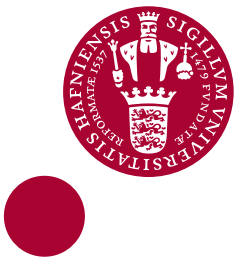

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Navigating between Tea and Rubber in Xishuangbanna, China: When New Crops Fail and Old Ones Work

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Abstract: Following the massive expansion of rubber plantations in China, considerable research has been conducted on the impact of these landscape changes. The general consensus is that there have been negative impacts on the environment and positive impacts on local economies. However, since rubber prices dropped after 2011, the economic benefit to the local people is challenged and the impact on the local people and communities remains unclear. Using a mix of qualitative and quantitative methods, this longitudinal study investigates how the drop in rubber prices has affected a local community and the local people in Manlin, Xishuangbanna, China. It investigates local coping strategies and the importance of alternative income sources and shows how differentiated access to alternative lands creates increased economic inequality within the village when prices fluctuate. Three general coping strategies were identified amongst local rubber farmers: doing business as usual, changing rubber management practices, and stopping- or decreasing tapping frequency. Differences in coping strategies are linked to factors including access to alternative income sources and rubber perceptions. Moreover, households with access to tea land were found to have experienced negligible impacts of decreasing rubber prices as income from tea has increased more than income from rubber has decreased, leading to increasing intra-village economic inequality. We conclude that while this is a clear case of how income diversification is important for reducing livelihood vulnerability, it also shows that the large focus on rubber farming has created benefits in terms of improved infrastructure and connectivity that has helped expand the market for tea as well.

Keywords: rubber; tea; price drop; land use; livelihoods; coping strategies; Xishuangbanna; China

1. Introduction

The commodification of smallholder agriculture has for long been associated with regional growth in Asia, where subsistence-based farming practices are undergoing a transition towards more commercially oriented production systems [1–5]. In the Xishuangbanna prefecture in southern China, rubber trees (*Hevea brasiliensis*) have become one of the most important cash crops and a dominant land use. After being introduced to China during the 1950s [6], the area of rubber plantations has expanded rapidly, replacing previous areas of forests and swidden-fallow systems with predominantly monoculture plantations [3,7] The positive local economic impacts from rubber

farming in Xishuangbanna are in many cases visible, and rubber farming has also been recognized for its poverty-alleviating properties in earlier studies [8–11].

However, previous studies have also warned how an increasing focus on commodity crops may increase livelihood vulnerability as local households have become more exposed to risks, including price shocks [2,12,13], making them dependent on the global market and commodity prices, over which they have no control [14]. The rubber market is no exception to this as the sharp increase in producer prices of natural rubber in mainland China from 2007 to 2011, that spurred the rubber boom [7], was followed by a drop in prices by more than 22% from 2011 to 2013 [15]. In the following years, the price continued to drop confronting local producers with a new reality after a number of highly profitable years. This has generated adverse consequences for the local people in communities specializing in rubber farming. Liu et al. [3] and Min et al. [16], using a quantitative approach with data from 2012, showed how rubber farming have increased household income risk by reducing income differentiation, and how the economic performance of rubber varies at different elevations, suggesting that geographical location is an important factor when looking at benefits, risks, and vulnerability. For example, rubber plots spreading into marginal areas of production above 900 m.a.s.l. have been found to have a negative net present value [17,18].

Concurrent with the fluctuating rubber prices, producer prices for tea in China more than tripled between 2003 and 2013—though with a slump in 2007—and cultivation of tea has also expanded rapidly in the country [19]. Tea is also a highly traditional crop in Yunnan and has been grown and maintained for centuries in forests, agroforestry systems, and other farming systems [20]. Yunnan is particularly known for the Pu'er tea, which had been grown and traded for centuries and, after some years in oblivion during the 1950s to 1980s, was rediscovered in the 1990s [9]. Its maintenance as an understory crop in forests, requiring very limited crop husbandry and care, ensured its survival during the "market-free" years of Maoist China [9] and for the same reason, the production of forest tea has a very high net present value that even competed with rubber production during peak rubber prices in 2011 [21].

This is the point of departure for the present case study on how the rubber price bust has affected Manlin, a local Yi rubber village in Xishuangbanna, and the importance of income diversification, here in the form of tea as a back-up resource. This paper builds on previous research by quantifying how the local people of Manlin have been economically affected by the drop in rubber prices and helps generate an in-depth understanding of how local rubber farmers deal with fluctuating commodity prices by looking into local coping, management strategies, and risk perceptions.

