Title of Research Project

Shifting Cultivation and Health Conditions of the Karen Hill Tribe in northern Thailand: Connection and Sustainable Intervention?

Project Summary

Traditional agroecosystem management practices of the Karen hill tribe in northern Thailand are in the process of transformation. Their land use systems traditionally included a shifting cultivation component characterized by a rotational cycle of land clearing, burning, cropping for 1-2 years, and relatively long fallow period of at least 10 years. Plants in regenerating secondary forest fallow areas restored soil fertility for the next cropping cycle. Although shifting cultivation often invokes images of massive forest destruction and land degradation, various studies have shown that rotational systems with these characteristics can be sustainable.

During recent decades, however, the area of cultivated land per capita has been declining with population growth and environmental restrictions, resulting in shortened fallow periods. This will likely lead to declining soil
fertility, resulting in lower productivity of upland rice, and eventually in insufficient subsistence food supplies. As some studies indicate that species richness in regenerating secondary forest fallow areas are higher than in some primary forests and most permanent agricultural areas, shorter fallow periods may bring loss of late-fallow species of nutritional and ecological importance. As a consequence, there is a significant risk that the Karen will experience both declining land productivity and inadequate food supplies, which could be expected to result in malnutrition and related diseases.

This proposed research project will investigate connections between ecosystem management under shortened-fallow shifting cultivation systems and health conditions of the Karen practicing those systems. Rice productivity, food supply and consumption will be assessed by structured interviews and questionnaires. As women are responsible for maintaining home gardens, food gathering and preparation, which determine the health of their family members, data will be gender specific. Soil fertility aspects of shifting cultivation in relation to rice productivity are currently being investigated. Health and nutritional status will be assessed by medical doctors, trained nurses, and health workers. Local people will be involved as data sources, and will collaborate with researchers in formulating intervention strategies to address ecological and/or health problems identified during the research.

Indicators of ecological and health status developed under this project will be used in conducting comparative assessments of conditions in Karen villages at other points in the land transformation process, including longer-fallow shifting cultivation and both subsistence-centered and commercial-centered forms of permanent field agriculture. Findings would be expected to make a contribution to improved understanding of the human and environmental impact of the land use transformation process occurring in upper watersheds of northern Thailand and the larger eco-region, and help better inform development programs and policy makers seeking to influence further change and transformation.

**Introduction**

Life in communities practicing shifting cultivation in the mountains of North Thailand is in the process of transformation. Population growth and migration, infrastructure development, commercialization of agriculture, and growing national concern about deforestation and watershed deterioration are influencing many poor mountain ethnic minority communities to change their traditional land use practices (Thomas, 1996). Given the subsistence orientation of traditional land use systems, these changes may also be having important impacts on human nutrition and health. This project would investigate linkages between agroecosystems and human health at a strategic phase of this transformation process.

**The Agroecosystem**

Traditional forms of shifting cultivation in North Thailand have been characterized by their combination of
cropping and fallowing periods, the details and relative lengths of which vary by ethnic group (Kunstadter et al., 1978). Overall, two major groups of shifting cultivators have been identified: pioneer or new cultivators, and long established cultivators. “Pioneer shifting cultivators” normally clear and burn large patches of primary or mature secondary forest, crop them for several years, and then move on to clear new forest areas. Examples of minorities belonging to this first group include the Hmong and Lisu. The second group, the “long established shifting cultivators” also clear, burn, and crop pieces of forested land, but usually crop them for only 1-2 years before returning them to forest fallow; formerly cultivated fields are cropped again on after a traditionally fairly long rotation cycle (more than 10 years) without clearing additional forest areas. Karen and Lua minorities belong to this second group. A number of studies have shown that established rotational forest fallow shifting cultivation can be a sustainable form of farming, provided that cultivated fields are given sufficient time after cropping for soils to recover their fertility (Kunstadter et al., 1978; Nakano, 1978). Nevertheless, although a range of factors contribute to deforestation in Thailand, shifting cultivation is often perceived by foresters and environmentalists as one of the primary causes of deforestation.

