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Traditional Farming and Sustainable Development of an Indigenous Community in the Mountain Area—A Case Study of Wutai Village in Taiwan

Qing-Xiong Ba ¹, Dau-Jye Lu ^{2,*} , Warren Hwa-Jen Kuo ¹ and Po-Hsin Lai ³

¹ Department of Agronomy, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei 10617, Taiwan; d94621102@g.ntu.edu.tw (Q.-X.B.); whjkuo@ntu.edu.tw (W.H.-J.K.)

² School of Forestry & Resource Conservation, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei 10617, Taiwan; djlu@ntu.edu.tw

³ Newcastle Business School, The University of Newcastle, 409 Hunter Street, Newcastle NSW 2300, Australia; po-hsin.lai@newcastle.edu.au

* Correspondence: djlu@ntu.edu.tw; Tel.: +886-2-3366-5275

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Abstract: The present study aimed to explore traditional farming and its role in sustainable development of the mountainous area based on the indigenous community of Wutai in Taiwan as a case study. It adopted qualitative methods with an ethnographic orientation, to conduct in-depth interviews, participant observation, and focus groups as an integral component of public participation geographic information system (PPGIS), and aerial photo analysis to collect and analyze field data, mainly in 2013 and 2017. The results revealed the continuation of traditional farming practices guided by the traditional farming calendar and characterized by mixed cropping, inter cropping, and rotation, which optimized the use of limited arable lands in the area. These practices also contributed to maximizing and securing local food supply, and maintaining endemic crop varieties. The results suggested that traditional farming offered a way to overcome the limitation of modern agriculture and support ecotourism as a sustainable alternative to mass tourism, by preserving crop diversity, social institutions and cultural traditions, and stabilizing the local environment. Furthermore, our findings showed that traditional farming, in keeping with local capacity, was adaptable to the impacts of climate change. In the last two decades, a returning tide of young residents and retired people involved in traditional farming might play a key role in the slowing down of the loss of agricultural lands in Wutai, influenced by the fashion of healthy foods and environments, as well as development of local ecotourism industry. Learned from this study, while there would be some opportunity for traditional farming to be recognized as one of the key components to promote the sustainable development of indigenous villages in mountain areas, more policy incentives might be considered.

Keywords: traditional ecological knowledge; agricultural landscapes; bio-cultural diversity; ecotourism; adaptation; policy incentive

1. Introduction

Numerous mountain communities have long depended on slash-and-burn agriculture, and hunting and gathering as their principal means of securing a livelihood, particularly in tropical areas [1]. Such practices are adapted to mountain ecological systems and support the unique social organizations and cultural characteristics of local indigenous communities. The interactions between mountain ecosystems and local indigenous communities are manifestations of social-ecological systems in which “people depend on the resources and services provided by ecosystems, and the ecosystem dynamics are influenced, to varying degrees, by the human activities” [2]. However, the social-ecological systems of

mountain communities can be vulnerable to various sources of stress, both human-made and natural. Government policies aiming for improving mountain community development, often accelerate modernization of communities and marketization of traditional economic systems. This trend, in turn, can impact and reshape the traditional economic, social and cultural practices, and further contribute to their vulnerability [3,4]. For example, given the sloping terrain of mountains, the modern agricultural practices can lead to soil erosion, loss of soil fertility, chemical pollution, and eventual deterioration of mountain ecosystems [5,6]. The stresses caused by modern agricultural practices increase the vulnerability of the mountain social-ecological systems which are often exacerbated by natural stressors such as typhoons and earthquakes [7,8].

To reduce the vulnerability of mountain communities, traditional ecological knowledge (TEK) is increasingly adopted and recognized as a key mechanism to enhancing ecological sustainability through localized practices, such as traditional farming [8–11]. As a highly complex system developed in the course of long-term interactions with local ecosystems, and cultural-social institutions, TEK has drawn attention and research interest from various scientific fields [12–14]. Since TEK involves “a cumulative knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmissions” [15], traditional farming, as a localized manifestation of TEK, is equipped with the capacity to cope and adapt in constantly changing environmental conditions [14,16]. Traditional farming in mountain communities has also been shown to support the cultural and biological diversity that is also attractive to tourists [17–19]. Consequently, traditional farming offers a mechanism to stimulate and support mountain cultural- and eco-tourism that accounts for 15–20% world tourism and thus could significantly contribute to local and national economies [20]. Recognizing the adverse impact of mass tourism on vulnerable mountain social-ecological systems [21,22], much attention is drawn to eco-friendly tourism to minimize the common negative impact of tourism and increase the overall benefits for the communities [11,23–25].

The growing literature on traditional farming practices and their support of bio-cultural diversity and ecotourism [11,26,27] has led to the call for more research on TEK in a wide variety of social-ecological systems (see [13]) to generate more contextualized understandings with respect to the various specific areas where it is applied [28]. Additionally, while some scholars urge the need to promote ecotourism to counteract the negative impact of tourism on mountain areas [29], few studies examine the link between traditional farming and sustainability in modern mountain areas. Consequently, our aim in the present study is to examine traditional farming in the Wutai village, its role in sustaining the area’s mountain resources and enhancing local adaptability to environmental changes, and influential factors that drive its coverage change. This role will be also examined in the light of its contribution to mountain areas’ adaptive capacity and the key themes adopted from literature review above, i.e., environmental friendliness, self-sufficiency, links with local culture and development, and adaptability to environmental change.

