Opportunities and Limitations for Agroforestry Systems in the Highlands of North Thailand

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Abstract

This paper begins with a brief review of forces and processes underlying current transitions in the highlands, organized under six themes: 1) geo-politics and geo-economics; 2) population growth and migration; 3) agricultural commercialization, capitalization and opium crop substitution; 4) forest resource management, watershed protection and environmentalism; 5) urbanization, industrialization and tourism; and, 6) adaptations in land use, society and culture.

Projected major roles of the highlands in the future are discussed within two broad categories: 1) ***protective functions***, including maintenance of watershed services, biodiversity, carbon stocks and esthetics; and 2) ***productive functions***, including agricultural production, forest products and tourism. The tension between protective environmental functions and productive developmental functions can be expected to continue as society continues to search for ways to balance and integrate the two.

Although many agroforestry systems potentially relevant to the highlands have been catalogued, there are two basic categories: 1) ***sequential systems***, which include both traditional and modified types of swidden agriculture, as well as relay and transitional intercropping; and 2) ***simultaneous systems***, which include both strip plantings (*e.g.*, alley cropping, boundary plantings) or mixed plantings (*e.g.*, home gardens, "jungle rubber"). Management approaches can be ***field-based*** or ***landscape-based***. The paper proposes a new type of simultaneous system that appears to fit with recent trends in the highlands: a landscape-based system that employs a community watershed mosaic pattern of land use management.

Contributions that agroforestry systems may be able to make toward improved sustainability, productivity, stability and equity in the highlands are discussed in terms of: 1) watershed regulation; 2) nutrient capture and retention; 3) biodiversity; 4) carbon sequestration; 5) household incomes; and, 6) equity. Although agroforestry cannot be expected to be a panacea for solving the range of complex problems related to land use in the highlands, it appears to offer some promising options for efforts to seek a "middle way" between extremes of environmental preservation and economic development.

Six general factors that may facilitate or limit the use of agroforestry systems in the highlands are briefly reviewed: 1) Increased ***land pressure*** is already inducing transitions in land use patterns and adoption of agroforestry-related practices. 2) Variation in ***resource base characteristics***, including both their capacity and current condition, can facilitate or limit adoption of agroforestry systems. 3) ***Access*** to roads, markets, inputs, capital, information and education can strongly influence adoption and development of agroforestry, as well as its opportunity costs; 4) The level of ***commercialization*** helps determine opportunity costs for agroforestry, selection of components and the direction of system development; 5) The strength of ***local organization and institutions*** can affect the viability of agroforestry, and is especially important in landscape-based systems; and, 6) The content, enforcement and perceptions of ***government policy*** can facilitate or limit adoption and development of agroforestry in the highlands, especially in terms of tenure, land use constraints, infrastructure and services.

Actual acceptance, adoption and development of agroforestry systems by households and communities in the highlands is likely to be based on a rational decision-making process. Incremental acceptance and adaptation can be expected, and is a process that can help strengthen their skills and ability to adapt to further changes expected in this rapidly changing region.

Finally, the paper very briefly introduces efforts that the International Centre for Research in Agroforestry (ICRAF) and the global Alternatives to Slash-and-Burn Agriculture (ASB) Programme have very recently begun to facilitate development of a regional-level analytical mechanism in North Thailand, aimed at accelerating the learning process associated with development and implementation of appropriate agroforestry systems, and understanding of their effects on national and global issues.

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David E. Thomas, Ph.D.[2]

This paper contains a fairly broad conceptual discussion of issues related to potential future roles of agroforestry systems in highland zones of North Thailand. It seeks to set the context of, and stimulate discussion on both: 1) wider implications of the interesting and useful research conducted by the Soil Fertility Conservation Project during the last several years; and, 2) issues and concepts related to the new research program ICRAF and a number of local and international partner institutions are just beginning in North Thailand. These activities are related in the sense that ICRAF and its colleagues seek to build on knowledge and experience accumulated under the SFC Project in developing the framework of its strategic research agenda for agroforestry and related land management systems in the region. *Thus, any criticism, comments and suggestions regarding the ideas presented here are welcome.*

I. Prelude to the Future: Forces and Processes of Transition in the Highlands

Although many of the various broader forces that have begun inducing a period of very rapid change and transition in the highlands of North Thailand are addressed elsewhere *(K.Rerkasem, et.al., 1994; K.Rerkasem and B.Rerkasem, 1994, 1995; M.Kaosa-art, et.al., 1994; U.Tan-Kim-Yong, et.al., 1988; TDRI, 1995; Royal Forest Department, 1993)* a very brief review of six broad themes helps us see more clearly trends in the region that will continue to be important factors in shaping opportunities and limitations for agroforestry systems in the highlands:

1) Geo-politics and Geo-economics.

