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Diversification of Livelihoods in a Society in Transition: A Case Study of Tibetan Communities in Southwest China

Franz K. Huber [a] , Yongping Yang [b] , Caroline S. Weckerle [c] & Klaus Seeland [a]

[a] Institute for Environmental Decisions, Society, Environment, and Culture, ETH Zürich , Zürich , Switzerland

[b] Kunming Institute of Botany, Chinese Academy of Sciences , Kunming , People's Republic of China

[c] Institute of Systematic Botany, University of Zürich , Zürich , Switzerland

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Diversification of Livelihoods in a Society in Transition: A Case Study of Tibetan Communities in Southwest China

FRANZ K. HUBER

Institute for Environmental Decisions, Society, Environment, and Culture, ETH Zürich, Zürich, Switzerland

YONGPING YANG

Kunming Institute of Botany, Chinese Academy of Sciences, Kunming, People's Republic of China

CAROLINE S. WECKERLE

Institute of Systematic Botany, University of Zürich, Zürich, Switzerland

KLAUS SEELAND

Institute for Environmental Decisions, Society, Environment, and Culture, ETH Zürich, Zürich, Switzerland

In recent years, large development and market integration programs have altered the socioeconomic structures and cultural identity of rural communities and ethnic minorities in Southwest China and influenced the management of natural resources. This article analyzes livelihood strategies in the Shuiluo Valley, a remote area of the Sino-Tibetan borderlands. Agricultural activities and the management of natural resources were studied in five villages of Muli Tibetan Autonomous County, Sichuan Province. Characteristic for rural societies in transition, livelihoods were found to be flexible, combining subsistence agriculture, off-farm employment, and the exploitation of both renewable and nonrenewable natural resources. Accessibility of villages did not influence household income and livelihood activities, and poorer households were not found to depend more on natural resources or on income from agriculture than wealthier households. The option of gold prospecting constitutes a major difference compared to more nontimber forest product-based livelihoods in adjacent areas of Southwest China.

Keywords accessibility, gold prospecting, natural resources, NTFPs, Shuhi, Southwest China

Received 5 November 2012; accepted 5 May 2013.
Address correspondence to Franz K. Huber, Institute for Environmental Decisions, Society, Environment, and Culture, ETH Zürich, Sonneggstrasse 33, 8092 Zürich, Switzerland. E-mail: huber@ethnobot.ch

Rural livelihoods in the Sino-Tibetan borderland of Southwest China are just as diverse as the landscapes and the many ethnic minority groups who dwell there, reflecting the high biocultural diversity of the area (Chirkova 2012; Xu et al. 2005). Agricultural systems range from paddy rice agriculture in the plains and valley floors to upland rain-fed barley and wheat cultivation and yak husbandry on alpine pastures (e.g., Goldstein et al. 2003; Salick et al. 2005; Shen et al. 2010; Tilt 2008; Yamaguchi 2011; Yi et al. 2007). As in many rural areas of the world, nontimber forest products (NTFPs) play an important role for many households, both for subsistence and for cash income (e.g., Pei et al. 2010). The traditional and predominantly local use of NTFPs for subsistence and primary health care needs has largely been surpassed by commercial and large-scale collection, especially for medicinal plants and edible mushrooms during the recent decades (Amend et al. 2010; Arora 2008; Huber et al. 2010; Law and Salick 2005; Weckerle et al. 2010; Xu and Wilkes 2004; Yeh 2000). This transition in the use of natural resources has raised concerns about overharvesting of plant populations and the sustainability of rural livelihoods (Huber et al. 2010; Pei et al. 2010; Weckerle et al. 2010; Xu et al. 2005).

The remote and mountainous areas of Southwest China are counted among the poorest countrywide (McNally 2004). In 2000, the Chinese government started the China Western Development Program (*xibu da kaifa*), which incorporates both poverty alleviation and conservation issues and induces socioeconomic change in rural areas (Goodman 2004; Lai 2002; McNally 2004). For example, the Natural Forest Protection Program (*tianranlin baohu gongcheng*) bans all logging activities in the upper reaches of the Yangtze (*chang jiang*) and Yellow rivers (*huang he*), and the Sloping Land Conversion Program (*tuigeng huanlin gongcheng*) aims to reduce cultivation on all slopes over 25° by compensating farmers for abandoning farmland and growing trees instead (Bullock and King 2011; McNally 2004; Shen et al. 2010; Weyerhaeuser et al. 2005; Xu et al. 2004, 2006). The consequent loss of cash income from logging and farming on both communal and household lands has increased interest in alternative sources of income, such as collecting NTFPs and working off-farm (Bullock and King 2011; Wellens 2010, 69–73; Winkler 2003).

Against this background, we here present a case study that analyzes local livelihood activities and strategies of Tibetan minority communities in a remote area of Southwest China. The aim of this study is to identify factors that influence household livelihood activities in five villages with comparable environmental and ethnic characteristics. First, we investigate what the local livelihood activities for subsistence and cash income are, and what roles NTFPs and other natural resources play. Then we compare these livelihood activities between households and villages to analyze (1) the interrelationships of activities, (2) the linkage of structural and sociodemographic variables, such as education and accessibility, with livelihood activities, and (3) the activities of wealthier versus poorer households. Finally, we discuss the local strategies in terms of socioeconomic change.

