Chapter VI

DISCUSSION: DRIVING FORCES OF LAND USE CHANGES

With agro-ecosystem perspective method which was mentioned in section 3.4, main socio-economic factors which influenced land use in this area were found to be population, marketing, technology, infrastructure, tourism and government intervention. The role of each is summarized in this chapter.

6.1 Population Pressure

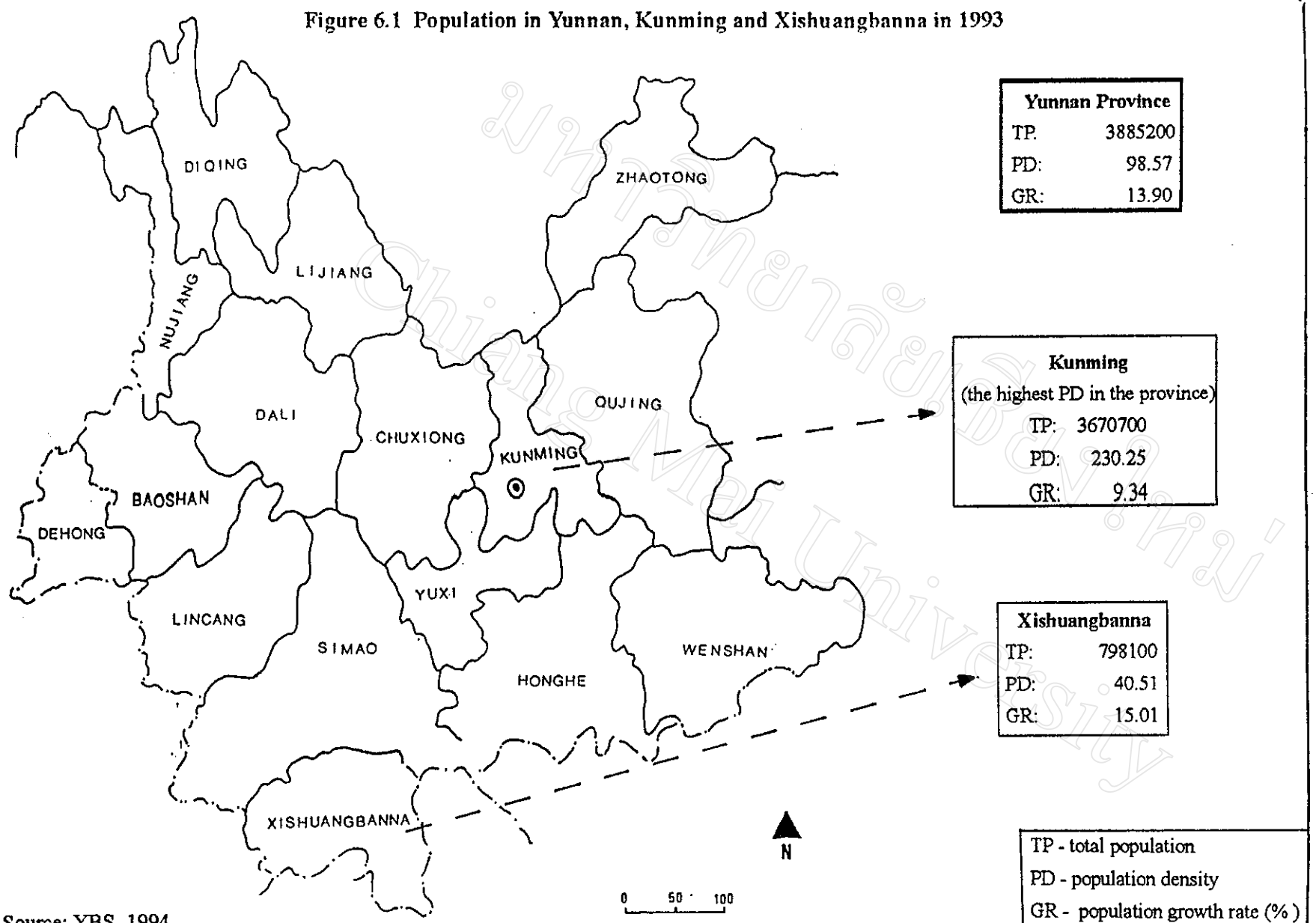
Population pressure on resource utilization in Xishuangbanna was referred in many study (Wang et al., 1990; Xu, et al., 1987). Even the population density in Xishuangbanna is lower than that of the whole province, but its population growth rate is higher than the average level of the province (Figure 6.1).

Population pressure on land use was well recognized by farmers themselves. The increase of population in three villages is notable in the last 45 years.

In 1963, there were only three households and 17 people in Manzhang when they moved to present place. After 31 years, the households in the village increased to 20 and population increased to 98 in 1994. During this period, average land area per capita decreased from 107.6 mu to 18.7 mu.

In Medeng, there was only around 40 households in 1967 when the village moved to present place. In 1979, it increased to 60 households, and a fire damaged almost half of the houses in the village, with a result that more than ten households moved out to establish another village in the territory. Households in the village increase to 60 again with the population of 313 in 1994. In the territory, the number of village also increased from one

Figure 6.1 Population in Yunnan, Kunming and Xishuangbanna in 1993



Source: YBS, 1994.

to two, and households increased from around 40 to more than 80 in total.

Similarly, there was only 12 households in 1971 when the villagers of Baka moved to present place from the old village, and additional 30 households moved in in the following year. In 1994, the households increased to 56 and the population increased from 164 in 1973 to 258 in 1994. Meanwhile, the land area per capita decreased from 53.4 mu to 23.8 mu in the same period.

For all three villages, population increased rapidly during the period from 1970s to the middle of 1980s. After that, population increased relatively slow because of the birth control policy. Actual population trends in the last ten years in the three villages is shown in Figure 6.2. However, due to the short period of the available statistics and birth control policy as well, population increase is not significant in the data period, and the population pressure on land use could not be reflected in the area response function, so this variable was deleted from the model.

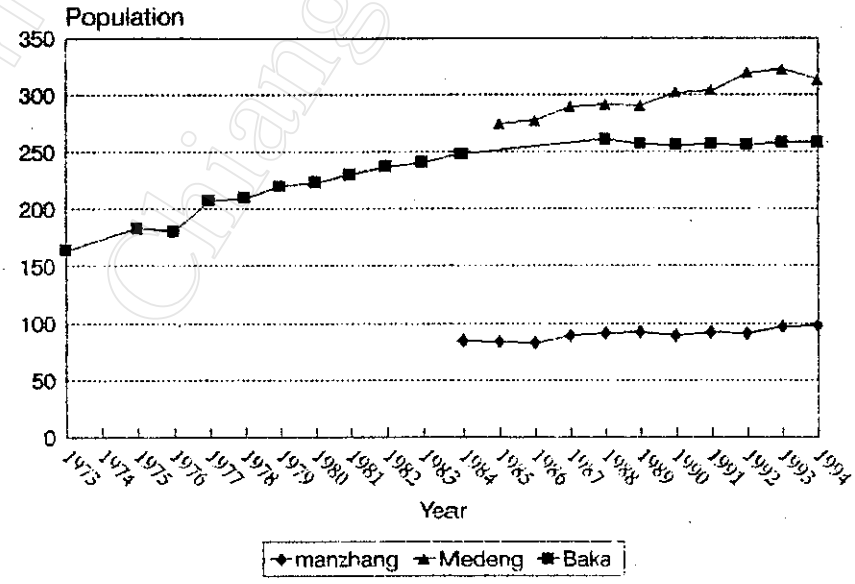


Figure 6.2 Actual Population Trend in Three Villages
Source: Village statistics.

