4
Traditional Agriculture in Northern Thailand

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Chiang Mai Province is an area of approximately two million hectares (ha) in the northern part of Thailand. Part of the province is remote highlands where people have maintained a traditional way of life. The lowland is a relatively modern valley area that has in large measure maintained its traditional agriculture in spite of widespread dissemination of modern agricultural technology. This chapter describes existing cropping systems in the two areas, how farmers make decisions on their agriculture, the value farmers see in their traditional agriculture, and how it has served their needs as they have adjusted to changing social and economic conditions.

THE HIGHLAND AREA (KAE NOI)

About 60 percent of Chiang Mai Province is forested highlands occupied by hill tribesmen who practice swidden cultivation (Figure 4.1). These farmers cut and burn the forest, grow upland rice or other crops for a year or more, and then leave the land fallow to revert to forest for six or more years before returning to cut, burn, and cultivate again. The agriculture in this area has been described in detail by Kunstadter (1978).

The villages in the Kae Noi area are representative of many villages in the highlands of Northern Thailand. Kae Noi is located 135 km northwest of Chiang Mai city in an intermontane valley with up to 100 percent slopes and an elevation ranging from 960 to 1,100 m. Mountains divide Kae Noi catchment from others in the Mae Taeng watershed, but Kae Noi is linked to Chiang Dao district by a 70-km access road (2–3 hours). The population of five villages in Kae Noi is 886 people, 32 percent of whom are less than 14 years old.

Land use in the Kae Noi area has changed rapidly over the past few decades. In the past, the gently sloping and fertile land along the Mae Taeng River and its tributaries was used for rice paddies by the Tai Yai people. They built small weirs upstream and diverted the water to their

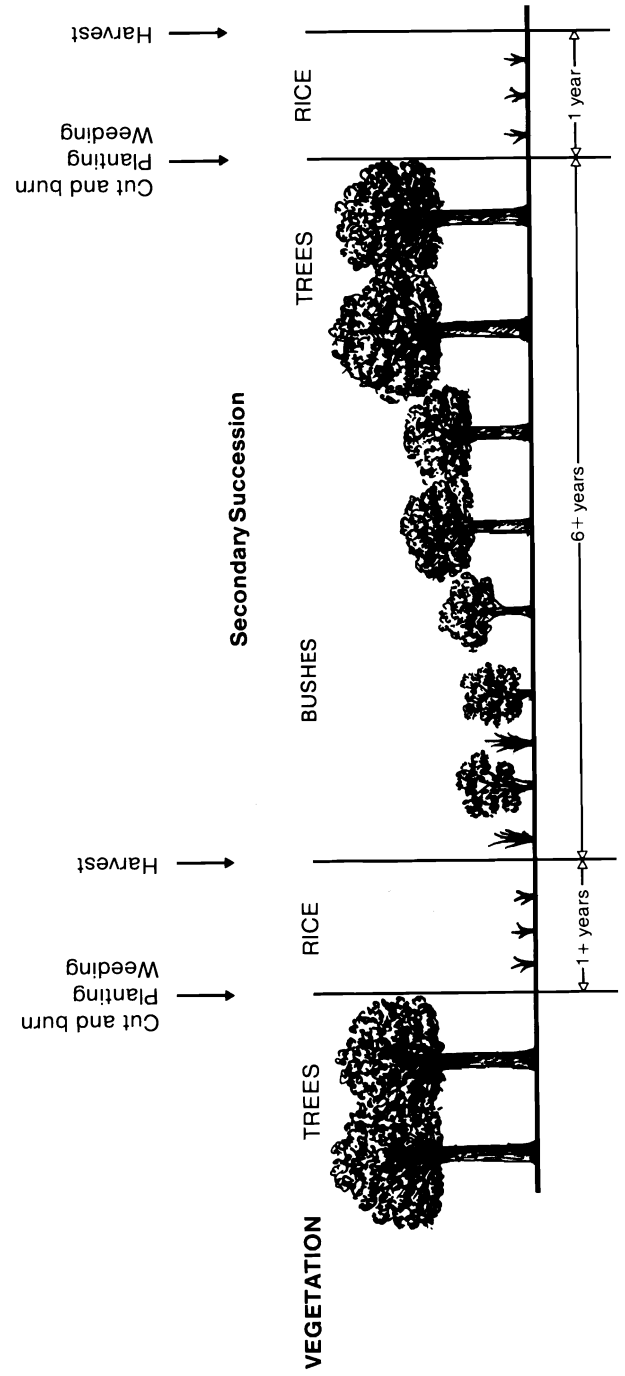


Figure 4.1. Sequence of Vegetation Through a Swidden Cycle

Table 4.1. Land Use in the Kae Noi Area

Land Use	Area (%)
Residential	1
Shifting cultivation[a]	11
Permanent agriculture[b]	13
Forest[c]	75

[a] Includes old clearings.

[b] Restricted to slopes less than 35 percent.

[c] Dry deciduous dipterocarps mixed with pine.

rice fields. During the past decade a number of Lahu and Yunanese or Chinese Haw people have migrated into Kae Noi highland, resulting in an increased use of slopes for swidden rice and corn (Table 4.1). Erosion, soil degradation, and low soil fertility are now evident on many of the large patches of swidden fallow land.

