Ecosystem services and the role of Indigenous Knowledge as rubber plantations take over land use. A case study from Xishuangbanna, China

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Abstract

The expansion of rubber plantation in Xishuangbanna, Southwest China, is eroding indigenous knowledge (IK). IK still plays an important multi-dimensional role in the lives of ethnic minorities in the region, especially those living in the higher elevations. This highlights the role and functions of IK in traditional and in fostering ecologically sustainable rubber plantations by protecting sacred and culturally significant places and encouraging expanded use of indigenous food resources and wild edible and medicinal plants. Based on a case study employing the empirical and analytical instruments of Participatory Rural Appraisal and Rapid Rural Appraisal, the findings show that conversion of natural forests into monoculture rubber plantations has resulted in a steep and rapid decline in the availability of wilds food and medicinal plants and associated IK. Although monoculture rubber plantations provide farmers with better income and higher yields, farmers no longer apply the methods such as crop rotation that sustain natural fertility and help prevent soil erosion. Younger farmers no longer know much about such practices. The analysis shows that utilization of IK could foster the wider use of sustainable farming methods, but this would now require the active involvement and co-operation of the government and plantations owners.

Keywords: traditional farming, ethnic minorities, monoculture rubber

1. Introduction

The intensification and unlimited expansion of rubber plantation in Xishuangbanna is not merely causing the loss of biodiversity in the region but loss of indigenous knowledge which cannot be ignored. Indigenous knowledge associated with and embedded in former cultural repertoires and farming practices is eroding due to drivers such as rapid population growth, the introduction of market-oriented monoculture agriculture and forestry, westernized education in schools, and environmental degradation due to deforestation. A communication gap is opening between the elders and the younger generation is also factor in the loss of traditional IK, and youngsters do not spend much time in their communities or have and are adopting different lifestyles from their ancestors. However, in recent years, many of the ethnic minorities are venturing to work on rubber plantation because this gives them a large gain in income and improved their living standards.
As the rubber plantations expanded deforestation further contributed to the disappearance of wild edible and medicinal plants in Xishuangbanna and is having a depressing effects on the knowledge related to those plants (Ghorbani et al. 2012). There has been an accompanying rapid transformation in social and economic life in southern Yunnan, especially in Xishuangbanna, at first in relation to the integration of rubber into traditional land use systems in 1950s, and thereafter as a result of the introduction of Household Responsibility System in the early 1980s (Tang 2010), and more recently, the opening to the market forces. The wave of transformations has brought significant impacts on the local populations, particularly on the ethnic minority peoples in the region, and challenged indigenous knowledge they used to practice.

2. Conceptual frame: Indigenous Knowledge
There are a great many definitions of indigenous knowledge. Indigenous knowledge plays an important role in ethnic minority livelihoods in the study area and has significant impacts on the environment. In this paper, IK is considered broadly as the distinctive knowledge of a given population constituted in their experiences, social organisations, traditions, values and beliefs, practices and recent events (Institute for Indigenous Theory and Practice, 1993; Haverkort, 1991; Warren, 1996).

The term IK confusingly has been used synonymously with folk knowledge, traditional knowledge, local knowledge, traditional ecological or environmental knowledge, indigenous technical knowledge, People's Science or ethnology and in village science (Atte, 1989; Das Gupta, 2011). These terms can be distinguished but often refer to the same thing. It is not fixed or static but is constantly changing, produced and reproduced in contingent circumstances, discovered as well as lost (Maurial 1999, Mwadime 1999; Castellano 2000; Melchias 2001). An important consideration is how exactly IK is formed. This issue turns attention to to local learning and communication systems, and how these are inflected by social status, age, gender and so on, the beliefs passed down the generations, local classification and quantification systems, use of plants for health and medicinal plants, the management practices of natural resources, agricultural techniques and practices, community organization and the embodiment of knowledge in seeds, tools, materials and handicrafts.