Population pressure on land use was well recognized by the farmers. The direct indicators in farmers opinion were extension of cultivated area, extending cultivated period and shortening fallow period on upland. This had a part to cause forest degradation. On the other hand, changes in cultivated period and fallow period led to significant land degradation. Some land could not be cultivated any longer because long cultivated period prevented land from restoring fertility. In farmers' thought, weed problem for upland rice plantation was directly caused by shortening fallow period.

6.2 Technology

As in other Asian countries, agriculture in China has also been strongly influenced by the so-called "Green Revolution". Some modern varieties especially hybrid ones were successfully introduced throughout the country. This led to significant increase in both production and productivity. Meanwhile, machinery use in agriculture, and the applications of chemicals including fertilizer, pesticides and herbicides, have been the important contributors to the agricultural production increase as well (Yuan, 1993).

In the study area, hybrid paddy rice variety was widely introduced into the village during the period of 1982 to 1985, and it occupies almost all the paddy land in the sample villages now. Some of the farmers also plant hybrid maize on the upland, especially in Baka. In the last fifteen years, some new varieties such as watermelon, chili, rubber, etc. were introduced into the area and became the important crops in the area sharing a big part in farmers' cash income. Rubber is commonly accepted in all villages while watermelon and chili are more acceptable in Manzhang.

Accompanying the successful introduction of some new varieties, fertilizer was rapidly applied in the area for hybrid paddy rice, watermelon and rubber. With the changes on land use i.e. shortening fallow period on upland land, herbicides had to be used for upland rice in Baka and Medeng to keep the productivity.

Even though some extension work had been done in the application of new techniques in the village, but some new techniques still not function fully due to many reasons. For instance, not so good tapping skill of farmers for rubber led to low productivity.

China had quite a good agricultural extension network before 1980. At prefecture level, there was an agricultural research institute which is responsible for transmission of new technologies from the provincial academy and even from the national agricultural academy within its own region. Each county and each township had agricultural technique experimental and extension stations which extended new technology from the higher institution down to village level and transmitted the feedback up to the higher research centers (Yuan, 1993). After land reform, agricultural research academy or institute at both provincial and prefecture levels, and the extension agency at county level, are still running, but the extension service at both township and administrative levels has already decomposed or not function well. In the study area, government at township level has been trying to resume the function of extension service station in township level in the last 15 years, and a lot of work has been done by the station such as extension of hybrid varieties and new varieties, providing fertilizer and so on. But there still was some difference on the extension work between two extension stations at township level in the study area. With more Dai people in Menglun Township, the extension station laid stress on the techniques of paddy land e.g. fertilizer application for paddy rice; meanwhile,

extension station in Jinuoshan Township paid more attention on upland techniques because almost all the residents are Jinuo who have the tradition of shifting agriculture.

With the development of marketing, private sector also joined the new technology extension work for commercial purpose in the area. Watermelon and chili were introduced into the area by the merchant with the contract.

6.3 Infrastructure

Chinese government has attached great importance to infrastructure for agriculture, and it claimed that "Infrastructure is the lifeline of agriculture". The most important components of infrastructure for agriculture in the study area are transportation and irrigation systems.

6.3.1 Transportation

Comparatively, topography in Xishuangbanna is more gentle, so the road system is relatively better developed than in other places of the province. All the township and more than 80% of villages in the prefecture are opened to traffic. As the joint of two counties, two main highways of the prefecture pass the study area which is called Jinghong - Menglun highway and Mengyang - Mengla highway. Mengyang - Menglun highway was built in 1970s, it was the first highway which linked Mengla County and Jinghong County, and it was the only access for the study area to transport the essential input and surplus of agricultural production. Jinghong - Menglun highway was established in 1985. and it became the main access to link two counties. With the development of marketing and

tourism, these two highways became the most important for the farmers in the area. They have brought a lot of customers including the tourists and the merchants into the area. This encouraged the increase of agricultural production according to the various demands. Meanwhile, the highways made it possible to plant some high input crops such as rubber by making convenient input transportation. There is no doubt that the development of transportation condition plays a great role in the commercialization of agricultural products, thus leading the agricultural production to change from subsistence to market-oriented.

On the other hand, this access also plays the role in resource degradation in certain extent. Some natural resource such as timber and wild animal were not only gathered and hunted for local subsistence, but also exported for cash income. According to the interview, there was a notable increase in timber gathering after 1985 when the Jinghong - Menglun highway was established.

6.3.2 Irrigation System

Before the application of land reform policy, irrigation system used to be taken care of and invested by the government in China. After 1982, the government still took the responsibility to manage the big irrigation projects such as reservoir and canal. The investment of small scale irrigation projects covering many villages were usually arranged by township government or county government, but the smaller scale irrigation projects which only involve few villages could not bring to government's attention. Meanwhile, " Household Responsibility Production System" has made the committee of the village -- the grass-roots organization of the government almost lose its power, and very difficult for it to collect enough fund for developing and maintaining various facilities at village level. In the

village, the benefit which can be gained from the irrigation project varies from household to household, so the fund for building and maintaining irrigation system is more difficult to be collected than that for other facilities, such as for getting the electricity.

All three villages have the serious flood problem due to heavy rain which made some households lose all of the paddy land. So it is very urgent to build the dike in three villages. Before the application of "Household Responsibility Production System", irrigation system was built by the government, and an official at village level was responsible for ditch net management and repair. In the last 15 years, lack of the management and repair of ditch net has led to problem of irrigation, as such some of paddy land cannot be irrigated well, which has impact on the productivity and land use. For example, some paddy land in Manzhang cannot be used for watermelon only because of water constraint.

6.4 Tourism

Xishuangbanna is a popular tourism attraction in China which is famous for its rich resources of flora and fauna, and multi-nationalities with varied and colorful customs. In recent years, the tourists in Xishuangbanna increased rapidly, according to the estimation, there were about 150,000 to 200,000 people coming to visit Xishuangbanna per year. Tourism has become more and more important sector in the prefecture.

Menglun is famous for the Menglun Tropic Botany Garden, a science research base of the Chinese Academy of Science. Almost all the tourists who come to Xishuangbanna would visit here, but most of them do not stay overnight in Menglun. An average of 500 outsiders per day throughout the year (during Songkarn Festival, the

number is almost twice) bring a big demand for food, souvenir and services. There was a marked increase of vegetable production in 1980s directly because of the increase of tourists. Consequently many new varieties of vegetable such as cauliflower, radish and eggplant were introduced into the area to meet the demand of the tourists. Hunting of wild animals and gathering of wild vegetables and fruits are no longer only for local subsistence, but also for consumption by tourists. Some households made them as the most important cash income source, for instance, one household in Baka got 15,000 yuan from selling butterfly in 1995. This poses a potential risk of damaging natural resources if such activities continue to increase with the increase of tourists. On the other hand, the increase of service demand has led to increasing number of restaurants, bars and other service industry, which attracted young people to leave the agricultural sector. In the sample villages, some young people are employed seasonally in township town or county town even farther, but most of them still come back to help in the busy season. With the greater employment chance, more and more people will be employed outside their farms. However, many farming activities that farmers now adopt and practice need high labor input, so off-farm employment is also the potential factor which will influence the land use in the future.

