

Changing Adaptive Strategies of Two Li Ethnic Minority Villages in a Mountainous Region of Hainan Island, China

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Abstract

The authors reconstructed the changes of adaptive strategies in two Li ethnic minority villages (Shuiman and Paori villages) in Hainan Island of China. Shuiman village lies at the foot of Mount Wuzhishan and has been influenced by government by-laws for environmental conservation and tourism promotion since the 1990s, while Paori village has adopted cash crops that have been introduced by the government since the 1980s. The interview surveys conducted with the villagers, together with the analyses of satellite images indicated that in Shuiman village, the past grasslands became secondary forest dominated by *Haname lidacea* over the past 20 years, while, in Paori village, the shrub/grasslands and secondary forest as well as the place where slash-and-burn gardening was practiced, were converted to cash crop gardens. The area of “mature forest” or “secondary forest” has increased in both village territories. “Triggers” of such changes were enforced by government by-laws in Shuiman and the villagers’ adoption of cash crops after “epochal” events in Paori village. External factors such as the price of cash crops on world markets and the conditions of infrastructure also affected changes in the adaptive strategies of the villages.

Keywords: cash crops, tourism, Li, Hainan, China

I Introduction

Hainan Island is located to the south of the Chinese mainland. In 2000, about seven million people inhabited the island with its subtropical monsoon environment. It was until recently one of the least developed regions in China. Large cities developed only in coastal regions and the road network did not fully extend to the mountainous inland until the 1970s. Developmental inequality between the coastal region and the inland region was remarkable. Since the 1980s when the transition from a planned economy to a market economy took place in China, various development projects have been launched,

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first in the eastern coastal regions and then extended to the inland [Liang, Umezaki and Ohtsuka 2003]. In 1988, the entire Island became Hainan Province (previously Hainan Island was part of Guangdong Province). The province was designated a Special Economic Zone (SEZ) by the Chinese government for the promotion of tourism and economic development. Since then, a huge amount of money has been invested in development projects by enterprises from mainland China or foreign countries, and since the 1990s it has been one of the most rapidly developing provinces in China.

We have conducted human ecology studies in Wuzhishan region of Hainan Island since 2000 [Shinohara 2004]. Our major concern was to reconstruct the transformation of the adaptive strategies of the ethnic minority communities which are under drastic change. In Wuzhishan region, the enforcement of new government policies was regarded as the fundamental trigger of change. Tourism policy, for example, together with an environmental conservation policy, affected people's daily subsistence behaviour in urban/peri-urban areas or the area around Mount Wuzhishan. In contrast, in the remaining areas, particularly along the major road at relatively lower altitudes, economic development policy initiated change in the indigenous food production system toward the market economy by introducing cash crops. Transformation in resource management and social organization followed in either of the areas, which eventually affected the health status and the welfare of the people, as well as the biomass and biodiversity of the natural environment surrounding the communities. Accordingly, land cover and use have changed drastically.

In the present article, we describe the changes in two inland communities, one from the area around Wuzhishan Mountain and the other from the area along the major road, in Wuzhishan region of Hainan Island. Special attention is paid to clarifying the internal and external "triggers" for each change and the consequent changes in land cover and land use.

II Research Localities

Wuzhishan city is located in the mountainous inland, some 250 km to the south of Haikou (the provincial capital) and 90 km to the north of Sanya (tourism centre). It is the home of the Qi dialect of the Li ethnic minority, and the autonomous government of Li and Miao ethnic minorities existed until the 1980s. The name of the region came from Mount Wuzhishan (1,867 m above sea level) located in the northeast of the current city territory (Fig. 1). Since mature forest and rich flora and fauna have been well preserved, a nature reserve was established on the mountain and its surrounding areas in 1986. This became a resource for tourism development since the early 1990s.

The introduction of market-oriented cash cropping and tourism were two major development

