

# **Development of Rubber Plantation in Upper Basin of Mekong River**

— A case study in Xishuangbanna, China —

メコン河上流域におけるゴム園の展開過程

— 中国・西双版纳地方を対象として —

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Science on Agricultural Economy and Symbiotic Society

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# Abstract

Rubber is an industrial material, but it is initially an agricultural product. Rubber has long been regarded as the most important international strategic commodity. China is the biggest rubber consumer in the world, but its self-sufficiency rate is only about 20% nowadays, was lower than the international safe line. More than 70% rubber needs to be imported from other countries, which makes China very passive in the rubber industry and relative industry such as automotive manufacturing.

Rubber plantation in China mainly consists of state farms and smallholder farmers, which respectively belong to the agricultural reclamation system (state owned) and private rubber plantation (collective land ownership). Xishuangbanna Prefecture is located in the upper basin of the Mekong River and had long been poor and desperate for development. It is also the highest quality and the second biggest area rubber production base in China. The rubber plantation had brought new wealth to the local people and affected the agricultural economy and other aspects of Xishuangbanna, which will further affect the whole GMS area. Nowadays, this area is attracting more and more attention of researchers all over the world.

Since the beginning of the 21th century, compared with the control of the increase by the state farm, rubber plantation area by smallholder farmers rapidly expanded. When people, even the local government are cheering for the significant benefits brought by the rubber plantations, only a few people worry about the long-term interests of local farmers and the development of entire rubber industry. On the other hand, by the end of 2009, Xishuangbanna State Farms began the new round of reform, and achieved initial results in territorial management, contracted to households and so on. However, although the managers of state farms and government are reluctant to admit, this reform has caused many adverse effects on the rubber plantations of state farms.

This study attempts to review the history of rubber plantation in Xishuangbanna and to investigate the current situation of rubber plantation by smallholder farmers and state farms. We carried on twice field survey in 2012 and in 2014, collecting the firsthand data of rubber plantation in Xishuangbanna, especially the data about state farm contractors, of which little information was available after the reform. This study tries to identify the rubber productivity and profitability of smallholder farmers; to judge the impact of reform to the rubber plantation of Xishuangbanna State Farms; to reveal the underdevelopment of the rubber industry in Xishuangbanna from the view of world system theory.

The main outcomes of this study are as follows. First, the income of rubber is high compared with other traditional crops in the same area of land. The rubber industry has also attracted a number of external capitals, which pulled the rapid increase of the local economy

and improved the whole living conditions of local residents.

Second, the per capita area of rubber plantation is generally small and cannot be expanded any more. The economies of scale of the big-scale rubber plantation do not work for both smallholder farmers and state farm contractors.

Third, the results show that the cropping system in Xishuangbanna has become more simplified and the planters are highly dependent on a rubber plantation, the income risk both of smallholder farmers and state farm contractors is high, especially when the rubber price fluctuates wildly and natural disaster comes. And the monoculture is also a double threat of agro-biodiversity and food security.

Fourth, rubber is a long-term cash crop, scientific cultivation technologies and high productivities severely affect the output and longevity of the rubber tree. However, the productivity of smallholder farmers has always been low for the reasons of education level, etc. Even worse, affected by the reform, the productivities of contractors rapidly decreased and irreparable damage occurred to the rubber plantation of state farms.

Fifth, in addition to the destruction on high-quality rubber plantation, the reform brought other adverse impact to the state farms. The difficulty of charging the contracting fee may cause the financial deficit.

The results of this study showed the weak status of the rubber planters and the whole rubber industry in Xishuangbanna behind the seemingly prosperous growth of the rubber plantations. The theory of the world system and the periphery theoretically can explain the current situation of rubber plantation in Xishuangbanna, and the unequal role in the world rubber industry. The economic growth pattern of Xishuangbanna, which focusing on the raw material production, will make the situation of underdevelopment in this periphery area worse in the future.

Therefore, to enhance productivity based on the existing scale of rubber plantation is considered to be a feasible way, and there is still a great space of rise to improve the cultivation technology. The government should improve the land policy to encourage the merger of small-scale and low-yielding rubber plantations for large-scale cultivation by professional person or organizations. Also the government needs to strengthen legislation to protect the long-term management rights of rubber plantation. In addition, for the planters, the government should increase investment in education and training for rubber cultivation, etc. Furthermore, to improve the unequal situation in the world system, Xishuangbanna should develop the other productive sectors of the rubber industry chain, such as the deep processing, the high-level of rubber products and even the automotive industry. It also can supply more employment opportunities and absorb the labor surplus from the merged rubber plantation. Through above approach, the rubber plantations can become advantageous resources to bring real development to the Xishuangbanna area.

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Jun Lai  
2015.9



# Chapter 1. Introduction

The Mekong is a trans-boundary river in Southeast Asia. It is the world's 12th-longest river and the 7th-longest in Asia. Its estimated length is 4,350 km, [S. Liu, et al. 2009] and it drains an area of 795,000 km<sup>2</sup>, discharging 457 km<sup>3</sup> of water annually [Mekong River Commission, 2010]. From the Tibetan Plateau this river runs through China's Yunnan province, Myanmar, Laos, Thailand, Cambodia and Vietnam. The extreme seasonal variations in flow and the presence of rapids and waterfalls in this river have made navigation difficult. The river is a major trading route linking China's southwestern province of Yunnan to Laos, Myanmar and Thailand to the south, an important trade route between western China and Southeast Asia.

The Mekong Basin can be divided into two parts: the "Upper Mekong Basin" in China, and the "Lower Mekong Basin" from the China border to the South China Sea, including the Mekong Delta [Mekong River Commission, 2005]. The most precipitous drop in the Mekong occurs in Upper Mekong Basin, a stretch of some 2,200 km. Here, it drops 4,500 meters before it enters the Lower Basin, where the borders of Thailand, Laos, China and Burma (Myanmar) come together in the Golden Triangle. Downstream from the Golden Triangle, the river flows for a further 2,600 km through Laos, Thailand and Cambodia before entering the South China Sea via a complex delta system in Vietnam [Mekong River Commission, 2005].

The Upper Basin makes up 24% of the total area and contributes 15 to 20% of the water that flows into the Mekong River. The catchment here is steep and narrow. Soil erosion has been a major problem and approximately 50% of the sediment in the river comes from the Upper Basin. In Yunnan province in China, the river and its tributaries are confined by narrow, deep gorges. In the south of Yunnan, in Xishuangbanna Prefectures, the river changes as the valley opens out, the floodplain becomes wider, and the river becomes wider and slower [Mekong River Commission, 2005].

Rubber is an industrial material, but it is initially an agricultural product. Rubber has long

been regarded as the most important international strategic commodity. China is the biggest rubber consumer in the world, but its self-sufficiency rate is only about 20% nowadays.

The rubber tree (*Hevea brasiliensis*) can only grow in areas with similar conditions in the Amazon rain forests, which effectively restricts production to regions between the latitude of N15° to S15° around the equator. Xishuangbanna Dai Autonomous Prefecture was considered by western scholars as the impossible area for rubber production because its latitude is about N 21°. However, the Mekong River makes it possible for rubber production by affecting the micro-climate of this area. The experiments of Chinese scientists enabled the successful production of rubber tree in Xishuangbanna area, which were called as a “miracle” of science.

In addition to being home to several ethnic minorities, Xishuangbanna is best known for Pu'er tea and wild elephants. Recently, however, Xishuangbanna has taken on a new identity: the land of rubber. According to a recent report, the area of rubber plantation in Xishuangbanna nearly tripled between 2002 and 2010 to account for more than a fifth of the area's total land [Horton, C. 2013]. And in those years, the rubber's positive impact on local livelihoods, especially among ethnic minorities: Traditional wooden homes have given way to modern concrete and rebar edifices and cars have replaced motorcycles.

Xishuangbanna covers only 0.2% of China's land area, yet it contains 16% of the country's vascular plant species and is home to more than one fifth of its mammals and well over a third of its bird [Horton, C. 2013]. Rubber remains a controversial crop for most scientists and policy makers. Experiences in Xishuangbanna clearly showed that rubber production is an effective proposition in moving households and communities out of poverty. Jianchu, X. et al. explored the political ideology and the ecological economy of rubber based on almost 20 years working in Xishuangbanna, argued that the establishment of rubber plantations is a good attempt by the state to forcibly develop a modern economic industry [Jianchu, X. 2006]. However, rubber is also considered environmentally destructive. Some researchers were concerned about the effects of rubber on rice production and varieties diversity. Based on twice surveys from 1989 to 1990, Saint-Pierre indicated that farming systems of Xishuangbanna were facing problems related to shifting cultivation and to a rapid development of rubber which induce a negative evolution of Agroforestry systems [Saint-Pierre, C. 1991]. Monoculture rubber plantations encounter many problems, e.g. pests,

diseases and erosion, pollution from chemical fertilizers and biodiversity loss [Horton, C. 2013]. Fu, Chen et al. did a lot of surveys in 3 villages from 1985 to 2005, contrasted with the significant erosion of rice-based agroecosystem of local households, called for increased attention to the livelihood vulnerability of households suffered from excessive rubber plantations [Fu, Y., et al. 2010].

## 1.1 General key definitions

**Rubber plantation:** A rubber plantation is a piece of land usually in a tropical or semitropical area where rubber trees (*Hevea brasiliensis*) are specifically planted for widespread commercial sale and usually tended by resident laborers. Rubber plantation is considered as the high productivity and the low biodiversity by natural scientists, although some other crops could be interplanted in the immature rubber plantations.

**Upper basin of Mekong River:** From the Tibetan Plateau to the south of Xishuangbanna Prefecture, Yunnan province, the borders of Laos, China and Myanmar come together in the Golden Triangle.

**Smallholder farmer:** Definitions often go by the size of operating land. Smallholder farmers produce relatively small volumes of produce on relatively small area of land; depend on family labors, but may hire other farmers; are often vulnerable in market and natural disaster. [The Ethical Trading Initiative ETI smallholder guidelines, 2005]

**State farm:** In this study, the state farm means the China State Farm (Group) Corporation, which is a large central enterprise with many levels of branches in major cities and numerous state owned farms mainly in the border area of China such as Yunnan, Guangxi, etc.

**State farm contractors:** Contractors of state farms are individuals who contracted as a family unit with state farms and worked in the rubber plantation of state farms. For example, 3 people from 1 family (household) together contract with state farm, there are 3 contractors using 1 contract. This contracting way is similar to the rural household contracting pattern.

## **1.2 Statement of the problem**

Rubber plantation in China mainly consists of state farms and smallholder farmers, which respectively belong to the agricultural reclamation system (state owned) and private rubber plantation (collective land ownership). After the cultivation for more than a half century, by the advanced level of rubber cultivation in the world, Xishuangbanna became highest quality and the second biggest area (Hainan is the biggest.) rubber production base in China.

Previous studies concentrated on the aspects of natural science, or the impacts of rubber plantation to the local minorities' culture and ecology. Such as the technologies and sciences that how to increase the yield and the life of rubber trees, the rubber tree diseases defense, the interplant with other crop or fruits in the immature rubber plantations, etc. Some articles mentioned the effects of rubber plantation on the local smallholder farmers. However, the discussion was simply limited to the fact that the rubber plantation improved the farmers' income and the concerns of food security. For the rubber plantation of state farms, most of the studies were in Chinese language, preferred to concentrate on the high level of rubber cultivation and the great achievements on rubber production of state farms.

Since the beginning of the 21th century, compared with the control of the increase by the state farm, rubber plantation area by smallholder farmers rapidly expanded. When people, even the local government are cheering for the significant benefits brought by the rubber plantations, only a few people worry about the long-term interests of local farmers and the development of entire rubber industry.

On the other hand, by the end of 2009, Xishuangbanna State Farms and other branches of the Yunnan State Farms Group began the new round of reform. The reform achieved initial results in territorial management, contracted to households and so on. However, there were also many problems appeared in the process of the reform. Although the managers of state farms and government are reluctant to admit, this reform has caused many adverse effects on the rubber plantations of state farms. Formal studies about the impact of reforms on rubber plantations are very few, most related information are mainly from the internal meeting reports and government departments' notifications, and the contents are more focused on the results achieved in the reform and contracting fees charged issues.

### **1.3 Objective and significance of the study**

The objectives of this study are as follows: To overview the general situation of rubber industry in the World, in GMS countries and in China; To review the history of rubber plantation in Xishuangbanna; To collect the firsthand data of rubber plantation in Xishuangbanna, especially the data about state farm contractors, of which little information was available after the reform; To investigate the current situation of rubber plantation by smallholder farmers and state farms; To know how exactly and to what extent rubber plantations affect the livelihood of smallholder farmers and state farm contractors; To identify the rubber productivity and profitability of smallholder farmers; To judge the impact of reform to the rubber plantation of Xishuangbanna State Farms. To reveal the underdevelopment of the rubber industry in Xishuangbanna from the view of world system theory.

As the systematic research on the rubber plantation in the upper basin of the Mekong River from the view of agricultural economy, this research could be a good stepping-ground for other studies on rubber industry in GMS countries and tropical rural development. Empirical information to be generated by this research would be of paramount importance. It could also be used by relative ministries in China and other Asian research institutions, who are also targeting rubber plantation in this area. The dearth of data and analysis available on village level in Xishuangbanna and on individual contractors of state farms, especially after the reform in 2010, posed acute challenges to the policy makers and to all researchers like us. In addition to contributing more broadly to the rubber plantation literature in social science, we also believe that this analysis fills a critical gap in the knowledge base for political leaders, lawmakers, and all kinds of research organizations interested in creating programs in this area.

#### **1.4 Structure of the thesis**

This thesis consists of six chapters. The first chapter presents the general introduction, general key definitions, statement of the problem, objective and significance of the study. Chapter 2 is the research background. It is the basic knowledge of rubber, natural rubber industry in the world and in the GMS countries, as well as the theoretical context of this research. Chapter 3 reviews the development history of rubber plantation in Xishuangbanna, including the development of smallholder farmers' rubber plantation and the state farms' rubber plantation. Chapter 4 assesses the current situation of rubber plantation by smallholder farmers based on twice field surveys in the Manjinghan Village, Xishuangbanna Prefecture in 2012 and in 2014. This chapter reveals the rubber productivity and profitability of smallholder farmers behind the rapid increase of gross income. Chapter 5 describes the reform status about rubber plantation in detail, analyzes the impact of reform to the rubber plantation of Xishuangbanna State Farms based on the field survey in Jinghong Farm and Dongfeng Farm in 2014. Finally, Chapter 6 briefly summarizes main findings and provides the conclusion and recommendations regarding the development and challenges of the research objectives in future.

## **Chapter 2. Research background**

### **2.1 Rubber**

Depending on the source, rubber is divided into natural rubber (NR) and synthetic rubber (SR). Natural rubber is extracted from rubber trees and going through processing of gelatine; Synthetic rubbers are made of various monomers after the polymerization. Around 25 million tons of rubber is produced each year in the world, of which 42 percent is natural rubber. The remainder is synthetic rubber derived from petrochemical sources. Around 70 percent of the world's natural rubber is used in tires.

#### **2.1.1 Natural rubber (NR)**

Natural rubber is an industrial material which has long been regarded as the most important international strategic commodity. Natural rubber, also called India rubber or caoutchouc, as initially produced, consists of polymers of the organic compound isoprene, with minor impurities of other organic compounds plus water. Forms of polyisoprene that are used as natural rubbers are classified as elastomers. Currently, rubber is harvested mainly in the form of the latex from certain trees. The latex is a sticky, milky colloid drawn off by making incisions into the bark and collecting the fluid in vessels in a process called "tapping". The latex then is refined into rubber ready for commercial processing. Natural rubber is used extensively in many applications and products, either alone or in combination with other materials. In most of its useful forms, it has a large stretch ratio and high resilience, and is extremely waterproof.

##### **A) Cultivation**

Rubber cultivation is highly restricted by natural conditions. The most suitable climate is hot, humid, windless and a temperature of 18-28 Degree Celsius. The soil requirement of the plant is generally well-drained, weathered soil consisting of laterite, lateritic types,

sedimentary types, non-lateritic red or alluvial soils. The planting density is about 450 rubber trees per hectare with a growing period 6-8 years. A mature rubber tree can produce latex for more than 25 years. Other crops can be interplanted only during the immature stage. Latex production is mainly from Apr to Oct.

#### B) Collection

Unlike most crops, rubber yield not only relies on variety and maintenance, but also good tapping skills.

Tapping normally takes place before dawn and early in the morning, when the internal pressure of the tree is highest. Tapping system, for example:  $s/2\ d/2$ , means one cut every two days, each time cutting with a half spiral secant. Many variations of tapping system are used such as  $s/2\ d/3$ ,  $s/2\ d/4$  and so on. A good tapper can tap a tree every 20 seconds on a standard half-spiral system, and a common daily "task" size is between 450 and 650 trees.

The latex, which contains 25–40% dry rubber, is in the bark, so the tapper must avoid cutting right through to the wood, else the growing cambial layer will be damaged and the renewing bark will be badly deformed, making later tapping difficult. It is usual to tap a panel at least twice, sometimes three times, during the tree's life. The economic life of the tree depends on how well the tapping is carried out, as the critical factor is bark consumption.

Progress in tapping technique research has greatly contributed to high-yield of rubber. Such progress includes changing the tapping system from  $s/2\ d/2$  to  $s/2\ d/4$ , pasting stimulus and using rain hat to protect the cut wound and reduce impurities in the latex.

The trees will drip latex for about four hours, stopping as latex coagulates naturally on the tapping cut, thus blocking the latex tubes in the bark. Tappers usually rest and have a meal after finishing their tapping work, then start collecting the liquid "field latex" at about midday. The latex has to be collected before natural coagulation.

#### C) Coagulation

The collected latex is transferred into tanks for the preparation of dry rubber or transferred into airtight containers with sieving for ammoniation. Ammoniation is necessary



to preserve the latex in a colloidal state for longer periods of time. Latex is generally processed into either latex concentrate or it can be coagulated.

Natural coagulated rubber is used in the manufacture of low grade rubbers. The processing of the rubber for these grades is a size reduction and a simple cleaning process to remove contamination and prepare the material for the final stage of drying.

Latex coagulated under controlled, clean conditions using formic acid, can then be processed into the higher-grade, technically specified block rubbers.