As the recent CMU symposium "Montane Mainland Southeast Asia in Transition" reminded us, North Thailand is part of a larger eco-region that includes mountainous regions of Myanmar, Southwest China, the Lao PDR, and Vietnam. During its many centuries as a hinterland buffer zone, criss-crossed by trade routes connecting surrounding lowland empires, relatively independent regimes controlled extensive areas for considerable periods. One prominent example was the Lanna Kingdom that founded Chiang Mai 700 years ago. Meanwhile, other ethnic groups utilized various ecological zones in the highlands, where they developed several forms of shifting agriculture; while little of their history has been documented, the Lanna Kingdom is believed to have developed working relationships with them. This situation continued for a considerable period, even after the colonial era advent of geographic nation-states began mapping national boundaries in the region. *(D.Wyatt, 1984; C.Keyes, 1987).*

It was only during the last century that the Bangkok-based Thai nation-state began to consolidate its administration of the North and lay claim to the growing revenue flowing from sale of forest resources, primarily teak, to companies of neighboring colonial regimes *(K.Pragtong and D.Thomas, 1990).* Especially during the last 40 years, government programs in the region grew rapidly, driven largely by national security concerns, by pressure to halt opium production, by the resource hunger of the booming Thai economy, and most recently by response to emerging environmental movements. Legacies of this period include an expanded strategic road network, expansion of specialized services for mountain minority communities, a land classification system and a variety of attempts to consolidate and resettle highland communities to sites lower in watersheds.

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At the broad macro level, the rate and depth of change during very recent years has been breathtaking. Cold War era fears of insurgency and military aggression have subsided, Vietnam has joined ASEAN, construction of transportation and communications infrastructure to link the nations and markets of the region (including Southwest China) has already begun, and new rules for international trade are being finalized under ASEAN and GATT. Especially China and Thailand have controlled their lowland population growth rates, and both are experiencing extremely rapid rates of economic growth. Vietnam is now heading in a similar direction, and Laos and Myanmar are planning to follow suit. Desire for cooperation, exchange and collaboration across borders is a now nearly universally-expressed goal among leaders in capitol cities governing the region. Indeed, forces pressing for rapid economic development and expanded international trade appear to be very powerful, and perhaps unstoppable.

2) Population growth and migration.

Spurred by increasing trade, public health and development programs during the last 40 years, lowland Northern Thai society began to flourish and grow. The ensuing population boom, before it was controlled through family planning, combined with increasing commercialization to help drive further intensification of North Thailand's irrigated lowland agriculture, and push lowland interests up the slopes from their increasingly limited valley lands. While there appear to have been several periods during the last century when various ethnic groups migrated into North Thailand from China, Myanmar and Laos, the relative peace and growing prosperity in Thailand during recent decades, as well as its relatively remote and permeable borders, resulted in further influx of mountain minority migrants, many of whom blended in with their ethnic kin who had been resident for medium to long periods. This process was facilitated by the lack of official recognition of most minority communities, where even long-term residents had never received Thai citizenship. Since highland communities were not included in family planning programs, the combined effect of population growth and migration resulted in very rapid increases in the highland population. Other recent migration trends include rural-to-urban movement, particularly among young people seeking an education and those marketing handicrafts, and a new wave of illegal immigrants from neighboring countries seeking employment in increasingly labor-constrained enterprise, including some high-value cash crop production in the highlands.

3) Agricultural Commercialization, Capitalization and Opium crop substitution.

