The Value of the Miao People’s Traditional Ecological Knowledge for a Solution to Rocky Desertification in Mashan

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Abstract: There are many branches of the Miao people in China, one of which is the Mashan Miao, who have been living in karst mountainous areas in southwest Guizhou Province. The Mashan Miao have adopted various measures for the conservation and effective utilization of the local ecological system and have made great achievements in this area. From the 1950s, their social environment has changed a lot due to political and economic movements. The rocky desertification in the Mashan area has gradually expanded. After the 1990s, relief work was carried out to address the desertification problem, but it was not very effective. We have been doing fieldwork in this area for more than 20 years and from our fieldwork records, we have found that the local Miao people have traditional ecological knowledge and skills that are of irreplaceable valuable for finding a solution for rocky desertification. Using the Miao knowledge we think a feasible way to control this disaster can be found.

Key words: traditional ecological knowledge of Miao people; rocky desertification in Mashan; solutions; ecological disasters

1 Ecological background in Mashan

Mashan can be found in historical Chinese texts from the Qing Dynasty, covering five counties of Guizhou Province in present day Ziyun, Wangmo, Huishui, Changshun and Luodian (Fig.1). The total area of Mashan, from Mengjiang in the east, Shuitangkecuo in the west, Sanglanghe to the south and Bandangzhiying to the north, is nearly 5000 km² (The Institute of Ethnology in Guizhou Province and Research Society of Ethnology in Guizhou Province 2000). Except for the Gebi River, which runs through the whole area from north to south, there is no surface runoff at all. This area is a highly developed karst mountainous area, full of peak clusters on the surface and many underground streams and karst caves; geologists call it a typically vulnerable ecological area (Liu and Li 2001:191).

At present, 60% of the land surface in this area has some degree of rocky desertification. In the most serious rocky desertification areas, more than 75% of the surface is covered by bedrock and gravel (Xiong 2002). The amount of desertification is between a moderate and high degree, where only sparse shrubs and weeds can grow and it is unsuitable for cultivation or grazing (Tang 2000:210). Rocky desertification has seriously disturbed the normal life of local people, to the point where local governments have to organize the migration and resettlement of the residents to alleviate poverty (Han 2000).

Mashan, in the southwest of China, is not the only rocky desertification area. Five other regions, Guizhou, Yunnan and Hunan provinces, Guangxi Zhuang Autonomous Region, and Chongqing City also have similar problems. The rocky desertification in these areas covers nearly 51 000 km² (Xie 2001:3) The most serious areas of rocky desertification besides Mashan in Guizhou Province are Du’an, Bama and Longlin counties in Guangxi Zhuang Autonomous Region. If a feasible solution for the control of rocky desertification could be proposed, not only will people in the Mashan area benefit, but it will also contribute to the sustainable development of economy and the improvement of living standards in other rocky desertification areas. This study could also provide valuable information for ecological preservation in similar environments worldwide.

The surface of the Mashan land is covered with Mesozoic limestone which is from 100 to 300 metres high. Due to multiple earthquakes and the presence of magma after the craton formed, the Yunnan-Kweichow Plateau, which was formed from limestone in a horizontal
distribution, became more rugged. In the following long Cenozoic era, the warmth and rain in this mountainous area caused serious dissolution of the limestone. The running water corroded along the vertical crack edge of the limestone and gradually formed underground streams and the net of karst caves, which became a place for the passage and storage of surface water loss and soil erosion. In addition, soil formation from limestone was slow, and it would take more than 100 years to form 0.2 mm of soil horizon by weathering 1 cm limestone (Liu and Li 2001:209). Since the size of soil particles formed from limestone were minute, they were easily moved by gravity or wind. This made it extremely difficult to form soil in this area and increased the likelihood of soil erosion. Only after millions of years would there be enough soil formation to produce a thick forest. Once the ground vegetation was destroyed, the combined effects of heavy rainfall and gravity caused the surface soil to move through the vertical crack edge of the limestone to the karst caves underground, and caused the surface bedrock and gravel to be exposed. This cataclysm was irreversible, and would lead to barren land and rocky desertification for hundreds of years (Liu and Li 2001:209).

This issue was not as serious in the past, and Mashan used to be the ideal homeland for many ethnic groups. Before the 13th century, Mashan was at the boundary of government control of both the central dynasties and local Nanzhao-Dali States, so the outside world knew little about this place and no systemic records were left. Texts from the Song Dynasty, such as The Ethnography of the Four States in South of Nanling in Southern Song Dynasty (1175), and The Introduction of the Local Customs and Practices of the Minorities in South China from the South of Nanling (1178), mention that the local force of Yi people passed through the Mashan area, transporting a large number of horses to Yishan County in Guangxi Zhuang Autonomous Region, and selling them to the Southern Song Dynasty as war-horses (Zhou [Song Dynasty] and Tu 1996). This indicated that Mashan was suitable for horse grazing at that time. With the unification of the Chinese territory of the Yuan Dynasty after the 13th century, the local forces in Mashan region were given different levels of Tusi (The general term of local administrative institutions governed by the local officials in the regions inhabited by ethnic groups during Yuan, Ming and Qing dynasties) by the central government (Song 1983). The Tusi had to pay taxes to the imperial court and organize soldiers to fight for the central government. This indicates that the Mashan region had economic strength at that time and rocky desertification was not a serious problem. The Ming and Qing dynasties followed the old system of the Yuan Dynasty and set up Tusi chieftain institutions in the Mashan region for the management of local affairs (Zhang Tingyu 1984). The government policy encouraged farming and Mashan became an important area for hemp production in the Qing Dynasty, giving “Mashan” its name. Since the late Qing Dynasty, political corruption of the local power caused successive years of tangled warfare among warlords. Forests were burned to destroy the hiding place of opponents. The man-made destruction of forest vegetation caused the largest ecological deterioration in the Mashan region.