#### D) Processing and uses

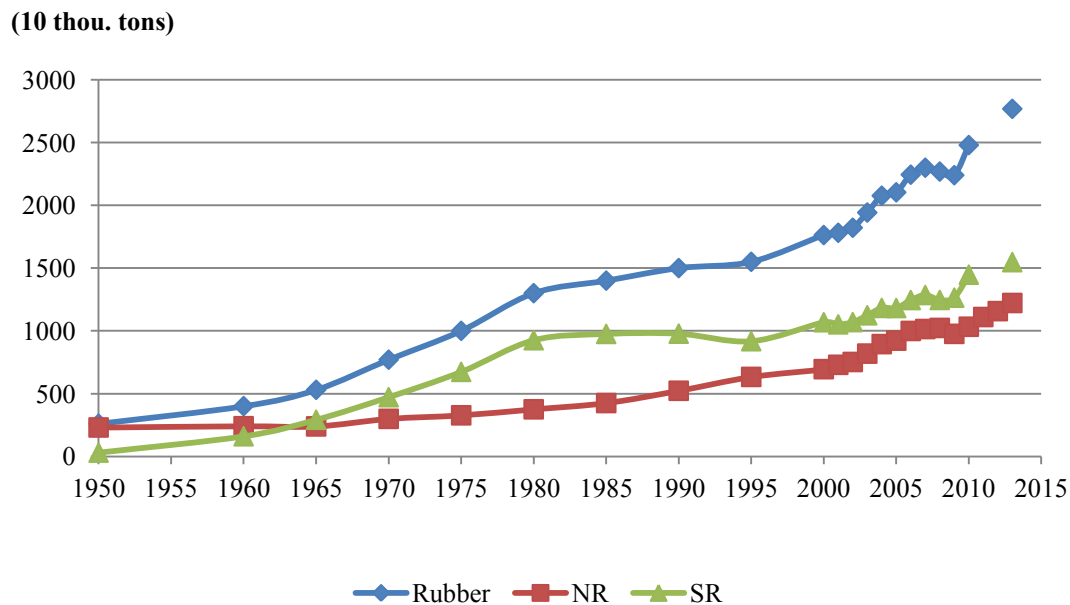
Most natural rubber produced conforms to the TSR (Technically Specified Rubber) scheme developed over the last 40 years or so. Individual rubber producing countries are in charge of setting the acceptable limits for each grade of rubber they produce. The four main countries producing rubber have their own schemes patterned after the TSR scheme: SIR: Standard Indonesian Rubber; SMR: Standard Malaysian Rubber; STR: Standard Thai Rubber; SVR: Standard Vietnamese Rubber and so on.

The top end of latex production results in rubber products such as surgeons' gloves, condoms, balloons and other relatively high-value products. The mid-range, which comes from the technically-specified natural rubber materials ends up largely in tires, but also in conveyor belts, marine products, windshield wipers and miscellaneous rubber goods.

Natural rubber offers good elasticity, while synthetic materials tend to offer better resistance to environmental factors such as oils, temperature, chemicals or ultraviolet light and suchlike.

#### **2.1.2 Synthetic rubber (SR)**

Synthetic rubber, invariably a polymer, is any type of artificial elastomer mainly synthesized from petroleum byproducts. An elastomer is a material with the mechanical (or material) property that can undergo much more elastic deformation under stress than most materials and still return to its previous size without permanent deformation. Global revenues generated with synthetic rubbers are likely to rise to approximately US\$56 billion in 2020. Synthetic rubber, like natural rubber, has uses in the automotive industry for tires,



**Figure 1 1950~2013 Rubber production in the world**  
**(Data source: rubber statistical bulletin, IRSG and FAO statistic)**

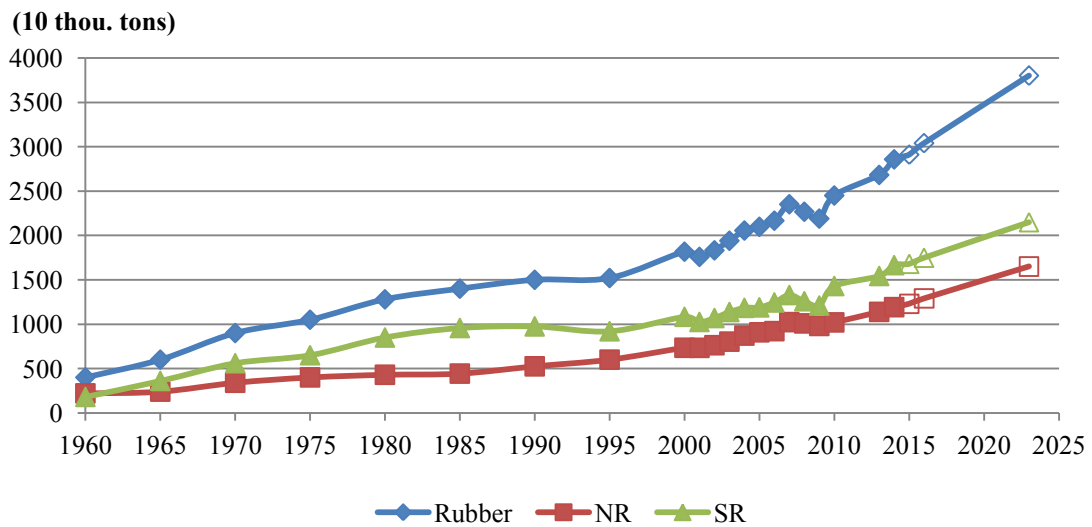
door and window profiles, hoses, belts, matting, flooring and anti-vibration mounts.

Synthetic rubber has the following advantages over natural rubber:

- Being more resistant to oil, certain chemicals and oxygen
- Better aging (lasting longer) and weathering
- Resilience over a wider temperature range

However, even the synthetic rubber has taken more and more part in the world rubber consumption, at the current stage, the natural rubber still has the following irreplaceable advantages over the synthetic rubber:

- Less heat buildup from flexing
- Greater resistance to tearing when hot
- Better dynamic performance
- Low level of damping



**Figure 2 1960~2013 Rubber consumption in the world and demand forecast**  
**(Data source: rubber statistical bulletin, IRSG and FAO statistic)**

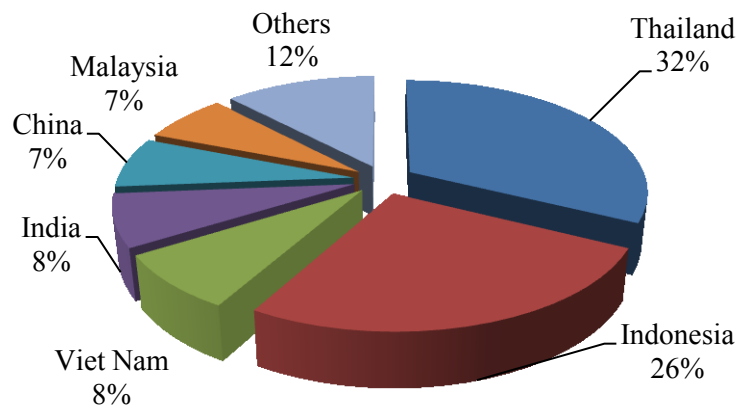
\*The data showed with hollow icon (2015-2023) is the demand data forecasted by IRSG.

### A) Production

According to statistics from the International Rubber Study Group (IRSG) and FAO statistic, the 2013 World rubber production reached 27.69 million tons, in which synthetic rubber production was 15.47 million tons and natural rubber production was 12.22 million tons. 55.88% of world rubber production was synthetic rubber and 44.12% was natural rubber. Figure 1 shows the world's rubber production from 1950 to 2013, the trend of world rubber production, both the natural rubber and the synthetic rubber, have skyrocketed.

### B) Consumption

In 2013, rubber consumption in the world was 26.82 million tons, in which synthetic rubber consumption was 15.43 million tons and natural rubber consumption was 11.39 million tons. 57.55% of world rubber consumption was synthetic rubber and 42.45% was natural rubber. Figure 2 shows the trend of world rubber consumption from 1960 to 2013 increased rapidly. According to the IRSG, world total rubber demand is forecast to increase



**Figure 3 World Natural Rubber Production in 2013**  
(Data source: FAO statistical data in 2013)

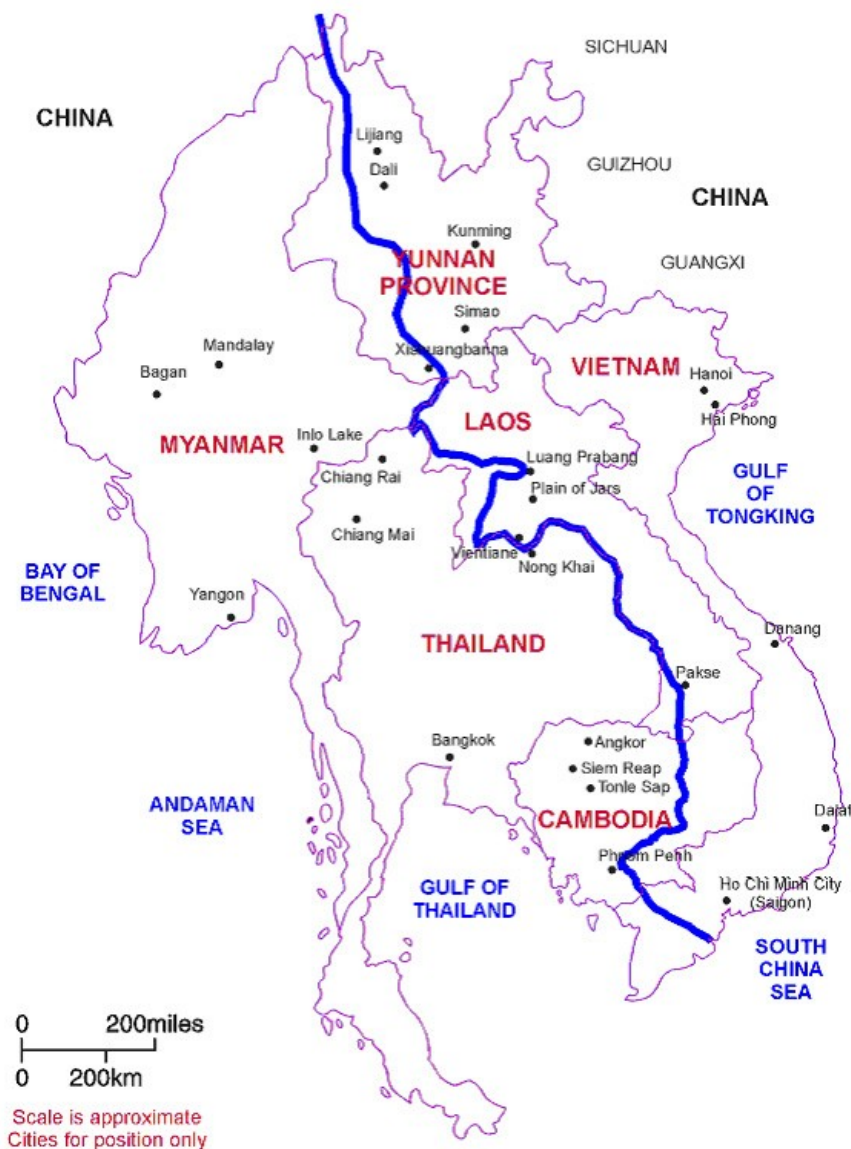
at 1.8% and 4.1% in 2015 and 2016 respectively.

World synthetic rubber demand is expected to increase to 16.8 million tons in 2015 and rise to 17.5 million tons in 2016. In 2023, the demand for synthetic rubber will be 21.5 million tons. World natural rubber demand is forecast to increase by 3.1% in 2015 and by 4.4% in 2016. The world total natural rubber consumption is expected to be 12.3 million tons in 2015, 12.9 million tons in 2016 and increasing to 16.5 million tons in 2023.

## **2.2 Natural rubber industry in GMS countries**

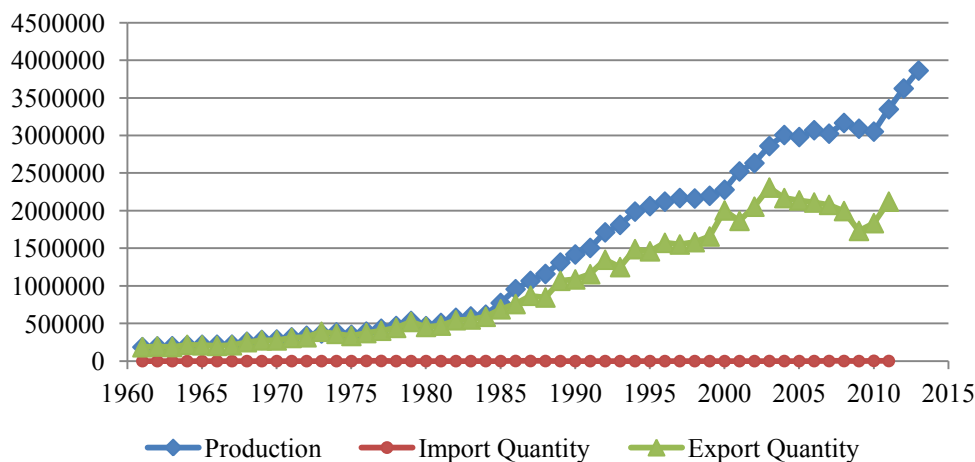
Food and Agriculture Organization (FAO) statistical data shows that in 2013 the world's top six countries for the production of natural rubber were Thailand, Indonesia, Vietnam, India, China and Malaysia. Three of them belong to the Greater Mekong Subregion (Figure3).

The Greater Mekong Subregion (GMS) is a natural economic area bound together by the Mekong River, covering 2.6 million square kilometers and a combined population of around 326 million. The GMS countries are Cambodia, the People's Republic of China (PRC, specifically Yunnan Province and Guangxi Zhuang Autonomous Region), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Vietnam (Figure 4).



**Figure 4 Locations of the GMS countries**

In 1992, with assistance from Asian Development Bank (ADB), the six countries entered into a program of subregional economic cooperation, designed to enhance economic relations among the countries. With support from ADB and other donors, the GMS Program helps the implementation of high priority subregional projects in transport, energy,



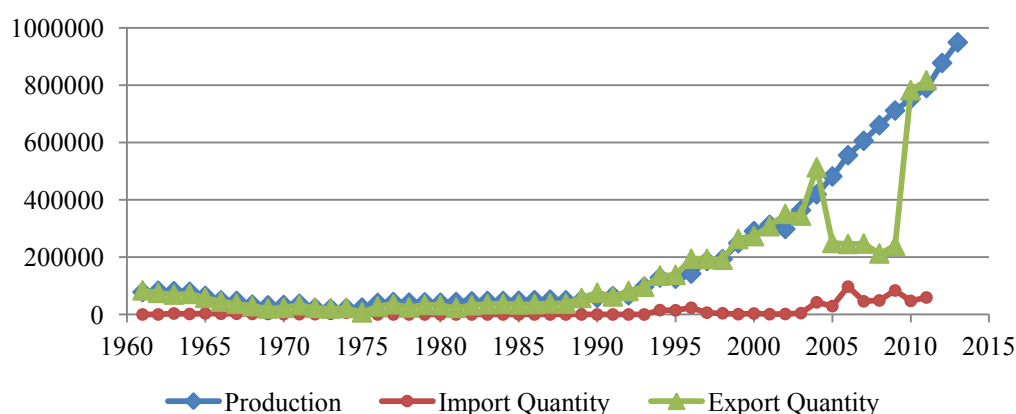
**Figure 5 1961~2013 Natural Rubber production, import and export in Thailand**  
(Data source: FAO statistic. Unit: tons)

telecommunications, environment, human resource development, tourism, trade, private sector investment, and agriculture. In 2011, the natural rubber production of three GMS countries was accounting for 44% of the total production in the world.

The rich human and natural resource endowments of the Mekong region have made it a new frontier of Asian economic growth. Indeed, the Mekong region has the potential to be one of the world's fastest growing areas.

### 2.2.1 Thailand

Natural rubber industry in Thailand is a major agricultural industry, rubber farmers are more than 6 million, accounting for about 10% of the population. Rubber as one of its top ten export products, exceeded rice in 1997 became the country's largest foreign currency earner. Currently the rubber planting area of Thailand is more than 2 million hectare, ranking second in the world after Indonesia. However, Thailand's natural rubber production had saturated, most of its rubber production is for export (Figure 5). Therefore, the Thailand government in its "1999~2003 national development strategies of natural rubber", decided to maintain the current level of the total area. The government also encouraged to plant alternative crops when updating rubber plantation, to increase the



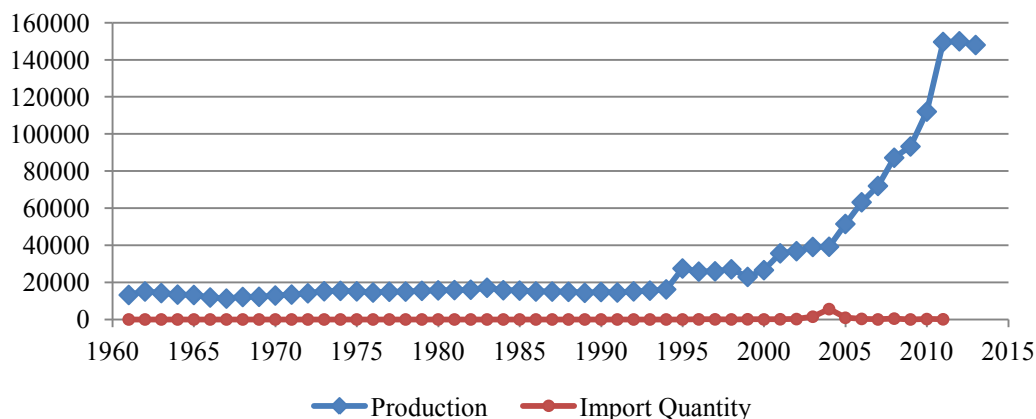
**Figure 6 1961~2013 Natural Rubber production, import and export in Vietnam**  
(Data source: FAO statistic. Unit: tons)

production of high quality rubber and domestic consumption of rubber.

Since the mid-1980s, domestic consumption of natural rubber in Thailand is growing rapidly. 1985 domestic consumption of natural rubber only 33,000 tons (less than 5% of its production), 2003 amounted to 282,000 tons, already accounting for 10% of its production, is the world's middle class. With MICHELIN, GOODYEAR, BRIDGESTONE and other international tire manufacturers have invested recently in Thailand, as well as in the south of Thailand Songkhla to build the world's largest rubber processing trade center, these initiatives will further boost domestic consumption of natural rubber in Thailand.

