

## **The Political, Social, and Ecological Transformation of a Landscape**

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Xu Jianchu

# The Political, Social, and Ecological Transformation of a Landscape

## The Case of Rubber in Xishuangbanna, China

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*Driven by economic and ideological policies, rubber plantations have been established in southern China since the early 1950s. Rubber was seen as a perfect way to modernize the “primitive” shifting agricultural practices of indigenous minorities and to “legitimize” the landscape according to new Maoist State ideals.*

*However, large-scale rubber production was dogged by problems, and most rubber production now emanates from smallholders, challenging the state notion that “bigger is better.” In the transition to a free market, smallholder rubber farms, which grow a wider variety of crops, have greater flexibility and are better able to adjust to market changes. These small mixed farms also enhance ecological and cultural diversity.*

**Keywords:** *Shifting cultivation; legible landscape; legitimate landscape; rubber plantation; Southeast Asia; China.*

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### Introduction

After the 1949 Revolution, the new government of China saw rubber (*Hevea brasiliensis*) as an important strategic resource. In an effort to ensure the availability of rubber for national defense and construction in the face of an international embargo, the Decision on Cultivating Rubber Trees was issued in 1951. This led to the rapid establishment of rubber plantations in the tropical regions of China, in particular in Xishuangbanna in southern Yunnan, and on Hainan Island. In Xishuangbanna the outcome was the establishment of large-scale rubber plantations worked by Han Chinese resettled from central China. The decision to introduce rubber into a marginal climatic zone—Yunnan is considered to be the northern latitude limit for rubber—was based on the state’s interest at the time in achieving self-sufficiency in rubber production.

Rubber remains a controversial crop for most scientists and policy makers, ‘uneconomical’ in a market sense, ‘non-subsistence’ in the production sense, and environmentally destructive from an ecological point of view. The present article outlines the history of rubber in Xishuangbanna, and argues that the establishment of rubber plantations is a good example of an attempt by the state not only to forcibly develop a modern economic industry, but also to advance its political ideology. Rubber plantations were perceived as ‘legible’ and

‘legitimate’ (Scott 1998), ie they were orderly and manageable: a manifestation of state power on a landscape scale.

The case of rubber in Xishuangbanna illustrates the different worldviews and ecological perspectives of the Chinese state and traditional farmers. In this sense the issues surrounding the rubber industry in Xishuangbanna, from its initial introduction to the more recent changes brought about by political reform and free market competition, incorporate a number of the key political ecology elements outlined by Blaikie (1994). Specifically, the socioeconomics use a variety of epistemologies for integrating physical and social science; the emphasis is on local history to understand environment and society.