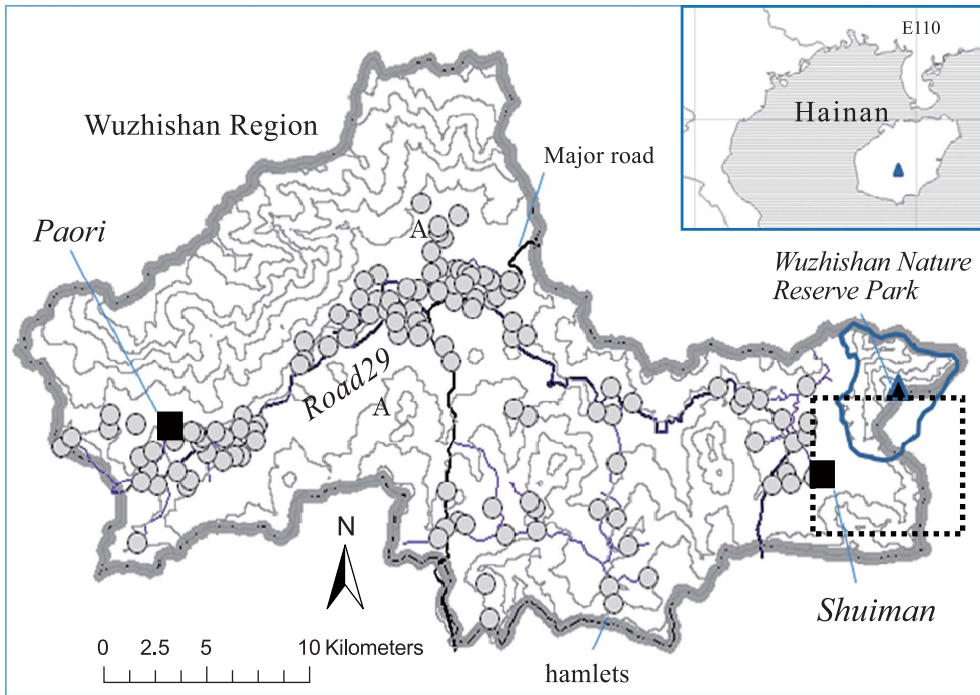


Fig. 1 Locations of Hainan Island, the Study Villages (Shuiman and Paori) and Mount Wuzhishan

Note: Contour line marked “A” shows the altitude of 300 m; interval between contour lines is 100 m. A dotted line square shows the coverage of IKONOS image shown in Fig. 3.

projects which were implemented in different intensities according to the infrastructure and environment in each area. Bananas, rubber, lychee and longan have been mainly introduced to the villages along the major road at relatively lower altitudes, while tourism development has been limited to urban/peri-urban areas and to the villages around Mount Wuzhishan.

Fieldwork was conducted in two Li ethnic minority villages, Shuiman and Paori (Fig. 1). Shuiman village had 190 people (32 households), while Paori village had 179 people (28 households) in 2001. Shuiman village lies at the foot of Mount Wuzhishan and has been influenced by tourism development, while Paori is on provincial road No. 29 (constructed in 1965) and has sought to increase income with cash cropping.

III Shuiman Village

III-1. Transformation of Food Production System from 1930 to 1980

Summarizing the Chinese literature on the Li people in the 18th and 19th century, Nishitani [2004] showed

that all people living near Mount Wuzhishan conducted shifting cultivation, hunting and gathering. Rice cultivation in paddy fields seems to have started about the beginning of the 20th century. A German ethnographer who traveled in Hainan Island in 1931 and 1932 stated that the people who lived near Mount Wuzhishan conducted rice cultivation in paddy fields and shifting cultivation in the mountains. Large areas around the villages were maintained as grassland through regular burning and people depended more on shifting cultivation than on rice cultivation in paddy fields for their livelihood. Rice, maize, foxtail millet, finger millet, sweet potato, bean, pumpkin and tobacco were planted in slash-and-burn gardens [Stübel 1937]. Monkeys and birds that damaged the crops in the gardens and deer in the forest were hunted. Villagers gathered wild edible plants instead of growing leafy vegetables in gardens. There was only one rice crop a year.

In the 1930s there were two villages 4–5 km further up the river from Shuiman. In 1958, their people were moved to Shuiman to create a single collective. During the period of “planned economy” between 1958 and 1980, the collective farm practiced rice cultivation in paddy fields and slash-and-burn cultivation in the areas around the village. Buffaloes were reared collectively in the grassland far from the villages.

III-2. Transformation of Food Production System from 1980 to Present

With the nation-wide economic-system transition from a planned economy to a market economy in the early 1980s, the collective was disbanded as an economic unit and the “Household Production Responsibility System” was introduced. Each household started to produce various crops in addition to rice in paddy fields so as to improve their own economic status. Also in 1984 a road passable by cars and trucks reached a small town 3 km from Shuiman, and a small path was constructed to Shuiman village in the late 1980s. Wuzhishan Nature Reserve was established in 1986 with 13,435 ha of land [Li *et al.* 2001]. The reserve covered all territory of the former small villages together with the eastern part of Shuiman village. The Hainan Provincial by-law for Nature Reserves prohibits the construction of buildings in nature reserves, deforestation, cattle grazing, hunting, gathering medicinal herbs, clearing for cultivation, collecting soil and stones, and mining. After this by-law was enforced, the people in Shuiman village abandoned slash-and-burn gardening in the mountain and regular burning for the maintenance of grassland. The frequency of hunting and gathering in the reserve was also reduced.

