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# Agricultural Commercialisation, Diversification, and Conservation of Renewable Resources in Northern Thailand Highlands

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## *Abstract*

The process of commercialisation-diversification in the highlands of upper northern Thailand and the accompanying dismissal of self-subsistence are documented based on the findings from seven case studies carried out in different agricultural and social situations during the past decade. The characteristics of the key driving forces powering this agrarian transition such as rapid economic growth, decrease in the share of labour employed in the agriculture, urbanization and changes in food consumption patterns, and improved communication infrastructures, are presented in the Thai context. The environmental impact of these profound agrarian transformations on the degradation of key renewable resources, particularly soil erosion, is assessed. Their socio-economic consequences on an extensive differentiation among farming households and equity issues are also discussed. Finally the authors draw several lessons from this Thai experience that illustrate the very strong adaptive capacity of small highland farmers. They could be useful in similar agro-ecological zones of neighbouring countries that are presently experiencing the same kind of agricultural transition in the Montane Mainland Southeast Asia ecoregion. Particularly, the article underlines the need for more holistic and integrated approaches to agricultural development and the management of renewable resources in highland agro-ecosystems to alleviate poverty while conserving the resource base.

## *Full text*

# Introduction

1 The process of commercialisation-diversification in Asian agriculture and the accompanying dismissal of self-subsistence have been extensively documented in the case of irrigated areas (Pingali 1997, Pingali & Paris 1996). But these agrarian transformations have been less studied in the sloping uplands and montane highlands agro-ecosystems where they are more difficult to document, especially in the case of transitional highland swiddening systems.

2 Because of the specificities of the local regional history, such profound agricultural changes have been at work over the last three decades in the northern Thailand highlands, an area covering approximately 15 million hectares (72% of the region), which is now exporting a variety of agricultural produce to lowland and international markets (Rutherford 2002). These highlands consist of small plateaus and mountain land with steep slopes (slope angles are most of the time higher than 35%), separated by narrow valleys covering less than 1% of the total area, situated at elevations ranging from 500 to more than 2,500 m amsl. National security concerns along border areas, rapid population growth and trans-border migrations, numerous state interventions (many of them supported by international aid programs) to resettle highlanders and control population movements in the mid-1960s, to eradicate illegal opium poppy production since the 1970s (Kesmanee 1989), to improve communication infrastructure, to conserve forest areas and modify land use through large projects covering approximately one third of the highland villages in the 1980s (Rerkasem *et al.* 1994), or to improve watershed management since the 1990s, occurred during the last four decades (McKinnon & Vienne 1989, Rerkasem & Rerkasem 1994, Seetisarn 1995). More recently, similar dynamics emerged in neighbouring countries of Montane Mainland Southeast Asia (MMSEA) following important economic reforms in Vietnam, Laos, Yunnan in the late 1980s and early 1990s. Therefore, the lessons on the transition from swiddening systems to market integrated and (semi)-permanent farming systems learned from the three-decade-long Thai experience could be useful to these less economically developed areas.

3 The difficulty to document agricultural and economic transformations and their related environmental impact in these still relatively remote highland areas is partly due to the paucity of specific and reliable time series of statistics and other kinds of quantitative data. Agricultural research and extension work in the highlands is also carried out by numerous agencies, often on a piecemeal basis, with much bureaucratic division of the task and a growing number of non-governmental actors during the past two decades (Rutherford 2002). But village monographs describing contrasted situations have been recently produced. In this article we analyse and illustrate these key agrarian changes by presenting the key findings obtained from seven complementary case studies carried out during the past decade in Chiang Mai and Chiang Rai provinces. The complementary objectives of this article are three-fold:

- To analyse the recent economic transformations and environmental changes in highland areas of northern Thailand due to the agricultural commercialisation and diversification of the production systems.
- To assess the environmental impact of these agricultural transformations and present the measures being taken to limit the degradation of renewable resources.
- To draw several lessons from this Thai experience that could be useful

in similar agro-ecological zones of neighbouring countries experiencing the same kind of agricultural transition in the MMSEA ecoregion.

4 First, a brief presentation of the seven case studies that provide illustrations and comparisons in the following sections of the article is proposed. It is followed by an analysis of the powerful driving forces of agricultural commercialisation-diversification that were at work in the kingdom during the last decades. Their original characteristics in the northern region are underlined. In the next section, an analysis of the effects of recent agricultural transformations on land use changes in the Thai highlands is proposed before a presentation of their environmental impact and a discussion of the actions used to mitigate the degradation of key renewable resources. Finally, several key lessons learned from this northern Thailand experience are proposed as well as an assessment of the sustainability of this type of agricultural development in MMSEA.

# A Comparative Approach Based on Case Studies Across Northern Thailand Highlands

5 Seven complementary case studies located across the Northern Thailand highlands of Chiang Mai and Chiang Rai provinces were selected to illustrate diverse and more or less advanced trajectories of agricultural commercialisation and diversification from pre-existing swiddening systems. The key characteristics of these study sites are summarized in Fig. 1 and their location is displayed in Fig. 2.

