The expansion of smallholder rubber farming in Xishuangbanna, China: A case study of two Dai villages

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A B S T R A C T

During the last half century, rubber plantations have spread widely and rapidly in Xishuangbanna, China. This study characterizes the process of expansion in smallholder rubber farming and the subsequent changes in upland use through an in-depth case study of two Dai villages in Xishuangbanna. The results show that the area of smallholder rubber farming has increased in the study villages, as observed in other parts of Xishuangbanna. The evolution of forest policy governing the community forest in Xishuangbanna is divided into three periods: the initial, transition and strict control periods. In the initial period, customary law governed the community forest, and planting rubber was a risky choice in the eyes of villagers, while the government-provided subsidy and techniques spurred the conversion from subsistence cropping to rubber gardens. In the transition period, forest governance by the government began to intervene in the land use customs. Villagers recognized the profitability of rubber farming, and they had chance to convert community forests into rubber gardens because the forest policy was ambiguous. The expansion of rubber farming had a substantial impact on forest cover in the transition period, while the village communities observed a part of community forest because they have a stake in conserving forest resource. In the strict control period, the government initiated a strict control, especially targeting logging. Consequently, even though there remains a strong demand for the expansion of rubber farms, the new lands chosen for rubber farms were areas in which other crops were already established. In conclusion, strict government governance with a clear objective and support from local communities has been sufficient to control the encroachment of smallholder rubber farming into natural forests in Xishuangbanna.

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Introduction

Xishuangbanna is an autonomous prefecture of Yunnan Province, China. The ecological and socioeconomic context of Xishuangbanna is representative of other tropical regions of Southeast Asia that contain high levels of biodiversity and are threatened with deforestation and environmental degradation (Li et al., 2007). The species diversity of Xishuangbanna is one of the highest in China (Zhang and Cao, 1995; Myers et al., 2000). This prefecture is the home of 45 ethnic groups, and the Dai ethnic group is in the majority. The Dai people have lived in Xishuangbanna since ancient times, and they have their own language and customs (Zhang et al., 2014). Historically, the Dai people engaged in subsistence farming in the nearby valleys and mountains.

In the early 1950s, the government established large-scale state-owned rubber farms in Xishuangbanna to achieve rubber self-sufficiency in response to military needs during the Korean War (Mann, 2009). The rubber boom was sustained primarily by these state-owned rubber farms before the 1980s, but the years since the Household Responsibility System was introduced in the early 1980s have been an era of smallholder rubber (Chapman, 1991). Smallholder rubber farming has brought the farmers of Xishuangbanna unprecedented wealth and meanwhile caused severe deforestation, biodiversity loss and soil erosion (Li et al., 2007; Mann, 2009; Ziegler et al., 2009; Fox and Castella, 2013). Li et al. (2008) noted that increasing demand and the high price of natural rubber will most likely lead to the continued expansion of rubber farming in Xishuangbanna, and until recently, the area of rubber trees still...
increased rapidly (Fu et al., 2009; Ziegler et al., 2009; Sturgeon, 2010; Yi et al., 2014a).

Effective solutions for stopping tropical deforestation remain elusive (Poore, 2003), although government policies play a crucial role in forest conservation (Brandon and Wells, 1992; Dao Minh Truong et al., 2009). However, monitoring the changes in forest policy in tropical countries is difficult because the content of policy is often unclear (Grainger and Malayang III, 2006). Most forests have traditionally been and continue to be inhabited and managed by local communities (Porter-Bolland et al., 2012); therefore, understanding the attitude of local people regarding implemented policies is important for achieving regulation goals. Pagdee et al. (2006) noted that successful community forestry management relies on creating a significant association between effective institutional arrangements and community incentives.

Land use studies often capture the spatial pattern of a selected theme over time through satellite image analysis (Xiao et al., 2006; Li et al., 2008; Su et al., 2011). Such methods can detect land use change at the macro-level and are clearly necessary. However, such methodology generally treats the period between time steps as a “black box” due to the limitation of data availability, and it is also difficult to accurately distinguish tiny, scattered ever-green plantations and swidden-related secondary vegetation from natural forest in the tropics when the study area is large.