2. Study Area and Methodology

The research was conducted in the Xishuangbanna autonomous prefecture in the southernmost part of Yunnan province. It is a mountainous and historically highly forested area with elevations ranging between 477 and 2429 m, annual mean temperatures ranging between 15.1 and 21.7 °C, and a monsoonal climate [22–24]. Xishuangbanna is an ethnically diverse region and home to more than 11 minority peoples [3,16,24–26]. The major ethnic group is Dai (27.9%), followed by Han (24.3%), and Hani (19.0%). Other ethnic groups include Yi, Lahu, and Bulang [27]. Traditionally, land management practices and crops have been diverse [27]. However, following an increased market economy integration and the introduction of a number of land-use policies [3,9,24,28], Xishuangbanna has experienced a rapid expansion of commercial agriculture. Rubber as a crop was originally introduced to Xishuangbanna in the 1950s on state farms when local households were still organized under communes [6,25,28]. It was not until after the land reforms in the early 1980s, when land plots were allotted to local households, that rubber spread beyond the state farms, promoted by state agents to spur economic development and meet domestic demand [10]. Since then, rubber has become one of the main land uses in Xishuangbanna, covering approximately 22.2% of the total land cover in 2010 [18]. Being predominantly managed by smallholder farmers [16,29], rubber is an important source of income for the local people [26]. Today, rubber and tea are the primary main livelihoods of most

people in Xishuangbanna, with rubber dominating livelihoods at low and medium elevations and tea at higher elevations [27] where conditions are suboptimal for growing rubber.

2.1. The Case Site: MANLIN, Xishuangbanna

The case study was conducted in Manlin administrative village in Mengla County in Xishuangbanna (Figure 1). Manlin was chosen as a case site based on the local involvement with rubber farming, and because previous research had been carried out in the village in 2013 [21,30], enabling a temporal investigation into the impact of fluctuating rubber prices. Manlin is located in Xiangming Township and consists of eight settlements of varying sizes and altitudes. The respective settlements are also largely separated by the households' different registration, or *hukou*, statuses indicating whether the households are officially listed in the village or not and thus entitled to local benefits or not. Of the eight settlements, three are comprised of predominantly locally registered households. These are the settlements and households that have been targeted in the present research. Households with non-local hukou statuses have been excluded as they differ from the households with local hukou statuses in terms of (amongst other) composition, tenure and ethnicity [21,30], making them difficult to compare. We expect that these households would be amongst the most vulnerable to a drop in rubber prices, but additional research would be needed in order to get the full insight into how these unregistered households are affected by fluctuating commodity prices.

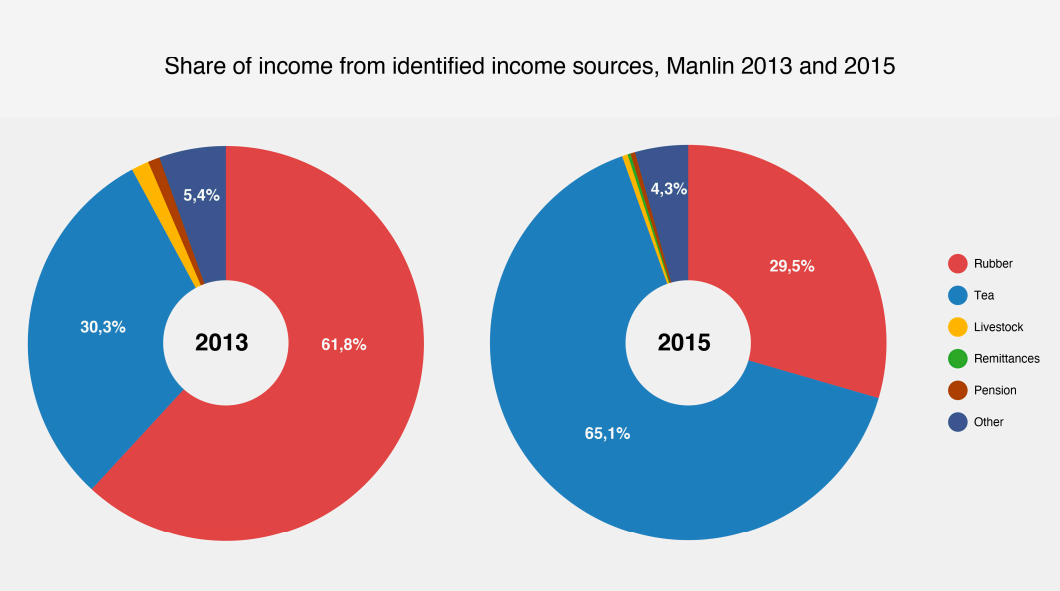

Figure 1. Importance of different income sources measured by their share of total income in Manlin, Xishuangbanna, in 2013 and 2015.

In the following, we use the term "main settlement" to refer to the oldest and largest settlement in Manlin located at an altitude of approximately 1100 m.a.s.l., and "new settlements" to refer to the two newest settlements in Manlin located at approximately 590 and 783 m.a.s.l.

Manlin is a predominantly Yi ethnic village. In 2011, 108 households were recorded [31]; however, in 2013, only 97 households were actually living in the village. The three settlements are located between 560–1100 m.a.s.l., with the two largest settlements at, respectively, the highest and lowest elevations of the village. The oldest settlement is located at the highest altitude, where the residences of the current elected village headman and former communist party leader are located. The current elected village vice headman lives in the second largest settlement at the lowest altitude. Despite the distance of only approximately 11 km, the transportation between the two settlements takes about 1–1.5 h by car, due to the mountain roads and their condition. From the lowest settlement,

Manlin is connected to a wider infrastructure network via a paved road that was built in 2000 in joint collaboration between the government and rubber concession holders, the local "lao bans" with large rubber plantations. In spring 2015, the process of improving the dirt road connecting the villages internally was commenced.