Study Area

Research was conducted in the Shuiluo Valley, situated at an elevation between 2,000 and 6,000 m above sea level (a.s.l.) at 28–29° N and 101° E, in Muli Tibetan Autonomous County (*Muli Zangzu Zizhixian*), in the southwestern-most part of Sichuan Province, PRC (Figure 1). Seasonal monsoon rains from June to October and dry winters characterize the climate, with annual rainfall from 400 to 700 mm

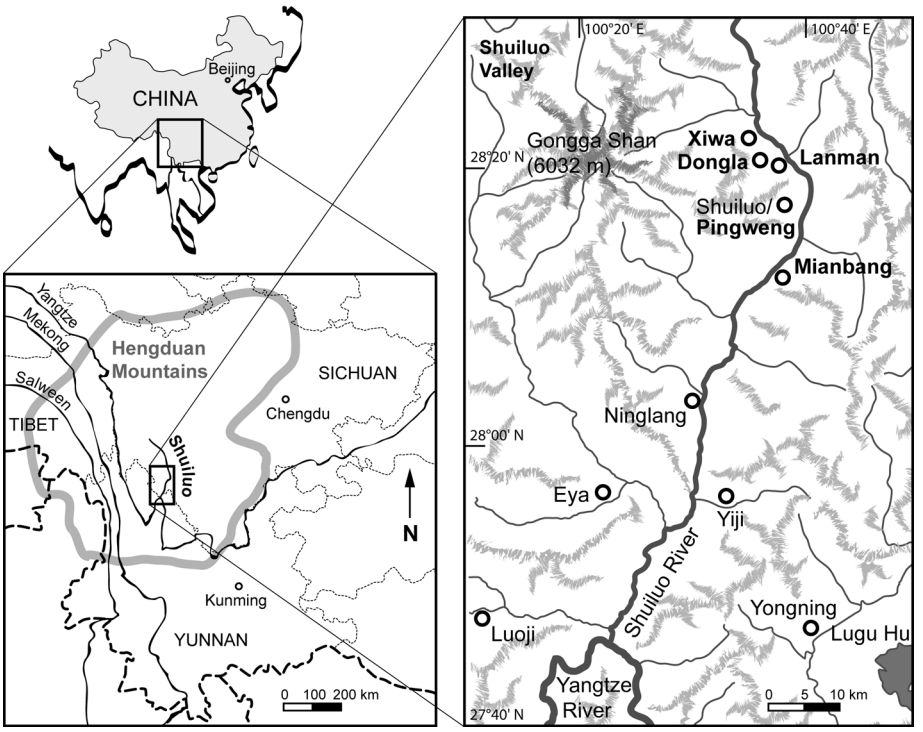

Figure 1. Shuiluo Valley in the southwest of Sichuan Province, PRC.

(Muli Zangzu Zizhixian Zhi 1995, 759; Wang 1961). Vegetation types can be vertically categorized as arid scrub in the subtropical dry valley bottoms, with pine forests as one gains elevation, then subtropical evergreen broad-leaved forests, temperate and cold-temperate conifer forests with a timberline at about 4,400 m a.s.l., subalpine scrubs and meadows, and finally alpine vegetation (Handel-Mazzetti 1921; Salick and Moseley 2012; Zhu and Cai 2004).

The Shuiluo Valley belongs to the Tibetan cultural area, and its inhabitants are officially classified as Tibetans and Naxi. In fact, the Tibetan population can be further differentiated into distinct Tibeto-Burman ethnic groups (Chirkova 2012; Hsu 1998): the Gami, Pumi, Shuhi, and Meng. Fewer than 1,500 of them are Shuhi people, living exclusively in the Shuiluo Valley. Both the Shuhi and the Meng are paddy farmers and are settled near the valley bottom; the other groups, living at higher elevations, cultivate mainly wheat, barley, and maize. The Shuhi, whose livelihood strategies are the subject of our inquiry, are not officially recognized as a distinct ethnic minority group (*shaoshu minzu*), and hence only limited recorded or published information about their culture is available. Recently, however, their language has been investigated thoroughly (Chirkova 2007, 2009; Chirkova and Michaud 2009; Sun 1990), and ethnobotanical research has been conducted on the use of wild and cultivated plants in their settlement area (Weckerle et al. 2005a, 2005b, 2006).

As a distinctive feature for Shuiluo, gold prospecting has a long history (CMTCC 1995). Before the establishment of the People's Republic and the 1950 takeover of power by the Communist Party in the area, all households were obligated to deliver a significant amount of gold plus half of the rice harvest and a fourth of the wheat and

barley harvest to the ruling elite and the monastery in Muli. The labor for gold washing came at the expense of agricultural work, and famines occurred. Since the 1970s, food shortages have not recurred. Relatively small government-managed companies prospecting for gold have been active since the 1970s, but since no heavy machines could be transported into the valley, the impact of this industry was limited. With the implementation of the logging ban imposed by the Natural Forest Protection Program, gold prospecting became a focus of the Muli government to compensate revenues from logging. Once the road from Muli Town to Shuiluo, built in a joint effort of the Muli government and private gold mining companies, was completed in 2001, the situation of gold prospecting in Shuiluo changed rapidly and profoundly. During the dry season, when gold can be prospected in the river, outside gold miners, mainly nonlocal Tibetan and Han Chinese, now outnumber local inhabitants.