This study tracked annual changes in upland use at two Dai villages for three decades. To examine the reliability of our findings, we visited local government, state-owned rubber farms and other villages, including those of Hani and Yao. The present study investigates how and to what extent customary and government rules are sufficient to control the encroachment of smallholder rubber farming into natural forests in Xishuangbanna. This objective can be further divided into the following questions: (a) how much of the uplands are available for villagers, (b) how did villagers acquire the land use rights: allocation or individual reclamation, and (c) how did socio-biophysical factors, especially forest policy, affect the process of expansion in smallholder rubber farming.

Material and methods

Study villages

The study sites are two Dai villages, Manlongle and Manjiang, located in Mengla County, Xishuangbanna Dai Autonomous Prefecture, Yunnan Province, China (Fig. 1). This area has a tropical climate with an average annual temperature and precipitation of 22.5°C and 1420 mm, respectively. The area of smallholder rubber plantations in Mengla County was 607 ha in 1980 but increased to 31,020 ha in 2000 and 72,600 ha in 2010 (SBMC, 1980, 2000, 2010).

The two villages are close together with a distance of 2 km between residential areas, but they have different accessibility. The upland plots in Manlongle are spatially dispersed, and some plots are located far away or separated by a river from the residential area. Therefore, it is not convenient for villagers to manage all of the upland fields. Conversely, the upland plots in Manjiang are spatially concentrated and located closer to the residential area, without obstacles to access such as mountains or rivers. Therefore, villagers can easily manage their upland fields. These villages were chosen to determine the influence of accessibility on rubber farming expansion.

Manlongle was established in 1879 when nine households moved there from the present Laos, and 76 Dai households have inhabited this village since 2001. The village is located approximately 10 km north of the county capital. The road connecting the village settlement with the county capital was constructed in 1978 and was improved to blacktop in 2011. The total area of this village is approximately 212 ha with an elevation ranging between 640 and 750 m.

Manjiang was established in 1914 after seven households from Manlongle settled across the Nanla River, and 100 Dai households have inhabited this village since 2005. The distance between the village settlement and the county capital is approximately 12 km. The road connecting the village settlement with the county capital was constructed in 1973 and was improved to blacktop in 2007. This village covers an area of 345 ha at an elevation of 650–1280 m (Zhang et al., 2014).

Data collection

Five field surveys, in September–October 2010, January–February 2011, July–August 2011, February–March 2012 and July 2014, were conducted in Mengla County. The surveys included observation of land use and cropping patterns as well as interviews with staff of local government and state-owned rubber farms, local farmers and businessmen. In both Manlongle and Manjiang, interviews were conducted with all household heads and the present and former members of the village committees. Mapping of upland plots was based on GPS maps, and the mapping was done by the local government in 2008 (Mengla administration, 2008).

Results

Upland plots of the study villages

In Dai, “Na” denotes the lowland fields that could be irrigated and drained, which were traditionally used as paddies. “Hai” describes upland fields that cannot be irrigated. “Guang” means mountain and is a part of “Hai”. Traditionally, the villagers determined the land use of upland fields according to the accessibility, and these upland fields under the same land use type are defined as a plot in this study.

Manlongle has 152.6 ha of upland fields consisting of six plots, two of which (Plots A and F) are located close to the settlement, two (Plots B and C) are at the opposite side of the Nanla River, and the others (Plots D and E) are 4 km from the settlement (Fig. 2). During the collective period (from the mid-1950s to the early 1980s when agrarian production in China was mainly managed by collective units, such as People’s communes), Plot A was used for the collection of firewood and bamboo, while Plots B and C were used for subsistence cropping (a mixed cropping of mainly maize and upland rice). Previously, Plots D and E did not belong to Manlongle, and the Hani people living nearby used Plot D for shifting cultivation. In 1982, these plots were allocated to Manlongle under a policy named “Three Clarifications Policy”, which was intended to demarcate the areas of state-owned forest, natural reserve and villages with an emphasis on mountainous areas. Plot F, near the settlement, is the holy hill of the village (the Dai people designate a hill near the settlement as a holy hill and conserve the forest there. Holy hill forest has cultural and spiritual significance in Dai daily life).