Traditionally, people have practiced shifting cultivation, growing mainly upland rice and maize in separate rotations while also engaging in animal husbandry including cattle, pigs, and poultry. Today, the two dominating land uses are rubber- and tea plantations. Since the 1980s, after smallholders in Manlin started to grow rubber themselves, rubber has been planted on nearly all suitable areas in the village, including on some marginal and less suitable areas above 1000 m.a.s.l. At higher altitudes, there are areas of state- and community forests, tea forests, and tea plantations. Most of the tea in Manlin is ancient forest tea, which comes from the fact that some of the trees can become several hundreds of years old. In Manlin, the oldest trees are more than 300 years old. Tea was originally grown for own consumption in the village, but due to significant increases in tea prices, it has become a cash commodity and an important source of income for local households. According to earlier research in the village [31], tea prices in Manlin had increased from 2.6 CNY/kg in 1990 to 200 CNY/kg in 2011.

The differentiation of crops according to altitude is reflected in the local households' livelihood activities, as almost all households have rubber plots while larger tea plots are mainly held by households residing at the main, higher altitude settlement.

2.2. Methodology

Previous research conducted in 2013 by Mertens et al. [30] in Manlin allowed us to do a temporal investigation into how rubber price changes have affected local management practices and rubber perceptions amongst the local people by conducting a household resurvey. The original survey was conducted with 30 percent of the local households, weighted for each settlement by size and using convenience sampling within the settlements. We were able to get a 100 percent response rate as all of the original 30 local households from the first survey participated in the resurvey. The resurvey was designed with a mix of open- and closed questions, and questions on rubber perceptions and price fluctuations were added to the original survey. This allowed the respondents to elaborate on their experiences with rubber farming and livelihood impacts. Data from the household resurvey were analyzed with the data from the 2013 survey using IBM SPSS Statistics 25 and Excel. The approach followed that from 2013 by Mertens et al. [30], where Levene's test was used to assess the equality of variances before running independent *t*-tests on the significance between the means of the 2013 and 2015 data. When variances between the groups were significantly different, the parametric *t*-test was discarded and the SPSS *t*-test for cases when equal variances were not assumed were used. Before running paired-samples *t*-tests, the data were tested for normal distribution. When normal distribution was not found, the non-parametric Wilcoxon test was used to estimate significance. For all tests, significance was tested at a 5 percent level ($p < 0.05$).

Qualitative data collection was conducted using the approach adapted from a 2014 version of the Gennovate methodology [32]. The guide features a qualitative approach to address issues related to, amongst others, rural innovation, agricultural practices, and gender norms by using interviews and focus group discussions as the main tools for collecting data. This provided contextual and qualitative data to support the household re-survey. An overview of the adapted Gennovate methodology applied is provided in Table 1.

Semi-structured interviews with male and female key informants in the village were used to draw a community profile and investigate local farming and community practices. In addition to the community profiling interviews, interviews were also used to investigate topics related to rubber farming, livelihood issues, local agencies, and changes in rubber income. Eight semi-structured interviews were conducted in Manlin: four with male respondents and four with female respondents. Local connections helped us identify male and female farmers from different socioeconomic strata and with different rubber farming experiences in order to capture local variation. Interviews were

conducted in Mandarin with the assistance of an interpreter. Results from the focus group discussions were not used in this paper due to our focus on economic inequality.

Table 1. Overview of the adapted Gennovate methodology, including activity names and target respondents.

Adapted Gennovate Methodology		Target Respondents
Semi-structured interviews	Community profiling	Male and female respondents
	Innovation pathways	Two male and two female respondents
	Individual life stories	Two male and two female respondents
Focus group discussions	Ladder of life	Two groups, one male and one female
	Capacities for innovation	Two groups, one male and one female
	Aspirations of youth	Two groups, one male and one female

3. Results

By 2015, local households in Manlin had transitioned from traditional subsistence-based to predominantly commodity-based agriculture, with rubber accounting for more than 80 percent of the land used in Manlin (HH survey). Between 2013 and 2015, the rubber sales price received by local producers was about halved, from approximately 16 to 8 CNY per kilo (mode-values, self-reported value from survey, Manlin; in 2015, 1 USD = 6.227 CNY, OECD (2019)). At the same time, tea prices had almost doubled from approximately 500 to 1000 CNY per kilo for spring tea and 200 to 400 CNY per kilo for autumn tea (interview data, Manlin).

The next sections investigate how the changes in rubber prices have affected local livelihoods and livelihood strategies in Manlin, including what impacts the price drop had on income, land use, and land use management decisions in Manlin.

3.1. Changes in Incomes

Rubber and tea were the two dominant income sources for households in Manlin in both 2013 and 2015, but the share from rubber income to total income had decreased: In 2013, rubber income made up approximately 60 percent of total income compared to about 30 percent in 2015 (Figure 1). Although there was no significant difference in the average total household income from 2013 to 2015, the average income from rubber and tea had changed significantly (Table 2). Besides rubber and tea income, there were no significant changes in other income sources at a village level.

Table 2. Mean changes in income from 2013 to 2015 computed in SPSS. The Wilcoxon signed rank test was used separately to calculate whether the changes in income were significant. Measured in 100 CNY.