**Fig. 1: Location of the Seven Case Study Sites Across Upper Northern Thailand**

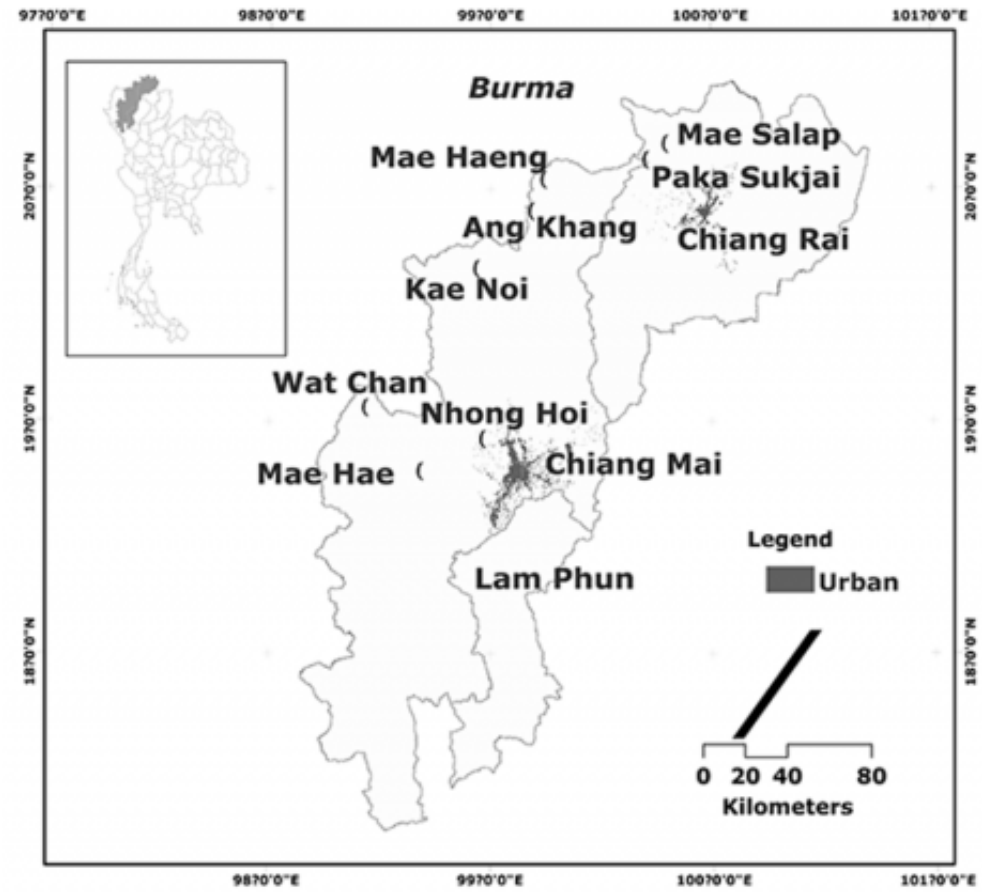


**Fig. 2: Key Characteristics of the Seven Case Study Sites in Northern Thailand Highlands**

| Location: Village, Province | Elevation (m amsl) | Main Ethnic Group(s) | Main Staple Crop | Average Fallow Length (Years) | Household Cash Income (USD/Year) | | Crop Diversification Pattern | | Stage of Agricultural Commercialisation -Diversification | Environmental Problems |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average | Range (min-max) | Type | Key species | | |
| Mae Haeng, Chiang Mai | 600-1200 | Lahu | Upland rice | 5-6 | Very low | n.a. | Fruit-based | Litchee | Very early | Weeds, soil borne pests, and soil erosion |
| Nong Hoi (RPF site) Chiang Mai | 1280 | Hmong, Northern Thai | None | 0 | 1,872 (2000) | 75-8,150 | Vegetable-based | Cabbages, Carrot, Sugar pea, lettuce, Green pepper | Very advanced | Soil erosion |
| Ang Kang (RPF site) Chiang Mai | 1,400 | Chinese Yunnanese, Lahu, Palong, Yao, Shan | None | 2-6 | 1,289 (2000) | 71-16,275 | Fruit & Vegetable-based | Potato, Kale, Red cabbage, leek, pear, abricot, plum | Very advanced | Soil erosion |
| Mae Hae (RPF site) Chiang Mai | 1,160 | Karen, Hmong | Paddy & upland rice | 2-3 | 1,372 (2000) | 63-11,548 | Fruit-based | Persimmo, Pear, Abricot | Advanced | Soil erosion, water shortage |
| Wat Chan (RPF site) Chiang Mai | 900 | Karen | Paddy rice | 4-5 | 566 (1992) | 0-3,600 | Vegetable-based | Lettuce, Japanese pumpkin | Advanced | Weeds, Soil erosion |
| Kae Noi, (RPF site) Chiang Mai | 1,000 | Lahu, Chinese Yunnanese, Shan | Upland rice | 0-1 | 246 (1992) | n.a. | Vegetable-based | Red kidney bean | Early | Weeds, Soil erosion |
| Pakasukjai-Mae Salaep, Mae Chan, Chiang Rai | 630-1100 | Akha | Upland rice | 1 | 447 (1994) | 63-3,338 | Vegetable-based | Cabbage, Fruits, Ginger, Green tea | Very advanced | Soil erosion |

Note: RPF= Royal Project Foundation; n.a.= not available.

6 A majority of these sites belong to the regional network of villages where the Royal Project Foundation (RPF) has been active in the promotion of market integration and commercialisation of agricultural production, particularly through the promotion of high commercial value horticultural cash crops. Presently, the RPF functions as an NGO thanks to donations and aims at becoming self-sufficient. The RPF covers 35 sites across northern Thailand comprising 295 villages with 14,109 families and 85,000 people in the upper northern region. This population represents roughly 15 percent of the total population of ethnic highland minorities in this region. In other nearby villages not covered by the RPF, one can observe a spillover effect of the RPF

promotion of cash cropping activities as crops like cabbage, tomato, potato, carrot, and ginger are commonly seen in communities not included in the network of RPF sites. Sometimes farmers are also exposed to cash cropping through other development projects and government agencies in much the same way as in the RPF sites. The main difference being that being outside of the RPF network, farmers have to market their product more independently. This is the case at the Mae Salaep and Pakasukjai Akhas villages, and in the Lahu village of Mae Haeng included in this study.

7 Findings of a farm survey implemented to characterize the diversity of household production systems at Ang Khang, Nong Hoi, and Mae Hae RPF sites carried our in late 2000-early 2001 are used in this article. These villages were chosen because of the different orientations of their agricultural production systems and dominant ethnic groups (see Fig.2). A total of 256 randomly selected households were interviewed (Ekasingh & Ekasingh 2001, Ekasingh *et al.* 2001, Ekasingh *et al.* 2002). The results of a remote-sensing study on land use changes between 1954 and 1984 at Kae Noi and Wat Chan RPF sites also illustrate this paper (Ekasingh *et al.* 1995). In Mae Haeng, a very detailed on-farm agronomic survey was carried out in this Lahu village between 1993 and 1996 to analyse farmers' upland rice-based cropping systems, the characteristics of their traditional planting material, and to rank the limiting factors of this key stable crop (Van Keer *et al.* 1998, Van Keer 2003). While in Pakasukjai, a comprehensive on-farm erosion survey was carried out at the same time over four cropping seasons to quantify changes in the risk of soil erosion due to crop diversification (Turkelboom & Trébuil 1998). An analysis of the extent of the differentiation among farming households was also achieved at this site (Turkelboom 1999). At the nearby village of Mae Salaep, a similar typology of farming units based on their socio-economic strategies and related agronomic practices was built in 1994-1995 (Trébuil *et al.* 1997, Thong-Ngam *et al.* 1997) and land use changes during the 1990s were also analysed at the watershed level (Trébuil *et al.* 2000).

# Driving Forces of Agricultural Commercialisation and Diversification in Thailand

8 The process of agricultural commercialisation-diversification is generally triggered by several interdependent driving forces such as a rapid general economic growth, a decrease in the share of labour employed in the agricultural sector, urbanization and the appearance of a growing middle class of citizens leading to structural changes in food consumption patterns among city dwellers, and improved communication infrastructures lowering the transport costs of agricultural inputs and products (Pingali & Rosegrant 1995).