A large number of ethnic groups live in the Mashan area and their utilization of ecological resources is distinct. The Miao and Gelao people, who have lived in Mashan for the longest time, used slash-and-burn cultivation in their early years. They mainly relied on the unique natural and ecological environment of the karst mountainous area and often moved regularly in accordance with the distance to the burn-plowed field. In addition to cultivation, they also lived by hunting and gathering. The ecological resources these two ethnic groups used are mainly found in the higher mountain ridge.

The Buyi and Zhuang people, who mostly live on
the river shoals and basins, make their living from rice cultivation and gathering in the jungle. Under normal circumstances, the Miao and Gelao are separated from the Buyi and Zhuang by the jungles and mountains, and only during special seasons do they trade with each other. There is seldom conflict over the possession and utilization of ecological resources. The traditional residential district of the Yi people was not in the Mashan area. When the Tusi of Yi nationalities were powerful, they occupied Mashan for winter pasture, but never settled there. This seasonal grazing had no negative impacts on the local ecological resources, on the contrary, it would bring various business opportunities to the local Miao and Buyi people and they would profit from the exchange of agricultural and pastoral products. The cultural balance of these five ethnic groups has lasted a long time. Since the groups used different ecological resources and the resources were used efficiently, ecological disaster did not occur.

Mashan has poor water and soil conservation, so once the vegetation was destroyed by man, it could easily lead to rocky desertification. Rocky desertification is not only a natural disaster but also a result of man-made interference. The ecological destruction by human activities is not the original intention of the traditional culture of local people. All of the ethnic groups were well adapted to the ecological environment, and man-made destruction often occurs during special periods, such as times of political unrest and ethnic conflict (Cai 2001:100).

2 Natural factors of rocky desertification

The vulnerability of ecosystems in Mashan comes from the geological and geographical features of this area, which could also support the continuation of subtropical monsoon jungles without human disturbance. If the utilization of the ecosystem keeps a delicate balance, even though the resources have been used intensively and efficiently, there may not be ecological disasters, and the vulnerability of the local ecosystem may not be exposed. On the contrary, if the weak link is affected, even the mild and limited use of resources could lead to disaster in the local ecological system. This is why rocky desertification is serious in this area today.

Mashan is in the middle period of karst landform evolution, characterized by crisscross underground streams and karst caves that connect with the surface along the vertical crack edge. The land surface is covered with small and large dissolution depressions separated by encircling steep rocky mountains, and funnels connecting to the underground karst caves in the lowest part of each depression. The land funnels have become the main passage for water loss and soil erosion (Liu and Li 2001:210). Under natural conditions, the land funnels with small openings are easily blocked by stones and tree branches, causing dissolution lakes and marshlands of various sizes to form (Liu and Li 2001:211). Once the peak clusters and depressions were formed, soil and water resources gathered at the bottom of the depressions, so that the water loss and soil erosion would be effectively controlled. If the land funnels were excavated artificially; there would be no efficient way to control the water loss and soil erosion. This is the first weak link of the local natural ecosystem.

The encircling rocky mountains around the depressions are not only steep, but also veined with knife-like cracks, and the combination of bedrock and topsoil is extremely weak (Liu and Li 2001:210). Through erosion, the topsoil would fully absorb water, and a sliding layer with minimal friction could form between the bedrock and the topsoil. The surface soil could then easily slide down, and this is the reason for the frequent occurrence of disastrous landslides in this area. Trees that grow in the limited soil can put roots deeply in the gull and effectively control the landslide in large areas. If people cut down tall trees and cause the roots to wither, the weight of topsoil itself could lead to widespread landslide from torrential rains (Liu and Li 2001:210). This is also the reason why the soil layer on steep slopes is difficult to build up. Large trees on steep slopes are crucial for water and soil conservation. This is the second weak link of the local natural ecosystem.

The encircling steep rocky mountains separate the depressions creating closed ecological systems that hamper species living in this area, especially plants and aquatic animals (Liu and Li 2001:210). If the rocky desertification disaster occurred in one depression there would be both positive and negative effects. The disaster would not affect other depressions, but it would be difficult for plant seeds and animals to enter into the depression, so the rocky desertification would last longer and the land would be more difficult to restore. This is the third weak link of the local natural ecosystem.

It is worth pointing out that human activities can help deal with this weak link. Humans can consciously bring various plant seeds and animal species to the rocky desertification to overcome the geographical barrier and help restore of the area.

Limestone bedrock has to go through a stage of shallow sea before becoming land. The surface soil and stone stored in this stage forms the limestone topsoil after the formation of land, and this process is irreversible. It is difficult to reverse the weathering of bedrock once soil erosion occurs. Even the dissolution of calcareous bedrock is vigorous, but the quantity of soil formation is small, so it is difficult to make up for the losses from soil erosion. In karst areas, it takes a long time to form a new soil layer in natural conditions after the original soil erosion. That is why rocky desertification in karst areas can last a long time. The irreversibility of the soil formation mechanism is the fourth weak link in karst ecosystems. The importance
of maintaining soil resources in this area is equivalent to the importance of protecting local ecological security, so we must put a higher premium on land. It is also necessary to seek ways to speed up the land formation of limestone, which could effectively control rocky desertification.

Limestone has to undergo many geological movements after becoming land, so in addition to the original horizontal bedding architectures, there are also countless vertical cracks in the land. The dissolution extends vertically and horizontally downwards and forms many potholes of various sizes in the interior limestone. These potholes become stuffed with soil, resulting in complex structures of the limestone area, including topsoil, soil in rocks and soil with stones. Ordinary ploughs or hoes cannot be cultivated this structure of soil and rock. This is not only because neither ploughs nor hoes can be used on the soil inside the rocks, but that the mechanical shocks from the cultivation could loose the complex structure of soil and stone and through to the underground karst caves, causing serious soil erosion. The fifth weak link of the local natural ecosystem is that the soil and stone structure cannot withstand mechanical shocks.