Manjiang has 268.8 ha of upland fields comprised of a large area called Namwa and scattered uplands near the settlements (Fig. 2). These uplands are grouped into seven plots, of which Plots A, B, C, and G are mainly scattered around the settlement, and Plots D, E, and F are located in the slope land of Nanwa. Before 1980s, Plot A, adjacent to the settlement, was used for the collection of firewood and bamboo, while Plots B, C, D, and E were used for subsistence cropping, including shifting cultivation, and Plot F was forest. Plot G is the holy hill of the village.
Table 1

Upland plots of Manlongle and Manjiang. Group-level allocation is a process by which the village community was first divided into groups, and the uplands of the village were also divided into several areas according to distance and accessibility. These areas were allocated within a group.

<table>
<thead>
<tr>
<th>Plot</th>
<th>Area (ha)</th>
<th>Traditional land use before 1980</th>
<th>Land acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manlongle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>13.3</td>
<td>Firewood and bamboo</td>
<td>Individual reclamation before 1982, land use right endorsed in 1982</td>
</tr>
<tr>
<td>B</td>
<td>12.0</td>
<td>Subsistence cropping</td>
<td>Equal allocation in 1982 (0.03 ha per person)</td>
</tr>
<tr>
<td>C</td>
<td>12.4</td>
<td>Subsistence cropping</td>
<td>Equal allocation in 1985 (0.2 ha per household)</td>
</tr>
<tr>
<td>D</td>
<td>80.9</td>
<td>Shifting cultivation by Hani (63.9 ha) and deep forest (17.0 ha)</td>
<td>Equal allocation in 1996 (0.2 ha per household)</td>
</tr>
<tr>
<td>E</td>
<td>32.0</td>
<td>Deep forest</td>
<td>Village collectively owns</td>
</tr>
<tr>
<td>F</td>
<td>2.0</td>
<td>Deep forest</td>
<td>Village collectively owns</td>
</tr>
<tr>
<td>Manjiang</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>11.7</td>
<td>Firewood and bamboo</td>
<td>Individual reclamation before 1982, land use right endorsed in 1982</td>
</tr>
<tr>
<td>B</td>
<td>12.8</td>
<td>Subsistence cropping</td>
<td>Individual reclamation before 1982, land use right endorsed in 1982</td>
</tr>
<tr>
<td>C</td>
<td>22.3</td>
<td>Subsistence cropping (shifting cultivation 17.2 ha)</td>
<td>Group-level allocation in 1985</td>
</tr>
<tr>
<td>D</td>
<td>46.5</td>
<td>Subsistence cropping (shifting cultivation 44.9 ha)</td>
<td>Group-level allocation in 1985</td>
</tr>
<tr>
<td>E</td>
<td>62.3</td>
<td>Subsistence cropping (shifting cultivation)</td>
<td>Equal allocation (46.5 ha) and individual reclamation (15.8 ha) in 1996</td>
</tr>
<tr>
<td>F</td>
<td>110.0</td>
<td>Deep forest</td>
<td>Village collectively owns</td>
</tr>
<tr>
<td>G</td>
<td>3.2</td>
<td>Deep forest</td>
<td>Village collectively owns</td>
</tr>
</tbody>
</table>
Villagers acquired land use rights for the upland fields mainly through the allocation procedures in 1982, 1985, and 1996 at both villages (Table 1). These procedures were instructed or permitted by local government, organized by village authorities and implemented based on an agreement among the villagers.

In Plot A of both villages, the villagers recognized the usufruct of firewood and bamboo of the person who planted them during the collective period. This customary usufruct right was legally endorsed when the Household Responsibility System, with its objectives of allocating collective land to individuals and giving farmers autonomy over decisions on agrarian management, was implemented at the end of 1982. The same principle was applied to Plot B in Manjiang. The villagers whose family reclaimed the area during the collective period or before acquired the land use rights of that particular area (12.8 ha) in 1982. Alternatively, Plot B of Manlongle was equally allocated to each villager (0.03 ha per household) in the same year. Plot C of Manlongle and Plots C and D of Manjiang were allocated to the villagers in 1985, of which each household of Manlongle and Manjiang averagely obtained 0.2 and 0.9 ha, respectively.

The price of rubber increased sharply in 1995 (Fig. 3), which triggered further land distribution. In 1996, the village authority of Manlongle allocated 0.2 ha of Plot D to each villager. In the same year, the village authority of Manjiang employed workers from other villages to clear the remaining swidden-related secondary vegetation in Plot E, for which the villagers collectively paid the cost, and allocated 0.1 ha of land to each villager. Subsequently, 29 households, whose allocated lands were located at the periphery of the cleared land, spontaneously cleared the adjacent secondary vegetation land in the same plot and obtained 0.07–1.3 ha per household. However, they never ventured into the nearby deep forest in Plot F.

