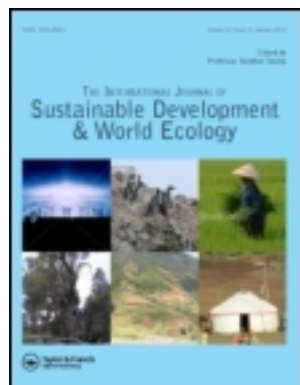




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Rain forest dwellers' livelihoods: income generation, household wealth and NTFP sales, a case study from Xishuangbanna, SW China

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Through annual in-depth household questionnaire interviews of 60% of households in Daka and Baka villages from 1998 to 2004, we explored wealth-related differences and similarities in the sale of NTFPs of tropical rain forest fringe dwellers in Xishuangbanna, SW China. Contribution of different NTFPs to cash income and different seasonal access to NTFPs between Baka and Daka were analysed. There were significant differences in income and role of NTFPs per household between Baka and Daka related to different access to: NTFPs in forests, labour and market sales in different seasons. In Baka, the ranking of NTFP income was: fungi, wild vegetables, bamboo shoot in 2000 and 2001. Differences in gender and generational involvement in NTFP sales was also examined. For example, households without a son, as well as those with a female householder depended more on income from NTFPs and less on income from rubber than other households. Resource use patterns between relatively wealthy and poor households were also analysed. Wealthy households sold 2.50 ± 0.50 types while poor households sold 2.08 ± 0.26 NTFPs. The Gini coefficient of gross income per household for Baka in recent years was 0.393, increasing to 0.414 without NTFPs. The Gini coefficient of gross income for Daka in recent years was 0.291, increasing to 0.292 without NTFPs, showing the different role of NTFPs in mitigating wealth inequality in the two villages.

Keywords: NTFP income; smallholder livelihood; rubber plantation; household demography; Gini coefficient

Introduction

The differences in sale of non-timber forest products (NTFPs) between societal and demographic groups are often poorly understood; yet they are an important element of sustainability. Concern on commercialization of NTFPs has been widely discussed as a means for sustainable development of tropical forest resources, so as to promote forest conservation while simultaneously supporting rural livelihoods (Hegde et al. 1996; Arnold and Perez 2001; Belcher et al. 2005; Kusters et al. 2006; Davidar et al. 2008; Sherbinin et al. 2008). However, practitioners and researchers are recognizing the need for a deeper understanding of factors that influence income generation among forest people. The level and type of wealth held by forest dwellers may be key to unlocking the diversity seen in forest product extraction among forest people, as income generation patterns of forest dwellers can be heterogeneous, both among neighbouring communities and among households within communities. (Wickramasinghe et al. 1996; Barham et al. 1999; Takasaki et al. 2001; Mahapatra et al. 2005; Shackleton and Shackleton 2006; Cocks et al. 2008). For example, many of these studies find that the livelihoods of poor households still depend on NTFPs from fallow and natural forest more than other income groups (Tickin 2004). The dependence of farmers on NTFPs mostly differs from one region to another, and determinant factors have been examined (Shaanker et al. 2004). The role of NTFPs in household livelihoods across the world, especially in tropical developing counties, for consumption (for food security) and income generation have also been extensively examined

(Apasamay 1993; Gunatilleke et al. 1993; Gakou et al. 1994; Boot 1997; Tewari 1999; Bahuguna 2000; Gram et al. 2001; Narendran et al. 2001; Shackleton et al. 2002; Dovie 2003; Senaratne et al. 2003; Odebo 2005; Paumgarten 2005; Delang 2006; Newton et al. 2006; Rigg 2006; Babulo et al. 2008; Shackleton et al. 2008).