3 Social factors of rocky desertification in Mashan

In order to steadily improve the local ecological system, the farming methods used in the plains cannot be applied for utilizing resources in this area. Agriculture and husbandry production methods that do not turn the soil must be explored. Otherwise, not only will the production of agriculture and husbandry be difficult to stabilize, but rocky desertification will easily occur.

The ancient residents from historical texts are the Miao and Yao people in the heartland of the Mashan region. The local Miao group is a branch of the Miao people from south-central Guizhou. The sub-branch of Mashan Miao use the common language of Mashan sub-dialect (Liu 2004). The local Yao group is a branch of Bunu and they use the Bunu dialect of the Miao language (Bai et al. 1990). Chinese texts called these people “Sheng Yao” and recorded that they made their living from slash-and-burn cultivation and hunting and gathering. Both Gui Hai Yu Heng Zhi and Ling Wai Dai Da in the Song Dynasty identified that none of the local governments at all levels had governed them directly, and the governments only associated with them through the local Zhuang forces (Fan and Hu 1986). Fortunately, field research and archaeological surveys have provided evidence that makes up for the lack of information in ancient records. After the Yuan Dynasty unified the whole country, the central government placated the Miao through the Buyi nationality Tusi around the Mashan area. In Yuan History they were called “Shangzhou Shengmiao” (Shanghai Bookstore 1986). It can be seen that they did not come within the jurisdiction of the central government until the 13th century. The records were still fragmented in the late Yuan Dynasty and early Qing Dynasty, and they only cite the “Miao Man” or “Miao Ren” who had been under the control of local Tusi when mentioning the Jinzhu Tusi in northeast Mashan, Bafan (Buyi zu) Zhang Guan Si in the east, Kangzuo (Buyi zu) Zhang Guan Si in the west and Sicheng (zhuang zu) Tusi in the South.

The systematic records of local Miao people began in The Notes Collection of the Perambulation in the Southern Border of the Empire, written by Tian Rucheng in the Ming Dynasty. This book called them “Ke Meng Gu Yang Miao”, and mentioned that they lived in the grottoes in cliffs and used ladders to climb up and down. There were also other records which showed that the local people used “Tie Bo Bo Tu” and they farmed the land without intertillage and weeding (Tian Rucheng [Ming Dynasty]). Because the records were so simple, the true nature of their cultivation methods was not fully understood for a long time. Until Bai Miao Tu was released, we could see from the pictures that “Tie Bo” was a farming tool comparable to the plough (Yang and Pan 2004). These records deepened the understanding of the shifting cultivation methods of the local Miao people. Combined with the present field survey and archaeological excavation information, we can adapt the local Miao culture to the special ecological environment.

During the Yongzheng period (1723–1735) of the Qing Dynasty, the central government led a massive “Power-shift Movement”. Formal officials took power in the regions inhabited by ethnic groups in Southwest China in the Ming and Qing Dynasties, subsequently abolishing hereditary local officials and weakening the remaining Tusi forces. Mashan was one of the regions affected by this movement. The texts in the Qing Dynasty declared that the Miao people came into the jurisdiction of the central government voluntarily. The new land was put under Anshun State’s administration immediately, and “Gui Hua Ting” (Ziyun County) was established soon after (Ai Bida [Qing Dynasty] and Du 1992). Subsequently, the Qing government implemented a series of measures to encourage economic development. The local Miao and Buyi people were encouraged to plant cash crops, such as cotton and hemp, so that they could exchange their products for currency and pay taxes, “Di Ding Yin” (The taxation in the Qing dynasty, including both the land tax and poll tax). This measure was exaggerated as a wise strategy for considering people living on the frontiers and the development of production. However, neither the central government nor the local people realized that this measure would be one of the potential causes of rocky desertification.

The former local Miao people in the Mashan area divided the land resources into three types and used them
in different ways. Firstly, the soil layer on the ridges of rocky mountains among the peak clusters and depressions is thin, and compared with the lower underground water level, this area is quite high, so that tall trees cannot grow here, and only open forest and grass slopes can be found. This region is suitable for slash-and-burn cultivation, which is characterized by less input and more output. Setting fire to the mountain annually can help regenerate vegetation and can also accelerate the formation of limestone from soil. This is a sustainable resource utilization method under the technical capabilities of the time. Secondly, the abrupt slopes of the peak clusters and depressions go through long-term sedimentary deposits of water and soil, so that thick forests can grow there and a treasure house of species and wildlife resources can form. The local Miao people never farmed this area, but used it as a hunting and gathering place. Thirdly, dissolution lakes and marshlands always form at the bottom of the peak clusters and depressions under natural conditions. The local Miao people used the dissolution lakes as a source of water in the dry season and to hunt a variety of migratory birds. It is evident that this traditional approach to resource utilization has avoided the five weak links of the local natural ecosystem. The natural resources were used efficiently and irreversible ecological disasters rarely occurred. This traditional ecological wisdom could still be useful today.

The traditional production methods of the local Miao people could also provide products that other nations needed, such as the bark of paper mulberry, honey, raw lacquer, tung oil and a variety of other wildlife products. Before the Power-shift Movement, all of these products had to be resold inland by surrounding Buyi and Yi people, and only after this movement did travelling traders of Han nationality begin to purchase the products in large quantities. In the short-term, both the Han merchants and local Miao people benefited from this exchange. In the long run, it was like killing the goose that laid the golden eggs. The Mashan area was limited, but the products were in high demand, so the forest resources that were used moderately in the past became exploited, and the abrupt slope forests were encroached on gradually.