Through these processes, 78% and 58% of the uplands were distributed to the villagers in Manlongle and Manjiang (Table 2). In Manlongle, 89% of that land changed hands via the allocation procedure, as did 74% in Manjiang.
Table 2
The area of evenly allocated land, spontaneously opened land, and village land at Manlongle and Manjiang (ha). Evenly allocated land was evenly allocated to villagers by a village authority. Spontaneously opened land was spontaneously reclaimed and owned by villagers. Village land is owned by the village community.

<table>
<thead>
<tr>
<th></th>
<th>Distributed to villagers</th>
<th>Retained by village</th>
<th>Total Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area (ha)</td>
<td>%</td>
<td>Area (ha)</td>
</tr>
<tr>
<td>Manlongle</td>
<td>105.3</td>
<td>69.0</td>
<td>13.3</td>
</tr>
<tr>
<td>Manjiang</td>
<td>115.3</td>
<td>42.9</td>
<td>40.3</td>
</tr>
</tbody>
</table>

The transition period (1987–1998)

Forest governance by the government started to intervene in the land use customs of villages during this period. In 1987, the State Council issued “An instruction on strengthening the management of community forests and prohibiting deforestation in southern China”, which officially approved community forest as the property of the village and prohibited logging and allocating community forests to individuals. In response to this policy, both village committees of Manlongle and Manjiang announced that spontaneous clearing community forests to grow rubber or other crops would result in a permanent ban on collecting timber from the community forests in 1988. This announcement is thought to have been effective in protecting the community forests because there was no timber market for the villagers until the late 2000s; therefore, they had to rely on the community forests. Swidden agriculture is the main traditional agro-ecosystem of hill tribes. For securing the livelihood of these ethnic groups, Yunnan Province issued a so-called “Liangshan yidi” policy with the objectives of demarcating freehold land to individuals and protecting swidden agriculture in 1983. As a result, logging swidden-related secondary vegetation and old-growth trees inside fallow lands for swidden agriculture was allowed.

The demand for an expansion of rubber farming increased in this period. Rubber trees are tapped at 6–10 years of age. Tapping of rubber started in 1994 in both villages, and the farm-gate price of rubber at that time was comparatively high, resulting in a boom of rubber planting (Fig. 3). Plot D (80.9 ha) of Manlongle and Plot E (62.3 ha) of Manjiang were converted into rubber farms in 1996 (Figs. 4 and 5).

Before clearing the forests, the village authority of Manlongle reported their plan to the local Forestry Department because they planned to log old-growth trees inside Plot D to open a rubber garden in 1996. These old-growth trees were scattered through an otherwise fallow area covered by secondary vegetation. The community forests of Manlongle were not located in the watershed area, which conserved the necessary irrigation and drinking water for this village. Some villagers proposed clearing all the community forests to plant rubber trees. However, most villagers rejected this proposal because they needed to collect timber from the community forests for building and maintaining houses. In addition, they feared the government’s reaction to forest clearing. Finally, they cleared secondary vegetation and 17 ha of old-growth trees in Plot D but conserved the deep forest in Plot E (Fig. 2).

The village authority of Manjiang reported to the local Forestry Department after clearing because they did not plan to log the deep forest. The community forests of Manjiang were located in the watershed area, which conserved the irrigation and drinking water for this village, so the villagers had incentives to protect community forests for the necessary water and timber (Fig. 2). The villagers remembered the consequences of rubber planting by a state-owned rubber farm in the watershed area of Hunhai (a lowland block of Manjiang) in 1964. Downstream lowland plots suffered from shortages of irrigation water after logging the upstream forest just for 2 years. This common experience contributed to the conservation of 110 ha of deep forest in Manjiang.
The strict control period (1998–present)

The government started to control activities strictly, especially logging, during this period. In 1998, a policy named “Natural Forest Protection Project” with a key objective of strictly prohibiting deforestation was implemented in China. The governmental control over forest resources became very strict in the study area. For example, seven households of Manjiang illegally logged 2.4 ha of forest in Plot F to plant rubber in 2006 and were fined by the Forestry Department, and the village committee seized the fields. In 2012, two households of Manjiang illegally logged 0.4 ha of forest in Plot F to plant rubber, and finally, they were also fined by the Forestry Department, and all the rubber seedlings were destroyed to allow natural vegetation to recover.