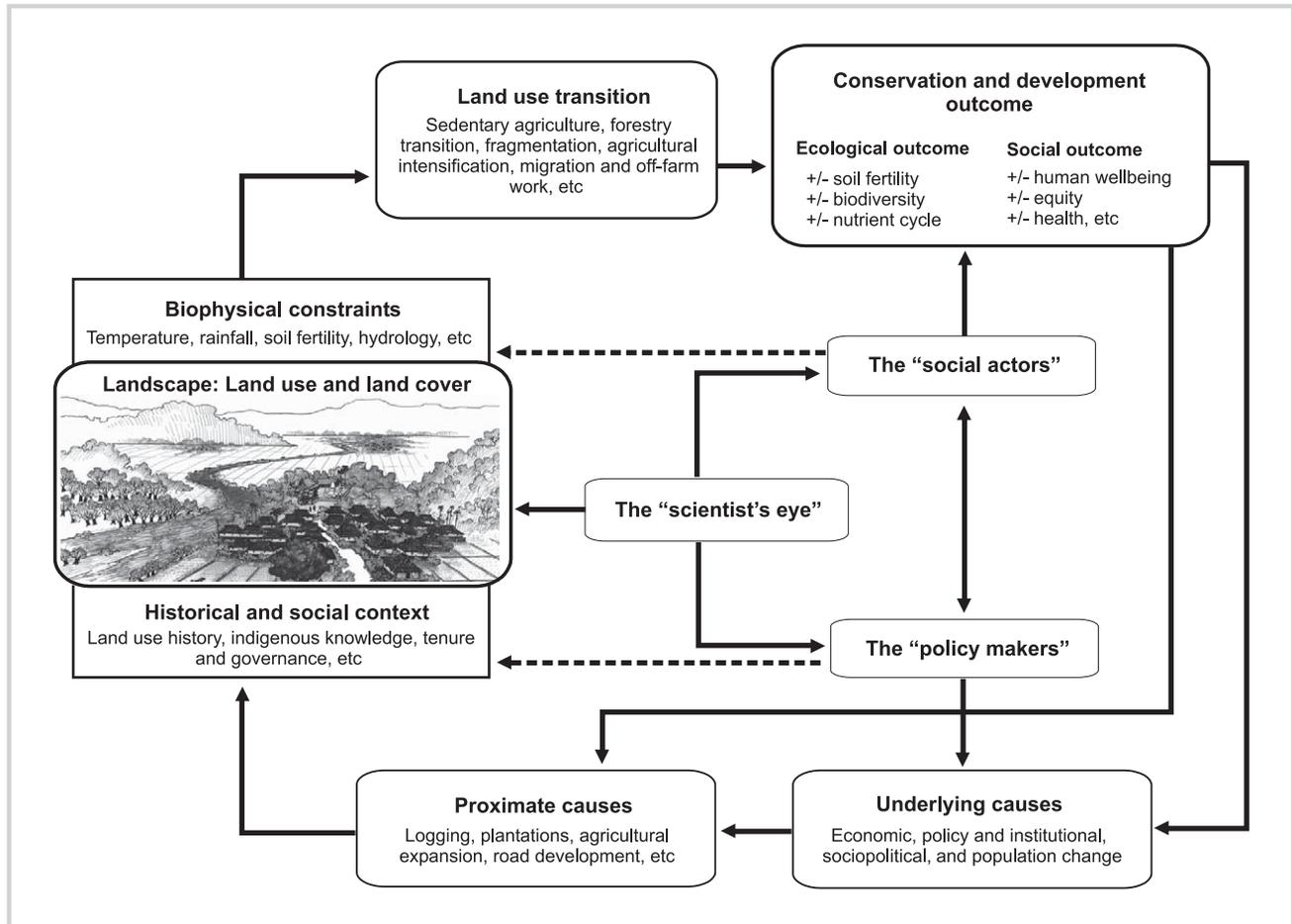
In order to shape a broader theoretical framework of political ecology, environmental change in the context of political power, cultural identity, social relations, and market economy, the present article particularly explores the political ideology of rubber in the state’s vision of a ‘legible’ and therefore ‘legitimate’ landscape, and the ecological and political economy of rubber in Xishuangbanna.

### Methodology

This article is based on almost 20 years of working and visiting with local villagers and government agencies in Xishuangbanna. Information was collected through literature reviews and interviews with key informants, including government officials, village leaders, retired state farmers, rubber researchers, and extension workers. Extensive household interviews were conducted with individual farmers to collect data on how families arrange their swidden–fallow plots across the landscape, and how they collaborate with neighboring farmers and ethnic communities. Secondary data on variables such as population and migration, cultivated rubber and its production, and documents on state policies, marketing, and land allocation were collected from different government agencies at local, township, state rubber farm, county, and prefecture levels.

More important, this political ecology research process facilitated information flow and policy dialogues on land use change among researchers, local farmers, and government officials through the interviews, local meetings, and workshops (Figure 1). The case of rubber was presented at the ‘Mobile Workshop’ on land use history, 15–27 January 2005 (see also pp 278–284 in this issue of *MRD*). The research team of the Mobile Workshop also conducted rapid field assessments in Xishuangbanna (southern Yunnan) and in northern Laos, which were discussed and synthesized in Chiang Mai (northern Thailand). The transdisciplinarity of the research team allowed various complementary disci-

