Changing Land Use Mosaics of (Former) Shifting Cultivators in Watersheds of North Thailand

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This paper has been submitted as a chapter in a book on the global CGIAR system-wide Alternatives to Slash-and-Burn (ASB) Initiative, being edited by Dr. Pedro Sanchez (ICRAF Director General and Chair of the Global ASB Consortium). The book is to be published by the American Society of Agronomy during late 2000.

The ASB research program in northern Thailand seeks to understand processes and dynamics of land use change important in the mountainous mainland Southeast Asia (MMSEA) ecoregion, and develop technologies and policies that can improve land use management in the region. MMSEA includes the large region of hill and mountain terrain that joins the Himalayan mountains in southwest China, and extends through northern portions of Myanmar, Thailand and Laos, to Vietnam in the east. Several major river systems flow through or have headwaters in this region, long known for its diverse ethnic composition and complex patterns of traditional land use that includes shifting cultivation. As this region also includes most of what remains of mainland Southeast Asia's rapidly dwindling forest resources, it is the focus of increasing environmental concern related to water, biodiversity and climate change at national and international levels.

Given strong and growing concern over water in these river systems, which supports major lowland populations, and their 'rice bowl' production areas and urban-industrial centers, the ASB program uses watershed units as a major component of its analytical framework. Moreover, particular focus is on land use in upper tributaries, where many poor and often marginal minority communities have benefited the least, and sometimes suffered from processes associated with the rapid economic development that has helped shape the international image of Thailand and the region during recent decades. We also seek to incorporate relevant lessons from the Asian economic crisis, as well as constitutional and governance issues emerging in Thai society and the wider region.

This paper focuses on trends of change in mosaic patterns of land use in the northern Thailand portion of MMSEA, with particular attention to changing land use practices of mountain minority communities and their impact on environmental services. As one of the more recently established ASB benchmark sites, much of the data on specific land use systems is still being analyzed for comparison with other benchmark sites using the ASB framework.

Changing Land Use Patterns in Mountain Watersheds

The ASB Thailand research strategy began with review of policy concerns and issues believed to be associated with changing mosaic patterns of land use in north Thailand, with emphasis on upper watershed areas [Thomas 1996]. We have also reviewed previous and existing efforts to understand and address these issues, and sought to identify strategic knowledge gaps, to provide the basis for selection of an appropriate benchmark site and further program development. Findings from this process are largely summarized in the following sections, including major characteristics of the 4,000 square kilometer Mae Chaem watershed, selected as the primary ASB benchmark site. Our secondary focus has been on one ridge of the Mae Taeng watershed, where the Sam Mun Highland Development Project was able to facilitate significant change in local land use patterns during 1987-94. This and other pioneering pilot efforts seeking to improve livelihoods and environmental conditions provide both the points of departure and initial direction for the ASB Thailand research program

Major forest policy concerns

As the vast majority of land in upper watersheds is officially classified as reserved or protected forest, our first task has been to examine forest policy concerns that focus primarily on deforestation and watershed deterioration.

Deforestation

Thailand entered its era of rapid economic growth in 1960 with the launching of its first national 5-year economic and social development plan. While considerable economic development has been achieved, one cost has been the loss of more than half of our natural forest resources, resulting in growing concern about loss of biodiversity and contributions to climate change. Table 1 summarizes three aspects of overall land use change since 1960 at the national level and for the northern region: 1) changes in proportions of land under forest, agriculture and other uses; 2) levels of each type of area per capita as the population has grown; and 3) the proportion of the population that has moved to metropolitan areas.

Although dramatic decreases in forest cover began later in northern Thailand than in much of the rest of the country, major losses occurred at both levels during the 1970's. Rates of loss appear to have recently begun to decline, but percentage declines in the north are still above the national average. Moreover, while most remaining forest is in the north, losses there are already greater than most portions of the MMSEA eco-region. Types of deforestation found in northern Thailand may be broken into three major components:

1. Conversion of forest. Initial conversion of forest after 1960 throughout Thailand was primarily associated with expansion of land for agriculture, as seen in Table 1, both to feed the growing population and for export crops to fuel the growing economy. Conversion to agriculture was

facilitated by heavy logging, and during the late 1970's, agricultural expansion combined with political and national security strategies to further encourage clearance of forests. As agriculture began to expand into increasingly marginal sites, overall population growth rates began to decline, the economy began structural adjustments emphasizing industrial and service sectors, and urban and suburban growth began to accelerate, further land use conversion became increasingly associated with cities, industry, housing, resorts, and more recently for land speculation. As Table 1 indicates, farmland per capita appears to be slowly decreasing, while the overall proportion of farmland appears to be stabilizing. Other non-forest land appears to be expanding roughly in proportion to overall population growth. Some of these non-agricultural land uses, such as resorts and golf courses, can

TABLE 1. Land Use Change in Thailand and North Thailand, 1960-98

Land Cover		Year				
		1960	1970	1980	1990	1998
		Proportion of total area *(percent)*				
Forest Cover	**National**	**54.0**	**46.0**	**32.0**	**27.3**	**25.3**
	North	**68.8**	**67.3**	**53.9**	**46.4**	**43.1**
Farmland	**National**	**20.0**	**29.0**	**37.1**	**41.2**	**41.5**
	North	**11.0**	**17.0**	**24.5**	**28.0**	**27.5**
Other Non-forest	**National**	**26.0**	**25.0**	**30.9**	**31.5**	**33.2**
	North	**20.2**	**15.7**	**21.6**	**25.6**	**29.4**
		Area per capita of total population *(hectares)*				
Forest Cover	**National**	**1.06**	**0.65**	**0.35**	**0.25**	**0.21**
	North	**2.04**	**1.44**	**0.95**	**0.72**	**0.60**
Farmland	**National**	**0.39**	**0.41**	**0.41**	**0.38**	**0.35**
	North	**0.33**	**0.36**	**0.43**	**0.43**	**0.38**
Other Non-forest	**National**	**0.51**	**0.35**	**0.34**	**0.29**	**0.28**
	North	**0.60**	**0.34**	**0.38**	**0.40**	**0.41**
		Proportion of total population *(percent)*				
Urban Population	**National**	**12.5**	**14.9**	**17.6**	**17.7**	**18.4**
	North	**6.4**	**5.8**	**7.0**	**7.6**	**7.4**

Sources: Adapted from 1) Charuppat 1998 (Royal Forest Dept.); 2) Center for Agricultural Statistics 1994; 3) Center for Agricultural Information 1998; 4) Institute of Population Studies 2000

convert land directly from forest, while others displace agriculture at the periphery of urban or industrial areas, and may thereby lead to further conversion of forest to agriculture. Note that substantially more unregistered people actually live in urban areas than reflected in the official figures in Table 1.

2. Logging of natural forest. Logging helped fuel economic growth initially, but the combination of huge concession areas overlapping with protected forest areas and local communities, high official and unofficial harvest rates, low replanting rates, settlement and cultivation of logged areas, and slow expansion of plantation forests finally proved unsustainable [Pragtong 1990]. Although logging concessions were stopped in 1989, illegal logging is still a problem in reserved forest and protected areas. Large illegal operators make various efforts to conceal their operations, frequently including the hiring of villagers to cut trees for their operations. Forest department policy now emphasizes forest conservation rather than timber production, including strict enforcement of rules to address this open frontier mentality.