Figure 4.2 shows a typical landscape profile for a Kae Noi hill-tribe village built on top of a gently sloping hill. The village consists of houses and a central living area for people and domestic animals. Vegetables and fruit crops (e.g., bananas, papayas, and local peaches) are common in the peripheral area adjacent to the village. Upland crops such as corn, dry rice, sesame, opium poppies, peanuts, soybeans, kidney beans, and potatoes are cultured somewhat farther away from the village, and many of these crops may be interplanted. Cultivation of upland crops is semi-swidden; i.e., the farmers use the land for two to three years and then leave it fallow for one to two years before returning it to cultivation. They grow paddy rice at the lower elevations, about 850 m above sea level. Semi-steep slopes, which are about 5–10 km from the village, are used for swidden cultivation.

Sesame and opium are the main cash crops (Table 4.2), with additional income from livestock (Table 4.3), off-farm labor, and the sale of forest products, including foods such as mushrooms, bamboo shoots, and wild vegetables that are gathered from the forest. Figure 4.3 shows traditional cropping schedules. Nonglutinous paddy rice and sesame are grown during the wet season, and nonglutinous upland rice and field corn are cultivated from the end of the hot season into the wet season. Opium poppies are grown from the middle of the wet season through the cool season. Opium is the most lucrative cash crop and is often cultivated for home consumption as well. About 93 percent of the Lahu people cultivate opium poppies, and approximately 10 percent of the tribesmen are opium addicts; two-thirds of the addicts are males. In the lowlands, crops such as tomatoes, chili peppers, garlic, and vegetables realize a higher price when they are cultivated in the off season. The Lahu people could grow the same crops (instead of opium) in the highlands and receive a good, off-season price provided there is an adequate water supply and the distance to markets is not excessive.

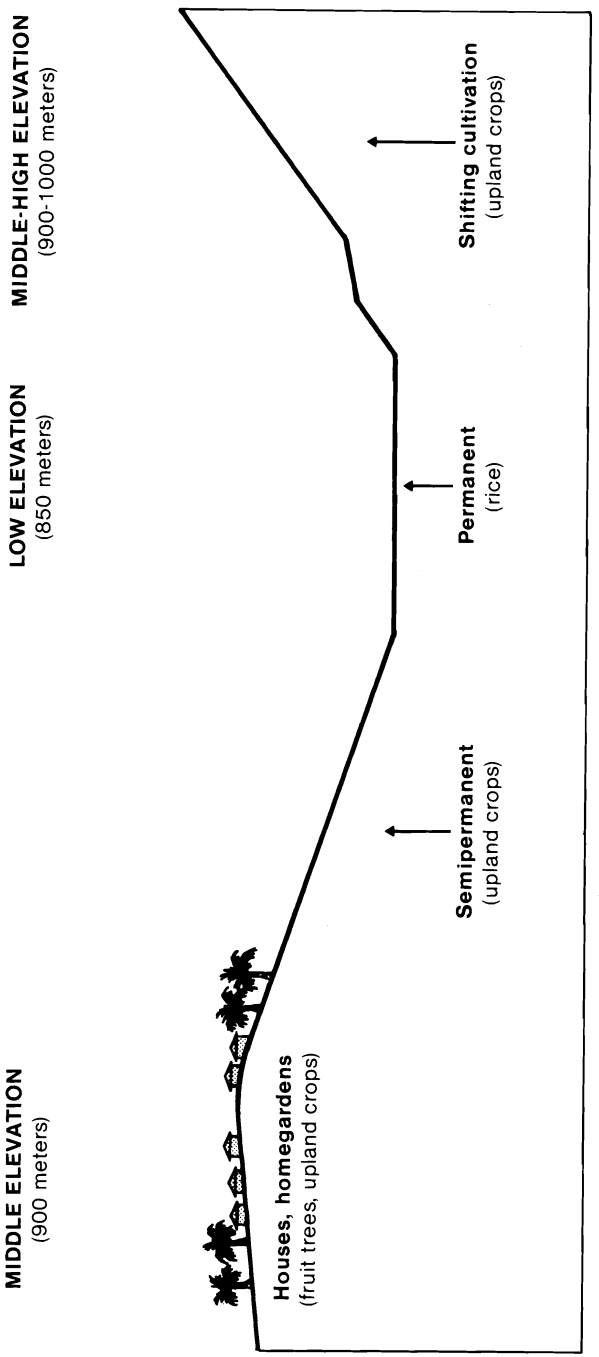


Figure 4.2. Landscape Profile for a Hill-Tribe Village in Kae Noi Area

Table 4.2. Main Crops of the Lahu Tribe in 1979

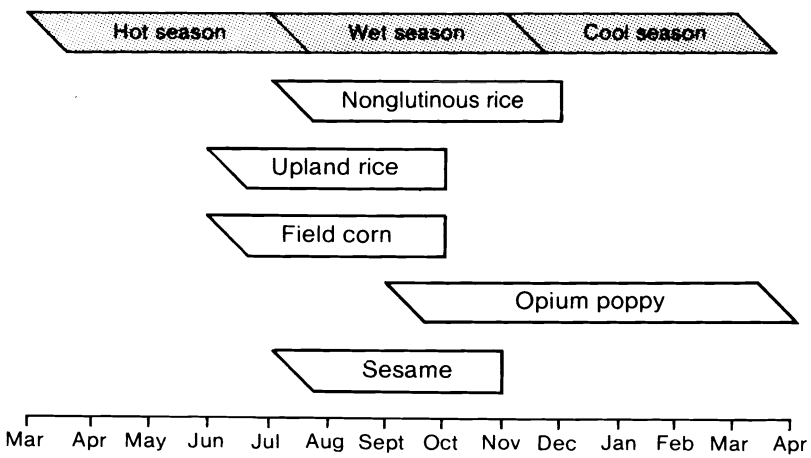
Crop	Land Area (%)	Cash Income[a] (%)
Opium poppy	17	74
Upland rice	31	—
Paddy rice	10	1
Sesame	16	24
Corn	26	1

[a] Corresponds only to the part of the crop that is sold.