Especially during the last decade, a general pattern of change has been emerging, wherein traditional forest fallow rotation cycles are progressively shortened. Increasing population densities have begun to limit land available for further expansion of cultivated area, thereby forcing villagers to shorten their rotation cycle. Further pressure from conservation groups is now being exerted on shifting cultivators to switch their farming into permanent agriculture located outside the national system of protected areas. Many mountain minority communities live and farm within, or overlapping, these protected areas, and villagers and community forestry supporters argue that they were established in the landscape long before establishment of the protected areas. In any event, some shifting cultivation systems are being replaced entirely with new forms of permanent field cultivation for subsistence and/or commercial purposes. There have been a mere handful of studies, which have compared the advantages, and disadvantages of switching from shifting cultivation into permanent agriculture. Although shifting cultivation normally provides relatively low rice yields in comparison with paddy rice, the system requires only labor input for clearing, planting and weeding. In contrast, permanent agriculture typically requires external inputs such as fertilizer, pesticides, and sometimes herbicides, which increase financial investment costs and may lead to environmental and health hazards. The change in system would also mean losses of some species found in fallow fields (Schmidt-Vogt, 1998), the consequences of which are not yet clearly understood. Recent events, such as the economic meltdown and the new national constitution indicate various pressures on these systems are likely to further intensify. Yet the impact of these land use transformation processes on livelihoods and health in poor mountain communities remains poorly documented or understood.

The International Centre for Research in Agroforestry (ICRAF) aims to improve human welfare by alleviating poverty, improving food and nutritional security, and enhancing environmental resilience in the tropics [see
One of its major research thrusts in the humid tropics seeks to help develop alternatives to unsustainable slash-and-burn agriculture, in collaboration with the global CGIAR System-Wide Alternatives to Slash-and-Burn (ASB) Initiative. The Mae Chaem watershed in the Chiang Mai Province of North Thailand is the primary benchmark site for ASB research directed toward the eco-region of mountainous mainland Southeast Asia. Research centered on this 4,000 sq km site seeks to understand these processes of land use change and potential roles for agroforestry systems in alleviating rural poverty, improving food and nutritional security, enhancing environmental resilience, and maintaining downstream environmental services under these conditions.

One of the most prominent mountain minority groups in both North Thailand and Mae Chaem is the Karen, whose traditional land use practices center on management of a subsistence-oriented landscape mosaic composed of varying proportions of paddy land, home gardens and protected forest areas, in combination with a rotational forest fallow shifting cultivation component. Due to the often very limited area of paddy that can be developed in the mountainous terrain inhabited by the Karen, much of their livelihood has centered on production of rice and a wide range of other subsistence products derived from the shifting cultivation rotation cycle. Upland rice farming typically produces low yields per hectares. While lowland paddy rice normally provides annual yields of up to 3,500 kg per hectare, upland rice produces only about 1,900 kg per hectare (Mae Chaem District Office, 1991). In 1992, The Chiang Mai Hill Tribe Development and Welfare Center (1995) reported that only about 50% of mountain minority families in Mae Chaem District had a sufficient rice supply.

While traditionally the Karen shifting cultivation cycle consisted of 1-2 years of cultivation followed by a fallow period of at least 10 years, growing constraints have resulted in sharp reductions in the fallow period. In Mae Chaem, while a few areas can be found with rotational cycles of 7 years or more, most have been reduced to 6 years or less. In some areas where the mix of pressure and incentives have been sufficient, permanent agricultural fields have been developed – some still center on upland rice production, while others have gone into intensely commercial production of horticultural crops. Development projects seeking to support this transformation hope that intensification of agriculture on permanent fields will allow remaining fallow land to return to permanent forest. In addition to reducing deforestation, foresters and environmentalists also believe this would help maintain biodiversity and watershed functions for the benefit of national society. Studies recently launched under ASB-Thailand are beginning to investigate details of new permanent field production systems, including preliminary assessment of some of the impacts these livelihood changes may have on both food security and utilization of non-cultivated components of the local landscape.