3. Farmers in the Forest. Issues associated with this component are much more complex and difficult. In the mountains of north Thailand various ethnic minorities have long lived as 'farmers in the forest', as described in the landmark book of that name [Kunstadter 1978]. A web of sometimes contested issues is associated with their land use practices, including opium production, shifting cultivation, rural poverty, and the impact of their land use practices on protected forest areas and environmental services. This component is the main focus of ASB in Thailand. The 1997 overall distribution of mountain ethnic minority populations living in the midlands and highlands (above 600 m.a.s.l.) are indicated in Table 2, at both the national and northern region levels, as well as for Chiang Mai province and the ASB benchmark site (Mae Chaem). In addition, Lowland Thais make up about 16 percent of the total population living above 600 m.a.s.l. at the national level, and about 11 percent in the ASB benchmark site. While overall proportions of mountain minorities are quite low, they frequently make up more than half of the population in upper watershed areas.

The grouping of communities into those with highland, midland and lowland traditions correspond with the altitude zones within which they have been most prevalent, and the types of agroecosystem management practices they have traditionally employed. Although such groupings are based on traditional distinctions widely applicable across the MMSEA ecoregion, altitude zones are approximate, geographic domains of ethnic groups overlap, and conditions change and traditions adapt over time. Table 3 presents estimates from the ASB benchmark site indicating how ethnic groups now distribute themselves among altitude zones, and resulting ethnic distributions within each zone. Note that 27 percent of highland tradition populations (Hmong) are now located in midland and lowland zones, whereas 42 percent of midland tradition populations (Karen) are located in the highland zone (usually near its lower boundary), where they outnumber traditional highland groups by a factor of four.

From an environmental point of view, the most important distinctions among traditional groups relates to their agroecosystem management approaches. Particular attention has usually focused on shifting cultivation, or 'swidden', components of their systems, where highland groups are associated with 'pioneer swidden', midland groups with 'established swidden', and lowland groups with 'northern Thai swidden' (T.C. Sheng 1979, unpublished report to FAO). There has never been a

Table 2. Mountain ethnic minority population above 600 m.a.s.l., 1997

	National	North	Chiang Mai	*Mae Chaem*
Highland traditions				
Hmong	**126,300**	**119,768**	**19,011**	**3,630**
Lahu	**85,845**	**84,262**	**32,583**	**-**
Akha	**56,616**	**56,157**	**5,486**	**-**
Yao	**48,357**	**42,561**	**353**	**-**
Htin	**38,823**	**40,302**	**-**	**-**
Lisu	**33,365**	**31,040**	**13,201**	**431**
Sub total	***389,306***	***374,090***	***70,634***	***4,061***
Midland traditions				
Karen	**353,574**	**310,909**	**111,667**	**29,197**
Lua	**17,637**	**16,225**	**5,473**	**1,451**
Khamu	**13,674**	**10,567**	**21**	**-**
Mlabri	**125**	**125**	**-**	**-**
Sub total	***385,010***	***337,826***	***117,161***	***30,648***
Mountain Minorities	**774,316**	**711,916**	**187,795**	**34,709**
- proportion of total:	***100%***	***92%***	***24%***	***9%***
Total Population	**60,816,227**	**12,091,337**	**1,573,757**	**67,912**
- mountain minorities:	***1%***	***6%***	***12%***	***51%***

Source: adapted from Hilltribe Welfare Division 1998

basis for official recognition of forest fallow fields as a component of agricultural land holdings, and clearing of fields in a shifting cultivation system are officially viewed as forest destruction. Critics of these official views claim that when a new field is cleared – especially under 'established' or rotational swidden – an old field is returned to fallow, resulting in no net deforestation. While remote sensing can provide estimates of the proportion of an area that is cleared of forest at a given point in time,

there is still a substantial range of issues and policy questions regarding the impact of changing 'farmers in the forest' practices on forest ecosystems.

TABLE 3. Distribution of Ethnic Groups in the ASB Site by Altitude Zone

		Distribution of ethnic groups among zones *(percent)*				
	Population	High peaks	Highlands	Midlands	Lowlands	total
Hmong/Lisu	6,192	-	73.19	11.51	15.29	100
Karen/Lua	42,900	-	41.88	47.46	10.66	100
Thai	18,820	-	-	3.40	96.60	100
Overall	67,912	-	33.13	31.97	34.90	

		Ethnic composition of altitude zones *(percent)*			
	Population	High peaks	Highlands	Midlands	Lowlands
Hmong/Lisu	6,192	-	20.14	3.28	4.00
Karen/Lua	42,900	-	79.86	93.77	19.30
Thai	18,820	-	-	2.94	76.70
Total	67,912	-	100	100	100

Source: unpublished ICRAF and Ministry of Interior data

Watershed Deterioration

There are three main aspects of these important issues that are high priorities for ASB-Thailand:

1. Deteriorating Watershed Services. The northern mountains are the headlands of the Chao Phraya river system that nourishes Thailand's key 'rice bowl' production areas in the central plains, as well as the vast urban-industrial complex around Bangkok. Concern about deterioration of mountain area watershed services began in the 1960's when a group of academics from the Kasetsart University Faculty of Forestry began research at three small highland sub-catchments at Doi Pui in northern Thailand. Findings through 1980 are summarized [Chunkao 1981], and a series of university bulletins were produced, such as those on effects of clearing hill evergreen forest on soil organic matter [Lapudomlert 1974], physical properties [Chunkao 1974], chemical properties [Santudgarn 1974], and sediment [Aksornkoae 1977]. Subsequent research related to opium crop substitution is also summarized [Chunkao 1983]. Whereas summary documents generally indicate impacts of shifting cultivation are modest, compared to impacts on stream flow, erosion and water pollution associated with permanent agricultural fields, road construction and human settlements, bulletins tend to make a

more negative assessment of shifting cultivation impacts. Several team members became influential in shaping basic views – especially in downstream society – related to watershed policies and impacts of land use in the mountains on watershed services. As environmental interest in society grows, various of these issues are being further elaborated at a wider range of sites. Forest department researchers led a team who summarized research findings in Thailand for the watershed component of a proposed forest sector master plan [Royal Forest Dept., 1993]. An independent case study of water-related economic issues in an upper tributary of the Ping river broadened analysis of upstream-downstream issues, and identified several data gaps preventing adequate assessments of policy alternatives [Vincent 1995] that have yet to be addressed [Kaosa-ard 2000, unpublished WRI report]. While a few studies have begun comparing effects of practices by different ethnic groups, considerably more work is required to assess various water use technologies, to assess shifting cultivation impacts on a full-cycle basis, or to address effects of interactions and lateral flows among mosaic patches at larger landscape levels. Since one of the most immediate policy concerns in the northern region focuses on downstream impacts of upland land use on stream flow, reservoirs, and crop yields, such work is a priority concern.

2. Growing Upstream-Downstream Conflict. Growing environmental awareness and concern with nature, pollution and sustainability [Hirsch 1997], are converging with increasing demands for water by agriculture, cities and industry, to increase focus of attention on land use in upper watersheds. These trends are projected to continue to build in coming years. Moreover, increasing competition for water resources among a growing range of stakeholders combines with shortages of key data and limited access to existing knowledge, to fuel debate, conflict and confrontation that is frequently based more on emotions than reason. Various 'schools of thought' are developing, some of which appear to reject most all notions of 'scientific' analysis, while others cannot accept notions of 'local knowledge'. What appears to be urgently needed is a widely-acceptable and accessible set of criteria, indicators and measurement tools, that are based on appropriate calibrations with science and local knowledge, for empirical assessment and monitoring of watershed and related environmental services. Associated institutions to manage disputes at various levels also need to be strengthened, along with information and support services. Meanwhile, since action programs must proceed with less than ideal knowledge and tools, we need to strengthen systematic learning from such experience to bring improvement to action programs at each step along the way.