6.5 Government Intervention

6.5.1 Land Tenure Change

The most important factor of government intervention which caused land use changes is land tenure changes. Before Xishuangbanna was liberated by Chinese

Communist Party in 1950, under the only and absolute land ownership of the highest ruler -- *Zhaopianling*, cultivated land was allocated to the rulers at different levels and villages, and then was distributed to farmers in different way according to the tradition of different ethnic groups. But all the farmers should pay tax for their production activities. However, as the managers of the cultivated land, farmers could made their own decision on land use according to their tradition. After 1950, the new government put all the land under state and collective titles, and people's commune management system was practiced during the period from 1950 to 1982, in which, farmers were divided into production groups, and each group had certain land for cultivation. All the productive activities were organized among the groups following instructions from upper administrative level, consequently, land use was totally arranged by the government, and farmers could not make decision on production at all. Each production group was given the quota of each crop in spite of the different land use traditions of different ethnic groups. And necessary inputs were contributed to each group by the government. Except the amount provided to the government, the members of the group share their harvests according to labor contribution of each member. From 1958 to 1960, the government initiated a campaign called "The Great Leap Forward". The campaign asked farmers to grow more grain crops and to smelt iron. As a consequence, a large amount of forest land was degraded during this period.

Xishuangbanna Natural Reserve was approved for its establishment by The State Council in 1965, but it was not implemented completely until 1977 when The Reserve Station was established to manage the reserve. In the beginning of 1983, all the farmers who lived around the Natural Reserve were not allowed to farm within the reserve. Baka had 3,000 mu upland included into the Natural Reserve, and the farmers could not cultivated since 1977. Even though the government gave back 400 mu forest from state

forest due to this reason in 1990, this had direct impact on land use for farmers shortening the fallow period. In Manzhang, all the land for Chinese cardamon in Natural Reserve was confiscated by The Reserve Station in 1992, so farmers could only plant a small amount Chinese cardamon in collective forest because of the limitation of suitable land. Medeng comparatively was influenced less than the other two villages because the villagers used to plant very little in the area of Natural Reserve, and the cultivated land they lost in the reserve was less than the other two.

After the beginning of 1980s when the Chinese government applied land reform policy throughout the country called "Households Contract Responsibility Production System", decision maker of agricultural production changed from government to farm households, and basic production unit changes from production group to household too. It is widely agreed that implementation of this policy increased productivity greatly. After the application of this policy, almost all the cultivated land and some of the forest in the village were allocated to each household.

6.5.2 Other Government Intervention and Land Use Changes

Shifting cultivation has been widely treated as a backward mode of production. After Xishuangbanna was liberated by Chinese Communist Party in 1950, government tried to change this mode of production to permanent agriculture. In 1950s, the government widely encouraged upland ethnic groups to open paddy land for grain production in Xishuangbanna. During 1952 - 1953, the government helped the villagers in Medeng to open some paddy land beside the river. Later on, farmers continued to open the paddy land in their territory till the maximum -- 220 mu. As the lowest elevation

village in Jinuoshan. Baka was the first village which opened paddy land for rice production in Jinuoshan, and the villagers have kept planting paddy rice in the last 30 years while the villagers of other village started to regularly plant paddy rice after land reform policy. During the period of 1982 to 1985, the government actively extended hybrid paddy rice in this area, and all the households in three villages used hybrid variety.

On the upland, government also applied some regulations to change the mode of production from shifting cultivation to permanent agriculture. In this area, farmers were asked to cultivate land permanently, some fertile land was cultivated without fallow period for more than ten years. This practice made some of the cultivated land become grass land, and could not be cultivated any longer. In Baka, 40 mu terrace was built in 1970s, but it was given up soon for the lack of irrigation system. In 1994, the government provided some subsidy to farmers for building terrace, so the villagers resumed these terrace again, but without the investment for irrigation, farmers still felt that it was very difficult to maintain the terrace for permanent cultivation. Meanwhile, some new techniques and new varieties which included rubber, hybrid maize, etc. were also introduced into the area by the government to achieve the same purpose, and therefore increased the farm productivity greatly.

Quota system that government used to achieve the agricultural development plan of the region or area is distributing down the quota of some crops till the household level. For example, a quota of passiflora plantation was allocated to Manzhang and Medeng in 1993 by the township government because a passiflora processing factory was just built. This quota is not so successful in these two villages, the villagers in both villages thought that they had not enough labor for it. But the surprise thing was that the passiflora was expanded rapidly in Baka which did not receive any quota requirement from their upper

government. Apart from the order, some other ways such as subsidies were also applied by the government to encourage farmers to plant certain crop(s) such as rubber extension in 1985.

6.6 Marketing Development

Chinese government once had centrally planned economic system from 1949 to the beginning of 1980s. During this period, all marketing activities which included supply of production materials and sale of products were controlled by the government. All farmers worked as farm workers following the arrangement of the officials without considering marketing demand. In the beginning of 1980s, the government applied economic reform policy, permitting free marketing system to operate throughout the country, and various agricultural products were allowed to be traded freely gradually. After farmers met their subsistence demand, they had to consider market demand when they made the decision on production (Fu, 1993).

According to government officials, marketing scale and facility improved rapidly in the last 15 years in the study area, and agricultural production in the area changed gradually from subsistence to market-oriented during the same period. Table 6.1 showed that every village has 4 - 5 crops planted mainly for market purpose. And figure 6.3 showed that the commercialization ratio in Manzhang and Medeng increased rapidly in the last 15 years (Baka is omitted because of the lack of statistics). In the study area, the main market is Menglun Town, and the scale of the market enlarged rapidly. To farmers, the functions of this market are mainly retailing of agricultural products and production materials. Only small amount of agricultural products are sold here by farmers, but most of production

inputs including fertilizer, seeds, herbicides, etc. are bought here. With the convenient transportation condition, middleman merchants are the ones who go to each village to conduct the wholesale activities of agricultural products including grain, rubber, Chinese cardamon, watermelon, etc.

Table 6.1 Commercialization rate of each crop of three villages in 1994 (%)

	Manzhang	Medeng	Baka
Paddy rice	0	12.59	36.29
Upland rice	-	3.92	17.54
Maize	76.4	17.77	100
Soybean	-	69.11	17.78
Peanut	27.78	21.93	6.19
Cotton	0	3.23	0
Watermelon	100	100	100
Chili	100	50	-
Chinese cardamon	100	100	100
Rubber	100	100	100

Source: formal survey.

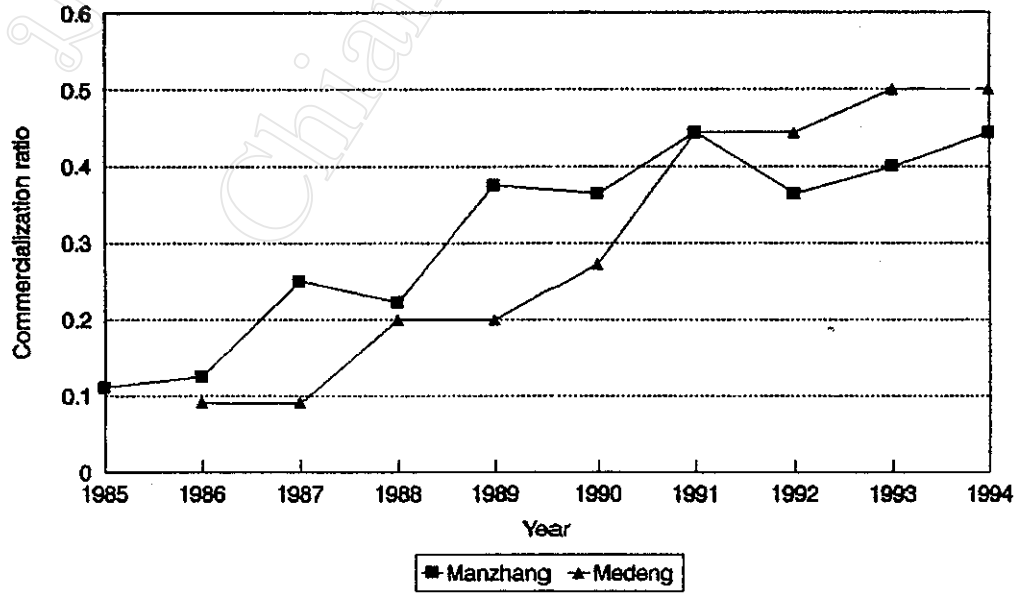


Figure 6.3 Trend of Commercialization Ritio in Manzhang and Medeng

Here an area response function was applied to show impact of price on main crop production for each village. The impacts of other socio-economic factors were already described above, and they are not put into the area response function due to lack of statistics. It is the farmers who directly respond to market information and make the decision on the production. The most direct and effective market information for farmers is price. Also due to the difficulty on data collection, the cost or net profit could not be taken into account. This model is only used to show the impact of price on land use.