Agricultural commercialization processes have tended to at least begin with movement in two directions: upslope from valley bottoms, and downslope from ridge-dwelling communities. Very brief indicative descriptions of these patterns and some of their effects would include:

Upslope movement has been driven by the combination of lowland population growth (now under control) and increased commercialization and capitalization of lowland agricultural industries. Prime examples include the soybean industry, which has enjoyed supportive government policies and substantial private investment. As all-weather road networks have penetrated further into mountain valleys, merchants and financiers for soybeans and other crops have followed. Incentives have proved sufficient to encourage lowland Thai communities to push their areas of cultivation upslope, even when they encounter lands with slopes and other conditions that exceed the previous experience of their agricultural technologies and systems. Still further upslope movement is being seen where lowland farmers want to participate in attractive production opportunities in highland areas.

In terms of ***downslope movement***, beginning in the 1960's, His Majesty the King of Thailand led efforts to develop crop substitution programs for highland communities producing opium as part of their shifting cultivation agriculture. With trade limited by Cold War-era tensions among nation states of the region, opium crop substitution programs supported by a range of local, bilateral and international agencies began promoting the (politically induced) comparative advantage of highland opium production zones (generally near or above 1,000 m. elevation) for intensive production of temperate zone plant products for expanding markets within Thailand; they also tested various other crops, from arabica coffee to shitake mushrooms, as well as technology for post-harvest processing and marketing *(UNEP, 1988)*. Only after 20 years of testing and promoting alternative crops were opium eradication efforts added to further reduce opium production in North Thailand to its currently very low levels.

Promising outcomes with various crops, together with expansion of infrastructure, increasing land pressure, increased familiarity with commercial markets, and emergence of private sector markets for products such as cabbage, has helped drive significant growth in production of horticultural cash crops for commercial markets, through which many highland communities have accumulated significant amounts of capital. They are now using their capital to purchase vehicles and agricultural inputs, as well as additional lands (including paddy lands) in downslope communities. Unfortunately, not all of them pay as much attention to their environmental impact as the Royal Projects have suggested.

Convergence. Upslope and downslope movement have converged in what has been dubbed the "middle zone crisis" *(U.Tan-Kim-Yong, et.al., 1988)*, wherein ethnic groups such as the Karen and the Lua, and their relatively environmentally-friendly traditional subsistence-oriented rotational forest fallow agriculture, have been caught in a land squeeze between lowlanders seeking to push their largely field-crop-oriented commercial enterprises upslope, and more capitalized highland horticulturists moving downslope to buy paddy land and expand their horticultural enterprise. Since all of this occurs in a context where no one has official rights to cultivate any land, fallow fields of middle zone rotational swidden systems are primary targets for both competing communities and government forestry programs. Predictably, these processes have brought increased frequency and intensity of land use conflicts, both among local communities and between local communities and government agencies.

4) Forest resource management, watershed protection and environmentalism..

Reserved forest lands. More than 60 percent of the land in North Thailand is classified as reserved forest, including the vast majority of highland areas, although only 48 percent or less still retains healthy forest cover *(RFD, 1993)*. Recent decades have brought growing awareness among government agencies and private interests of the importance of these areas in producing two important products: wood and water. More recently, national parks, wildlife sanctuaries and protected watershed headland areas have also been expanded, thereby "upgrading" more areas to "protected forest" status, wherein access and land use are even more severely restricted than in economic production forest zones. The extent of these restrictions in North Thailand by 1992 are reflected in Table 1.

Table 1. **Forest Reserve Categories of Land in North Thailand, 1992**

% area	*Forest Reserve Status Category*
48.2	Protected forest *(parks, wildlife sanctuaries, watershed headlands)*
12.9	Economic production forest *(much subsequently transferred to land reform)*
01.1	Designated for land reform
37.8	Non-reserved *(all other private and public holdings)*

source: Royal Forest Department, 1993

Under more recent government policies *(MIDAS, 1993)*, parks and wildlife sanctuaries are being further expanded, largely by incorporating portions of protected watersheds, including various areas already heavily settled and cultivated by highland communities. At the same time, many of the economic production forest lands were turned over to the Office of Agricultural Land Reform to select areas where land use certificates or title could be issued to households occupying and cultivating significant portions of it. The vast majority of highland areas remain inside the protected area system, and only minority households with Thai citizenship could be considered for land reform program eligibility.