The consequences of widely planting cotton and hemp were also unexpected. Although the original intention was good, there lacked a proper understanding of the local ecological environment. There were neither large nor stable land resources in highly developed mountains of the peak clusters and depressions. The cultivation of cotton and hemp needed large and fertile areas with thick soil layers and good drainage. In this area, only the bottom of the depressions could provide suitable land resources. The only way to grow cotton and hemp was to excavate the land funnel to drain the dissolution lakes, and then plant at the bottom of the lakes. This practice was beneficial in the short-term, but it contributed to rocky desertification over the long-term. Once the land funnels were excavated, the precious soil resources could flow to the underground karst caves driven by running water and gravity. When the situation became more serious, the soil at the bottom of the dissolution basin would totally run off, and there was even no drinking water available in the dry season (Tang 2000:208). The condition arose slowly, and the rocky desertification in the present Mashan area is the accumulation of destructive actions over two centuries.

After the Power-shift Movement, there was another great change to the livelihood of the local Miao people. Large price differences existed between native products used for self-consumption and those for sale in the market, so it was cost-effective to sell the native products and get food in return. Therefore, deforestation of the steep mountains for farmland was profitable. The food structure of early Miao people was the same as other nationalities whose cultivation was changing. It contained hundreds of plants and animals, but each output was not high and food for long-term storage was very limited. The Miao had to change their diet depending on the season to ensure that the food supply was abundant and stable. The situation changed after the introduction of grain varieties that were easily stored. A clear sign in the change of livelihood was the movement of living places. The local Miao people moved out from the caverns in the hillside and gradually settled down at the bottom of the dissolution basins. There were multiple reasons for this change. The hemp gardens had high economic value and living nearby them was crucial for their maintenance. After the land funnels were excavated, the groundwater level declined, so living at the bottom of the dissolution basins was convenient for accessing water during the dry season. More importantly, as other ethnic groups visited Mashan more frequently, threats to the stability in the region increased, so settling at the bottom of the basin was also for security reasons. This process lasted for more than a century, and consequences from changing living places were also unexpected.

One of the prerequisites for settling at the bottom of the basin was that the Miao had to sell a large amount of cotton and hemp products to exchange for food in order to ensure adequate food supply for the dense population. Once people settled, the shift in cultivation practices would be restrained and people would gradually form the habit of living off the storage of food. Since the main wholesale product was hemp, fluctuation of its market price would significantly impact their livelihood. To ensure a stable livelihood, people had to grow food to feed themselves instead of relying on imported food. Land resources at the bottom of the dissolution basin were extremely limited, so the main problem of the area was allocating the land between food and hemp. The only way to alleviate this problem was to gradually deforest the area.
for farmland. This was a slow process and there were no obvious negative effects at the beginning. As deforestation expanded, steep mountains lost vegetation and water loss and soil erosion became more serious. Coupled with the construction of farmland and repeated cultivation, which loosened the bedrock and soil layer, the channels connecting the land surface and underground caves were expanded and the water loss and soil erosion problems were further aggravated. After long-term accumulation, large areas of rocky desertification appeared in the steep sections. Meanwhile, the hunting and gathering products which were of high benefit could not be obtained anymore due to the deforestation; people fell into poverty. In order to keep the pot boiling, people had to deforest more land. The Miao people in Mashan fell into a vicious circle. The more land they deforested, the poorer they would become, and the poorer they became, the more land they would deforest, all the while aggravating the ecological environment.

The historical process of rocky desertification in Mashan was related to certain policies, but it was not the immediate consequence of policy changes. The original intention of the formulation and implementation of the policies was good, but the consequences of imposing the national culture on this area exceeded their expectations. People brought in the rice planting culture of the Han nationality, which was not suitable for the local ecological environment, and made it a policy to cultivate large farmland in the peak clusters and depressions. These actions impacted the five weak links of the local ecological system, and caused large areas of rocky desertification in Mashan.

Some Chinese scholars have attributed the cause of rocky desertification in the Mashan area to the devastation of forests in the tangled warlord warfare during the late Qing Dynasty and early Republic of China, or the deforestation of farmland in the 1950s and 1960s. From the developmental process of the local rocky desertification, we could see that these two factors accelerated the process of rocky desertification, but they were not the dominant factors at fault. People brought in an external culture and unknowingly changed the traditional livelihoods that were adapted to the local ecological environment, the ecological wisdom and skill of local Miao people were lost and rocky desertification occurred after long-term accumulation.

4 Difficulties faced by ecological construction in the contemporary Mashan area

The rocky desertification over large areas of Karst Mountains in Southwest China has long since concerned the government. The Government has taken numerous positive measures to control the rocky desertification and restore the environment in the past twenty years, however, these measures have not been as effective as expected and rocky desertification has been steadily increasing. Therefore, it is important to review the current measures of the ecological construction, determine the advantages and disadvantages, and then seek a solution for this area.

From a technical level, the following three countermeasures are typical. When it comes to ecological restoration, administrative officials, the general public, and even technicians take the planting of trees and grass, and the return of grain plots to forestry for granted (Liang 2000). This restoration method should be effective in areas where soil and water resources are developed and vegetation deterioration has just begun, but it will not work in the Mashan area. Water loss and soil erosion in this area are irreversible. Once the raw soil in this area has run off, the bedrock is exposed and both the trees and grass lose their foundation for growth. Even if trees and grass are planted here, regardless of cost, and they survived, it would be difficult for them to grow and many trees would be left in the rocky crevices. Since there is no vegetation or soil in the rocky desertification slopes, water resources run off each day. If the growth of shrub-grass and trees cannot keep up with the speed of water loss and soil erosion, the planted vegetation would be washed away with the soil. In the high developed rocky desertification areas, there is no arable land to return to forests, and local people have given up on these lands a long time ago. Only the land in which desertification is not too severe is still used today. Vegetation could survive in these regions, but if they were conceded to forest, people would lose their basic livelihood. Even if legal steps were taken to return grain plots to forestry and to plant trees and grass, restoration would not be achievable. From a technical level, the challenge that needs to be resolved is how to plant trees and grass in highly developed rocky desertification areas, which require special techniques and skills, rather than general cultivation methods. These special techniques and skills can only be found in the traditional culture of local the Miao people.