9 The Thai economy has enjoyed a robust economic growth during the past decades, particularly from1986 to 1996 when the country's gross domestic product (GDP) increased at an average annual rate of 9.2% in real term. In agriculture, the growth rate was higher during 1980-85 at 4.3% and decreased to 3.5% during 1985-1996 according to the Bank of Thailand. These booming years came to an abrupt halt in June 1997 when the local currency was devalued, generating a sudden financial crisis which sent the GDP plummeting by—10% during the 1997-98 fiscal year. But, recently, the Thai economy has been recovering from this recent crisis and reached a real growth of GDP

averaging 4.5% per annum during 1999-2002 and reaching 6% in 2003 thanks to generous government spending and incentives powering the current consumption-led economic recovery. In the case of Thailand, recent rapid economic growth has been following an export-led model, especially in the agricultural production and agro-industrial sectors up to the point that several authors have described this economic growth as the emergence of a "newly agro-industrialised country". This pattern is reinforced by the current government vision of Thailand as the "kitchen of the world". Figure 3 provides an example of the impressive recent performances reached by the exports of horticultural products from Thailand, with specific data for some of the species relevant to the highland areas of the northern region.

**Fig. 3: Volume and Value of Horticultural Products Exported from Thailand in 2002 and 2003**

| Year | 2002 | | 2003 | |
|---|---|---|---|---|
| | Volume (ton) | Value (million $) | Volume (ton) | Value (million $) |
| Vegetable crops and products | 452,558 | 379.0 | 490,814 | 418.5 |
| Ginger | 26,908 | 9.4 | 21,779 | 8.7 |
| Fruits and fruit products | 1,131,222 | 793.5 | 1,224,713 | 914.1 |
| Fresh litchi | 16,110 | 9.6 | 5,237 | 3.7 |
| Canned litchi | 13,948 | 12.4 | 13,139 | 11.5 |

Source: Office of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok.

10 While the economy of the northern region followed closely the evolution at the national level (the northern region economy registered an average growth rate of 7.1% during the years preceding the 1997 crisis), it has been more dependent on the primary sector as the percentage of agriculture in the total gross regional product was (and is still) accounting for approximately 20% in 1994-96 compared to only 11% for the whole country during that same period. While the average rate of agricultural growth for the whole country was 3.8% per year during this period, the northern region was doing better with a higher rate of 5.8% per annum. In spite of this faster regional agricultural growth, the per capita GDP of the northern region was only 48% of the national average at that time. At the national level, it took five years for the national economy to reach again the pre-crisis GNP per capita level of some 1,250 US$ in 2002.

11 The share of the total labour force employed in the Thai agricultural sector declined from 70% in 1980 to 60% in 1990, and approximately 44% in 2003, according to the Labour force survey of the National Statistical Office. A similar, but slower, trend occurred in the northern region where 59% of the total labour force was still employed in the agricultural sector in 1996 (down from 82% in 1976), leading some authors to describe a process of "deagrarianization" (Rigg & Nattapoolwat 2001). In the northern region, the growth of the handicraft and tourism-related activities (from "hilltribe trekking" among colourful minorities to construction sites) are particularly strong: the number of tourist arrivals in Thailand jumped from one million visitors in the mid-1970s to three millions in the mid-1980s and reached 10 millions in 2001 according to the Tourism Authority of Thailand. On that year, foreign visitors brought more than 6.7 billion US$ in receipts from tourism,

including 1.5 billion US$ in the northern region and this is the first sector for hard currency earnings in the national and regional economies.

12 The on-going process of urbanization is leading to structural changes in food consumption patterns and strong increases in the demand for fruit, vegetable, and animal products from urban and more quality conscious consumers with middle and high incomes. The total population of Bangkok and its vicinity increased from 6,4 millions inhabitants in 1976 to reach 8 millions in 1986, and could break the 10 millions barrier in 2004 according to the National Statistical Office. Regarding the main urban centre in the northern region, the population of Muang District in Chiang Mai Province also keep increasing, from less than 75,000 inhabitants in 1993 to more than 85,000 in 2000.

13 Tremendous improvements in communication infrastructure leading to lower transport cost of agricultural inputs and products were observed in northern Thailand during the last decades. The number of fixed telephone lines available in the region jumped from 91,000 in 1986 to 229,000 ten years later, not to mention the more than 18 million mobile phones being used nowadays across the kingdom. The length of the road network (concrete, asphalted, and unpaved ones) almost doubled every ten years from 3,500 km in 1971 to 6,600 km in 1981, and 14,300 km in 1993 according to the Department of Highways. The rapid improvement of communication networks has been obvious even in the remote highland and border areas of the northern region because of national security problems along border areas, the policy of administrative integration of ethnic highland minorities, and state interventions aiming at the eradication of opium production. At Mae Hae research site, where opium production was practiced in the early days, the first road was built in 1966 and was gradually improved. By 1975, opium poppy cultivation was much curtailed and the introduction of horticultural cash crops by a Royal Project started in 1978. In 1988, electricity arrived in the village and hill farmers started to market part of their produce by themselves. A first asphalted road to the village was built in 1995 and was extended in 2002, while concrete roads within the local villages and agro-tourism activities were introduced.

14 The combined effects of these major driving forces increased the market demand for a wide range of non-staple grain products from agriculture, for both domestic consumption and exports. The access of hill farmers to these markets improved very significantly, especially for a wide range of diverse horticultural products benefiting from the ecological comparative advantages of highland areas (cooler temperatures, relatively deep brown soils on shale) as shown in Figure 4. Their cultivation led to a rapid diversification and intensification of highland farming systems, out of zero external input upland rice and maize traditional crops, to adapt themselves to rapidly increasing pressures from population density, environmental conservation, and new institutional setting.

**Fig. 4: List of Important Introduced Horticultural Cash Crops in the Highlands of Northern Thailand**

| | |
|---|---|
| **Vegetables** | - Major ones: cabbage (common, Chinese, red), tomato, potato, strawberry, lettuce, pumpkin, carrot, ginger, taro, celery, red kidney bean. |
| | - Other species: cauliflower, radish, zucchini, sweet pepper, onion, sugar pea, brussel sprout, leek, snap bean, etc. |
| **Flowers** | Statis, rose, Gypsofilla, lily, Chrysanthemum, Gladiolus, Anthurium, etc. |
| **Fruits** | Persimmon, pear, apricot, peach, litchi, mango, longan, tangerine, plum, |

| | |
|---|---|
| | avocado, dragon fruit, macadamia, etc. |
| **Others** | Arabica coffee, tea (Assam, Oolong), barley, wheat, etc. |

15 These economic transformations allowed highlander farming households to increase their incomes through cash cropping, but also thanks to more readily available off-farm employment opportunities in the village, the region, in the capital, or abroad in countries like Malaysia and Taiwan (Vaddhanaputhi 1995, Rigg & Nattapoolwat 2001). A recent study conducted in Chiang Mai and Chiang Rai provinces found that the number of migrant highlanders increased from some 2,500 in 1996 to 4,690 persons in 2001 (Kwanchewan, cited by Rutherford 2002).