After these changes, the land use pattern of Shuiman changed drastically. The sites previously used for slash-and-burn gardens and the grasslands around the villages changed to secondary forest. People explained that the secondary growth currently dominated by *Haname lidacea* were the previous grasslands, while secondary growth where we could find pioneer species such as *Alchornea liukiensis*

hayata and *Mallotus japonicus* were former slash-and-burn gardens. We can use this ethnobotanical knowledge to reconstruct the past distribution of grassland and slash-and-burn gardens as will be described later. The area presently used for cultivation is far smaller than that used in 1980.

The introduction of cash crops paralleled the abandonment of slash-and-burn gardens and grasslands. Crops such as bananas, tea, a species of medicinal herb (*Alpinia oxyphylla*) and a timber tree (*Cunninghamia lanceolata*) were planted in slope gardens behind the paddy fields. In 2001, the average area per household for bananas was only 0.18 ha, 0.01 ha for tea, 0.13 ha for *Alpinia oxyphylla*, and 0.03 ha for *Cunninghamia lanceolata*. Pigs, ducks and fish were also reared. Rubber (*Hevea brasiliensis*), longan (*Dimocarpus longan*) and lychee (*Litchi chinensis*), the major cash crops in lower areas in Hainan, were introduced to Shuiman but did not grow due to the cooler environment. Overall, cash cropping in Shuiman provided only a marginal income.

The intensification of rice cultivation in paddy fields was another notable change in Shuiman village. Hybrid cultivars of rice have been planted since the 1980s, to which fertilizer and pesticide sold by the national agricultural institutions were applied. Improvement to the irrigation system made it possible to stabilize water flow to the paddy fields. Liang *et al.* [2003] reported that the per hectare land productivity of rice increased from 1,130 kg in 1952 to 2,040 kg in 1980, then to 3,000–4,500 kg in 2000–01. The difference between 1952 and 2000 was even greater (6–9 times) if we considered annual land productivity, because the people cultivated rice only once a year in the 1950s, while they grew two crops in 2000. Even during the last two decades, the land productivity of rice increased by 1.5–2 times. As a result, total production of rice in the village far exceeded the dietary requirement. The surplus rice was sold to the government, who purchased it at a fixed rate, or it was traded for meat, fish, or vegetables brought to the village by the motorbike peddlers several times a day.

In 2001, the subsistence strategy in Shuiman heavily depended on intensified cultivation of rice in paddy fields. Per capita area of paddy field was 770 m², which produced 450–690 kg of rice annually [Umezaki 2004]. Since one person consumed 0.5 kg of rice in a day, per capita amount of surplus rice was 250–500 kg, equivalent to 400–800 Yuan in 2001 (1 kg rice = 1.6 Yuan) About half of the surplus was used for obtaining cash to purchase fertilizer, pesticide, rice seed, and implements for the next cultivation cycle. The remaining surplus, equivalent to 200–400 Yuan, was used to purchase pork (6 Yuan/500 g), fish (3 Yuan/500 g) and other foods. In case one individual spent all of the 200–400 Yuan just for pork, they could purchase 17 to 33 kg of pork in a year, or 50–100 g daily. During an 18 day period in August 2001, an average of 6 out of 10 Shuiman households purchased pork or fish from motorbike peddlers at least once a day. It was judged that the people's nutritional requirement could be fulfilled mostly by the production of rice in paddy fields, if they could obtain appropriate amounts of vitamins and dietary fibers

from other sources. This is in great contrast to the situation in 1980; a one-time village leader explained that several households were then short of rice during the period before the harvest.

In Shuiman village, side dishes other than purchased ones included wild plants/animals, and vegetables grown in kitchen gardens adjacent to the villages. Sweet potatoes, cassava, and maize were also inter-cropped with the cash crops. It is worth noting that various wild grasses were frequently collected in or around paddy fields. Of 38 species of grasses found in an irrigation channel, 25 were edible. Of the 29 species in a ridge between rice fields, 5 were edible. Of 19 species grown in paddy fields, 8 were edible. Also 13 species were used as medicinal herbs for daily health problems. Shuiman people tended not to spray pesticides on the ridge between paddy fields or in irrigation water channels, because of concern about chemical pollution of the wild vegetables. Miyazaki [2002], in his vegetation survey, reported that five plant communities were found in paddy fields in Shuiman, while only one was found in Paori.