Table 4.3. Livestock in Lahu Villages in 1979

	Number	Cash Income (%)
Oxen	218	28
Buffalo	119	23
Horses	87	2
Pigs	840	46
Chickens	1,182	1

Figure 4.3. Highland Cropping Schedules



THE LOWLAND AREA (CHIANG MAI VALLEY)

The Chiang Mai Valley (Figure 4.4) is a relatively affluent area of moderately fertile, alluvial soils serviced by irrigation networks that allow cropping outside the rainy season. Major factors influencing the agriculture in the area are the availability and reliability of the water supply, access to markets and processors of agricultural produce, opportunities for off-farm employment, and distance from Chiang Mai city. The Multiple Cropping Project at Chiang Mai University has made a long-term effort to improve agriculture in the area, particularly through the development of triple cropping. The description here is based on observations made in the context of the Multiple Cropping Project (Gypmantasiri et al. 1980, Srimongkol et al. 1981).

Villages

Most villages in Chiang Mai Valley are quite similar in appearance. The size of villages varies from 48 to 328 households (average, 140). The number of households depends on soil fertility, the amount of land available for cultivation, and the length of time since establishment of the village. The average size of agricultural households is 5.5 people.

Figure 4.5 shows a typical landscape profile for villages in Chiang Mai Valley. The villages are surrounded by cropland located at discrete elevations. Residential areas composed of houses, homegardens, roads, and shade trees are situated in the upland areas. The upper paddy level has the best water supply for rice cultivation and usually supports the highest cropping intensity. Flooding, especially during the wet season, is a problem in lower paddy areas, so rice is the only crop that can be grown there. In addition, problems with crop security occur because the villages are located quite a distance from lower paddy areas.

Figure 4.6 shows a map of Ban San Sai Village. Village areas are clustered on both sides of the road, each compound comprising up to five houses with no fences between the houses and many shade trees around the edge of each compound (Figure 4.7). Each household consists of a house, a rice barn, an outhouse, fruit trees, a pigpen, a buffalo shed, and a small kitchen garden. The average size of a household plot ranges from 0.5 to 1.0 hectare. The average distance from a house to the farmer's fields is 0.6 km, though some farmers have fields more than 3 km from the house.

Cropping Systems

Ban Mae Kung and Ban Han Kaew villages can be used to illustrate the traditional cropping systems in Chiang Mai Valley. Since these villages are only 18 km from a major city, they have been exposed to modern agricultural technology but nonetheless retain much of their traditional agriculture. There has been a dramatic decline in the birthrate; the 15- to 19-year-age group has the largest proportion of the population. The natural growth rate of the village population is only 0.37 percent per year. A household works 0.9 ha of land on the average. About half the households own all