3. The context
3.1 Natural resources
In the past the Xishuangbanna region was dominated by tropical seasonal rainforest, mountain rainforest and sub-tropical evergreen broadleaf forest (Li et al., 2008). According to Xu (1988), with the burgeoning population and the development of cash crops such as rubber, tea and tropical fruits in the region, by the 1950s had reduced the tropical forest to 60%; by the 1990s cover had fallen further to around 30%, leading to the loss of about 600 plant species and the primary forest reduced to 4.0% (see fig 1).
Forests
Rubber plantations

Figure 1. The expansion of rubber forest in Xishuangbanna from 1976 and in 2003 (Li et al. 2008: p. 20)

Although it covers only 0.2% of China’s land area, it holds about 16% of China’s higher plant species (Zhang & Cao, 1995). The total area of the region is 19220 km², with about 94% is covered by mountains and hilly terrain. Xishuangbanna is located within 21°10’ - 22°40’ N, and 99°55’ - 101°50’ E. It is rich in cultural and biodiversity and represented by 13 ethnic minorities, but there is only 6 ethnic minorities living in NNNR: Hani or Akha (23.37%), Lahu (50.34%), Kemu or Yi (3.34%), Dai (11.37%), Han (10.22%) and Bulang (1.35%). Owing to its richness of biodiversity, it is often referred as “Kingdom of plants and animal” of China. Xishuangbanna is a place where ethnic diversity and biological diversity meet together (Margraf, 1999). Li et al. (1996) reported that a total of 4669 higher plant species, subspecies or varieties belonging to 1697 genera of 282 families have been recorded in Xishuangbanna.

In the NNNR region, there are more than 2345 species and subspecies of higher plants, 156 species of non-vascular plants, 437 species of vertebrates and 327 species of invertebrates were reported (Liu et al. 2010; Ghorbani et al. 2012). There are 182 species of food plants available in NNNR (Zhang et al. 2004). Wild food plants are important resources for the ethnic minorities’ subsistence. Until 1980s, the ethnic minorities living the mountainous region were highly dependent on the collection of wild food plants for their daily vegetables’ consumptions (Li et al, 1996, Wang & Long, 1995; Xu et al, 2004). Ethnic minorities in NNNR still used and practiced the collection of Non-Timber Products and wild foods.

3.2 Farming systems
Before the liberation of Xishuangbanna and its integration into China in the 1950, the local community depend on traditional agriculture, principally especially rice production in the lowlands and slash-and-burn farming in the mountain regions (Wehner, 2010). In the early of 1950s, local farmers lost their independence and their lands were converted into collective lands and the first plantations of rubber were established. During that time, rubber trees were first incorporated into traditional land use systems and cultivated in mixed-cropping and intercropping systems. Over time monoculture rubber plantations became the norm, and rubber became a high benefit cash crop (Wu et al. 2001). Because of the high demand for natural rubber, the expansion of rubber plantations in Xishuangbanna had a positive short term
economic impact. The longer term trend is uncertain, as synthetic materials with similar properties come to market.

Before the introduction of rubber into Xishuangbanna, villagers practised crop rotation (Table 1). The arable land was divided into pieces that were cultivated for two or three years, followed by a fallowing period of four to twelve years to recover land capacity and soil fertility (Tang et al 2010; p.1077).

<table>
<thead>
<tr>
<th>Year</th>
<th>Land piece 1</th>
<th>Land piece 2</th>
<th>Land piece 3</th>
<th>Land piece 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965-1968</td>
<td>Dry paddy</td>
<td>Fallow</td>
<td>Fallow</td>
<td>Fallow</td>
</tr>
<tr>
<td>1968-1971</td>
<td>Dry maize</td>
<td>Dry paddy</td>
<td>Fallow</td>
<td>Fallow</td>
</tr>
<tr>
<td>1971-1974</td>
<td>Fallow</td>
<td>Dry maize</td>
<td>Dry paddy</td>
<td>Fallow</td>
</tr>
<tr>
<td>1974-1977</td>
<td>Fallow</td>
<td>Fallow</td>
<td>Dry maize</td>
<td>Dry paddy</td>
</tr>
<tr>
<td>1977-1980</td>
<td>Dry paddy</td>
<td>Fallow</td>
<td>Fallow</td>
<td>Dry maize</td>
</tr>
</tbody>
</table>

Table 1. Four-field crop rotation
Source: Tang et al. 2009; p.9

Over the last thirty-four years the landscape in Xishuangbanna has been converted from highly diverse forests and complex agriculture into monocultures of tea and rubber (Sturgeon 2012). Currently, Xishuangbanna is the second largest rubber producer in China next to Hainan Island (Tang et al. 2009; p.6). Rubber production promises the highest incomes to the local communities compared to all other cash crops in the region. The increase of the rubber plantation in Xishuangbanna has caused a decline in the yields of wild food and medicinal plants.