A drop in the price of rubber and natural disasters did not fundamentally change the attitude of villagers to rubber farming. In December 1999, a frost destroyed half of rubber seedlings in Manlongle, while it destroyed nearly all the rubber seedlings in Manjiang. The villagers of Manlongle recovered their rubber gardens in 2000, except 13 households who chose to sublet 10.7 ha of upland fields to nearby stated-owned rubber farms and villages. The villagers of Manjiang recovered their rubber gardens 1–7 years after this disaster, but they did not sublet their upland fields. The Asian financial crisis led to a sharp decrease in rubber prices during the period of 1997–2001 (Fig. 3). As a result, the villagers of Manlongle collectively subleased Plot C with rubber trees to a staff of a state-owned rubber farm in 2001 (24-year lease). However, the rubber price rebounded from 2002 and fully recovered by 2006 (Fig. 3). In fact, most villagers regretted subletting their rubber farms, and none did so when the price slumped again in 2008–2009.

Firewood and bamboo in Plot A (13.3 ha) in Manlongle and Plots A (11.7 ha), B (12.8 ha), and C (22.3 ha) in Manjiang were replaced by rubber trees during this period. Cash crops, such as sugarcane and jujube, in Plot B (12.0 ha) in Manlongle were also replaced by rubber trees (Figs. 4 and 5). Consequently, the area of rubber farms increased by 25.3 and 46.8 ha in Manlongle and Manjiang, respectively.

Discussion and conclusions

This study shows that the area of rubber cultivation has increased in the study villages during the past three decades. The different accessibility did not significantly affect the process of expansion in smallholder rubber farming, and the two villages have notably similar rates of growth in the rubber trade. The evolution of forest policy about community forests in Xishuangbanna is divided into three periods: the initial period (forest governance by customary law), transition period (forest governance by the government started to intervene in the land use customs) and strict control period (strict government control, targeting logging).

Subsistence-oriented farmers are often risk-averse (Henrich and McElreath, 2002), and risk-averse farmers can hedge against the uncertainty they face by allocating land to different crop species (Falco and Perring, 2005). In 1982, the Chinese government established the Households Responsibility System that provides villagers the right to take advantage of more diverse opportunities. Farmers are also responsible for any losses of an enterprise. In the eyes of villagers, planting rubber was a risky choice in the initial period, and they were particularly concerned about markets. The government subsidy covered the cost of growing rubber; therefore, growing rubber was a chance to earn cash without investment risk. Lambert and Parker (1998) noted that the implementation of the Household Responsibility System effectively promoted grain production of China in the early 1980s. In the study villages, the yield of paddy increased from 4 to 6.5 ton/ha after legalization of this system. The excess uplands were used for risky commercial cropping that would not substantially affect their livelihoods. Under these conditions, some of upland fields used for subsistence crops were converted into rubber farms.

Granger and Malayang III (2006) noted that high deforestation rates often occur if forest policy is ambiguous. In the transition period, the Chinese government targeted both forest conservation and swidden agriculture synchronously, and the villagers still had the chance to convert community forests into rubber farms. In the study villages, portions of the community forests were converted into rubber gardens, which had a substantial impact on forest cover over the three decades. Sunderlin et al. (2005) noted that deforestation negatively affects the livelihoods of people dependent on forest products and services, and inhabitants who have a stake in conserving forest resource contribute to robust forest conservation (Gibson and Marks, 1995). This study found that the tropical forest provides the necessary water, timber and spiritual needs to the villagers; therefore, they have incentives to keep a balance between profit and forest conservation. The links between community forest and rural livelihood can affect the decisions of villagers. The villagers of Manlongle conserved forest exclusively for collecting timber, and they logged some old-growth trees for growing rubber. Conversely, the villagers of Manjiang conserved forest for timber and water, so they did not log deep forest in this period. Importantly, the self-management of village community was effective, and once a proposal received support from most villagers, the dissenters had to abide this decision. It is not clear how such strong community cohesion was created in history in the study villages. Still today, they dance, cook and eat together on festival days, and they collectively maintain roads and water channels. It was basically understood that a village community is required to cope with various challenges. For instance, the villagers of Manjiang collectively hired a technician to learn techniques of banana farming (Zhang et al., 2014).