III-3. *Impact of Tourism*

After unsuccessful trials by several enterprises in the 1990s, full-scale tourism development was undertaken by a joint venture, Wuzhishan Tourism Limited (WTL) [Liang *et al.* 2003]. This joint venture opened a resort on 1 May 2002. The concept was to show the “exotic culture of Li ethnic minority” as well as the “beautiful primeval nature around Wuzhishan Mountain.” More than 1,000 tourists visited the resort during the first three months after opening. They enjoyed the view of Mount Wuzhishan, and visited replicas of traditional houses and storehouses in the villages. The resort is still under development. In 2004, a 5 km promenade was constructed in the forest adjacent to Shuiman village. A butterfly garden operated by a different company was also opened.

The tourism development has influenced the daily life of the Shuiman people in several ways. People could earn money by being employed by the company or by selling the materials (bamboo and timber) for construction of the resort. They also received compensation payment for the crops and trees in the customary land, the collective use right of which was transferred to the company. Secondly, the indigenous resource management norms showed signs of change. The Li people had long made very strict distinction between what was “planted/grown” and what “grew naturally.” While the planted crops were used only by the people who planted them, the plants that grew naturally were used by anybody, irrespective of their place of residence or ethnicity. Medicinal herbs, edible plants, wild animals, honey, and wild tea leaves, for example, have been utilized not only by the Shuiman people but also by the neighbouring Li villagers, Miao ethnic minority people, or Han people. No spatially defined commons under collective resource management existed. The people who have such magnanimous

resource management norms were good guides for the visitors who wished to make money from wild resources. Traders of precious butterflies, giant stag beetles (Genus *Docus*), orchids, or medicinal herbs, arrived at Shuiman village and exploited such animals or plants, despite the fact that collection in the reserve is prohibited by law. The Shuiman people did not complain at first, but some of them later started to claim that such economically valuable resources around Shuiman village should not be exploited freely by the people from outside. The indigenous norms for resource management may change toward “tighter” ones as the people understand the economic value of these resources on the world market.

IV Paori Village

IV-1. *Introduction of Bananas, Rubber, Longan, and Lychee*

Paori is one of villages in Fanyang township that is located in the northwest of Wuzhishan city. Provincial Road No.29 runs along Chang Hua River that flows from east to west through the township. Paddy fields and villages are located in the flat areas between the river and the mountainous hinterland. The people in Paori speak the Ha dialect of Li ethnic minority.

The indigenous food production system in Paori in the 1930s consisted of cropping rice in paddy fields, slash-and-burn cultivation, hunting and gathering. In contrast to Shuiman, the people may have depended more on rice cultivation in paddy fields than on slash-and-burn cultivation [Odaka 1944; Stübel 1937]. Per capita annual production of rice has increased from 130 kg in 1952 (double cropping; South-Central College for Nationalities 1992) to 240 kg in the early 1970s, then to 480 kg in 2000 (also double cropping) [see Jiang 2004]. This was due to the introduction of hybrid cultivars of rice and improvement of the irrigation system, together with the application of effective pesticides and fertilizer. The production of rice exceeded the nutritional requirement level and the people produced a surplus.

Bananas were first planted as a cash crop in Paori village after the economic system's transformation to a market economy in the early 1980s. Since banana shoots could be reproduced in the village, most households started to plant bananas in their gardens by 1984. A part of the production was sold to the market, while the remainder was consumed in the village. In 1985, rubber was introduced. One person decided to purchase 600 rubber seedlings for 600 Yuan (equivalent to the price of 4,000 kg of rice in 1985) and planted them in his slash-and-burn gardens where he had planted rice and cassava the previous year. In 1987, among the 24 households in Paori village, 12 planted rubber when the township government provided free seedlings according to the number of holes people prepared in their gardens. However, many of them did not take serious measures such as drainage or fencing to protect seedlings

from damage by buffaloes. Many rubber gardens were neglected.

An event that changed the people's understanding of cash cropping occurred in 1995. The person who had first planted rubber started tapping and could earn a considerable amount of money. He used the profit for protein-rich foods such as pork and fish, and also for the professional training of his son at an agricultural college in an urban area. The people in Paori village had a clear image of success. As a result of this, the area of rubber gardens has rapidly increased and the people have started to intensively manage the rubber.

Another epochal event occurred in 1998. One person in a neighbouring village succeeded in harvesting longan and lychee fruit and earned what looked to the Paori people like an enormous sum of money (400 to 600 Yuan from each tree). He received an official commendation as a model farmer from the Chinese government and traveled to Beijing to participate in an award ceremony. His success shocked the people in the township resulting in many people in Paori starting to devote their effort to grow more lychee and longan. Almost all secondary forest areas were converted to cash crop gardens for lychee and longan. People eventually spent longer hours on cash cropping than before, while surplus rice from paddy fields was used for investment in cash cropping rather than for purchasing protein-rich foods.