### 2.2.2 Vietnam

As early as 1897, rubber tree was introduced to Vietnam, but the rubber cultivation began in 1907, and reached to 132,600 hectare in 1939, the annual output was 65,200 tons. (Figure 6) But before the liberation of South Vietnam in 1974, rubber plantation area decreased to 83,800 hectare, while the actual harvest area was only 24,000 hectare, production was 20,800 tons, and mainly rubber plantation was operated by large foreign companies. After Vietnam's unification, the state took over all the rubber plantation. The rubber production was restored over 40,000 tons in 1977 [Youxing, L. 2005]. In the late 1980s, Vietnam actively implemented a comprehensive innovation, its natural rubber industry developed



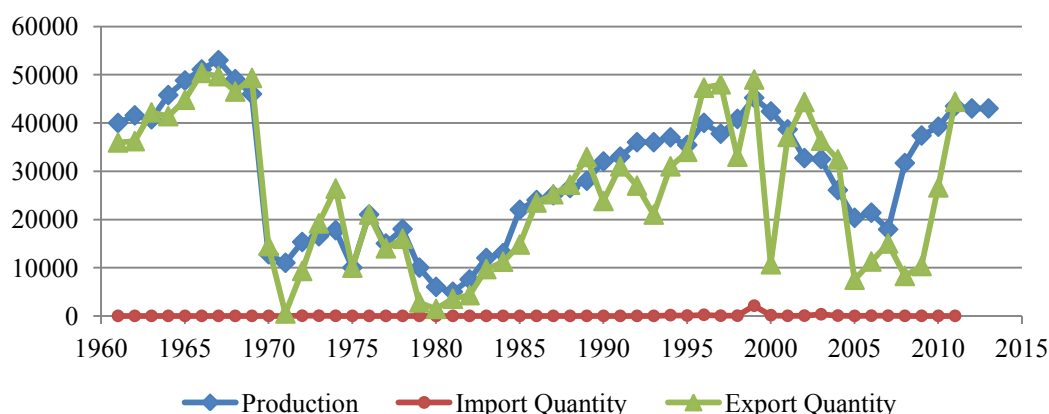
**Figure 7 1961~2013 Natural Rubber production and import in Myanmar**  
(Data source: FAO statistic. Unit: tons)

rapidly. Since the 1990s, Vietnam quickly expanded the area of rubber plantation. In 2013, Vietnam's natural rubber production from less than 100,000 tons in the early 1990s jumped to 949,100 tons, ranking the second largest rubber producing country in the world.

### 2.2.3 Myanmar

Before World War II, the Myanmar rubber plantation area was about 44,000 hectare, the annual output was about 14,000 tons [Youxing, L. 2005]. In 1955 and 1973, although the government has announced a rubber plantation would not be nationalized, but for various reasons the area and production of rubber plantation did not significantly increase. Since the 1990s, Myanmar has expanded rubber plantation not only in the traditional southern part, but also in the northern part of the country. Myanmar existing area of rubber plantation was about 186,000 hectare, more than 80% was private rubber plantation. Rubber production increased rapidly in recent years, whose annual production reached nearly 150,000 tons (Figure 7). According to the Myanmar Ministry of Agriculture and Irrigation, the area of suitable land for planting rubber is about 2.62 million hectare. The government plans to expand the rubber plantation area to 400,000 hectare, the annual production reaches 150,000 tons expected to 2020. At present, about a third of the rubber production in Myanmar was for domestic use, and the remaining two-thirds were for exports, mainly exported to China.





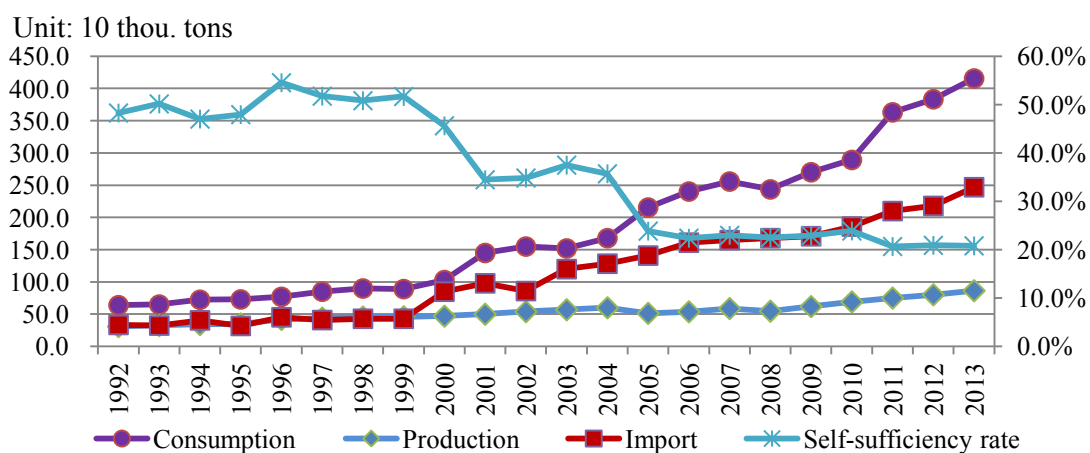
**Figure 8 1961~2013 Natural Rubber production, import and export in Cambodia**  
(Data source: FAO statistic. Unit: tons)

#### 2.2.4 Cambodia

Cambodia has about 70,000 hectare of rubber plantation, and 80% are state-owned rubber plantation. According to the FAO estimates Cambodia has about 330,000 hectare suitable land for rubber plantation, and the production potential is more than 600,000 tons. However, affected by perennial war, Cambodia's rubber production has been unstable. The production of rubber is less 50,000 tons (Figure 8). Due to the increasing demand for rubber, the Cambodian government takes various measures to encourage family rubber plantation. Rubber is Cambodia's largest agricultural export industry. As currently Cambodia has no deep processing, products can only be sold in the Asian market, and the price is lower than other countries.

#### 2.2.5 Laos

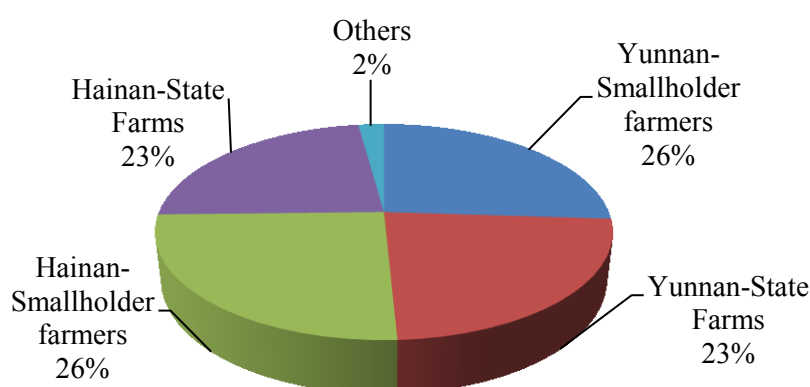
Laos has a weak industrial base and backward agricultural production. Laos currently only has a small amount of rubber plantation. The space of rubber development in Laos is very large, many foreign companies have set foot in the development of natural rubber. Many countries, especially Thailand, Vietnam and China, actively invest rubber plantation in Laos.



**Figure 9 Supply and demand of natural rubber in China in 1992-2013**  
(Data source: rubber statistical bulletin, IRSG and statistical yearbooks of China)

### 2.2.6 China

Since 2002, China becomes the biggest natural rubber consumer in the world. Although the consumption increased rapidly, the production of natural rubber increased slowly (Figure 9). It leads the self-sufficiency rate decreased from about 50% to 20%. The



**Figure 10 The production ratio of Chinese rubber plantation in 2013**  
(Data source: statistical yearbooks of China and some Provinces 2013)

self-sufficiency rate is the ratio of production accounting for the consumption, whose about 30% is the basically safe line in the international practice. After 2004, the self-sufficiency rate of China was lower than the safe line, more than 70% rubber needs to be imported from other countries, which makes China very passive in the rubber industry and relative industry such as automotive manufacturing.

According to the geographical distribution and the management right, in 2013, the largest rubber production of China is in Yunnan Province, 425,604 tons; Hainan Province is the Second, 420,816 tons; Guangdong, Guangxi, and Fujian Province are total 18,386 tons (Figure 10). Smallholder farmers and state farms are two main parts of Chinese rubber producers. In this thesis, these two parts will be shown in chapter 4 and Chapter 5 respectively, with case studies in Xishuangbanna Prefecture, which are the second largest and the best rubber producing base in China.

### **2.3 Theoretical context (theory of the World-system and the periphery)**

World-system theory is a macro-scale approach to world history and social change that stresses the world-system (and not nation states) should be the primary (but not exclusive) unit of social analysis. It was regarded as a sort of Neo-Marxist Theory. Immanuel Wallerstein has developed the best-known version of the world-system analysis by writing the books named “The Modern World-System”. Samir Amin, an Egyptian economist, is one of the leading theorists of World Systems by writing the book named “Accumulation on a World Scale: A critique of the Theory of Underdevelopment”.

According to the theory of the world system, like a class system with a nation, the countries in the world are classified to centre countries and periphery countries. The class positions in the world economy result in an unequal distribution of rewards or resources. Centre countries focus on high skill, capital-intensive production, and receive the greatest share of surplus production. Periphery countries focus on low skill, labor-intensive production and extraction of raw materials, and receive the least share of surplus production.

At present, according to Samir Amin, all societies form part of the so-called capitalist world system, which has expanded gradually over the last few centuries. As a consequence

of this development, not a single concrete socioeconomic formation of our time can be understood except as part of this world system [1974, p. 3].

Amin's theory of accumulation on a world scale starts from the idea that the centre and periphery play different, unequal roles in the capitalist world system. The centre is the dominant part of the world system and is therefore able to impose its will upon the countries of the periphery with respect to the relations of exchange. The exchange of commodities between the centre and the periphery turns out to be *unequal*, i.e., favourable for the centre and unfavourable for the periphery.

Analysis according to Amin, underdevelopment is not a lack of development. It is the reverse side of the development of the centre countries. The centre countries depend on the active exploitation of other countries, which renders the latter "underdeveloped". The ever-continuing tapping of resources from the periphery causes a situation of *underdevelopment*. In Amin's view, underdevelopment is first and foremost a situation of unbalance. Underdevelopment is not so much a *quantitative* as it is a *qualitative* characteristic [1991, p. 312].

As one of the most typical feature of underdevelopment, Amin mentions the "disarticulation", or lack of linkages, between different productive sectors, due to the periphery's orientation to the centre's needs. In Amin's view, the periphery is condemned to play the role of exporter of raw materials and agricultural produce. Because of this "unequal specialization" [1976, p.191], the periphery is extremely dependent upon the centre. This fact limits the transmission of economic benefits throughout the economy of the periphery.

The theory of the world system and the periphery theoretically explained the current situation of rubber plantation in Xishuangbanna, and the unequal role in the world rubber industry. Our field survey data also showed the poor and the weak status of the rubber farmers, both from small households and state farms, behind the seemingly prosperous growth of the rubber plantations. In a globalized world, only to research and analyze the rubber plantations of Xishuangbanna in the world system, we could truly understand its economic nature.

## **Chapter 3. Historical Review of Rubber plantation in Xishuangbanna**

Rubber was first introduced into Xishuangbanna in 1904, but rubber plantation was initiated in 1953 after a series of attempts, because Xishuangbanna was not a traditional rubber cultivation area. Yunnan Province achieved dry rubber production of 330,630 tons in 2010, of which 255,270 tons are from Xishuangbanna, accounting for 77% [Yunnan Statistical Yearbook 2010]. The rubber plantation in Xishuangbanna mainly consists of state farms (SF) and smallholder farmers (SH). Based on several significant historical transformations, the development of rubber plantation in Xishuangbanna can be divided into three different phases (Figure 11).

### **3.1 Motivation, establishment and setback**

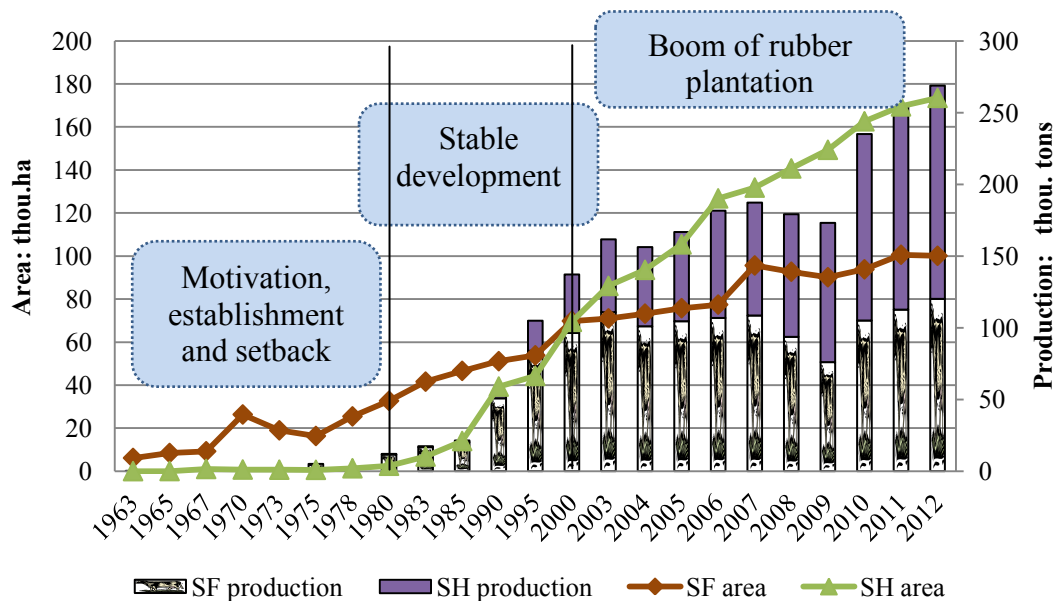
#### **3.1.1 1904~1950—First introduction**

Mr. Dao Anren (An ethnic minority headman) bought 8,000 rubber trees from Singapore to Yunnan Province, at Fenghuang Mountain, in today's Xincheng Township, Yingjiang County. This was the first plantation of the Amazonian rubber trees *Hevea brasiliensis* in China. (Only one exists now, which was protected by the State)

#### **3.1.2 1950~1955—Embargoes of rubber**

During the Korean War and a long period after it, the United States, NATO countries (North Atlantic Treaty Organization) and Japan, implemented a complete trade embargo that forbade the export of more than 400 product categories (including rubber) to China from any country. It was a direct result of China's decision to involve in the American-Korean war.

On the one hand, in order to break the US-led economic blockage and embargo policies,



**Figure 11 1963~2012 Rubber plantation area and production in Xishuangbanna**

Data source: Statistical Bureau of Xishuangbanna.

\*SF: State Farm;

\*\*SH: Smallholder farmer

the central government of China made a decision to expand rubber plantations at any possible places within its territories, for achieving rubber self-sufficiency to meet huge demand for national industrialization. On the other hand, the state needed to reclaim and defend the southern border area in the early days of new state (Most State Farms are in the border area). Together with Hainan, Xishuangbanna was selected as a production site for rubber.

However, it was considered by western scholars as the impossible area for rubber production. The experiments enabled the successful production of rubber tree in Xishuangbanna area, which were called as a “miracle” of science.

As such, all managers and workers in the state farms during this establishing period were either transferred soldiers or Han Chinese farmers from other parts of China, particularly from Hunan province, Chairman Mao’s hometown. Local ethnic minorities were excluded in these state rubber farms as they were regarded “backward” and no “quality”

for this kind of “advanced” work [Xu, 2006; Sturgeon, 2009].

### **3.1.3 1955 ~ 1977— Establishment and setback**

In 1955 the Bureau of Reclamation began to organize extensive land clearance using demobilized soldiers, often veterans of the Korean War, almost all of whom were Han Chinese [Yunnan Bureau of Reclamation 2003; Deng, 1993]. After a series of investigations and feasibility research, 14 state farms were established in Yunnan in 1956. 10 farms were established in Xishuangbanna in 1956 following a pilot planting of variety introduced from Myanmar and survey on suitable land and feasibility research pertaining to rubber planting [Lu Xing, 2010].

However, the state rubber farms could produce far less rubber than what the state needed and yet they could not expand the plantations endlessly due to lack of “advanced” Han labor as well as the fact that the majority lands were still occupied by ethnic minorities, who practiced swidden agriculture which was regarded “primitive”, “unproductive”, and “illegible” or “illegitimate”. From the state’s point of view, local natural resources were “wasted” and local people (particularly ethnic minorities) were not “cultured”, both which needed to be “utilized” and “mobilized” for the state building. For the state, the best way to solve these problems was to replace local swidden agriculture with rubber plantations and, in doing so, transform local ethnic minorities into rubber farmers. This would allow the state to kill two birds with one stone—to control over local resources and people, and to produce more rubber with little or no state cost. Therefore, the Ministry of Agricultural Reclamation ordered the state farms in Yunnan (and in Xishuangbanna) to help local governments develop rubber plantations for smallholder farmers. Consequently, the first collective rubber plantation was established in Jinglan village, near Jinghong City in 1964, and more collective rubber plantations were established in other places of Xishuangbanna and other tropical areas of Yunnan Province in the following a couple of years. About 29 hectare of rubber was planted by rural households in 1964 with state farm mobilization and support.

Rubber plantation was significantly adversely influenced by the political activity of the Cultural Revolution from 1966 to 1976 and twice serious frosts during the winter of 1973 and 1975. [Lu Xing, 2010] More than 7,000 hectare rubber land was lost, accounting for

26% of the total, and the lowest production was less than 2,000 tons per year [Yearbooks of Xishuangbanna]. In 1977, state farms had planted about 22,000 hectare rubber, in which 11,000 hectare rubber produced latex for more than 7,000 tons [Yearbooks of Xishuangbanna].

### **3.2 1980s~2000: Stable development**

#### **3.2.1 The “6+1” system and the first reform of the state farms**

Drawing on from the painful experience, the state farm carried out researching on anti-frost varieties and a system of high standard rubber cultivation. All these technical support had contributed to a stable expansion of the rubber in the whole Xishuangbanna.

6 estimated indicators (Time, production-about 70% belonged to the state farms, quality, cost, expense and surplus) were assignments for workers, and beyond this level, there would be a bonus which was the “plus one”. A series of strict scoring mechanism decided whether the workers completed the assignments, if it did not, their basic salary would have been deducted.

From 1989, the state farms started to replant new rubber trees. The second generation rubber plantations were the better varieties in cold resistance than the original varieties. From 1993, the state farms gradually changed the tapping system from s/2, d/2 to s/2, d/3(4) to save labor force and to extend the producing period of rubber tree to more than 35 years.