$$A_i = f(Pi, Pj)$$

Where A_i = planted area of *i*th crop measured in mu;

p_i = price of *i*th crop measured in yuan;

P_j = price(s) of the competitive crop(s) of *i*th crop measured in yuan.

Because the actual form of planted area - crop price relationship is unknown with certainty, several functional forms were tested. Finally, linear model was found as the generally good functional form for the crops in all the villages. As shown in Table 6.1, rubber and maize are with highest commercialization rate in perennial and annual crops, hence, they are chosen to be the samples for illustrating price impact on land use. And this impact on other crops are analyzed by qualitative method. However, the upland crops including upland rice, maize and rubber competed with each other in terms of land use. With high correlation among the prices of these three crops, the price ratio was chosen as the independent variable instead of the prices of the crops. In the model of rubber, high correlation still exists between price ratios of rubber to rice and rubber to maize. Considering that maize has higher commercialization rate than upland rice (upland rice is

only for subsistence, and it was abandoned in Manzhang in 1991), the price ratio of rubber to rice is dropped from the regression.

$$A_i = f(Z_1, Z_2)$$

Variables specification were defined as: Ai = planted area of ith crop measured in mu;

$Z_1 = P_{\text{ith crop}} / P_{\text{competitive crop1}}$

$Z_2 = P_{\text{ith crop}} / P_{\text{competitive crop 2}}$

OLS was run by computer software 'LIMDEP', and the result is shown in Table 6.2.

Table 6.2 Result of area response function

		Coefficient	T-ratio	Mean	Min.	Max.
Rubber						
Manzhang	One	350.94	24.55***	1.00		
	P_{rubber}/P_{maize}	0.24	10.81***	3.99	0.55	6.36
	$R^2 = 0.936$	F = 116.91***				
Medeng	One	972.23	10.35***	1.00		
	P_{rubber}/P_{maize}	0.475	3.20***	3.99	0.55	6.36
	$R^2 = 0.561$	F = 10.23***				
Baka	One	431.52	64.05***	1.00		
	P_{rubber}/P_{maize}	0.08	4.64***	3.99	0.55	6.36
	$R^2 = 0.811$	F = 21.48***				
Maize						
Manzhang	One	26.37	0.30	1.00		
	P_{maize}/P_{rice}	36.34	0.31	0.74	0.63	1.00
	P_{maize}/P_{rubber}	-0.01	-0.22	0.50	0.16	1.8
	$R^2 = 0.02$	F = 0.08				
Medeng	One	318.63	2.97***	1.00		
	P_{maize}/P_{rice}	-250.41	-1.75*	0.75	0.63	1.00
	P_{maize}/P_{rubber}	-0.03	-0.90	0.50	0.16	1.8
	$R^2 = 0.36$	F = 1.70				
Baka	One	434.96	2.65**	1.00		
	P_{maize}/P_{rice}	-327.61	-1.48	0.77	0.63	1.00
	P_{maize}/P_{rubber}	-0.16	-1.92*	0.50	0.16	1.8
	$R^2 = 0.48$	F = 1.86				

(***: significant at 95%; **: significant at 90%; *: significant at 80%.)

A. Rubber

Rubber is mainly planted on the flat and sunny upland with elevation lower than 800 m. It also starts to occupy some sloping land in all three villages. It has become a main cash crop of all the villages since 1993 or 1994. In 1994, it shared more than 90% of total upland in Manzhang, 40% in Medeng and 20% in Baka.

The estimation of the area response functions shows that the relative price of rubber to maize is highly significant with positive sign in all villages. However, R^2 of the regression in Medeng is lower than that in other two villages, this probably caused by the comparatively lower competition between rubber and maize in terms of land use because of bigger upland area in Medeng (Table 6.2).

However, the trend of rubber planted area also shows that it increased with the increase of rubber price (Figures 6.4, 6.5 and 6.6)

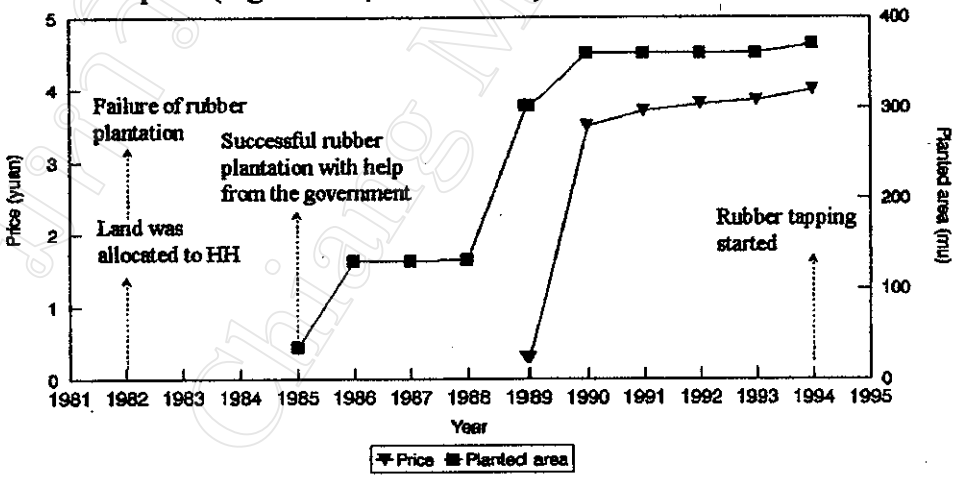


Figure 6.4 Trend of price and planted area of rubber in Manzhang

B. Maize

Maize is a semi-commercial crop which is also used for feed in the area. It mainly occupies the upland lower than 200 m above gullies. The area of maize declined in all three villages in the past ten years mainly because of rapid expansion of rubber plantation.