Methods

Analytical Framework

Our research is shaped by the Sustainable Livelihoods Framework (DFID 1999–2001; Ellis 2000; Scoones 1998), sharing the people-centered viewpoint and emphasis on the local level, the multiple dimensions of livelihoods, and the need to employ both quantitative and qualitative methods to analyze the inherently complex systems of human–environmental interactions. Livelihoods include economic activities, the social, human, and natural resources of households, and the cultural and political context of household sustenance. We follow Scoones (1998) by grouping livelihood strategies into the three main options for rural households: agricultural intensification (achieving more output per area unit) or extensification (putting additional land under cultivation), livelihood diversification with off-farm activities, and migration. To the Sustainable Livelihoods Framework, we add the concept of subsistence capacity (Fischer 2006), which provides a rationale for the analysis of the commodification of rural labor against the background of subsistence production, with special reference to the situation in Tibet.

Data Collection

Fieldwork was conducted in the Shuiluo Valley in 2004 and 2005, totaling 12 months and covering all seasons of the year. In 2010, a revisit was made for discussing the results with the people involved in the study. Data were gathered in five Shuhi villages (*cun*) belonging to one rural township (*xiang*), all situated near the bottom of the valley, at 2,100–2,450 m a.s.l. The selected villages represent the complete north–south expansion of Shuhi settlements and show comparable ecological and climatic conditions, but they vary in terms of accessibility (for detailed information about the villages, see Table 1). Information on $N_I = 462$ individuals from $N_H = 50$ households was gathered. In Lanman village, interviews were conducted in all houses of one hamlet and two additional houses in another hamlet ($n = 15$ plus 2). We attempted to conduct interviews with one-fourth to one-half of the households in the other villages: Xiwa ($n = 9$), Dongla ($n = 6$), Pingweng ($n = 11$), and Mianbang ($n = 7$). Households for conducting interviews were randomly selected from a prior compilation of all households in the villages. Semistructured interviews were used to document quantitative and qualitative aspects of the socioeconomic and sociodemographic

Table 1. Overview of structural and sociodemographic variables among five Shuhi villages in Shuiluo Valley, SW China, in north (Xiwa) to south (Mianbang) direction

	Xiwa	Dongla	Lanman	Pingweng	Mianbang	ANOVA/ Kruskal–Wallis
Accessibility	Low	Low	Medium	High	Very low	n/a
Elevation[1] (m a.s.l.)	2,370 ± 104	2,434 ± 33	2,215 ± 17	2,423 ± 41	2,148 ± 15	n/a
Total households	25	16	34	41	14	n/a
Average household size (number of people)	6.9 ± 1.4^{a}	7.6 ± 1.5^{a}	6.4 ± 1.3^{a}	6.8 ± 0.8^{a}	7.4 ± 2.0^{a}	$F = 1.124$, $p = .355$
Landholding per capita (*mu*)	0.81 ± 0.25^{a}	$0.87 \pm 0.33^{a,b}$	0.78 ± 0.23^{a}	0.59 ± 0.11^{a}	1.15 ± 0.26^{b}	$F = 6.604$, $p < .001$
Total crop yield[2] per capita (kg)	258 ± 87^{a}	$389 \pm 141^{a,b}$	$369 \pm 131^{a,b}$	233 ± 35^{a}	460 ± 105^{b}	$F = 7.289$, $p < .001$
Rice yield per capita (kg)	20.1 ± 28.4^{a}	$50.8 \pm 47.5^{a,b}$	76.6 ± 24.3^{b}	$50.7 \pm 15.3^{a,b}$	133.0 ± 16.2^{c}	$F = 17.916$, $p < .001$
Local school	None	Primary school (3 grades)	Primary school (3 grades)	Primary school (6 grades)	Primary school (3 grades)	n/a
Education[3,4] (yr)	1.88 ± 3.17^{a}	2.08 ± 3.03^{a}	2.66 ± 2.55^{a}	4.87 ± 4.37^{b}	$3.23 \pm 4.23^{a,b}$	$F = 7.146$, $p < .001$
Education men[3] (yr)	$3.30 \pm 3.87^{a,b}$	$3.00 \pm 3.37^{a,b}$	3.28 ± 2.90^{a}	5.65 ± 4.17^{b}	$4.13 \pm 3.80^{a,b}$	$F = 2.850$, $p = .027$
Education women[3] (yr)	0.56 ± 1.47^{a}	$1.11 \pm 2.33^{a,b}$	$2.14 \pm 2.10^{b,c}$	4.03 ± 4.48^{c}	$2.67 \pm 4.46^{a,b,c}$	$F = 5.017$, $p = .001$

Note. Values are given as means and standard deviation. For pairwise comparison of means, the Tukey post hoc test was used when the variances were similar, and the Games–Howell post hoc test was used for unequal group variances. Means sharing the same superscript letters are not significantly different from each other ($p < .05$) and thus can be grouped together.

[1]Average elevation of the households included in the survey.

[2]Cumulative yields of summer crops (rice and maize) and winter crops (barley and wheat).