The second countermeasure is to use local materials to riprap the ridges, and dig soil from the rocky crevices for the construction of terraced fields (Weng 2000). This proposal should be effective in other mountain areas, but could cause unexpected disastrous effects in Mashan. The mountains in this area are too steep and the rocks are slippery, flooding during the heavy rain season would easily wash away the rubble ridges. Digging both soil and rocks will break the structure of the local mountains and excavate the crevices connecting to the underground karst caves unintentionally, forming a new path for water loss and soil erosion. The consequences of using explosives for stone mining are even greater, because the loose mountains can easily collapse. Digging soil from the rocky crevices to build terraced fields would limit the acreage, and also cause serious rocky desertification in
more areas. The farmlands in rocky desertification areas are separated, and they can’t exchange material and energy with the surrounding environment. The soil here loses its vitality and cannot maintain its fertility without the input of chemical fertilizer. This also increases the crops vulnerability to pests. As far as the nature of the terraced fields are concerned, they resemble large flowerpots and their capacity for water retention is low. Drought during hot summer days occurs in this area yearly, so the yield of crops cannot be guaranteed. The construction of terraced fields, which require a lot of work, but produce very little output, are limited in their alleviation of local desertification (Yuan 2000).

The third countermeasure is to use engineering techniques to explore water resources, sparing no expense to build irrigation systems and river improvement projects to solve the seasonal drought in the Mashan area (Tang 2000:205). However, the local water resources are either deep underground or far from the residences, therefore, this requires a lot of funds and is difficult to implement. There are also technical problems, such as water seepage, both in the river improvement project and in digging the irrigation channels. After repeated practices, people have obtained drinking water during the dry season, but the rare water resources could not be used for food cultivation. An effective countermeasure would be to build small water kilns, which were invented by the local Miao people (Yang and Lv 2000).

The three technical countermeasures mentioned could be effective in some areas, but in the Mashan area they disturb the weak links of the local ecological system, causing large areas of rocky desertification rather than controlling the disaster. General technical measures and the import of advanced technology for restoration are not effective in this area and may actually be detrimental.

From a social perspective, to control the rocky desertification in Mashan, restoration funds must be increased to improve the quality of life for the local Miao people. Many people propose that the local residents should move out of the Mashan area and settle in places with better natural conditions, so that the rocky desertification in this area could be controlled and the original vegetation restored (Han 2000). This approach is theoretically feasible, but the process would be extremely slow and would take more than one hundred years (Liu and Li 2001:210; Xie 2001:248–249). It is also impossible to ensure that nobody enters the Mashan area over a century. The economic pressures on population movement are high. In the new settlements, social conflicts could arise between the former and the new residents. Moreover, idle land resources are extremely limited in Southwest China, so it would be difficult to settle hundreds of thousands of residents from Mashan in another area. As a result, since the “Yi Di Fu Pin” policy was carried out, less than 10% of the local residents have moved. Natural population growth of the local residents has negated any progress by taking the place of the people who did move out. Controlling rocky desertification in the Mashan area through social measures has also proven to be difficult.

The implementation of disaster-relief programs has also been unsuccessful. Slash-and-burn cultivation is still popular with the Miao people and a lot of wood is consumed as fuel in daily life. Following expert recommendations, the local government has proposed a variety of policies and decrees, such as the prohibition of slash-and-burn cultivation and deforestation for fuel. There are also policies to supplement the local people for the prohibition of slash-and-burn cultivation, such as providing free chemical fertilizers, pesticides and seeds. Policies of under-quoting coal to restrict deforestation for fuel by the local Miao people have also been implemented.

The policies mentioned show that the government cared for the local people and environment. The problem is that they did not take the nature of the local ecological system nor the difficulties in implementing the policies into consideration. Therefore, the policies were merely in writing. On one hand, the function of chemical fertilizers, pesticides and improved varieties should be considered in the policies, but in Mashan this premise does not exist. Therefore, even with a high input of fertilizers and pesticides, their intended purposes cannot be achieved. The worst result would be if the cost of fertilizers and seeds were higher than the value of food output. Once the government stops the supply of these materials, the implementation of relevant policies would stop immediately. On the other hand, since more than half of the living beings in the developed rocky desertification area are living on the farming land, the negative effects of fertilizers and pesticides can be serious. The use of pesticides can affect biological diversity in large areas and fertilizers can harden soil in the farming land in two or three years. These negative effects could further exacerbate the dependence on pesticides and fertilizers. At present, the value of agricultural products in some counties in the Mashan area is less than 10% of the total economic output, whereas the input of pesticides and fertilizers is more than half. Meanwhile, the demand for chemical fertilizers and pesticides in the Mashan area is increasing and the implementation of policies causes the “black hole” in finance expenditure.

The laws and decrees mentioned above present some practical difficulties. Mashan is sparsely populated, and transportation is inconvenient, so it is impossible to control slash-and-burn cultivation effectively through administrative management. To maintain their living, the local Miao people have to keep using slash-and-burn cultivation and avoid inspection by the government. These actions show that the implementation of policies
and decrees in the past twenty years have not been as successful as expected. Rocky desertification areas continue to expand and policies for controlling it have been ineffective.