**FIGURE 1** Conceptual model showing where, during processes of land use transition, national-level policy makers are likely to have the greatest impact on underlying causes of land use change. Local government officials will more easily impact the proximate causes of change, while scientists aim to catch ‘snapshots’ of the landscape and analyze the local biophysical and sociopolitical environment. The social actors—including NGOs and civil society—are concerned about outcomes of conservation and development programs. However, unless the varied epistemological and empirical issues and underlying causes are addressed in a concerted effort, local land use may not be sustainable. (Sketch by author)



plines to go beyond the limits of their own discipline and generate new frameworks, new methods, and new knowledge to address the complexity of rubber plantation economy under local cultural, economic, ecological, social, and political conditions and in the regional context. The active participation of government officials during the workshop enabled policy makers to understand how state policies can alter land use and how altered land use affects landscape functions and local people's livelihoods where rubber is concerned.

### Xishuangbanna case study: biological and cultural diversity

Xishuangbanna Prefecture is a biologically diverse region in the tropical zone of southwestern China. The prefecture covers only 0.2% of the land area of China, yet it contains 25% of all the country's plant species. Between 1950 and 1985 forest cover in this region decreased dramatically, from 63% to 34%. Today, forests occur primarily in nature reserves and state forests while previously forested lands have been largely converted into rubber plantations (Xu et al 2005).

Xishuangbanna is the home of many ethnic minority peoples, including the valley-dwelling Dai and upland peoples such as the Hani (called the Akha in Thailand), Jinuo, Yao, Lahu, and Bulang. The Dai are Hinayana Buddhists, but they also worship nature in the form of 'holy hills'—protected cultural landscapes that often constitute the only undisturbed vegetation found in a Dai village (Pei 1991). Coward (2002) notes that the Dai have played a long and important role in organizing social institutions in the uplands and establishing economic relationships between valley inhabitants and upland swidden cultivators. The Dai predominantly managed the fertile lowlands; the other groups such as the Hani and the Lahu had to live in the hills to earn a livelihood. The Hani are animists and place strong emphasis on worshiping their ancestors, as exemplified in their strictly protected cemetery forests. They practice a composite swiddening system that includes jungle tea gardens in the forest, intensively terraced paddies, livestock grazing, and shifting cultivation in the uplands (Xu 2002). Similarly, the Bulang culture is based on a mixture of beliefs and religious practices including Hinayana Buddhism, polytheism, and ancestor worship.

**TABLE 1** Rubber plantation area and yields over recent decades in Xishuangbanna Prefecture. (Source: Jiang 2003)

Year	Area (ha)	Yield (tons)
1963	6,130	27
1970	18,282	732
1975	27,227	1,767
1983	49,678	17,426
1990	88,711	53,400
1993	88,911	n.a.
1997	108,065	123,557

Before 1949, Hani, Lahu and other upland ethnic groups paid taxes or tributes to the Prince in the Dai principality. They also exchanged forest products such as rattan, tea, and wildlife meat with lowland Dai people for betel nut, metal, and salt. The lowland–upland networks allowed lowland political centers to extend their governance over the uplands, and helped upland communities to access markets and information. Customary rules maintained a ring of forest surrounding the hamlet and at the foothills of mountains, which served as an ecological and political buffer between the lowlands and uplands. Land property relations within and across ethnic groups were diverse, flexible, overlapping, and certainly fuzzy from the perspective of private, exclusive property (Sturgeon 2004). These socially constructed patterns of interdependence fostered a certain degree of autonomy and self-governance among the indigenous peoples and enabled them to govern an ecologically diverse area for cultural and subsistence needs.

### History of rubber in Xishuangbanna

Rubber was not introduced to Xishuangbanna until 1940, when a Chinese settler returning from Thailand planted it in trials. Later, in 1953, the state investigated the feasibility of starting rubber plantations. In 1955 the first state rubber farm was established. This was staffed by Han Chinese from the inland province of Hunan. Many of these resettled laborers were retired soldiers and Han Chinese farmers who had volunteered to “settle the frontiers” (*zhibian*), which was further reinforced by the massive state-orchestrated migration of ‘educated youths’ to rural areas during the late 1960s and early 1970s. They would continue to provide the labor for the continued expansion of state farms. The first rubber was planted by local farmers in 1963; encouraged by technical support from state farms, rubber spread quickly into most of the hilly areas of Xishuangbanna, eventually resulting in large-scale deforestation (Xu et al 2005) (Table 1).

