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Authors: Shen, Shicai, Wilkes, Andreas, Qian, Jie, Yin, Lun, Ren, Jian, et al.

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Agrobiodiversity and Biocultural Heritage in the Dulong Valley, China

Impacts of and Responses to the Sloping Land Conversion Program

Shicai Shen¹, Andreas Wilkes^{2*}, Jie Qian¹, Lun Yin¹, Jian Ren³, and Fudou Zhang⁴

* Corresponding author: a.wilkes@cgiar.org

¹ Center for Biodiversity and Indigenous Knowledge, 3rd Floor Building A, Zhonghuandasha, Yanjiadi, Kunming, Yunnan Province, 650034, China

² Center for Mountain Ecosystem Studies, Kunming Institute of Botany of the Chinese Academy of Sciences, Yunnan, 650204, China, and World Agroforestry Centre China Programme, Beijing, 100081, China

³ Pratacultural Science Department, Yunnan Agricultural University, Kunming, 650201, China

⁴ Agricultural Environment & Resource Research Institute, Yunnan Academy of Agricultural Sciences, Kunming Yunnan 650205, China

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Swidden agriculture is central to the livelihoods and culture of the Dulong people in northwest Yunnan, China. In 2002, the Sloping Land Conversion Program (SLCP) was first being implemented in the Dulong Valley. Under this

program, all swidden land and most permanent arable lands were converted to forest, in return for which villagers received grain subsidies. In view of the importance of traditional agriculture in Dulong livelihoods and culture, and the potential uniqueness of agrobiodiversity in the Dulong Valley, the Center for Biodiversity and Indigenous Knowledge (CBIK), a nongovernmental organization based in Yunnan, has been undertaking surveys and action research on the impacts of the SLCP since 2005. By drawing on previous studies, data provided by the local government, and a new survey of the current status of traditional crop cultivation conducted in 2 villages in 2009, this article describes some of the impacts of

the SLCP on agrobiodiversity, livelihoods, and traditional culture in the Dulong Valley. Results of surveys found that, before 2002, at least 12 crop types were commonly planted in swiddens, including 7 underutilized species. By 2009, only a minority of households continued to cultivate these crops. Changes in land use and grain availability have also led to a significant reduction in the number of livestock raised, and, in some cases, animal genetic diversity is being threatened. Elder Dulong villagers are concerned that these changes will lead to the erosion of traditional culture. The article also describes activities that are now being conducted to conserve agrobiodiversity and support cultural transmission in Dulong Valley. Events such as seed fairs, arts competitions, and revival of swidden cultivation on a small scale have attracted the attention of villagers and local government, and conservation of agrobiodiversity through value addition is now on the agenda.

Keywords: Swidden agriculture; Sloping Land Conversion Program (SLCP); agrobiodiversity; conservation; Dulong; Yunnan; China.

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Introduction

Swidden agriculture, widely practiced in the eastern Himalaya region, has long been seen as the antithesis of state forest management and conservation policies. State policies throughout the region have sought to restrict or eradicate swidden practices. More recently, it has been recognized that swidden practices may contribute to the maintenance of biological diversity, in terms of both tree and crop genetic diversity (Kerkhoff and Sharma 2006); swidden practices also form a core part of mountain people's biocultural heritage (Wilkes and Shen 2007).

In 1999, China's central government announced the Sloping Land Conversion Program (SLCP) or "Grain for Green" program. Under this nationwide program, cropland on slopes that exceed 25° is converted to forests or grasslands, in return, farmers receive subsidies for 5–

8 years paid in the form of grain or cash. The objective of the SLCP is to reduce land degradation by increasing vegetation cover and by reducing soil and water erosion (Bennet 2008). Poverty alleviation through increased participation in off-farm labor markets has been another subobjective of the program (SFA 2003). As one of the world's largest environmental compensation schemes, the SLCP has been the subject of a great deal of research, including its impacts on indicators of ecological processes, incomes, and the structure of rural economies (Liu et al 2008). Impacts of the program on indigenous communities, their management of natural resources, and related cultural institutions have attracted little attention to date (but see Xu and Ribot 2004; Xu and Wilkes 2005).