2. Materials and Methods

2.1. Wutai

Wutai Village has been home to the Rukai people (one of 16 indigenous peoples in Taiwan) for centuries. It is one of the six villages and the township office location of Wutai Township, Pingtung County, Taiwan (Figure 1). The township is 278.8 km² in area and its terrain is dominated by undulating ridges, peaks, cliffs, and steep slopes with an average altitude of 1000 m above sea level. Wutai is usually shrouded in misty clouds during the spring and summer, and the average temperature is about 18 °C. The monsoon season occurs from June until September when most of the typhoons are recorded followed by the dry season from October to May. The area’s geology is dominated by slate which makes it vulnerable to natural stressors, such as typhoons and heavy rains, which sometimes trigger landslides and mudflows [30,31].

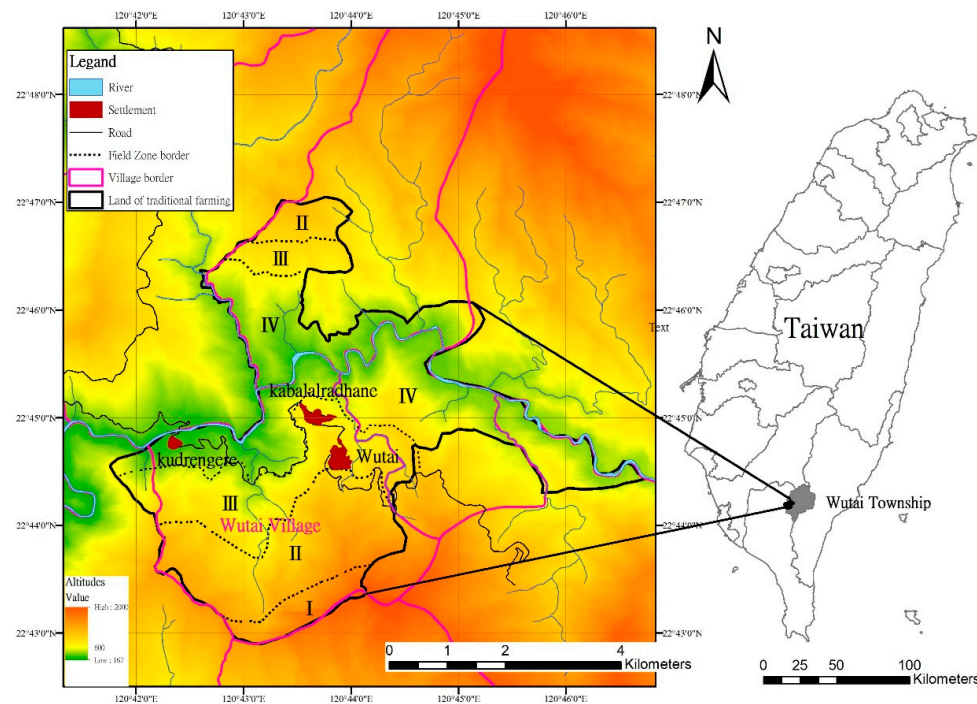


Figure 1. Location of Wutai village and zones of traditional farming (background information was from Aerial Survey Office of Taiwanese Forestry Bureau, interviews with informants and the PPGIS workshops).

The most recent official record shows that Wutai Village comprises 418 households and 1320 residents [32] compared to 1025 residents recorded in 1956 [33]. The population is primarily distributed in three small settlements—Wutai, Kabalalradhanc, and Kudrengere (Figure 1)—that can further be divided into 15 sub-settlements [34]. The village has been experiencing significant emigration since the 1960s in part due to limited job opportunities, out-marriage, and improved transportation [35]. Consequently, the actual number of residents residing in the area is much smaller than the official record. In this study, a former Village Chief said that there were only about 180 people in the village at weekdays in recent years.

Traditionally, the Rukai society was structured hierarchically and composed of a Chief, nobles, and general residents. Animals and plants play an important role in the Rukai culture symbolically and materially, for example as names and decorations of family houses, costumes, and personal headwear [36]. Some are symbols of status. For example, only the noble can wear aristocrats with feathers of Hodgson's Hawk Eagle (*Nisaetus nipalensis*), an endangered species, and the lily headwear represents great hunters [37]. A millet headdress means excellent capacity of cultivation [34].

Wutai's arable lands are mainly distributed at altitudes from 350 m to 2100 m, and divided into three field zones: Dreka, Kabiceacelrake, and Labalabe (Table 1). Wutai settlements are located mainly in Kabiceacelrake and Labelabe zones [38]. Local residents traditionally relied on agriculture, mainly slash and burn, supplemented by hunting and fishing to support their livelihoods. Both males and females learned and participated in traditional farming since their childhoods [33]. Same as other mountain agriculture [39], family farm is the major type of agricultural practice in Wutai. Before the end of the Second World War, millet, sweet potato, and taro were recorded as the main crops with millet being the most precious crop for its key role in Rukai culture and the latter two staple food [33,35]. The overall coverage of agricultural lands in Wutai Township decreased from 4242.78 ha in 1976 to 1001.23 ha in 2015 with only 25.91 ha left in Wutai Village according to the governmental records [35,40].