Over the past decades, rubber, tea, sugarcane, and tobacco have contributed the lion’s share of the Yunnan government’s revenue derived from commodities. These crops served the state interest of transforming China into a socialist country by enabling self-sufficiency in a period of international embargo, and, moreover, transformed agricultural-based production into an industrial mode of production. Not only were these crops important products in their own right; since they required some level of industrial processing, they furthered the state objective of creating and enhancing the role of a proletariat in rural industries.

During the collective period between 1958 and 1978, people’s communes collectively owned agricultural and forest lands. Land use decisions were not based on collective consent from within the commune but were administered through a centrally planned state quota system. In the late 1970s, the Xishuangbanna government, like those of other areas of China, wanted to diversify the rural economy and develop rural industry. Local communities were encouraged to plant rubber (the only available industrialized crop) for supplemental income. A total of 200,000–300,000 ‘educated youths’ played a significant role in the expansion of rubber plantations in Xishuangbanna in the late 1960s and early 1970s, after successful rubber plantations had been established by the retired army and volunteer (*zhibian*) farmers in the 1950s (Shapiro 2001).

### Production of a ‘legible’ landscape

Since the foundation of the People’s Republic of China in 1949, the state has implemented numerous and sometimes conflicting policies affecting both agricultural and forest land ownership (Xu et al 1999). The common practice of ‘state simplifications’ described by Scott (1998) for constructing a ‘legible landscape’ is also highly relevant to China. In effect, this is an attempt by the state to transform the people and even the landscape with some common quantifiable standards to enable, as Scott puts it, a synoptic view. At its most literal, this ‘legibility’ is a physical expression of organizing nature: rubber is planted in evenly spaced straight rows of even-aged trees, managed by paid state labor, which can be easily quantified and taxed (Figure 2). In a similar vein, Chairman Mao Zedong’s ideology, which built upon Marxism-Leninism, turned rural landscapes into an ideological landscape embodying the transformation of society from a feudal mode of production into a socialist society by eliminating classes, mobilizing the masses, and centralizing productivity and land use decisions.

States often identify subjects and citizens as a means to impose order (Sahlins and Scott 2000), and abstract definitions of citizens and subjects are often

included in civilizing projects (Harrell 1995). This was exemplified in China, where membership in the nation was categorized by nationality (*minzu*) and class (*jieji*), and locked in place by the household registration system (*hukou*) in which people had to register locally and inherited their parent's status (urban or rural citizen). This rigid system of social identification is another manifestation of a 'legible landscape' and illustrates the techniques of legal and political inclusion and exclusion, as the state divided up and allocated access to social goods and benefits.

The civilizing project described by Harrell (1995), aiming to make ethnic nationalities or people more equal to the Han Chinese, can be demonstrated by three metaphors:

1. The metaphor of sex (indigenous people are passive, constitute a sexual attraction), based on the male dominant Han society, who develop the stereotype of erotic minorities in art and painting, tourism or cultural villages;
2. The metaphor of education (indigenous people are like children who need to be educated in the higher values of the Han culture); and
3. The metaphor of history (the evolution of societies from primitive via feudalism and capitalism to socialism).

The Han Chinese has the "historical task" to "civilize" the "minorities" in a perceived ethnic hierarchy, with the Han as the most developed nationality at the top. The development and modernization of the Han state has led to the disintegration of the social life of indigenous people. Forest resources are depleted in areas with indigenous people who have been expelled from their territories to settle as farmers. Shifting cultivation has been replaced by paddy and rubber plantations.

Mao's belief that "Man can conquer nature" contributed to the Great Leap Forward in 1958 and later to the Cultural Revolution (1966–1975) (Shapiro 2001). Mao's analysis of classes in Chinese society divided the population into a 'peasantry' in the countryside and a 'proletariat' in urban areas. Peasants were considered to be tied to ownership of some of the means of production and therefore they could not be the leaders of the revolution; thus the proletariat was the only class that could lead the transformation to a socialist model. Beyond the proletariat (or workers) and peasants, however, the mass or entire collective of people was thought to have infinite power. Following this logic, collectivization became the strategy that would free peasants from the constraints of a 'peasant mentality' characterized by individualism, ignorance, poverty and vulnerability to natural disasters (Menzies 2004).