3. Relevance for the Larger Eco-Region. Although the impact of change may be greatest in north Thailand, processes underlying this change are already in motion elsewhere in the larger MMSEA Asia eco-region, which includes portions of the Hong (Red), Mekong, Salween, Irawaddy, Yangtze and Xi Jiang (Pearl) river systems [Revenga 1998; CMU 1996; Kaosa-ard 1995]. As these issues and processes are also important elsewhere, we hope linkages through the global ASB initiative can facilitate even wider relevant exchange.

Complexities Underlying Forest Policy Issues

In order to more effectively address these types of forest policy concerns, we must develop a more clear understanding of processes that underlie changing land use patterns, and forces that determine directions and rates of change. Three major factors contributing to the complexity of these processes in northern Thailand include: incentives and pressures for land use change, impacts on traditional mountain land use systems, and the spatial distribution of land use change.

Incentives and Pressures for Land Use Change

The first factor contributing to the complexity of land use issues in northern Thailand is the convergence of five types of pressures and incentives for change:

1. Demographic change. High population growth rates in mountain ethnic minority communities, relative to lowland rates, have combined with migration from neighboring countries to increase land pressure [Rerkasem 1994]. During recent decades, Thailand has been a safe haven and/or an economic magnet for many people in neighboring countries. Since many ethnic minority communities in the midlands and highlands are still being integrated into the regular Thai administration system, they are only included in more recent demographic data. Estimates of mountain minority populations living above 600 m.a.s.l. in 1997 [Hilltribe Welfare Division 1998] are compared with total populations in Table 2. Compared with estimates from the same source in 1972 [Kunstadter 1978], highland groups had an average increase of 10 percent per year, whereas midland groups averaged 2 percent in the north and 3 percent in Chiang Mai province. This compares to an average annual growth rate of 2.0 percent for total populations in Chiang Mai and north Thailand during this 25 year period. While some highland may not have been counted in 1972, rapid increase remains clear.

2. Commercial agriculture. Expansion and commercialization of agriculture has followed both from opium crop replacement efforts in the highlands, and from expansion of lowland agro-industry up hill slopes from valley bottoms [TDRI 1994]. Work in northern Thailand on replacement of opium with intensive commercial crops was largely pioneered by projects under the patronage of H.M. the King, followed by a range of publicly, privately and internationally supported projects in various northern areas. While some highland production activities, from cabbages to barley, ginger and some fruit crops, are now conducted through private channels, a range of Royal Project centers specializing in fruits, vegetables or ornamentals have come together under the umbrella of the Royal Project Foundation. Activities now even include marketing a range of products under their own Doi Kham brand name. Lowland-focused Thai agro-industry has been expanding into mountain valley areas, resulting in expansion of soybean, maize, potatoes, longan, mango, lychee and other crops, up slopes into the midland zone. While these efforts often have the blessing of government rural development and poverty reduction programs, investment requirements, risks and profitability have varied substantially, often in relation to fluctuating environmental and economic conditions. Although a

small minority have been successful enough to move out of the lowest income categories, the vast majority of people in mountain areas remain poor.

3. Government policies. Forest policy has brought forest reserves, national parks, wildlife sanctuaries, and protected watershed forests, which preclude formal recognition of land use claims in most mountain areas. In some areas, land has been degazetted from reserved or protected status when local communities have demonstrated long term residency and met other requirements. The magnitude of the impact of reserved and protected areas on populations living above 600 m.a.s.l. are indicated in Table 4. Note that the ASB benchmark site (Mae Chaem) is well placed to study issues associated with communities living within reserved forest, planned reserves and parks, and de-gazetted areas.

Table 4. Status of land occupied by populations above 600 m.a.s.l., 1997

Land category	National	North	Chiang Mai	Mae Chaem
Reserved forest	611,400	589,279	174,224	30,794
National parks	39,421	37,877	15,742	311
Wildlife Sanctuaries	40,600	30,900	6,755	-
No hunting areas	2,001	1,957	1,895	-
De-gazetted areas	283,878	250,104	46,689	3,309
Planned reserves	8,322	8,322	8,322	4,615
Military lands	5,500	-	-	-
Total	991,122	918,439	253,672	39,029

Source: adapted from Hilltribe Welfare Division, 1998

The perceived importance of watershed issues has prompted another set of policies directly related to land use in mountainous areas of northern Thailand. A watershed classification system was developed and implemented throughout the country, initially under the aegis of the National Research Council, and subsequently under the Ministry of Science, Technology and Environment. Five categories of watershed classes have been overlaid on 1:50,000 scale topographic maps, and a set of restrictions on land use associated especially with categories 1 and 2 have official standing under a resolution of the ministerial cabinet. The distribution of land among these categories at several nested levels of resolution are indicated in Table 5.

While proportions of land in classes with severe restrictions appear modest at the national level, this changes as one moves to increasingly smaller upstream units. Although only 25 percent of the country is placed in class 1 and 2, the proportion doubles at levels of the northern region and major basins like the Ping, and climbs to about 90 percent in the Mae Chaem watershed, a major tributary of

Table 5. Distribution of Land by Watershed Class at Nested Levels of Analysis

		Distribution of land by watershed classification (percent)						
		Class 1	*Class 2*	class 3	class 4	class 5	water	total
Thailand	*Overall*	***18.1***	***8.3***	7.7	15.8	49.0	1.1	100
North	*Overall*	***32.6***	***15.0***	10.8	9.5	31.8	0.3	100
	Ping Basin	***38.3***	***14.2***	9.6	8.9	28.3	0.7	100
Mae Chaem	*Overall*	***63.9***	***25.0***	8.7	1.8	0.7	-	100
(ASB site)	High peaks	***100.0***	-	-	-	-	-	100
	Highlands	***82.6***	***14.5***	2.9	0.0	-	-	100
	Midlands	***54.7***	***32.4***	10.2	2.7	-	-	100
	Lowlands	***17.7***	***41.9***	28.2	6.0	6.1	-	100

Sources: 1) Chunkeo, 1996; 2) ICRAF unpublished data

the Ping River. Thus, conditions at the ASB site are rather typical of conditions in upper tributaries. Since downstream environmentalists and other interests are using these maps in calling for severe restrictions and even relocation of communities out of mountain areas, related watershed policies need considerable careful analysis and exploration of options. Other forest land zoning exercises associated with specific policy initiatives have had various further effects on local communities and land use in the north.

Rural poverty programs in the mountains have largely been conducted through the Public Welfare Department, various special projects, or by missionaries [Renard 1988]. However, rural development decision making, is now shifting to elected local governments under the 1997 constitution and associated reforms. Various new provisions, including a community forestry law, are now being considered by Parliament. All government agencies, including the forest department, must now reform their policies and programs to conform with the many new mandates involved.

Since mountain areas are also the focus of other concerns, including illegal logging, narcotics and national security, the government has developed multi-agency development policies, plans and projects specifically for highland and midland areas. While opium eradication programs have made

major progress, problems remain with illegal logging, illegal import of methamphetamine, and spillover effects of armed conflict in neighboring countries.

4. Infrastructure & services. Programs for opium eradication and national security further increased efforts to expand road infrastructure in mountain regions. In addition to their direct environmental impact, roads have brought market access for alternative cash crop production to many remote areas, as well as access for illicit logging and forest extraction operations. Expansion of services is another dimension of public policy, including registration of minority communities, as well as education and health services, electricity and media access, all of which help increase opportunities for integration of these communities into national society.

5. Urban industrialization and tourism. Expansion of tourism, resorts and recreational facilities are bringing new claims, pressures and opportunities to mountain areas [Dearden 1996]. Urbanization and industrialization have also begun affecting various aspects of life and decision making in areas of the north. These processes have encouraged land speculation in many areas, as perceptions of land shift from a production input into a financial asset; substantial areas are now in limbo after the Asian financial crisis.