Practicing agriculture is challenging constrained by limited water supply, cultivation techniques, and access to external markets in mountain communities. Wutai Village remains as one of the very few

indigenous communities in Taiwan in which local residents continue practicing traditional farming that supports most of the local diets supplemented by imported rice, noodles, and other groceries from outside of the village. The planting of cash crops (e.g., rice and vegetables), acacia and fruit trees were once prevalent shortly but have soon reduced to small-scale operations since modern agriculture was introduced during World War II. The area is still faced with the challenges of outmigration and young residents were often forced to move to urban areas in search of better employment and education opportunities leading to an aging population. In the meantime, the improvement of transportation infrastructure and services since the 1970s was a main driver of the introduction of tourism. Since early 2000s, local tourism development has accelerated with government support. It increased from 2852 in 1996; 2137 in 1997; 8640 in 1998; 10,442 in 1999; 10,408 in 2000; to 51,113 in 2001 for the number of visitors to Wutai Township [41]. The success of tourism development encouraged young Wutai natives to return to their home villages [42]. Located by the main road and being the political center of the township, Wutai Village was the main destination of visitors which owned the majority of homestays in this township [41].

Table 1. Three field zones for traditional farming in Wutai.

Name	Field Zone	Altitudes/m	Annual Average/°C
Drekai	Hunting, gathering, and water conservation (I)	>2100	
	Wet-cold (II)	900–2100	13–20.8
Kabiceacelrake	Transient (III)	600–900	20.8–22.6
Labelabe	Warm (IV)	350–600	22.6–244

As tourism has created employment and brought in economic revenue for local people [42], there was increased evidence showing that more negative impacts on environmental resources for tourism development, such as faster degradation of natural resources, loss of soils, traffic congestion during weekends and holidays, and increase of garbage [41]. In order to reduce these negative impacts, the government introduced ecotourism in Wutai since 2004. It sponsored relevant training courses for local people to link agricultural, environmental, and cultural resources, and assisted local people to improve homestay, which was also able to increase local job opportunities [43,44]. Under these circumstances, there were some young people and retired residents interested in traditional farming, have begun to cultivate and sow fields that had stood fallow for many years.

Wutai was selected as the study area because of its long and continuous history of traditional farming. Moreover, it is the homeland of the first author who is intimately connected to the area. As a native Rukai of Wutai, he can communicate directly with the villagers in the Rukai language. Most importantly, it is hoped that the research results could contribute to the sustainability of Wutai area and shed light on the broad debates over development in mountain areas.

2.2. Methodology

Due to the exploratory nature of this research, this research primarily adopted qualitative methods emphasizing an anthropologic approach that included interviews, participant observations, focus group, and participatory workshops. The qualitative research design aimed to gain an in-depth understanding of the local practices of traditional farming, how they were informed by Rukai's traditional ecological knowledge, and the role of traditional farming in sustaining the area's mountain resources and enhancing its adaptability to environmental changes. Following the methods employed by Pulido and Bocco [32], one of the researchers participated in the mixed-cropping practice of traditional farming with local Rukai farmers—including tree cutting, soil preparation, cultivation, and harvesting—to document the processes and related ceremonies, events, and institutional arrangements, and their social and cultural meanings between 2005 and 2013. The village elders who were involved in traditional farming and other livelihood activities (e.g., hunting, gathering), and/or acquired the traditional ecological knowledge relating to these practices were identified and invited to participate in

the research through snowball sampling. Interviews were conducted in 2013 until data saturation when no more new information was revealed from the study participants. Overall, 19 informants—10 males and 9 females with an average age of 74.8—were interviewed (Table 2). All collected materials were cross-validated prior to further evaluation to avoid bias due to personal subjectivity or social status [45].

Table 2. List of informants (not including 2 in 2017)

CODE	SEX	AGE	Occupation Other than Farmer
A	M	80	Hunter
B	F	77	Housekeeper
C	M	85	
D	F	72	Housekeeper
E	F	73	Housekeeper
F	F	84	Housekeeper
G	M	79	Hunter, former officers, and elected representative
H	F	77	Housekeeper
I	F	70	Housekeeper
J	M	70	Hunter
K	F	74	Housekeeper
L	M	66	Hunter, noble
M	F	80	Housekeeper
N	M	70	
O	M	69	Hunter
P	M	77	Farmer
Q	F	72	Farmer, Housekeeper
R	M	74	Farmer, Civil servant 20 years
S	M	72	Hunter, Farmer

All informants were farmers. They were civilians except L. All the information was mainly from informants.

In 2017, PPGIS (public participation geographic information system) was conducted that involved interviews and participatory workshops to identify lands that were used for traditional farming. The results were compared with the aerial photos that documented the area's land uses between 1940s and 2010s to show the trend of local land use change. Two additional (one male at his age of 50, one female of 70) and three old informants interviewed previously (two males and one female: two above 80, one in his 70s) were invited to join above activities.

This study identified the range of traditional farming in Wutai Village that encompassed an area of 2373 ha, which exceeded the village border and its coverage of 1377.91 ha (Figure 2).