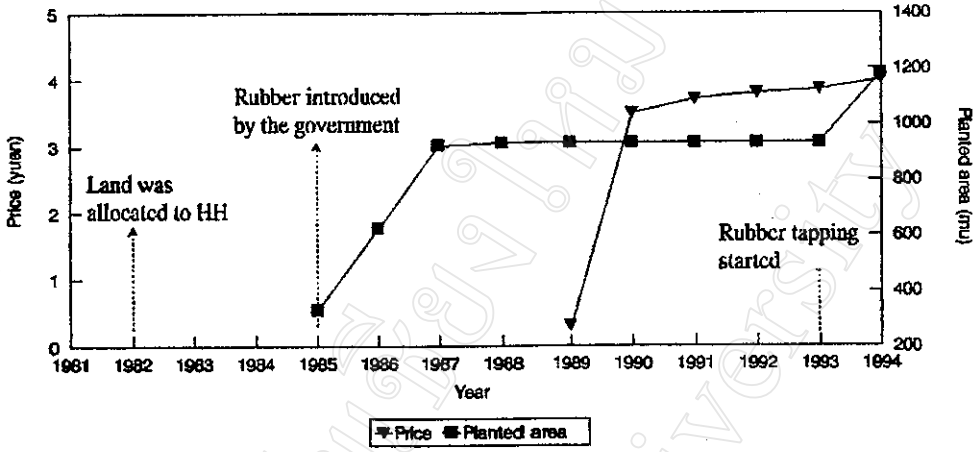


Figure 6.5 Trend of price and planted area of rubber in Medeng

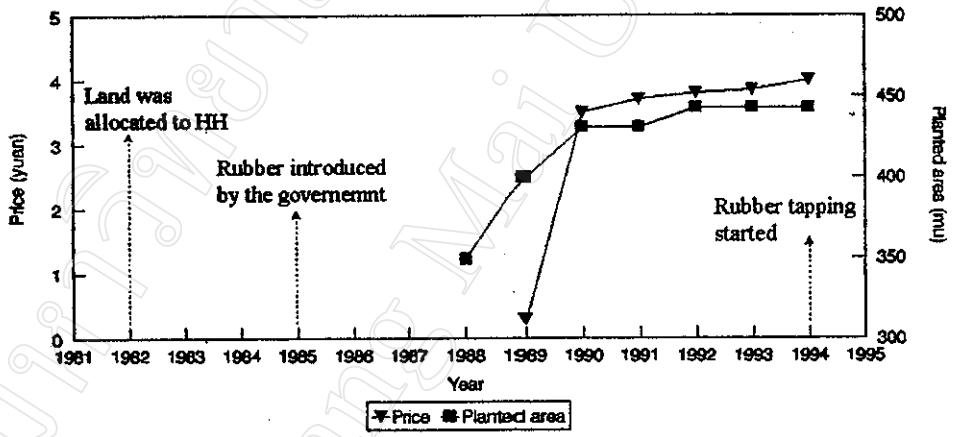


Figure 6.6 Trend of price and planted area of rubber in Baka

In 1994, planted area of maize was only 25 mu, 50 mu and 120 mu in Manzhang, Medeng and Baka respectively. In the sample villages, it is more commercialiaed in Baka (100%) than in other two villages (Table 6.1).

The estimation of the area response functions shows that the relative prices of maize to rubber and maize to rice are not significant in Manzhang and Medeng because this crop only takes a small part in these two villages. In Baka, even R^2 is just 0.48, considering only price factor, the regression still can explain dependent variable. In this

regression, relative price of maize to rubber is significant at 80% level also confirms the estimation of rubber plantation.

Figures 6.7, 6.8 and 6.9 show that the trend of maize planted area does not respond to the trend of maize price.

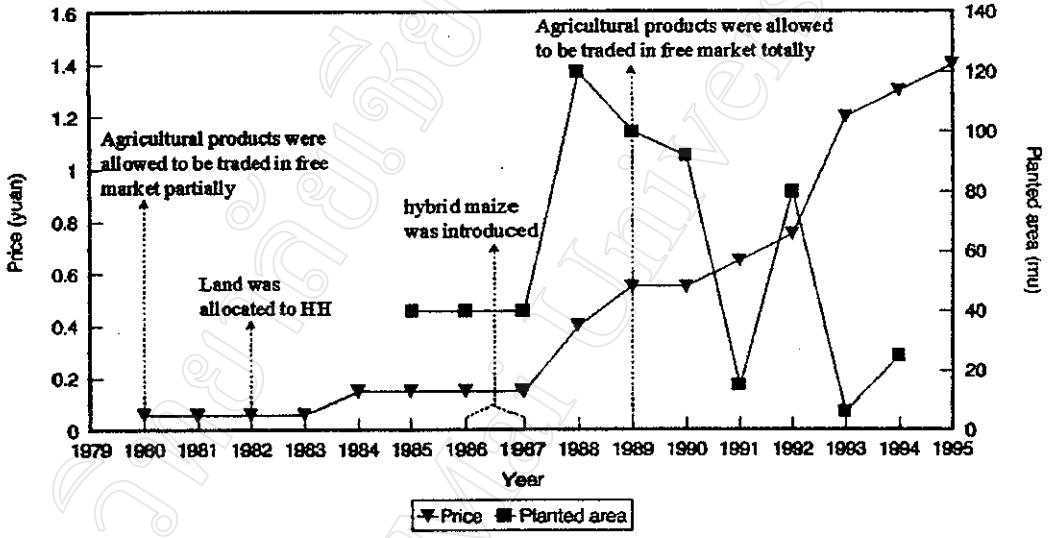


Figure 6.7 Trend of price and planted area of maize in Manzhang

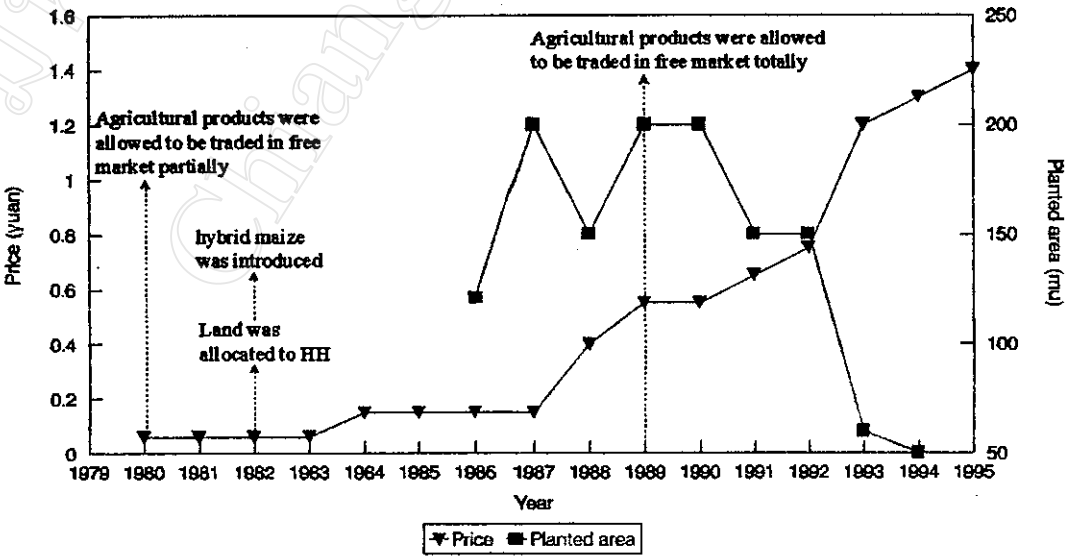


Figure 6.8 Trend of price and planted area of maize in Medeng

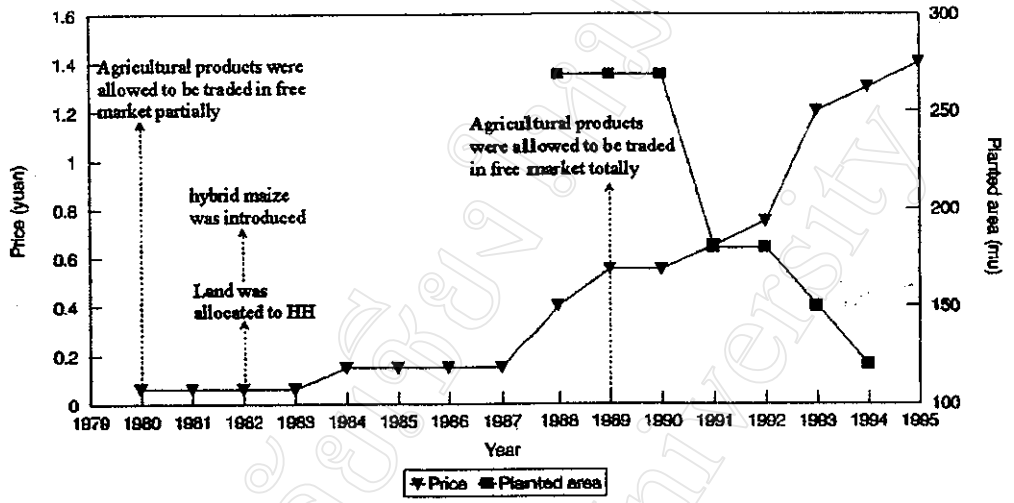


Figure 6.9 Trend of price and planted area of maize in Baka

Meanwhile, Chow test was also applied to test the difference or identity of land use response to price among three villages, in which,