[3]For people between 18 and 60 yr of age.

[4]Xiwa: $n = 48$; Dongla: $n = 39$; Lanman: $n = 79$; Pingweng: $n = 71$; Mianbang: $n = 39$. n/a: Not applicable.

situation and household organization (including household size, income sources, and age, education, and occupation of all family members), land use and local agriculture, and forest and forest product use and management. Interviews were conducted in Chinese or Shixing, the local language, with the assistance of interpreters. Participant observation and informal conversation with people met by coincidence in the fields supplemented our data collection. Contextual information about the land reform, forest policies, and environmental protection programs comes from interviews with county government and Forestry Department officials in charge in the town (*xian*) of Muli ($n = 10$) and with local village heads in the surveyed villages ($n = 5$). Anonymity was guaranteed to all interviewees, and informed consent was given by involved authorities and interviewees for the use and publication of the obtained results. Interview data, official figures, and participant observation allowed for cross-checking the data.

Data Analysis

Household Data

All data used for calculations derive from the household surveys. Annual household cash income was determined from questions about separate sources of income. When interviewees reported income ranges, the average was used in the calculations.

Cash income sources have been classified as agriculture (including animal husbandry), nontimber forest product (NTFP) collection, gold prospecting, government and public service, and nongovernment off-farm employment. Cash income used for calculations is reported as net cash income in Chinese Renminbi (CNY; 1 USD = 6.6 CNY; December 2005) and as the percentage income of each livelihood activity relative to the total household cash income.

The term "subsistence income" is here used for the cash equivalent value of subsistence production. It has been calculated by multiplying the crop yield by the state-regulated price. Wild food plant collection for subsistence is of minor quantitative importance for the local diet in this area and has therefore not been considered in the subsistence income calculations.

Household income diversification has been measured by using the Shannon index (H), which is calculated as follows: $H_{income} = -\Sigma_i [(s_i) \cdot \ln(s_i)]$, where s indicates percentage income of i = NTFP, gold, agricultural, public service, and off-farm income. Additionally, households have been stratified by income into three approximately equal-sized groups (tertiles), according to their total cash income. The low-income group has annual incomes up to 5,000 CNY; the medium-income group, 5,001 to 11,000 CNY; and the high-income group, more than 11,000 CNY.

Village accessibility as a proxy for market integration has been differentiated into four categories: very low = distant from any road, with footpaths only; low = not directly accessible by car; medium = accessible by car, accessible by truck only partially or not at all; high = accessible by car and truck.

Land area has been measured in the Chinese standard unit of measurement *mu*, which corresponds to 1/15 of a hectare.

The amount of fuelwood used by the households throughout the year was approximated by extrapolating from average daily consumption.

Analytical Tools

IBM SPSS Statistics 19 was used for statistical analyses. Analysis of variance (ANOVA) was applied to compare villages by household- and individual-level

socioeconomic variables and thus to identify variables with significant village-level differences and to compare livelihood activities among the three income groups. The data were first tested for normal distribution using the Shapiro–Wilk test. A Levene test was used to detect whether the variances of the groups are homogeneous. In case of normal distribution of the data, one-way analysis of variance (ANOVA) was applied and followed by post hoc tests for multiple comparisons (Games–Howell for variables with significantly different variances, Tukey test for variables with homogeneous variance) to determine pairwise differences among villages. In cases where normal distribution could not be assumed, the Kruskal–Wallis test was used. To investigate associations between livelihood activities and other structural and sociodemographic variables, such as accessibility and education across all villages, the Pearson correlation (r) was used for continuous data and the nonparametric Spearman rank correlation (ρ) for variables on an ordinal scale (i.e., accessibility classification) and percentages. The significance level α for all tests was set at .05.

Results

Livelihood Activities for Subsistence and Cash Income

Households

Table 1 outlines the studied villages in terms of structural and sociodemographic variables. With the implementation of economic reforms (*gaige kaifang*) in the late 1970s and early 1980s and in particular the 1982 land reform, communal land was divided into plots and allotted to individual households (decollectivization) under the Household Responsibility System (*jiating lianchan chengbao zerenzhi*). Each household received around 0.6 *mu* paddy fields and 0.1 *mu* dry fields per capita, as well as around 3.5 *mu* land for fruit tree cultivation (because of the location and population size, the households in Xiwa received 1.0 *mu* per capita of arable land). This distribution was first limited to 15 years but was extended in 1986 and 1994, and is now valid for 50 years. Nonagricultural land, specifically forest land and pastures, remains public and community-managed.

Since the land reform, only minor changes have been instituted in the arable land distribution. In case of marriage within the village, cultivated land might be reassigned, especially if a new household is founded. Shuhi households typically comprise 4 to 11 people (mean = 6.9, $SD = 1.4$ people) belonging to three to four generations. Birth control results in an almost steady population and household size, and therefore the size of fields per capita have remained practically the same. In addition, loss of agricultural land imposed by the Sloping Land Conversion Program is small, due to the small share of steep farmland and due to fragmentary implementation of the policy due to the remoteness of Shuiluo. However, any land use is subject to government control.