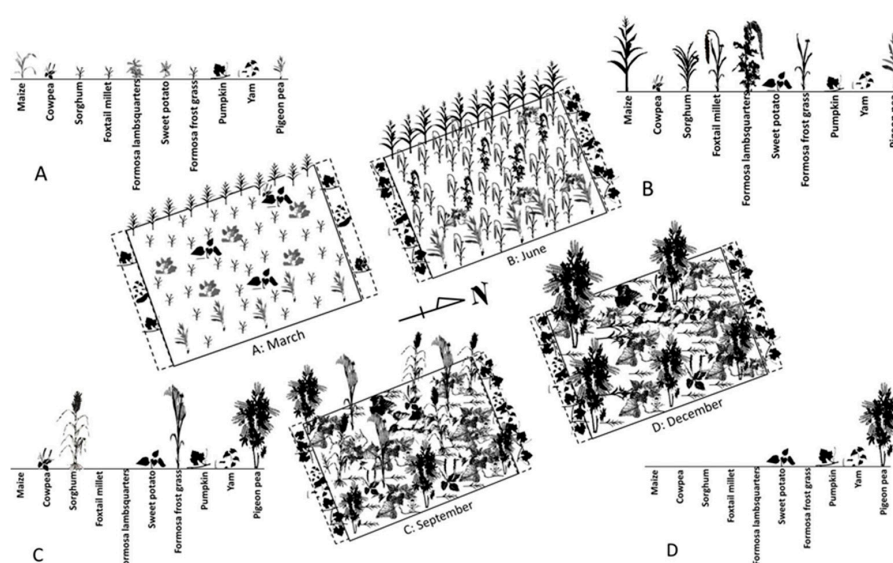


Figure 2. Growth and decline of 10 major crops in the inter-cropped millet fields in different seasons (information was from those informants).

3. Results

3.1. Physical Environment and Rraditional Cultivation Method

Traditional farmers in Wutai use a mixture of cultivation methods—including mixed-cropping, crop rotation, and inter-cropping—to raise a wide variety of crops at different times of the year (Figure 2) and in different locations with varying topographical features. These locations are characterized by various microclimate conditions in temperature, humidity, sunlight, and soil temperature. Local farmers apply specially tailored farming methods to optimize their use of the limited arable lands in the rugged local topography and maintain the efficiency of crop production and crop diversity. Overall, 26 species and 78 local strains of crops under cultivation in the Wutai area were recorded.

Wutai farmers employ fallowing with crop rotation to reduce costs, decrease pollution, and restore soil fertility, all of which are key elements in producing a stable food supply. For example, upland taro is cultivated in mixed-crop fields in Drekaï (wet-cold field zone) for two years, and continued for another two years by digging and harrowing the fields. After the fourth upland taro harvest, the land is left idle for two to five years to allow the land's fertility to be restored.

Kabiceacelrake (transient field zone) and Labelabe (warm field zone) are two main areas where local farmers apply crop rotation to their fields to recover land fertility (Table 2). For example, peanuts are often planted for nitrogen fixation in the mixed-cropping millet fields after cultivation for two years. The following year, sweet potato stems are cut into pieces or burned, and then the residual peanuts and sweet potato ashes are buried into the soil as natural fertilizers. Additionally, since some of the lands are located in difficult terrain and vulnerable to natural stressors, Wutai farmers have developed terraced fields and used thick tree trunks at the edge of the fields to prevent soil from erosion, and enhance water and soil conservation.

3.2. Farming Calendar

Despite the absence of written records, the Wutai villagers follow a farming calendar that has been transmitted orally among their forebears for centuries. Based on the interview data and participant observations, Wutai's traditional farming calendar was reconstructed (Figure 3). The calendar guides the local Wutai people in determining when and what crops to sow to secure a sufficient food supply to support the community for the entire year. Following the calendar, farmers reclaim lands and plant crops in the dry season from October to April. March and April are the least productive season when usually only sweet potatoes are harvested and available for consumption. In August, right after the harvest of millet, Wutai villagers hold their harvest ceremony and many special activities when the local farmers are free from farming chores and engage in exchanging seeds.

3.3. Cultivation Adjustment Mechanisms

This study documented the ways in which the Wutai residents adapt to recent changes in the environment and climate. Wutai tribal males tend to be both farmers and hunters, and carefully keep track of changes in the ecosystem, such as the disappearance of certain native flora, the emergence of exotic species, unusual wildlife behavior or population changes, and ecological imbalances. Once any such significant change is noticed, the message is disseminated throughout the community. Moreover, all village men patrol the surrounding areas in groups to monitor and record changes during and after typhoons and heavy rainfalls. Local farmers carefully adjust the timing of the cultivation of seasonal crops based on the observations collected from tracking and monitoring activities. For example, after Typhoon Morakot struck in 2009, the villagers began cultivating their crops approximately two-weeks, or even one month, earlier than usual to secure food supply.