2013–2015	Manlin
Total income	52.3 (655.8)
Rubber income *	−263.5 (337.5)
Tea income *	358.3 (534.2)
Livestock	−8.3 (36.4)
Remittances	2.3 (8.9)
Pension	−4.9 (31.8)
Other income	−6.6 (112.2)
Debt	−122.3 (572.1)

* Indicates a significant difference at the 0.05 level.

3.2. Land Use Changes

Between 2013 and 2015, there was little change in overall or individual land use types (Figures 2 and 3). The area under rubber was by far the most dominant land use and had increased slightly from 181 to 193 ha, corresponding to about 7 percent in two years (Figure 2). This indicates that the decline in rubber prices had not affected local land use decisions so far. Because rubber trees are not taken into production until they are approximately 7–8 years, the total area of rubber does not reflect the current economic potential as it includes trees of all ages. Dividing the area under rubber plots into mature and immature trees showed that the area of mature rubber plots had increased almost 100 percent from 2013 to 2015, increasing the potential rubber income for local households (Figure 3). By 2015, the area of rubber in production had increased since 2013, despite that only about 60 percent of the mature rubber trees were actually in production by 2015, leaving the potential income from rubber unrealized (Figure 3).

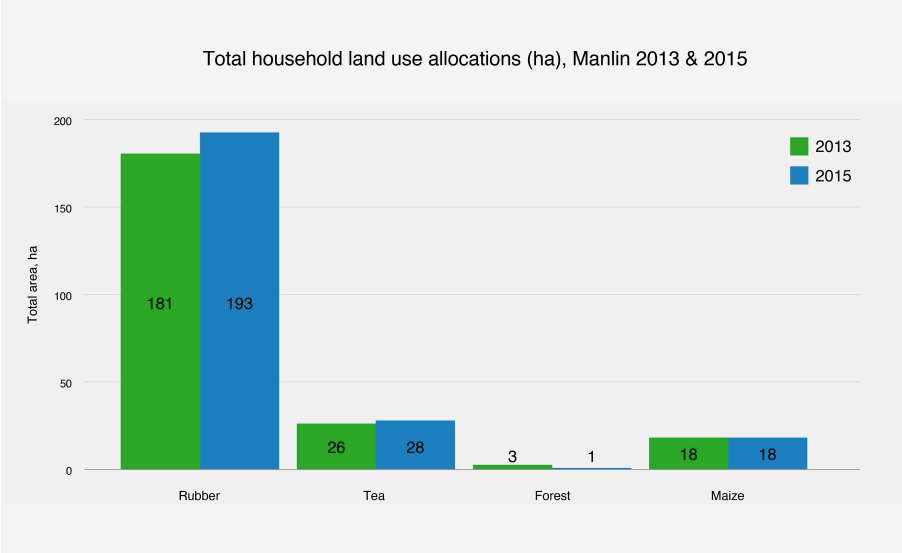

Figure 2. Changes in household land use allocation in Manlin village from 2013 to 2015, measured in ha. The category "Forest" refers to areas of forests without rubber or tea.

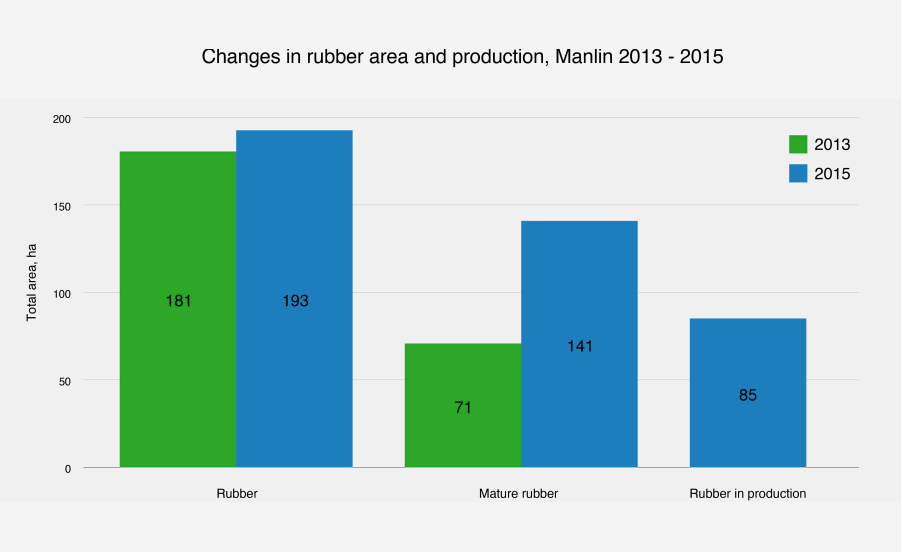

Figure 3. Changes in, respectively, total rubber and mature rubber areas between 2013 and 2015, measured in ha.