Because of the relatively high proportion of irrigated land, the land in Shuiluo is sufficient to sustain subsistence needs for most of the households throughout the year. In recent years, however, with improved roads and increasing off-farm employment, labor-intensive rice cultivation has been reduced and cheap rice is purchased from outside.

On average, selling of agricultural products contributes 428 CNY ($SD = 457$ CNY) per household in Shuiluo, or 6.9% ($SD = 9.3\%$; maximum 42%) of the total household cash income. Average subsistence income is equivalent to 4,680 CNY

($SD = 2{,}249$ CNY) per household, or 38.5% ($SD = 17.3\%$; minimum 9%; maximum 71%) of the average total income (comprising of household cash and subsistence income; see Table 2).

Nontimber Forest Products

Nontimber forest products (NTFPs) provide for both cash income and subsistence needs. Fuelwood, fodder and bedding for animals, and plants for religious uses are the most intensively collected plant resources. An average household uses 25,500 kg ($SD = 12{,}660$ kg) of fuelwood per year, ranging from 5,500 kg to 40,000 kg, depending on household size, the use of on-farm biogas production, and the number of farm animals (since around 50% of all fuelwood is used for preparing pig feed). The extraction of NTFPs for subsistence food consumption depends on the season, with mushroom abundance peaking in summer. However, wild foods from the forest do not contribute significantly to the caloric intake of the villagers and instead provide a welcome change to the daily diet. Collection of NTFPs is performed equally by men and women.

NTFPs are collected by the villagers only on occasional short-term orders by middlemen and traders from outside the region, and are not marketed and sold on their own. NTFPs contribute on average 13.0% ($SD = 18.9\%$; maximum 91%) of the total household cash income (see Table 2), and can generate 10–30 (or rarely up to 50) CNY per day during the collecting season. Foremost is the high-priced edible matsutake mushroom (*Tricholoma matsutake* [S. Ito & S. Imai] Singer), which accounts for an average of 11.1% ($SD = 17.5\%$; maximum 91%) of the total household cash income. Other NTFPs collected commercially as commodities are plants or plant parts used in Chinese medicine. At the time of this study, collecting plants for Chinese medicine was much less economically important for Shuhi livelihoods than mushrooms; medicinal plants contributed only 0.5% ($SD = 2.6\%$; maximum 16.7%) to the total household cash income. For more remote villages at higher elevations, the medicinal caterpillar fungus *Ophiocordyceps sinensis* (Berk.) G.H. Sung, J.M. Sung, Hywel-Jones & Spatafora (syn. *Cordyceps sinensis*) is important. For Shuhi villages, all in the valley bottom, however, the *Ophiocordyceps* season would coincide with rice planting—one of the busiest times in paddy-based agriculture. Moreover, the alpine meadows where *Ophiocordyceps* occurs have informally been allocated to the highland villages, and annual admission fees of 200–400 CNY per person need to be paid. Nevertheless, a few (8.7%) Shuhi households collect *Ophiocordyceps*, and for some, it accounts for up to 27.8% of the total household cash income.

Gold Prospecting and Off-Farm Work

Gold washing and activities directly related with the gold prospecting constitute an average of 58.8% ($SD = 30.5\%$; maximum 100%) of total household cash income (see Table 2). Gold prospecting is seasonal and income ranges from nil to more than 100 CNY per day. Gold prospecting is having pronounced effects on land use and management. As male workers turn away from agricultural tasks, the labor-intensive cultivation of rice is abandoned (correlation of percentage of gold income of total cash income with rice yield per capita: $\rho = -0.343$; $p = .033$). External gold miners, mainly nonlocal Tibetan and Han Chinese, and their activities cause major changes with uncertain environmental and social long-term effects. The amount of fuelwood and timber collected by local villagers for sale to gold washers has been reported by the interviewees to be significant in Shuiluo. Although villagers risk heavy fines, both

Table 2. Income from livelihood activities showing economic differences and commonalities among five Shuhi villages in Shuiluo Valley, SW China, in north (Xiwa) to south (Mianbang) direction