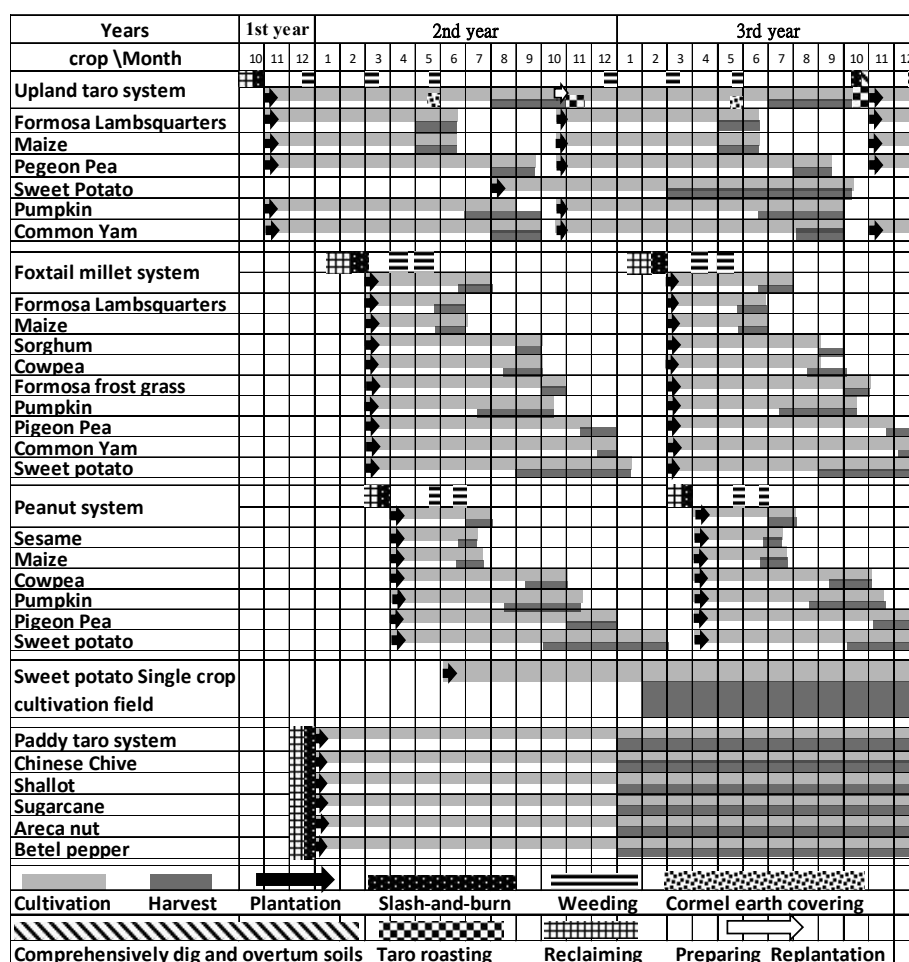


Figure 3. Traditional farming calendar in Wutai (the information was collected from informants).

An example of adjustment made by local farmers as an adaptive strategy to secure local food supply in response to food shortages following a pestilence, typhoon, or heavy rainfall is growing sweet potato and paddy taro crops. Such a strategy is adopted, because of minimal labor and a relatively short growing season required to replenish food supply. Since there are 10 different strains of sweet potatoes cultivated in the Wutai area, it has been developed as a highly adaptable crop. Additionally, different strains of sweet potatoes offer a wide variety of flavors to appeal to different palates, another key factor contributing to local farmer adaptability [46,47].

3.4. Food Diversity

In total, 26 species and 78 local strains of cultivated crops were recorded in the Wutai area based on the modern agricultural classification scheme. These local crops can be divided into nine categories: cereals or grain crops, legumes, tuber crops, root crops, oil crops, stimulants, fruits, vegetables, and sugar plants. There are differences between this modern system and the traditional one used by the local Wutai residents. For example, the Wutai people categorize peanuts, sesame, pumpkins, bananas, and guavas as basic food crops. The Wutai people continue the cultivation of these local strains to sustain their own food supply, which reveals a close link between food diversity and traditional farming in the Wutai area. It was also found that non-timber forest products (e.g., mushroom, wild taro) are also an important food source for local people.

3.5. Food Supply and Seed Conservation

Wutai villagers tend to harvest their main crops—i.e., sweet potatoes, yams, cassavas, pumpkins, upland taro, and paddy taro—in stages in order to provide the local residents with a continuing fresh food supply; on the other hand, millet, sorghum, and bananas are harvested only after they are fully mature. Harvested crops are stored variedly based on their respective traits. Grain crops, such as millet, sorghum, and Formosa frost grass, are dried and stored by category in warehouses or hung up in ventilated areas. Upland taro is roasted for immediate consumption or sundried for longer-term preservation. Other crops are collected and consumed as fresh produce.

Wutai farmers also select and store high quality seeds to build up their seed supply for the following year. Different households or families have their own storage and seed selection preferences, and seeds are exchanged and shared among households or families. By using such traditional farming methods, Wutai farmers have been able to cultivate and maintain 78 local strains of crops over the years.

3.6. Crops and Social-Cultural Activities

Crops, particularly millet and upland taro, play a vital role in Wutai's community life. As millet is harvested at the end of July after which no other dedicated farming activity is conducted, August is the beginning of the Rukai tribal year. The entire month is devoted to a harvest celebration that consists of many of the major ceremonies and rituals of the Rukai people. Millet and its products are widely used in Wutai tribal rituals ('tatulrisisysane'). The most important ritual is 'tangidrakakalane', the harvest festival. It is followed by 'capi' or a divination ceremony to predict the weather and harvest conditions of the following year, 'Kyatudariti' or a ceremony for men's tools, and a number of closure rituals at the end of August.

Local crops have special connotations and play significant roles in a range of Rukai tribal social occasions. For example, a prospective groom's family needs to prepare millet, millet wine, sugarcane, paddy taro, betel nuts, betel peppers, bananas, and other gifts as the dowry in marriage engagement.