IV-2. *Abandonment of Buffalo, Logging, and Rural-urban Migration*

Notable changes in Paori village in the recent past are the abandonment of buffalo rearing, increased frequency of logging in mature forest far from the village, and migration of all unmarried females to urban areas. Buffaloes were indigenously reared in grasslands or secondary forest around the village. After the government's by-law regulated the burning of grasslands and most secondary forest were converted to cash crop gardens, the people came to tie buffaloes to stakes in the village to prevent damage to cash crops, which resulted in their allocation of additional labour resources for rearing buffaloes.

In 2001, a buyer visited Paori village to purchase buffaloes. Since the price of one buffalo was equivalent to a small tractor, most people decided to sell their buffaloes and to buy small tractors. The villagers told how they were released from the burden of rearing buffaloes as well as plowing paddy fields with buffaloes.

Logging of valuable trees such as *Dalbergia odorifera* or *Gmelina hainanensis* is a common activity for men during the agricultural off-season. Of 52 men between 15 and 40 years of age, 36 logged in 2001. A portion of the earnings was used for investment in cash cropping. On the other hand, all 17 unmarried women in Paori (aged 16–30 years) migrated to urban areas in the northern part of the

province. They worked in the service sector to remit money to their families regularly and also to bring electrical goods, such as televisions and videos, or motorbikes back to the village. Sometimes a portion of their remittances was also used for investment in cash cropping.

V Land Cover and Land Use Changes Over the Past 20 Years

V-1. *A Case in Wuzhishan Region: An Analysis of Landsat Images*

To investigate the land cover change due to social and subsistence changes in Wuzhishan region, a Landsat ETM+ image was taken on 31 December 1999 and a Landsat MSS image taken on 1 January 1980 were analyzed. First, ground control points were recorded using a global positioning system (GPS) (Trimble Pathfinder Pro); post processing differential correction of the ground control points was done using data collected by a GPS base station. The images were then geo-referenced. Second, supervised classification of the Landsat ETM+ image was done based on 25 training sets that represented each of the 6 land use categories: “mature forest,” “shrub,” “grassland,” “paddy fields,” “wasteland or urban area,” and “watery area.” Training data for the classification of the Landsat MSS image were obtained by interviewing people about the land use in 1980 for 31 training sites.

Systematic accuracy assessment on the basis of randomly sampled test sites could not be conducted because the limited road networks in the target region made it difficult to visit all the test sites within the period of our fieldwork. Alternatively, we brought the results of land cover classification in 1980 and 1999 to the study villages and investigated its validity with the villagers. For example, on the site that was secondary forest at the time of our fieldwork but was classified as grassland in 1980, the authors asked the villagers if the site was really grassland in 1980. On the site that was shrub at the time of our fieldwork but was classified as mature forest in 1980, the authors asked the villagers if the site was mature forest in 1980. Through such on-site investigation, we judged the results of land cover classification in 1980 and 1999 was usable for descriptive comparison, though they lack objective accuracy assessment restricting the quantitative analyses of land cover change over time.

Fig. 2 shows the land cover maps of four townships in Wuzhishan city in 1980 and 1999. We can see the vast transition of “shrub/grassland” to “mature forest.” This observation is in agreement with the people’s narratives. They explained that, during the period of people’s commune in the 1960s and 1970s, most of the secondary forest was burned for cultivating gardens and paddy fields, and valuable timber trees in mature forest were cut down. In contrast, in the 1980s, the government banned any burning of the shrub/grassland and restricted the hunting of wild animals and gathering of plants in the mature forest. An observation post was established on the top of the mountain for close watch over the