The role of wealth in income generation of forest households like those in Xishuangbanna, SW China, has not yet been carefully examined. Moreover, studying peasant wealth, even over time, is likely to be a more straightforward undertaking than estimating household incomes derived from multiple sources. Wealth within these communities is distinct and unequally distributed across households. How do forest peoples come to hold different types and levels of wealth? Clearly a broad suite of factors can influence wealth accumulation, including the initial endowment in land or capital, access to labour, market and forest. The household characteristics related to labour, wealth and income will influence NTFP sales of local people, as cash income generated by collecting NTFPs will compete with income generated by other activities, such as rubber plantations and off-farm work in Xishuangbanna. Studies on NTFPs in Xishuangbanna have been reported (Du et al. 2001; Luo 2001; Du 2002; Xu et al. 2004; Fu et al. 2009), however, quantitative analyses with socioeconomic factors are still scarce. Here, we explore wealth-related differences and similarities in the use and value of NTFPs between villages to obtain a deeper understanding at household level, as well as to explore the role of NTFPs in local livelihoods. Daka and Baka have different forest access, market access, land allocation and labour

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availability. The two villages were studied over 7 years in terms of eco-botany and socioeconomics as part of the United Nation University project on People, Land management and Environmental Change.

Materials and methods

Study area

Daka is a Hani/Ahka village in Menglun town, Mengla County, Xishuangbanna Dai Autonomous Prefecture (Figure 1). Daka means a 'place rich with bamboo or edible herbs' in the Hani language. The village ($21^{\circ}41'N$, $101^{\circ}25'E$) is about 10 km from Menglun State Nature Reserve. The climate is seasonally tropical with an average annual temperature of $21.5^{\circ}C$ and a rainfall average of 1563 mm per year. Daka covers 727 ha, the original vegetation was tropical seasonal rain forest, but now consists of community forest, rubber plantations and fallow land. This small village is a rural community; the most recent census recorded 332 people in 65 families, 164 male and 168 female. There is a country road of 8 km to Menglun.

Baka village, Jinuo town, Jinghong City, Xishuangbanna Prefecture, is at an elevation of 720 m (Figure 1). The village ($21^{\circ}59'N$, $101^{\circ}9'E$) is close to Menglun State Nature Reserve and shares a similar seasonal tropical climate to Daka. Baka covers an area of 173 ha, comprising fallow land and cash crop plantations. The most recent census recorded 269 people in 68 families, 144 male and 125 female. Land and tree tenure in this village adjacent to the nature reserve have shifted dramatically because of establishment of the reserve. A highroad passes through Baka and is 6 km from Menglun.

Field methods

We performed a socio-economic investigation involving 60% of village households (30 sample households each in

Daka and Baka) using an annual questionnaire including demographic and cultural aspects, gender, land and crop yield, production and livelihood input and income generation, from 1998 to 2004 according to the household-based agrobiodiversity assessment method (HH-ABA) (Guo et al. 2002). This survey aimed to monitor land use and level of income generation within households. Market investigations involved person hours from Baka and Daka to sell NTFPs at weekends in the market of Menglun town, and weight and price of each NTFP between 17 March and 2 June 2001.

Data analysis

In this paper, the livelihood of a household is understood as cash earned through different means of living. Through this definition, the contribution of NTFPs to household livelihood or dependence of a household on NTFPs is measured as the proportion of cash generated from selling NTFP to total cash income. We used ANOVA with means and standard error (SE) to compare household demography, income, NTFPs sales and wealth among households and between the two villages. Additionally, a *t*-test was applied to examine significant differences in the variables using SPSS 13.0 software (Li and Luo 2005). We calculated the Gini coefficient of Baka and Daka in different years to compare differences between villages and time in terms of gross income per household.