All of the crops grown in the upland taro mixed-cropping fields, excluding leek and shallot, are used in the dowry. Millet and other crops are also given as gifts on a wide range of social occasions, for example, to people who are moving to a new house, parents of a newborn baby, or elders celebrating their birthdays. Moreover, millet and local crops are utilized as the lease fees of farmlands paid to the noble landholding families ('padulru'). For ages, the Wutai people have shared millet and local crops to ensure that every villager has sufficient food. This practice has served as an important element in bonding the community.

The diversity of crops and their connection with the Rukai culture have become a local tourism attraction. The Rukai cultural heritages are preserved largely due to the continuing practice of traditional farming and have become the most valuable assets for ecotourism development in the Wutai area.

3.7. Tendancy of Coverage for Traditional Faming Lands in Wutai

Based on the results of interviews with elders involved in PPGIS and analysis of aerial photos between 1948 and 2015, the change in the coverage of land used for traditional farming in Wutai was revealed. The results showed that traditional farming covered an area of 2382.1 ha, about 74% of lands in Wutai in 1948. However, there was a continual decline of its coverage that decreased to 1304.1 ha (74%) in 1974; 1005.6 ha (57%) in 1983; 400.4 ha (23%) in 1995 until early 2000s. Then there was a slight increase in the coverage, 477.2 ha (27%) in 2007 and a decline again, 332.5 ha for (19%) in 2015 (Figures 4 and 5).

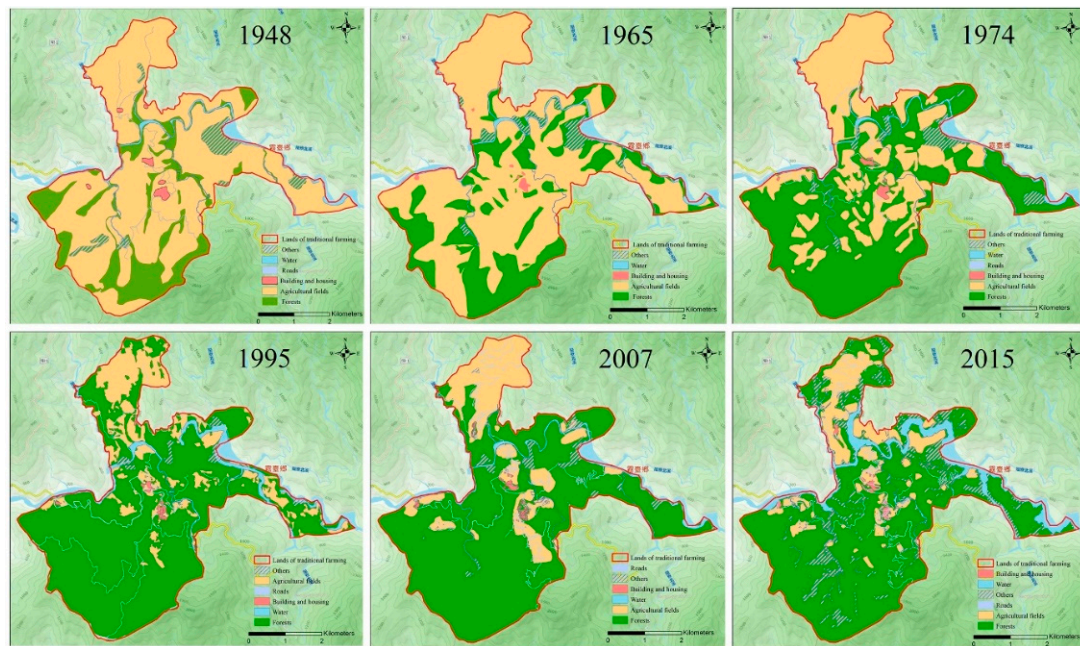


Figure 4. Coverage of traditional farming in Wutai in different years. (the aerial photos of 1948 and 1965 were provided by Academia Sinica, and the others were collected from the Aerial Survey Office of Taiwanese Forestry Bureau. The land use data were analyzed and interpreted by this study)