Figure 4.4. Map of Chiang Mai Valley

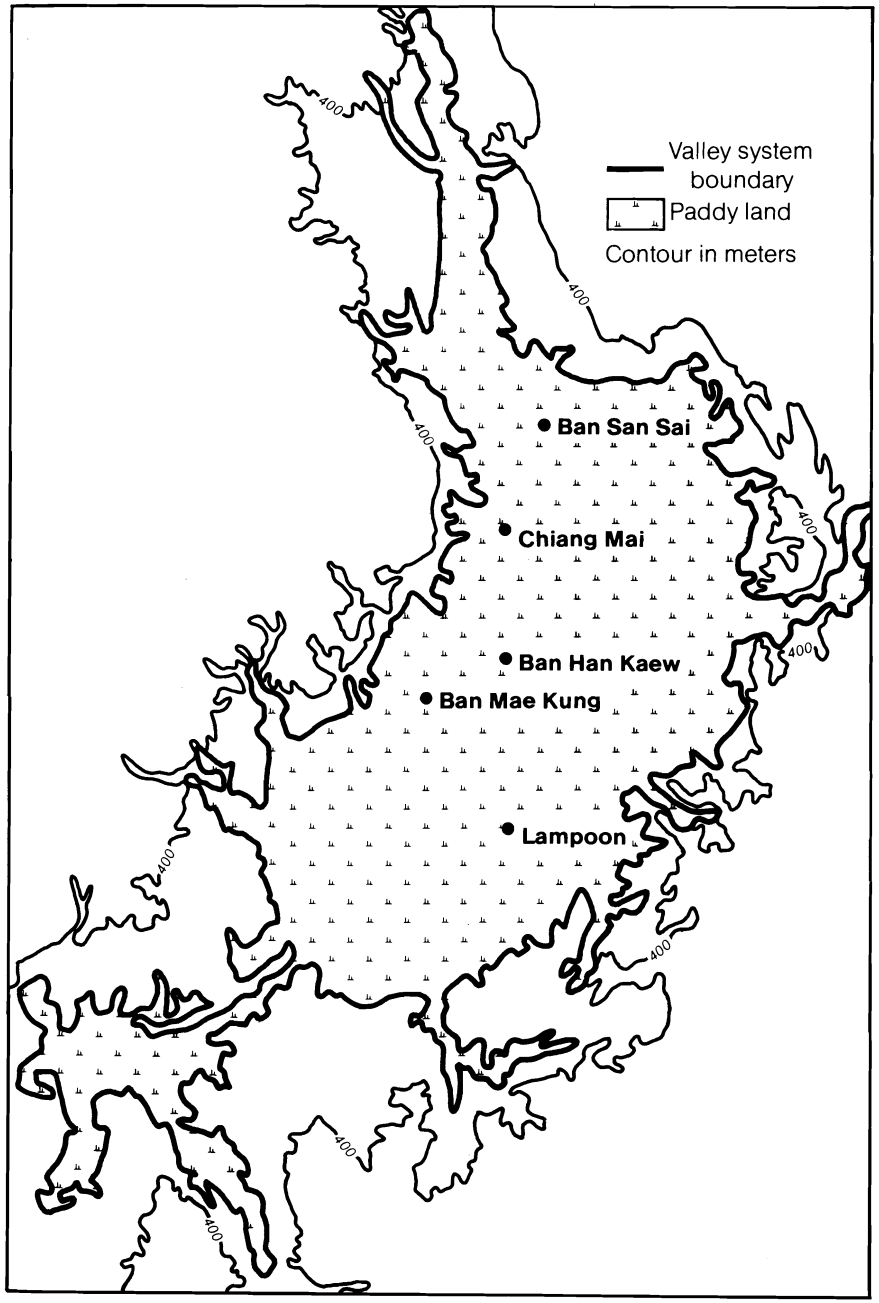
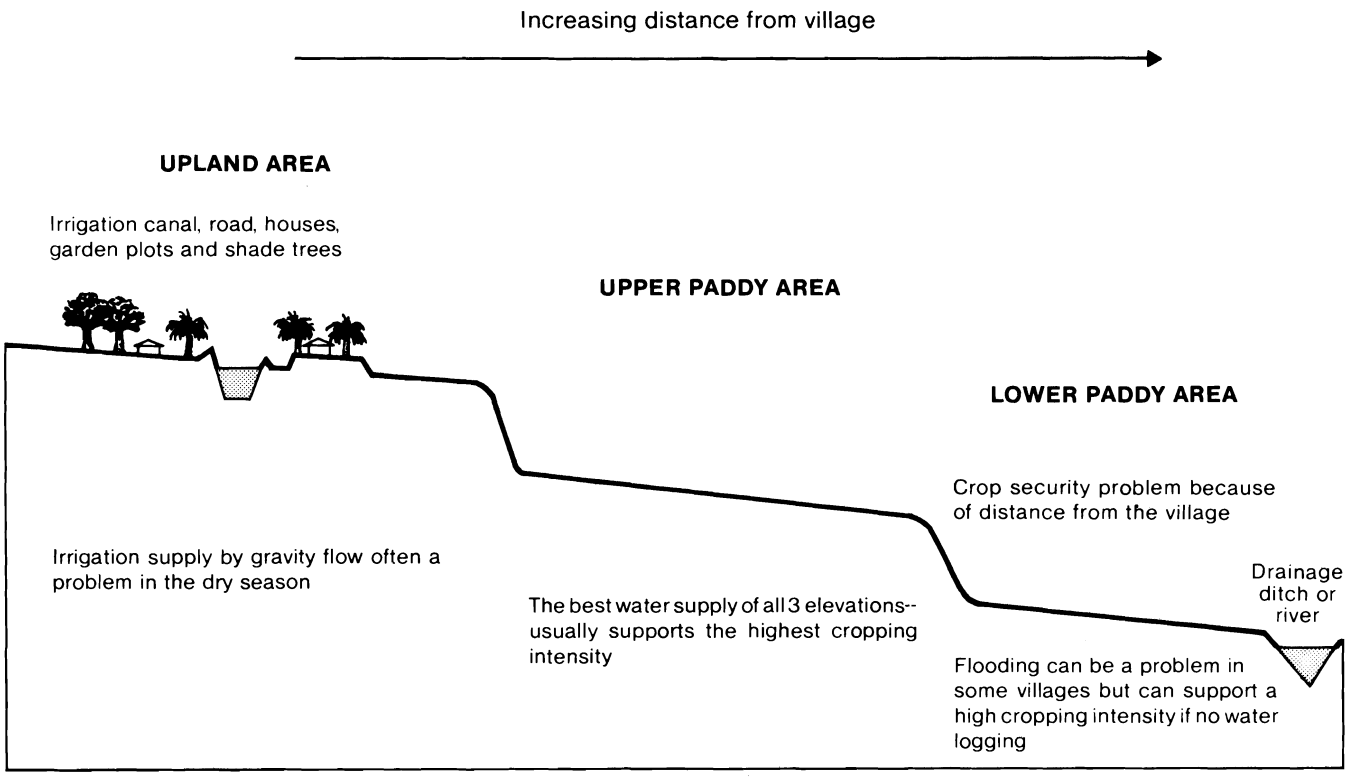