16 In the case of Wat Chan, where the diversification out of rice production is mainly based on vegetable and flower production, the local 49 farmers obtained on average a cash income of 157 US$ from crop production in 1992. But this amount corresponded to only some 28% of the average total cash income per household as wage employment in construction, trading and handicrafts provided another 410US$ per annum. Part of this income was used to buy rice as the village was only producing some 80% of its total needs. More recently, Ekasingh *et al.* (2001) found that Mae Hae, Ang Kang and Nong Hoi households obtained on average 362,290 and 413US$ from off-farm activities corresponding to 26%, 22.5%, and 22% of their average total annual cash income per household respectively. In Mae Hae, Leewisitpattana (2003) found that by raising 429US$ per household and per year (or 18% of the total household cash income) Hmong people were less dependent on off-farm revenues than Karen families who earned on average 508US$ from off-farm employment representing more than 40% of these total household cash income for the year. In 2002, Mae Salaep Akha villagers reported that almost every household had members involved in off-farm activities and that their availability is significantly modifying the allocation of labour to agricultural production and their choice of cropping systems.

17 An indicator of the opportunity cost for labour is provided by the minimum rate of daily wage in Chiang Mai Province, which increased only marginally from 3 to 3.6US$ in real term between 1990 and 2004, after reaching almost 6US$ per day just before the devaluation of the Thai bath in June 1997. In general, as almost every highland community is now integrated into the market economy, there is a clear trend toward less and less linkage between ethnicity and the combination of agricultural productions on the farm. Cash cropping of sub-tropical and temperate fruits, vegetables, plantation crops, and flowers for larger and richer cities and foreign markets is the most obvious effect of recent policies and, in general, has proved to be an effective way to increase land productivity and farmer incomes on increasingly more limited amount of farm land.

# Recent Land Use Changes in the Thai Highlands

18 Two main types of shifting cultivation were identified in early studies of indigenous highland agriculture in northern Thailand (Kunstadter *et al.* 1978, Grandstaff 1980):

- "Pioneer" swiddening systems were attributed to the Hmong, Lahu, Lisu, Akha, and Yao who moved their villages to new sites every 8-10

years. This system almost disappeared during the last two decades.

- "Established", "rotational" or "partial" swiddening characterized by long (8- to 10-year-long) fallow periods in the uplands associated with paddy production on valley bottoms was formerly practiced by Karen and Lua people living in permanent settlements. Strong communal organization was key to the sustainability of this agricultural system that can still be found even if the fallow period is often shortened (Rerkasem *et al.* 1994).

19 In practice, following two decades of rapid land use changes during which shifting cultivation has been receding in front of large-scale reforestation projects, it is presently difficult to associate any particular ethnic group or area with one of these early types of agricultural systems as the share of permanently cropped fields keeps increasing. Many well-off Hmong, Lahu, Lisu, and other former pioneer swiddeners and opium growers have acquired paddy land and settled down, while the traditionally subsistence-minded Karen people have taken up commercial production of field and horticultural crops and are involved in off-farm wage-earning activities (Rerkasem & Rerkasem 1994).

20 The transition from various types of self-subsistence-oriented swiddening systems to (semi-) permanent farming units in the highlands of northern Thailand, often carried out in a remarkably short time, led to important changes in land use and agricultural practices in parallel. Shortening fallow periods forced farmers to till their fields more and more intensively to control weeds, increasing the risk of "dry" (tillage erosion down the slopes) and "wet" (by concentrated run-off) soil erosion and of a decrease in land productivity. Because the rural landscape is both a factor and a product of farming practices, it is possible to assess quantitatively the importance of such agrarian transformations by analysing land use changes at the watershed level over a suitable period of time. A multi-date remote-sensing analysis of land use changes in Nong Hoi and Mae Hae from 1983 to 2000 revealed a striking picture. Figure 5 shows that in Nong Hoi, large areas of forest and shifting cultivation land were converted into permanently cropped fields, even on steep slopes.

**Fig. 5: Land Use Changes at Nong Hoi Study Site between 1983 and 2000**

| **Land use** | **Slope angle (%)** | | | | |
|---|---|---|---|---|---|
| | 0-12 | 12-20 | 20-35 | >35 | All |
| | Ha | | | | |
| Forest | -31 | -35 | -69 | -65 | -200 |
| Farm land | 45 | 49 | 89 | 84 | 267 |
| Villages | 11 | 6 | 7 | 4 | 28 |
| Roads | 5 | 4 | 7 | 7 | 23 |
| Fallow/shifting cultivation land | -31 | -24 | -34 | -30 | -119 |

21 In Mae Hae, during the same period, one can observe a shift of farmed land towards lower, less steep, slopes and a reduction of the cropped area on steep slopes (see Fig. 6). As a consequence, the share of the land under forest cover increased in Mae Hae in parallel with an active process of commercialisation of its agricultural production at this RPF site. This has been a result of an

intensive dialogue and land use planning between villagers and government agencies resulting in the enhancement of community forestry practices in Mae Hae.

**Fig. 6: Land Use Changes at Mae Hae Study Site between 1983 and 2000**

| Land use | Slope angle (%) | | | | |
|---|---|---|---|---|---|
| | 0-12 | 12-20 | 20-35 | >35 | All |
| | Ha | | | | |
| Forest | -34 | -7 | 118 | 242 | 319 |
| Farm land | 42 | 28 | -8 | -80 | -18 |
| Villages | 9 | 12 | 13 | 6 | 40 |
| Roads | 0.1 | 0.1 | 0.4 | 0.1 | 0.7 |
| Fallow/shifting cultivation land | -25 | -39 | -137 | -176 | -377 |

22 Farmers in Nong Hoi, many of them Hmong ethnics, have been well-known highland commercial vegetable producers and have opted for more soil and water conservation practices in newly opened land to mitigate the higher environmental risk of land degradation associated with the use of higher and steeper land. Farmers' survival strategies and choices of production systems at these two sites differ very much, one reason being ethnic differences between the two sites as Karen people in Mae Hae, and elsewhere in northern Thailand, have been well known to greatly value their forests. But the comparison of these case studies also supports the claim that is often made across the region with respect to the desirability of land use planning with stakeholders and stronger community forestry practices at the agriculture-forest interface.