Impacts on Traditional Mountain Land Use

The second factor adding complexity relates to how these forces affect ethnic groups and land use within key altitude zones. As a conceptual baseline, Table 6 presents some of the basic features of altitude zones that are important for understanding distribution of resources, people and activities in northern Thailand and many parts of the MMSEA ecoregion.

TABLE 6. General Land Use Patterns before 1960 by Altitude Zone

Zone	Altitude range *m.a.s.l. (approx.)*	Natural Forest	Ethnic Groups	Traditional Agriculture
High peaks	**> 1,800**	**Moist temperate (cloud forest)**	***-none-***	***-none-***
Highlands	**1,000 – 1,800**	**Hill evergreen & coniferous**	**H'mong, Lisu, Akha, etc**	**Pioneer shifting cultivation (+/- opium)**
	1,000 – 1,200		**Thai, Karen**	**'jungle' tea (in some areas)**
Midlands	**600 – 1,000**	**Mixed deciduous**	**Lua, Karen**	**Paddy (limited) + Rotational long fallow shifting cultivation**

Lowlands	**< 600**	**Dry deciduous & swamp**	**Thai**	**Paddy, gardens (+/- short fallow shifting cultivation)**

Source: ICRAF and Royal Forest Dept. staff

The complex natural ecology associated with mountain terrain in northern Thailand is reflected in natural forest types, which are strongly associated with altitude, as modified by geology, aspect, fire, and other factors. In combination with the ethnic complexity of the region, it becomes apparent that past complex traditional patterns of land use in largely forested landscapes have reflected both the ecological and cultural diversity of the region. Literature reviews of classic studies on the range of traditional land use systems are included in research documents by Grandstaff [1976], Kunstadter [1978] and various others. A recent study by Schmidt-Vogt [1999] includes an updated bibliography.

Core categories of traditional systems have associated highland traditions with relatively mobile villages and 'pioneer'-type long cropping - very long 'abandoned' forest fallow that is really only viable in areas where small populations have access to extensive areas. Midland traditions are associated with more 'established' villages and systematic short cropping - long 'rotational' forest fallow systems that often include paddy land where geography allows, and quite systematic management of landscape compartments, including areas kept under permanent forest cover. Some areas include 'miang' or 'jungle tea' production, where *camellia sinensis L*. is planted as an understory tree in hill evergreen forest. Leaves are steamed and sold with or without fermentation, for chewing as a traditional stimulant by people in the region. Livestock also graze in these systems. Lowland Thai traditions have largely focused on irrigated paddies and home gardens, sometimes with supplemental short cropping - short fallow cultivation on nearby lower slopes.

During recent decades, however, incentives and pressures for change have brought changing mixtures of land use [Thong-Ngam 1996], with substantial loss of mature secondary forest. A basic summary of some major land use trends and issues is presented in Table 7 by altitude zone.

TABLE 7. Current Land Use Trends and Issues by Altitude Zones

Zone	Altitude range *m.a.s.l. (approx.)*	Land Use	User issues	Environment issues

High peaks	**> 1,800**	***-none-***	**n.a.**	**Die-back**
Highland	**1,000 – 1,800**	**Commercial horticulture, grasslands, (forest plantations)**	**Crop markets, land security**	**Deforestation, water use, pollution**
	1,000 – 1,200	'jungle' tea (in some areas)	**Crop markets, land security**	**Less forest buffer**
Midlands	**600 – 1,000**	**Paddy (limited) + Shortened-rotational shifting cultivation, permanent upland fields**	**Food security, land security, crop markets**	**Deforestation, water use, pollution**
Lowlands	**< 600**	**Paddy, gardens, upland field crops, orchards**	**Crop markets, irrigation water, (land security)**	**Deforestation, water use, pollution**

As a result of such trends, we now see changing land use mixtures in mosaic patterns of each zone

1) Highlands. Pioneer shifting cultivation and opium have been largely replaced by commercial vegetable production that is now pushing into the midlands [TDRI 1994]. There is growing downstream concern about impacts on stream flow, erosion and pesticide pollution.

2) Lowlands. Expansion of field crops, and in some cases orchards, into forested watersheds above paddies is now pushing into the middle zone from below.

3) Midlands. Pressure from population growth, expanding lowland and highland systems, and government policy, has reduced land availability, often resulting in much shorter forest fallow cycles, and some conversion to fixed fields. Even sacred groves in their landscapes are now threatened.

4) Overall. Recently, projects have begun promoting more trees in the landscape in all zones, with primary emphasis on fruit trees and community forest. In addition to eliminating opium, many projects now seek to establish or strengthen locally protected forest areas, control fire, and restrict activity on steep slopes and watershed headlands. There is also renewed interest in 'jungle tea' complex agroforests in some lower areas of the highlands, which continue to endure and seem to help protect at least nearby forest areas.

Spatial Distribution of Land Use Change

The third factor contributing complexity to these issues is that these influences, processes and patterns of tradition and change are not evenly distributed across major landscape levels. Estimates of the proportions of land in forest, agriculture and other non-forest categories at levels within which the ASB-Thailand research site is nested are presented in Table 8. As one moves down the hierarchy from

nation to northern region to Mae Chaem watershed, for example, forest cover increases from 27 to 46 to 79 percent, while agriculture decreases from 41 to 28 to 1.5 percent. Within Mae Chaem, roughly similar trends occur among altitude zones from valley bottoms to mountain peaks. One must be cautious, however, in interpreting how such data represents midland and highland agricultural systems. Agricultural land major lowland agricultural zones is associated with quite clearly recognizable boundaries. In areas such as Mae Chaem, however, estimates from remote sensing currently limit forest fallow agriculture to cropped clearings after the end of the rainy season – harvested, uncropped and early fallow land are often seen as 'other non-forest', while older fallows are considered forest. Considerably more work is needed to improve our ability to monitor and assess traditional and transitional land use systems in these areas.

Another important level of variation occurs among units within watersheds at the level of the ASB-Thailand site or larger. One useful way to disaggregate the 4,000 sq. km. Mae Chaem watershed into sectors is to use administrative sub-district (tambon) boundaries. .There are 10 sub-districts that cover about 90 percent of the watershed and define the domains of elected local government bodies that are being up-graded under the 1997 national constitution, which includes provisions for local

TABLE 8. Nested Levels of Distribution of Land Cover and Resources per Capita, 1990

		Proportion of total area *(percent)*			
		Total	**Forest**	**Agriculture**	**Non-forest**
Thailand	***Overall***	**100**	**27.3**	**41.2**	**31.5**
***North* Region**	***Overall***	**100**	**46.4**	**28.0**	**25.6**
Mae Chaem (ASB)	***Overall***	**100**	**79.4**	**1.5**	**19.0**
	High peaks	**100**	**98.8**	**-**	**1.2**
	Highlands	**100**	**81.5**	**0.4**	**18.1**
	Midlands	**100**	**74.8**	**1.6**	**23.7**
	Lowlands	**100**	**85.4**	**7.5**	**7.1**

Sources: Adapted from 1) Charuppat 1998 (Royal Forest Dept.); 2) unpublished ICRAF data

TABLE 9. Sub-Districts in ASB Benchmark Watershed by Altitude Zone

Mae Chaem Sub-District	**Area** ***hectares***	**Proportion of total area** ***percent***				**Upland Features**
		Peaks	**Highlands**	**Midlands**	**Lowlands**	
Ban Chan	**18,504**	**-**	**91.8**	**8.2**	**-**	**hi-value horticulture**