On the one hand, after more than 40 years development, there were a large number of surplus labors in Xishuangbanna state farms. More than 71,000 formal workers (retired workers were not involved) worked in Xishuangbanna state farms and the output value per capita was only about 12,600 yuan in 1996.

Affected by the Southeast Asian Financial Crisis, the rubber price plummeted from 13,000 yuan per ton in 1995 to 8,900 yuan per ton in 1997 and 7,300 yuan per ton in 1998. Large scale layoff of state farm started in 1997 because of first deficit since 1970. About 25,000 workers left the positions in state farms in 3 years, which became a hidden peril. The average compensation for the unemployed was about 10,000 yuan per capita in 1997 which was about 1.5 times of their annual salary. However, until 2000, the formal worker



population decreased to 46,000 and the output value per capita increased to 21,100 yuan.

On the other hand, the average annual salary in Xishuangbanna state farms was about 2,500 yuan in 1994, much lower than the average level in the whole prefecture which was about 4,000 yuan. Some workers were voluntary resignation in the reform from 1996 to 1997.

### **3.2.2 The Household Responsibility System for the smallholder farmers**

Between 1978 and 1983 the Chinese government implemented the Household Responsibility System, which dismantled the farming communes and introduced a new ideology of land use, turning farm households into entrepreneurs responsible for caring for their own needs. Agricultural lands, such as paddy, were contracted out to individual farmers while forests remained under state control. The rubber plantations of smallholder farmers were not developed until 1985 after agricultural lands were contracted out to rural households in 1982-1983 under a national policy called *Jiating Lianchan Chengbao Zherenzhi*, or Household Contract Responsibility System.

In 1983, Yunnan Province implemented a policy called *Liangshanyidi* (freehold and contracted forestland and swidden field) with the objective of stabilizing forestland and swidden field through land demarcation. The main goal of this policy was to shift forest management from the state to individuals. Under this policy, both freehold plots and collectively held forests were leased or contracted to individual households who were given long-term use rights [Xu et al, 2006].

During this period, technology and the fund supports from state farm were still given to the smallholder farmers. Regarded as an alternative to traditional swidden agriculture, these rubber plantations were valued by the governments not only produce higher economic and ecological values, but also be more legible and controllable [Chen, 1979; Huang et al, 1984; Xu, 2006]. The Yunnan provincial government requested the state farms to allocate 6% of their total profits to help develop more rubber plantations for smallholder farmers in various forms, including providing free loans, seedlings and technical support whilst smallholder farmers provided lands and labor, to develop rubber plantations [Li & Wang, 1989].

A combination of domestic protection of rubber prices, the introduction of the

Household Responsibility System, and the introduction of new technology all encouraged smallholder farmers to plant rubber as a cash crop, particularly during the period between the 1980s and mid-1990s. Under a major state campaign to encourage upland farmers to plant rubber at elevations below 700m in fields used for swidden, state farm personnel provided seedlings and technical training. Later, a subsidized state anti-poverty campaign encouraged farmers to plant rubber on sloping lands. In addition, the Chinese government initially protected domestic rubber prices. In the late 1980s, China terminated subsidies to state rubber farmers and reduced the tariff on imported rubber. These actions pushed both state farms and smallholder farmers to compete in the international market.

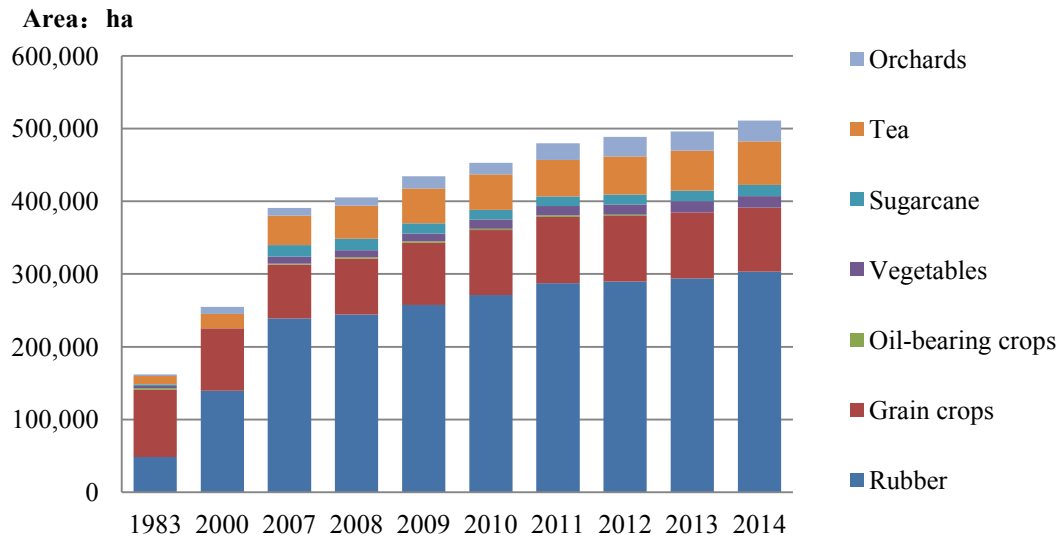
Before the outbreak of the financial crisis, the global rubber price increased rapidly in 1994-1995. At the same time, the Chinese government carried out the marketization of rubber price, natural rubber prices in China was directly connected to international rubber price, which lead to rubber purchase price per ton increasing quickly from about 6,000 yuan to 12,000 yuan. The smallholder farmers were motivated due to rubber price rising such that even the Southeast Asian Financial Crisis did not affect their enthusiasm too much. The rubber price decreased to about 7,000 yuan per ton, but the smallholder farmers had believed that in the future rubber could bring wealth to them like a few years ago.

### **3.3 2000~now: Boom of rubber plantation in Xishuangbanna**

#### **3.3.1 The rapidly expand of rubber plantation by smallholder farmers**

Since 2000, the total area of smallholder farmers plantations had surpassed that of the state farms in Xishuangbanna. Furthermore, almost all of the rubber plantations have been developed under a collective operating group, it is distributed among households in Xishuangbanna by 2000s.

In 2002, the “Grain for Green Project” was introduced to promote the development of China’s western provinces and protect the environment; this program provided farmers with grain for eight years if they planted forest cover on degraded slopes. In Xishuangbanna, the authorities decided to count rubber trees as forest cover. About the same time, get rid of the impact of the Southeast Asian Financial Crisis, a rapid rise in rubber prices occurred, from



**Figure 12 1983~2014 Area change of farm crop in Xishuangbanna**

Data source: Statistical yearbooks of Xishuangbanna from 1983~2014.

about 7,000 yuan in 2001 to 22,000 yuan in 2008. Eager for wealth, households began planting rubber in their traditional woodlands, in village forests, and on the remaining and steeper slopes. Below 700 m, but even higher, rubber became ubiquitous.

Today, rubber farmers in Xishuangbanna have achieved unprecedented wealth. Janet Sturgeon (2010) quotes a rubber farmer as noting that “Money is the most important thing; money makes everything possible.” That “everything” includes sending their children to high school, and for some, on to university; buying insurance for retirement and health care; and even a holiday in the city for an entire village. Indeed Sturgeon argues some ethnic-minority rubber farmers in Xishuangbanna have achieved a standard of living today that has more in common with middle-class urban residents than with most fellow farmers.

Compared with the control of the increase by the state farm, rubber plantation area by smallholder farmers rapidly expanded. Both planted area and rubber production of smallholder farmers exceeded the state farm’s targets. The traditional cropping system of Xishuangbanna which mainly cultivated grain crops was changed. Figure 12 shows that before the rubber tree had been massively cultivated by smallholder farmers, the area of

grain crops such as paddy and maize was 57% of the total cultivated land area in 1983, while the rubber plantation area was only 30%. 20 years later, the rubber plantation area went beyond half of the total and kept up around 60% until now. The area of rubber plantation increased rapidly while the area of traditional crops increased slowly in 30 years. Per capita area of rubber increased from 0.07 hectare to 0.24 hectare, while the per capita area of grain crops decreased from 0.14 hectare to 0.08 hectare.

Nowadays, rubber has become a very important agricultural product in Xishuangbanna. In 2012, the sale of total agricultural products in Xishuangbanna was about 11.52 billion yuan, while the sale of rubber was about 5.84 billion yuan, accounting for 51%.

### **3.3.2 The second reform of the state farms**

Due to a long period of special political, economic and social system, Xishuangbanna State Farms became a complicated pattern, with local economic and social “mismatch”. Its characteristic was “non-government and non-corporate, non-urban and non-rural, non-agricultural and non-industrial”. In recent years, Xishuangbanna State Farms was showing a lot of problems, such as the high labor-intensive of workers with low-income, the contradiction deepened by a big income gap between workers and managers, the heavy burden of high debt on enterprises, and the resentment of laid-off and unemployed people leading to other issues. After the Financial Crisis, the rubber price increased rapidly to 22,000 yuan per ton in 2008. In 2009, the average annual salary in state farms was about 9,700 yuan, while that was 12,000 yuan in the whole prefecture. And there was about 5 times big gap of salary between the workers and the managers [Han Jun, 2012, Research report of Yunnan state farms reform].

In January 20th, 2009, about 1,000 workers, most were laid off in the 1990s, including some formal workers and temporary workers, clashed with state farms and protested the low-income, the lack of social insurance and the corruption had been existed in state farms for a long time.

By the end of 2009, the Yunnan provincial government and Xishuangbanna government introduced the Document [2009] No.19 “Several opinions of the CPC (Communist Party of China) Yunnan Provincial People’s Government in promoting reform, development and

stability of State Farms” and relevant Document [2010] No. 45. Xishuangbanna State Farms and other branches of the Yunnan State Farms Group began the new round of reform. The Yunnan State Farms focuses on development and economic structural adjustment. Based on new mechanism and scientific innovation, the Yunnan State Farms Group is striving for reinforcing pillar industry and integrating resources, setting Yunnan State Farms to be the leading enterprise in Yunnan Province.

The reform achieved initial results in territorial management, contracted to households and so on. These measures improved the management mechanism, activated the operating mechanism, adjusted the distribution of benefits, and rationalized the labor relationship and other aspects of the state farms. However, there were also many problems appeared in the process of the reform. The content of state farms will be described in detail in the Chapter 5.

## **Chapter 4. Rubber Plantation by Smallholder farmers (a case study in Manjinghan Village)**

### **4.1 Introduction**

Rubber plantation in Xishuangbanna mainly consists of state farms and smallholder farmers, which respectively belong to the agricultural reclamation system and private rubber plantation. Rubber was first introduced into Xishuangbanna in the 1940s. In 1953, China changed private ownership to socialist public ownership. After that, rubber trees were cultivated in large scale by smallholder farmers in Xishuangbanna area. After the 21 Century, compared with the control of the increase by the state farm, rubber plantation area by smallholder farmers rapidly expanded. After 2000, rubber plantation area of smallholder farmers exceeded the rubber plantation area of state farms. After 2009, rubber production of smallholder farmers exceeded the rubber production of state farms. In 2012, the sales amount of total agricultural products in Xishuangbanna was about 11.52 billion yuan, while the sales amount of rubber was about 5.84 billion yuan, accounting for 51%. This situation still continues up to now. However, rubber cultivation is highly restricted by natural conditions. Because of the climate and geography, suitable land for rubber cultivation is limited. How to enhance productivity in the existing scale of rubber is an important task for China.

The rapid increasing of rubber plantation made a lot of effect for the life of smallholder farmers. Such as the living standard, the level of education for a new generation, the belief and culture are more or less changed in the past 30 years. A series of research illustrated the agronomic and socioeconomic complexity of the rural household cropping system, and how the inter-cropping of immature rubber had contributed to improving rural livelihoods through raising household income and capital assets [Jianchu, X. 2006]. Meanwhile, some researchers were concerned that excessive rubber plantations would negatively affect local

environment in the long term. The diverse land use systems practiced by smallholder farmers may be the most ecologically appropriate and culturally suitable means for promoting sustainable local economies and livelihoods [V.H.L. Rodrigo, et al. 2001].

Previous studies had shown that the rubber plantation affected the local ecological environment, tropical species from the perspective of biosciences, and environmental science. The changes in smallholder farmers were also mentioned, but more focused on forestry and ecosystem or humanistic culture.

This study aims to investigate the current situation of rubber plantation by smallholder farmers from the view of agricultural structure, reveals the rubber productivity and profitability of smallholder farmers, and finally identifies how exactly and to what extent rubber plantations affect the livelihood of smallholder farmers. For that, the author did twice survey in the Manjinghan Village, Xishuangbanna Prefecture in 2012 and in 2014.

## **4.2 Research methodology**

Both historical data citation and field survey were used in our research.

The historical data was mainly cited from the Manjinghan village committee record, statistical yearbooks of Jinghong City and Xishuangbanna Prefecture.

We carried out our first original survey in 2012 and second time in 2014. The empirical analysis of this study is based on the firsthand data.

The first socioeconomic structured interview was performed in December 2012. The interview was conducted according to the prepared questionnaire. Interviewees include key informants and individual households. Village head was interviewed as key informants. 50 farmers from different households which were selected randomly from a household namelist of 93 households in the village, including 37 males and 13 females, answered our questionnaire. All of them were the head of the household and there was no state farm household involved in this survey.

The second supplementary survey in 2014 was a return visit to the sample village. In the second survey, we tried to do the same questionnaire with the same sample smallholder farmers in the first survey. However, due to several reasons, 10 farmers were absent in the

interview. We compared the data from twice survey and analyzed the issues of rubber plantation of smallholder farmers. At the same time, we also compared some data of smallholder farmers and the data of state farms, to analyze the difference and the reason.

The questionnaire included close-ended and open-ended questions, and was mainly consisted of demographic aspects; cropping system; production and livelihood input, such as cash offered for crop seeds, chicks, fertilizer and pesticide, as well as clothes, education, health care; income structure; awareness and perceptions of farmers on limiting factors for agricultural development such as land, labor and capital access, etc.

The collected data was processed, classified and analyzed by using appropriate statistical tools.

#### **4.3 General information about the Manjinghan Village**

Manjinghan is a Dai ethnic group village located in the middle of Xishuangbanna Prefecture at about N 21°80', E 100°55'. It is a flatland area surrounded by mountains. The village is about 3 km far from the central city-Jinghong City (Figure 13). The total land area of Manjinghan is 1.79 sq. km; the altitude is 580 meters above sea level. Its annual average temperature is 22.6 Celsius degree and the annual average rainfall is 1,200 mm. The climate of this area is suitable for planting rice, tropic fruits, rubber and other crops. It is a typical agricultural and minority area.

Manjinghan village has 30.4 hectare cultivated land; of which all of it is the irrigated land. The per capita area of cultivated land is 0.07 hectare. This village owns 71.5 hectare of woodland, 1.1 hectare fishery area and 76.1 hectare other lands for roads and house buildings including a minority temple. There was no dry land, grassland or wasteland.

At the end of 2013, the village has 93 households, a total rural population of 415 people, including 195 males, 220 females. The population decreased 14 people than at the end of 2012. The employed population was 324, about 78% of the total. In 2013, 10 people went out to other area of Yunnan Province for working, this was the first time in 8 years at least that some people went out the village to find jobs. The minority population was 412, about 99% of the total registered population. The overall educational level was very low, and there



## Xishuangbanna Prefecture



**Figure 13 Location of Manjinghan village, Xishuangbanna Prefecture**

were 88% people who had been educated less than 6 years, including 3% illiteracy in 2012. However, the educational situation is getting better in 2013. There are 14% people who had been educated more than 6 years, increased 2% in 2 years.

By the end of 2013, no one in the village had bought the rural social pension insurance; 407 people participated in the rural cooperative medical care, increased 23 people than in 2012. The medical care of the villagers mainly relies on the clinic in the Gasa town 3.00 km from the village.

The road of the village is the gravel road; 3.00 km from the nearest station and the nearest market in the Gasa town. At the end of 2013, there are 5 households in the village are living in the Dai minority traditional wood-brick mixed houses and 88 households are living in the brick-steel mixed houses. Compared with the data in 2012, 15 households had changed their house from the traditional wood-brick mixed to the brick-steel mixed

**Table 1 Household Category of Manjinghan village in 2012**

Household Category	Ratio (%)
Full-time farm household	0
Part-time farm household	100
● Earning main income from farming	96
➤ Mainly engaged in rubber cultivation	84
➤ Mainly engaged in other farming	12
● Earning main income from other jobs	4

Data source: Village committee record

structure. No household is living mixed with livestock.

#### **4.4 Agricultural structure of the Manjinghan Village**

According to the definition from the “Ministry of Agriculture, Forestry and Fisheries” [Website of the MAFF], the households in Manjinghan are “commercial farm household”. In our 50 samples (Table 1), there was no “full-time farm household”. In these “part-time farm household”, 96% were “farm household earning main income from farming” and 4% was “farm household which earning main income from other jobs”. Those 4% households mainly engaged in other jobs such as making and selling Dai ethnic clothes to local people and travelers.

We further classified the “farm household earning main income from farming” into two classes by labor time: “households mainly engaged in rubber cultivation” (more than half the labor time was occupied) and “households mainly engaged in other farming”. As the rubber trees were already ripe for tapping, no longer be able to interplant with other crops but only a small amount of breeding chickens under the trees. Therefore, there were only 12%

households mainly engaged in other farming such as upland rice and vegetables (although their main income came from rubber cultivation).

In rural China, the ownership of the land belonging to the village collective, farmers only have the management rights. The farmers contract the village land by unit of household. The size is determined by the number of persons per household, the more persons assigned to more land. For example, a normal household has 3 persons, each person can contract about 0.08 hectare land, the total contracting area of this household is 0.24 hectare by using only one contract with the village.

In 2013, the total output value of the agricultural economy in Manjinghan village is 1.32 million yuan, of which: the output value of farming is 120,000 yuan, the output value of livestock is 140,000 yuan by slaughtering 48 pigs, the output value of forestry is 1.06 million yuan which mainly comes from the rubber plantation. The total output value of secondary and tertiary industries is 390,000 yuan, which mainly comes from the perennial migrant population working out of the village. The per capita net income of farmer is 7,445 yuan, which mainly comes from the forestry.

This village was one of the earliest villages to plant rubber before the 1980s and it is a typical village which mainly cultivates is rubber around the central city. Since a large number of smallholder farmers began planting rubber in the 1980s, the traditional cropping system of Manjinghan Village was changed. Although the data of the cropping system in the 1980s was unavailable, we had got some information from the old generation in Manjinghan village. In the 1980s, farmers in Manjinghan village just began to cultivate a few rubber trees by the supporting of the state farms. All the households were “full-time farm household”, mainly cultivated paddy, glutinous rice and tropic fruits.