$$F = \frac{(RRSS - URSS)/(k+1)}{URSS/(n_1 + n_2 - 2k - 2)}$$

Where ***RRSS*** is the restricted residual sum of squares, ***URSS*** is the unrestricted residual sum of squares. The result of Chow test was shown in table 6.3.

Table 6.3 Result of Chow Test

	Manzhang-Medeng	Manzhang-Baka	Medeng-Baka
Rubber (d.f. = 2, 20)			
P_{rubber} / P_{maize}	1.47	0.38	2.24
Maize (d.f. = 3, 17)			
P_{maize} / P_{rice}	0.76	0.78	0.03
P_{maize} / P_{rubber}	0.11	1.2	0.78

*: Reject at 99% level; F_{table} (2, 20) = 3.49 at 5%, 5.85 at 1%;
**: Reject at 95% level. F_{table} (3, 17) = 3.20 at 5%, 5.18 at 1%.

The result of Chow test expressed that the farmers' responses on land use to price are similar among three villages

C. Paddy rice

On paddy land, all the farmers in three villages mainly plant one season paddy rice. It has become the important staple food for all ethnic groups. Table 6.1 shows that this crop has very low commercialization rate in all the villages, and planted area trends of paddy rice in all three villages do not respond to the change of rice price as shown in Figures 6.10, 6.11 and 6.12.

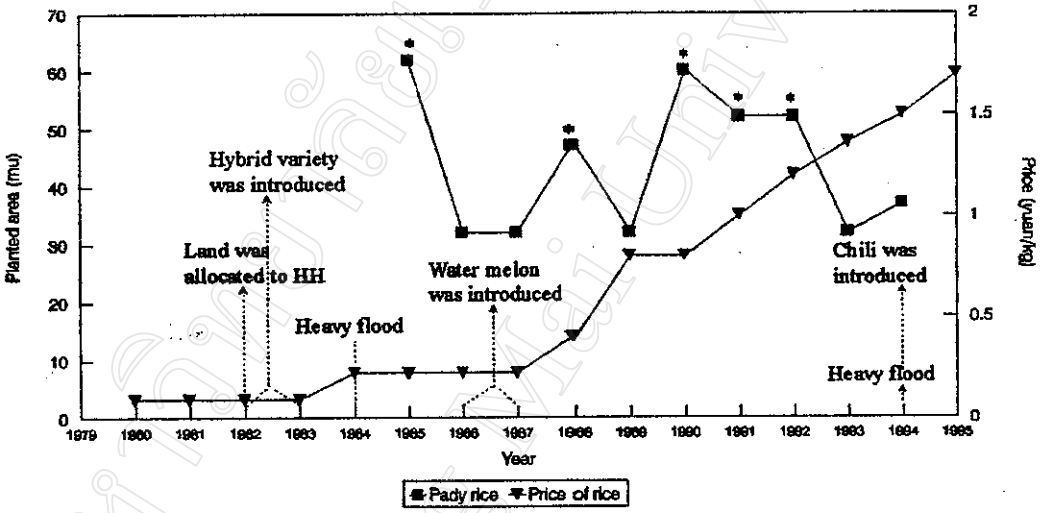


Figure 6.10 Trend of price and planted area of paddy rice in Manzhang

*: Two seasons paddy rice was pracitced.

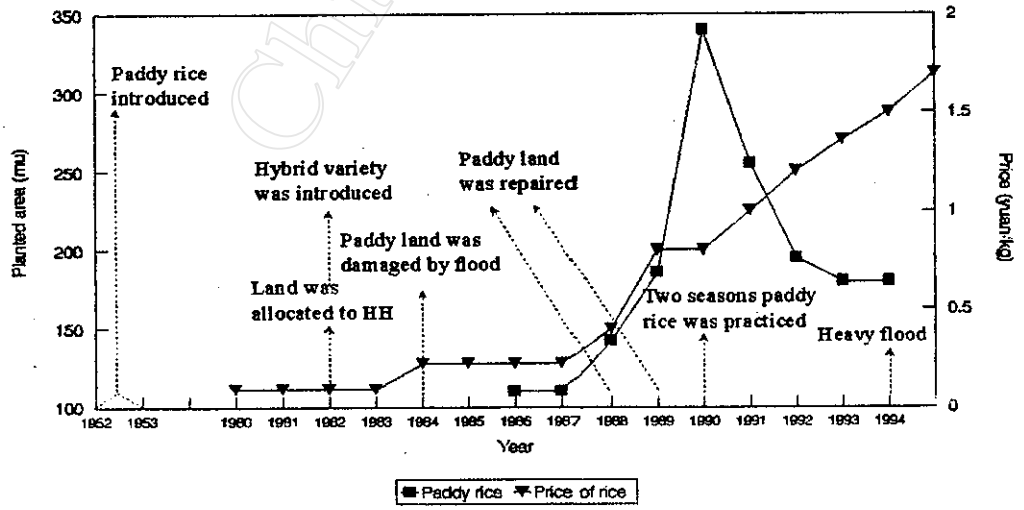


Figure 6.11 Trend of price and planted area of paddy rice in Medeng

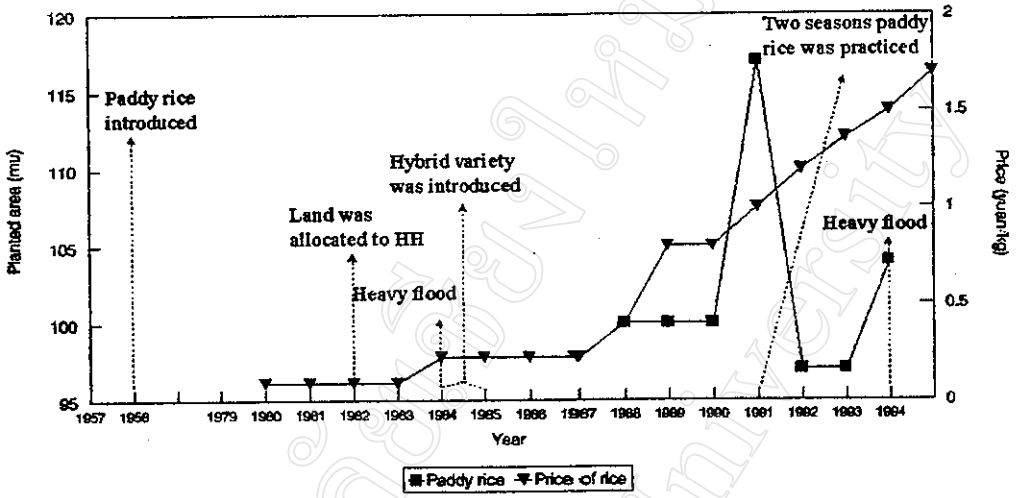


Figure 6.12 Trend of price and planted area of paddy rice in Baka

D. Upland rice

Upland rice has good suitability on upland, so it is the first crop which can be substituted by rubber in terms of land use. In Manzhang, it was abandoned since 1991. However, it still is the staple food for Jinuo in Baka and Hani in Medeng, so it will keep certain area in the long term for subsistence purpose. Figures 5.13, 5.14 and 5.15 show that the rice price changes has no significant influence on upland rice plantation.