Although timber production was the primary objective of forest management in the North for most of the last century, its relative importance has declined rapidly during recent years. As natural teak forests. the best of which were located in lower reaches of various valleys, became depleted, the Royal Forest Department and the Forest Industry Organization sought to expand teak plantations, but their efforts have been dwarfed by the combination of legal and illicit harvest. The reorganization of the Royal Forest Department subsequent to the ending of commercial forestry concessions in late 1988 has changed the mandate of the RFD to emphasize forest conservation rather than forest production.

Watershed protection became an important aspect of forest management in North Thailand because of concern over potential effects on large reservoirs constructed to regulate flow of major tributaries of the Chao Phraya River, providing water control for Thailand's critically-important "rice bowl" production zone in the Central Plains region, as well as for the powerful Bangkok metropolis area. Fears that siltation would shorten the useful life of these reservoirs resulted in concern by government agencies that shifting cultivation practices in mountain watersheds posed a major soil erosion problem; little thought appears to have been given to the intervening effects of downstream rice paddies, or to the role of road construction. Early soil conservation programs for highland communities, such as the FAO project in Mae Sa, began emphasis on engineering approaches to soil erosion control through terracing, contour ditches, *etc.*, including use of heavy equipment to construct bench terraces. Effects of such programs, however, appear to have been neither widespread nor, with a few exceptions, lasting. More recent efforts by the Department of Land Development and a number of development projects have promoted biological soil conservation, such as contour hedgerows, vegetative strips and alley cropping.

Meanwhile, ***highland forest plantations*** were promoted by the RFD Watershed Management Division to both improve watersheds and provide commercial timber. These efforts, especially in the western half of the region, focused largely on monoculture pine plantations that were to feed future downstream pulp and perhaps other types of mills. Priority sites targeted areas "degraded by shifting cultivation", which was seen as a uniformly destructive form of land use, and in any event illegitimate since the fields had no official tenurial status and their "owners" usually did not have Thai citizenship. Proposals for dramatic further expansion of pine planting programs continued even long after they began to flounder as a result of low survival rates, poor growth rates and many "mysterious" fires.

Although environmental issues in North Thailand have long been the rationale used to establish and upgrade governmental units such as the Watershed Conservation Division, the policy impact of the growing and diverse ***environmental "lobby"*** has greatly increased during the last ten years. Two rather distinct lines of activity can now be distinguished that relate directly to highland areas in the North:

The first type, which emphasizes perhaps more ***"traditional" lines of conservation*** reasoning, underlies efforts conducted under the National Research Council and the Ministry of Science, Technology and Environment, to define and map a 5-category set of watershed classification zones that place restrictions on land use, depending on an area's physical characteristics and position within major watersheds. While the system has been applied to the entire country, its first target and by far the zone of its greatest impact is the North. The magnitude of its impact is demonstrated by the data presented in Table 2.

Table 2. Watershed Classification of Lands in North Thailand, 1992

class	*% area*	*criteria*	*allowable types of land use*
1	33.0	high elev, steep slopes, erosive	permanent forest only
2	15.1	high elev, steep slopes, less erosive	commercial forest plantations, mining, grazing
3	10.8	uplands, steep slopes, less erosive	commercial forest/fruit tree plantations, grazing
4	09.3	gentle slopes (<25%)	row crops, fruit trees, grazing
5	31.5	gently sloping to flat (0-25%)	agriculture w/few restrictions

source: Royal Forest Department, 1993

One result of this classification system, which has been approved at Cabinet level, has been to assure that the presence of many established mountain minority villages remains illegal, by including all class 1 and 2 watershed lands in the protected area system. This line of reasoning also underlies recent efforts to expand the area of national parks and wildlife sanctuaries in the region, which further strengthens the legal claim by the state to lands in target areas occupied by mountain minority communities.

The second line of reasoning, which might be termed a more ***"populist" approach to environmentalism***, rests on the proposition that a more effective and sustainable approach is to allow and facilitate local communities to help manage and protect the natural resources and environment around them. A classic

example of this type activity within government agency circles has been pilot efforts to develop and implement a community-based participatory land use planning methodology in highland watershed areas under the Sam Muen Highland Development Project, an approach developed through collaboration between RFD officers and Chiang Mai University *(S.Limchoowong and U.Oberhauser, 1995)*. This line of reasoning has also been taken to its extreme, however, by a few radical proponents who have called for virtually all reserved forest lands to just be turned over to local communities to manage.

5) Urbanization, Industrialization and Tourism.

