incurred by farmers in pest prevention and control, elevated their revenue, and facilitated the sustainable development of agricultural production.

Also, over the past few years, the HDARES has actively helped indigenous tribes in building stable, high-quality crop production systems, developing organic farming, adopting the concept of eco-agriculture, preserving wildflowers, and building hedges around organic farmland ridges. In doing so, the HDARES helps locals to maintain biodiversity, sustain food production, improve their livelihoods, and protect the agricultural landscape (Fan et al. 2013).

2.2 Promotion of the indigenous tribe leisure tourism industry

Indigenous tribes in Taiwan are often located in places with stunning natural landscapes, with each tribe having its own distinct culture, which gives them advantages in attracting and developing tourism. HDARES made an inventory of tribe resources and then customized strategies for each tribe according to the results. Counselling tutors provide suggestions and advice to every tribe and meet with tribe members regularly to discuss and brainstorm tour content. The purpose of this resource is to help these tribes in developing mature and

distinguishing tourism industries, revitalizing the economy of the indigenous tribes (Sun et al. 2016).

■ 3. Development of ecological farming and conservation of the agriculture landscape

In general, planting rice requires a large paddy field and monoculture (i.e., only one type of crop is grown) which typically leads to lower biodiversity and a higher risk of pests and diseases. To resolve these problems, the HDARES modified the international concept of eco-agriculture to include ecological engineering methods appropriate for Taiwan. To protect indigenous traditional wisdom, HDARES has started researching and promoting indigenous crops. They focus on recovering both indigenous and organic farming technologies and industries. The Xinshe Tribe community recovers and applies its traditional farming skills and makes efforts for maintaining the cultural customs of the Kavalan ethnic group indigenous to Taiwan. Additionally, the Fushin Eco Farm has introduced an organic pest control measure to implement the concepts of the Satoyama Initiative (Tseng et al. 2015).

Thus, the work of HDARES connects traditional knowledge and cultural values of indigenous people in Eastern Taiwan to the conservation of biodiversity in the agricultural landscape.

3.1 In the Xinshe Tribe

Located in the Fengbin Township on Taiwan's



Figure 2. The agriculture landscape of Xinshe Tribe (Author: Chung-Yu Hsu)



Figure 3. The agriculture landscape of Fushin Eco Farm (Author: Li Lin)

east coast, the settlements of the Xinshe Tribe are surrounded by paddy fields (see Figure 2); rice has been grown there continually for a century. For the Kavalan ethnic group residing in the area, rice harvesting has been their livelihood for generations. They have a strong affection for rice because it is their staple food, and the custom of brewing rice wine is also an important part of Kavalan rituals.

HDARES first conducted a soil test in the area from which they found that the paddy fields have accumulated a wealth of organic matter, making them highly suitable for organic farming. The team recommended the use of Taikeng No. 2, a rice variety that is not only suited to the Hualien region but is also delicious and resistant to numerous pests and diseases. In regards to planting techniques, the spacing between each row of rice was increased to facilitate ventilation. Additionally, the amount of nitrogen fertilizer was controlled to prevent the rice tissues from becoming overly soft and susceptible to pests and diseases.

As part of the implementation of the concept of eco-agriculture, HDARES planted specimens of the *Asteraceae* family as ridge vegetation to attract natural enemies of pests - a method that disproves the traditional belief that weeds must be removed from ridges.

As mentioned, paddy field pests, such as planthoppers, leafhoppers, and snout moths, can be effectively prevented and controlled by using their natural predators, such as ladybugs and parasitoid wasps. These effective pest killers can be retained by constructing an eco-friendly environment, thus minimizing the need of pesticides. The retention of pests' natural predators and growing of flowering plants on ridges are new methods that challenge the traditional idea that emphasizes the removal of weeds on ridges. These new ideas can serve as a reminder to those in agriculture to think outside the box, such as considering replacing

monoculture with biodiversity which will increase the prevention and control of pests and diseases as well as enrich the agricultural ecosystem.

The concept of ecology extends beyond paddy fields, it is also a part of life. For example, farmland can be used to enrich the educational content of the Municipal Xinshe Elementary School. Students from the Municipal Xinshe Primary School and Preschool visit the farm monthly to perform various farming activities, enabling them to learn about the rice-growing process and agricultural ecosystem. Rice growing allows children to connect with their land. Moreover, for the Kavalan family, rice is something that brings the family together and allows their family bonds to become stronger.

3.2 In the Fushin Eco Farm

The Fushin Eco Farm primarily focuses on performing farm-related experiments. Located in the Ruisui Township, Hualien County, the Fushin Eco Farm is divided into three land types: public farmland, private farmland, and natural areas (see Figure 3).

The public farmland is used for experiments; various experiments are performed by the Fushin Eco Farm in collaboration with the National Dong Hwa University, HDARES, and the Forestry Bureau. The experiments aim to find the means of resolving conflicts between farmers and animals, such as through the exploitation of purse nets and the natural predators of pests. The habitat is composed of wetlands, bustling with biodiversity and life. In the future, this area may be open to visitors for eco-experience tours.