Figure 4.5. Landscape Profile for Villages in Chiang Mai Valley



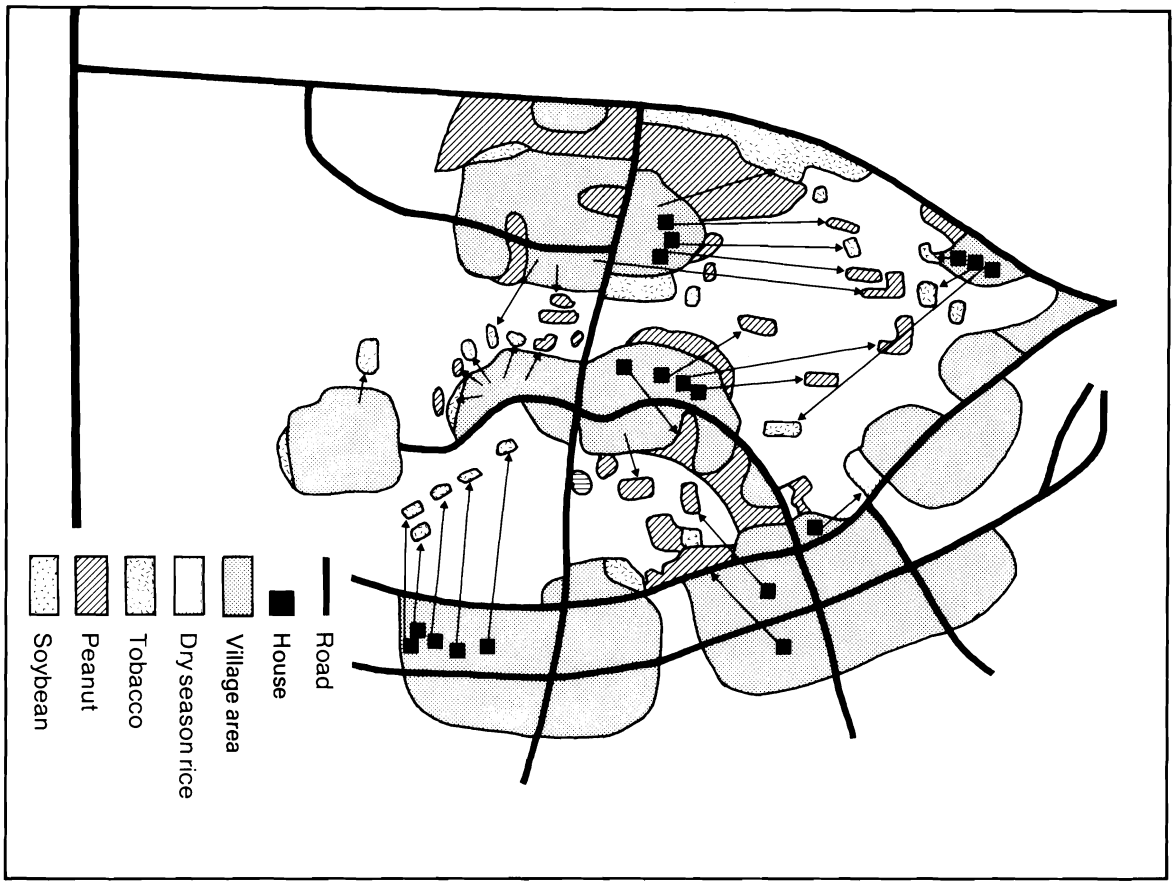
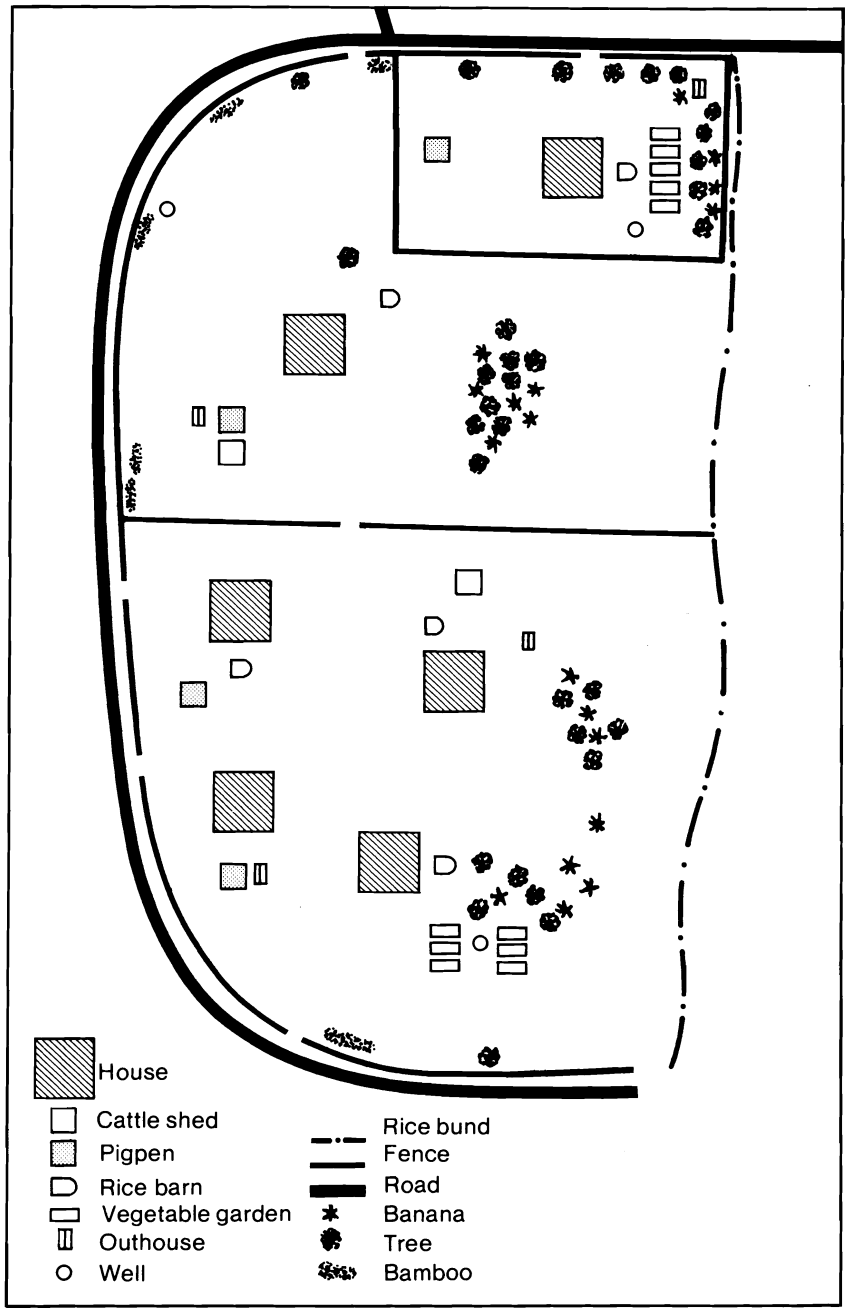


Figure 4.6. Dry Season Cropping Pattern in Ban San Sai Village[a]

[a]Some of the houses in the village have been placed on the map with arrows to illustrate which households work which fields.