Table 2 shows the cropping system of Manjinghan village in 2013, 2012 and 2008. The agricultural land area of this village was 72.53 hectare in 2013. After 2008, the area of cultivated land in Manjinghan village deceased 3.6 hectare because of the city construction. The area of rubber plantation in Manjinghan village was 41.07 hectare. There was no more suitable land for planting rubber trees in Manjinghan village, the farmers cannot increase the area of rubber plantation in the village any more. However, some farmers rent rubber plantation from other villages far from the city, some farmers work in other rubber

**Table 2 Cropping system of Manjinghan village (2008~2013)**

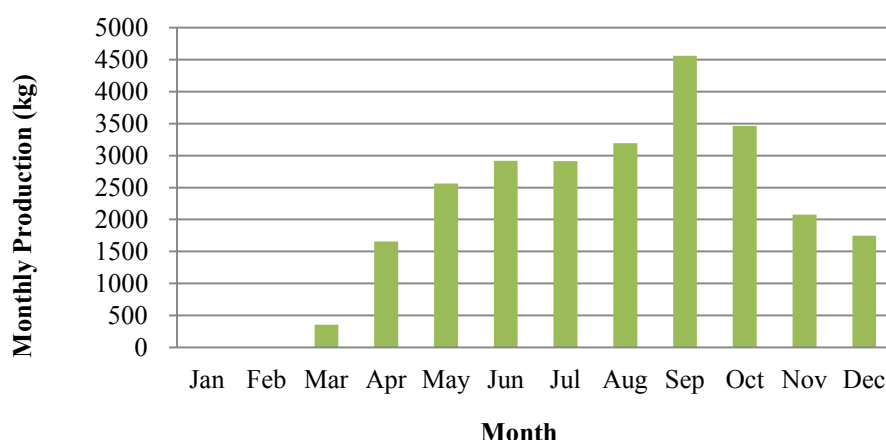
Items		2013 (2012)		2008	
		Area/ Amount	Ratio	Area/ Amount	Ratio
Agricultural land		72.53 ha	100%	76.14 ha	100%
1	Rubber land	41.07 ha	57%	41.07 ha	54%
2	Cultivated land	30.4 ha	42%	34.0 ha	45%
	➤ Banana	26.67 ha	37%	0	0%
	➤ Other crops (Paddy / maize / vegetables)	3.73 ha	5%	34.0	45%
3	Fishery area	1.07 ha	1%	1.07 ha	1%
Pigs		48 (24)		41	
Chicken		600			

Data source: Village committee historical record.

plantations after finishing their own work.

Paddy field was about 26.67 hectare which was rented out to the specialized production households from other provinces to plant banana from 2010, accounting for 37% of total agricultural land. The agreed rent period was 6 years. The annual rent would be determined after the negotiations by villager representatives. Usually, in accordance with the local land rental price, all of the villagers should collectively sign on a common contract every year. The annual rent was 18,750 yuan per hectare in 2012 and increased to about 20,000 yuan per hectare in 2013.

Manjinghan village is very close to central city, the rent price of land increased quickly



**Figure 14 Monthly production of dry rubber in Manjinghan village in 2012**  
(Data source: Village committee record)

affected by the city expansion. At the same time, Xishuangbanna area is one of the most famous traveling areas in Yunnan Province, where there are more than 4.5 million people arrivals every year. This situation also makes the rent price of land around the central city-Jinghong being higher than other places.

As the rubber trees were already mature for tapping, no longer be able to interplant with other crops. There was only a small amount of breeding chickens under the rubber trees. Therefore, there was only about 3.73 hectare land, accounting for 5%, can be used to plant upland rice, maize and vegetables. Only several households bred pigs and fish in a small scale, and no household bred other livestock. In 2013, the scale of pig breeding increased to 48 pigs.

#### **4.5 Rubber productivity and profitability of the smallholder farmers**

Figure 14 was the monthly production of dry rubber in the Manjinghan village in 2012. The total production was 49,000 kg from 41.07 hectare. The highest production was recorded in September having 4,559 kg, which was almost 20% of the year production. The

**Table 3 Area of rubber land managed by households in Manjinghan**

Class	Size	Households		Average area
	hectare	Nos.	Share (%)	hectare/HH*
non-rubber	<0.1	2	4	0.00
Small	0.1-0.5	32	64	0.31
Medium	0.5-1	11	22	0.55
Large	$\geq 1$	5	10	1.10
Total	21.47	50	100	0.43

Data source: Samples survey of 50 households in 2012. \*HH: household

period from November to April was the dry season and virtually, there was a little latex. However, some rubber trees were in the exuberant period of latex production, rubber tapping could last to the end of the year.

The rubber plantation area of each household was an important indicator for us, since we used it in order to classify smallholder farmers into 4 classes (Table 3). In our survey, the smallest area of rubber per household was above 0.1 hectare. By this definition, areas less than 0.1 hectare of rubber were classified as non-rubber plantation households. Manjinghan village is in the plain region, with the impact of urban sprawl of Jinghong city, the forest land is relatively few. The land area is small for each household. Meanwhile, there was no any land rent in from other places. Most of the rubber plantation area was on small and medium scale, large scale rubber planting households were rare. The average area of rubber plantation was small for each household. In contrast, rubber contract area of household in state farms was generally larger. For example, the average contract area of rubber plantation in Jinghong Farm is 2.34 hectare per household in 2009 [Xishuangbanna Yearbook, 2010].

**Table 4 Comparison of rubber productivity in different classes in 2012**

Class	Main varieties	Tree-age	Planting density	Tapping system	Yield per hectare	Yield per HH*
		years	trees/ha		kg/ha	kg/HH
non-rubber	n	n	n	n	n	n
Small	RRIM600	20-30	480	s/2 d/2	1487	461
Medium		20-30			1469	808
Large	RRIM600, YUNYAN 77-2	10-25	480, 450		1248	1373
State farm in Xishuangbanna	YUNYAN 77-2, 77-4, GT1	n	450	s/2 d/3 s/2 d/4	1745	n

Data source: samples surveys on 50 households in 2012. \*HH: household

The original varieties of rubber which was introduced from Brazil in the last century have been improved by scientists into better varieties. New varieties of rubber tree have higher yield and disease-resistance than the original varieties. However, replanting new variety of rubber plantation means a large of investment in one time or into debt. And the income of smallholder farmers will decrease during the growing period of the new rubber trees. Most of the households still kept the old variety of rubber tree planted in the 1980s (Table 4). Only a few households in the large class replanted part of rubber plantation with an improved variety from 2006. The large scale of rubber plantation could ensure the basic income for living and farming during the replanting period. Some households also changed the planting density from 480 to 450 which is more appropriate. As the stable, high-yield period of the replanting rubber plantation did not yet come, the average of yield per hectare in large class was temporarily lower than other classes. The stable, high-yield period of

YUNYAN77-2 is usually after 12-15 years, and expected yield is above 1,600 kg per hectare. It means 3 or 4 years later, the average yield per hectare of large class will exceed.

The cultivation and tapping of the rubber tree is a high technical content work. Every year, state farms provided the training course and tapping guide for the smallholder farmers to improve their cultivation technology and tapping skill. However, farmers' passion of training was not very high, especially in the older generation. Most smallholder farmers followed the traditional cultivation and tapping methods and rules. The management method of rubber plantations is optional. The smallholder farmers used less fertilizer or low-cost low-quality fertilizer, or even without fertilization; capacity for responding to tree disease or pests was weak. These influences will reduce the production life and the total production of rubber trees.

There was a common date of starting tapping every year (It is usually in the middle of March, after the new year of the Dai minority.), but there was no strict planning schedule and tapping method for different natural situations. The tapping frequency of smallholder farmers was one cut every two days, which would decrease the production cycles of rubber trees. In addition, drug stimulation, rain hat and other scientific methods had been barely used by the smallholder farmers in Manjinghan village. The bark damage normally arose, which also would affect the output of rubber production.

Generally, affected by rubber variety, cultivation technology, tapping system and other factors, rubber production capacity of smallholder farmers was lower than the average level of Xishuangbanna. For example, the average yield of rubber in Xishuangbanna Prefecture was 1,745 kg per hectare in 2012 [National Economic and Social Development Statistics Bulletin of Xishuangbanna Prefecture (2008-2012)].

On the other hand, the smallholder farmers naturally coagulated latex outdoor in the forest, or collected latex entrusting business to the farmers of large class and coagulated with microwave drying. Both the unit quantity and the quality of rubber in Manjinghan village was lower than the state farm's, the selling price of rubber was relatively lower.

Table 5 shows the rubber profitability in each class. In three rubber plantation classes, rubber area was larger, the rubber gross income per household was higher. However, the gross income and profit per hectare of each class decreased when the rubber plantation area



**Table 5 Comparison of rubber profitability in different classes in 2012**

	(1)	(2)	(3) = (2) / (1)
Class	Average area	Rubber gross income per HH*	Rubber gross income per hectare
	ha / HH	yuan/HH	yuan/ha
non-rubber	0.00	0	n
Small	0.31	9544	30787
Medium	0.55	16780	30509
Large	1.10	28470	25882

	(3) = (2) / (1)	(4)	(5) = (3) – (4)
Class	Rubber gross income per hectare	Rubber production cost per hectare	Profit per hectare
	yuan/ha	yuan/ha	yuan/ha
non-rubber	n	n	n
Small	30787	6844.40	23943
Medium	30509	6753.50	23756
Large	25882	7243.90	18638

Data source: sample surveys on 50 households in 2012.

increased, especially between the large class and others. The main reason was that the yield per hectare in large class was lower, but the households used better fertilizer and spent more labor time on the replanting rubber plantation to insure a higher yield and quality of rubber

in the future. If the assuming yield per hectare was 1,600 kg in the large class and the assuming unit price was 20 yuan/kg, *ceteris paribus*, rubber gross income would reach 32,000 yuan per hectare and 35,200 yuan per household, much higher than that in other classes.

#### **4.6 Gross income structure of smallholder farmers in Manjinghan village**

Table 6 shows the household gross income structure in each class. Gross income consisted of agricultural gross income and non-agricultural gross income. Among them, the agricultural gross income was from rubber cultivation and other farming activities, including wage income from agricultural employment. The non-agricultural gross income included the wages of labor hire from secondary and tertiary industry, such as transportation, construction and tourism; as well as property and transfer income, such as land rent, subsidy and others.

Rubber relative gross income in the non-agriculture is the rent of machinery for rubber plantation and the profit got from difference of prices as being a dealer of rubber. The dependent ratio on rubber is the result of the rubber gross income divided by the total gross income.

In relation to whether planting rubber, there was a wide gap between the gross income of non-rubber plantation class and the rubber plantation class. The gross income of non-rubber plantation class was 8,423 yuan, while that of the rubber plantation class was more than 17,000 yuan, which was more than double of the former.

The gross income of rubber-plantation classes heavily depended on rubber, the dependent ratio on rubber was large, which all above 50%. When the market price of rubber decreases badly, it will give a huge shock to the income of smallholder farmers who mainly cultivated rubber trees. This impact is shown in our second survey data. Due to the rubber price decreased from above 20,000 yuan in 2008 to below 18,000 yuan per ton in 2013, and the price indices for means of agricultural production continued to rise since 2010, the net income of smallholder farmers in Manjinghan village decreased to 7,445 yuan per capita in 2013, decreased 17.2% than in 2012 (Table 7).

**Table 6 Comparison of gross income structure in different classes in 2012**

	(1)=(2)+(5)	(2)=(3)+(4)	(3)	(4)
Class	Total gross income	Agricultural gross income		
			Rubber	Others
non-rubber	8423	3486	0	3486
Small	17353	12721	9544	3177
Medium	28905	21101	16780	4321
Large	55019	34795	28470	6325
Total	23304	16403	12647	3756

	(5)=(6)+(7)	(6)	(7)	(8)=(3+6)/(1)
Class	Non-agricultural gross income			Dependent ratio on rubber
		Rubber relative	Others	
non-rubber	4937	0	4937	0%
Small	4632	0	4632	55%
Medium	7804	1860	5944	64%
Large	20224	18971	1253	86%
Total	6901	2306	4595	64%

Data source: sample surveys on 50 households in 2012.

The gaps of rubber relative non-agricultural gross income between the medium class and large class was big, because that large class not only planted more rubber, but also acted as the role of dealer, which could get additional profit from the acquisition, drying latex, transport and sale dry rubber. The large class bought latex from other households in the

**Table 7 Comparison of living conditions of Manjinghan village with other areas**

2012	Per Capita Net Income	Engel's Coefficient	Per Capita Living Space
Manjinghan	8988	40.1%	30.25
Xishuangbanna	6174	46.5%	31.36
Yunnan rural	5417	45.6%	27.44
China rural	7917	39.3%	32.42

2012	Main Durable Consumer Goods in 100 households				
	Motorcycle	Refrigerator	TV set	Washing Machine	Mobile Phone
Manjinghan	140	96	98	64	274
Xishuangbanna	148	83	98	58	267
Yunnan rural	33	10	96	34	91
China rural	53	30	110	49	96

Data source: Manjinghan village committee record and the National Economic and Social Development Statistics Bulletin 2012 (China, Yunnan and Xishuangbanna).

village, after the filtration and microwave drying, they transported and sold dry rubber at a higher price to the local rubber processing factories about 3 km away from the village. At the end of the year, the large class invited other households to dinner to show their appreciation.

Many rural households benefited a lot from rubber, and the standard of living is apparently higher than the average level of rural households in Yunnan Province and China.

Table 7 is the comparison of living conditions of the Manjinghan village with other areas. Main statistical indicators were calculated according to the formulas of China Statistical Yearbook as follows:

- Net Income = Gross Income – Total Expenses
- Per Capita Net Income =  $\frac{\text{Household Net income}}{\text{Average population per household}}$

Net Income refers to the gross income after the deduction of the total expenses. The total expenses are mainly farming and non-farming operation cost, including labor cost and land cost, as well as the payment for taxes and other expenses. The expenses do not include living consumption expenditure. Labor cost and land cost were calculated as follows. In Xishuangbanna, the local labor hire price per day is about 60 yuan and the average land rent is about 30,000 yuan per hectare.

- Labor cost (per day) =  $\frac{\text{Labor time}}{8 \text{ hours}} \times \text{Local labor hire price per day}$
- Land cost = Area  $\times$  Average land rent of similar land

Net Income can be spent for investments in productive and non-productive construction, for consumption in daily life and for savings deposit. It is a comprehensive indicator to show the actual level of the income of the rural household. “Per capita net income” is the level of net income averaged by population, reflecting the average income level of rural farmers.

Some indicators in Table 7 showed that Manjinghan village has a better life. The per capita net income is higher than the average in Xishuangbanna and Yunnan Province. Such income level would put a family in “basically well-off” class in China’s prosperous coastal areas, but in Yunnan, one of the country’s poorest provinces, it affords a very high standard of living. The Engel’s Coefficient reaches the average level of China rural and higher the average level in the same region. The occupation of durable consumer goods takes a leading position in rural area. All the smallholder farmers in our survey agreed that the rubber

plantation makes them a better life than normal farmers. Even the price of rubber continues to fluctuate every year, but they are confident that rubber plantation still plays the most important role of income source in the future.

#### **4.7 Discussion**

Xishuangbanna had long been a poor area, desperate for development. The rubber had brought new wealth to the smallholder farmers and affected the local agricultural economy.

First, from the micro point of view, the income from rubber is high, especially with the rapid rise of rubber prices in recent years, which has remained around 20,000 yuan per ton. The income of rubber-planting households is much higher than the income of those only planting other crops. From a macro point of view, the rubber industry has also attracted a number of external capitals, which pulled the rapid development of the local economy and improved the whole living conditions of local residents, such as a lot of rubber processing factories.

Second, the results show that the cropping system of the smallholder farmers has become more simplified. As higher returns from rubber plantation compared with other crops, smallholder farmers were more willing to invest capital in the rubber. In addition, the households cannot interplant other crops more than 25 years in the rubber mature stage. Gradually, smallholder farmers planted rubber on almost all the land where rubber could be planted, abandoned many traditional crops, such as paddy, glutinous rice, vegetables and so on. Compared with the self-sufficiency mode, farmers would rather buy the necessities of life with the surplus of rubber. This situation was prevalent in Xishuangbanna, which is a double threat of agro-biodiversity and food security.

Third, the analysis reveals that the differentiation of rubber planting size will lead to a giant gap of the gross income among the rubber planters. The smallholder farmers who cultivate rubber, depended on rubber income too much. It implies that the farmers would face higher risk, especially when the rubber price fluctuates wildly and natural disaster comes.

Finally, the rubber plantation history and the results of this survey indicated that

smallholder farmers increased their income mainly by the expansion of the rubber area. But now it is no longer a feasible way. Nowadays, the government gradually tightened the examination and approval on a rubber plantation. According to the <Natural Rubber Management Regulations of Xishuangbanna Dai Autonomous Prefecture> (2011 revised edition), some areas such as state-owned forests, basic farmland are banned from planting rubber. The government also urges smallholder farmers to restore their rubber plantation which slope more than 25 degrees, to natural forest. Furthermore, all the replanting of rubber and reclaiming of new rubber land need government's permission.

Conversely, to enhance productivity in the existing scale of rubber is considered to be a better way, and there is still a great space of rise for smallholder farmers to improve the cultivation technology. On the one hand, to enhance productivity can increase the return on invested capital based current scale. On the other hand, to control the size of rubber plantations will help rural households with saving labor force and labor time, which can diversify the income sources and reduce the risk of smallholder farmers who depended on rubber plantation too much.

The smallholder farmers in Xishuangbanna still have a lot to learn from the state farm, not only cultivation techniques, but more important is the rational development pattern, such as how to use limited resources more effectively, how to increase income and reduce costs, including environmental costs may be paid in the near future.