Chaem Luang	**24,851**	**1.9**	**83.5**	**14.6**	**-**	**med-SC, veg., (park)**
Pang Hin Fon	**24,167**	**-**	**75.0**	**25.0**	**-**	**short-SC, veg., (park)**
Mae Daet	**16,453**	**-**	**69.5**	**30.5**	**-**	**med-SC, veg., [park]**
Mae Suk	**68,200**	**-**	**59.3**	**37.6**	**3.0**	**short-SC, vegetables**
Mae Na Chon	**72,545**	**0.6**	**44.9**	**51.2**	**3.3**	**short-SC, veg., [park]**
Ban Tub	**40,647**	**-**	**35.8**	**53.2**	**11.0**	**short-SC, veg., (park)**
Kong Khaek	**36,918**	**0.2**	**18.0**	**60.6**	**21.3**	**fixed fields, park**
Ta Pha	**10,672**	**0.1**	**24.9**	**44.8**	**30.1**	**fixed fields, park**
Chang Koeng	**19,961**	**7.9**	**19.5**	**48.7**	**23.9**	**town, fixed fields, park**
Total	**332,917**	**0.8**	**50.5**	**41.3**	**7.4**	

Sources: Adapted from 1) unpublished Royal Forest Dept., ICRAF, and Care-Thailand data;
2) unpublished Ministry of Interior data

participation in natural resource management. Table 9 indicates the relative size of these sub-districts, how their land is distributed among altitude zones, and a few major features of upland land use within their domain. Note that general effects of changes in altitude zones are modified locally by such factors as geology and geography, road access, projects and government programs. One current major challenge is to understand how processes within and across altitude zones interact in influencing change in mosaic patterns of land use, and the benefits and costs of this change for both local communities and larger society.

Efforts to Adapt to Changing Conditions

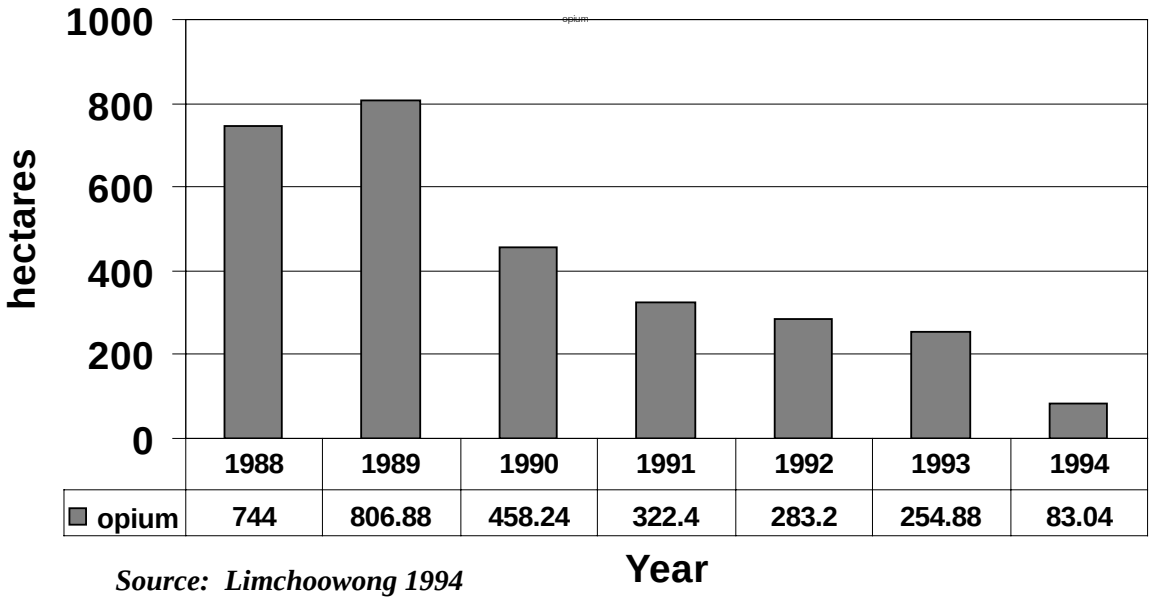
In response to these influences, trends and patterns of change, various innovative farmers and pilot projects have been seeking ways to improve livelihoods while reducing pressure on forest lands and protected watersheds. Some of these are very local efforts by individual households or local leaders, while others are facilitated or promoted by recent or on-going projects of various scales conducted by government agencies or non-governmental organizations. ASB-Thailand seeks to learn from, build on, and support such efforts. In addition to learning from the continuing efforts of the Royal Project Foundation, several projects are providing useful insights regarding organized efforts to influence patterns of land use change:

Sam Mun Project. One recent project particularly noteworthy in this regard is the 1987-94 Sam Mun Highland Development Project (hereafter referred to as the Sam Mun Project), an inter-agency project led by the Royal Forest Department in coordination with the Office of the Narcotics Control Board, with funding assistance from the United Nations Drug Control Program and the Ford Foundation. The 2,000 sq km project area was located in midland and highland zones of a ridge of mountains beginning northwest of Chiang Mai city and extending to the Myanmar border. This area, like ridges in the

ASB-Thailand benchmark watershed, was once an important opium production area, which in 1988 still totaled over 800 hectares. Although this was one of the last in a series of internationally-supported projects meant to focus on opium crop substitution, it is generally recognized as the most effective and the most integrated in its approach. Its Thai leadership made serious efforts to learn from both the mistakes and successes of previous projects, and even academics usually very critical of forestry policies and projects have recognized the value of their approach [Ganjanapan 1997, p. 208].

To paraphrase the words of a former project director, the Sam Mun Project focused on developing and improving the capability of community organizations, so that they could be self reliant in managing their communities, food resources and other natural resources (soil, water, forest) in a manner that 1) is appropriate to their lifestyles and values; 2) ensures community stability; and 3) develops their community and environment in response to both local needs and government policies, including control of opium production. [Limchoowong 1994, p. 11] The project assumed that people and forests can live in harmony, and emphasized food self-sufficiency, income generation, reduced chemical usage, reduced swidden cultivation, forest protection, initiation of watershed management networks, and tools for local land use planning. Many of the methods and tools pioneered by this project, such as participatory land use planning [Tan-kim-yong 1994] and 3-dimensional village land use models, are now being used and further adapted by subsequent projects in Thailand and neighboring countries. In addition to some of the land use changes mentioned in following sections, the project also assisted communities in gaining access to health and education services, citizenship, and infrastructure improvements needed to implement their development plans. In terms of its major objectives, areas under shifting cultivation were reduced by more than 80 percent, while total forest are more than doubled [Tan-kim-yong 1994, p. 58]; Figure 1 provides data on areas planted to opium in the project area, as verified by national and international drug agencies through remote sensing.

FIGURE 1. Opium Poppy reduction under the Sam Mun Highland Development Project



Source: Limchoowong 1994

Queen Sirikit Reforestation Project (Suan Pah Sirikit). Building on previous smaller-scale efforts, this interagency project in the Mae Chaem watershed has been conducted under the patronage of H.M. the Queen of Thailand since 1996 [Suan Pah Sirikit Project 2000]. The Royal Forest Department has a leading role in implementation through its 10 watershed management units in the area. The project philosophy is that people can live in harmony with the forest through community participation in conservation and forest resource development, collaboration among villagers and government agencies in local land use planning, improving livelihoods and the quality of life in ways that protect watershed headlands, and coordination of relevant government agencies to facilitate systematic development. Initial work began in response to rapid deforestation after the end of a foreign funded project in the late 1980's, which despite some useful innovations was unable to have a lasting positive impact on watershed management. The Suan Pah Sirikit project has built on promising innovations, and adapted several participatory methods and tools used in the Sam Mun Project, along with experience from various Royal Projects and other sources.