The private farmland is divided into 20 equally sized parcels, with local residents invited to farm the land. The villagers can use the farmland to grow crops, at no cost for the

first three years, on one condition: they must practice organic farming. Villagers who fail to meet this requirement lose their access to the farmland (Tseng et al. 2015).

The Fushin Eco Farm owner explains that the purpose behind the provision of the private farmland is so, that the Fushin community will learn to accept the practice of organic farming. The Fushin community is mostly surrounded by conventional farmlands and the residents have little organic farming experience. Therefore, by providing access to their farmlands, the Fushin Eco Farm enables villagers to learn, accept, and adopt environmentally friendly farming methods. Additionally, these activities enable conventional farmland to be transformed into organic farmland. Promoting organic farming through practice is an idealistic approach with the goal that villagers get in contact with organic farmland, familiarize themselves with it, and ultimately accept it.

The Fushin Eco Farm possesses an objective identical to that of the HDARES and the organizations have enjoyed a productive partnership, especially in the implementation of the concept of eco-agriculture. The farm insisted on using organic materials for planting even without using *Bacillus thuringiensis*¹. Therefore, when faced with an invasion of corn borers (*Ostrinia furnacalis*), the farm sought guidance from the HDARES, which subsequently introduced them to the concept of ecological protection and they built a corn borer prevention and control experiment location for the farm. HDARES also planted a row of Chinese hibiscus flowers beside the cornfield to prevent and control the corn borers pest. Additionally, HDARES added a sheet spread with parasitoid wasps (*Trichogramma ostriniae*) during the initial experiment stage, and planted sunflowers before the hibiscus blossomed.

■ 4. Promotion of indigenous tribe leisure tourism industry

Taiwan's indigenous agriculture, cultural, and ecological resources are quite diverse and interesting. Leisure developments in indigenous areas, combined with the cultural creativity industry, have not only contributed to the establishment of leisure features, but have also helped conserve indigenous culture and promote tribal economic prosperity.

To promote indigenous tribe's agriculture industry in Eastern Taiwan, HDARES assisted tribes in enhancing their strengths and competitiveness for tourism. Eight tribes were chosen based on their potential in tourism: Leshui, Syanox, Tafalong, Fushin Eco Farm, Kiwit, Ceiroh, Namukang and Cilamitay

tribes. HDARES provides suggestions and advice for every tribe and meets with the tribe members regularly to discuss and brainstorm tour contents.

In the case of Fushin Eco Farm, due to the fact that the farm is mainly for crop production, they faced many problems in the development of the leisure industry. For instance, the division of labor is unclear, there is a lack of manpower and a lack of design of experiential activities. HDARES made an inventory of the tribe resources and they designed experiential activities for the Fushin Eco Farm according to the result. The most attractive characteristic of the farm is the use of the concept of eco-agriculture in their agricultural practices. Therefore, HDARES recommended that the farm provides visitors with agricultural technology instruction, eco-guided tours, and farmer's cooking activities.

After the development of the leisure industry, the Fushin Eco Farm found that the cohesion of the community increased, not only in restoring the traditional farming model and the protection of indigenous culture, but also in enhancing economic benefits.

■ 5. Future research

Ecological farming involves the introduction of symbiotic species to support the ecological sustainability of the farm. HDARES will continue to develop an organically friendly environment to cultivate and explore ecological agriculture cooperation and promotion strategies suitable for rural communities by following the Satoyama Initiative.

With financial support from the Council of Agriculture from 2017 through 2020, HDARES will cooperate with the following international institutions to conduct a 4-year integrated project, called "Integrated project for enhancing eco-agriculture and sustainable development of rural Taiwan": the National Dong Hwa University (NDHU), National Taiwan University (NTU), Agricultural Engineering Research Center (AERC), Miaoli District Agricultural Research and Extension Station (MDARES), Chinese Taipei Committee, and the International Commission on Irrigation Drainage (CTCID).

The main research strategy is to combine the efforts of social sciences and natural science studies with a focus on enhancing landscape resilience and community adaptive capacity. It aims to encourage the preservation and utilization of biodiversity. There are five research strategies:

- i. To increase the diversity and resilience of agricultural production landscapes.

¹ *Bacillus thuringiensis* is a Gram-positive, soil-dwelling bacterium, commonly used as a biological pesticide.

ii. To increase the agrobiodiversity of paddy fields and enhance ecosystem services through habitat restoration within the farmlands and its surroundings.

iii. To enhance the adaptive capacity of rural communities through collaborative planning and multi-stakeholder participation.

iv. To explore relevant international policies for promoting eco-agriculture in Taiwan.

v. To learn from innovative international technologies and practices, and to share Taiwan's experience with international societies.

Following the Satoyama Initiative, HDARES will continuously support the promotion and recovery of nature-culture linkages in agricultural landscapes for the conservation of biodiversity, cultural traditions, and to achieve the objectives of increasing food production and improving rural livelihoods.

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