3.3. Intra-Village Differences

In the previous sections, we have shown how the drop in rubber prices has had little impact on the overall local income in Manlin, mainly due to increased income from tea. But this is not the case when analyzing the village according to its settlements as different ages and locations are reflected in the current land use patterns: Households in the main settlement hold significantly more areas of tea and maize than the new settlements, which in turn are much more specialized in rubber farming (Table 3, Figure 4). There are two main reasons for this difference: Firstly, when rubber gained popularity, the local people were moving to new areas where they could plant rubber. This explains why the age of the settlements correlate with the time when rubber was first introduced to the area and why rubber is the main crop. Rubber plots have also to a higher degree replaced previous areas of forest in the new settlements than in the main settlement, where rubber often replaced previous areas of shifting cultivation or other crops. Secondly, most of the tea in the village is very old and grown at altitudes above 1000 m.a.s.l. where rubber is not deemed suitable and thus is not a competitive crop. All households in the adjoining and older main settlement have plots of tea compared to 80 percent of households in the new settlements (HH survey) who are likely to have tea plots through relatives in the main settlement. The size of tea plots held by households in the main settlement is on average approximately five times larger than plots held by households in the new settlements (Table 3).

Table 3. Average total and crop-specific land use areas in 2015 for households within the main- and new settlements. Measured in ha. Standard deviation is shown in brackets. The differences between settlements were tested using independent samples *t*-tests.

2015	Main Settlement	New Settlements
Total area	9.35 (6.57)	6.62 (3.41)
Rubber area	6.84 (4.80)	6.00 (3.30)
Rubber area, in production	2.47 (2.58)	3.20 (1.51)
Tea area *	1.58 (1.88)	0.28 (0.31)
Maize *	0.91 (0.81)	0.29 (0.43)
Self-owned forest	0.01 (0.03)	0.04 (0.09)

* Indicates that the difference between settlements for this crop is significant at the 0.05 level.

The differences in land holdings and land uses reflect how income is divided among households in the main and the new settlements: while households in the main settlement made significantly more money from tea than households in the new settlements in both 2013 and 2015, the households in the new settlements made significantly more money from rubber (Table 4). For households in the main settlement, this means that while rubber income significantly decreased between 2013 and 2015, tea income significantly increased and so did the total income (Table 5). For households in the new settlements, rubber-, and tea income also changed significantly, while total income appeared to be smaller but not significantly (Table 5). Looking at the standard deviations in Table 5, there are big intra-settlement variations (CV $\geq$ 1) in the average changes in total-, rubber-, and tea income for households in both the main and new settlements, indicating that some households were more affected by the price increase in tea and price decrease in rubber than others. This variation is also visible in Table 4, where there are large variations in rubber income for households in the main settlement in 2015 and in tea income for households in the new settlements in both 2013 and 2015.

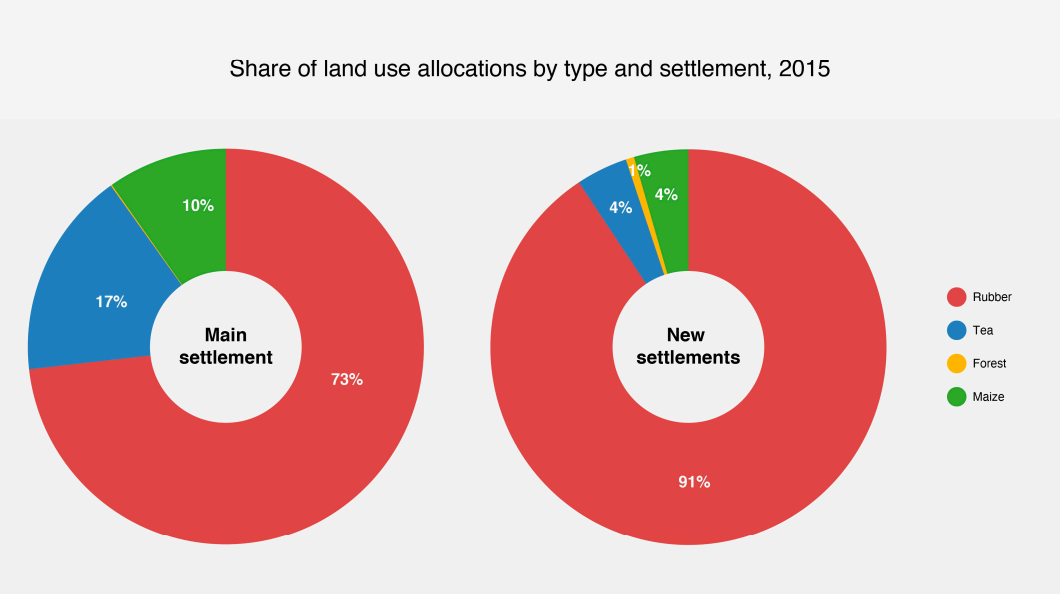

Figure 4. Allocation of land use in Manlin by settlements measured in ha. The pie charts show that rubber is the dominant land use (measured by area for all cases), followed by tea and maize in the main settlement, and maize and tea in the new settlements.

Between 2013 and 2015, average total income changed by 41 percent for households in the main settlements and −27 percent in the new settlements. So although the overall picture is that there has been no financial impact on local households from the drop in rubber prices (Table 2), it seems that the more specialized farmers in the new settlements have experienced negative impacts on their income that have not been felt by households in the main settlement. Instead, tea has been a buffer crop for both the main and the new settlements, but most successful in the main settlement where the increased income from tea exceeds the decreased income from rubber. From no significant difference in total household income between settlements in 2013, households in the main settlement now earn a significantly larger income than households in the new settlements (Table 4).