Although overall rates of urbanization and industrial growth in North Thailand lag far behind those of the Bangkok metropolitan area and the Eastern Seaboard, change is evident in the region. Urbanization has tended to redistribute population toward major centers, particularly Chiang Mai and Chiang Rai, and other smaller "hot spot" areas where economic boom occurs for one reason or another. Urbanization is even beginning to occur in certain highland areas, especially where commercial production is flourishing *(K.Rerkasem, et.al., 1994)*. Industrialization, in terms of the industrial estate-type of development that is most commonly referenced by this term, has been more limited to areas such as Lamphun province, but many provinces are actively seeking to promote additional areas.

To be more accurate, however, industrialization in the North must include both tourism and crafts industries. With access for Westerners denied in neighboring countries during the Cold War era, and with the exotic lure of the Golden Triangle and the opium trade, the region's array of "colorful" minority groups, and stories of the Indochina War, the tourist industry in Northern Thailand began to boom. As it grew, "hilltribe" dances, mountain "jungle treks" and river rafting were added, as well as illegal opium smoking expeditions. The industry subsequently diversified further with attractions such as elephant shows and orchid and butterfly farms, and extended its reach through both very simple and well-equipped tourist resorts (now including golf courses) at ever more distant locations. Major centers and larger resorts are becoming venues on the international convention circuit. Air traffic into Chiang Mai alone includes more than 10 flights per day, and a growing number of direct international flights.

Another of the North's tourist attractions has long been the wide range of its traditional crafts. The tourist boom stimulated revival, upgrading, adaptation and expansion of craft production, which has now grown to include production for buyers from a number of countries contracting for large quantities for direct export. As interest grew among foreigners in the "exotic hilltribes", missionaries initially helped various minority groups add their wares to the range of handicrafts being revived in established centers such as Chiang Mai, and to adjust their production to meet Western needs and tastes. These markets now also pull in crafts produced by communities in neighboring countries.

6) Adaptations in Land Use, Society and Culture.

Despite the images sometimes conveyed by "authorities" on mountain minority groups, change is not entirely new to highland communities. Many have moved and adapted to new and changing conditions repeatedly during the last century. And of these, we are now beginning to see that some of the same ethnic groups that also reside in other countries of the region have developed quite different approaches to their livelihoods and land use patterns. Even among those who have resided in remote valleys of North Thailand for more than a century, it would seem presumptuous to assume that they have never had to adapt to changing conditions. Indeed, recent research indicates that even long-resident middle zone communities are developing a range of strategies for adapting and responding to increased land pressure, commercialization and conflict.

It is of potential interest to agroforestry to note that two apparent outcomes of the increasingly intensive competition for untenured land use in the highlands include: 1) as ethnic communities become more engaged in commercial production, the differences in their cultural backgrounds appear to be of less importance in influencing their behavioral responses; and, 2) traditional land-extensive forms of shifting cultivation are rapidly being converted to more permanent forms of agriculture *(K.Rerkasem, et.al., 1994; K.Rerkasem and B.Rerkasem, 1994)*. Moreover, the commercialization of agriculture and expansion of tourist and craft industries have also begun to attract members of highland communities to

migrate to urban centers, and encouraged young people to begin taking more advantage of growing access to educational opportunities provided by Thai society. Indeed, the number and sophistication of ethnic minority vendors marketing agricultural products and crafts directly in urban centers and tourist areas continues to grow, and companies are appearing that include the names of the ethnic groups involved. A growing number of minority youth who have obtained relatively high levels of education in the Thai system and are now residing in urban areas and are reluctant to return home. A new program of CMU's Social Research Institute hopes to help them become cultural "brokers" who can help highland communities in coping with the pressures for accelerated change that are expected in the near future.

On the dark side of the transitions in progress, highland communities are now also the targets of heroin dealers and prostitute procurement. While traditional opium consumption within highland communities was relatively manageable, the shift to heroin has begun to cause significant problems. And as heroin usage starts shifting from smoking to injection, it joins with prostitution to form a channel extremely conducive for the transmission of the AIDS virus, which has already reached frightening levels of infection in North Thailand and is spreading through minority groups to Burma and China.

The effects of these processes on the social institutions and culture of highland communities are still relatively poorly understood by both lowland Thai society and the larger world community.