3.3 Social life and IK
The expansion of rubber plantations in the region brought increasing environmental problems and has accelerating economic stratification among the farmers, with farmers in the higher elevations becoming relatively poorer and those in the lower elevations becoming relatively richer. The Dai, Mountain Han, Hani or Akha and Lahu people in Xishuangbanna continue to engage in many traditional practices and cultural activities, conserving the associated knowledge, but the changes in land use systems has impacted their farming and ecological knowledge. Historically, they were isolated from the outside world and engaged in subsistence agriculture, forestry and animal husbandry. Up until recently, their indigenous knowledge played an important role in the conservation and protection of biodiversity (Sinha, 1996). For example, the Dai ethnic do this by maintaining “Holy Hills” and temple yard plants (Pei, 1991) and the Hani by maintaining “Rattan Forest” (Chen et al. 1993). Indigenous knowledge is important to the ethnic groups living in Xishuangbanna as it provides them with the basis for problem-solving strategies for local communities, especially to the poor before introduction of modern agriculture. For example, the local healers and villagers from Naban, ZhongZhiChang, XiaoNouYouShangZhai, BanQianDi, Manmo and BanPoZhai collected the wild food and medicinal plants for self-consumption and for sales. The farmers conducted local experiments based on their personal experience and trial and error to solve the plants and animal diseases (BanQianDi and XiaoNouYouShangZhai).

4. Methodology
The study was carried out in Xishuangbanna Dai Autonomous Prefecture. It is a tropical region located in southwestern China, bordering Laos and Myanmar. The Langchan (Mekong) River passes across the area (Figure 2). In the past, Xishuangbanna was known for the use of elephants in farming and forestry and the cultural practice of tattooing.

The field work was carried out in Nabanhe National Nature Reserve (NNNR) which is located in the central north of Xishuangbanna. The reserve was established in 1991 and protects a 211 km² watershed area which is surrounded by hills and mountains. The range of altitude in this
reserve varies from 539m to 2304 m. The reserve is divided into 3 zones: core zone, buffer zone and experimental zones.

Figure 2. Maps of China, Yunnan, Xishuangbanna, NNNR (adapted from GORBANI et al. 2012: p. 3)

Field studies were carried out in six ethnic villages, namely Naban, ZhongZhiChang, BanQianDi, XiaoNouYouShangZhai, Manmo and Ban Po Zhai, as shown in table 2. These villages were selected along transect based on criteria such as ethnicity, elevation and socio-economic condition in the village. Empirical and analytical instruments were used, drawn from the repertoires of Participatory Rural Appraisal and Rapid Rural Appraisal. They included open and semi-structured interviews, group discussions, transects, and participant observation. The interviews were conducted with adult men and women and elders.

Table 2. Selected villages in study area

<table>
<thead>
<tr>
<th>Study area</th>
<th>Village</th>
<th>Ethnicity</th>
<th>Altitude (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within NNNR</td>
<td>Naban</td>
<td>Dai</td>
<td>690</td>
</tr>
<tr>
<td></td>
<td>ZhongZhiChang</td>
<td>Han</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>BanQianDi</td>
<td>Lahu</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>XiaoNouYouShangZhai</td>
<td>Mountain Han</td>
<td>1550</td>
</tr>
<tr>
<td>Outside NNNR</td>
<td>Manmo</td>
<td>Aini</td>
<td>623</td>
</tr>
<tr>
<td></td>
<td>BanPoZhai</td>
<td>Aini</td>
<td>1800</td>
</tr>
</tbody>
</table>