Table 4 shows that besides total income and income from rubber and tea, there are no significant changes in income from the remaining income sources between the two settlement types, indicating that the local households have not diversified their incomes as a result of the low rubber prices. Working as hired labor is not common amongst the households in Manlin—only one household reported income from this source. Still, although not significant, the numbers in Table 5 suggest that income from "Other" sources has increased in the main settlement and decreased in the new settlements where a need for supplementary income sources is more acute. The income from "Other" is a small contributor to total household income (Figure 1, Tables 2 and 5) and only a few households have income belonging to this category (8 in 2013 and 9 in 2015). In the new settlements, a large share of the 'Other' income comes from land rent or from selling use rights to their land for a number of years. These households have typically rented out rubber land in exchange for a share of the profit. When rubber prices went down, so did this type of "Other" income. It is quite common that households in the village have rented out land but if they are not included in this list, it is because they either have received a different kind of payment—a onetime payment–or because their tenants are not yet tapping rubber, generating no income to share. In the main settlement, a much larger share of income belonging to the "Other" category is generated from small shops. In one case, the "Other" income is generated from a tea business. From 2013 to 2015, the reported income from this activity has increased from 8.000 CNY to 35.000 CNY, driven by the increasing tea prices. These causes help explain the development in income from "Other" sources, and why households seem to have been more affected in the new and rubber specialized settlements than in the main settlement.

Table 4. Average total- and source-specific incomes for 2013 and 2015 for households in Manlin, according to settlements. Measured in 100 CNY. Standard deviations are shown in brackets. Significant differences between groups were measured using independent samples *t*-tests.

	Main Settlement	**New Settlements**
Total income		
2013	842.5 (438.9)	882.9 (515.1)
* 2015	1.187.7 (812.5)	642.4 (328.8)
Rubber income		
* 2013	388.3 (350.1)	706.7 (484.0)
* 2015	170.0 (201.7)	398.0 (249.3)
Tea income		
* 2013	410.0 (156.1)	126.7 (129.4)
* 2015	1.010.0 (734.5)	243.3 (244.1)
Livestock		
2013	7.0 (15.3)	18.3 (46.9)
2015	7.7 (18.2)	1.1 (4.1)
Remittances		
2013	0.0 -	0.0 -
2015	4.7 (12.3)	0.0 -
Pension		
2013	15.5 (45.8)	1.6 (4.5)
2015	4.8 (5.2)	2.5 (5.3)
Other income		
2013	8.1 (21.5)	88.3 (231.9)
2015	32.3 (92.8)	51.0 (122.8)
Debt		
2013	456.7 (738.9)	320.0 (386.7)
2015	273.3 (345.3)	258.7 (302.3)

* Indicates a significant difference at the 0.05 level.

Table 5. Using paired-samples *t*-tests to investigate the changes in income from 2013 to 2015 and whether they have been significant for the main settlement and the new settlements. Measured in 100 CNY.

2013–2015	Main Settlement	New Settlements
Total income	345.2 * (587.1)	−240.5 (602.0)
Rubber income	−218.3 * (322.9)	−308.7 * (356.8)
Tea income	600.0 * (649.5)	358.3 * (534.2)
Livestock	0.7 (26.1)	−17.3 (43.5)
Remittances	4.7 (12.3)	0 -
Pension	−10.7 (44.8)	0.9 (3.6)
Other income	24.2 (71.7)	−37.3 (137.6)
Debt	−183.3 (708.5)	−61.3 (409.9)

* Indicates a significant difference at the 0.05 level.

3.4. Rubber Price Drop: Coping Strategies, Impacts, and Perceptions

As a result of the drop in rubber price, 60 percent of the households in Manlin have changed their rubber farming practices in some way (Figure 5). The overall most common response has been to stop or reduce the rubber tapping area or frequency (43 percent), followed by decreasing the amount of farming inputs such as fertilizers and hired workers (27 percent). The reasoning behind these adjustments is that the income cannot justify the time spent or previous levels of inputs. Furthermore, many households have lost the motivation for tapping their plantations even if they have not changed their practices (HH survey). So far, there have not been problems selling the latex despite lower demand. The principal buyer remains the nearby rubber factory, which sends someone to pick up the rubber on a regular basis.

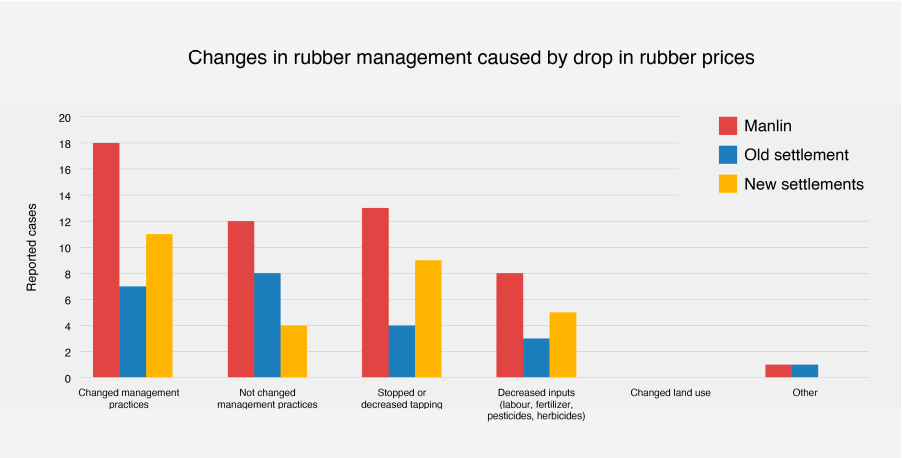

Figure 5. The share of households who have changed management practices due to the drop in rubber prices, shown for Manlin overall and the main and new settlements.