Perhaps the least understood or investigated condition in this process is that of communities with a shortened 4-6 year fallow cycle who have not yet pursued one of the permanent field directions. Given the inherently low soil fertility associated with most upland tropical soils, many researchers suspect a reduced fallow period will result in less accumulation of soil nutrients available for the crop, and thus much lower upland rice productivity.
Others point to increased weed competition, resulting in increased labor demands trading off with reduced productivity. In any event, villages in this situation appear to usually have inadequate rice production to meet their subsistence needs, and often also have insufficient commercial production to purchase rice. After increasing for several years during the economic boom, opportunities for off-farm wage production appear to have been negatively effected by the economic crisis. Moreover, most research on shifting cultivation has focused mainly on soil properties and the tree species composition of the system (Kunstadter et al., 1978; Kyuma et al., 1985; Tulaphitak, et al., 1985a, 1985b; Andriesse and Schelhass, 1987; Tiessen et al., 1992; Rerkasem and Rerkasem, 1994). There have been very few specific studies of the relationship between soil fertility and the productivity of shifting cultivation systems, especially in reduced-fallow systems.

One member of this research team, Mr. Prasit Wangpakapattanawong, has been conducting Ph.D. thesis research since June 1998 on ecological aspects of Karen shifting cultivation to establish the relationship between soil fertility and rice productivity. This thesis work is under the supervision of Dr. Kimmins, our Canadian partner from UBC, and field research is being conducted in association with ICRAF.

This investigation is focused on Mae Hae Tai village, in Mae Chaem District of Chiang Mai province. Families in Mae Hae Tai and nearby villages practice shortened-cycle rotational forest fallow shifting cultivation in which upland rice is the main subsistence crop. Approximately 60% of the families in Mae Hae Tai produce enough rice to meet their annual needs. In the nearby villages of Hoa Kao, Hoa Mai, Se Do Sa, and Din Kao, only about 30%, 27%, 7%, and 2% of families, respectively, produce an adequate annual rice supply (CARE-Thailand, 1996). As in other mountain communities, during the past few decades villagers in this area have been obliged to reduce their fallow period due to land scarcity associated with population growth. In addition, the growing environmental movement has led to increased public awareness and pressure against extensive clearing of forest land, even if it is part of a forest fallow shifting cultivation system. As a result, after long discussions with an NGO (CARE-Thailand, 1996), the villagers of Mae Hae Tai village agreed in 1995 to allocate one of their remaining shifting cultivation plots of 30 hectares to be a protected forest.

At this point, the village grows 1 year of upland rice followed by 5 years of fallow (a recent reduction from falls of more than 10 years). With the inherently low soil fertility of most upland tropical soils, there is a high risk that such a reduction in fallow period will lead to a substantial reduction in soil fertility, which is expected to result in a significant reduction in rice productivity. In other words, the following sequence of events could result from the change in agricultural land use systems:

Reduced farming area ↑ shorter fallow period ↑ lower soil fertility ↑ lower rice yield and supply.

Moreover, if there are progressive changes in soil physical properties, soil erosion may increase with attendant negative effects on rice yields. If these trends occur, they are expected to result in insufficient food intake by
the villagers. This would pose the risk of malnutrition, especially in children, which is one of the most nutritionally vulnerable groups (Whyte, 1974). Pinstrup-Anderson (1984) pointed out that food deficiency and malnutrition are often experienced by subsistence or semi-subsistence farmers. This is because their food supplies are directly dependent on the productivity of their land, usually located in relatively low productivity upland sites.

Human Health

Malnutrition contributed roughly 12% of the world's deaths in 1990 (Murray and Lopez, 1996 in WRI, 1998). It is considered one of the most common causes of death in preschool children worldwide. Most of 14 millions death in children are due to malnutrition (Lewinter-Suskind et al., 1993; WHO, 1997). The children who survive will experience a number of consequences from early malnutrition, such as poor learning ability and increased susceptibility to diseases, throughout their lives (Lewinter-Suskind et al., 1993; The World Bank, 1997).