Source: Author’s field notes, 2013

A total of 41 local people were selected variously for free-listing and semi-structured interviews by village leaders or the research team using snowball methods, where 27 were men and 14 were women (Table 3). The interviews were conducted through an interpreter in the Mandarin and the local dialects of Dai, Lahu or Akha. After each interview the notes were transcribed and translated into English. The majority of the interviewee listed the name of the wild vegetables
but some of them were not able to complete the tasks. From the results of free-listing, we noted that younger generation in rubber villages did not know how to identify the wild edible food plants from inedible plants. Younger generation from non-rubber village are relatively better in identification and listing the names of the wild food plants and medicinal plants.

**Table 3:** Distribution of interviewee in the study area

<table>
<thead>
<tr>
<th>Types of village</th>
<th>Name of villages</th>
<th>Sex of respondents</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>female</td>
</tr>
<tr>
<td>Rubber</td>
<td>Nabang</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ZhongZhiChang</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BanQianDi</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Manmo</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Non-rubber</td>
<td>XiaoNouYouShangZhai</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BanPoZhai</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>27</td>
<td>14</td>
</tr>
</tbody>
</table>

Source: Author’s field notes, 2013

**Focus group discussion**

A total of six focus group sessions were held in the six villages (Naban, ZhongZhiChang, BanQianDi, Manmo, XiaoNouYouShangZhai and BanPoZhai), where one focus group session was held per village. 41 local people participated in the focus groups discussions with four to six respondents per session. The focus group discussion and semi-structured interview data were studied and analysed until reached the limits of the data saturation. Information related to the monoculture rubber, planting and harvesting time, yields and effects on food crops and soil moisture were asked.

**Transect walk and participant observation**

According to IUCN (1997; p.162), transect walks are defined as ‘community-based environmental assessment’. A total of 11 interviews were carried out while walking to and within forest, rubber plantations and garden in the six villages. Information on the knowledge of wild food plants and medicinal plants were asked to get an overview of the level of dependency on the wild food and medicinal plants. Apart from that, transect walk to rubber plantations enable us to get the general understanding of the tapping process, latex collection and selling to the middleman or direct to the rubber factory.
5. Findings and Analysis

The Findings section has two parts. The first presents each ethnicity in the study area, by village, and examples of its traditions, religious beliefs, farming system and IK. Thereafter we present some recent impacts of rubber cultivation.

5.1. Comparisons and contrasts, by village and ethnic group

The Dai are the biggest ethnic group in Xishuangbanna. The Dai can be further sub-divided into Water Dai, Han Dai and Flower Belt Dai. Most of the villagers in Naban are Water Dai. Naban is located at an altitude of 690 m above sea level in Nabanhe National Nature Reserve (NNNR) and comprises 42 households and about 187 people from the Dai ethnic group, with some Han and Lahu. According to the village head, Naban village has existed about 500 years. It consists of 42 households and 187 villagers. Their income is derived mainly from growing hybrid rice, muskmelon, and watermelon but majority of their lands are cultivated with rubber. Dai are the followers of Hinayana, a sect of Buddhism The Dai have written language which evolved from Sanskrit and their own calendar which started in 638 A.D. Dai's festival such as “Door-Opening” festival, “Door-closing” festival and “Water Splashing” festival are closely related to their religious activities. Water splashing festival is the most important festival as it is the New Year for the Dai ethnic in Dai calendar. The festival usually falls in the mid-April of the solar calendar.
The Han people in ZhongZhiChang migrated from Benggan village in 1984 because their old lands were located in the NNNR's experimental zone and because the land in ZhongZhiChang is more suitable for rubber cultivation. A pioneer rubber farmer from ZhongZhiChang village said that her daily profit has increased about 200 times since 1989. Her daily profit from one rubber tree was about 0.10 RMB back in 1989 (0.10 RMB*1000 rubber trees = 100 RMB/ day), one RMB is equivalent to 0.15 US dollar. ZhongZhiChang is a natural village (Chinese: 自然村; pinyin: zirâncūn) i.e. the naturally formed rural settlement similar to hamlet in England but it is without administration status (Liao & Huan, 2015). It is situated around 700 m above sea level. The majority of the households are Han. It consists of 22 households and 101 villages and according to the Village Head they have been cultivating rubber since 1987. The Han celebrated Spring Festival (Chinese Lunar New Year). During the festival, they will prepare table with tobacco and rice wine and water in the middle of the They will dance around the table. The festival is held on the first, second, third, fourteen, fifteen and sixteen day of Chinese calendar (lunisolar calendar).