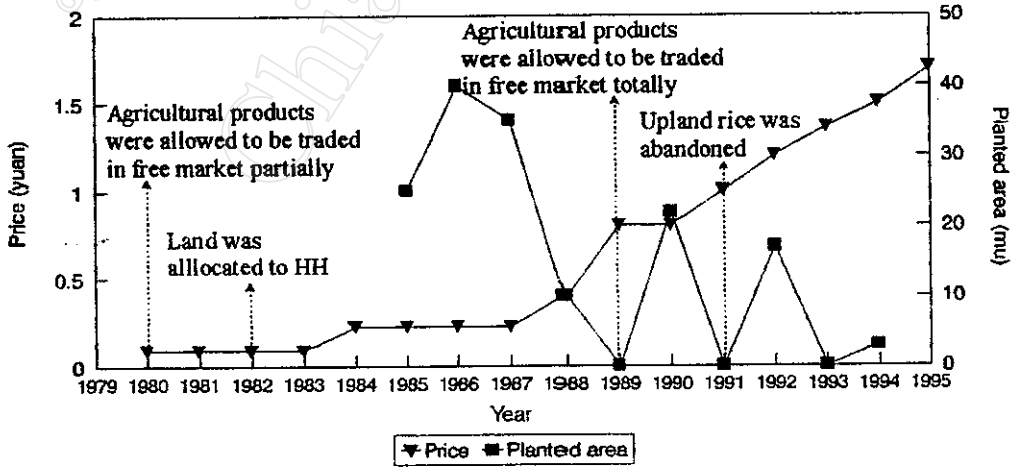


Figure 6.13 Trend of price and planted area of upland rice in Manzhang

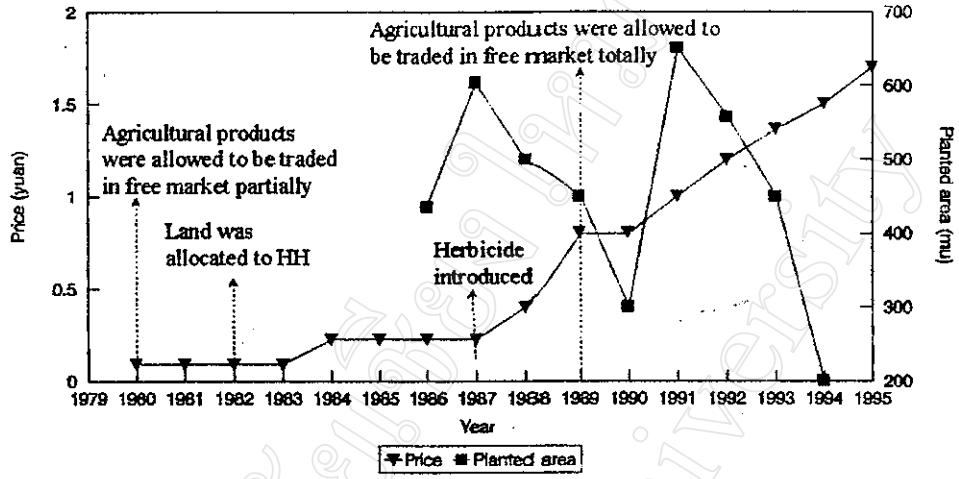


Figure 6.14 Trend of price and planted area of upland rice in Medeng

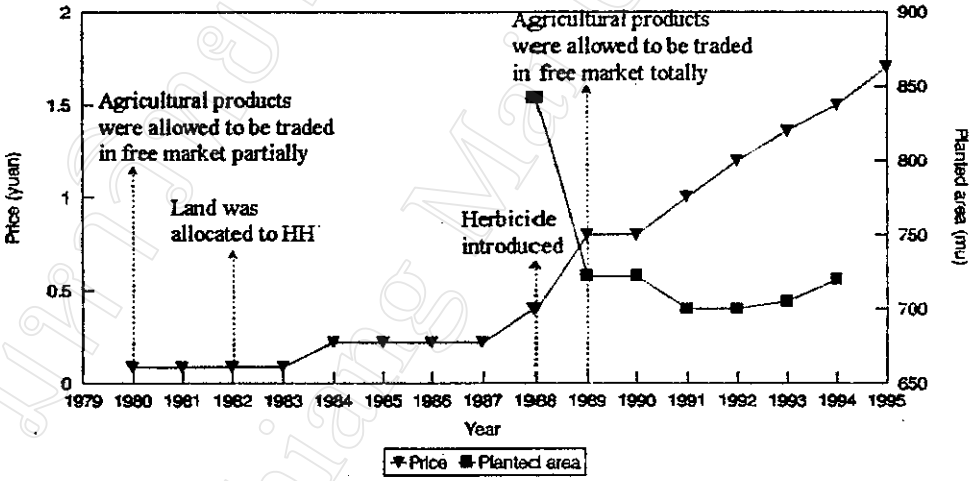


Figure 6.15 Trend of price and planted area of upland rice in Baka

E. Chinese cardamon

Chinese cardamon is planted along gullies under natural forest. Due to the serious deforestation in the study area, the suitable land for Chinese cardamon is limited in all three villages.

Figures 6.16, 6.17 and 6.18 show that the price of Chinese cardamon has significant influence on its planted area. During the period from 1990 to 1992 when serious price fluctuation happened in the study area, the planted area kept instant or

fluctuated with the price changes in the study sites. After 1993, the planted area of Chinese cardamon in two villages increased after increase of price. However, due to the short period of statistic data, the impact of price on planted area cannot be illustrated correctly in the area response function, so the regression is not applied for this crop.