To help Mashan recover from rocky desertification, past lessons need to be summarized, the mistakes corrected and new ideas for treatment explored. Various measures for disaster alleviation in the past have followed the thinking and methods of agriculture and husbandry production of the Han people, to plan the introduction of technology, social reform and the implementation of policies. These practices have been queried for some time, because they ignore cultural differences and go against the popular theory of cultural environmental protection (Hong 2001). Due to the special ecological structure of Mashan, the technical measures that are effective in the developed regions occupied by the Han nationality cannot be adapted. The social organization and the corresponding values between the Han and the Miao people in Mashan are different. The local Miao people have become spectators, and their own ecological wisdom and skills have been marginalized.

To find a solution for disaster control, the traditional ecological wisdom and skills of the local Miao people should be explored. The ideas of the local people should be initiated, so that according to the understanding of the ecological environment, they can explore the native biological resources and inorganic resources in their own way. Changes to the measures of resource utilization could avoid the five weak links of the local ecological structure, and promote ecological restoration. This is a new method of disaster control that relies on the culture.

5 The discovery and utilization of the local Miao people’s traditional ecological skills

Miao people, who have lived in Mashan for generations, have gained a lot of experience from observing the local natural and ecological environment over the long-term. To ensure their own existence and development, the local Miao people had to combine their ecological knowledge with the means for survival, deal with fluctuations of natural factors, and defuse risks (Harper 1996). This process of considering both knowledge and behavior helped them to understand the environment accurately. Because of the particular features of the local ecological structure, the Miao people were exposed to rocky desertification a long time ago. They reformed and utilized the damaged lands with their wisdom and skills. The ecological wisdom and skills from the traditional culture of the Miao people is made up of three aspects from the accumulation of experiences and skills. It is clear that their ecological wisdom and skills were adapted to this area, and outsiders are rarely aware of this local knowledge.

The Miao people’s knowledge is rooted in their traditional culture. This local knowledge is difficult to uncover when the daily life of the Miao people is observed by outside societies with their own well-known knowledge hierarchy. Even though the difference in their lives and special skills is noticeable in fieldwork, it is difficult to analyze the causes and applicability of these differences. The combination of local knowledge and individual behavior makes it difficult to separate valuable wisdom and skills from individual ecological behaviors. The local Miao people do have irreplaceable ecological wisdom and skills, but they can only be discovered and utilized purposefully through interdisciplinary analysis and research. Therefore, defining local ecological wisdom and skills is not a simple observation process, but an exploration based on understanding.

Discovering the local knowledge and skills did not mean they would be widely popularized immediately. The achievements of the Miao people based on their experience became apart of their daily life and reflected in their social behaviors. Such local knowledge cannot exist alone and has no significance without the social background and traditional culture. Only when the perceived local knowledge and skills were restored to the traditional culture of the Miao people could their meaning and value be realized. In this sense, the utilization of this ecological wisdom and skills is for both the protection and development of the traditional culture, the spread of knowledge and skills and the social operation.

The key objective of the disaster control in Mashan is to restore vegetation through human intervention as soon as possible. It is difficult to restore vegetation because it is hard to find a location in which plants will survive in the rocky desertification area. The previous forest planting initiative failed for this reason.

During field research, we found that the Miao people planted a variety of fruit trees around their houses and grew grain and grass on the barren mountain, all of which survived and were in good condition. It was a pity that the Miao people could not explain their success themselves. We lived together with the local people for several months before they provided us with an explanation through a series of visual metaphors. They thought that grass and trees were just like people, who had to live together with their relatives and friends, and form family and village communities for development. Therefore, when they planted grass and trees, they would not only choose the soil, but also check which plants were currently there, in order to find a compatible companion for the new plants. After researching their planting choices, we found that what they said perfectly coincided with what they did. For instance, when they planted paper mulberry trees and locust trees, they looked for rock crevices where root crops, such as Polygonum multiflorum and kudzu vine, were already growing. When planting chestnut
trees (Castanea) and walnut trees (Juglans), they always chose rock crevices with luxuriant couch grass. We could summarize hundreds of land planting choices from the daily life of the local Miao people, and verification results showed that they were very effective. The trees grew fast after planting, and they could grow into towering trees. Further analysis showed that there were huge karst caves or large gulls under the narrow rock crevices, which were filled with enough soil to support the growth of ten-meter-tall trees. The Miao people found the best sites for specific plants according to indicator plants.

Another way they chose the best sites for planting was to observe rock crevice patterns and the cross point of the rock grain. The local people thought that trees could not survive in the rock crevices extending down mountains because these places would lose “Qi”, or in the rock crevices paralleling to the massif because “Qi” could not gather there. “Qi” could only gather in the cross points of transverse and vertical crevices, where trees could be planted. They further explained that for the same reason they always chose the location where two rivers or mountains cross to establish a village; only then can the village be prosperous. Irrespective of their explanations, we found two distinct features of the chosen sites by surveying the field. The first was that the bedrock was breaking and filled with soil, and the groundwater levels were high enough to support the growth of tall trees. The second one was that there was a huge karst cave filled with soil underground, which could also support the growth of trees. The local people’s explanations cannot be logically analyzed through modern scientific ideas, but the results of their actions can be verified by scientific validation.

The local people also had a series of fancy technical ideas for planting trees. Generally, they did not begin by building nurseries and growing seedlings. Instead they planted the seeds or germinated seeds in the chosen site directly. After careful observation, we found that they did not select seeds by themselves. Birds and animals store edible plants seeds in the rock crevices or thick grass for the winter. Based on their experiences, they could easily find the granary of the birds and beasts. In spring, the leftover seeds will germinate. It is of low cost to collect these seeds, which are adapted to the local ecological environment and have a high survival rate. Using this method, tree planting is very simple and convenient. Since, neither digging of the tree pits nor the soil preparation were needed, people just chose suitable sites, dug a hole in the soil with crabsticks, put the seed in and covered it with soil.