**FIGURE 2** A 'legible' and 'legitimate' landscape according to the Maoist perception of nature as an environment to be completely domesticated so that it will serve mankind: rubber plantation in Menglong Township, Jinghong County, Xishuangbanna. (Photo by Xu Jianchu)



Shifting cultivators in Xishuangbanna such as the Lahu, the Hani and the Jinuo were thought to represent a primitive mode of production. Based on this appraisal, ideologically driven planners concluded that state rubber farms needed to be staffed by people whom they saw as the more 'educated' and 'advanced' peasants, that is, by Han Chinese farmers and 'educated youths' resettled at the 'frontier' of inland China. Those 'advanced' peasants were organized collectively in rubber plantations to become state workers representing forces of production in the socialist model. This reflected a general trend towards managed, 'legible' landscapes (Table 2).

### 'Legitimizing' swidden landscapes

In Xishuangbanna, local farmers practiced a 'composite swidden' or mosaic land use system, as described by Rambo (1995). This may include a range of swidden—fallow fields, home gardens, fishponds, cash crop plantations, secondary forest, and even terraced rice paddies in upland areas (Figure 3). This production system also involves a complex social network of property relations, labor sharing, and decision-making processes. However, under the state ideologies, such sustainable swidden practices were deemed to be destructive, backward, and low in productivity. Even today, the state attitude toward shifting cultivation is often negative, blaming it for soil loss, deforestation and environmental degradation in the tropics. Since the mid-1980s the government has also been putting pressure on the upland minorities to abandon swidden agriculture in favor of crops such as rubber (Xu et al 1989; Yin 2001).

**TABLE 2** Comparison between smallholder agriculture and industrial plantation.

Smallholder agriculture	Industrial plantation
Unprocessed output	Processed production
Organic and manual farming	Fuel input and mechanical farming
Subsistence and cash-oriented	Market-oriented
Smallholder/individual	Large-scale/collective
Peasants or farmers	Proletariat or workers
Diversity and flexible practices	Monoculture, machinery technology
Non-measurable and difficult to tax	Measurable and taxable
Accountable to social group and community	Accountable to state or enterprise
Local knowledge	Scientific knowledge
Autonomous	Dependent

The state was keen to establish large-scale uniform rubber plantations in Xishuangbanna, and these were primarily located in the large forests and mosaic landscapes of the foothills (Dai practices of worshipping and preserving 'holy hills' and Hani customs of spiritual and cemetery forests were often suppressed by the state as 'superstition'). These indigenous people began to face land scarcity and conflicts over land use, and land tenure disputes between indigenous people and immigrants increased significantly after de-collectivization in the late 1970s. In deference to the new trends, most farmers sold their cattle and water buffalo, bought or hired tractors to plow paddy fields, and shifted to the use of chemical inputs in agriculture (Wu et al 2001). Consequently, the traditional exchange of products between Hani and Dai people was gradually eroded. These exchanges had been a strategy to resist climatic uncertainty and also helped to maintain social relations between ethnic groups.

Further large-scale changes to land use management began when the nationwide Household Responsibility System was implemented in 1978, which devolved communal land to households. Reforms in the forestry sector began in 1981, and over the next few years the central government decentralized land management to local levels of government, thereby enabling counties, townships and administrative villages to make an increasing number of decisions, even allowing democratic elections for village leadership (Oi 1998). Under this reform, both freehold plots and collectively held

forests were exclusively leased or contracted to individual households with mapped property rights.