Zooming in, we see that there are differences between how farmers respond at a settlement level. 73 percent of households in the new settlements changed management practices compared to 47 percent of households in the main settlement. In the new settlements, 60 percent of households decreased or stopped tapping activities and 33 percent decreased inputs (Figure 5). Decreasing inputs minimizes costs and explains why this is the most common practice amongst households from the more rubber-specialized settlements which are more vulnerable to price drops. Surprisingly, households in the new settlements are also more likely to decrease tapping activities, causing a double impact on their incomes. This could be an attempt to save tapping the trees for times when prices are higher, as a few households have mentioned, hoping or expecting better prices in the following years (HH survey).

14 of the 15 households in the new settlements felt an impact of the lower rubber prices (HH survey) and the majority of households also reported that the drop in rubber prices affected their everyday lives. Examples include reducing spending on clothes, food, transportation, and education. In some cases, households have also obtained loans to pay for daily expenses and are afraid of becoming ill in case they will need to pay a hospital bill. Larger investments, such as the building of a house, have also been postponed (HH survey). In the main settlement, only one of the 15 households felt an impact from the drop in rubber prices.

Looking at local risk perceptions, the main concerns are related to how rubber trees are prone to damage from wind and pests rather than prices. Local households reported no change in their perceptions of price risks between 2013 and 2015 (HH survey). This could be due to recall bias, or it can be an indication of local awareness of price fluctuations. By 2015, some households expected rubber prices to rise again in the coming season, which can explain the strategy to decrease tapping activities and wait. The local people have already experienced a great increase in income due to rubber, allowing them to improve their education and standard of living. For the past decades, rubber has been at the center of local livelihoods and the land use transition towards rubber plots has already been completed: *"No rubber, no life"* (Informant, Manlin). However, the local peoples' satisfaction with their rubber plots dropped between 2013 and 2015, to the point where 30 percent of households were not generally satisfied with their plantations. Still, no households in Manlin changed land use as a result of low rubber prices by 2015 (Figure 5), and only few households (7 percent, HH survey) had considered a change in land use, in part due to identifying as rubber farmers but also due to a lack of know how: *"I will never change to another crop other than rubber. I never think about it. It would also be impossible without government support—the provision of knowhow"* (Informant, new settlement, Manlin). Changing land use was thus not strongly considered by local households as a solution to the price shock, showing some robustness in the current land use to fluctuating prices.

3.5. The Increased Importance of Tea: Readjusting Focus

Despite that rubber plots dominate the landscape and land allocations for all settlements in Manlin (Table 2), the case from Manlin shows how important tea production is for the local community. Since tea prices have increased, more buyers come to Manlin to buy the tea. Even when prices are competitive, the production of tea and rubber complement each other as they grow at different altitudes, with small or no competition of land, and have different peak seasons and workhours. Activities in the rubber plots are primarily in the wet season where tapping is done after dark and the latex is collected in the morning. On the other hand, tea harvesting and processing is done during the day and is the most valuable in spring, when there is little activity in the rubber plots. Traditionally, the workforce is also split, with more women and elders taking part in tea production. Table 2 shows how rubber in Manlin was the most important livelihood activity in monetary terms in 2013, but for households in the main settlement, tea income was already higher than rubber income by 5 percent. In 2015, the income from tea was 2.5 times the income from rubber (Table 4). In contrast, tea has neither in the years 2013 or 2015 been more important than rubber in the new settlements, making only about 1/5 of rubber income in 2013 and 3/5 in 2015 (Table 4). This is due to both decreasing rubber prices and increasing tea prices. The drop in rubber prices made local households invest less in rubber production

while rising tea prices increased the importance of tea for households with tea land. *"After the rubber prices went down, we now put more time into tea picking."* (Informant, main settlement, Manlin). Between 2013 and 2015, income from tea has increased by 134 percent at the village level while the area of tea has increased by 7 percent (Figure 3), showing that the increase in income from tea has been from increasing prices and from refocusing on the existing tea production by increasing labor hours.

4. Discussion

The case of Manlin exemplifies how the commodification of agriculture, a widely occurring phenomenon at the global scale, often entails economic growth for the local people and communities, but also comes with elements of social disruption as access to development opportunities is seldom equal [2], such as in the case of access to tea land in Manlin.

In Xishuangbanna, the commodification of agriculture has been closely linked to the changing policies from the 1950s and onward, with local land use strategies being shaped by tenure reforms along with governmental promotion and economic incentives from a protected market to adopt rubber farming. As such, the Chinese government has played a very active part in the commodification of agriculture and in the expansion of rubber in Xishuangbanna. The initial interest in state production of rubber in Xishuangbanna also affected the commodification process indirectly by entailing large investments in infrastructure development [33], helping to develop the area in general, and especially the areas suited for rubber farming. In Manlin village, the influence of rubber on local infrastructure and development is clearly felt: The road network has improved greatly over the past ten years with help from both the local government and rubber companies, allowing easier transportation and opening up the area for economic development and business (SSI, village informants) [21]. In this sense, rubber farming in Xishuangbanna has affected local farmers not only directly through increasing income but through improved infrastructure and related benefits such as market access, connectivity, and mobility thus paving the way for increasing the trade of tea, which, according to local respondents, would otherwise not have reached its current volume. This shows how the household economies benefiting from tea in Manlin today are in part enabled by the rubber production.