Figure 4.7. Homegarden Layout in Ban San Sai Village



the land they work, 30 percent work only rented land, and the remainder work a combination of rented land and land they own. Ninety percent of the farmers are served by the local irrigation system, which provides all the water they need during the wet season. In the dry season only one-third of the farmers receive as much water as they feel they need.

Upland crops are grown in monoculture, contrasting with hill-tribe areas where a number of upland crops are often interplanted. Each farmer is likely to employ different cropping systems on different fields, however, in an effort to spread his production resources more evenly over the year and to minimize his risks.

Rice is the main subsistence crop, grown primarily in the wet season (Table 4.4). It may be grown as the only crop, but most of the land is double-cropped with rice as the base. Glutinous rice is generally grown for subsistence, the main variety being Niaw San Patong, though other rice varieties, both glutinous and nonglutinous, are used extensively, depending on the timing strategies of various cropping systems. Any of the rice varieties grown during the wet season can be combined in a double-cropping sequence with a second crop of rice (nonglutinous) or any cool-season field crop like those shown in Figure 4.8, provided the rice crop finishes before the cool-season crop must be started. A few double-cropping sequences have proved most popular. For example, Daw Prao is a variety of traditional glutinous rice that matures quickly (in about three months) and is used widely before early cool-season crops such as chili peppers or garlic. Late-maturing rice varieties are often cultivated in sequence with soybeans.

Government price guarantees have stimulated the farmers to grow non-glutinous rice. Most people in Northern Thailand prefer to eat glutinous rice, but they cultivate an improved nonglutinous variety (R.D.7) in addition to glutinous rice. They sell the nonglutinous rice and use some of the money to buy glutinous rice for home consumption if necessary. R.D.7 is grown mainly in the hot season when most fields are in fallow because of insufficient water. Hot-season crops, such as rice or vegetables like Chinese cabbage, must be irrigated or planted in waterlogged areas where there is sufficient soil moisture.

Improved rice varieties seem to have pest problems different than those of traditional varieties. Farmers say there are more insect problems with improved varieties, but birds are more of a problem with traditional varieties. About half the farmers use chemical insecticides, and all use poisons for birds, rats, and crabs.

Nearly all farmers use the traditional method of weeding; only 11 percent use herbicides. The traditional method is to pull the weeds by hand, laying the larger ones out on the paddy bund and trampling the small weeds into the soil. Somewhat fewer than half the farmers apply chemical fertilizer to traditional rice 20–25 days after transplanting and some make a second application. Many more (75 percent) apply chemical fertilizers to improved varieties.

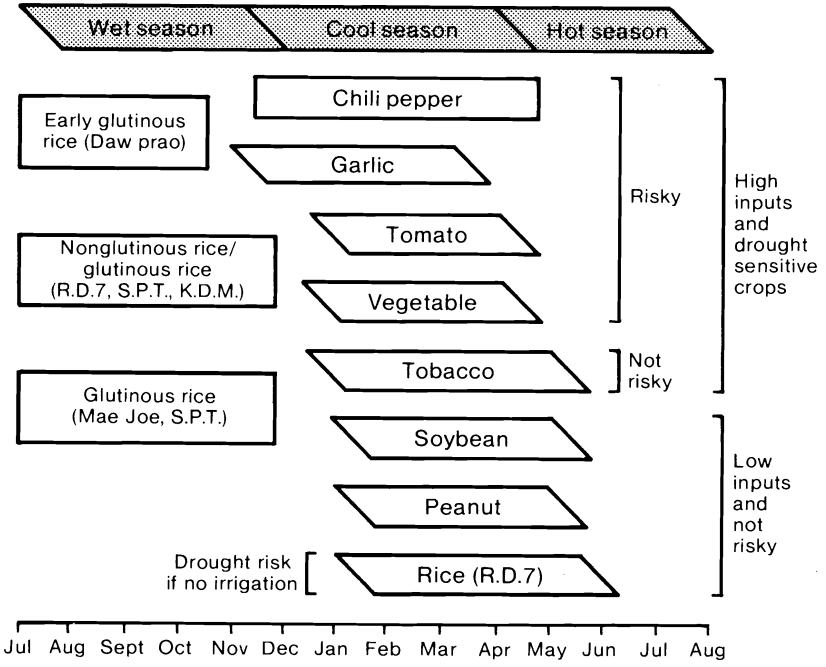
Upland crops such as chili peppers, garlic, tomatoes, soybeans, and peanuts are grown in the cool season after the rice is harvested. Chili

Table 4.4. Rice Varieties Used During Wet Season

Rice Variety	Percent Using	Average Yield (tons/ha)
Traditional glutinous rice[a]	70	4.2
Improved glutinous rice[b]	7	4.1
Improved nonglutinous rice[c]	49	5.3

[a] San Patong, Daw Prao.
[b] R.D.6, 8, 10.
[c] R.D.7.