II. Future Roles of the Highlands

Given the complex set of factors influencing both actual land use in the region and perceptions among stakeholders of what visions are most desirable for the future, the region finds itself caught in a classic tension between environment and development. Thus, we can recast the roles of the highlands in the future of Thailand into two generic categories: protective and productive. Some of the major issues in each category that may be of particular importance for agroforestry in the highlands include:

1) Protective Functions

Watershed services

These are widely believed to be the most important environmental functions provided by the mountains of North Thailand, where all the major tributaries of the Chao Phraya river system originate. Although there is still controversy over relationships between forests and water yields, soil erosion and sedimentation control in Thailand *(TDRI, 1995)*, it is clear that perceptions of the importance of forests and tree cover in maintaining the quantity, timing and quality of downstream water flow, as well as their role in preventing siltation of downstream irrigation and electrical generation facilities, will continue to be a major justification for efforts to maintain forest and tree cover and impose a variety of constraints on land use by local populations in the mountains of North Thailand. The magnitude of the constraints implied by the government-approved watershed classification scheme (Table 2) are one clear indicator.

Biodiversity and Carbon Stocks

Additional important protective functions that can be expected to continue to be issues affecting land use in the highlands of North Thailand include maintenance of biodiversity stocks and carbon stocks. Benefits from both of these functions are usually believed to be maximized through preservation of natural forest ecosystems, which is commonly associated with the virtual exclusion of human use, especially those requiring major changes in vegetative structure. National parks and wildlife sanctuaries are clear examples of designated reserves where preservation of biodiversity is the primary management objective, although parks tolerate some human impact in return for recreational and educational values.

Esthetics and Intangible Values

While still a rather vague notion in Thailand, there is a growing sentiment especially among people in politically and economically powerful urban industrial areas, that society should invest in protecting and preserving esthetics and intangible values associated with natural landscapes in highland

areas. As we have already seen in other countries, this notion can exceed the pragmatic calculations of value for the tourist and recreation industries as urban environmental movements begin to push for protection of areas and ecosystems that they will never even visit themselves.

Distribution of Benefits from Protective Functions. The major justification for protection of watershed services is the perception of benefits derived by major downstream agricultural production zones and urban-industrial areas. Justification for protecting biodiversity is usually based on needs to maintain genetic stocks that may become valuable resources in the future, as well as on the more vague need to maintain the "balance of nature", whereas justification for maintaining or increasing carbon stocks relate to the need to compensate for processes that appear responsible for significant global warming. In short, relatively few of the major benefits believed to be associated with these protective functions are thought to accrue directly to local communities residing in the mountains, other than to the extent that they are members of larger society and the global community.

2) Productive Functions

Agricultural production.

Current estimates are that just under one million people now live within mountain zones of North Thailand, and their numbers continue to grow faster than lowland society. Agriculture has been, and continues to be, their primary livelihood, but growth of supplementary and alternative occupations, especially those related to tourism and crafts, is also rapid. As infrastructure is pushed further into formerly inaccessible areas, and land pressure and expectations rise, commercial trends in highland agriculture can be expected to continue. At the same time, as alternative uses outbid agriculture for land near rapidly developing urban industrial centers in major valleys, lowland agriculture will likely continue to push its commercial field crop and horticultural production industries up the slopes of major watersheds. Thus, the pressure to expand and further develop commercial agricultural production in the highlands can be expected to continue for at least a considerable number of years.

The nature of commercial agriculture in the highlands, however, can be expected to undergo considerable transition as new transportation systems and international trade agreements remove the artificial barriers that have provided the North Thailand highlands with a comparative advantage in production of temperate zone fruits and vegetables for the Thai market. As temperate zone horticultural products beginning to appear in North Thailand markets indicate, high-quality temperate products from China can be sold for substantially cheaper prices. At the same time, however, North Thailand is about to find itself with a new locational comparative advantage as the region closest to the rapidly growing and potentially enormous Chinese market for sub-tropical and tropical products. Whether this locational advantage will outweigh comparative ecological advantages of production areas further south, however, remains to be seen. It also remains to be seen how rapidly and how far agro-industrial processing will develop in Thailand, and whether highland agriculture can compete in producing horticultural or other feedstocks for agro-industry. As market forces in the region shift, it will take considerable research and entrepreneurial effort for highland agricultural production to find its new comparative advantage niche.