XiaoNouYouShangZhai village, established in 1957, is inhabited mainly by mountain Han, with a few Lahu. It is located about 1550 m above sea level. It consists of 33 households and 154 villagers. Their income is derived mainly from growing tea, hemp, maize and sugarcane. Sugarcane was introduced into the village in 2012. The villagers also keep pigs, buffalos and chickens, and harvest the honey of wild bees. A former Village Head explained how tea cultivation was introduced in 2002 by the local government in order to improve living standards.
BanQianDi is one of the villages in the NNNR inhabited by the Black Lahu. The Lahu were nomads and hunters. Their name in the Lahu dialects means tiger hunter. The Lahu were resettled in Xishuangbanna around 1953. The Lahu community can be sub-divided into two main groups based on their dialects, traditions and customs: Black Lahu and Yellow Lahu. According to the Deputy Village Head, the Yellow Lahu’s customs are closely related to the Han whereas the Black Lahu still practise the customs associated with their former life, such as shaving women’s hair after marriage. The first names of males usually start with “Zha” and for females, with “Na”. It consists of 10 households and 60 villagers. Their income is derived mainly from growing tea, rice and collection of wild vegetables. Rubber was introduced into the village in 2005. Lahu celebrated Lahukuo festival, which is a new year for the Lahu people. During the festival, they will play lusheng (a reed pipe wind instrument which is a traditional flute), singing and group dance around a tree which is known as “tiaoge”. The festival is held on the first and fifteen day of the Chinese Lunar calendar, usually falls on the same date as the Han’s spring festival.

Manmo village is inhabited by the Aini (Akha). It is adjacent to Xishuangbanna Tropical Botanical Garden (XTBG) and the border the Menglun block of the Xishuangbanna National Nature Reserve (XNNR). The village originated from Wuxiang, a big, old Manmo village that is now part of Menhan town. They moved to Manmo in early 1971 because of problems with overpopulation, limited agriculture land and food shortages at their old village location. Manmo village is located in a valley lying between 680-1000 m above sea level. The average altitude is 623 meters. The highest point is 980 meters. The average annual temperature and precipitation is 22.50 °C and 1336.6 millimeters respectively. At present there are 71 households and 362 people in Manmo village. In the past, incomes were derived mainly from food crops, sugarcane, amomum fruit or cardamom seed (*Fructus Amomi*) and poultry for self-subsistence. The valley in the early 1980s was still heavily forested, before the introduction of rubber. Rubber was
introduced by the government in 1984. Since then rubber production in Manmo has expanded from small scale cultivation to large scale enterprises, opening a new pathway for the economic development of the valley and for improving the living standards of the villagers. By 2012 the total area under rubber was 7255 Mu (483.7 hectares) and 217650 rubber trees. The total rubber-tapped area was about 5118 Mu (341.2 hectares) with 153540 rubber trees, and the dried rubber output per year produced by Manmo was 644 tons. Rubber cultivation and processing has become the dominant activity and source of employment and income.

Ban Po Zhai is an Aini (Akha) village located in Menghai Township, lying about 1800 m above sea level. It is a traditional natural village that still preserves its traditional culture. The Aini (Akha) people in China are identified as a branch of the Hani Minority Nationality. Currently, there are 130 households in Ban Po Zhai. Rice cultivation remains the major activity in the village but tea is also grown. Sugarcane is considered a modern crop that was introduced in Ban Po Zhai in 1995. Today it is widely cultivated in the village because of its high profit. Aini in Ban Po Zhai has more access to the forests and able to collect the non-timber forest products (NTFP) such as bamboo shoots, bamboo worms, and mushroom for own consumption and for the market.