Figure 4.8. Cropping Schedules in Ban Mae Kung Village[a]



[a] S.P.T. = San Patong glutinous rice.

peppers are planted and harvested early because farmers know they can bring a better price then. Garlic also is planted early because the bulbs are larger and of better quality when they are grown during the early part of the cool season. After finishing work in the fields, farmers work in their homegardens or do off-farm work to earn more money. The recent shift from subsistence to commercial agriculture has affected the labor exchange system in the village, so many farmers now use paid labor instead of working through the traditional labor exchange.

The crops selected for cultivation in the cool season depend to a large extent on the availability of water and the market price. Chili peppers, garlic, tomatoes, vegetables, watermelon, and tobacco demand large amounts of water, labor, fertilizer, and pesticide inputs. Farmers usually grow these crops only when they have enough labor. Soybeans and peanuts need smaller amounts of the inputs and are less risky. Cucumbers also need fewer inputs but are risky unless planted in waterlogged areas or where reliable irrigation is available. Low input crops can be grown farther from the houses because they have a lower value and do not need to be watched so carefully.

A number of factors enter into a farmer's decision on what cropping system to employ (Table 4.5). The most decisive factor is water, with the key question being whether the irrigation canal will provide enough water in the dry season to sustain a crop. This depends upon the location of a particular field in the irrigation network and can be judged only from previous experience with different crops. The prices of soybeans, peanuts, and nonglutinous rice are relatively stable from year to year, but the prices of chili peppers, garlic, tomatoes, and vegetables fluctuate considerably. Planting decisions generally are based on prices the previous year.

Soybeans are a popular crop for the cool season because the price has been stable, labor inputs are low, soybeans add nitrogen to the soil, and they require only a small amount of water. Soybeans provide an instructive comparison of traditional and recently introduced management practices because both now occur in the area. The traditional method is to sow the soybeans into the rice stubble immediately after burning the rice straw, cover them with ash, and flood the paddy. This method involves no other land preparation. Most farmers apply chemical fertilizers to the preceding rice crop on fields of low fertility and do not apply chemical fertilizer to the soybeans because they believe there is enough left over from the rice to meet the needs of the soybeans. Weeds are not a problem because weeds and weed seeds are killed when the rice straw is burned. The main problems are fungi and insects, and many farmers who otherwise follow traditional management practices now control insects with sprays.

Recently introduced practices for soybeans differ from the traditional in two major respects: preparation of raised beds and use of chemical fertilizers. The introduced method, which extension agents have represented as better practice, is to cultivate the field and plant the soybeans in raised beds. This requires significantly more labor than the traditional method, and chemical

fertilizer is applied. Unfortunately, the farmers are not realizing higher yields from the introduced methods, which means their net income from those methods are lower since the costs of inputs are higher (Table 4.6).

Other things being equal, a cropping system that has worked successfully in the past will be the one of choice. The interaction of all these factors can be summarized into two basic strategies (Table 4.7). One strategy aims at minimizing risks in the presence of constraints on water, chemical inputs, or crop security; the other strategy aims at maximizing profits when none of these constraints is a problem.

The use of modern inputs is better developed in the lowlands than in the highlands. Farmers in Chiang Mai Valley are intensely interested in any new agricultural practices that will increase their income. Most farmers listen to the radio daily, particularly to agricultural programs that provide information on new technologies, markets, and weather. They also see television several times a week, but television is more important for news and dramatic entertainment. They talk with extension agents several times a year and with neighbors on technical agricultural matters about once every month or two on the average. Nonetheless, for the most part they have not adopted the new technology because they are willing to do so only when convinced it will serve them better than their traditional technology.

Chemical fertilizers are discussed with extension agents and neighbors more than any other aspect of soil management. Chemical fertilizers are still a relatively new technology in the area, and farmers do not feel they know precisely which formulas and levels of application are best for each of their cropping systems on the different kinds of soils. They are therefore interested in learning from experiences of other farmers.

Problems perceived by farmers in the village include:

- Low yields of rice and peanuts because of low soil fertility,
- Uncertainties about best rates of fertilizer application,
- Shortage of irrigation water in the dry season,
- Low prices for peanuts,
- Weeds in rice fields, and
- Rice stem borers.

Problems perceived by research workers include:

- Nematode problems in rice fields,
- Inequitable land distribution,
- Low quality of improved-variety rice seeds, and
- Lack of technical knowledge.

Soil Problems

The soils in Chiang Mai Valley are derived from alluvial deposits and may be classified as old, semi-recent, and recent alluvials. The two major

Table 4.5. Properties of Some Component Crops for Multiple Cropping Systems

Crop	Productivity	Stability	Sustainability
Traditional glutinous rice	Poor nitrogen user High grain quality High straw yield	Cultivated only in wet season so no drought risk	Broad resistance to pests and diseases
Soybean	Moderate yields	Stable yields Stable price	Produces own nitrogen
Improved nonglutinous rice	Efficient nitrogen and phosphorus user	Drought risk if cultivated in dry season	Limited resistance to pests and diseases

Table 4.6. Comparison of Traditional and Introduced Management Systems for Soybeans

	Traditional	Introduced
Input costs (baht/ha)	488	2,895
Yield (kg/ha)	1,524	1,605
Net return (baht/ha)	7,375	5,348

Note: One U.S. dollar = approximately 20 baht.