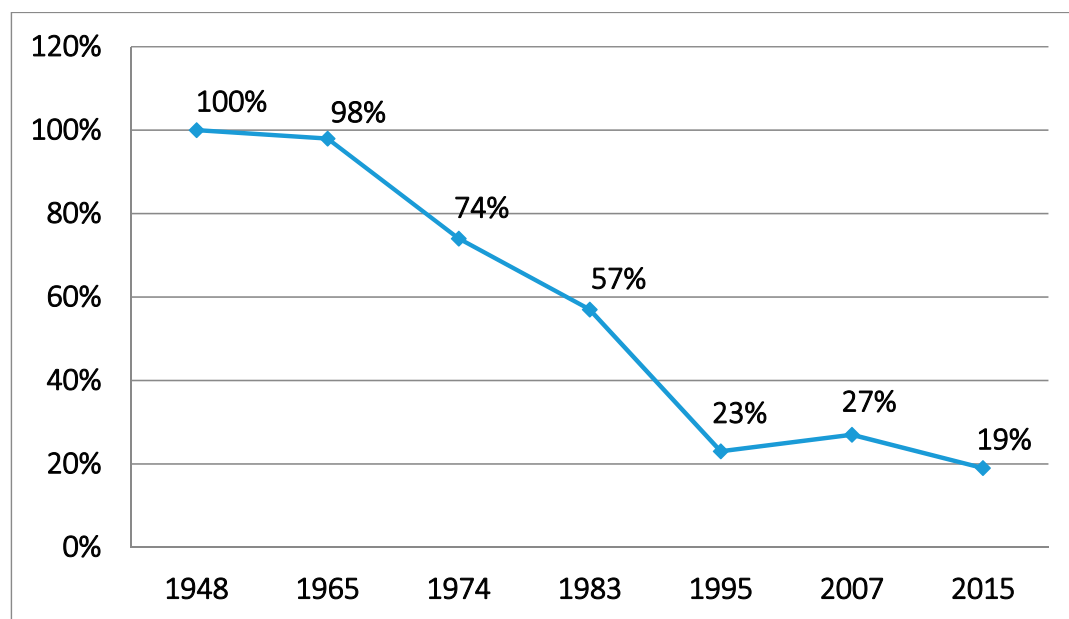


Figure 5. Change of coverage for traditional farming in Wutai (information sources same with Figure 4).

4. Discussion

Mountain social-ecological systems are vulnerable to changes induced by human-made and natural stressors. Establishing the adaptive capacity of these systems is essential to sustainable mountain development. Adaptive capacity represents “the capacity of actors, both individuals and groups, to respond to, create, and shape variability and change in the state (condition) of the system” [2]. The adaptive capacity of mountain social-ecological systems can be enhanced by managing the systems to maintain or strengthen their biological, economic, and cultural diversity that supports a wide range of options available for adaptation. Adaptive capacity also relies on the capacity of the systems’ actors to increase these options by engaging in learning, experimenting, and innovation. Moreover,

an understanding of how systems react to changes informed by traditional ecological knowledge derived from long-term interactions with the local environment and the ability of individuals and groups to work collaboratively to manage shared problems are also required for forging the systems' adaptive capacity [2]. Traditional farming practiced by the Rukai people in Wutai Village helps maintain biological and cultural diversity that collectively contributes to the more diverse economic opportunities (e.g., farming, tourism) available to its residents. It is a product coevolved with Rukai people's continuous learning and experimenting for generations through trial and error, and the traditional ecological knowledge accumulated from the same process. The practice of traditional farming helps maintain the tribal group's cultural identity and social institutions that continue to bind the community members together to cope with new challenges collaboratively. The characteristics of traditional farming that contribute to the adaptive capacity of Wutai Village are discussed below in relation to environmental friendliness, self-sufficiency, adaptability to environmental and climate change, and links with local culture and development.

4.1. Environmental Friendliness

Wutai farmers have developed a zoning system for different land uses. Similar practices have been reported for traditional farmers in the Himalayas and Mexico [48–50]. In Wutai, different cultivation methods (e.g., mixed-cropping, crop rotation) are applied in different zones and a wide variety of crops are sown at different times of the year and in various locations of the rugged mountain area. By applying these age-old traditional farming practices, Wutai farmers developed a variety of niche crops to fit the different specific microenvironments, which in turn not only optimize arable land use and enhance crop productivity but also encourage the maintenance of crop diversity. Furthermore, crop rotation is employed to restore soil fertility and, thereby, reduce the need to use chemical fertilizer and minimize pollution. The Rukai tribal farming calendar developed from a long-term interaction with the environment and accumulation of local ecological knowledge is used to guide local farmers in sowing and cultivating their crops and is adaptable to specific local environmental conditions. Use of traditional farming calendars to help farmers adapt to varying environmental conditions has also been reported elsewhere [26,48,51–54]. More importantly, traditional farming practices minimize soil erosion, loss of nutrients, and chemical pollution that are byproducts of modern agricultural practices [5,6]. As such, traditional farming has been suggested as a mechanism for promoting sustainable agriculture [8–11]. The environmentally friendly practices of traditional farming also provide desirable habitats that support biodiversity, including rare species such as Russet sparrow (*Passer rutilans*) that is listed as an endangered species and under protection in Taiwan [55].

4.2. Adaptability to Environmental Change

As mentioned, traditional farming relies on environmentally friendly practices to optimize land use in the Wutai area. Local people closely monitor changes in the environment and adjust their cultivation timing and methods accordingly. Moreover, shown in previous research [53,56], crop diversity maintenance and the cultural preference for certain crops over others are evidence of environmental adaptation and resilience. Traditional farming in the Wutai area has been highly adaptable to the local environment, as evidenced in their farming practices, to achieve self-sufficiency guided by the local farming calendar. It has been suggested that traditional farming is well-equipped to cope and adapt in response to natural stressors, such as typhoons and climate change [16], as demonstrated in this study.

4.3. Crop Self-Sufficiency

Crop self-sufficiency is crucial to ensure food security in remote and inaccessible mountain areas where many indigenous communities reside [13,57]. The Rukai tribal farming calendar guides the farmers in selecting crop varieties, and the best methods and seasons of sowing crops to secure a stable food supply. The staged crop harvests—like sweet potatoes, pumpkins, and other crops—provide

locals with a daily fresh food supply. They also augment the supply for local agricultural categories, such as vegetables (pumpkin) or fruits (banana, guava). Non-timber forest products are also an important food source for the local people in the mountains. Furthermore, since both sweet potato and paddy taro are easily cultivated, they can be planted to meet immediate demands arising from disasters. Wutai farmers also select the best seeds and employ appropriate storage methods to preserve their seed supply for the following year. All these features of traditional farming have contributed to the ability of the Rukai people to remain self-sufficiency for food.