Forest products

Products from the forest have been and remain an important source of income for the highlands. Even if we assume enforcement of the watershed classification system, about 25 percent of the region is covered by class 2 and 3 lands, in which commercial timber production is possible. Questions about how such production might be organized, and whether smallholders and/or local communities might be able to share in its management and benefits, however, remain unclear.

But timber is not the only type of forest product that is potentially important for the highlands. A wide range of non-timber forest products are already harvested in North Thailand, from specialty foods to medicinals to industrial feedstocks, at various intensities and levels of sustainability. Although this is also an area of possible growth as market linkages expand with China and other export markets, relatively little appears to be known in Thailand regarding their market potential.

Tourism and Crafts

While North Thailand can expect its long-established and thriving tourism and crafts industries to continue to play a major role in the regional economy, they too may be strongly affected by changing conditions. As Laos, Myanmar, Vietnam and Southwest China open up to tourism, an increasingly modern North Thailand may lose some of its comparative advantage among tourists seeking exotic, undeveloped locations. Various scenarios might result: North Thailand might, at least for a while, be an entry and exit point for a tourist "circuit" of remote sites in neighboring countries. Or, it might play on its modern facilities in focusing on less adventuresome tourists and expanding its convention center function, with short side trips to remote areas for participants. Moreover, North Thailand's highly developed crafts industry might be able to help it continue to be a crafts production center, perhaps with even greater emphasis on export and marketing in overseas markets. In any event, tourism as it has existed in the highlands during the last decade cannot be taken for granted during the coming decades.

III. Agroforestry Systems for the Highlands

Although agroforestry systems have been classified in many different ways, there are only two functionally different types, simultaneous and sequential *(P.Sanchez, 1995)*. At least for clarity in understanding the case of North Thailand, each type can be further classified according to two sub-categories based on the land management unit employed: field-based and landscape-based systems.

1) Sequential Systems:

In these systems maximum growth rates of the crop and the tree components occur at different times, even though both components may have been planted at the same time and are in close proximity. Interactions between crop and the tree components are minimized with time in sequential agroforestry. Some of the major types of sequential systems relevant to the highlands in North Thailand include:

a) Field-Based Sequential Systems

In these systems, the boundary of the land management unit site is the cultivated field, and all off-site activities are considered to be external to the system itself. Two examples of these systems are:

Ephemeral (pioneer) swidden systems

The traditional "pioneer" form of shifting cultivation, commonly associate with various more ridge-dwelling highland communities, is characterized by the cutting and burning of fields in mature forest, which are repeatedly cropped for a number of years. As upland rice, corn or (formerly) opium productivity drops due to weed infestation, reduced soil fertility and/or pest and disease problems, fields are abandoned to natural forest regeneration; after desirable sites in an area are exhausted, the village moves to a new mature forest location. This can be considered a form of sequential agroforestry, where the forest fallow is extremely long and the subsequent cultivators may not even be known to previous ones. This is not management at the landscape level, however, because little or nothing is done to encourage regeneration and the very long fallow is left without any form of management or protection.

As the term "pioneer" implies, this type of system is adapted to conditions wherein a small population is able to move freely and cultivate small fields within a vast forest area. As these conditions no longer apply in North Thailand, this system has now virtually ceased to exist in its classic form. Attempts to employ these concepts now invite conflict, since most remaining mature forest is protected by, or targeted for, national park or wildlife sanctuary status, and/or is protected by local communities as part of broader landscape systems of agroforestry management *(see below)*.

Relay and transitional intercropping systems

Beyond simply abandoning crop fields to natural forest regeneration processes, sequential agroforestry systems can include a variety of forms that are dynamic over time. Some forms and

structures may even begin to mimic stages of natural forest succession, including ephemeral forms that help achieve useful products or services during the transition to longer-term mature forms. Two examples may help clarify how such concepts might be useful in developing alternative approaches for a transition from shifting agriculture to permanent agroforestry in the highlands:

Taungya. One of the most long-standing and frequently cited examples of agroforestry, the taungya system originally developed in Burma, is actually a relay intercropping system used to help establish forest plantations. Its most common early, and even fairly recent, use was to provide subsistence crops for workers in forest plantations. In this system, food crops were intercropped between tree rows (or as Grandstaff *(1980)* discusses, trees are intercropped in swidden fields), until closure of the forest tree canopy prevents further cropping. Since the trees are usually on a very long rotation, sustainability of this approach depends on availability of opportunities for workers to harvest and plant another area, where they can begin a new cropping cycle. Although there are indications that young trees may actually benefit from weed control and soil fertility management of interplanted food crops, it is still a fairly new idea to share benefits from tree crops (usually timber) with crop cultivators, rather than limit their share to employment as wage laborers during thinning or harvest.