23 Complementary field and farm-level surveys are needed to understand and interpret such changes in land use, as well as to assess their consequences on farmers' socio-economic conditions and land degradation mechanisms. Field surveys articulating these complementary and interrelated levels of organization were conducted between 1994 and 1998 in the main watershed of Mae Salaep village, covering approximately 360 ha of farm land, where crop diversification started more than two decades ago (Trébuil *et al.* 1997 , Trébuil *et al.* 2000). The main findings from this study are summarized below.

## More Numerous and Smaller Fields

24 As the number of farmers' fields increased from 90 in 1990 to 215 in 1998, their average size decreased significantly from 1.4 ha in 1990 to 0.65 ha in 1998. The rural landscape looked more and more like a patchwork of tiny cropped fields mixed with and separated by expanding fallow land.

## A Limited Expansion of Farmed Land and More Fallows on Steep Land

25 The increase in the total farmed area (cropped fields and fallows), from 124 to 140ha (corresponding to 34% and 38% of the total watershed area,

respectively) between 1990 and 1998, was modest. By the late 1980s, most of the land considered as suitable for agricultural production by Mae Salaep farmers had already been cleared. An important increase in the absolute area (from 13 to 82ha between 1990 and 1998) of fallow land (corresponding to 10% and 59% of the total farmed area in 1990 and 1998 respectively) was observed in this watershed, particularly on steeper slopes. It is possible that the fallow area mapped by a previous project in 1990, before the beginning our field research, was underestimated, but this increase can also be partly attributed to the several following factors: the impact of "forest fire control unit" and the "Mae Chan-Mae Pha Luang Development for Security Reforestation Project", both initiated in 1993 and aiming at reforesting 50% of the local farmed area; the important decrease in upland rice production in large fields, previously cultivated for two successive years and which used to rotate with three- to seven-year fallows; the growing importance of cash cropping in smaller fields during the past decade; an increase in the production of livestock on large farms in the village (several herders rearing up to 60 heads of cattle grazing mainly on fallow land during the wet season), and a lack of labour on the larger farms.

## Less Upland Rice but More Terraced Paddies

26 The area planted to upland rice, the local key staple and subsistence crop also displaying the highest risk of soil erosion, decreased rapidly over this period of time. The areas under upland rice were 60 and 10ha in the 1990 and 1998 wet seasons, respectively. At the same time, the average size of an upland rice field decreased from 1.7 ha in 1990 to 0.4ha in 1998. Farm surveys showed that although the economic role of upland rice has been decreasing significantly, its cultural role is still very much alive and will ensure its cultivation on a smaller scale than before for many years ahead.

27 The construction of bench terraces to grow paddy rice was first introduced in Mae Salaep by a foreign-funded project in 1983. After 1994, the expansion of paddy land has been limited by the scarcity of suitable land (less steep slopes, water availability) and in 1998 several rice terraces were fallowed due to labour shortage or were planted to cash crops providing higher incomes. Further expansion of terraced paddies is desired by most farmers but will now be limited to small fields of less than 0.1ha each. Irrigated rice allowed farmers to practice double cropping, but a soybean crop after rice during the cool season was found on only a few paddies in 1990, 1994 and 1998. Because of low yields, the production of beans was completely abandoned in this village by 2002. The expansion of the terraced paddies was also found in a remote-sensing study on land use changes at Kae Noi and Wat Chan study sites (see Fig. 7).

**Fig. 7: Land Use Changes During 1954-1994 at Kae Noi and Wat Chan Study Sites**

| Land use in | | Kae Noi | Wat Chan |
|---|---|---|---|
| 1954 | 1994 | Ha | Ha |
| Unchanged (Ha) | | 6,077 (71%) | 11,016 (86%) |
| Paddies | Paddies | 10.8 | 107.3 |
| Forest | Forest | 6,066 | 10,909 |
| Changed (Ha) | | 2,500 (29%) | 1,761 (14%) |

| | | | |
|---|---|---|---|
| Forest | Bush fallow | 2,255 | 1,366 |
| Forest | Paddies | 70 | 264 |
| Bush fallow | Paddies | 72 | 21 |
| Forest | Village | 81 | 105 |
| Bush fallow | Village | 21 | 5 |

28 While at both sites, the most important change was the conversion from forest to bush fallow, paddy areas expanded at the expense of these two types of land cover. The creation of new paddies was more important in the Karen area of Wat Chan where the terrain was more appropriate than in Kae Noi where mainly upland crops expanded during this period. If in northern Thailand almost all the land with a slope angle of less than 15% has already been developed into paddy fields by farmers, at Pakasukjai site this was done over a period of just four years between 1987 and 1991, the number of households with paddies jumping from one to 25 during this short period (Turkelboom *et al.* 1995a). A similar switch from the upland to irrigated rice on bench terraces is also under way in many other places of MMSEA, such as southern China, northern Vietnam and northern Lao PDR.

## An Important Production of Annual Cash Crops with Increasing Commercial Value

29 An important production of annual cash crops was observed in Mae Salaep and in nearby Pakasukjai watersheds throughout the 1990s. Cash cropping was first introduced in the area in 1977 when Chinese traders from neighbouring town of Mae Salong started to buy the surplus of maize production from local farmers. By 1980, groundnut, sesame and black glutinous rice were also common annual low-value commercial crops (LVCC). With low levels of input and labour requirements, and limited economic risk, they provided a relatively stable income. Partly as a result of external project interventions, the area under LVCC expanded rapidly during the 1980s to reach 33 ha in 1990. Farm surveys showed that the economic importance of this group of annual LVCC peaked in the late 1980s. During the 1990s, the area planted to LVCC decreased from 26% of the total farmed area in 1990 to only 12% in the 1998 wet season. But in recent years, most farmers maintained a significant maize production because of its low economic risk and its relatively stable market price.

30 By 1994, this first generation of LVCC was partly replaced by either fallow land (as explained above) or a second generation of high value commercial crops (HVCC) such as vegetables (ginger and common cabbage) and fruit trees (litchi, mango, jackfruit, etc.) grown with more external inputs and higher agronomic and economic risk. During the 1994 wet season, ginger was produced on some 3% of the farmed area, in small fields averaging 0.2 ha. Later on, this production, characterized by important seasonal fluctuations of market prices and soil-borne disease control problems, receded in recent years.

## A Recent Expansion of Perennial Cash Crops

31 In 1990, the whole watershed had only one bamboo plantation field. Following the start of fruit tree planting in 1992, 26 small orchards, averaging 0.4ha in size, were occupying some 7% of the total farmed area in 1994. Between 1994 and 1998, the area under perennial crops more than doubled to reach 20 ha, with 46 small perennial plantations were covering 15% of the total farmland. Because they are easy to market, litchi and Assam tea were the two most popular perennial crops selected by farmers. More recently, Oolong tea with a higher commercial value has also been introduced by Mae Salong traders (who are very linked to the Taiwanese markets) and is planted in small fields equipped with sprinkler irrigation. Generally, plantation crops were first established on the largest (3 to 4 ha of farmed land) and most well off holdings where the diversification of on-farm (paddy rice, LVCC and HVCC annual cash crops, livestock rearing, etc.) and off-farm activities (such as trading, transportation, and earning wages abroad) have already reached a very advanced stage. But they are also spreading to tiny holdings of around one hectare managed by farmers aiming at securing their access to land in front of advancing reforestation projects, and at generating a regular cash income.