Variables	Xiwa	Dongla	Lanman	Pingweng	Mianbang	ANOVA/Kruskal–Wallis
Household subsistence income[1] (CNY)	$4{,}227 \pm 2{,}010^{a}$	$5{,}753 \pm 2{,}613^{a,b}$	$4{,}359 \pm 1{,}793^{a}$	$3{,}227 \pm 477^{a}$	$7{,}557 \pm 2{,}551^{b}$	$F = 6.534$, $p < .001$
Agricultural income (CNY)	$433 \pm 413^{a,b}$	$470 \pm 438^{a,b}$	718 ± 549^{a}	154 ± 176^{b}	$207 \pm 283^{a,b}$	$F = 3.586$, $p = .013$
Percent of total cash income	$8.4 \pm 12.2^{a,b}$	$3.7 \pm 3.5^{a,b}$	13.7 ± 11.0^{a}	2.0 ± 3.2^{b}	$2.5 \pm 3.0^{a,b}$	$F = 3.825$, $p = .01$
NTFP income (CNY)	356 ± 381^{a}	$1{,}025 \pm 1{,}415^{a}$	573 ± 556^{a}	$1{,}327 \pm 3{,}019^{a}$	$1{,}014 \pm 722^{a}$	$F = 0.593$, $p = .67$
Percent of total cash income	7.6 ± 7.3^{a}	7.6 ± 11.9^{a}	13.5 ± 17.1^{a}	12.3 ± 28.0^{a}	22.9 ± 19.3^{a}	$F = 0.732$, $p = .576$
Gold income (CNY)	$6{,}056 \pm 5{,}750^{a,b}$	$9{,}325 \pm 1{,}831^{a}$	$3{,}833 \pm 2{,}393^{b}$	$2{,}918 \pm 2{,}420^{b}$	$2{,}471 \pm 830^{b}$	$F = 4.331$, $p = .005$
Percent of total cash income	81.7 ± 17.1^{a}	$79.0 \pm 23.1^{a,b}$	$59.7 \pm 19.7^{a,b}$	42.2 ± 41.3^{b}	42.4 ± 26.5^{b}	$F = 3.785$, $p = .01$
Public service income (CNY)	0	0	$747 \pm 2{,}669$	$4{,}448 \pm 6{,}647$	$5{,}057 \pm 8{,}576$	$\chi^2 = 7.232$, df = 4, $p = .124$
Percent of total cash income	0	0	5.5 ± 17.4	30.2 ± 41.9	25.3 ± 41.8	$\chi^2 = 7.330$, df = 4, $p = .119$
Off-farm income (CNY)	89 ± 267	$2{,}000 \pm 4{,}000$	487 ± 409	$3{,}091 \pm 8{,}986$	$714 \pm 1{,}890$	$\chi^2 = 7.438$, df = 4, $p = .114$
Percent of total cash income	2.3 ± 7.0	9.7 ± 19.5	7.7 ± 7.2	13.4 ± 30.2	6.9 ± 18.3	$\chi^2 = 6.227$, df = 4, $p = .183$
Total household cash income (CNY)	$6{,}933 \pm 5{,}604^{a}$	$12{,}820 \pm 5{,}451^{a}$	$6{,}358 \pm 3{,}697^{a}$	$11{,}939 \pm 8{,}244^{a}$	$9{,}464 \pm 7{,}885^{a}$	$F = 1.920$, $p = .125$
Percent of subsistence income in total income[2]	41.8 ± 17.9^{a}	32.9 ± 12.5^{a}	46.2 ± 16.9^{a}	27.3 ± 15.9^{a}	51.2 ± 17.1^{a}	$F = 3.123$, $p = .025$

Note. Values are given as means and standard deviation. For pairwise comparison of means, the Tukey post hoc test was used when the variances were similar, and the Games–Howell post hoc test was used for unequal group variances. Means sharing the same superscript letters are not significantly different from each other ($p < .05$) and can thus be grouped together.

[1]"Subsistence income" is the cash equivalent value of subsistence agriculture.

[2]Total income comprises total household cash and subsistence income.

the local people and the outside gold washers assume that logging, which supports prospecting activities, is de facto included in the gold concessions issued by the county government. The use of mercury and sodium cyanide is strictly prohibited near the river, but other direct and indirect disturbances of the local living occur. For instance, the crime rate and conflicts between locals and externals increased. The most profound impact observed was the allocation of arable farm land to mining groups for the extraction of gold, with the consequence of possible irreversible loss of this land. As external gold washing groups are heavily dependent on local support for food, timber, fuelwood, labor, and sociopolitical backing, some of the households were able to establish monetary rewarding relations with them, while others failed to participate. As a result, social cohesion on both intra- and intervillage level was reported to decrease, while social status is increasingly depending on economic assets.

Besides gold prospecting, other opportunities for local off-farm work exist in Shuiluo. Government positions in education and administration are well paid (30–70 CNY per day, full-time), have a high level of job security, and a pension after retirement will be paid. They are held predominantly by better-educated people, almost exclusively men. Other off-farm jobs are in private business, trade, transportation, and building construction (20–30 CNY per day, seasonal). Long-distance migrant working is uncommon in Shuiluo. The average income from off-farm work is reported in Table 2.

Analysis of the Livelihood Activities

Correlations between livelihood activities are reported in Table 3. When focusing on income from natural resources, we found that the percentage income of gold prospecting shows a strong negative correlation with the percentage income from public service, but no significant correlation could be found between the income from public service and NTFPs.

Table 4 shows the correlations between livelihood activities (measured in percent of total cash income) and the total household cash income, education, household size, farm size, accessibility, and the Shannon diversity index for household cash income. The subsistence income depends significantly on the accessibility of the villages (ANOVA: $F = 7.791$, $p < .001$). Remote households are reporting more than twice as much subsistence income as easily accessible households ($7{,}313 \pm 2{,}492$ CNY vs. $3{,}227 \pm 477$ CNY), with a strong negative correlation between accessibility and subsistence income ($\rho = -0.538$, $p < .001$). For NTFPs, there is no significant correlation between both absolute and percentage income and household accessibility.

While larger percentages of agricultural income, income from NTFP collection, and off-farm income show a significantly positive correlation with the Shannon income diversity index, the percentage of income from gold prospecting shows a negative correlation with the index (Table 4). This also holds true for the absolute incomes (agriculture: $\rho = 0.433$, $p = .003$; NTFPs: $\rho = 0.590$, $p < .001$; working off-farm: $\rho = 0.545$, $p < .001$; gold: $\rho = -0.311$, $p = .035$). Thus, NTFP collection is associated with diverse and low income generation, while gold prospecting tends to be a more focused income strategy.