Care-Thailand Integrated Natural Resources Conservation Project. The Integrated Natural Resources Conservation project sought to conserve watersheds in the northern provinces of Chiang Mai (Mae Chaem district) and Mae Hong Son degraded by illegal logging, forest fires and expanding farmlands. During 1994-99, the project worked with local communities to promote sustainable management of agriculture and fragile watershed forests. Project components included agroforestry, soil and water conservation, rice paddy and fish pond development and non-farm income generating activities. Project partners included the Royal Forest Department, other agencies in the Ministry of Agriculture and Cooperatives, and the local government administration. They also worked closely with Chiang Mai University to study and implement approaches for promoting community

participation in sustainable land use. The project provided valuable assistance during establishment of the ASB-Thailand benchmark site, and we have developed a partnership for implementation of their follow-on project being launched during 2000.

Other Projects. ASB-Thailand is also seeking to learn from the experience of a range of other previous projects, including the Thai-German Highland Development Project, the Thai-Australian Highland Development Project, the Thai-USAID Mae Chaem Development Project, and others.

Promising innovations to improve land use technologies

Drawing on experience of these projects, including numerous examples of ideas and adaptations that came directly from innovative local farmers, we can see that most promising technical approaches to improving livelihoods while reducing pressure on forest and/or watersheds have focused either on decreasing the area required for upland rice and/or increasing trees in the landscape.

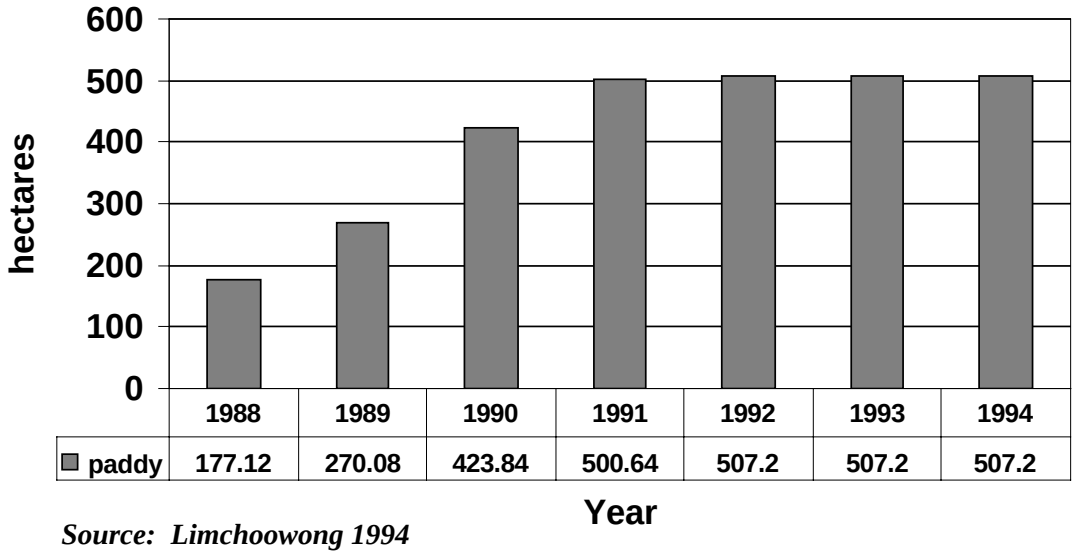
Meeting food security needs, while decreasing the area required for upland rice

Increased pressure to reduce the total amount of land used to produce upland rice under shifting cultivation has induced three basic types of response to altering approaches for meeting basic food security needs. All three are based on the expectation that intensified agricultural production will reduce pressure on forest components in the landscape.

1. Increasing paddy fields. Preliminary findings indicate that expansion of irrigated paddy land in areas where terrain and water resources are suitable, often in small pocket areas, can allow communities to greatly reduce land requirements for upland rice production. Given the greater productivity per unit area of paddy rice, reductions can be by a factor of 10 to 20, depending on paddy yields and the length of the swidden fallow cycle. The response of farmers to efforts by the Sam Mun Project to help them overcome existing barriers to paddy expansion are indicated in Figure 1.

Preliminary data from portions of the ASB benchmark indicate that profitability to farmer producers of paddy rice is much greater than upland rice as it is currently being produced, largely due to increased weeding labor requirements and decreased productivity of upland fields [Ekasingh, B, unpublished data]. Additional data from some other sectors of Mae Chaem appear to verify these findings [V. Punyawadee, unpublished data]. Initial experiments have also been launched using new rice varieties to explore the possibility and potential impacts of double cropping of rice in midland paddies. Since some question expansion of paddy as using too much water [Kaosa-ard 2000, unpublished World Resources Institute report], water use is also being measured.

FIGURE 2. Rice Paddy Expansion under the Sam Mun Highland Development Project



Source: Limchoowong 1994

2. Permanent field upland rice. In some areas under the Suan Pah Sirikit Project where terrain does not allow sufficient expansion of paddy to meet local subsistence needs, innovative farmers developed a crop rotation system for permanent upland fields, in which upland rice is rotated to soybeans every third year. This has allowed them to reduce the total area required for upland rice production by a factor of 3 to 7, and also provides some cash income from the soybeans. Land taken out of upland rice is converted to permanent community-protected forest. Farmers using this system for 10 years claim they have not experienced yield reductions. Due to poor soybean prices since the Asian economic crisis, many farmers are now switching to maize for their rotation crop, and it is not yet clear whether or how this will affect the sustainability of crop yields. ASB-Thailand is conducting the first known agronomic and economic studies of this system.

3. Permanent fields of high-value commercial vegetables. This approach involves meeting food security needs through generation of cash income, primarily in highland areas where the climate supports production of temperate zone vegetables. One prime example of this approach is found in the Ban Chan sub-district of Mae Chaem where a project of the Royal Project Foundation has been operating for many years [Royal Project Staff 1999]. Many villagers are producing high value specialty vegetables that are largely marketed through the Royal Project. These intensive systems use much less land than shifting cultivation, but while profits can be quite high, various crops suffer from periodic severe damage due to pests or climatic variation, or from sometimes drastic fluctuations in prices. Many villagers are responding to these factors by diversifying their production into two or more crops [Ekasingh, B, unpublished data], including some fruit trees. Another stabilizing factor in this area has been expansion of paddy land, which was possible in some fairly large areas of gentle

terrain. Traditional forms of shifting cultivation are now quite rare in this area, and locally-recognized land ownership has largely been privatized to households. Several ASB studies are being conducted in this area on current technologies and historical their development. Diversified cash crop approaches are also found in other areas of the watershed [V. Punyawadee, unpublished data].

Although highland cabbage production also involves this strategy, it has come under strong criticism on environmental grounds due to planting on steep slopes and heavy application of pesticides. Some projects are trying to introduce conservation farming practices and alternative pest management technologies into these systems, but with little success so far. Our partner pilot projects in Mae Chaem are continuing to explore alternatives.

Improving local livelihoods, while increasing trees in the landscape

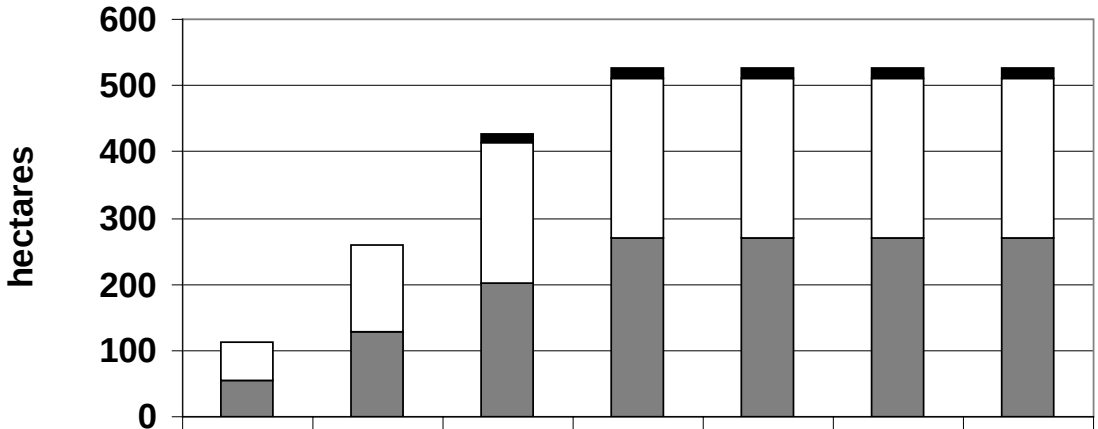
There have generally been three major directions of efforts to increase trees in midland and highland landscapes.