This article discusses the impacts of the SLCP on land use and agrobiodiversity, livelihoods, and ethnic culture in Dulong Valley, northwest Yunnan, China. The valley is

home to one of China's least populous ethnic groups, the Dulong, for whom swidden agriculture is an integral part of their cultural heritage. Implementation of the SLCP in the Dulong Valley since 2002 has effectively brought traditional agriculture to an end, threatening crop species diversity and traditional culture, and transforming livelihoods. The article also describes a series of activities that have raised awareness of the value of agrobiodiversity and supported communities and local government in initiating conservation actions.

Conversion of traditional agriculture in the Dulong Valley

The Dulong Valley is situated in the northwest of Yunnan province, China (98°–98°5' E, 27°5'–28° N), bordering Myanmar to the west, Tibet to the north, and the Salween Valley to the east. The area is inhabited by just over 4000 members of the Dulong (also written as Drung) ethnic group, one of the least populous ethnic groups in China (Li 1999). This valley's unique location makes it an area of extremely high natural biodiversity (Chen 1993), and its traditional agriculture system generated significant agrobiodiversity.

Swidden agriculture is central to the traditional livelihoods and culture of the Dulong people (Yin 2001; Gao 2003; Qi 2006). Besides swidden agriculture, traditional Dulong agriculture also comprises permanent maize fields and vegetable gardens. Irrigated rice paddies were created in a small number of locations in the valleys in the 1950s (Luo 2006). Traditionally, primary or secondary forest is cleared for swidden agriculture and crops are cultivated for 1–3 years before cropping is abandoned and the fallow is allowed to regenerate. The period of cropping is combined with a number of agroforestry practices.

Sites that are dominated by *Alnus nepalensis*, a fast-growing, nitrogen-fixing tree species, are the most preferred areas for swidden agriculture. During clearing, larger *Alnus* trees are selected to be retained and pollarded, whereas smaller trees and other undergrowth are cut, dried, and then burned. Burning the dried vegetation accelerates decomposition, releases useful nutrients for crop production, and kills weeds and pests. Some months after burning, *Alnus* saplings previously collected from nearby locations are transplanted to the cleared site. Pollarding the retained *Alnus* trunks reduces shading impacts on crops, and the thin branches that subsequently grow are sometimes also cut and burned in the second and third years of cropping to maintain soil fertility. The cropping phase lasts up to 3 years.

During the cropping phase, a variety of annual rotations among several crop types (eg maize, millet, buckwheat, upland rice, finger millet, beans, and taro) are used, depending on household needs, the fertility of the soils at each site, and the perceived site requirements of

each crop type (see Yin 2001). The fallow period that follows the cropping is managed to some extent. The retained and planted *Alnus* trees and other trees that occur at the site will be allowed to regenerate for at least 5–6 years. *Alnus nepalensis* trees are very important because they have nitrogen-fixing properties that have benefits for maintaining soil fertility for future cultivation (Li et al 2006). Fallows are also exploited for other purposes, such as livestock grazing, hunting, and non-timber forest product (NTFP) and timber collection.

When the site is cleared again, transplanted trees will also be cut, along with other vegetation, unless they are selected to be retained and pollarded. A scheme partially comparable with the *Alnus nepalensis* improved fallow system can be found in northeast India and in the Nagaland, and is described by Cairns et al (2000). Such systems support agrobiodiversity because they create and depend upon landscape and habitat diversity, while also meeting multiple livelihood needs.