Forest agencies encouraged farmers to increase forest cover. For any commercial timber cutting, farmers needed (and still need) a permit; therefore many farmers preferred to plant rubber trees on the contracted or freehold forest land. Rubber trees were either categorized by the forest agency as forest cover, or by the agricultural agency as agricultural production. In this way local farmers who had been members of people's communes converted large areas of fallow forests (secondary regrowth) into smallholder rubber farms or plots. Thus, a second wave of rubber planting followed in the 1980s, in tandem with the continued development of rural industry. This planting resulted in a hybrid landscape, including composite swidden together with a number of different crops and different management practices. Generally, rubber replaced rice, or agro-forestry systems included young rubber intercropped with pineapple, upland rice, or vegetables. Significantly, with the inclusion of rubber, these small plots of land (varying from 0.06 to 0.5 ha) were considered by the state to be 'legitimate.' Even the clearing of collective forest lands to plant rubber was encouraged by the state, since the former were considered to be neither productive nor, in Scott's terms, 'legible.' As a result, upland rubber plantation increased by 1300 ha per annum (Xu et al 1989). In this way the swidden agriculture in Xishuangbanna was legitimized through crop substitution and the intensification of agriculture.

### Scale of power: state versus smallholder farmers

In the context of the ideological landscape of Xishuangbanna, the decision by the state to establish state farms to manage rubber was not simply a question of more efficient production at an industrial scale, but, more importantly, of the development of an 'advanced productive' force (ie state proletariat), to distinguish this from smallholder peasants. Part of this social shift involved the active increase of the Han Chinese population in frontier regions; consequently, from the 1950s there was a large-scale resettlement of Han Chinese to the Xishuangbanna foothills accompanying the establishment of rubber farms.

In a frontier area like Xishuangbanna, the intent of the state was to harmonize fraternal relations among minority ethnic groups and the Han Chinese by solidifying Han dominance over ethnic minorities, as the Han represented the advanced productivity in rural society. The Han Chinese settlement in Xishuangbanna changed not only the ecological landscape, but also the local social networks and the political landscape between locals and outsiders. The proportion of Han

Chinese increased from 0.3% of the total population in 1949 to 8.8% in 1956, and by 1982 they accounted for 28.8% of the population. As a reward, all of these immigrant Han Chinese, some of whom had once been peasants, became members of the proletariat and enjoyed social benefits including free schooling, electricity, healthcare, and a pension system. This social welfare eventually became a large burden for state farms. In fact, these indirect expenses account for 50% of the total cost of rubber production (Gu and Li 2001). On the other hand, the ethnic minorities felt that they had been further marginalized due to exclusion from the social welfare system and from decision-making.

Although the state attempted to establish rubber plantations in Xishuangbanna on an industrial scale, they were thwarted by the nature of the landscape. These large rubber plantations were often highly fragmented and effectively an amalgamation of numerous smaller plantations. Moreover, the knowledge of Han

Chinese workers was rooted in lowland, temperate agriculture, so indigenous smallholder farmers often had an advantage in montane cultivation due to their profound knowledge about land clearing, intercropping and multi-cropping systems, land rotation, fallow management, and microenvironments. Echoing Mao's war against nature, traditional farming practices, and indigenous beliefs, 'educated youths' in particular labored to introduce rubber trees in zones at more extreme latitudes, altitudes, and temperature, although these were sometimes totally unsuitable for rubber.

With economic reform in the late 1970s, disillusioned 'educated youths' working in Xishuangbanna initiated what became the 'Return to the Cities' national protest movement. Many state rubber farms nearly collapsed. Some upland Hani villages were persuaded to move to lower altitudes to provide state workers to meet the labor deficit after the departure of the 'educated youths.' In order to make them more efficient

**FIGURE 3** Example of the type of land use considered by the government as 'backward,' unproductive, and environmentally detrimental: swidden-fallow landscape with fishponds, paddy, rainfed crops, fruit trees, fallow, etc in Mengsong Hani Administrative Village, Menglong Township, Jinghong County, Xishuangbanna. Today, the value of such mixed management is assessed far more positively. (Photo by Xu Jianchu)



TABLE 3 State and smallholder rubber plantations and yields in Yunnan. (Source: Jiang 2003)

Agricultural system	Plantation area (10,000 ha)	Production area (10,000 ha)	Dry rubber chip (10,000 t)	Average yield (kg/ha)	Total value (million US\$)
State farm	10.09	6.88	11.87	1725.00	119.39
Smallholder	11.03	4.41	5.93	1345.50	59.76
<b>Total</b>	<b>21.12</b>	<b>11.27</b>	<b>17.89</b>	<b>1535.25</b>	<b>179.15</b>

and profitable, state farms have been broken down into units under smallholder management since the late 1980s. A number of rubber trees or measurable plots were allocated to individual workers who had to tap a minimum quantity of rubber to guarantee basic salary and social benefits.