32 In parallel with these important changes in crop choices and land use due to new economic and institutional environments, farmers' cultivation practices were also radically transformed.

# Profound Changes in Farming Practices

33 The introduction and expansion of soil tillage by hoe followed the gradual decrease in fallow length and the increasing pressure from weeds, especially *Imperata cylindrica,* which dominates in the young and grassy fallows. In recent years increased non-farm employment opportunities has led to a jump in the use of herbicides (see Fig. 8). The transition from manual to moto-mechanized power is limited by the slope steepness and the kinds of horticultural cash crops produced by farmers. Shinawatra and Krummel (1997) found that 32% of the Karen farmers in Wat Chan owned a multipurpose two-wheel hand tractor in 1992 thanks to larger areas of paddies, compared to only 6% among the Lahu farmers of Kae Noi where upland field crops on sloping land dominated. But motorization is occurring for grass cutting in orchards, pesticide applications, and the transport of farm inputs and products. The investment in a pick-up truck is very common on well-off farms.

**Fig. 8: Type, average amount and proportion of farming families using chemical fertilizers in vegetable production at several Royal Project Foundation sites in Chiang Mai Province in 2000 crop year**

| Type of fertilizer | 46-0-0 NPK | | 13-13-21 NPK | | 15-15-15 NPK | |
|---|---|---|---|---|---|---|
| Village name | Kg/ha | % users | Kg/ha | % users | Kg/ha | % users |
| Mae Hae | 326 | 29 | 646 | 65 | 446 | 71 |
| Ang Kang | 592 | 36 | 829 | 61 | 559 | 73 |
| Nong Hoi | 584 | 41 | 550 | 70 | 464 | 72 |

34 Even more radical technological change occurred in many areas where farmers shifted from their traditional rotational and zero external input upland rice, and maize-based swiddening systems to the permanent

production of new species of fruits and vegetables. Recommended seeds and selected planting materials from government agencies and private companies are used. In the highlands, irrigated areas are limited and are usually owned by a minority of larger and relatively well-off farmers. Very often, their families were belonging to the early settlers who could have access to suitable land to build paddies. In upland fields, sprinkler (for cabbage and tea production) or furrow and drip irrigation (in orchards) are often needed to secure high yields or quality products. The requirements of these horticultural crops increase significantly the amount of water consumed in the highlands.

35 Large amounts of chemicals are also applied as traded inputs replace non-traded ones. Chemical fertilizers were first introduced in Mae Hae in 1988. In 1992, more than half of Karen farmers in Wat Chan and almost one fifth of Lahu farmers in Kae Noi were already using an average 54 and 73 kg/ha of chemical fertilizers respectively (Shinawatra & Krummel 1997). Figure 8 indicates that, during the 2000 crop year, the extent of fertilizer use and the amounts applied to vegetable crops were very high at three other RPF sites.

36 Figure 9 shows that, at the same three sites and during the same year, pesticide use on horticultural crops was also very widespread.

**Fig. 9: Use of pesticides in fruit and vegetable production at three Royal Project Foundation sites in Chiang Mai Province in 2000 crop year.**

| Type of pesticide | Insecticides | Fungicides | Herbicides |
|---|---|---|---|
| Village name | % of farming household using such chemical input | | |
| Ang Kang | 56 | 53 | 22 |
| Nong Hoi | 92 | 84 | 89 |
| Mae Hae | 94 | 91 | 67 |

37 No major change in the crop-livestock interaction occurred along this diversification process. Crop and animal rearing sub-systems tend to be more separated. Like everywhere in the kingdom, the water buffalo is less used as draft animal for soil preparation and many smallholdings can no longer afford to keep large animals. But maize production in the highlands is benefiting from a strong demand from the animal feed sector at the national level. Because maize was already part of the traditional rotational system and was usually planted after one or two harvests of upland rice, it played a key role in the transition from subsistence to market-oriented crop production when the market demand for the maize surplus increased.

38 In summary, a real agricultural revolution occurred at these sites during the last three decades as traditional rotational farming in the forest gave way to (semi-) permanent crop production on a more limited amount of land. It is a profound transformation out of the no external input upland rice or maize staple crops, which is dismantling former integrated swiddening systems and replacing them with more land-intensive and market-oriented ones.

# Environmental Impact of Agricultural Commercialisation-Diversification

39 Figure 10 shows how far some negative externalities of cash cropping systems are affecting the farming households at three RPF sites. But there is a need to compare them to the environmental conditions created by swiddening agricultural practices.

40 This figure displays high proportions of farmers affected by the use of chemicals at each site. Weekly application of insecticides is usually practiced in litchi orchards between flowering in March and the end of the harvest in late May. Health risks due to (over) use of pesticides is potentially an important problem, but very limited substantial evidence exists in the context of the highlands.

**Fig. 10: Farmer perceptions of environmental problems related to their current farming practices at three Royal Project Foundation sites of Chiang Mai Province in 2000 crop year**

| Village name | Mae Hae | Ang Kang | Nong Hoi |
|---|---|---|---|
| % of farming households in the village experiencing: | | | |
| - Rill erosion | 53 | 66 | 78 |
| - Landslides | 14 | 29 | 30 |
| - Negative effects from chemical products | 66 | 57 | 60 |
| - An increase in the use of pesticides | 27 | 28 | 16 |

## Deforestation

41 More than half of Thailand forest area is located in the northern region, especially in its highlands. At the national level, the forest cover decreased marginally from 29% to 25% from 1985 to the late 1990s according to the National Statistical Office. But if single-stand tree farms are excluded, forest coverage is down to below 20% (Rutherford 2002). As far as the northern region is concerned, the share of the land covered by forest decreased more significantly from 49.5% to 43% during the same period. A total ban on logging was introduced for the whole country in early 1989 following major and deadly landslides in the southern region and nowadays the forest frontier can be considered as closed by the state and no extensive “slash-and-burn” cultivation is tolerated anymore. The importance of the services provided by highland communities looking after forest areas is more recognized. This is the case for the frequent and devastating forest fires occurring during the hot and dry period from February to April, as they need to be rapidly controlled before they expand and to avoid the accidental burning of orchards and other kinds of perennial plantations. Between 8,000 and 12,000 such incidents occurred each year in the country, damaging between 16,000 and more than 40,000 ha of forest and plantations.