Implementation of the SLCP began in Gongshan County in 2002 (GFB 2009). Most of the quota for land conversion for the first year of SLCP implementation was allocated to the Dulong Valley, and special implementation measures were established. In most other areas of China, land conversion targeted land on slopes over 25°, primarily to reduce soil erosion. In Dulong Valley, which is characterized by steep valley slopes (>25°) in almost all locations, rather than targeting specific land plots, the subsidies provided by the SLCP were divided equally among all farming households, and all land in the cultivated phase of swidden agriculture was required to be planted with trees (*Alnus* and *Pinus*). In addition to swidden fields, 78% of permanent arable land was converted to forest. At the end of 2002, a total of 933 ha of cropland had been converted in Dulong Valley. Of this area, 663 ha was land in the cultivated phase of swidden agriculture. In return, farming households were given 8 years of grain subsidy (later converted to direct cash payments); these subsidies are to end in 2011. In addition to the grain subsidy funded through the SLCP, local villagers also began to receive a "subsistence allowance" in the form of a cash transfer from the local government. By 2009, the total subsistence allowance paid by local governments had reached more than 1.86 million Yuan (US\$ 1 = RMB 6.83) (GFB 2009).

Methodology for assessing the impact of the SLCP

In view of the importance of traditional agriculture in Dulong livelihoods and culture, and the potential uniqueness of agrobiodiversity in the Dulong Valley, the Center for Biodiversity and Indigenous Knowledge (CBIK), a nongovernmental organization based in Yunnan, has been undertaking surveys and action research on the impacts of the SLCP (Xiao 2005; CBIK

TABLE 1 Cultivation of crop species in 2 study villages in 2009. (Source: survey data, 2009)

Crop type	Farmers cultivating crop in Dizhengdang (n = 25)	Farmers cultivating crop in Kongdang (n = 25)	Maximum seed storage time (y)
Maize: <i>Zea mays</i> L.	13	21	1
Soybean: <i>Glycine max</i> (Linn.) Merr.	13	15	2–3
Bitter buckwheat: <i>Fagopyrum tataricum</i> (L.) Gaertn.	9	15	1
Sweet buckwheat: <i>Fagopyrum esculentum</i> Moench	9	11	1
Finger millet: <i>Eleusine coracana</i> (L.) Gaertn.	8	9	1–2
Millet (variety unknown): <i>Echinochloa</i> sp.	0	7	5–6
Foxtail millet: <i>Setaria italica</i> (L.) Beauv.	0	5	3–4
Pearl millet: <i>Setaria italica</i> var. <i>germanica</i> (Mill.) Schrad.	0	2	1–2
Amaranth: <i>Amaranthus paniculatus</i> L.	0	3	3

2006; Wilkes and Shen 2007). By drawing on these previous studies, an additional survey of the current status of traditional crop cultivation was conducted in 2 villages in 2009, and data provided by the local government was analyzed.

The 2009 survey focused on 2 villages, Dizhengdang in the upper reaches of the valley, about 65 km from the seat of township government and the local market, and Kongdang in the central area, only about 2 km away from the township seat and the local market. These communities were selected to represent different degrees of access to market and government support, as well as different natural resource endowments. Dizhengdang (61 households) has more abundant forest and cropland resources per household, whereas Kongdang (73 households) has limited cropland per household. Our survey sampled 25 households at random in each village. In addition, 15 unstructured individual interviews and 3 focus group discussions that involved 45 elderly villagers and women were held in these 2 villages, to qualitatively understand diverse perceptions and responses of households to the SLCP. Interviewees were selected to opportunistically represent diverse social groups.

The impacts of the SLCP

Loss of agrobiodiversity

Since the implementation of the SLCP, agricultural land use and crop varieties have changed greatly. In 2002, the cultivated area under swidden agriculture accounted for 67% of all cropland in Dulong Valley. In 2009, all land in the cultivated phase of swidden agriculture and a large proportion of permanent maize fields had been

converted to forest. Surveys in Dizhengdang and Kongdang both showed similar trends in land-use change. The total cropland area of surveyed households in both villages in 2002 was 68.7 ha, of which cultivated swidden land accounted for 71%; maize land, 22%; and vegetable gardens, 7%. In 2009, the surveyed households maintained a total of fewer than 11 ha of permanent maize fields and vegetable gardens, although the average land area in Dizhengdang was higher than in Kongdang.