# **Chapter 5. Rubber Plantation by State farms (a case study in Jinghong Farm and Dongfeng Farm)**

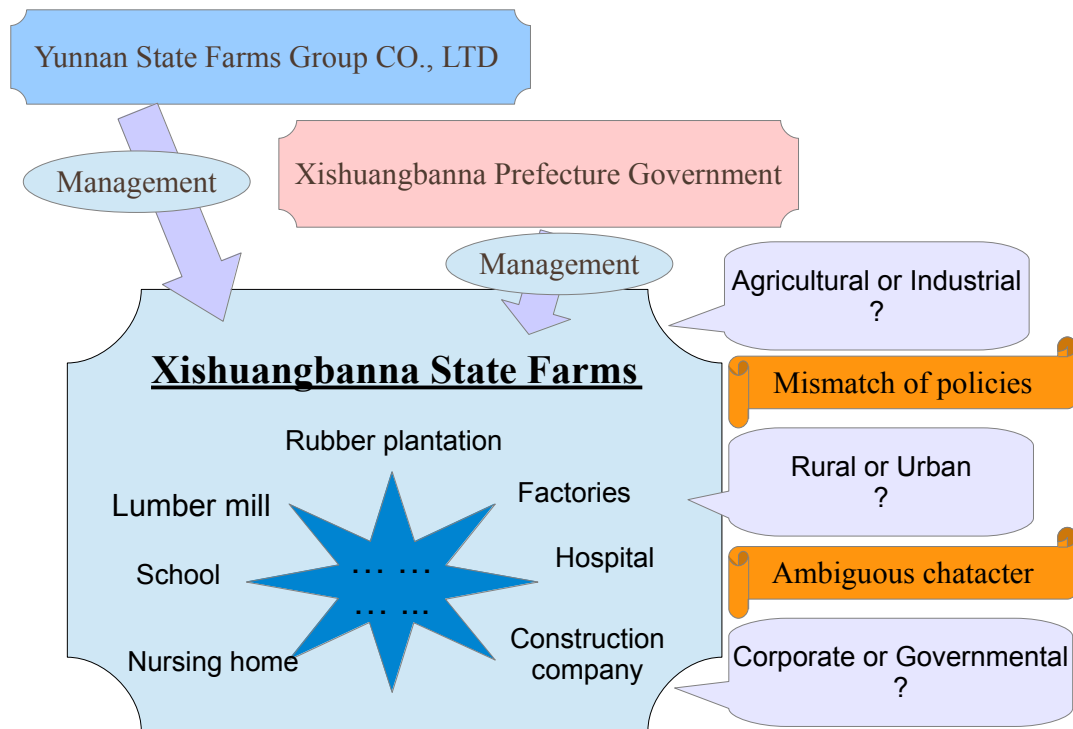
## **5.1 Introduction**

To understand the situation of rubber plantation in Xishuangbanna, it is imperative to pay sufficient attention to the agricultural reclamation system. By the advanced level in the world of natural rubber planting techniques and per unit production, Xishuangbanna State Farms became the best natural rubber plantation base in China. Xishuangbanna Branch of Yunnan State Farms Group has been keeping high yield of rubber almost 20 years since 1993 with an output per hectares of more than 1,600 kg. The highest yield for per hectares was 2,072 kg in 2003 [Yearbook of Xishuangbanna, 2004].

However, due to a long period of special political, economic and social system, Xishuangbanna State Farms became a complicated pattern, with local economic and social “mismatch” [Han Jun, 2012]. Its characteristic was “non-government and non-corporate, non-urban and non-rural, non-agricultural and non-industrial” (Figure 15). In recent years, Xishuangbanna State Farms were showing a lot of problems, such as the high labor intensive of workers with low-income, the contradiction deepened by a big income gap between workers and managers, the heavy burden of high debt on enterprises, and the resentment of laid-off and unemployed people leading to other issues.

By the end of 2009, the Yunnan provincial government and Xishuangbanna government introduced the Document [2009] No.19 “Several opinions of the CPC (Communist Party of China) Yunnan Provincial People’s Government in promoting reform, development and stability of State Farms” and relevant Document [2010] No. 45. Xishuangbanna State Farms and other branches of the Yunnan State Farms Group began the new round of reform and





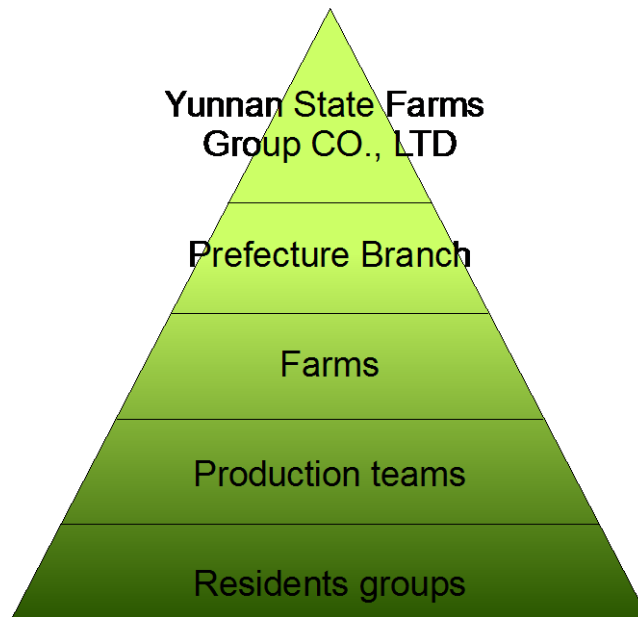
**Figure 15 The complicated pattern of Xishuangbanna State Farms**

achieved initial results in territorial management, contracted to households and so on. These measures improved the management mechanism, activated the operating mechanism, adjusted the distribution of benefits, and rationalized the labor relationship and other aspects of the state farms. In order to understand the impact of reform to the rubber plantation of Xishuangbanna State Farms, in May, 2014, the author carried out the field survey<sup>①</sup> in Xishuangbanna state farms.

## 5.2 General information about the Xishuangbanna State Farms

The development of Xishuangbanna State Farms was initiated right after the founding of the People's Republic of China. With 60 years of development and two-generation great

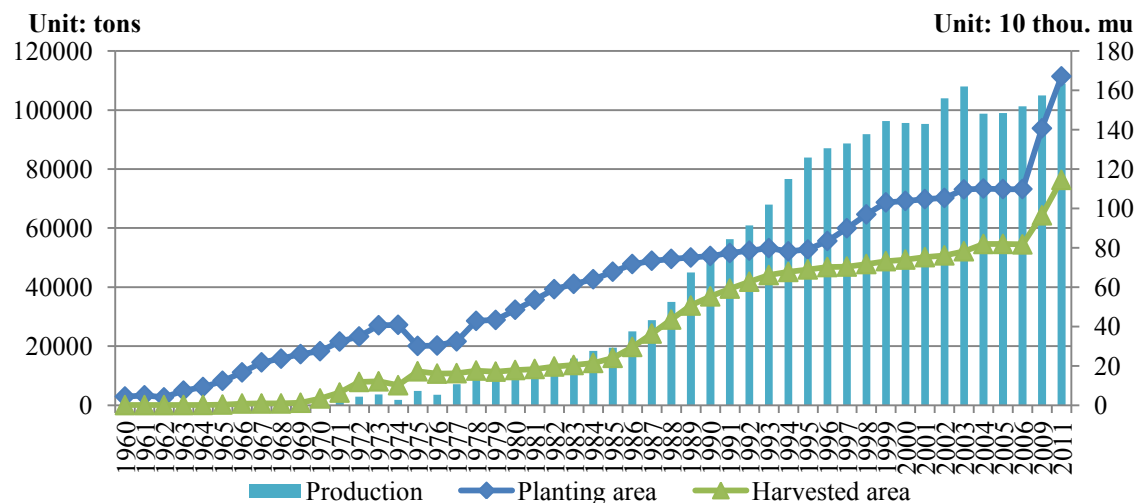
<sup>①</sup> Survey detail is in 5.3.research methodology of this chapter..



**Figure 16 Agricultural reclamation system**

dedication, Xishuangbanna State Farms have made a proud achievement in frontier safety and tropical products production. Xishuangbanna State Farms operate both under the management of Yunnan State Farms Group CO., LTD and Xishuangbanna Prefecture Government. The Yunnan State Farms Group has 6 branches located in 6 prefectures with 92 organizations covering 40 farms. Since January, 2012, Xishuangbanna state farms had become the “farms-production teams-residents groups” 3-level management structure (Figure 16). Xishuangbanna Branch has become the biggest state-owned agricultural enterprise with a total land of 101,800 hectares in which 87,520 hectares are cultivatable. Xishuangbanna State Farms have a population of 158,164 of which 43,769 are formal staff and workers [Yearbook of Xishuangbanna, 2009].

Natural rubber production is the pillar industry of the Yunnan State Farms Group. With a total plantation area of 165,059 hectares in 2011, rubber planting has become one of the economic pillar industries in the frontier tropical zone [Statistical Bulletin of Yunnan State Farms, 2011]. After half-century development, Xishuangbanna State Farms summarizes a high-yielding rubber planting know-how at high altitude in the northern tropical zone,



**Figure 17 The rubber cultivation of Xishuangbanna State Farms**

Data source: data of 1960~2002 is from the rubber cultivation review in Yearbook of Xishuangbanna, 2002; data of 2003~2011 is from yearbooks of Xishuangbanna each year.

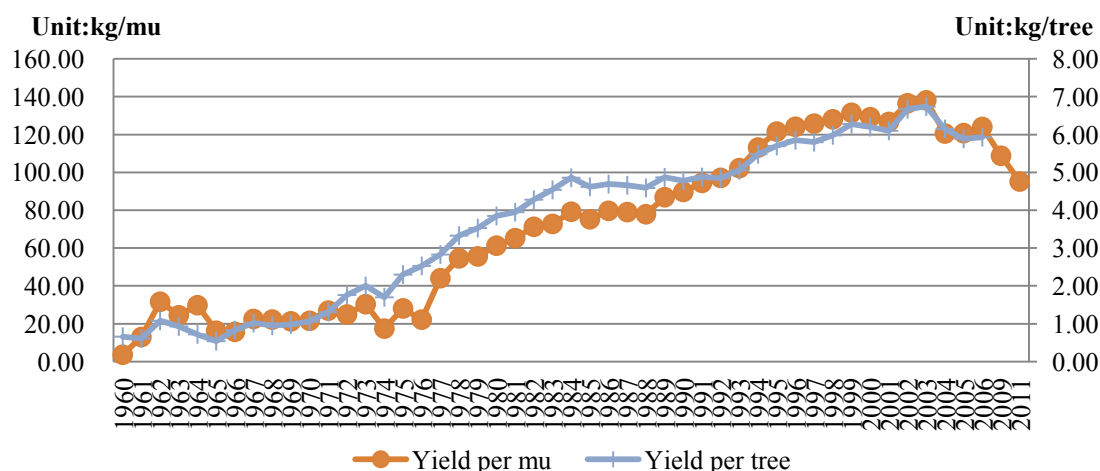
“mu” is a unit of land area which is used in rural China. 15 mu = 1 hectare

making a great breakthrough in the traditional rubber planting area. By the advanced level in the world of natural rubber planting techniques and per unit production, Xishuangbanna State Farms became the best natural rubber plantation base in China. (Figure 17,18)

Table 8 is the comparison of average per unit yield of dry rubber in 2009. We can see from the table, the average per unit yield of the Xishuangbanna State Farms was the highest, much higher than the smallholder farmers in the same area. Although Hainan Province is the biggest rubber cultivation base in China. Xishuangbanna State Farms make the producing level of Yunnan Province to be the highest in China. Yunnan Province becomes the only province, of which producing level of rubber is close to the biggest rubber producer in the world—Thailand.

### 5.3 Research methodology

We randomly selected a number of production teams from Jinghong farm and Dongfeng



**Figure 18 The unit yield of dry rubber in Xishuangbanna State Farms**

Data source: as same as Figure 17.

“mu” is a unit of land area which is used in rural China. 15 mu = 1 hectare

farm to investigate, because these are two of the biggest farms and mainly engaged in rubber planting (Table 9).

Jinghong farm is located in the western part of Jinghong city (Figure 19) with a total of 10,694 hectares land area, of which 7,579 hectares rubber plantation. It was established in March 1956. After the 2010’s reform, it is composed of 9 production teams (including 104 resident groups) and 8 varieties of organizations (such as rubber factory, lumber mill, construction company, pig farm, nursing home and so on). The population of Jinghong farm was 18,180, including 9,233 active employees. There are 8,452 households in the farm, in which 6,693 households, involved 9,050 contractors, has contracted rubber plantation [Jiping L, 2014].

Dongfeng farm was established in the spring of 1958. After the 2010’s reform, it is composed of 13 production teams (including 158 resident groups) and several varieties of organizations. The population of Dongfeng farm was 24,028, including 13,342 active employees, 754 management staff, 4,927 retirees, and 1,207 inside early retirement people. Dongfeng farm is located in the southern part of Jinghong city with a total of 16,753 hectares land area, of which 11,631 hectares rubber plantation. Other land area is 4,907

**Table 8 Comparison of average per unit yield of dry rubber in 2009**

<b>Area</b>	<b>Xishuangbanna State Farms</b>	<b>Xishuangbanna Smallholder Farmers</b>	<b>Yunnan Province</b>
Yield per hectare	1632	1348	1575
<b>Area</b>	<b>Hainan Province</b>	<b>Thailand</b>	<b>Asia</b>
Yield per hectare	1125	1594	1230

(Unit: kg/ha)

Data source: Yearbooks of Xishuangbanna and Yunnan Province; survey data; Fu Guo Hua (2013).

hectares. Overall, there were 12,588 people involved in resource contracting in which 11,691 people contracted rubber plantation and 897 people contracted other resources (paddy field, dry land, fish ponds, shops, etc.) in the farm [Yearbook of Jinghong, 2013].

Both historical data citation and field survey were used in this research. The historical data was cited from the Bureau of Jinghong Reclamation and statistical yearbooks of Jinghong. A socioeconomic structured interview was performed in May 2014. A total of 50 contracted households from different production teams which were selected randomly from a household list, including 20 households from 9 production teams in Jinghong farm and another 30 households from 13 production teams in Dongfeng farm, were involved in this survey.

The questionnaire included close-ended and open-ended questions, and was mainly consisted of demographic aspects; contracting situation; rubber work experience, rubber cultivation and tapping situation, such as survival rate, annual growth, tapping system, etc., awareness and perceptions on limiting factors for rubber plantation of state farms. The collected data was processed, classified and analyzed by using appropriate statistical tools.

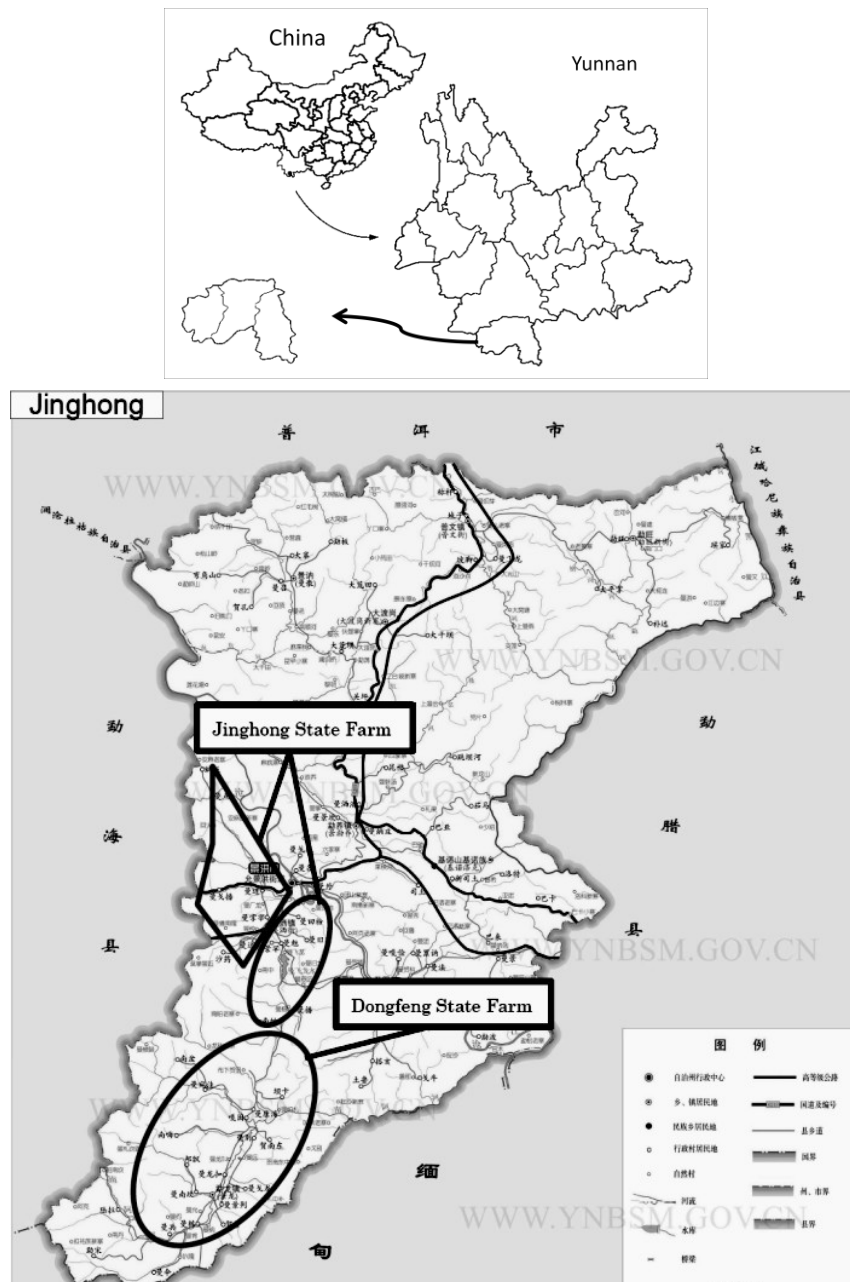
Since the beginning in 2010, until now the reform is still going on. From time to time, the government and the farm management departments at all levels, introduce new and

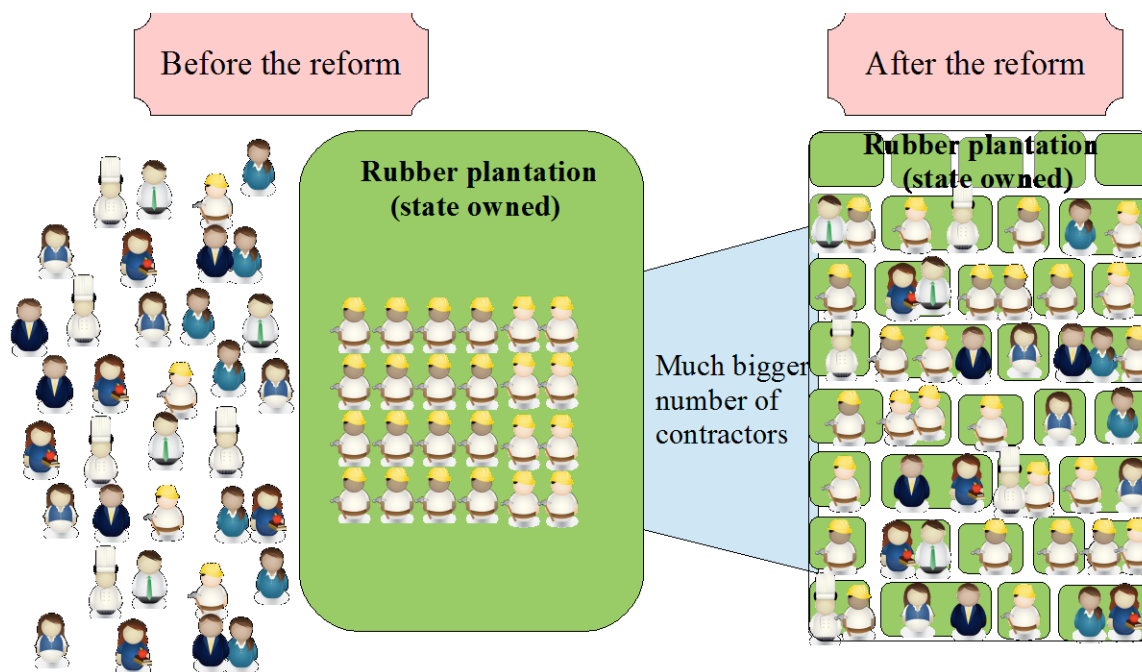
**Table 9 General situation of Jinghong Farm and Dongfeng Farm**

	<b>Jinghong Farm</b>	<b>Dongfeng Farm</b>
<b>Established</b>	March, 1956	Spring of 1958
<b>Located</b>	Western part of Jinghong city	Southern part of Jinghong city
<b>Land area</b>	10694 ha	16753 ha
<b>Production teams</b>	9	13
<b>Residents groups</b>	104	158
<b>Rubber plantation area</b>	7579 ha	11631 ha
<b>Rubber contractors</b>	9050	11691

Data source: Yearbook of Jinghong, 2013; Jiping, L. 2014.

additional policies in accordance with the actual situation of the reform. Farm structure and management authority of the departments are constantly adjusted. Since 2012, a lot of detailed official data has not been collected and update. In the process of survey, the primary data was collected directly from households and other relevant staff. This study compared the survey data with the data in 2009 which before the reform, and tried the maximum extent possible to objectively reflect the effect of reform on the rubber plantation of state farm. However, the effect we raised is just a presentation of the current situation, it may become long-term effects, or not, as the progress of reform, there will be different future development.