Results and discussion

Components of household income in Baka and Daka

In Baka, each household had an average of 4.70 family members, of which 1.5 were male labourers and were 1.8 female. While in Daka the total number of family members was 6.0, with 1.6 male and 1.9 female labourers. There was almost no difference between available household labour in Baka and Daka ($<50\%$ significant) in 2000 (Table 1). However, there were large and significant differences in land wealth between Baka and Daka. The area of paddy in Baka was 0.06 ha and in Daka was 0.28 ha, the area of fallow land in Baka was 1.94 ha and in Daka was 1.02 ha, and the area of rubber plantation in Baka was 0.98 ha and in Daka was 3.89 ha. Land wealth inequality led to income inequality, and there was a significant difference in gross income of households between Baka and Daka. There were also significant differences in income generated from NTFPs between the two villages: Baka US\$76 and Daka US\$17. Furthermore, there was a large and significant difference in proportion of income generated from NTFPs: Baka 12.3% and Daka 1.7%. There were also significant differences in income (and percentage income) generated from rubber: Baka US\$150 (23.5%) and Daka US\$649 (59.8%). The population demography, land wealth and income from NTFPs and rubber of households in Baka and Daka were little changed in the 2003 survey.



Figure 1. The study area and pilot villages in southernmost Yunnan Province, China.

Table 1. Differences between Baka and Daka in household demography, wealth and income in 2000 and 2003.

	2000				2003			
	Baka	Daka	F	t-test	Baka	Daka	F	t-test
Population	4.70 ± 0.23	6.03 ± 0.29	12.968**	0.001	4.10 ± 0.23	5.30 ± 0.25	12.163**	0.001
Labour	3.30 ± 0.23	3.60 ± 0.19	1.037	0.313	3.37 ± 0.20	3.27 ± 0.23	0.113	0.738
Male labour	1.50 ± 0.18	1.63 ± 0.31	0.364	0.549	1.73 ± 0.13	1.77 ± 0.18	0.023	0.879
Female labour	1.80 ± 0.16	1.97 ± 0.11	0.761	0.387	1.63 ± 0.17	1.50 ± 0.13	0.402	0.529
Paddy area	0.06 ± 0.01	0.28 ± 0.02	67.350**	0.000	0.04 ± 0.01	0.31 ± 0.02	133.349**	0.000
Fallow area	1.94 ± 0.16	1.02 ± 0.15	17.237**	0.000	0.77 ± 0.11	0.43 ± 0.04	7.978**	0.006
Rubber area	0.98 ± 0.10	3.89 ± 0.34	66.979**	0.000	1.24 ± 0.22	3.43 ± 0.17	62.815**	0.000
Gross income	641 ± 63	1021 ± 115	8.381**	0.005	701 ± 115	1600 ± 119	29.507**	0.000
Income per capita	144 ± 16	175 ± 20	1.513	0.224	170 ± 25	322 ± 29	15.593**	0.000
NTFPs income	76 ± 19	17 ± 5	8.990**	0.004	46 ± 10	19 ± 4	6.039*	0.017
Off-farm income	72 ± 28	38 ± 37	0.512	0.477	119 ± 54	281 ± 84	2.613	0.111
Rubber income	150 ± 28	649 ± 80	34.276**	0.000	265 ± 47	1069 ± 78	78.568**	0.000
Breeding income	45 ± 14	49 ± 14	0.048	0.828	199 ± 64	46 ± 20	5.266*	0.025
NTFP (%)	12.3 ± 2.3	1.7 ± 0.6	19.035**	0.000	14.6 ± 4.8	1.4 ± 0.3	7.496**	0.008
Off-farm work (%)	8.7 ± 3.0	1.7 ± 1.6	4.210*	0.045	8.7 ± 3.4	13.4 ± 3.7	0.885	0.351
Rubber (%)	23.5 ± 3.9	59.8 ± 3.5	47.995**	0.000	38.2 ± 5.9	69.9 ± 3.2	22.445**	0.000
Breeding (%)	5.5 ± 1.5	4.1 ± 1.3	0.478	0.496	24.2 ± 5.4	2.2 ± 0.9	16.167**	0.000

Note: Mean ± SE. Area: ha; income: US\$. *Significant at 0.05; **significant at 0.01.