1. Simple agroforestry. This approach has primarily centered on planting of fruit trees in agricultural fields, following approaches pioneered in the Royal Project. In highland zones, primary focus is on temperate zone fruits, such as Chinese apricot, plums, pears, persimmons, and others. In midland zones emphasis shifts more to sub-tropicals, such as litchee. Results of Sam Mun Project efforts to encourage fruit tree production are indicated by data in Figure 3 on expansion of planted area. This data actually understates the full impact, since many trees were also planted around houses, along field boundaries, or in other ways that did not facilitate calculation of area planted. Further planting has continued after the end of the project.

A preliminary ASB study of fruit tree agroforestry in Sam Mun Project areas [Withrow-Robinson 1998], found a substantial range of strategies and planting configurations deserving further analysis.

2. Complex agroforests. The primary example of an indigenous complex agroforest in northern Thailand is the ‘miang’ or ‘jungle tea’ plantations embedded in hill evergreen forest. As mentioned earlier, this system continues to endure despite concern that its market may be disappearing as young generations stop the practice of chewing the leaves. The Sam Mun Project encountered some success in helping Karen producers get out of debt cycles linked to buyers in the market, allowing them to obtain higher prices and profits. Moreover, prices for ‘miang’ tea appear to have recovered from low levels of 10 years ago, and many producers now claim their biggest problems are sources of hired labor and fuelwood required to process the tea. One forestry officer formerly working on the Sam Mun Project has conducted substantial research on the practices involved [Preechapanya 1996].

FIGURE 3. Fruit Tree Expansion under the Sam Mun Highland Development Project



	1988	1989	1990	1991	1992	1993	1994
litchee	0	0	12.32	14.88	14.88	14.88	14.88
mango	59.04	129.12	213.28	240.96	240.96	240.96	240.96
temperates	54.24	129.12	201.6	269.92	269.92	269.92	269.92

Year

Source: Limchoowong 1994

An interesting variant on the direction for development of this system has been observed among farmers in an area adjacent to the Sam Mun Project area. Their approach involves gradual transformation of 'miang' complex agroforests, by substituting trees producing fruits and seeds crops for many or most of the forest and/or tea trees. During this process, they are careful to maintain a very complex structure in their agroforest, which mimics the complexity of the original. One preliminary study examined 19 examples of this type of operation [Tanpanich 1997], and further explorations appear warranted.

3. Community-managed forest. These efforts seek to maintain and expand areas of permanent forest that local communities protect and manage. Such efforts often seek to build on traditional concepts and beliefs of especially midland groups, in finding ways to convert forest fallow in fragile areas to permanent forest, or to reforest other types of degraded areas, either through tree planting or protection of natural regeneration. It is interesting to note that during implementation of the Sam Mun Project, the forest department reforested 4,855 hectares using their standard planting techniques. Although villagers used these techniques on only 242 hectares, they collaborated in protecting 59,220 hectares of naturally regenerating forest. The key to this approach was in reaching clear mutual agreement on land use plans, and active roles by village institutions in controlling use, fire, etc. A second key was in reaching clear understanding about how areas of community managed forest could be used by the local community.

One of the concerns expressed by various academics and NGO workers is that communities who stop shifting cultivation will lose access to an important range of natural products that they obtained from

forest fallow fields during intermediate stages of regeneration. This is yet another area where existing data is very poor or absent, and further study is urgently needed.

Promising institutional changes and pilot project innovations.

While these changes in technologies can help shift proportions among components within land use mosaics, there are also important institutional developments. Three major examples include:

1) Land Use Planning. Pilot experiments have shown it is possible to reach mutually-acceptable land use agreements among villagers and agency officials using participatory methods. Pioneering efforts under the Sam Mun Project developed what is now a widely accepted approach known as 'participatory land use planning' (PLP). In the words of its chief architect: "Participatory land use planning can be defined as an operational tool or process which creates conditions of frequent communication and analytical discussions, hence strengthening local organization by generating common understandings and shared rights and responsibilities among project partners, who carry out activities that lead to the solving of local forest management problems and other related community problems" [Tan-kim-yong 1994, p. 6]. The conceptual framework of PLP is conflict resolution applied to issues of natural resource management and development, and cannot be understood simply as a method of land use planning. The ability to manage land use comes out of basic changes in the roles of the stakeholders, with changes occurring as parties come to understand each others' positions. Essential to this concept is open access to information on all sides, involvement of a third party, and presence of long-term community workers. The end goal is to help upland villagers become active participants in watershed forest protection rather than the unwilling subjects of government control.

Various tools were explored to help facilitate this process and document mutual agreements that were reached. Particularly useful tools include scale contour maps and scale 3-dimensional models of the local landscape, which served both as a centerpiece for discussions and negotiations, and as a clear and accessible record of land use zones established through mutual agreement.

Once basic agreements were reached, villagers articulated their own sets of rules, penalties for violators, and mechanisms for enforcement. Penalties often included fines substantially higher than those imposed by lowland law, and communities subsequently proved their willingness and ability to enforce their rules. And on occasions when violators were outsiders who challenged their rules and rights to enforce them, local leaders sought assistance from project staff or local authorities.

Variations of this approach and its tools are being further adapted and refined by various next-generation projects, including those conducted by ASB pilot project partners in Mae Chaem. If these efforts can provide a basis for land security, a major obstacle will be removed [Shinawatra 1994].

2) Watershed Management Networks. Projects have also experimented with local, multi-village, and usually multi-ethnic group, watershed management networks to coordinate land use management across larger sub-watershed landscapes. Building on earlier work, the Sam Mun Project facilitated establishment of watershed networks, and encouraged them to formulate their own rules, penalties and

enforcement mechanisms. The approach was basically an extension of the PLP process to the wider sub-catchment level, involving communities already familiar with PLP at the village level. With increased levels of upstream-downstream conflict now being encountered in many areas, various projects and organizations are promoting watershed management networks, again including those conducted by our partner pilot projects in Mae Chaem. One recent study indicates they have considerable potential for continuing after the end of the projects that help facilitate their establishment [Kaosa-ard 2000, unpublished WRI report].

3) Constitutional and Legal Reform. Under the 1997 constitution and related legal reforms, opportunities are emerging that may allow arrangements such as those being formulated and mapped using participatory land use planning to gain formal recognition. Examples include constitutional provision for local participation in natural resource management, laws and programs to upgrade and strengthen elected local governments, and community forestry legislation now under consideration by Parliament (but still opposed by some environmental interests). Yet a range of questions regarding how to implement such changes remain unresolved, including how to strengthen the still embryonic sub-district governments frequently found in poor mountain ethnic minority areas, as well as how agencies such as the forest department can best interact with the thousands of local government bodies involved. ASB partner pilot projects in Mae Chaem are among those seeking effective ways to address these issues.

What is ASB-Thailand adding to these efforts?

As we have seen, land use in northern Thailand is in a period of stress and transition. Although there have been many negative impacts, and conflict is growing among various stakeholders and segments of society, there is also a growing body of experience that suggests promising approaches for improving directions and rates of change. Yet, there are numerous major gaps in the knowledge, methods and tools required to further develop these approaches, and effectively implement them on a broad scale across a complex range of conditions. The Royal Forest Department has given a mandate to ASB Thailand to assist the department and other key organizations in addressing these needs and challenges.