Relations between structural and sociodemographic variables show that accessibility of the villages has a strong positive correlation with the average level of household education, but no significant correlation with the highest education in the household (Table 5). This is supported by sociodemographic data indicating that in

Table 3. Correlations between livelihood activities ($N = 50$ households)

	Percent of subsistence income in total income[1]	Percent agricultural income[2]	Percent NTFP income	Percent gold income	Percent public service income	Percent off-farm income
Percent agricultural income[2]	$\rho = 0.381^{**}$					
Percent NTFP income	$\rho = 0.392^{**}$	NS				
Percent gold income	NS	NS	$\rho = -0.340^{*}$			
Percent public service income	$\rho = -0.389^{**}$	NS	NS	$\rho = -0.516^{***}$		
Percent off-farm income	NS	NS	NS	NS	NS	
Total household cash income	$\rho = -0.820^{***}$	$\rho = -0.349^{*}$	$\rho = -0.291^{*}$	NS	$\rho = 0.385^{**}$	NS

Note. Significant correlation indicated by: $^{*}p \leq .05$, $^{**}p \leq .01$, $^{***}p \leq .001$; NS: not significant.
[1]Total income comprises total household cash and subsistence income.
[2]Percentage income of a livelihood activity relative to the total household cash income.

Table 4. Correlations between livelihood activities and structural and sociodemographic variables ($N = 50$ households)

	Accessibility	Average household education	Highest education in household	Household size	Total agricultural land	Shannon index
Share of subsistence income in total income[1]	$\rho = -0.348^{*}$	$\rho = -0.337^{*}$	NS	NS	$\rho = 0.401^{**}$	NS
Percent agricultural income[2]	NS	NS	NS	NS	NS	$\rho = 0.514^{***}$
Percent NTFP income	NS	NS	NS	NS	NS	$\rho = 0.593^{***}$
Percent gold income	NS	$\rho = -0.408^{**}$	NS	NS	NS	$\rho = -0.441^{**}$
Percent public service income	NS	$\rho = 0.334^{*}$	NS	NS	NS	NS
Percent off-farm income	NS	NS	NS	NS	NS	$\rho = 0.558^{***}$
Total household cash income	NS	$\rho = 0.325^{*}$	$r = 0.369^{*}$	NS	NS	$\rho = -0.354^{*}$

Note. Significant correlation indicated by: $^{*}p \leq .05$, $^{**}p \leq .01$, $^{***}p \leq .001$; NS: not significant.
[1]Total income comprises total household cash and subsistence income.
[2]Percentage income of a livelihood activity relative to the total household cash income.

Table 5. Correlations between the structural and sociodemographic variables ($N = 50$ households)

	Accessibility	Average household education	Highest education in household	Household size	Total agricultural land
Average household education	$\rho = 0.540^{***}$				
Highest education in household	NS	$r = .734^{***}$			
Household size	NS	NS	NS		
Total agricultural land	$\rho = -0.485^{***}$	NS	NS	$r = .667^{***}$	
Shannon index	NS	NS	NS	NS	NS

Note. Significant correlation indicated by: $^{***}p \leq .001$; NS: not significant.

less accessible villages the differences in educational attainments within the households are more pronounced.

The analysis of the different income groups (according to total cash income tertiles; Table 6) shows no significant difference in subsistence income or in the absolute amount of cash income from agriculture and from NTFPs. Likewise, there

Table 6. Average income from separate sources for the different income groups ($N = 50$ households)

	Low-income group[1]	Medium-income group[1]	High-income group[1]	ANOVA
Household subsistence income[2] (CNY)	$5{,}002 \pm 2{,}220$	$4{,}078 \pm 1{,}368$	$5{,}405 \pm 2{,}734$	$F = 1.461$, $p = .243$
Agricultural income (CNY)	448 ± 570	530 ± 418	305 ± 346	$F = 0.928$, $p = .403$
NTFP income (CNY)	512 ± 554	647 ± 826	$1{,}313 \pm 2{,}565$	$F = 1.136$, $p = .331$
Gold income (CNY)	$2{,}350 \pm 1{,}158$	$5{,}167 \pm 2{,}363$	$5{,}573 \pm 5{,}339$	$F = 4.167$, $p = .022$
Public service income (CNY)	13 ± 50	$487 \pm 1{,}664$	$5{,}868 \pm 7{,}694$	$F = 7.973$, $p = .001$
Off-farm income (CNY)	144 ± 266	533 ± 915	$2{,}987 \pm 7{,}823$	$F = 1.790$, $p = .179$

[1]All households stratified by total cash income into three approximately equal-sized groups (tertiles).

[2]"Subsistence income" is the cash equivalent value of subsistence agriculture.

is no significant difference in income from off-farm activities because of high intragroup variability, although richer households tend to earn more from these activities. In contrast, high-income households earn significantly more from public-service jobs than low- and medium-income households. Likewise, the absolute income from gold prospecting is significantly higher in medium- and high-income households.