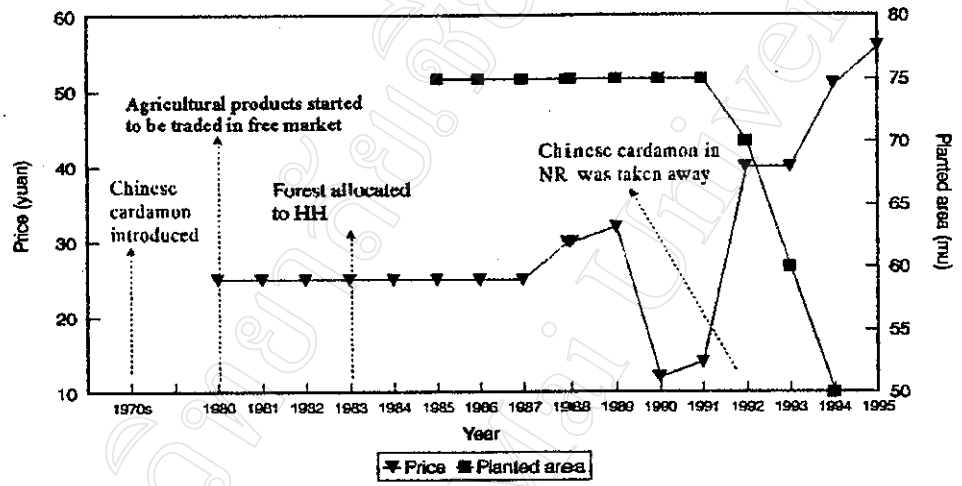


Figure 6.16 Trend of price and planted area of Chinese cardamon in Manzhang

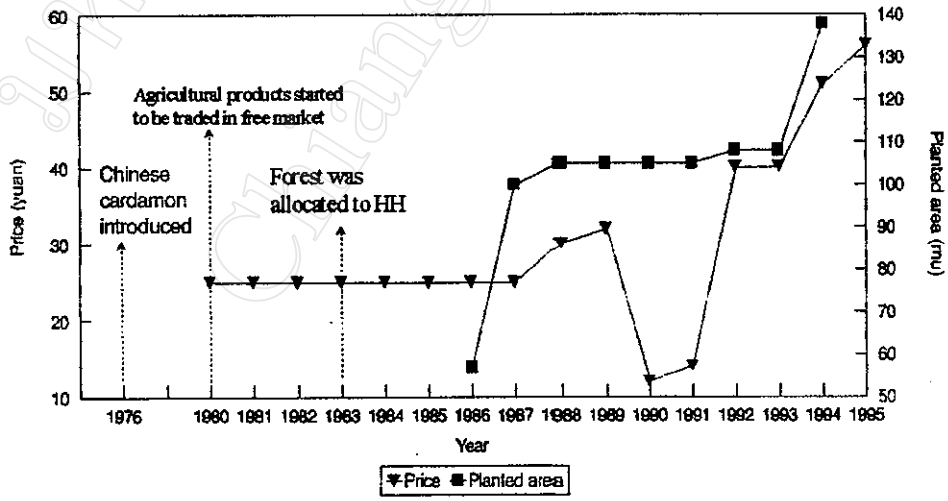


Figure 6.17 Trend of price and planted area of Chinese cardamon in Medeng

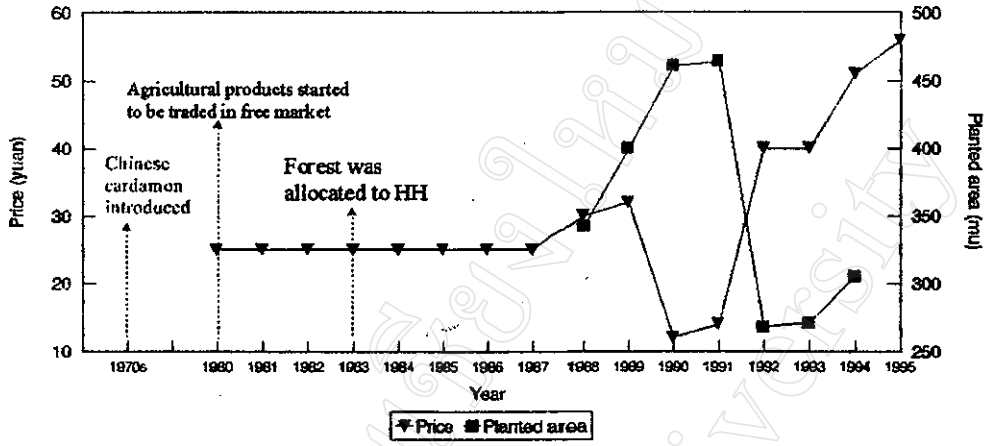


Figure 6.18 Trend of price and planted area of Chinese cardamon in Baka

F. Water melon

Water melon is a winter crop on paddy land. It is only widely planted in the Dai village. In Baka, mature period of water melon is one to two weeks later than that in Manzhang, farmers cannot get a good price from water melon, so it was given up after two years plantation. Meanwhile, because it is a high labor and chemical input crop, Hani people in Medeng would not like to accept it. Figure 6.18 shows that water melon price has very significant influence on its planted area. Nevertheless, after introduction of chili, another winter cash crop with lower labor and chemical inputs on paddy land, planted area of water melon rapidly decreased since 1994.

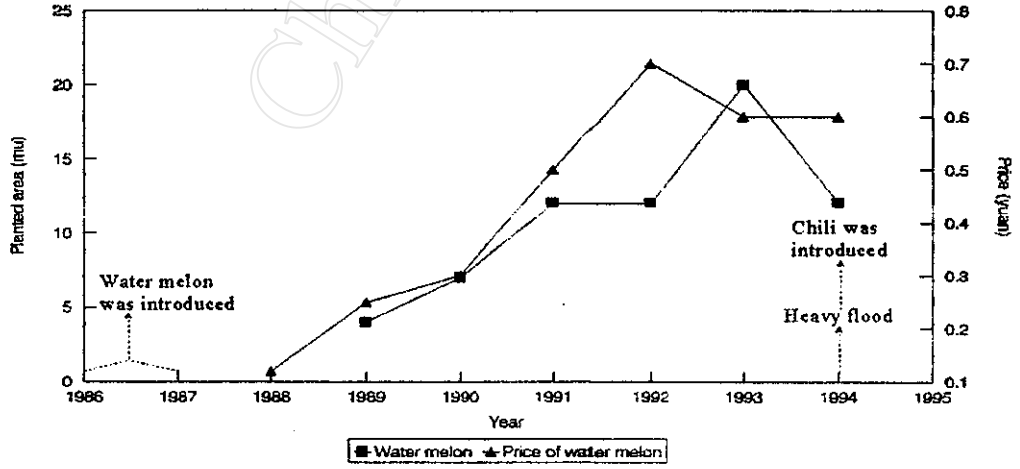


Figure 6.19 Trend of price and planted area of water melon in Manzhang

6.7 Highlights

This chapter identifies main socio-economic driving forces and analyzes their role on land use changes.

The most important socio-economic factor which has great impact on land use changes is identified as government intervention. It is the direct cause which changed land use from traditional shifting cultivation to permanent cultivation. Apart from this, changes of land tenure policy also have great impact on land use by the means of changing right of land use: individual decision making before 1950 → government arrangement from 1950 to 1982 → individual decision making after 1982. Before 1950, every ethnic group used their land in different traditional way, the Dai mainly engaged in paddy rice production on paddy land while other hilltribe minorities practiced shifting cultivation on upland in different ways. During 1950 to 1982, people's commune management system was adopted by the government, in which, the government arranged all the production activities without considering land use difference from ethnicity. After 1982, land was allocated to individual farmers, and farmers became the decision maker on land use. In addition, establishment of natural reserve in the study area also has the impact on land use through changing land tenure which used to be cultivated by farmers.

The changes of some other socio-economic factors including population, technology, transportation, irrigation condition and tourism have impacts on land use through various ways. Population growth gave serious pressure on land use, and led to more intensive and extensive land use, especially swidden land use. Technology improvement provided available new varieties and techniques to farmers to improve their production and also led to abandonment of some local varieties. Transportation improvement provided access for market, but it also plays the role in resource degradation.

Tourism development brought incentive on production of some farm and forest products while it led to over hunting and gathering in forest; It also provided employment opportunities in service sector to young farmers, which probably will lead to labor competition between agriculture and service sectors.

Another socio-economic determinant on land use change is marketing development since the beginning of 1980s. It is the decisive driving force of land use change from subsistence to market-oriented. With the development of marketing, more and more production activities are conducted for cash income purpose, and ethnic differences of land use also disappeared gradually mostly due to this reason. In the area response function, the significance of the price factor confirms that farmers in the area are very responsive to market force. However, there is limitation of using area response function since the function does not contain other factors, the impacts of other factors would be absorbed by the constant term, the coefficient of the price variable could be biased or inconsistent. However, disregarding of the magnitude of the coefficient, the estimates are useful indication of the influence of the price on the area planted.