In contrast to the study from Li et al. (2007), Senf et al. (2013) noted that the total forest area of Xishuangbanna was stable between 2003 and 2011 despite nearly a tripling of the rubber plantations, most likely because of the “Natural Forest Protection Project”. In the strict control period, the government took determined steps to conserve forest resources. For the strict conservation of tropical forest and mitigation of land-related conflicts, the local cadastral office improved the accuracy of land mapping by GPS measurement in 2007 and 2008, demarcating household-owned fields, community forest and state-owned forest. The villagers only have right to grow rubber in household-owned lands, and the new land chosen for rubber farms was in areas where other crops (sugarcane, jujube, firewood and bamboo) were already established.

Religious beliefs also contribute to the protection of small-scale forests. Currently, there are approximately 250 holy hills in Xishuangbanna, occupying approximately 1000–1500 ha (Liu et al., 2002). The village community does not need to make rules for protecting the holy hill forest because all of the villagers we interviewed believed that the gods would punish them if they disturbed the holy hill forest. Under this condition, the holy hill forests were not affected by the strong demand for the expansion of highly profitable rubber farming throughout the three periods.

The farmers prefer to choose high return and low risk enterprises (Shahabuddin et al., 1986; Zhang et al., 2014), and rubber trees are the preferred choice of the farmers in Xishuangbanna (Fox et al., 2014; Yi et al., 2014b). The return of tapped rubber trees reached approximately 36,000 yuan/ha in 2010, while firewood per hectare is equivalent to approximately 15,000 yuan of gas in terms of being fuel in the same year. The villagers choose modern cookers (gas stoves or induction cookers) to achieve a better life and it is not appropriate to judge the conversion of firewood into rubber simply from the viewpoint of benefit. In 2008, only 35% of households owned modern cookers, while the proportion doubled after
three years. The rubber trees can be tapped for 20–30 years, and the villagers can immediately sell latex in their villages or nearby villages via middlemen after harvest. Conversely, they have to sell sugarcane and jujube by retail in local market by themselves, and the sale channel is quite unstable.

The diverse livelihood systems and modes of wealth accumulation imply that the villagers are not vulnerable to market risks and the logging ban. In addition to tapping rubber, villagers also have a variety of choices for additional income. For example, the villagers of Manjiang have converted their dry season crop from maize, paddy and fallow to watermelon and banana, and the villagers of Manlongle engage in wage-paying labor work. In 2010, the income derived from these enterprises (off-farm employment, livestock breeding and lowland agriculture) represented 47% and 77% of the total income of Manlongle and Manjiang, respectively. The annual income of the study villages was approximately 13,000 yuan per person, or about twice rural China’s average. Moreover, a large area of untapped rubber ensures a substantial growth of household income for both villages in the near future. In this context, it should be a positive thing that the government has successfully controlled the encroachment of smallholder rubber farming into natural forest.

The villagers are definitely eager to expand rubber farms when the return on rubber farming is high. However, any villager who intends to convert community forests into private rubber gardens in fact infringes upon the interest of other villagers. Today, the government and village community rely on each other in conserving forests in the study area. The government supports the villagers’ collective decisions to conserve the community forest by means of forestry protection policies and consequent governance, while the village community reports illegal logging to the government in a timely manner. Under this paradigm, even though there is still a strong demand for the expansion of rubber farms, the encroachment of rubber farming into natural forest has ceased. Therefore, we conclude that strict government governance with a clear objective and support from local communities has been sufficient to control the encroachment of smallholder rubber farming into natural forests in Xishuangbanna. Smallholder rubber farming will most likely continue to expand within the framework of forest governance until most of the low-return crops in areas, which rubber trees can grow, are converted into rubber farms.

Acknowledgements

We deeply appreciate the local villagers, who provided valuable information. Our sincere thanks also go to Mr. Jingyun Cui for his advice. This research was financially supported by the Grant-in-Aid “Livelihood Transition in Rural Southeast Asia,” JSPS, National Basic Research Program of China (973 Program) 2012CB955800 (2012CB955804), Project 41401200 supported by NSFC, Global Environment Research Fund (E-1002) “Incentive of Local community for REDD and semi-domestication of non-timber forest products,” Ministry of Environment, Doctoral Start-up Fund of Henan University (B20113105) and Project 41371525 supported by NSFC.

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