There is a negative correlation between the households' average education level and percentage of cash income from gold washing ($\rho = -0.408$, $p = .005$), because better-educated people are significantly more often employed by the state ($\rho = 0.334$, $p = .025$) in full-time jobs and are generally well paid. There is no significant correlation between either household size (and thus the available labor) or accessibility and the percentage of income from gold. The interviews show that poorer people work in mining, whereas the better off tend to be more engaged in trading with gold washers or hiring employees to work for them temporarily, and thus confirm the quantitative data.

Discussion

Southwest China is known for a high diversity of livelihood activities performed by its inhabitants (Zhang et al. 2008). Our study shows that also on a small scale and within one ethnic group considerable diversity of activities can be found. In Shuiluo, Shuhi households combine agricultural activities for subsistence (primarily by women), collection of wild plant resources for both subsistence and cash (by both men and women), and cash-income jobs like gold prospecting, trade, wage labor, and state employment (held primarily by men). There is no statistical correlation between village accessibility and the diversity of household cash income sources. However, we found that the higher the total household income, the less diverse were the income sources. Further, a larger percentage of gold prospecting is statistically correlated with reduced income diversity. This indicates that income from gold washing is achieved by a high labor input, which reduces the options of working in other sectors. Although vital for all households, the yield from subsistence agriculture is significantly more important for communities in more remote areas, and field sizes are larger in less accessible villages. This is distinct from what Salick et al. (2005) report for Khawa Karpo in northwest Yunnan, where no significant differences in subsistence agriculture and field size were found between villages with and without road access. In Shuiluo, cash income from selling agricultural products is similar for all households and villages, regardless of income level, educational attainment, or accessibility.

Nontimber forest products (NTFPs) play a minor role for cash income compared to other areas in Southwest China. For example, mushrooms and medicinal plants count for 40%–90% of average income in research sites across Southwest China (Arora 2008; Buntaine et al. 2007; Weckerle et al. 2010; Winkler 2008), but on average only for 13% in Shuiluo. Accessibility is not correlated with either absolute or percentage income from NTFPs. There is also no significant difference in absolute income from NTFPs among income groups, as in the occasional case of demand by middlemen usually all households participate in the collection, regardless of the household's wealth or accessibility of the village. The relative contribution of NTFPs to household income, however, is higher for households with low income, a pattern often found in remote communities (e.g., Hedge and Enters 2000). We conclude that in the case of Shuiluo, gold, which generates around 60% of cash income, takes on the

role of the attractive and relatively easy exploitable and marketable natural resource, which in adjacent areas is assumed by high-value NTFPs.

The livelihood activities performed in Shuiluo to increase household income are exclusively part of a livelihood strategy focusing on off-farm diversification (Scoones 1998). There is neither agricultural intensification nor extensification, and, in contrast to other rural areas in China, long-distance migrant working is not significant in Shuiluo. For Tibetan communities, similar diversification patterns are also described by Fischer (2006).

Households in Shuiluo can be characterized as having a strong absolute subsistence capacity (Fischer 2006). In general, the available land resources guarantee households to sustain their subsistence needs and produce a surplus of agricultural products. Land resources in China are equally allocated among the rural population and not saleable, maintaining smallholder agriculture and supporting rural livelihoods. This freedom of having a sufficient livelihood base reduces the compulsion for pursuing low-wage labor for meeting vital needs, and thus leads to relatively high wage expectations of around 20–30 CNY per day and a flexibility in choosing cash income strategies. Relating to the collection of NTFPs, high subsistence capacity and people's options for alternative income sources, some of which can be very remunerative (e.g., gold prospecting), reduce the collection pressure on plant populations, as income from the collection of NTFPs has to be competitive and collectors may switch to other compensatory activities. This possibly averts overharvesting, and medicinal plant populations, for instance, do not appear to be as critically endangered as elsewhere. As a result, no further community-based measures to protect the NTFPs have been established in Shuiluo, in contrast to areas where NTFPs play a more pronounced role for cash income (Weckerle et al. 2010; Yang et al. 2008; Yeh 2000).

Conclusions

In a fragile mountainous habitat, diversification and risk reduction of any kind are welcomed by people who live a subsistence lifestyle. The processes of economic opening and development of the past decades allowed for diversifying livelihood activities in Shuiluo, comprising subsistence agriculture, off-farm employment, and the collection and trading of NTFPs. Recent environmental policies further influence local livelihoods. While the Sloping Land Conversion Program did not have a strong impact, the logging ban imposed by the Natural Forest Protection Program indirectly translated into the promotion of large-scale gold prospecting, providing opportunities for remunerative occupations. This affects livelihoods in opposing ways. On the one hand, additional opportunities for cash income generation and thus diversification emerged, such as employed or self-employed gold prospecting and supplying raw material for nonlocal gold miners. On the other hand, however, diversity of livelihood activities decreases, as soon as one remunerative occupation prevails.

The resilience of a diversified livelihood strategy based on strong subsistence agriculture still secures locally sustained livelihoods and associated cultural identity. However, the currently observable gold rush in Shuiluo is redefining social status and intracommunity cooperation schemes in a way not experienced since the times of the land reform in the 1980s. It remains to be seen what the socioeconomic and environmental long-term consequences will be, considering the foreseeable depletion of the remaining gold deposits in Shuiluo.

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