**Figure 20 Comparison of rubber contractor's before and after the reform**

#### **5.4 Rubber plantation contract status**

2013 is the third year after Jinghong farm and Dongfeng farm to reform. According to the Xishuangbanna Prefecture Government Document [2010] No. 45, on the basis of maintaining land owned by state, state farms divided the original rubber plantation and contracted with all adults, of which household registration status was in the farms before December 31st, 2008, including a large number of people without cultivation and tapping technology, to manage the entire rubber plantations.

The contract period for formal workers is until retirement, for others is about 18 years. The contractors do the maintenance work and pay the expense themselves. State farms provide technical support services and charge the contracting fees, coagulation cost, marketing cost and taxes.

In principle, the contractors cannot sell or rent out rubber plantations, cannot abandon rubber plantations, and cannot hire other people working in rubber plantations; the



**Table 10 Comparison of rubber contractor's status**

Descriptive (Unit)	2009	2014	Differences
Employment rate (%)	26.41	63.17	36.76
Per capita contract area (ha)	2.34	0.93	-1.41
Main business of rubber (%)	100.00	66.00	-34.00
Rubber plantations experienced (%)	100.00	64.00	-36.00
Training (engaged) (%)	100.00	52.00	-48.00

Data source: 2009 state farms statistical data and 2014 survey

contractors must sell latex or dry rubber to the rubber factories of state farms, must obey the land acquisition for purposes of government construction project.

In addition to the original formal workers and contract workers of the farm, family members of many workers, temporary workers, and even the people who had been fired due to personal fault or illegal problem, as well as in previous years, the people who did not pay the fees and other issues, are involved in the contracting rubber plantation of the farm (Figure 20). One of the most obvious benefits of doing this is in large extent promoting the employment rate of the farm population (Table 10). The employment rate is the ratio of the population who are working in state farms and receive remuneration payment divided by the total population aged 16 and over who are capable to work in the state farms.

In these people, although the household registration of some people is in the farm, but they never had a labor relationship with the farm; or they had taken another stable work outside the farm since many years ago; or they are the children of workers who study and work in other cities, also require contracting the rubber plantation.

The whole number of contractors in two farms was changed from 10,154 in 2009 to 20,741 in 2013, more than 2 times. At the same time, the total area of rubber plantation

decreased from 23,760 to 19,289 because of the urban construction, etc. That leads to per capita contract area reduced from 2.34 ha to 0.93 ha. Since the contractor's area is generally small, the main business of contractors also has undergone tremendous changes. The ratio of a contractor who takes rubber cultivation as the main business reduced from 100% to 66%.

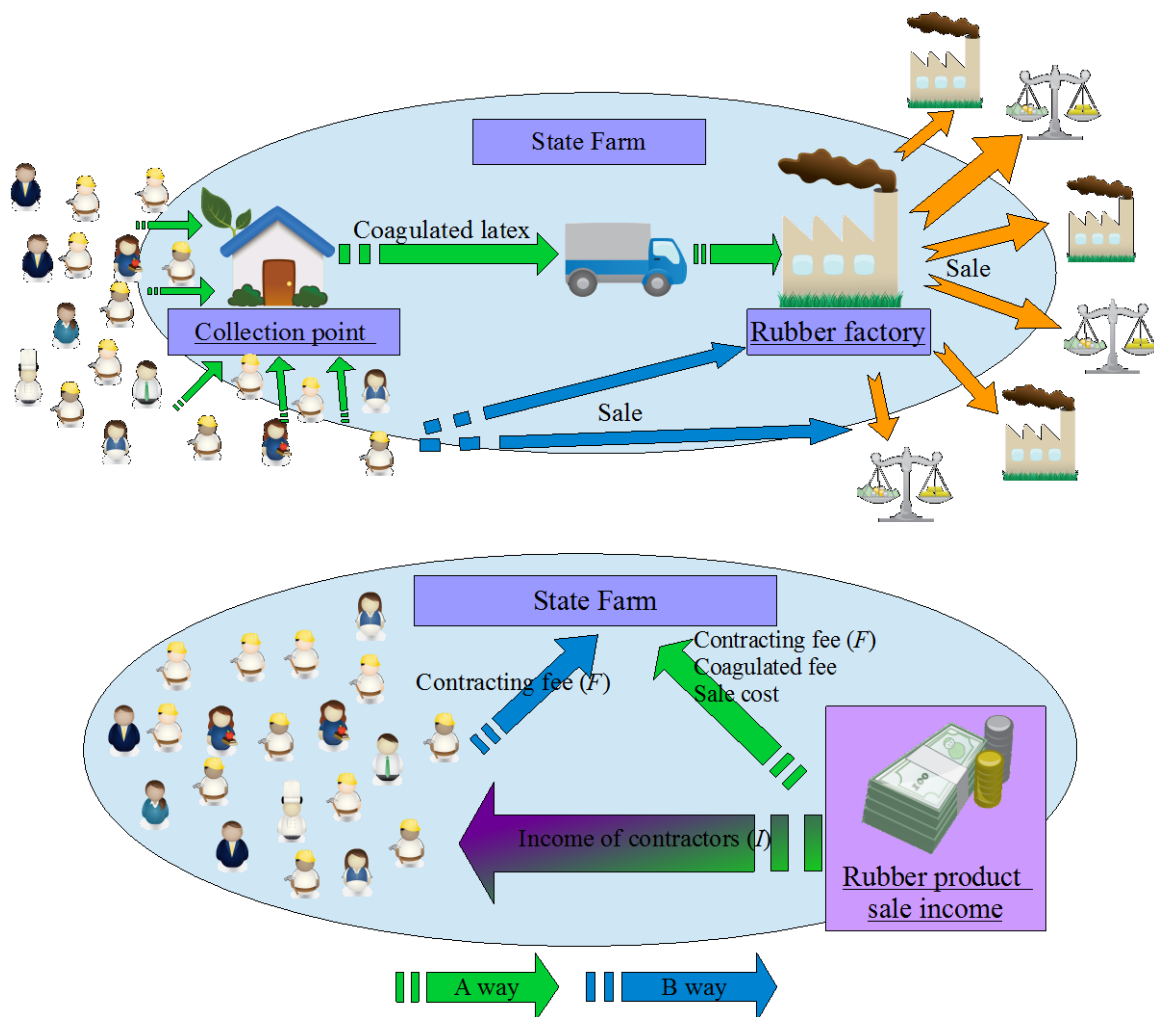
Before the reform, the state farms stipulated that, no matter the formal workers, contract workers or temporary workers, only those who passed formal training and assessment of the farm, could formally work in the rubber plantation of the farm; and an annual assessment of the worker's technical level would determine next year whether they could continue to work in rubber cultivation or not. Unqualified workers should pay the penalty and even returned to the training phase until passing the examination again.

After the reform, the level of training for planters decreased badly. In our 50 respondents of the survey, only 32 people used to have experience in planting rubber, accounting 64%, in which only 26 people used to engage in rubber plantation for a long years and had received formal training of cultivation more than 3 times, accounting for only 52%.

### **5.5 Contracting fee and income of contractors**

Before the reform, due to undertake a variety of non-corporate functions, in order to run correctly, the financial burden of state farms pressured on workers. The paid proportion of rubber workers was high, accounting for 65%-70% of rubber product sales. The income of rubber workers was low. In 2009, the statistical average wage of farm workers only 9,697 yuan per capita (informal workers' income was lower), less than 40% of the average wage of Yunnan (26,992 yuan). However, employees' social insurance base was the average wage of Yunnan in the previous year, the average annual cost of the social insurance fee was more than 3,000 yuan per capita, and workers' burden was too heavy.

After the reform, according to the Xishuangbanna Prefecture Government Document [2010] No. 45, the contractors must submit latex to the collection point of state farm (Figure 21). The collected latex will be coagulated under controlled clean technical conditions, and then coagulated latex will be transferred to the rubber factories of state farms and be processed into dry rubber or other primary products. The technical coagulated latex can then be processed into the higher-grade rubber products than naturally coagulated latex. State



**Figure 21 Process diagram of rubber production in state farms after the reform according to the Document [2010] No.45**

farm will charge coagulation cost (about 1 yuan/kg) and marketing cost (about 0.4 yuan/kg) from the contractors.

If state farm collects and sale rubber from contractors, state farm can directly charge the contracting fee from rubber sale income, then gives the remaining income to contractors (A way); If contractors sale rubber themselves, they pay the contracting fee to state farm each month or one time (B way).

**Table 11 Adjustment of contracting fee (F) according to the rubber price (P)**

Rubber price (P)	Contracting fee (F)
Less than 14	P decrease 1, F decrease 7%
14-18	6.8
More than 18	P increase 1, F increase 3%

Unit: yuan/kg      Data source: Ph. S., wp. W. (2013).

**Table 12 Proportion of contracting fee by installment in each month**

Month	Mar.~Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.~Dec.
%	15	13	12	11	11	13	13	12

Data source: State farm website. [http://www.yndf.com.cn/Pages\\_100\\_3925.aspx](http://www.yndf.com.cn/Pages_100_3925.aspx)

State farms used 2009's output as the base to determine the standard production ( $S$ ); The standard production ( $S$ ) will be multiplied by the unit price of rubber ( $P$ ) to be the expected sales; The expected sales will be multiplied by the ratio ( $R$ ) to be the contracting fee ( $F$ ). The ratio ( $R$ ) is about 40%, it will be adjusted based on natural disasters and other cases. The basic price of rubber is 16 yuan/kg, state farms will adjust the contracting fee based on the current month market price shown in Table 11. The contractor can pay the contracting fee ( $F$ ) by monthly installment in proportion shown in Table 12.

Let  $A$  be the actual production ( $A$ ) of the contractor, then the  $A \cdot P$  is the actual sales; The actual sales deducting contracting fee ( $F$ ), sales costs ( $C$ ) and taxes ( $T$ ) is the income of contractors ( $I$ ). The calculated formulas are flowing:

$$\blacklozenge F = S * P * R \quad (1)$$

$$\blacklozenge I = A * P - F - C - T \quad (2)$$

However, the reality is not carried out as the foresight of state farms.

On the one hand, contractors do not want to pay the coagulated fees and sales cost, they naturally coagulated latex outdoor in the forest; and according to the price situation, contractors sell coagulated latex to other small rubber factories for getting more income, especially when the rubber price of state farms was lower than other buyer's.

On the other hand, due to the economic contradictions accumulated in the past, some contractors believed that the state farms took too much profit from them in the past. After the reform, the contracting standard changes several times in one year, many contractors do not trust the state farms, and boycott pay the contracting fee.

The government documents had no detail standard, each farm can decide their standard, so there are differences. Contractors compared standard with other state farms, they thought others standard is better than their standard. So they ask their state farm to change the standard. For example, the ratio of contracting fee, it can be from 35% to 45%.

Some standard was lack of consideration, when it carried on, some problem arose. For example, at first one of the contracting standard was: 4 units rubber trees for formal worker, 2 units rubber trees for the temporary worker. But not all the rubber trees are the same quality, some contractors were unsatisfactory. After their protest, the standard changed, there are 3 units rubber trees also. After several times, some contractors believed that the protest is useful, when they are unsatisfactory, they protest again.

Plus due to charge decreased from about 60% in the past to about 40% now, the per capita income rapidly increased to 13,201 yuan (Yunnan Agricultural Reclamation average) in 2010, in our survey in 2014, the per capita income reached 14,687 yuan.

In addition, the configuration of contract resources among the families is largely different. The allocation of resources in each family is imbalance. In the guiding principles of "One farm one policy, one team one case" from Document [2010] No. 45, each unit of rubber plantation resource is about 100 rubber trees. However, because of the differences in the

varieties of rubber tree, micro-environment such as sunlight, temperature, water, air, soil and other natural conditions, the unit amount of resources is not fixed.

From the perspective of the individual contracting amount, formal workers are 4 units, temporary workers are 2 units, while there also has the configuration of 3 units. The quality and quantity of the rubber plantation among individuals are different, which caused an income gap among individuals. The per capita income was from 10,410 yuan to 48,990 yuan in our survey.

From the perspective of the family, due to the expansion of contractors, as well as differences of member family scale, there is a large difference in the amount of resources among the family. Contract units per family is from 2 units (Minimum) to 12 units (Maximum); the number of tapping rubber trees per family is from 240 (Minimum) to 1,320 (Maximum). It is an important factor of uneven distribution, which is leading to the large difference of the total resource allocation in each family, and an important factor in causing income gap among families. The income per family was from 11,520 yuan to 126,720 yuan in our survey.

## **5.6 The management of rubber saplings**

In our survey, 24 people from 50 different families contracted rubber sapling plantation (per capita contracted area is 0.89 hectares); Table 13 shows the salary for management of rubber saplings. The salary is a little different according to the difficulty of managing saplings. Table 14 is the comparison of the management of saplings before and after the reform.

Before the reform, state farms required workers to manage rubber saplings in strict accordance with the management standards, including fertilizing, weeding, pruning, pest, etc., to create favorable conditions for the growth of rubber saplings. Production teams checked and assessed the quality and quantity of managing work; the results would directly influence the income of workers. At the same time, state farms can also keep track of the rubber saplings growth situation and make adjustments in time. The sapling survival rate was 96.6% and the average growth per year was 24.9 cm.

After the reform, the original mode of management was broken, which changed from

**Table 13 Annual salary for management of rubber saplings** Unit: yuan/ha

Descriptive	1-3 years old sapling	4-6 years old sapling	7-9 years old sapling
Salary	2850	2250	2400

Data source: 2010 Jinghong farm contracting regulations

**Table 14 Comparison of the management of saplings**

Descriptive (Unit)	2009	2014	Differences
Per capita management area (ha)	3.99	0.89	-3.10
Survival rate (%)	96.6	89.4	-7.2
Annual growth (cm)	24.9	21.5	-3.4

Data source: 2009 state farms statistical data and 2014 survey

intensive management to decentralized management. Because of the limitations of resources, the actual rubber saplings area assigned to each contractor is only about 0.89 ha, currently there is no output, only a little salary shown in Table 13, so most of the workers are not willing to spend time and effort to manage rubber saplings. The effectiveness of rubber saplings management obviously decreased. The sapling variety and quality of state farms were excellent in the past, smallholder farmers and private rubber cultivation people were eager to buy, but now, it is hard to sell even the rubber sapling's price of state farms has dropped to nearly half the market price.

**Table 15 Comparison of tapping technology**

Descriptive (Unit)	2009	2014	Differences
Per capita tapping task (trees)	851	406	-445
Tapping frequency (%)			
✧ d/2	4.50	53.00	48.50
✧ d/3	47.00	12.00	-35.00
✧ d/4	48.50	4.00	-44.50
✧ Randomly	0.00	31.00	31.00
Average number of tapping* <sup>1</sup> (cut/year)	81	132	51
Average bark consumption* <sup>2</sup> (cm/year)	17.5	36.5	19
Newly increased TPD* <sup>3</sup> rate (%/year)	0.57	32.50	31.93
Rate of wounded tree (%)	5~20	100	80~95

Data source: 2009 state farms statistical data and 2014 survey

\*<sup>1</sup> and \*<sup>2</sup>: Because the total bark area of the rubber tree is limited, the less tapping number and less bark consumption mean the longer producing years.

\*<sup>3</sup>TPD (tapping panel dryness) is a complex physiological syndrome widely found in rubber tree plantations, which causes severe yield and crop losses in natural rubber-producing countries.

## 5.7 Tapping technology for mature rubber

Tapping is a high technical content work. Before the reform, state farms trained workers to improve tapping accuracy every year, and made strict planning schedule and tapping



method for different natural situations, in order to maximize the production cycles and the output of rubber production. In addition, drug stimulation, soil testing fertilizer and others had strict rules. Production teams checked and assessed tapping work, and the results would decide reward or punishment for workers.

It is easy to find out in our survey in 2014, the level of management and tapping decrease badly (Table 15). Driven by the interests, tapping frequency of contractors changed from one cut every 3 or 4 days to one cut every two days, even two cuts in one day, and according to the change of market price rather than natural conditions, to decide whether to do more tapping. Varying degrees of bark damage arises.