4.4. Links with the Local Community and Development

Significant social and cultural links between traditional farming and the Wutai community are identified: crops and associated products, mainly millet and paddy taro, are essential to the preparation and practice of rituals, ceremonies and various other social occasions in Wutai culture. Different crops play different roles and have different values in daily life in Wutai. Moreover, traditional farming not only contributes to the conservation of the diversity of local crop strains, but also helps in the preservation of cultural diversity, as reported elsewhere [58,59]. Human resources is another element that contributes to the link between traditional farming and the Wutai community. Consistent with the findings reported elsewhere [60,61], this study shows that traditional farming motivates local residents to allocate labor and adjust agricultural practices in accordance with the farming calendar.

Wutai farmers cultivate at least 78 local strains of crops. This wide variety of crops can be regarded as another crop adaptation mechanism because such diversity in plant genetics can reduce losses from crop vulnerability [46,47,53]. Certain social elements, such as traditional ceremonies, local foods, social occasions, and the landscapes enhanced by traditional farming have evolved as key elements of ecotourism as special attractions for the tourists [62,63]. Furthermore, official support for tourism in the area has included provision of the transportation infrastructure needed for ecotourism development. Given its environmentally friendly practices, traditional farming could provide an excellent base for ecotourism. Besides the possible impact of natural disasters, the main challenges facing ecotourism development may reflect the competing interests among local stakeholders of different approaches on development, as shown in other research [62].

4.5. Opportunities to Restore Maintain Coverage of Traditional Farming Lands

Despite of the positive effects of traditional farming presented above, Wutai, similar to other mountain communities [39,64], is faced with barriers to sustain and promote related practices, including difficult access to markets, small size of farming units, and extreme weather contributed to decline of traditional farming in Wutai after the second World War. This study revealed that a labor shortage was also one of the barriers.

Without any direct evidence, a former Village Chief pointed out that it was very key for infrastructure on mountain agriculture as observed by previous research [64]. This study proposed that at least part of decline for traditional farming since 1970s attributed to roads destruction by extreme weather, such as typhoons and/or torrential rains.

A point should be sort out here is that why it had a reverse and then slowing down for the decline of traditional farming lands in Wutai in recent decades. As it was seen in the fields, tourism development particularly since 2000s attracted young people to return their homelands and join the tourism. There were also several retired people involving in traditional farming for the fashion of better healthy environment and society. This explains the reverse for the coverage of traditional farming lands in Wutai in 2000s (Figure 5).

Good fortune will not last long. There was a slowing down for the coverage in 2010s. Little clues have been found to explain this development. Nevertheless, we had new policies to promote indigenous development and to sponsor organic agriculture over the last two years, which might help. As it cannot guarantee a success for any economic incentive to promote traditional farming in Wutai, a special focus on policy incentive might deserved to have a try. In this case, this study

urges to consider the ways to promote functions of biodiversity conservation and adaptation for climate change by traditional farming. It shall be included in the scope of sustainable agriculture for biodiversity raised by FAO [65]. A similar approach has emerged, particularly in Europe, to consider biodiversity conservation via landscapes of traditional farming [66,67]. Such is the perspective on disaster prevention in order to maintain, and even rehabilitate, traditional farming lands.

5. Conclusions

This study examines the role of traditional farming in enhancing mountain sustainability using Wutai Village as a case study. Traditional farming, practiced in this village, is characterized by optimal local land use, mix-cropping, inter-cropping, rotation, fallow fields, no or few fertilizers, and no pesticide, which contributes to biodiversity and cultural diversity, making the areas more adaptable to extreme weather. It is also clearly linked with different dimensions of local institutions. It is guided by local traditional ecological knowledge which needs to be explored and understood from those who are directly involved in related farming practices informed by this knowledge. Traditional farming in Wutai Village has shown characteristics of adaptive capacity and become manifested in environmentally friendly practices, self-sufficiency, adaptability to environmental and climate change, and links with local culture and development.

Wutai Village experienced a sharp decline in the coverage of traditional farming lands since 1960s, which was influenced by difficult access to markets, small-scale farming, extreme weather, poor infrastructure, and labor shortage. Since the early 2000s, as tourism development attracted young Rukai to return to their homelands and retired residents to seek healthier environment, the previous pattern of decline in traditional farm lands in Wutai Village was stopped. The study findings suggest a direct link between government policies that promote indigenous development and organic agriculture and the slow-down of the decline in traditional farm lands in recent years. As such, it is recommended that more policy incentives supportive of traditional farming practices conducive to biodiversity conservation and disaster prevention could be considered. Going forward, measuring yields of different crops and sectors should be put on the priority list, as well. A monitoring system may also be developed to collect relevant data to better understand and provide evidence for the direct relationship between mountain sustainability and traditional farming.

Regarding this study, there are several limitations. Among them, the lack of official information, mainly the demographic information of local Rukai residents who are directly involved in traditional farming and economic measures of the output from related practices have limited more in-depth analysis and discussions. Moreover, the high average age of the informants made it difficult to collect or supplement information.

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