This trend toward a contract responsibility system with rubber farms reflects a general shift in modern China, where not only industrial production but even social services such as hospitals and schools have been contracted out since the late 1980s. Because of the reduction in state rubber farms, recent years have seen a slight decrease of Han Chinese in Xishuangbanna. In particular, the young generation of Han have no additional land for planting more rubber, and fewer job opportunities within state rubber farms.

While state farms experienced difficulties with rubber production, government initiatives led to an increase in rubber plantation by private smallholders. One of the aims of the forestry reforms implemented in 1981 was to sedentarize shifting cultivation in response to purported deforestation in the uplands. As outlined above, many shifting cultivators and smallholders started planting rubber at this time, both to satisfy government reforestation demands and to generate some income. Rubber plantation was promoted by the government as 'scientific' land use which would lift the local farmers out of primitive land use practices and a miserable lifestyle into the modern world. Furthermore, the most enlightened local farmers, primarily young people, pursued rubber plantation, as it was less labor-intensive and provided cash income, as demonstrated by the desire for modern consumer goods and lifestyle. Thus the goal, achievable through generational transformation, was to achieve modernity and the Han norm of a settled community and legible land use (Blaikie and Muldavin 2004). By 2001, the total area of smallholder rubber had exceeded that of the state rubber plantations, although the total value from smallholder production is still less than that of the state (Table 3).

### Plantation techniques

Rubber's natural habitat is the species-rich Amazonian rainforests. In some regions, rubber is cultivated in this way—as part of a diverse forest system. For example,

Indonesian smallholders cultivate rubber in a mixed forestry system (Gouyon et al 1993). Agroforests near Gunung Palung National Park intercrop rubber with *Shorea stenoptera*, durian fruit, and timber, forming a mosaic of rubber gardens, fruit gardens, and dry rice fallows. These rubber agroforests contain up to 300 other plant species (Salafsky 1994). This smallholder technology is, in part, derived from colonial plantation management (eg tapping techniques), but also from their own innovation (eg high-density planting and allowing secondary forest to regenerate around the rubber trees instead of clean weeding) (Dove 2000). In comparison to humid tropic and alluvial plains in the Amazon Basin and Southeast Asia, rubber plantation in Xishuangbanna is primarily located in sub-tropical mountain regions, where temperatures are relatively low and soil fertility is poor. In such a marginal biophysical environment, more labor input is necessary for weeding and more terracing for soil erosion control and soil fertility management.

Mixed rubber agroforestry is not predominant in Xishuangbanna, but the mixed cropping implemented by many smallholder farmers allows them some flexibility, by comparison with state farms. Smallholders are able to manage rubber more intensively while the rubber price is high, and concentrate on other crops when the rubber price is low. This less intense management (as well as the younger average tree age) is reflected in figures that show lower average rubber yields for smallholders (see Table 3).

### Transition to the market economy

Until 1990, rubber was well protected by state subsidies, but since the transition to a market economy, state rubber farms have come under greater duress. State farms now have to bear their own costs for education, healthcare, and other social welfare. The total social welfare budget for rubber farms in Yunnan amounted to US\$ 16.23 million in 2001, of which about 78% had to be met by the farms themselves. In 2000, direct rubber production costs for state farms were about US\$ 478/t in Xishuangbanna; however, the total cost (including social welfare) was almost double that, at about US\$ 899/t. For smallholder farmers, direct production costs amounted to US\$ 582/t, but smallholders are

still burdened with high indirect costs (tax on agricultural special products and local fees), bringing their total costs to about US\$ 848/t (Jiang 2003). Although smallholders—mainly ethnic minorities—are more competitive in the Chinese market, their costs are still high by international standards (US\$ 660–700/t in Malaysia, Indonesia, and Thailand).