The most widespread form of malnutrition in children is protein and energy under-consumption (marasmus and kwashiorkor diseases). It is associated with decreased muscle mass (wasting), and lack of growth and development (Gurson, 1972 in Silano et al. 1982; Figueroa-Colon, 1993). It is also harmful to the immune system, making malnourished children more prone to diseases such as measles, diarrhea, respiratory infection, tuberculosis, and malaria, than normal children (WRI, 1998). However, deficiencies in micro-nutrients like iodine, iron, and vitamin A and E, are also common (The World Bank, 1993 in WRI, 1998; Kootathep et al., 1997). Some 3.6 billion people worldwide have an iron deficiency problem, which can decrease physical productivity and affect learning ability. Up to 50% of women are anemic, which can increase the risk of childbirth death from hemorrhage (The World Bank, 1993 in WRI, 1998). Some 42 million children under age 6 suffer from vitamin A deficiency, which can cause blindness when extremely deficient. This is the number one cause of blindness in children in developing countries, while some suffer from loss of night vision (Levin et al, 1993 in WRI, 1998). It is estimated that 254 million children under 6 years of age are prone to vitamin A deficiency (WHO and UNICEF, 1995 in WRI, 1998). Countries in Southeast Asia and Africa face problems with malnutrition and diseases combined rendering the problems more severe (WRI, 1998).

In Thailand the rate of malnutrition tends to be higher among vegetarian and mountain minority ('hill tribe') children (Tienboon et al., 1997a). Several factors affect weight and height of children such as hemoglobin, hematocrit, amount of food eaten per day, birth weight, parental income, and parental age (Tienboon, 1995). In 1997, about 30 - 40% of the hill tribe children under 5 years old in Mae Hong Son and Phayao provinces of northern Thailand were malnourished in various degrees (Limmtrakool, 1998; Mae Hong Son Public Health Office, 1998). It is reported that 57% of children aged 1 -12 years old in Lamphun, the adjacent province south of Chiang Mai, were stunted in varying degrees (Tienboon et al., 1997a). In addition, 67% of those aged 1 to 6 years had a high tendency of vitamin A deficiency, which can cause diarrhea, pneumonia, and increase other incidence of infection. It can also extend the course of illness such as measles (Tomkins and Watson, 1989 in
Roles of women as food collectors, food preparers, and feeders should be noted, as this will influence nutritional intake and subsequent health conditions. Poor infant feeding practice is an important factor contributing to malnutrition. At present, some mothers choose to feed their children with powdered milk (tin milk) without proper knowledge. In fact, human milk meets the nutritional needs of healthy infants in the nutritionally demanding early months of lives. Breast feeding is the best way to feed infants for the first four to six months. Tienboon (1995) reported that at least 3 months of age, 36 percent of children in urban areas were solely breastfed, 9 percent of them were solely bottle-fed, and 55 percent were fed with both artificial milk and breast milk. Main reasons for using commercial formula fed to their children were inadequate breast milk, working mother, and cracked nipple. Fifty-five percent of children were given solid foods (supplementary feeding) at the age of 3 months (9.5% at 4 months, 4% at 5 months, and 10% at 6 months). In rural and hill tribe families, most mothers lack proper knowledge in choosing commercial infant formula and introduction of solid foods. Health and nutrition education can alleviate this problem. Nimsakul et al. (1997) found that after nutrition education to parents for about 1 year the Usual Pattern of Food Consumption (UPF) score of children aged 1 – 6 years was increased from 88 to 134 (52% increase). The Consumption Index (CI) score was also increased from 7 to 13 (85% increase). In addition, the total number of children in the high-risk group of vitamin A and other nutrient deficiencies were reduced to the moderate-risk group.