**Photo 4:** Ban Po Zhai village (Source Author, 2013)

Some features of the traditional marriage as disappeared due to era of globalization in China. In the past, when the boys reached puberty age, they usually move to live in a small hut called “Flowers Room” next to their parents’ house. “Flower Room” was a place where the boy slept, alone or with a lover. It was centre of the sexual freedom for the young Aini enjoyed in the past. When the girl is pregnant, only the marriage ceremony will be allowed. The bride and groom have to live in the “Flower Room” during the first year of marriage. They are only allowed to move to live with the groom’s parent or move to new built house after one year. The tradition is no longer practised by the Aini in Manmo and BanPoZhai anymore.

Figure 3 illustrates how those aspects of IK common to the villages in Xishuangbanna are interlinked at the time of the study. The diagram shows no hierarchy in the level of importance in the classifications used. It was derived is important from listing the activities that take place in each of the villages of study area, and linked these activities to the classification.
5.2. Rubber and its impacts

About 70% of the villagers in Naban, ZhongZhiChang, BanQianDi & Manmo have given up rice cultivation and have converted almost all of their agricultural lands to rubber plantations. Moreover, the success of rubber production on state-owned farms has encouraged this trend. As a result, farmers are able to purchase tractors to cultivate their fields and no longer use the traditional way of cultivation, buffaloes are sold to non-rubber villages. Grazing lands for cattle had reduced and converted into rubber plantations.

They have become dependent on the market for their food supply. According to interviews with rubber farmers (Farmers 3 & 4) the income from their own rubber production, and work on others’ plantations, has enabled even poor households to buy rice and any other goods from the market. Other Manmo villagers said in discussions:

“Rubber cultivation is not as labour intensive as the paddy rice I have cultivated before. I can use more of the money I receive from selling of latex to buy rice and other products from the market”.

We also interviewed young and old women rubber farmers, about their work in rubber plantations and they responded as follow:

“Rubber plantation in our village also liberated us from many heavy traditional duties such as fetching water, collect and carrying firewood due to improved living standards”.

Living standards in rubber villages have been improved significantly through the increased income from their rubber production (Table 4). They are able to get better shelters, better transportations, and better communications with their income from rubber production. The farmer’s income obviously increases and daily life also changes. During the free time, the villagers usually gamble and drink.

Table 4: Comparison of livelihoods between rubber and non-rubber villages
<table>
<thead>
<tr>
<th>Types of villages</th>
<th>Rubber villages (Naban, ZhongZhiChang, BanQianDi &amp; Manmo)</th>
<th>Non-rubber villages (XiaoNouYouShangZhai &amp; BanPoZhai)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural products</td>
<td>Rubber</td>
<td>Rice, maize, pineapple, bananas, tea, watermelon, vegetables, and so on</td>
</tr>
<tr>
<td>Labor need</td>
<td>Labor intensive during the taping season (April-October), hired workers</td>
<td>Self-hired labor</td>
</tr>
<tr>
<td>Source of main income</td>
<td>Rubber latex</td>
<td>Agricultural products, Handicrafts, wild food and medicinal plants, bamboo, odd jobs</td>
</tr>
<tr>
<td>House</td>
<td>Big and concrete house</td>
<td>Traditionally architecturally design; houses build from bamboo and wood on stilts</td>
</tr>
<tr>
<td>Consumables</td>
<td>cars, small lorries, motorbikes, cable TV, laptop, mobile phones, washing machine, laptop, telephone line and other electronic products, sofa</td>
<td>Few vehicles, few villagers own mobile phone, some houses without electronic products, wooden stools and tables</td>
</tr>
<tr>
<td>Ploughing powers</td>
<td>Tractors</td>
<td>buffalo</td>
</tr>
<tr>
<td>Character of livelihood</td>
<td>Self-sufficiency</td>
<td>Market-oriented</td>
</tr>
<tr>
<td>Celebration</td>
<td>normal</td>
<td>Large scale</td>
</tr>
</tbody>
</table>