Despite the fact that the natural rubber yield in Xishuangbanna and throughout China (mainly in Hainan) has been increasing over the past 30 years, China's share of self-produced rubber in domestic markets has decreased (Wu et al 2001). Stagnant market prices make rubber production less profitable: the break-even price is approximately US\$ 900/t for state and US\$ 850/t for smallholder farmers. In the transition to a market economy, the author found that livelihood strategies for state rubber workers included:

1. Diversification of intercropping in young plantations;
2. Transfer of labor to other sectors, such as the service sector (restaurants, transportation, etc);
3. Decentralization of farm administration through household contracts;
4. Shared tapping and leasing of land from upland farmers;
5. Migration to cities for off-farm work; and
6. Specialization in processing and marketing.

### Using science to justify a rubber landscape

In China, rubber is officially regarded as forest. By comparison with shifting agriculture, establishing rubber plantations (ie 'forest') is considered to be environmentally beneficial by enhancing watersheds and reducing soil erosion. Superficial acceptance of this sort of scientific dogma has been used to bolster the government's contention that, in terms of land use practice, rubber plantations are 'good' and shifting cultivation is 'bad.' However, there is increasing awareness that forest cover does not necessarily equate with better watershed protection (Calder 2002) and that there is no biodiversity at all in monoculture plantation.

Moreover, interpretations of scientific information might not be objective from the perspectives of the different stakeholders involved, particularly socially marginalized people (as is the case with swidden cultivators), who often have poor or no access to research processes. Therefore they rarely participate in policy debates and decision-making. Furthermore, interpretation of scientific studies may be influenced by political ideology, which can change. Indeed, science is a type of socially constructed knowledge and a dynamic outcome of contesting, competition, accommodation, and resistance (Bäckstrand 2004; Blaikie and Muldavin 2004).

Scientific knowledge is "co-produced" by a much wider range of actors than independently minded scientific actors alone (Blaikie and Muldavin 2004). For example, during the Maoist period, and especially during the Cultural Revolution, scientists were sent to 'educational camps' for re-education to become a part of the 'advanced' production forces or the proletariat, while the key rubber research institute, the Xishuangbanna Tropical Crop Institute, was directly under the supervision of the Ministry of Land Reclamation (*Nong Ken Bu*), which had a mandate for rubber plantation. During the Cultural Revolution, scientific research was thus directly guided by communist party leaders or political ideology.

### Conclusions

Earlier attempts to 'legitimize' the landscape through rigid large-scale state farms are giving way to pragmatism, with rubber becoming part of a mosaic of crops which may or may not be utilized by local people, depending upon economic viability. Rubber plantations may have been seen as the way to construct a 'legible landscape' in southern China, but the diverse land use systems practiced by smallholders may be the most ecologically appropriate and culturally suitable means for promoting sustainable local economies and livelihoods in the mountain areas. Acceptance of this notion requires some fundamental changes in the way development is envisioned and land use policies are formulated in China. Two responses are particularly important: a) emancipating local knowledge, and b) strengthening research and policy links.

Local knowledge is not necessarily static, pristine, and culturally specific; it is dynamic and continuously evolving, in that farmers learn both by evaluating the outcomes of their previous actions (eg trials of rubber in swidden-fallow fields), observing the environment (eg limits of altitude for rubber), and interacting with other people or institutions. Emancipating local knowledge requires recognition that ethnic identity and social networks are reshaped and modified by cultural changes, land use, resettlement, and development policies. Utilizing this knowledge and incorporating it in scientific research and policy calls for state openness to new practices, tolerance of local people's scope for experimentation (Coward 2000), and participation of smallholder farmers in land use decision-making. Policy makers must recognize long-term ecological and economic realities. The legitimacy of state authority does not stem from the exercise of political power but is earned by taking better account of scientific realities and serving the people. This is being emphasized by the current leadership, particularly with respect to smallholders on the periphery.

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