No baseline survey of crop diversity before 2002 exists, although Long et al (2004) report results of a rapid assessment that identified more than 20 crop species planted in Kongdang village in 2002. Interviews and informal discussions with villagers in both Kongdang and Dizhengdang identified 12 different types of crops (19 varieties) that were commonly planted by most households before 2002. Of these, 7 crop types were “underutilized species,” such as foxtail millet (*Setaria italica* [L.] Beauv.), pearl millet (*Setaria italica* var. *germanica* [Mill.] Schrad.), an unknown variety of millet (*Echinochloa* sp.), amaranth (*Amaranthus paniculatus* L.), and coco yam (*Colocasia esculenta* [L.] Schott). Because of the valley’s location as a link between Chinese and Indo-Burmese genetic resources (Chen 1993), some varieties are likely to be unique to the area. The status of 2 common crops and 7 underutilized crops planted by households interviewed in the 2 study villages in 2009 are shown in Table 1. In 2009, most households no longer cultivated the traditional crop varieties (Table 1). Compared with Dizhengdang, a larger proportion of households in Kongdang continue to cultivate traditional crops because the proximity to the inhabitants of the township seat provides some market demand for these crops and their

TABLE 2 Structure of per capita income in 2 study villages in Dulong Valley, Yunnan (2002, 2009). (Source: Local government statistical reports, 2002, 2009. NB: 6.83 RMB $\approx$ US\$ 1)

Village income sources	Dizhengdang		Kongdang	
	2002	2009	2002	2009
Total annual income (RMB)	789.00	2301.00	1156.98	2734.00
Forestry (%)	24.65	34.21	28.05	31.01
Cropping (%)	54.21	26.03	41.05	17.76
Livestock and poultry (%)	9.80	4.50	13.95	4.92
Transportation (%)	0	1.01	2.85	6.15
Trade (%)	0	3.57	4.09	14.41
Subsidies (%)	11.34	30.68	10.01	25.75

products, eg buckwheat (*Fagopyrum esculentum* Moench) flour, and foxtail millet (*Setaria italica* [L.] Beauv.) wine.

Land-use change has been the main reason for discontinuing cultivation of traditional crops. Specifically, few farmers continue to plant traditional crops because their yield is lower when planted in permanent fields than on swidden land. Some varieties can grow only on swidden land. Many crop seeds can be stored for only 1–3 years (Table 1), so maintenance of genetic diversity requires that these varieties continue to be cultivated. Results of surveys found that many households think other farmers are retaining the seeds of traditional crops and expect that, if, in the future, they want to plant these crops, then they will be able to obtain seeds through exchange with these seeds. But, in fact, only a few farmers continue to grow some of the traditional species.

Livelihood changes

Implementation of the SLCP has changed the pattern of livelihood activities and the structure of incomes in the Dulong Valley (Table 2). In 2002, the main income sources were agriculture, forestry, and, to a smaller extent, livestock husbandry. Forestry income was largely derived from the collection and marketing of NTFPs. In addition, agriculture and forestry supported livestock production by providing feed and grazing lands. Because the Dulong Valley is sparsely populated and far from the county town, few households engaged in transportation or trade activities. Because the SLCP, most households were unable to meet all their grain needs based on their own agricultural production (Long et al 2004), but supplementary cash income from hunting, NTFP collection, and livestock husbandry enabled them to procure grain from other sources.