Even though malnutrition tends to be prevalent among poor and hill tribe children, over-nutrition incidence is increasing in transitional societies like Thailand. It is reported that increased prevalence of overweight, obesity, and hyper-lipidemia in children from well-to-do urban families has been found (Tienboon et al., 1995a, 1995b, 1996a, 1996b, 1997). Such data from poor and hill tribe families do not exist. It is expected that children from these families rarely suffered from these diseases due to low fat intake and poor infant feeding practices.

According to the 8th National Economic and Social Development Plan (1997 – 2001), the target is to reduce the percentage of malnourished children to less than 20% (Public Health Policy and Planning Office, 1997). Clearly, this target will not be met unless current trends of agro-ecosystem sustainability are reversed. Food supplies of the Karen practicing subsistence shifting cultivation are dependent on their land productivity, and consequently determine their nutritional and health conditions. As population increase and expansion of protected forest areas are threatening land productivity in these systems, there is an urgent need to understand basic
ecological determinants of the productivity of the systems, and, based on this knowledge, to seek modifications to current practices that are sustainable in both ecosystem and health aspects.

Objectives

Overall Objectives:

1. To investigate the connection between ecosystem management and health conditions of Karen people employing subsistence shifting cultivation systems
2. To investigate and recommend appropriate modifications in Karen farming systems to improve sustainability and productivity, and to forecast the future needs for intervention based on the findings of these studies

Specific Component Objectives:

3. To determine the productivity of food (rice) in shifting cultivation systems of the Karen in Mae Chaem watershed, northern Thailand, and how this will respond to the reduction in fallow areas expected to be associated with increases in population and in areas of forest reserves.
4. To assess food supply and consumption patterns in a Karen village practicing shortened-cycle shifting cultivation
5. To examine roles of Karen women as food collectors and preparers, which help determine health conditions of their family members
6. To evaluate nutritional values of domestic and wild plant species used by the Karen
7. To assess health conditions of Karen children in villages

Research Site Duration

Mr. Wangpakapattanawong (Project Researcher) has been conducting research on soil fertility aspects of the Karen shifting cultivation system in Mae Hae Tai village since June 1998. This village is located about 160-km southwest of the city of Chiang Mai in the Mae Chaem watershed in northern Thailand. The watershed is a benchmark site for research conducted by the International Centre for Research in Agroforestry (ICRAF), an International Agricultural Research Centre in northern Thailand, under the CGIAR System-Wide Alternatives to Slash-and-Burn (ASB) Initiative. Land use practices in this watershed are representative of land use in montane mainland ecosystems of much of Southeast Asia. Therefore, this village is proposed as a primary site for this research.

Mae Hae Tai village presently (1997) has a total of 57 households (increased from 41 in 1986, Sujumnong et al.,
1987), and a total population of 343; 171 males and 172 females (Prungkaew, 1998). The village is Karen, which is the largest mountain ethnic minority (“hill tribe”) group both in Mae Chaem and in Thailand. Most village members are involved in shifting cultivation activities, and total land under cultivation by the villagers is approximately 548 hectares. They grow rain-fed rice for one year, leave the field to fallow for 5 years, and then return to crop again. On average, 91 hectares of land is cultivated for upland rice each year. Although about 18 households have paddy rice fields (usually located close to streams), these collectively account for only 22 hectares of land area.

Methodology

1. age 1-6 Years
2. Inclusion Criteria
3. Excursion Criteria
4. Discontinuation Criteria
5. Analysis and data collecti

Assessment of Nutritional and Health Statuses

1. Nutritional Status

0. Anthropometric assessment: The following anthropometric measurements will be obtained: weight, length/height, head circumference, body mass index (BMI), skinfold thickness (triceps and subscapular), midarm circumference, and bioelectrical impedance (BEI).

1. Body composition assessment: BEI to assess body composition changes (lean body mass and fat mass changes) will be performed with a RJL whole body pathysmograph model BIA-101.