Contribution of different NTFPs to cash income and differences in seasonal access to NTFPs

Products such as fungi and bamboo shoots are collected and sold during very short seasons of availability, whereas other products are available almost throughout the year. For example, businessmen came to Baka to buy seasonal fungal NTFPs, such as *Russula vinosa* and *Lactarius volemus*. In Baka, the ranking of NTFP income was fungi, wild vegetables and bamboo shoot in 2000 and 2001, while the ranking of household members engaged in different NTFP products was fungi, bamboo shoots and wild vegetables (Figure 2). Furthermore, income and household wild fruit sales dropped from 2000 to 2001, possibly because of reduce fruit yield or a drop in price.

In the dry season, there were no differences in household sales of NTFPs in Menglun market between Daka and Baka (12 and 11.7 person/h per week, respectively, in March). However, difference emerged gradually after the dry season (Figure 3). For example, two and 13 person/h in Daka and

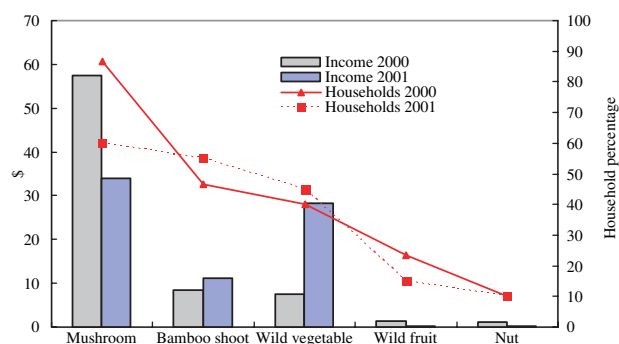


Figure 2. Income and households of different NTFPs of Baka in 2000 and 2001.

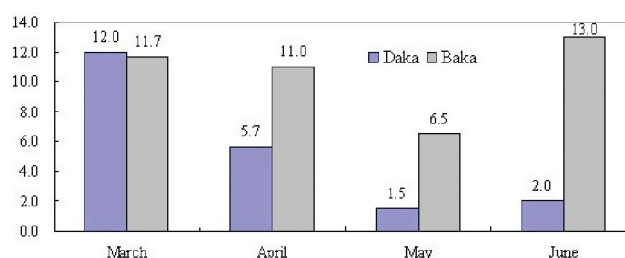


Figure 3. Person-time per week of households selling NTFPs in market in 2001.

Baka in June, respectively, were found in Menglun market because of labour scarcity in the rainy season of households in Daka as most labour is used for rubber extraction, and also because wealthy households in Daka were not willing to sell NTFPs due to poor roads in the rainy season.

Cost and benefit trade-offs seem to influence when edible plants are collected (Ladio and Lozada 2004). The number of NTFP sale outlets accessed by collectors was the most important variable determining the number of NTFPs collected and the overall contribution of NTFPs to the household (Bista and Webb 2006). Moreover, due to land limitation, male smallholders in Baka also sell NTFPs in Menglun market to earn cash, while male smallholders in Daka seldom sold NTFPs in this market. It is noteworthy that Baka is close to the nature reserve, where residents are permitted to harvest NTFPs (except wildlife) in return for occupying land outside the reserve, especially seasonal higher-priced NTFPs, such as fungi and bamboo shoots. In Daka, income generated from NTFPs is derived from secondary forest and fallow land rather than primary forest that is the focus of conservation for watershed protection, as in Cameroon (Ambrose-Oji 2003). The labour index of Daka is less than that of Baka,

Table 2. Market investigation in Menglun of Daka and Baka smallholders' plant trade in 2001.