The Miao people used another method for collecting seeds for berry or fleshy fruit plants. Birds and beasts eat the fruit, but the seeds cannot be digested, and are discharged with feces. The local Miao people collected the feces and squeezed them into the chosen rocky crevices directly. This method saved labor and time.

The local people also had their own explanations about tree planting. They thought that the relationship between animals and plants was just like the human relationship, which had internal relation. The seeds moved by birds and beasts had spirituality, and could easily survive and grow. Although this explanation was illogical according to modern science, we concluded that their experiences were not contradictory with scientific principles. The seeds chosen by animals were definitely disease-free, and digestive juice from the animals could corrode the coverings of the seeds and activate seed germination. The Miao people thought that plants in a nursery had harmonious relationships with each other, so if some plants were moved, this relationship would be broken and without their close partners, the transplanted plants would not grow. Based on this, they often rejected the free nursery stock supplied by the government, or made chalk marks on the nursery-grown plants to remember the tree position and the direction of treetops, so they could replant them in their original orientation and the neighboring trees in the adjacent positions. The tracking study showed that their operations were effective. The survival rate of saplings not replanted in this manner was low, and even if they did grow, the wood fiber was distorted into spirals. When the seeds are planted directly, without nursery, complicated tracking operations can be abandoned and consequently the cost is reduced. If we could effectively use this local knowledge, without huge financial investment, ecological restoration in the Mashan area could be smooth and achievable.

Social conflicts in the ecological restoration of the Mashan area concern the protection of the local Miao people from outside influence, and how to alleviate the severe shortage of local land resources. Some areas in Mashan where rocky desertification is serious are almost barren, and cannot be utilized at all. Local Miao people can only live on the limited farmlands on the bottom of the dissolution basins. They have planted millet and buckwheat in the rocky crevices in the surrounding mountains through slash-and-burn cultivation, and they could also graze sheep and cattle in these regions. Any ecological construction to the land in use would directly affect the food supply for local people, and it is impossible to cultivate more of this land. The only land resources that are currently available are the land on steep slopes with highly developed rocky desertification. Using modern scientific and technological measures this land could hardly be utilized in crop farming or livestock breeding projects.

Through old texts and local oral legends, we learned that before rocky desertification occurred the exported products from Mashan included hemp, bark of paper mulberry, raw lacquer, tung oil, white wax, tussah and other wildlife products, most of which were from the steep
slopes that have highly developed desertification now. As rocky desertification increased, the value of traditional products gradually decreased. Currently, only individual villages or families still produce these products and as a consequence, they are wealthy in the Mashan area. If we use the traditional ecological restoration methods and plant adjacent nectar forests, chestnut forests and paper mulberry forests in rocky desertification slopes, the traditional production should resume and the local Miao people will rise out of poverty. The food shortage may also be solved by selling products in the market and the ecological construction and economic development might become mutually compatible.

The local Miao people are willing to produce traditional products, a reflection of their ecological wisdom. To produce these traditional products, the soil does not need to be turned frequently, and once planted trees survive, the people would benefit for decades. Weak links of the local ecological system will be avoided, while water loss and soil erosion will not occur. In addition, the Miao people will also master special skills to promote forest regeneration. Aging trees need to be cut down to five inches above the ground, then the tree stumps should be burned or daubed with lime water. The stumps could germinate in the coming year, and a closed canopy could be created in two years. This technique can be applied to paper mulberry, chestnut trees and locust trees. This technical operation could protect the vitality of stumps and maintain the root system that protects the soil. With this method, if there is a rainstorm in the cutting season, soil erosion will not occur.

Further investigation has shown that local Miao residents use multiple plant resources. The comprehensive utilization of paper mulberry is a good example. The berries are good nutrition for pigs, while pig manure is breeding fertilizer for trees. The paper mulberry leaves can be used to feed pigs, cows, goats, and even tussah. As high-quality papermaking raw material, the bark of paper mulberry is an important export product, and can also be used for spinning and weaving. Limbs without bark can be used as firewood fuel. The trees are useful as timber and are preferred locally. The local Miao people consider paper mulberry a treasure. Since the paper mulberry trees can easily survive in rocky crevices, they could be used as the control plant in rocky desertification efforts. In addition to paper mulberry, there are several other trees that can multiply and grow in the poor rocky crevices of Mashan, such as Chinese toona (Cedrela sinensis), Coriaria sinica Maxim, and locust trees (Robinia).

The core objective of ecological management in Mashan is to control water loss and soil erosion, and speed up soil formation. The main passage for water loss and soil erosion is the land funnel in the dissolution basin. In the past, land funnels were blocked for natural or man-made reasons, resulting in the formation of dissolution lakes and marshlands. Once the dissolution lakes were formed, the flow of land and water resources could be maximally controlled. With the technology available today, it is not difficult to block land funnels, but there are three problems to address before taking action. We should find the exact location of land funnels and make note of the structure of surrounding rocks. We should know the direction of flow of runoff during the rainy season and various other physical parameters of the running water. We should know the position and trend of rocky crevices at the bottom of depressions, and use them as geologic parameters for programming the area and volume of the dissolution lakes. The current investigation shows that the local Miao people have abundant knowledge and experience to address these three problems, and they should be successful in blocking land funnels.

There are five functions of the ecological construction of man-made dissolution lakes. Soil and water resources could be held effectively, so that rocky desertification land layers would thicken each year. The potential for flooding in the lower reaches could be reduced during the flood season, and blocks of the lower watercourse could be avoided. The stored water resources could be used to supply the local Miao people for production and domestic use during the dry season. The dissolution lakes could become a base for the production of aquatic products, and the shallow water region could be used as rice fields. Corn would no longer be the only crop planted in this area. Overcoming the difficulties of species spreading would have to be addressed first. The regain of dissolution lakes also creates conditions for the diversity of species in the local ecosystem. For instance, a habitat for migratory birds could be provided and water resources for birds and beasts could be supplied. Meanwhile, species diversity could form new industries.