In 2009, the main household income sources were forestry and state transfers. Some of the increased income from forestry was from cultivation of cardamom in the

understory of secondary forests that were not converted as part of the SLCP, which has been promoted by local government since 2007 in the Dulong Valley. However, most of what is classified as “forestry income” in government statistical reports is direct cash payments made in lieu of grain subsidies under the SLCP. Some households in Kongdang, which is close to the township seat, have developed off-farm income sources (eg transportation and trade). Because of restrictions on all uses of all forests converted under the SLCP, as well as the establishment of a nature reserve that covers forests more distant from residential areas in the 1980s, many traditional activities, such as hunting, NTFP and timber collection, and livestock grazing, ceased by 2009. State income subsidies now comprise approximately 25–30% of income in the 2 study villages, whereas cash payments made in lieu of grain subsidies under the SLCP account for a further 18–27% (Table 2).

Changes in land use and grain production have impacted livestock husbandry. Before 2002, livestock husbandry was important for meeting household food security needs, mostly through sales of animals on the market. Animals raised included pigs, chickens, goats, sheep, cattle, and some equines (horses, mules, or donkeys). In 2009, most livestock were used to meet household consumption needs. Conversion of cultivated swidden land and restrictions under the SLCP rules on use of these lands after conversion mean that cattle, sheep, and goats are no longer allowed to graze in these areas, so the scale of livestock husbandry has declined (Table 3). Some villagers have had to give up livestock husbandry because they do not have enough grain to use as feed.

Changes to traditional culture

Traditional agricultural practices are an integral part of Dulong culture. In northern parts of the valley that have not converted to Christianity, clearing of forests for

TABLE 3 Average livestock holdings per household in 2 study villages. (Source: Local government statistical reports, 2002, 2009)

Village livestock population	Dizhengdang		Kongdang	
	2002 (average)	2009 (average)	2002 (average)	2009 (average)
Pigs	6.2	2.3	5.5	2.1
Cattle	4.2	1.6	1.0	0.9
Chicken	14.2	5.6	14.9	7.8
Goats/sheep	3.9	1.3	4.7	1.4
Equines	0.5	0.3	0.2	0.1

swidden agriculture was preceded by religious rituals performed by a *namusa*, a kind of shaman. The purpose of the ritual is to seek the support of spirits for a good harvest. Such rituals stopped with the end of swidden cultivation in 2002. Some older Dulong villagers are concerned that the knowledge and abilities required to perform these rituals will disappear, particularly because younger people are not interested in learning them.

Agrobiodiversity is also central to ethnic cuisine. Traditional Dulong food does not include paddy rice, the form in which grain subsidies are provided under the SLCP, and most villagers have not been able to eat traditional grains since the implementation of the SLCP. A traditional cultural view is that grains other than rice are good for health. For example, when mothers who have just given birth rest for a month after delivery, they are mainly given these grains to eat (CBIK 2006). Finger millet (*Eleusine coracana* [L.] Gaertn.) (Figure 1) is also a widely known cure for diarrhea.

FIGURE 1 Crop species of *Eleusine coracana* (L.) Gaertn. in the Dulong Valley. (Photo by Shen Shicai, 2006)

Besides changes in diet, many elder people worry about the overall loss of distinctive ethnic culture (CBIK 2006; Wilkes and Shen 2007). They see that, “if young people are not good in school and are unable to find work, and they no longer understand ethnic food, and don’t know which wild vegetables to eat and how to cultivate ethnic foods,” then young Dulong people will be in a severe state of anomy. Other villagers wonder, “if you don’t know these things then are you still a Dulong?” This illustrates that swidden agriculture and traditional foods are an important part of what it means to be Dulong. However, many younger villagers say that, even after the SLCP ends, they do not want to renew traditional practices, because they are labor intensive and physically demanding.

Responses to the impacts of the SLCP

Since 2002, the local government has implemented several programs to support implementation of the SLCP and its goals as understood by local officials. These interventions have mainly focused on promoting alternative energy sources (eg biogas and hydropower electricity) to reduce dependence on fuelwood in the areas near the township seat in Kongdang and support for importing building materials from outside the valley to reduce demand for locally sourced timber. The conservation of agrobiodiversity and related culture, however, was not previously a priority of local government.