Source: Author’s field notes, 2013

Local people from XiaoNouYouShangZhai and BanPoZhai still use high variety of wild food and medicinal plants in their daily life as compared to the local people in Naban, ZhongZhiChang, BanQianDi and Manmo. This showed that in rubber villages, their traditional knowledge of wild food and medicinal plants use has lost their importance in their daily life because they are earning more income from their rubber plantation and the villagers especially the younger generation prefer to buy the vegetables from market. Conversion of communal forests into rubber plantation in ZhongZhiChang, BanQianDi, Naban and Manmo had caused reduction in the availability of Wild food plants (WFP) which also one of the reason the villagers forsake the WFP collection. Local people in rubber villages tend to be more interested in changing and improving their livelihoods towards a more modern lifestyle. Another factor is the village relocation of ZhongZhiChang also caused disappearance of indigenous knowledge in their village. It reveals that the relocation occur in the under-financed and not well-planned situation. Although, villagers in BanPoZhai and XiaoNouYouShangZhai still practiced WFP collection but they would have chosen to grow rubber if they could but due their village's location (altitude above 1000 m above sea level), rubber is not suitable to grow in their village. The deterioration of knowledge is affected by the deforestation, land use changes, introduction of cash crops in the region, economic development and the attitude of the young generation who prefer to choose modern medicine and consume produced food and other goods as they are more appealing and attractive to them.
5.3 IK in rubber agroforestry

For instance, in 2011, BanQianDi village participated in an indigenous cropping and research project introduced by NNNR in collaboration with Xishuangbanna Tropical Botanical Garden (XTBG) and the China Academy of Sciences. About 60 mu (4 ha) in BanQianDi has been set aside for intercropping rubber with medicinal herbs such as *Flemingiaphilippinensis* (*Qianjinba* 千斤拔), *Cortex cinnamoni* (*Rougu*: 肉桂), and *Rauvolfiaverticillata* (*Luofumu*: 萝芙木). The aim is to diversify rubber monoculture by creating new kinds of agroforestry systems that have potential to improve productivity and economic profitability and restore some degree of biodiversity. There is a compensation of 40 RMB/mu/year for farmers whose lands are selected for the project. Based on the research carried out by XTBG and China Academy of Sciences shows that *QianJinBa* is able to maintain soil moisture and improves soil nutrients in the rubber plantations. It extends the lifespan of the rubber trees to 32 years, compared to the normal lifespan of 24 years for rubber trees without intercropping with *QianJinBa*. Associate Prof. Tang Jianwei from XTBG conducted the project “Test and demonstration of stereo-agriculture ecosystems in tropical montane areas” since 2004 to study the diversified rubber agroforestry systems. The rubber trees that are intercropped with *QianJinBa* matured 1-2 years earlier, and could be tapped at the 6th year instead of the normal 8th year. The leaves from *QianJinBa* also can be used as fodder and for human consumption.

5. Discussion

Approximately two-thirds of 50,000 medicinal plants in use are still harvested from the natural habitat and about one fifth of them are now endangered. (Edwards 2004). According to WHO (2008), it is estimated that more than 80% of the population of the world especially in developing countries depends primarily on herbal medicine for their basic healthcare needs (Vines, 2004). WHO (2008) stated that medicinal plants are plants that have medicinal properties or compounds that can be used for therapeutic function or those which synthesized metabolites to produce useful drugs and the global market for medicinal plants is estimated to reach US $ 115 billion by end of 2020 (Global Industry Analysis, 2015). Wild food plants (WFP) are defined as plant resources which are gathered or collected from uncultivated and unmanaged natural resources for human consumption (Heywood 2011).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>English name</th>
<th>Local chinese name</th>
<th>Non-Rubber village</th>
<th>Rubber village</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Celosia argentea</em></td>
<td>plumed cockscomb or silver cock’s comb</td>
<td>青葙</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><em>Crassocephalum crepidioides</em></td>
<td>ebolo, thickhead, redflower ragleaf, or fireweed,</td>
<td>野葛蒿/老胖草/九柳光</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><em>Diospyros kaki</em></td>
<td>Japanese persimmon, Chinese persimmon, Kaki,Kaki persimmon, and Oriental persimmon</td>
<td>柿</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><em>Eryngium foetidum</em></td>
<td>Culantro, Mexican coriander and long</td>
<td>刺芹</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
The Lahu and Dai people prefer to use medicinal herbs to treat their disease instead of using the western medicine. When medical insurance is introduced in 2008 by China government, more villagers will go out to seek treatment than going to mountain to collect the medicinal herbs.