Table 4.7. Cropping System Strategies

	Risk Minimizing	Profit Maximizing (high risk)
Situation	Chemical inputs unavailable	Chemical inputs available
	Water supply inadequate	Water supply adequate
	Crop security problem	No crop security problem
Examples	Glutinous rice–soybean	Early glutinous rice–chili pepper
	Glutinous rice–peanut	Early glutinous rice–tomato
	Glutinous rice–nonglutinous rice (R.D.7)	Glutinous rice–nonglutinous rice–vegetable

soil series in the valley are Lampang (old) and Hang Dong (semi-recent). They are low in organic matter and stable aggregate content and are therefore very hard when dry. They have moderately good to poor internal drainage and fair to good water infiltration. They are low in macro- and micronutrients. Since most land in the valley is bunded for rice paddy cultivation, the soils are subjected to continuous waterlogging for three to four months a year. The waterlogging lasts as much as eight months a year in areas that are double-cropped with rice. In the past, multiple cropping was confined to the recent alluvial soils that have a well-developed soil structure and are relatively fertile, partly because of rainy season flooding and partly from animal manure applications.

On the Hang Dong and Lampang soils, good yields are possible only with frequent fertilization. Experiments on Multiple Cropping Project plots and in farmers' fields suggest that applications of 50–150 kg/ha of nitrogen are optimal for nonleguminous crops. Only cabbage and soybeans respond to phosphorus, and only soybeans respond to potassium. Micronutrient studies show that peanuts respond to boron, copper, and calcium but not to other micronutrients. Most farmers use some form of fertilizer for their crops. Animal manure is most commonly used on wet-season rice, soybeans, and peanuts; chemical fertilizer is used on dry-season rice and garlic. Recent experiments in farmers' fields suggest no response (or only localized responses) of glutinous rice to nitrogen applications up to 50 kg/ha.

Severe soil acidity has developed on the Multiple Cropping Project experimental plots, which have been subjected to continuous cultivation for ten years. Foliar analyses indicated potentially toxic levels of manganese (> 2,000 ppm) in peanut and mung bean leaves. Yearly liming since 1971 does not appear to have solved the problem, even though liming has returned the pH to normal levels. The rice yield declined from a peak of 7 tons/ha in 1971 to 4 tons/ha in 1977–78. Other crops also have suffered. Wheat, mung beans, and soybeans now seldom yield more than 1 ton/ha, and French beans have failed completely in the past two years, although these crops previously had shown considerable potential.

The soil problem is almost certainly a consequence of the intense cropping with high inputs that has characterized the "improved" management in the Multiple Cropping Project, but the precise cause is not yet known. It appears to be a complex mixture of several factors, including:

- Depletion of soil nutrients due to large harvests in the first few years;
- Heavy use of ammonium fertilizer (inevitable in intensive rice production), which causes a drop in soil pH and a loss of calcium;
- Inhibition of reversion of potentially toxic divalent manganese ions to insoluble tetravalent manganese in the acid soil; and
- Nutritional imbalances caused by liming.

Alarmingly, the same soil problem is now appearing in farmers' fields. They are complaining that their soils are becoming "lifeless." Plant symptoms

Table 4.8. Farmers' Perception of the Values of Various Soil Treatments for Dealing with Different Soil Problems

Treatments	Problems			
	Difficult to Plow	Low Soil Fertility	Sandy Soil	Soil Pests
Apply animal manure	H	H	H	0
Apply lime	L	L	0	L
Irrigate before plowing	L	0	0	0
Apply chemical fertilizer	0	L	0	0
Apply green manure	0	0	L	0
Plow and sun dry	0	0	0	L

Note: H = Higher value.
L = Lower value.
0 = No value.

similar to those at the experimental station can be seen in peanuts and mung beans throughout the valley. In some areas farmers have stopped growing mung beans as the third crop in a triple cropping sequence because the yield has become so low. Recent experiments at the experimental station have shed some light on the soil chemistry involved. Soil pH can fluctuate over two pH units in a single year under some of the cropping systems. The pH drops one unit following a crop of paddy rice, regardless of the nitrogen fertilizer used, but an even greater decline in pH under field crops is associated with the use of ammonium fertilizer. It also appears that boron may be depleted from the soil by intensive cropping.

The two measures that farmers consider the most effective for soil problems in general are animal manure application and liming (Table 4.8). They use chemical fertilizers because animal manures are not available in the quantities they desire.

FARMERS' PRACTICES THAT MERIT FURTHER STUDY

There are numerous farmers' practices that should be better understood to develop improved cropping systems. The following are some examples:

- *Existing practice*—To prepare the land for rice, farmers irrigate their fields and leave them for two weeks before plowing. *Apparent reason*—This facilitates plowing and allows the rice seedlings to be transplanted deep enough so they do not fall over.
- *Existing practice*—Farmers plow many times to make the soil muddy and form a hardpan. *Apparent reason*—To prevent water loss by percolation to the subsoil.

- *Existing practice*—Nitrogen fertilizer is not employed for rice. *Apparent reason*—Nitrogen fertilization leads to pest and disease problems (e.g., stem borer and bacterial leaf blight).
- *Existing practice*—Peanut fields are weeded before the peanuts start to form, but there is no weeding once the plants start to inject the peanuts into the soil. *Apparent reason*—The soil disruption caused by weeding could damage the newly formed peanuts.
- *Existing practice*—Fertilizers are not used for peanuts. *Apparent reason*—Fertilizers are not necessary. Just liming at 625 kg/ha/yr seems to produce the best results.
- *Existing practice*—During the cool season when rainfall is unusual, farmers wash garlic plants after any rainfall by pouring irrigation water over them. *Apparent reason*—This practice is believed to protect garlic plants from leaf blight (also called purple blotch). Perhaps rainwater contains fungus spores from the atmosphere while irrigation water does not.

ACKNOWLEDGMENTS

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