	Daka	Baka	Total
Species	44	42	64
Time (h)	174	202	376
Weight	550.3	858.9	1409.2
Income	203.1	313.3	516.4
Most person-h species	<i>P. excelsum</i> , <i>A. pennata</i> , <i>A. auricula</i>	<i>P. excelsum</i> , <i>I. singulispicula</i> , <i>S. torvum</i>	<i>P. excelsum</i> , <i>A. pennata</i> , <i>P. sagittata</i>
Most biomass species	<i>P. excelsum</i> , <i>A. pennata</i> , <i>C. sinensis</i>	<i>I. singulispicula</i> , <i>Musa</i> <i>acuminata</i> , fungi	<i>P. excelsum</i> , <i>I. singulispicula</i> , <i>M. acuminata</i>
Most income species	<i>C. sinensis</i> , <i>A. pennata</i> , <i>P. excelsum</i>	<i>I. singulispicula</i> , fungi, <i>C. annum</i>	<i>C. sinensis</i> , <i>A. pennata</i> , <i>I. singulispicula</i>

Note: Weight: kg, income: US\$. Primary resource.

which means that the labour force of Daka is centralized on high-income activities, such as rubber plantations, rather than lower income-generating products. For example, if food and other necessities can be purchased, people are able to concentrate their efforts on activities that provide the highest rewards (Shone and Caviglia-Harris 2006).

In Daka, 44 NTFP products were found in market investigations during the dry season (Table 2): 30 vegetable species, four flavoring species and three fruit species. High quantities of some low-value species that can be harvested throughout the year are found in the market: 100 kg *Pteridium excelsum* (Turkey foot), 26.3 kg *Acacia pennata* (Snake acacia) and 14.5 kg *Parabaena sagittata*. *Camellia sinensis*, *A. pennata* and *P. excelsum* produced the most income and had the highest biomass, while *P. excelsum*, *A. pennata* and *Auricularia auricula* required the most person-hours. In Baka, there were 42 NTFPs found in market investigations. *Indosasa singulispicula*, fungi and *Capsicum annum* generated the most income and had the highest biomass, and *P. excelsum*, *I. singulispicula* and *Solanum torvum* required the most person-hours. In the dry season, 64 NTFP species were sold in the market by villagers from Daka and Baka, 23 of which were common to both villages. In the following rainy season, 69 species were found in the market, 19 of which were sold by villagers from both Daka and Baka. Overall, 25 and 62 species of NTFPs were sold by villagers from Daka and Baka, respectively (Du et al. 2001).

The role of NTFPs in cash income according to demography of villages and households

Household demography, i.e. total number of family members and family structure, plays a critical role in NTFP sales (Quang and Anh 2006). A traditional saying of the Hani is 'Woman is not human as crab is not a meal'. Therefore, having son will influence householder income generating strategies. Households without a son had less gross income than households with a son, and households without a son depend less on rubber. Some households without a son almost depend totally on NTFP sales for all their income (Figure 4). In addition, decision-making of households may

be affected by householder gender in terms of survival option strategies, such as proportion of income from rubber or NTFPs. For example, in Daka in 2003, female householders had a lower gross income, which came more from NTFPs than rubber. Male households had higher gross income, and sold less NTFPs (Figure 4).

Resource use patterns between relatively wealthy and poor households

There was a significant difference between relatively wealthy and poor households in terms of resource use patterns of NTFPs (Shackleton and Shackleton 2006). Similarly, according to gross income, there were significant differences in income from NTFPs between the three wealth groups ($F = 3.805$; $p = 0.035 < 0.01$), between poor and wealthy ($p = 0.010$), between medium and wealthy ($p = 0.024$), but not between poor and medium income ($p = 0.492$), while income generated from NTFPs were US\$60, 77 and 252 per household, respectively, for the three wealth groups in Baka in 2000 (Table 3). However, a high income from NTFPs may not constitute a high proportion of household gross income because of differences in income from seasonal fungi ($F = 3.864$; $p = 0.033$) and seasonal bamboo shoots ($F = 17.655$; $p = 0.000 < 0.05$) between the three groups, apart from income from regular wild vegetable collection ($F = 0.900$; $p = 0.419 > 0.05$). Households with more labour can generate more NTFP income from fungi and bamboo shoots in a season. However, of five NTFP types, there was no significant difference in the mean number sold between the three wealth groups in terms of gross income ($F = 1.673$; $p = 0.207 > 0.05$). The wealthy households sold a mean of 2.50 ± 0.50 types of NTFP, the intermediate households 2.38 ± 0.14 and the poor households 2.08 ± 0.26 .