## Water

42 Conflicts between highland and lowland communities are increasing over the access to sharing of fresh water resources. The expansion of irrigation in the highlands is needed for successful production of horticultural crops and the use of sprinkler irrigation in vegetable fields and furrow irrigation in

orchards is presently very common. These practices have significantly increased water consumption in the highlands. In litchi orchards managed under common farmer practices, each tree consumes more than 5 cubic meters of water (Stahr *et al.* 2003) and in areas like the Mae Sa Noi sub-catchment of the Mae Sa valley, northwest of Chiang Mai, more than 70% of the land is presently occupied by irrigated litchi plantations (Tomforde *et al.* 2002). Because the highlands and the lowlands are now interconnected and no longer evolve independently, this linkage must be used when looking for acceptable solutions to water issues requiring improved coordination mechanisms at the landscape level.

## Loss of Biodiversity

43 Sutthi (1989) described the disappearance of indigenous highland rice germplasm, like the "400 variety" of rice grown successfully at about 1,000 m amsl by the Lahu, Nyi and Hmong people. Van Keer *et al.* (1998) described the interesting agronomic and grain quality characteristics of traditional tropical japonica cultivars grown by Lahu upland rice swiddeners in Mae Haeng. They belong to different groups of varieties covering different needs: early maturing and non glutinous types for food security at the household level, late maturing non glutinous cultivars as key staple crop, late maturing glutinous types for cultural ceremonies, etc. They display relatively high potential paddy yields under no input use reaching 3 t/ha for early maturing varieties and more than 4 t/ha for the late maturing ones (Van Keer 2003). There is a real risk to see these traditional cultivars being lost as, like at many places before, upland rice cultivation starts to decrease because population density reached 40 inhabitants per sq. km and more than 50 per sq. km of swiddening land. Litchi orchards expanded in Mae Haeng in the early 1990s followed by the construction of the first paddies in the village in 1994. In litchi orchards, repeated applications of herbicides are also leading to a reduced diversity in the undergrowth vegetation dominated by grasses with few flowering plants left. This change in the vegetation has negative effects on arthropod and insect natural enemies of major pests species of litchi that could help farmers manage their orchards with less pesticide use (Sauerborn *et al.* 2003).

## Soil Erosion

44 Because of shorter fallow periods, farmers are compelled to clear new fields before the necessary biomass regeneration can take place. In humid Southeast Asia, five- to ten-year fallows are needed to ensure such regeneration depending on local ecological conditions. The reduced fallow duration has a negative impact on the control of weeds and the maintenance of soil fertility, especially the stability of soil aggregates under the storms. This is increasing the risk of severe soil erosion in large upland rice fields on steep land (slope lengths exceeding 50 m are common) as ploughing by hoe is now necessary to destroy the grassy vegetation such as in Pakasukjai and Mae Salaep Akha villages. Dry tillage erosion to create a fine seedbed for upland rice produce soil losses varying from 8 to 18 t/ha and per hoeing (Turkelboom & Trébuil 1998). Land preparation is followed by one to three weedings by hoe before the crop canopy can protect the soil surface, sometimes not before more than 100 days after sowing. In large upland rice fields with long slopes, soil losses due to rill and plough layer erosion can exceed 150 t/ha and reach 350 t/ha in

the worst situations. Under the same conditions, more protective crops like maize and beans sown on rough seedbeds and receiving only one weeding having a period of susceptibility to erosion by concentrated runoff limited to 40-45 days after sowing, lead to soil losses varying from 5 to 60t/ha (Turkelboom 1999). Soil losses in smaller vegetable fields with reduced slope lengths are similar during the wet season, while they are far lower in the same fields cultivated during the cool and dry season. Soil losses are negligible in mature orchards if the undergrowth vegetation is not removed. Road building in this region is another major contributor to major soil erosion damages such as landslides destroying unstable slopes after heavy rains.

45 Following strong and very costly efforts to introduce soil conservation practices (bench terraces, contour hedgerows, grass strips, etc.) for many years in the 1980s and early 1990s, by more than fifty projects in this region at one time, their adoption has been very limited. Where it occurred, reasons other than erosion control, such as farmers' concerns about the insecurity of land tenure, played a role in their adoption. But ten different indigenous soil and water conservation techniques were observed in Pakasukjai fields, showing that where the risk of severe erosion damages is high, farmers are trying to find appropriate techniques to mitigate this problem. They prefer declining ditches and (cultivated) mulch strips because of the short-term benefit they bring and their limited competition with the crops. These are also easy to implement without requiring major labour input or disturbances in the current functioning of their production systems (Turkelboom *et al.* 1995).

46 Many aspects of the diversification and commercialisation of agricultural production in the highlands have positive effects on the limitation of soil erosion risk such as:

- a decrease in the size of fields, and hence their slope lengths;
- the increasing share of fallow land, which is filtering runoff from cropped fields and limiting field-to-field cumulative effects of soil erosion;
- a very important decrease in the production of upland rice, the crop with the highest erosion risk, and its partial replacement by irrigated rice on bench terraces;
- an important production of annual cash crops in smaller fields, with shorter periods of susceptibility to erosion, and
- the expansion of plantation crops, reversing the trend towards a reduced tree cover and maintaining a higher percentage of permanent soil coverage.

47 Overall, at most places in the Mae Salaep main watershed, results show that, in comparison with the earlier, more subsistent agricultural system, land use changes that occurred during the past two decades tend to decrease the risk of land degradation via concentrated runoff (Trébuil *et al.* 2000). It is still possible to increase the impact of sustainable land use practices by building on current indigenous dynamics such as the concentration of cash cropping in smaller fields, a further expansion of more diverse perennial crops and the construction of rice terraces. Such an approach could be far more efficient than the past direct introduction of new techniques that are difficult to fit into existing farming systems.

# An Increased Diversity of Strategies

# and Inequalities Among Highland Farming Households

48 The process of commercialisation-diversification of highland farming systems has led to a very extensive differentiation among households at the village level. Figure 11 display several degrees of integration into the market economies in the case of farming units at three RPF sites.

**Fig. 11: Distribution of self-subsistence and commercialisation strategies among farming households at Ang Khang, Nong Hoi and Mae Hae sites of Chiang Mai Province, 2000 crop year**

| Village name | Ang Kang | Nong Hoi | Mae Hae |
|---|---|---|---|
| Type of farming system: | % of farming households in the village | | |
| A. Sales < 25% total gross product | 5 | 9 | 10 |
| B. 25< sales < 50% total gross product | 12 | 11 | 18 |
| C. 50< sales < 75% total gross product | 17 | 27 | 26 |
| D. Sales > 75% total gross product | 52 | 51 | 20 |
| E. Fruit production > 50% total gross product | 14 | 2 | 26 |

49 Type B farmers sell mainly field crops of some vegetables while type C and Dhouseholds market mainly vegetables, ornamental plants, and some maize. Figure 12 displays the extensive differentiation among households in terms of annual incomes at these same three RPF sites. The key role played by off-farm employment, especially to help type A, B and C farming units to survive and to limit food insecurity and poverty, is clear.