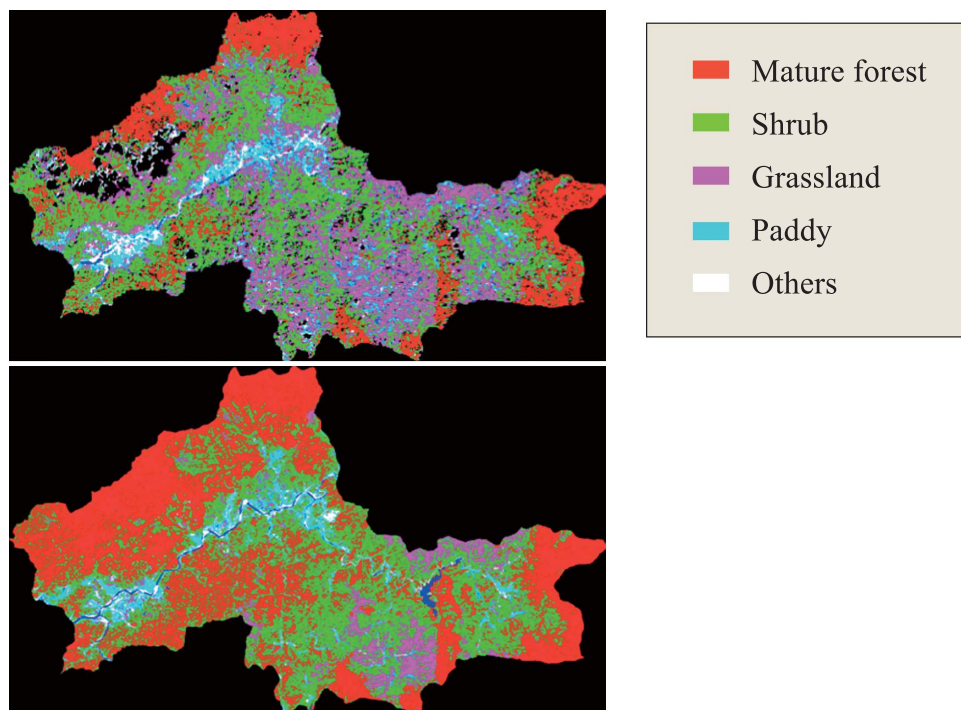


Fig. 2 Land Cover Maps of Wuzhishan Region in 1980 (up) and 1999 (down)

Note: Landsat MSS image taken on 1 January 1980 was used to make the land cover map in 1980;
Landsat ETM+ image taken on 31 December 1999 for the land cover map in 1999.
Black spots on 1999 map indicate the location of cloud cover and its shade.

resources. At relatively higher altitude areas (which Shuiman people inhabited), the past grasslands became secondary forest dominated by *Haname lidacea*, currently used as a symbol of nature conservation park in Wuzhishan area. In low altitude areas (where Paori people live), the shrub/grasslands and secondary forest, as well as the places where slash-and-burn gardening was practiced, were converted to cash crop gardens. They were also classified as “mature forest” or “secondary forest.” Triggers that increased the size of “mature forest” and “secondary forest” from 1980 to 1999 were different by region. This was accompanied by the enforcement of government by-laws in the higher altitude areas (Shuiman), and the planting of cash crops in the lower altitude areas (Paori).

V-2. A Case in Shuiman Village: Analysis of IKONOS Image

An IKONOS image taken on 24 March 2001 was used to produce a map of land cover for the Shuiman village territory. Training data (n=91) were collected for each of the 21 land cover categories. On the basis of the results of the supervised classification, land cover maps that distinguished “paddy field,”

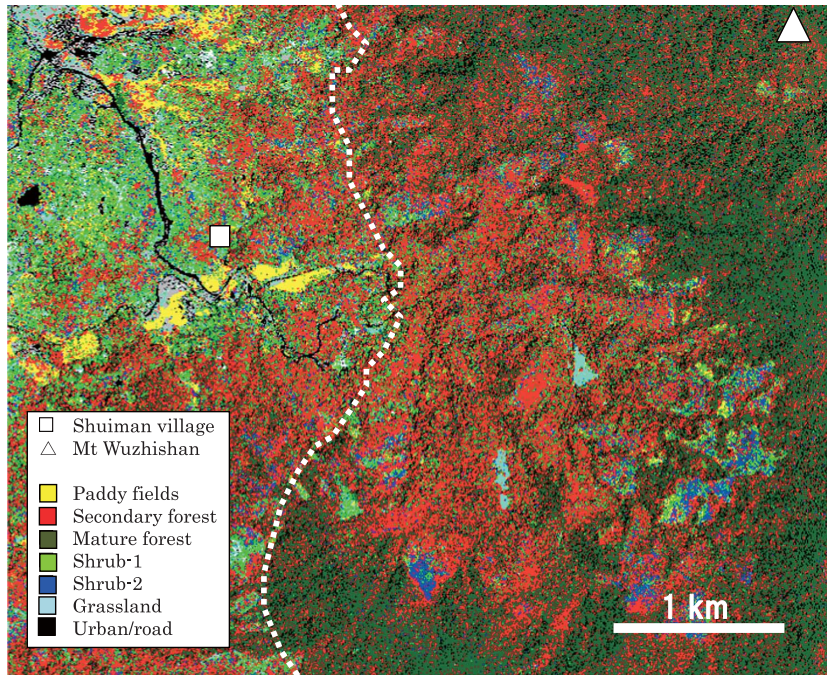


Fig. 3 Land cover of Shuiman Village in 2001 Drawn Based on an IKONOS Image Taken on 24 March 2001
 Note: See Fig. 1 for the location of this image in Wuzhishan region.

“secondary growth dominated by *Haname lidacea*,” “mature forest” and “others” were made.