Northern Mountain Region Agroforestry Systems Research and Development Project

In order to facilitate collaboration under ASB-Thailand, the Royal Forest Department has officially established the 'Northern Mountain Area Agroforestry Systems Research and Development Project'. This is an open-ended project with a national steering committee and working-level administration arrangements. The project interfaces with and facilitates interdisciplinary, multi-institutional research by the ASB-Thailand Consortium in subject areas of mutual interest in Thailand, as well as collaboration with international research and information exchange at eco-region, Southeast Asia and global levels. Our approach seeks to build on existing knowledge and experience, and

strengthen ongoing research and development efforts, by identifying and filling strategic gaps in research and pilot project testing required to improve policies and expand adoption of promising approaches. Key partners in the Mae Chaem watershed include the Suan Pah Sirikit Project and the new Collaborative Natural Resources Management Project being launched by Care-Thailand and the Raks Thai Foundation. Appropriate linkages will also continue to be maintained or established with other relevant programs or research projects active in the area. There are five areas where we expect ASB-Thailand consortium to make major contributions:

Measuring and predicting costs, benefits and trade-offs of component land use practices.

One of the key weaknesses of pilot efforts to improve land use technologies has been the lack of quantitative data on their impact on either local livelihoods or environmental services (watershed services, biodiversity, climate change), on trade-offs between these factors, or on their prospects for longer-term sustainability. Yet, this information is critical for formulating and justifying changes in forest land policies required for their widespread adoption and sustainability. Thus, the first stage of ASB-Thailand activity is focusing much effort on filling cells of the ASB 'linkages matrix' for component land use practices in north Thailand. Data from initial field work is now being analyzed, and will be supplemented by continuing and additional studies to further assess complexities and variation encountered during initial studies, as well as potential new practices such as double-cropped midland paddy or drip irrigation to replace sprinklers now used in some areas.

Scaling-up to real-world landscapes.

The second major area of activity is directed toward scaling-up these analyses to the level of landscapes actually found in mountain areas of north Thailand, which relates directly to the ASB Phase 3 agenda. In addition to combining properties of mosaic pattern components, landscape-level interactions and emergent properties also need to be studied to assess overall impacts of mosaic land use patterns. One study of two villages in the Sam Mun Project, for example, found that while villagers perceive substantial improvement in forest components of their landscape over the last decade, water and wild animals have become more scarce, and they still have questions about their food and economic security in the future (Kaosa-ard 2000, unpublished WRI report).

Expanding on earlier pioneering work [Ekasingh 1996], studies in several sub-watersheds of the ASB site with different mosaic patterns have already been established. One of the next major tasks will be to identify suitable criteria for assessing livelihood and environmental impacts, as well as site qualities and potential 'carrying capacities' of major types of mosaic land use patterns. These criteria need to be associated with standards that accurately reflect management goals, and indicators that can be used to assess current status and progress toward meeting those goals. During this process, we also seek to understand conditions, constraints, markets, services, institutions and policies that influence establishment and maintenance of major mosaic land use patterns. Development of a geographic

information system for the ASB-Thailand benchmark watershed is already quite advanced, and further analyses will require linking this system with analytical models and field verification of their outcomes. We plan to apply these models in assessing impacts of alternative policy scenarios.

Improving technology for local land use planning, watershed networks and local governance.

The third major area of activity is to develop and test improved technology to support local land use planning, watershed management networks, and associated functions by local institutions and government agencies. Particular emphasis is to be placed on: a) Criteria for use in negotiating, establishing and monitoring localized land use agreements developed through participatory land use planning processes; b) Simple, widely-accepted tools that can be used at local levels to measure land use impact criteria, helping to resolve local disputes and document local conditions; c) Information systems for monitoring compliance and providing transparency and accountability in enforcing land use agreements, as well as helping to monitor the overall status of livelihood development and environmental conditions. Pilot efforts have already begun to develop a simplified GIS node in Mae Chaem to help link mapping conducted through participatory land use planning with our GIS system in Chiang Mai, and to test approaches for both providing support to local planning processes, and for establishing systems to help increase transparency and accountability of local land use agreements in upper watershed areas.

Providing technical support for scaling up

The fourth major area will be to provide technical support for formulation and implementation of larger-scale pilot activities to test ASB findings beyond the benchmark watershed site, in collaboration with the Royal Forest Department and other implementing organizations. We fully anticipate that the knowledge and experience gained through collaboration in ASB will be a significant contribution to forest department efforts to improve the design, implementation and assessment of appropriate policies and approaches for program and project improvement.

International research collaboration and information exchange

The final major area is to facilitate and support meaningful exchange and collaboration with organizations and programs conducting related work in neighboring countries of MMSEA, as well as in other ASB ecoregions around the world. Our vision is to help strengthen Thailand's ability to function as a peer-to-peer node, both contributing to and benefiting from the emerging global web of scientific infrastructure aimed at addressing rural poverty, land use and environmental issues. The Royal Forest Department is working closely with ICRAF and ASB-Thailand in further developing and strengthening specific partnerships and activities to accomplish this goal.

Conclusion

Land use in upper tributary watersheds in northern Thailand is in a period of transition. Traditional land use management practices resulted in a complex pattern of fixed and shifting cultivation components embedded in a forest matrix, reflecting both the ecological and cultural diversity of these areas. Due to a range of influences converging on the region, these largely officially unrecognized traditional systems are under stress, land use patterns are changing, and many communities are among the poorest in the nation. There is also growing concern in downstream society about the implications of these changes for their own livelihood systems and for the overall environment. While some pilot development projects are demonstrating the potential effectiveness of participatory approaches to improved land use management in these areas, there is still inadequate knowledge to assess the feasibility and implications of efforts to scale-up these approaches, or mechanisms to monitor and assess their longer-term impact and effectiveness over large areas. ASB Thailand is seeking to address these issues.

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Villagers use fire to clear land for cultivation and, despite rules to prevent accidents, fires often â€˜â€˜escapeâ€™â€™ and burn out of control over extensive areas. 2.3. Vegetation and Stage of Degradation.Â GPS and Google Earth were used later, as those technologies became available. Practical considerations, such as ease of access and de facto land occupation, predominated over ecological factors in determining plot locations. Consequently, aspect, slope, land use history, etc. varied among the plots over the years. However, all plots were former evergreen forest, above 1300 m altitude, with severe forest degradation and natural regenerants absent or sparsely present at densities well below that needed to close the canopy within 3 years. A brief description of the Rebirth Of The Urban Immortal Cultivator manga: Chen Fanyu failed in the process of his ascension and for unexplained reasons.Â A brief description of the Rebirth Of The Urban Immortal Cultivator manga: Chen Fanyu failed in the process of his ascension and for unexplained reasons returned 500 years ago, when he was young. Magic, sa Chen Fanyu ints and the strongest battle experts â€“ all this remained only in his memories. Chen Fanyu has not forgotten the resentment of his past lifeâ€¦ Encouraged by the desire to repay, he begins his journey again. Show more. The matter of land use changes has been measured in many international and interdisciplinary researches such as remote sensing, environment and biogeography [1, 2]. In Southeast Asia, including Thailand, deforestation has been occurring during the last 15 years because of an increase in agricultural crops [3]. Land use land cover change in Prachuap Khiri Khan province was reported by the Office of Agriculture Economics (OAE) in 2014 that deforestation has been occurring 6.96% while agriculture and other land use increase 34.97 and 45.44% respectively.Â The Khlong Kui watershed is a large watershed in the Southwestern Thailand and is