**Fig. 12: Distribution of levels of incomes per type of farming household, pooled data for Ang Khang, Nong Hoi and Mae Hae sites of Chiang Mai Province in 2000 crop year**

| Type of income | Net farm | Off-farm | In kind | Total |
|---|---|---|---|---|
| Type of farming system: | US$ per farming household and per year | | | |
| Sales < 25% total gross product | 52 | 505 | 314 | 871 |
| B. 25< sales < 50% total gross product | 264 | 382 | 382 | 1,028 |
| C. 50< sales < 75% total gross product | 616 | 282 | 340 | 1,238 |
| D. Sales > 75% total gross product | 1,447 | 307 | 176 | 1,930 |
| E. Fruit production > 50% gross product | 1,735 | 730 | 246 | 2,711 |

50 Similar ranges of farming situations regarding market integration were found in Mae Salaep and Pakasukjai sites and are described in Trébuil (1997) and Turkelboom (2000). Figure 13 present the very important variation of agricultural labour productivity among these five types of farming households.

51 Figure 13 shows that off-farm activities contribute to compensate a large part of the inequalities in agricultural productivity among households. Consequently, a more mobile and integrated labour force could tap more employment opportunities across the whole economy to increase benefits from commercialisation, particularly among the smaller farming units.

**Fig. 13 : Distribution of net income per labour among the different types of farming households at Ang Khang, Nong Hoi and Mae Hae sites of Chiang Mai Province, pooled data for 2000 crop year**

| Type of income | Net farm income | Total income |
|---|---|---|
| Type of farming system: | US$ per labour and per year | |
| A.Sales < 25% total gross farm product | 9 | 172 |
| B. 25< sales < 50% total gross farm product | 44 | 185 |
| C. 50< sales < 75% total gross farm product | 98 | 196 |
| D. Sales > 75% total gross farm product | 251 | 328 |
| E. Fruit production > 50% gross farm product | 258 | 452 |

# Lessons Learnt from the Northern Thailand Experience

52 The above-mentioned transformations of highland farming systems constitute an irreversible phenomenon that is now spreading to the whole MMSEA ecoregion having the same climatic comparative advantages. The Thai experience illustrates the very high capacity for adaptation to changing environments of small-scale household-based farming units. It is a suitable mode of agricultural production in such agro-ecological setting and there is no need to move people out of such areas to solve resource management problems. Small farmers made use of many state interventions to adapt their production practices and to seize multiple market opportunities, and suitable policy incentives can be used to guide the rural development in those areas. They are still needed as, socially and economically, fragile lives still predominate in village communities where the increasing importance of off-farm employment for the survival of resource-poor farms and of capital accumulation on the larger ones is obvious.

53 Particularly, such policy incentives are needed to reduce the risks of further degradation of renewable resources in these fragile environments. Using them to improve the local governance of resource use is a promising way to mitigate problems regarding soil and water conservation. This is timely, as we observe a mutation in the institutional context regarding rural development in highland areas. Large internationally and government supported projects are completed and government officers are likely to be less present in these areas in the future. They are replaced by new local administrative units (such as the sub-district administrative councils and organizations) and institutions from the civil society like numerous NGOs. Neef *et al.* (2003) reported that not less than nine government and three non government organizations are presently operating at their survey site in Ban Mae Sa Mai area in Mae Rim District of Chiang Mai Province. Better communication among this increasing number and diversity of institutional actors is needed to improve the management of the very dynamic and uncertain complex farming systems in the highlands in an adaptive and concerted way.

# Conclusion: Assessment of the

# Sustainability of this Type of Agricultural Development

## Economically

54 This Thai experience demonstrates the importance of the basic linkages connecting faster agricultural growth to faster growth in the overall economy. Improvements in the functioning of horticultural markets are still needed to reduce the fluctuations of farm gate prices (from baht 8 to 80 per kg in the case of litchi for example) and to stabilize incomes from cash cropping. New risk-spreading mechanisms could also be introduced to improve the resilience of highland farming facing destructive "trade shocks". New local credit institutions at the village level could be used for such a purpose.

55 But a clear threat to horticultural production in the highlands of northern Thailand comes from the rapidly increasing cross-border trade of agricultural products in the so-called "golden quadrangle", especially with China. In this new context, the main comparative advantage of the Thai highlands, their cool climatic conditions, is fast disappearing in front of Chinese competitors, with cheaper labour and lower production costs, exporting fast increasing volumes of the same high-value produce such as sub-tropical and temperate fruits and vegetables. This threat is even more likely following the signature of a fruit-and-vegetable agreement between Bangkok and Beijing in June 2003, sweeping away all barriers to imports of these products from China (Murphy 2004).

## Socially

56 Household welfare, health issues, income distribution and equity are important topics in the highlands because agricultural commercialisation is a very unequal process. Its positive effects on the availability of employment to mitigate rural poverty and help small farmers to cope with rapid changes in their environment is constrained by the limited mobility of labour due to a lack of citizenship. But more attention needs to be paid to the social impact of increased migrations of thousands of young male and female "hill tribe" youths across the overall Thai economy. The emergence of a better cooperation between the state and local people to examine and find solutions to environmental and social problems at the watershed level is a positive trend to be encouraged. This could be accelerated by strengthening the rich tradition of community-based management of local resources, make it recognized by state agencies and improve the land rights of highland farmers.

## Ecologically

57 The severity of the risk of degradation of scarce renewable resources varies across sites, but they usually seem manageable. Among the seven sites included in this study, the authors observed that where this risk was high farmers tend to be more resource conservation-minded. In Mae Salaep for example, they are looking for ways to diversify their perennial crops by finding species, like tea, adapted to very small holdings. The increased

demand from the "rice bowls" of the irrigated lowlands, industrial and urban areas will put more pressure on irrigation and water consumption in the highlands, where water use efficiency should be significantly improved. But recent research findings have identified new technologies and practices to help highland farmers save precious water and to lessen this potential open conflict with their powerful lowland neighbours.

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## List of illustrations

**Title** **Fig. 1: Location of the Seven Case Study Sites Across Upper Northern Thailand**

**URL** http://moussons.revues.org/docannexe/image/2005/img-1.png

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**Title** **Fig. 2: Key Characteristics of the Seven Case Study Sites in Northern Thailand Highlands**

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**File** image/png, 93k

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