Han ethnic minorities living in ZhongZhiChang and XiaoNouYouShangZhai passed the knowledge of wild food and medicinal plants from one generation to generation orally. In the past, the children started to follow their parents to mountain or forests at age of 6 years old to learn and identify the edible and non-edible wild food and medicinal plants. But in recent years, the tradition was no longer practiced by the younger generation as they prefer to choose modern medicine and consume produced food and other goods as they are more appealing and attractive to them, especially in the Han ethnic in ZhongZhiChang. Under the influence from the local and national goal of economic growth, the landscape in Xishuangbanna has rapidly converted from high diverse forests and complex agriculture into monoculture of tea and rubber.
cultivation (Sturgeon 2012). Currently, Xishuangbanna is the second largest rubber producer in China next to Hainan Island (TANG et al. 2009; p.6). Introduction of modern agriculture systems especially monoculture rubber has reduced the genetic variability and availability of the wild food and medicinal plants.

Grenier (1998, p. 8) highlights the following advantages of IK in development processes:

- Mutual respect, local participation and partnerships for joint problem resolution can be created with indigenous knowledge
- Facilitates the identification of suitable practices for investigation, adaptation and improvement
- Helps in the designation and implementation of appropriate cultural development
- Helps in the development of sustainable futures.

The indigenous knowledge among Aini ethnic minority are transferred orally from one generation to another, starting from their ancestor through process of socialization and it usually disseminate internally among the communities as part of their lifestyle and daily activities. However, the indigenous knowledge are barely documented or written down in texts or manuscripts their descendants or outsiders. According to Warren (1996), indigenous knowledge is by its very nature gender sensitive. Gender differentiation or gender specialization comes about as a result of the particular experiences, knowledge and skills which women and men develop as they carry out the productive and reproductive duties allotted to them (Feldstein & Poats, 1989). For example, in Aini ethnic minority, the women have much more knowledge on weaving and livestock management than men, whereas the men have much more knowledge about soil classification measures than women.

According to Aluma (2004, p.25), traditional agriculture in developing countries receive little attention in the agriculture research activities. For example, local people in rubber villages neglected the importance of food crops that are vital for food security such as rice, pumpkin and corn. Rice is important food staple for the local people. Aini minority groups had traditionally cultivated rice before 1980s. When rubber is introduced in Manmo in 1984 following the government policy, they intercropped rice on swidden agriculture land. However, intercropping rubber trees in their paddy field had caused significant decrease in their rice harvest. Since then, a lot of the villagers give up their rice cultivation and mainly focused on rubber plantation and converted almost all of their agriculture to rubber plantation. Besides that, successful rubber production in state farm also leads the villagers to plants rubber in their land.

If this precious indigenous knowledge is not protected, it will be overwhelmed and lost forever and we lost the chance to the unique practices in the field of sustainable agriculture and natural environment. The loss of indigenous knowledge will be fatal as it means losing the highly valuable information on conservation of natural resources, linguistic ecologies, values of forests and sustainable ecosystems built on mutually-reinforcing cultures and ecosystems.

6. Conclusion
The transformation brought by the rubber plantation into the environment could be restored, but the loss of the indigenous knowledge among ethnic communities such as forest stewardship is not able to restore without preservation methods taken by local government. It is vital to establish new systems that can links and incorporate indigenous knowledge and modern knowledge with technology towards sustainable resources development in the region. Without any active involvement and co-operation from government and respective parties, indigenous knowledge could not be preserved. IK can play a significant role in terms of economic benefits to the local people as the wild vegetables and medicinal plants. Therefore, there is a need to identify and recognise the importance of IK and preserve and disseminate the IK skills and practices toward sustainable agriculture practises.
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References