As previously mentioned, the villagers explained that the secondary growth currently dominated by *Haname lidacea* was previously grasslands. *Haname lidacea*, a deciduous broad-leaf tree, often grows in stands and its light-green leaves turn yellow or red in December and January. The leaves fall not long after and new leaves bud in February to March. When the IKONOS image was taken on 24 March 2001, *Haname lidacea* trees had vivid light-green leaves, which made it possible to distinguish the trees from others.

Fig. 3 shows the classified IKONOS image. Yellow parts show the location of paddy fields under use. The mature forest expanded around Mount Wuzhishan to the south and then to the west. The secondary growth dominated by *Haname Idacea* is indicated with red color. The classification results agree with the villagers’ explanation that the areas around the village were mostly grassland in 1980, then transformed to secondary forest over the 20 years.

V-3. A Case in Paori Village: Analysis of QuickBird Image

We investigated land use patterns of Paori village in 2004, using a geo-referenced QuickBird satellite image (60-cm resolution panchromatic image, acquired on 3 December 2003) which we linked to field data as described below. First, one of the authors (H.W.J.) and a villager visited his plot(s), and mapped the boundary of each “parcel” (a portion of or whole paddy field or cash crop garden) on the printout of the satellite image. A GPS device (GPS Pathfinder Pocket, Trimble, Inc.) was used, if needed, to delineate the exact shape and location of each parcel. Then each parcel was labeled with a serial number. This process was repeated with all the household heads (n=37), and, in total, 747 such parcels were identified. The 747 parcels served as the units of land use, since size and shape of these parcels appeared to remain unchanged for twenty years (from 1985 through 2000). Then, the land use types of each unit for the years 1986, 1995, and 2000 were reconstructed through interviews with the landowners. On the satellite image displayed using geographic information system software (ArcGIS 9.0, ESRI, Inc), the boundaries of cash crop gardens, paddy fields, and other types of agricultural fields, which were visually identifiable, were traced, and vector files of each of these were made. By applying an ArcGIS area calculation algorithm (ArcGIS manual: Using ArcGIS Spatial Analyst, ESRI inc.), we calculated the size of each parcel.

Maps in Fig. 4 are the land use of the Paori villagers in 1986, 1995, and 2004 [Jiang and Umezaki 2009]. In the 1980s, the people in Paori conducted rice cultivation in paddy fields and slash-and-burn cultivation on the slopes. Grasslands were maintained in the back of the hamlet for rearing buffalo. Since the introduction of cash crops, all slash-and-burn gardens and grasslands, and most of the secondary forest have been converted to cash crop gardens. Of 556,100 m² cash crop gardens in 2004, 46% (255,800 m²) were shifting fields, 33% (183,500 m²) were secondary forest, 9.6% (53,300 m²) were grassland, and 2.9% (16,100 m²) were paddy fields in 1985 [Jiang 2006]. After 2004, cash crop gardens were further enlarged; the area was 710,350 m² in 2008, which was 128% of that in 2004 [Jiang *et al.* unpublished data].

VI Conclusions: Triggers of Land Cover/use Changes in Wuzhishan Region

In this paper we have shown how, over the past 20 years, in Shuiman village, the past grasslands became secondary forest dominated by *Haname lidacea*, while the shrub/grasslands and secondary forest, the place where slash-and-burn gardening was practiced, were converted to cash crop gardens in Paori village. They were classified as “mature forest” or “secondary forest.” Triggers that increased the size of “mature forest” and “secondary forest” from 1980 to 1999 were the enforcement of government by-