Local Miao people have a whole set of technical knowledge and skills to solve the problem of soil that is difficult to form, but easy to run off. Their technical knowledge and skills can be divided into two modes, “to broaden sources of water” and “to reduce expenditure”. “Reducing expenditure” refers to the cultivation of horizontal land of shrub and grass on the abrupt slopes to lower the soil flow rate through the shallow grass, and reduce the impact of rainfall on the surface soil by the branches and leaves of the trees. The shrub-grass zone should be constructed along the contour line, three to eight meters in width, and will play the role of a biological dam to ensure that soil from the abrupt slopes is not washed to the bottom of the dissolution basins. As the soil layer becomes thicker, the biological dam will expand and cover the rocky desertification land, resulting in the formation of new arable soil. The biological dam only needs to be constructed once, but it will continue to function; it is
the most labor-saving and material-saving method for controlling rocky desertification.

The local people use two methods for accelerating soil formation, burning and planting moss. On the top of circular ridges in depressions, they continue to use the traditional production method, slash-and-burn cultivation. The high temperature from burning the crop stubble and weeds burns the surface of bedrocks, producing lime, and after the rainwater erosion, the lime and silica form the new soil matrix. Slash-and-burn cultivation might thicken soil in the rocky crevices by 0.2 mm at one time. There are opponents to slash-and-burn cultivation that think this farming method accelerates soil erosion. The Mashan area is an exception to this assumption for a number of reasons. Except for the rocky crevices, there is only bedrock in these areas of Mashan, so there is no soil to erode. As long as there are biological dams in the mountainside, the new soil particles from burning are effectively held in place and covering of the barren mountains with soil is accelerated. Additionally, grain from the farming zone could be used to create land for grazing during the fallow period. Slash-and-burn cultivation should not be completely banned in this area; rather it should be encouraged, because it may help drive soil formation.

The dissolution rate of limestone increases in acidic environments and causes the formation of soil to progress faster. Based on their experiences, the local Miao people know that various plants, such as moss, pteridophyte and stringy stonecrop herb (Sedum sarmentosum Bunge), can accelerate the dissolution rate of limestone. They plant these plants in rocky crevices and once the plants survive, they will cover the rock, enhance the capability to trap atmospheric precipitation, and form a thin soil layer on the surface of rocks. They can also eat some of these plants, and some can be used as feed. In addition to accelerating the formation of soil, this planting method can also provide economic value for the people.

It has been proven that there is abundant wisdom and skills in the Miao culture and their local ecological knowledge has irreplaceable value for ecological construction in the Mashan area. In order to explore and take advantage of this local knowledge, there should be a process to follow, including the discovery, discussion, and initiation period. The administrative officials, technology experts and the local people should also unite and work together through the process. The key to success is patience, tolerance and mutual respect among all parties. The discovery and utilization of local knowledge to promote ecological construction is just a start, and more work lies ahead.

6 The prospects and existing problems of rocky desertification control in Mashan

We lived together with the local Miao people in Mashan for several months, before they trusted us and would talk openly. Under the circumstances, we bluntly asked them why the trees had a high survival rate when they planted them by themselves, but the survival rate decreased when they planted with funds and technical assistance supplied by the government. The answers we received were different among the people, including village military officers, Miao masters, elders, and able men, due to various taboos. We analyzed the different answers and can summarize the main points. Here is what they said:

“A few years ago, the policy of “grain for green” was carried out. The government showed concern for us and organized training in the town. The streets of the city were broad, white, and tree-lined. All of the trees were of the same variety, and the houses in the city looked similar too. When we were trained by the technicians, we were required to dig plant pits and manure the soil before planting. They only gave us one kind of tree sapling that we were unfamiliar with. We thought the men from the government must know witchcraft and they could transform the barren mountains into cities. We were taught to plant the trees here in straight in rows. The only challenge was that there were so many rocks that it was impossible to dig the plant pits and the technicians did not know how to overcome this problem. They didn’t insist on the former rules, and just asked us to try our best to the plant trees in a row. We did as they required and piggybacked soil to places unavailable for digging pits. We already knew at that moment that the trees would not survive, but we still hoped that the government’s methods would have supernatural power. In the end, these planting methods failed. As an old Miao saying goes, the foreign masters can’t expel the domestic ghost.”

This statement should affect all parties. The simple and honest Miao people were filled with trust and hope in the government, science and technology. Their opinions were ignored and there would be a price to pay. They had already known the cultural and environmental differences between themselves and the outside world, and they know how to adjust measures to the local conditions. The problems arose because the policy executors were overconfident and they neglected the cultural and environmental differences. We should analyze this failure calmly and fairly, squarely face the cultural and environmental differences and learn to trust the local Miao people so they can operate according to their own knowledge and understanding. The government should play the role of a supervisor and examiner, providing some scientific and technical information, and helping the local people with marketing communication to determine their market risks. Following these guidelines would help improve ecological construction in the Mashan area without huge investments and projects.
论苗族传统知识在贵州麻山石漠化灾变救治中的价值

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摘要：20世纪中期以来，麻山喀斯特山区随着周边社会环境的巨变，这些巨变冲击了麻山地区生态系统的脆弱环节，使麻山地区石漠化灾变日趋扩大。国家从20世纪60年代开始虽经多方救治，成效甚微。我们在对苗族生计方式的田野调查后发现，生息在这里的苗族积累有高效利用与精心维护喀斯特生态系统的经验和技能，发掘和利用苗族传统的地方性知识和技能，在石漠化灾变救治中具有不可替代的特殊价值。

关键词：苗族；生态知识；麻山；石漠化；灾变救治