To promote agrobiodiversity conservation and preservation of traditional culture, CBIK has been working with community members and local government, convening workshops and other community events to raise awareness and provide support for agrobiodiversity and culture conservation. One of the main activities since 2008 has been to convene traditional cultural exchange meetings in different communities in the Dulong Valley (Figure 2). The core activity is to convene a seed fair in which villagers bring traditional seed varieties and exchange knowledge of seeds, as well as exchange the

FIGURE 2 Seed exchange in the Dulong Valley. (Photo by Shen Shicai, 2006)



germplasm itself. The fairs have provided local government a chance to understand the range and characteristics of traditional seed varieties and their current conservation status. The fairs also provide an occasion for cultural shows and competitions, and local “superstars” are selected and awarded prizes in various categories, such as traditional crop variety preservation, traditional food making, song and dance, and traditional costume making. To date, 563 villagers from 11 communities in the Dulong Valley have been involved in these meetings. Incomplete statistics collected to evaluate the impact of these workshops show that at least 21 additional households have renewed their cultivation of traditional crops (Figure 3).

The county forestry bureau and township government also agreed to approve 1 ha of land to be used for swidden cultivation since 2008. A plot of land was selected in the upper region of the Dulong Valley, and, since 2008, 8 traditional crops have been cultivated by using traditional methods on the approved plot (cocoyam [*Colocasia esculenta* L. Schott.], bitter buckwheat [*Fagopyrum tataricum* L. Gaertn.], sweet buckwheat [*Fagopyrum esculentum* Moench.], finger millet [*Eleusine coracana* L. Gaertn.], millet [*Echinochloa* sp.], foxtail millet [*Setaria italica* L. Beauv.], pearl millet [*Setaria italica* var. *germanica* Mill. Schrad.], and amaranth [*Amaranthus paniculatus* L.]). These crops were chosen by villagers primarily on the basis that they do not grow well in permanent fields. Five villagers and one township official were nominated as being responsible for doing the cultivation, but many other villagers have volunteered to participate in the work in the fields.

With support from CBIK, the government official has documented the process of swidden cultivation, including ritual observances, by using a digital video camera. Together, these activities serve to preserve

FIGURE 3 A Dulong farmer who has voluntarily cultivated traditional crop species in permanent land in the Dulong Valley. (Photo by Andreas Wilkes, 2006)



agrobiodiversity and to document traditional agricultural practices and culture. When the video is completed, a Dulong language version will be used to educate school children about traditional agriculture and related culture. Chinese language versions may also be useful to support dialogue with policymakers in the future. Some villagers have begun to package traditional seeds and crop produce for sale to tourists, and local government agencies are now assessing the feasibility of developing processed products on the basis of traditional crop varieties. This can be taken as a sign that villagers and local government officials are now aware of the potential value of maintaining agrobiodiversity.

Discussion and conclusions

For many mountain peoples in the eastern Himalayas, swidden agriculture is an integral part, not only of natural resources management and genetic resources conservation, but also of ethnic identity and biocultural heritage. In inhabited areas with rich natural biodiversity, the persistence of swidden practices is mostly seen as a “problem” that obstructs the achievement of conservation objectives, and policies originating from a forest conservation perspective often seek to eradicate swidden agriculture practices. However, swidden agriculture contributes to the maintenance of diversity of both crop and animal genetic resources, which play important roles in maintaining cultural identity (Wilkes and Shen 2007).

Since the conversion of all areas of cultivated swidden to forest in the Dulong Valley, many farmers have incorrectly assumed that other farmers are preserving traditional seed varieties, and the duration of storage of viable seeds is often short. Given the centrality of these

genetic resources to Dulong cultural identity, as well as uncertainty over the extension of the SLCP after 2011, preserving the genetic resources that maintain traditional farming systems is an urgent task. Activities supported by CBIK in the Dulong Valley have shown that communities

and local governments, including officials sometimes of local ethnic origin, can reassess the value of traditional agricultural practices, even in the face of a dominant policy environment oriented to achieving forest conservation objectives.

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