NTFPs mitigate wealth inequality

NTFPs can play a role in decreasing cash income inequality across village households (Reddy and Chakravarty 1999; Mahapatra et al. 2005). In the present study, income from NTFPs mitigates wealth inequality among

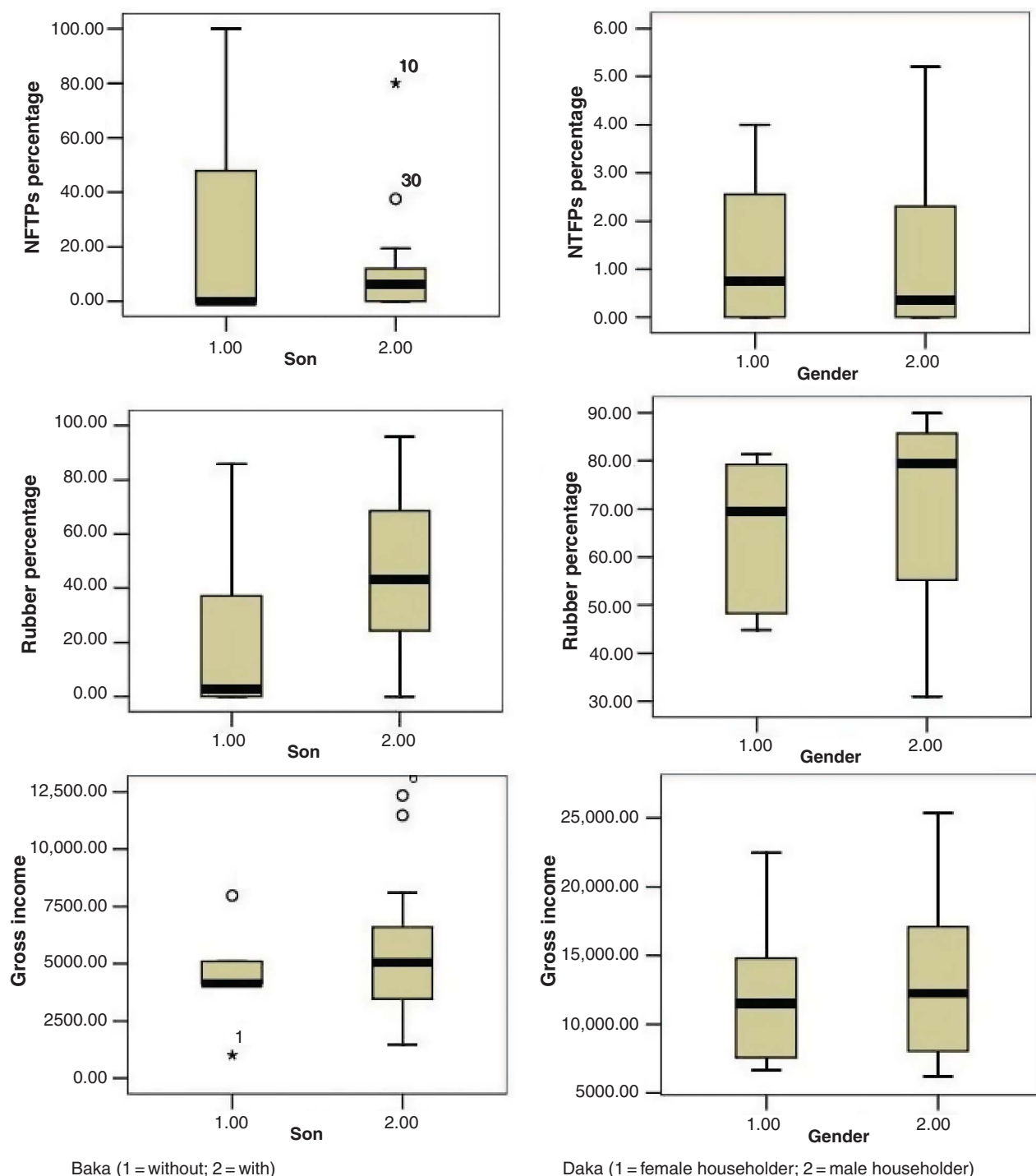


Figure 4. Household demography and NTFPs dependency in pilot villages in 2003.

households as the Gini coefficient of gross income per household of Baka in recent years was 0.393, and increased to 0.414 without NTFPs (Table 4), while the Gini coefficient was 0.291 of gross income, 0.292 without NTFPs in Daka in recent years, demonstrating different roles of NTFPs in different villages. These results reflect findings reported in other studies such as forest incomes and rural livelihoods in Chiradzulu District, Malawi, where the impact was much smaller for villages without

access to the reserve, but was in the same direction (Kamanga et al. 2009).

Conclusion

Like many former studies, the livelihoods of poorer households still depend on gathering NTFPs from fallow and natural forest relatively more than those of other wealth groups (Tickin 2004); poorer households depend more on

Table 3. Differentiation of NTFP sales among different wealth households in Baka in 2000.

Criteria	Sum of household	Fungi	Wild vegetables	Bamboo shoots	Wild fruit	Nuts	Mean NTFP species & income per household	Percentage of household selling at least one NTFP
≤625								
Households	16	12	4	7	3	1	2.08 ± 0.26	81.3%
Income		48 ± 14	11 ± 5	16 ± 3	10 ± 8	2 ± 0	60 ± 15	
625–1250								
Households	12	12	7	5	4	2	2.38 ± 0.14	100%
Income		62 ± 25	25 ± 17	11 ± 4	3 ± 1	6 ± 3	77 ± 31	
>1250								
Households	2	2	1	2	0	0	2.50 ± 0.50	100%