On the other hand, due to the lack of training and supervision, the management of rubber plantations is optional. The contractors use less fertilizer or low-cost low-quality fertilizer, or even without fertilization; capacity for responding to tree disease or pests is weak. These influences will reduce the production life and the total production of rubber trees.

## **5.8 Discussion**

After decades of exploration and improvement, state farms summed up a high yield producing management system. For rubber workers, the state farms formed a complete rigorous training and assessment system, technically ensured years of high-yield and sustainable development of rubber plantation.

The reform is highly controversial so far, but from the point of sustainable development of rubber resource as well as the long-term interests of farm workers, the problems far outweigh the benefits caused by the reform.

First, the employment rate has promoted greatly which has played a certain role in the social stability in border areas.

However, in the absence of other policies to increase employment situation, this promotion is limited to digital surface. In essence, it is a kind of dilution of the employment rate. More people participated in the allocation of fixed amount of resources; it is equivalent to the original full-time workers allotted part of the work to the unemployed.

Therefore, compared to the past, the situation that more people (the original full-time workers and new entrants) need to find another job would appear after the reform. The

reform had failed to effectively integrate and strengthen the rubber industry chain of Xishuangbanna (worse still even weaken the existing advantages), and state farms did not create more opportunities of employment. It did not fundamentally solve the problem of labor surplus in state farms.

Second, the per capita income of workers has improved significantly, which improved the living standards of workers, many people bought a new car within one or two years and built a new house. But this increase is at the price of destroying rubber resources and unsustainable development.

There are a variety of reasons for the crazy tapping by contractors:

Reason one is the qualification of contractors. In order to solve the unemployment and reflect so-called fair, the state farms ignored the particularity of rubber, contracted the high-quality rubber plantations without limiting the contractor's rubber cultivation and tapping technical level. It led to the rubber resources have been severely damaged, and even led to some rubber trees were going to scrap in the short term.

Reason two is the contract period which is until the retirement of contractors. In order to get more money through the rubber before retirement, approaching retirement contractors desperate tapped the rubber trees in the short term.

Reason three is the contracting area. The contracting area generally reduced, the unit cost of small-scale cultivation has risen instead. The contractors do the maintenance work and pay the expense themselves. They recovered the more cost through tapping more.

Third, state farms lacked restraint to the contractors and the rubber management. Another important factor of contractors' income growth is they did not pay the contracting fee. This is an occupation of some part income of the state farms. After the reform, as the main income source of state farms, the contracting fee is not only important for the operation and development of the state farms, but also important for the insurance fee and training fee of workers, as well as the future update fund of rubber plantations. The lack of funding will result in serious consequences.

For example, in 2013 over 430 hectares of rubber plantations in Dongfeng farm was damaged by hail disaster, but fortunately the farm had bought policy insurance for the contractors early, the contractors had gotten 2.5946 million yuan of insurance compensation.

If in the future there is no money to pay the insurance fee, the contractors will bear the risk of huge losses caused by disasters. However, there was no strong legal protection of rubber plantation, in addition, the government used to give benefits and compromise to frontier minorities in order to safeguard stability. Therefore, for those contractors who did not pay contracting fee as required and had destructive behavior, state farms neither could to compulsively collect the contract fee, nor dare to forcibly withdraw the rubber plantations. Even the data of actual production is difficult to accurately collect because of the contractors sold rubber secretly.

Fourth, from the perspective of the rubber industry development in Xishuangbanna, the region itself did not have deep processing capacity of rubber products, only limited to the raw material which is the upstream of the industry chain. The rubber enterprises of Xishuangbanna highly depended on the downstream of industry chain. In the past, with leading technology and large-scale cultivation of advantages, rubber enterprises have been known for a steady yield of high-quality rubber, and have long-term good relationships and trust with some large enterprises. Today, unstable quantity and quality of latex were seriously affecting the operation of the rubber business. At the same time, neighboring GMS countries such as Myanmar have been the rising stars added to the rubber market competition. The current rubber production mode and operating results will make Xishuangbanna state farms losing their rubber industrial advantages in the future.

In short, rubber is a long-term cash crop, scientific cultivation methods and technologies severely affect the output and longevity of the rubber tree. These impacts will be sustained, slowly appearing. If the deficiencies of the reform will not be improved as soon as possible, the existing advantages of state farms and the sustainable development of the rubber industry in Xishuangbanna are very worrying.

## Chapter 6. Conclusion

As an important area of the upper basin of the Mekong River, Xishuangbanna had long been poor and desperate for development. The rubber plantation had brought new wealth to the local people and affected the agricultural economy and other aspects of Xishuangbanna, which will further affect the whole GMS area. Nowadays, this area is attracting more and more attention of researchers all over the world. The main outcomes of this study are as follows:

First, the income of rubber is high compared with other traditional crops in the same area of land, especially with the rapid rise of rubber prices since 2000. The income of rubber-planting households is much higher than the income of those only planting other crops. From a macro point of view, the rubber industry has also attracted a number of external capitals, which pulled the rapid increase of the local economy and improved the whole living conditions of local residents. The per capita income of planters have improved significantly, which improved the living standards. But this increase is at the price of destroying tropical rainforest and unsustainable development of rubber plantation.

Second, the rubber plantation history and the results of the survey indicated that rubber planters in Xishuangbanna (including smallholder farmers and state farm contractors) increased their income mainly by the expansion of the rubber area. But now it is no longer a feasible way. The area of rubber plantation for smallholder farmers is generally small and cannot be expanded any more. After the reform, the rubber plantation for each contractor also reduced to small pieces of the area. The unit cost of small-scale rubber plantation has risen instead. The economies of scale of the big-scale rubber plantation do not work for both smallholder farmers and state farm contractors.

Third, the results show that the cropping system in Xishuangbanna has become more simplified since 1980s when rubber plantation expanded. As higher returns from rubber plantation compared with other crops, smallholder farmers and state farms were more willing to invest capital in the rubber plantation. In addition, the planters cannot interplant

other crops more than 25 years in the rubber mature stage. Gradually, smallholder farmers and state farms planted rubber on almost all the land where rubber could be planted, abandoned many traditional crops, such as paddy, glutinous rice, vegetables and so on. Compared with the self-sufficiency mode, farmers would rather buy the necessities of life with the income from rubber. Due to the monoculture of cropping system and high dependence on a rubber plantation, the risk of both of smallholder farmers and state farm contractors is high, especially when the rubber price fluctuates wildly and natural disaster comes. And the monoculture of rubber is also a double threat of agro-biodiversity and food security.

Fourth, rubber is a long-term cash crop, the scientific cultivation technologies and the high productivities severely affect the output and longevity of the rubber tree. Nowadays, the scale of rubber plantation of smallholder farmers has already exceeded state farms in area and production in Xishuangbanna. However, the productivity of smallholder farmers has always been low for the reasons of education level, etc. Even worse, affected by the reform, the state farms contracted the high-quality rubber plantations without limiting the contractor's rubber cultivation and tapping technical level. It led to the productivities of contractors rapidly decreased, and the irreparable damage occurred to the rubber plantation of state farms.

Fifth, in addition to the destruction on high-quality rubber plantation, the reform brought other adverse impact to the state farms. The difficulty of charging the contracting fee maybe cause the financial deficit. As the main source of state farm's income, the contracting fee is not only important for the operation and development of the state farms, but also important for the insurance fee and training fee of workers, as well as the future update fund of rubber plantations. The lack of funding will result in serious consequences.

The results of this study showed the weak status of the rubber planters and the whole rubber industry in Xishuangbanna behind the seemingly prosperous growth of the rubber plantations. The theory of the world system and the periphery theoretically can explain the current situation of rubber plantation in Xishuangbanna, and the unequal role in the world rubber industry.

From the perspective of the rubber industry development in Xishuangbanna, the region

itself did not have deep processing capacity of rubber products, only limited to the raw material which is the upstream of the industry chain. As one of the most typical feature of underdevelopment, lack of linkages between different productive sectors, the Xishuangbanna (periphery) plays the role of exporter of raw materials-rubber. Because of this “unequal specialization” [Amin, S. 1976], the rubber enterprises of Xishuangbanna (periphery) highly depended on the downstream of industry chain located in other provinces and countries (centre). Finally, the end products of rubber industry such as cars are sold with high price to the rubber planters in Xishuangbanna, which takes more surplus from the periphery.

Today, the low and unstable quantity and quality of rubber production were seriously affecting the operation of the rubber business in Xishuangbanna. At the same time, neighboring GMS countries such as Myanmar have been the rising stars added to the rubber market competition. The economic growth pattern of Xishuangbanna, which focusing on the raw material production, will make the situation of underdevelopment in this periphery area worse in the future.

Therefore, to enhance productivity and increase the return on invested capital based existing scale of rubber plantation is considered to be a feasible way, and there is still a great space of rise to improve the cultivation technology. Due to the particularity of rubber, the government should improve the land policy to encourage the merger of small-scale and low-yielding rubber plantations for large-scale cultivation by professional person or organizations to use the limited resources more effectively and reduce costs. Also the government needs to strengthen legislation to protect the long-term management rights of rubber plantation. In addition, for the planters, the government should increase investment in education and training for rubber cultivation, as well as the supporting of buying sapling and updating of rubber plantation.

Furthermore, according to the theory of periphery, to improve the unequal situation in the world system, Xishuangbanna should develop the other productive sectors of the rubber industry chain, such as the deep processing, the high-level of rubber products and even the automotive industry. It also can supply more employment opportunities and absorb the labor surplus from the merged rubber plantation. By the mutual promotion of productivities

among productive sectors, the transmission of economic benefits throughout the local economy of the Xishuangbanna (periphery) could be achieved, instead of flowing to the centre. Through above approach, the rubber plantations can become advantageous resources to bring real development to the Xishuangbanna area.

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## Appendix 1.

### 1960~2011 Basic statistical data of rubber plantation in Xishuangbanna State Farms

	Planting area	Number of planting trees	Harvested area	Number of harvested trees	Production	Yield per mu	Yield per tree
Unit	10 thou. mu*	10 thou. trees	10 thou. mu	10 thou. trees	tons	kg/mu	kg/tree
1960	4.3607	62.6389	0.01	0.0549	0.365	3.65	0.66
1961	4.9751	134.1327	0.01	0.4243	2.597	12.99	0.61
1962	3.9198	116.0442	0.01	0.5855	6.332	31.66	1.08
1963	7.3671	191.9108	0.04	1.0498	9.795	24.49	0.93
1964	9.1866	246.0541	0.09	3.7223	26.829	29.81	0.72
1965	12.3657	334.9193	0.3	8.9881	48.9	16.30	0.54
1966	16.6411	451.4061	0.81	15.4051	127.542	15.75	0.83
1967	21.7412	479.2786	0.83	18.4216	187.1088	22.54	1.02
1968	23.6016	652.3449	0.84	19.7384	187.6328	22.22	0.95
1969	25.9221	699.915	1.2	26.1982	255.56	21.30	0.98
1970	27.4068	735.7361	3.39	69.0148	731.35	21.57	1.06
1971	32.3401	847.6009	6.39	131.4078	1722.69	26.96	1.31
1972	34.896	831.8018	11.78	166.833	2931.957	24.89	1.76
1973	40.5962	992.6516	12.1	182.9635	3675.639	30.38	2.00
1974	40.8216	980.1942	10.12	102.8883	1767.078	17.46	1.70
1975	30.1013	679.3593	17.19	211.5743	4837.105	28.13	2.30
1976	30.2861	664.7453	16.0105	140.53	3539.975	22.20	2.53
1977	32.4125	711.3019	16.2397	252.478	7146.106	44.10	2.83
1978	42.8171	992.1541	17.5745	276.6068	9257.197	54.60	3.33
1979	43.2906	997.3791	17.0359	268.2246	9474.081	55.61	3.53
1980	48.4729	1116.9951	17.8409	283.9647	10937.27	61.30	3.85
1981	53.5447	1275.6639	18.3868	303.6791	11996.88	65.25	3.95
1982	58.9361	1441.6556	19.6338	326.92	13992.81	71.27	4.28
1983	61.6321	1488.4	20.3971	347.2	15765.39	72.80	4.54
1984	63.9963	1542.04	21.449	379.13	18441.85	79.22	4.86
1985	67.8109	1685.688	24.0322	420.22	19453.68	75.26	4.62
1986	71.7177	1775.5043	29.5918	532.63	25003.21	79.72	4.69

	Planting area	Number of planting trees	Harvested area	Number of harvested trees	Production	Yield per mu	Yield per tree
1987	73.3919	1810.215	36.384	618.47	28852.39	79.04	4.66
1988	74.3355	1826.7924	43.5043	760.4644	34942.04	77.90	4.59
1989	75.0261	1845.7282	50.6129	924.02	44970.15	86.90	4.87
1990	75.8179	1860.8344	55.2772	1044.18	50124.44	89.70	4.78
1991	77.3193	1901.168	59.2318	1154.19	56293.61	94.50	4.88
1992	78.5134	1923.6325	62.7335	1256.6	60964.26	97.13	4.85
1993	79.791	1969.7181	66.1272	1342.27	67974.71	102.30	5.06
1994	78.1794	1890.27	67.7111	1399.21	76624.55	113.16	5.48
1995	79.11	1997.27	68.9842	1464.6	83894.6	121.60	5.70
1996	83.43	2070.3	70.1885	1489.05	87050.59	124.16	5.85
1997	89.92	2283.29	70.45	1532.13	88657.89	125.80	5.80
1998	96.95	2497.57	71.72	1535.16	91862	128.08	5.98
1999	103.06	2628.41	73.18	1533.11	96229.54	131.53	6.28
2000	103.8	2669.55	74	1567.28	95649.8	129.20	6.20
2001	104.7	2675.77	75.22	1555.93	95330.94	126.70	6.10
2002	105.29	2683.66	76.12	1558	103968.3	136.58	6.67
2003	109.65	2747.68	78.23	1602.49	108046.5	138.12	6.74
2004	110.1	2748	81.92	1606.34	98757.23	120.57	6.15
2005	109.84	2713	81.95	1658.81	99000	120.77	5.89
2006	109.83	2709.49	81.71	1707.87	101300	124.05	5.93
2009	140.7	null	96.5	null	105000	108.81	null
2011	167.1	null	114.5	null	109000	95.20	null

\*mu is a unit of land area which is used in rural China. 15 mu = 1 hectare

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Appendix 2.

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**Survey on rubber plantation in Xishuangbanna Prefecture**

Household code No.\_\_\_\_\_

Date of interview:2012.12.\_\_\_\_\_

Location: Group\_\_\_\_\_Village\_\_\_\_\_Town\_\_\_\_\_

Name of head household : \_\_\_\_\_ Name of interviewer : \_\_\_\_\_

### 1. The basic information of household members

Household members	Head						
Relationship with head:							
Sex							
Age							
Ethnic							
Can speak Chinese? Yes/No							
Household register type: Rural/Urban							
Education							
Rubber relative training (engaged)							
Occupation	Primary						
	Minor						

### 2. Agricultural production situations

	Contract area	Rent in	Time	Area	Fee	Rent Out	Time	Area	Income	Actual operating area
Rubber plantation										
Paddy fields										
Upland										
Fishery										

**3. Main crop cultivation**

	Varieties	Season		Annual output	Own consumption	Annual sales	Sales Price	Income
Rubber								
Grain								
Sugar cane								
Vegetable								
Fruit								

**4. Rubber cultivation calendar**

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Activity												
Rubber production												

**5. Labor usage in rubber plantation**

Labor source	Labor time	Payment type	Payment/ day
Household members			
Hire labors in same village			
Hire labors from other places (_____)			



**6. Rubber sapling usage**

Varieties	Time	Area	Nos.	Purchases source	Purchase price	Annual growth	Survival rate

**7. Fertilizer and pesticide usage**

	Time	Usage (owned)	Usage (purchases)	Purchases source	Subsidies	Purchase price
Manure						
Fertilizer						
Herbicide						
Pesticide						

**8. Farming Assets**

	Nos.	Purchasing price	Obtained time	Funding source	Service life period
Cattle / horses / donkeys / mules					
Tractor					
Irrigation pumps					
Sprayer					
Weeder					
Generator					
Others					

**9. Rubber cultivation and tapping**

Growing experience (years)	Whether Inter-planting Other crops	Inter-planting area	Whether does under Forest breed	Under forest breed amount

Varieties	Tree-age	Planting density	Tapping system	Daily tapping task	Tree disease

**10. Expenses of rubber plantation**

	Time	Type	Amount	Unit	Per unit price	Expense
Irrigation						
Tapping tools						
Drying latex						
Prevention of burglary						
Rent machinery						

**11. Selling income of latex and dry rubber**

	Quality level	Customer	Sales area	Selling amount	Purchasing price	Income of selling
Latex						
Dry rubber						

**12. Selling fee of rubber**

	Process fee	Storage fee	Transportation fee	Handling charge	Other fee
Latex					
Dry rubber					

**13. Other income and expenditure of household members****13-1 Other income**

Household members	Head				
Income from other crops farming (_____)					
(_____)					
Income from other agricultural activities (_____)					
(_____)					

Income from other rubber related activities (_____)					
(_____)					
Income from non-agricultural activities (_____)					
(_____)					
(_____)					

### 13-2 Other expenditure of household

	Per day (a) per month (B) Per year (C)	Total Expenditure (A) x 365 (B) x 12 or (C)
Foods		
Clothes		
Education		
Fee (electricity, fuel charges, etc.)		
Entertainment expenses (Congratulatory gift, etc.)		
Housing (Rent or Repair etc.)		
Tax (Land tax, income tax, etc.)		
Transportation		
Amusement (karaoke, alcohol..		

#### 14. Luxury living facilitates

Type of assets	Number of units	Original cost (yuan)	Year acquired	Method of acquiring fund
TV set				
Video				
Refrigerator				
Air-condition				
Cars and trucks				
Motorbikes				
Mobile phones				
Others				

#### 15. Awareness of the smallholder farms

(1) **Problems in your Production (Please choose 2 problems among the following distinguishing first and second)**

Land area		Soil, water		Disease, pest		Natural disaster	
Varieties		Knowledge and skill		Lack of labor		Market price	
Cost of production		Loan problem		Experience		Others	

(2) **What is your perspective** (Please select 1 or 2 items)

1. Enlargement of land scale

2. Keeping actual situations

3. Contraction of land scale

4. Diversification or Intensification of Farming Systems

What do you want to cultivate in the near future? ( )

3. Simplification of cropping pattern

6. Reliance to the non-agricultural activities.

What do you want to do as non Agri-activities? ( )

7. Remove to other places

Where do you want to go? ( )