2. Clinical assessment: All children aged 1-6 years will be examined by a qualified medical doctor to assess general health and other clinical signs of nutritional deficiencies. Children who were found to have vitamin and mineral deficiencies will be treated accordingly. Some clinical signs resulting from malnutrition are edema, hair change, hepatomegaly, skin disorders, and wasting (Protein Energy Malnutrition, PEM) (Gurson, 1971 in Silano et al., 1982); Bitot’ s spots, conjunctival xerosis, corneal xerosis, and follicular hyperkeratosis (vitamin A deficiency); spoon-shaped nails and koilonychia (iron deficiency) (Figueroa-Colon, 1993; Olson, 1993).

3. Biochemical assessment: A whole blood of 300 μL will be obtained by “fingerstick” for determination of retinol concentration and the concentrations of the main pro-vitamin A carotenoids in blood (β-carotene, α-cryptoxanthin, β-carotene) by High Performance Liquid Chromatography (Thurnham et al., 1988; Singkamani et al., 1989). Standard nutritional biochemical indices will be measured including total protein, albumin, retinol binding protein, lipid profile, hemoglobin, hematocrit, and ferritin (the last three as indicators for iron deficiency (Linpisarn et al., 1996). The status of selected vitamins and
minerals with an emphasis on those known to effect immune function in deficit states will also be determined including vitamin A and E, folate, B12, zinc, copper, and selenium.

4. Dietary assessment: A group of children will be assessed for their nutrient intakes, food beliefs, food likes and dislikes, and infant feeding practices. The three-day (including Saturday and Sunday) prospective study of dietary record will be used.

2. Health Status

0. Assessment of infection morbidity: Health workers will visit the households and record frequency of fever, diarrheal disease and respiratory tract disease symptoms reported for that child. Diarrhea is defined as any stools that contain blood as determined by the child's caretaker (Bartlett et al., 1985); passage of a minimum of three loose or watery stools or any number of stools containing blood in a 24-hour period (Baqui et al., 1991). Chronic diarrhea is defined as diarrhea that persists >2 weeks (Bartlett et al., 1985). Episodes of runny nose, ear pain/discharge, sore throat, hoarseness, cough, or difficulty breathing are also recorded. The diagnosis and grading of severity of acute respiratory illness (ARI) will be executed according to the WHO algorithm (Stansfield, 1987). An ARI is considered a new episode if the child is symptom-free for a minimum of 2 weeks preceding an illness (Tupasi et al., 1988). Need for a clinic visit or hospitalization, duration of hospitalization, and duration of illness will be recorded as additional measures of severity of diarrhea or respiratory illness.

1. Stool microscopy for parasites: A stool sample will be obtained from all children and be examined by microscopy after formalin ether concentration (Ritchie, 1948). The stool concentration is more sensitive than direct examination. Individuals identified with pathogens will be treated.

3. Scoping

1. Blood sampling have detail in times quantity and frequency

**Ethical Consideration**

1. Protection
2. Health control and problems
3. Patient or Subject Information Sheet

**Informed Consent**

Written informed consent (verified through a signed Thai language form) will be obtained from each subject before any study-related procedure (including pretreatment procedure) are performed. The subject shall be given copy of informed consent form when signed; the consent shall be kept on file by the investigator.

**Confidentiality**
All information generated in this study will be considered highly confidential and will not be disclosed to any person. Subjects will be identified only by initials in case report forms. All laboratory specimens, evaluation forms, reports, and other records will be identified by a coded number only, to maintain the subject's confidentiality. The list of the subject will be stored separately from coded files. Clinical information will not be released without the written permission of the subject.

Source of Funding Budget Schedule

The proposal has been submitted for a research grant (149,555 Canadian Dollars) from the Canadian (International Development and Research Centre, IDRC) - ICRAF (International Centre for Research in Agroforestry) Collaborative Research Grants in Agro-Ecosystem Management for Human Health. The proposed duration is 3 years (October 1999 – September 2002)

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