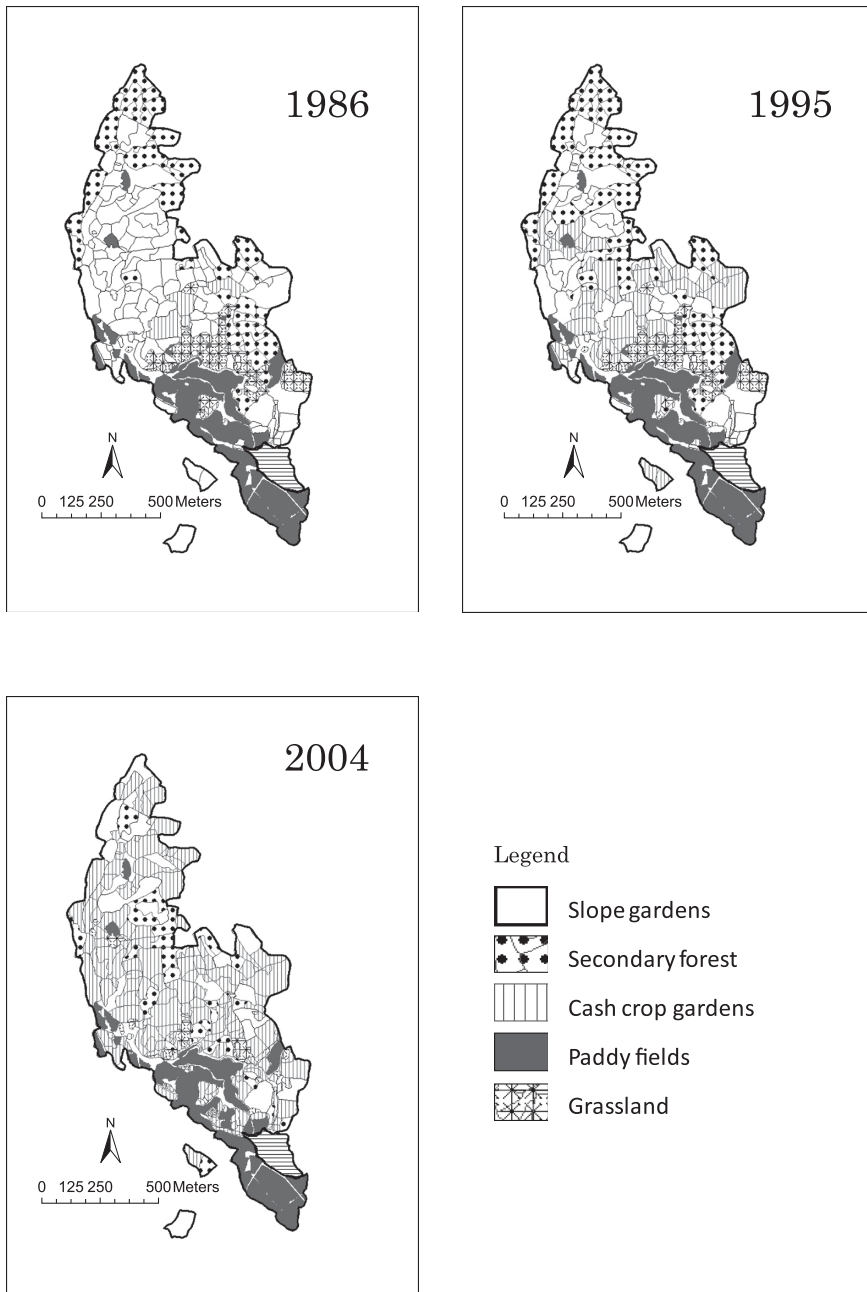


Fig. 4 Land Use Maps in Paori Village in 1986 (upper-left), 1995 (upper-right) and 2004 (bottom-left)

laws for environmental conservation and tourism promotion in Shuiman village as well as the villagers' adoption of cash crops in Paori village.

During our fieldwork in 2000–04, the adaptive strategies in Shuiman and Paori villages were still undergoing rapid transformation. The Government further intensified the policy to encourage re-growth of secondary vegetation around Shuiman village. The people could receive money depending on the area where they planted tree crops (e.g. the medicinal plant *Alpinia oxyphylla*, rubber, longan, or lychee). They will continue to receive the same amount of money each of the following years if the forest is managed well. This policy led most Shuiman people to plant tree crops in every part of their gardens on sloping land or secondary forest areas. Some of the people also planted tree crops in the customary lands of the village, which were then registered to those individuals. Understandably, inequality among the villagers in the amount of money received brought about some tension among the people.

The environment around the villages has also been affected in different ways. Secondary forest has grown on the previous grasslands and slash-and-burn gardens around Shuiman, while the exploitation pressure on valuable wild plants/animals has gradually increased due to tourism development. Indigenous species of crops grown in slash-and-burn gardens almost disappeared, while the edible plants around the paddy fields have been well preserved. In Paori village, all the areas where slash-and-burn gardening was previously conducted were converted to gardens for cash crops. Indigenous species of crops grown in slash-and-burn gardens also disappeared. Specific species of trees in mature forest were logged for money.

What this shows is that adaptive strategies in Shuiman village seemed to be more stable, sustainable and environmentally-sound than those in Paori village at present. However, any fluctuations in external factors can change the adaptive strategies in Shuiman either toward vulnerable outcomes or more sustainable ones. Paori people may or may not succeed in obtaining sufficient money from cash crops in the near future, depending on the price of crops and on future climatic conditions. The lesson that we learned from the Shuiman and Paori cases is that adaptive strategies were influenced by various factors such as conditions of the Hainan or Chinese economy, development ideas and decisions of the villagers, and resilience of the natural environment. Since the impact of government policy or development projects on adaptive strategies or land use/cover may, in nature, vary over time, only long term observation can lead to the formulation of paths for sustainably sound development.

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