Income		206 ± 169	3 ± 0	31 ± 6	0	0	252 ± 164	

Note: Income: US\$.

Table 4. Gini coefficients with and without NTFPs for Baka and Daka from 1998 to 2004.

	Baka			Daka			Baka + Daka		
	N	Mean	SE	N	Mean	SE	N	Mean	SE
With NTFPs	5	0.393	0.032	7	0.291	0.029	12	0.334	0.025
Without NTFPs	5	0.414	0.035	7	0.292	0.028	12	0.343	0.028

Note: Data for Baka from 1998, 1999, 2000, 2001 and 2003; data for Daka from 1998, 1999, 2000, 2001, 2002, 2003 and 2004.

income generated from NTFPs between villages and among households in Baka and Daka. The importance to livelihoods of NTFPs has declined whereas some households now specialize in NTFP selling, similar to results of other research showing that commercial trade drives a process of intensified production and household specialization among forest people (Ruiz-Pérez et al. 2004). Income generated from NTFPs in Baka and Daka was influenced by factors such as household gender, gender of offspring and labour index, in addition to land wealth in terms of paddy, fallow and rubber plantation land. For example, households without a son, or with a female householder generated more income from NTFPs, while households with a son, or with a male or young householder generated more income from rubber. Wealthy households in Baka generated NTFP income mainly from seasonal higher-priced fungi and bamboo shoots from the nature reserve rather than from regular wild vegetables for households with adequate labour, but would suffer most from any restriction on access to the nature reserve. NTFP sales may mitigate income inequality among households. The Gini coefficient of Baka and Daka without NTFPs indicated different roles of NTFPs in these two villages.

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