Our finding that rubber-specialized households in Manlin are highly affected by fluctuating commodity prices also corroborates findings that rubber farming has generally reduced income diversification in Xishuangbanna [8,16,33,34]. How the local people respond to the drop in rubber prices may be contingent on a number of aspects. The nature of rubber as a perennial crop with potentially high costs in start-up investments makes it difficult for producers to respond quickly to price fluctuations. Producers may also be restricted by limited market information, or local policies leading to what Brown and Gibson [34] call the planning problem: trying to decide how to manage their lands without knowing the timing and scale of future market trends. Min et al. [16] describe how perceived risks are expected to influence land use decisions of local smallholders, as people will make decisions based on their perceptions. Since the study by Min et al. [16], rubber prices have dropped, leaving the authors to expect that the risk perception has changed since then: *"If risk perceptions have a significant impact on the land use of smallholder rubber farmers, this relationship will provide an interesting perspective from which to better understand the possible land use situations of small holder rubber farmers in the context of declining rubber prices"* [16] (p. 197).

When local people in Manlin adopted rubber, it was after seeing how profitable it was in other places, and seeing that it was a product sought after and promoted by the local government. As such, it is likely that local farmers have considered risks related to rubber as very small, focusing on optimizing profits rather than risk mitigation. This translates into the highly specialized rubber landscapes we see today. Since the price drop, we see that even though some specialized rubber farmers respond to the declining rubber prices by decreasing tapping activity and that the drop in rubber prices has affected their income, it generally has not done so to a point where it has become a push factor for new income-generating activities such as off-farm work. The unavailability of land is also a constraint for crop diversification as local farmers are not willing to cut down some of their rubber. The complete

lack of using land use change as a coping strategy was a surprising find, as replacing rubber with other crops has been observed elsewhere in Xishuangbanna (Slothuus, C.F, unpublished from observations and interviews of smallholders). While tea may have acted as a buffer crop to counteract the economic push for land use change, we expected to see a difference between the settlements and households with or without access to tea land and alternative income sources. Instead, the reluctance to convert to other land uses in Manlin could be explained by a persisting expectation in 2015 that rubber prices will increase again and/or a hesitation to lose the initial investment in plantation establishment after only 4 years of low rubber prices.

Min et al. [16] showed that people at different altitudes are at different risks. Firstly, geographic location determines the vulnerability of rubber farming as rubber plots at unsuitable elevations and marginal areas are more exposed to risks than plantations at lower altitudes [18]. Secondly, the geographic location also influences access to alternative income opportunities. This would suggest that households in the new settlements in Manlin should be less vulnerable than households in the old settlement, as they live at lower altitudes and are in closer proximity to infrastructure easing access to alternative income sources. However, in Manlin, non-farm incomes are rare in all settlements. Instead the geographical location of settlements is largely an indicator for whether the local households have access to tea plots and tea as an alternative income source or not, favoring the most remote and high-altitude settlement. In this case, the characteristics of tea and rubber farming, and the fact that they are not competing for land, may coincidentally have led to more diversified incomes in the main settlement and buffered the impact of the drop in rubber prices. As a consequence, intra-village economic inequality has increased due to the drop in rubber prices and simultaneous rise in tea prices, with households from the new settlements earning significantly less than households in the main settlement in 2015.

5. Conclusions

Similar to how other farmers in Xishuangbanna have adopted rubber beyond expectation [9,26] and improved their livelihoods, many households in Manlin have benefitted greatly from rubber farming. Rubber production has become so incorporated into the local peoples' livelihoods that they identify as "rubber farmers" rather than just "farmers", which translates into land use decisions that are not yet challenged by the drop in rubber prices. It also shows how local rubber farmers are not completely free from the notion of needing government guidance to adapt to the new market situation and how risky the transition to becoming specialized rubber farmers has been. The importance of having a crop to fall back on when new crops fail is well known in traditional shifting cultivation systems, where smallholders scale up or down on rice cultivation and rubber when rubber prices fluctuate [35] and similar crop flexibilities are shown for other cash crop-rice systems such as pepper [36] and maize [37]. However, the way that tea is being used as a buffer cash crop by local people engaged heavily in the rubber rush has not been analyzed in detail previously. In Manlin, households in the main settlement have been lucky to have tea as a buffer as they have not been as affected by the drop in rubber prices as their neighbors in the new settlements. As a non-competing land use, tea lands have not been directly impacted by the massive focus on rubber in the region. Instead, households with tea have benefitted indirectly from infrastructure improvements that were in part made to support rubber production, which, together with the timing of high tea prices, has created an effective buffer to the low rubber prices. Going forward, the increased focus on tea could be a way for local farmers to reframe themselves, except for those without tea land who risk losing status in the identity of being successful rubber farmers.

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