Relay contour strips. A variation on this theme was presented recently by Sawatdee Boonchee of the Land Development Department, in his description of a highland system where farmers established contour vegetative strips that included fruit trees in their fields. Once the trees began to mature and develop more canopy, contour strips became less necessary and even inconvenient. One of the lessons they learned from this experience was that, under some conditions, one desirable characteristic of a species used for contour vegetative strips may be the ease of its removal when it is no longer necessary.

b) Landscape-Based Sequential Systems

In these systems, the boundary of the management unit is drawn around a larger landscape unit than an individual field. While the determination of an appropriate landscape unit will depend on local conditions, its scale would generally not be expected to exceed the lands directly influenced by one, or not more than a few, villages.

Rotational forest fallow swidden systems

This type of system underscores the fact that agroforestry is not new to this region. Indeed, traditional middle-zone rotational swidden systems, such as those associated with the Karen and Lua, are classic examples of this type of sequential agroforestry. Under this system, fields of secondary forest are cut, burned, and cropped with upland rice and other crops for one or two years, after which natural secondary forest is allowed to regenerate for 7 to 20 years before the process is systematically repeated. Examples of management practices employed by these systems to assure rapid regeneration have included indigenous erosion control measures, minimum tillage, retention of pollarded seed trees of forest species in cleared fields and maintenance of natural upslope vegetation *(T.Grandstaff, 1976)*. While individual fields may be managed by households, this is usually done within a framework set at the community level, which can mobilize labor, enforce local rules (*e.g.*, control of fire and grazing), or even re-allocate fields among households, as required. Community organization is also responsible, for example, for weirs and irrigation canals for small areas of paddy land that are also commonly present. Moreover, these systems also include elements of community-level management of various components of the landscape other than individual crop fields, such as "cemetery forests" or protected forest areas where spirits associated with springs and water sources are located *(A.Ganjanapan, 1995)*.

Although this form of agroforestry has not yet ceased to exist in North Thailand, it is now very rare to find in its full traditional form. As land pressure from sources discussed above push systems into supporting more people with less land area, communities are forced into shortened forest fallow periods, that in the extreme have reduced fallow vegetation to grass and bamboo. Reduced productivity in these degenerating systems appears to be primarily associated with reduced accumulations of nutrients in fallow biomass, increased weed competition with crops, and perhaps increased difficulty with crop pests and diseases. Even traditionally protected forest areas in their landscape are being threatened and

damaged by other communities and groups, particularly those looking for swidden sites in mature forest. The overall reduction in forest cover, increased conflict and the fears of adverse downstream effects, such as reduced dry season stream flow and increased siltation of reservoirs, have increased calls for restricting shifting cultivation and even resettling communities out of the highlands. This situation, together with the attractive features of cash cropping, has set the stage for farmers in many communities under severe pressure to begin making the transition to permanent field cropping.

Improved rotational fallow systems

Despite this situation, conditions in some areas (*e.g.*, where road access is still difficult and land pressure is not yet too severe) may still be more conducive for the development of at least transitional system improvements based on sequential rotational forest fallow concepts. For example, in addition to better soil conservation measures, such improvements might include enrichment plantings or even more intensive management of forest fallows to improve their ability to more quickly replenish soil fertility and structure and suppress weeds and diseases when long forest fallows are no longer possible. Indeed, as management of fallows becomes more intensive, at some point this system transforms itself from a fallow system into a crop rotation system. Community-level management can still play an important role in re-allocating land and implementing improvements (*e.g.* contiguous contour strips) and regulations (*e.g.*, control of fire and grazing), although maintenance of untenured community-protected natural forest against encroaching outsiders will likely continue to be a difficult problem.

2) Simultaneous Systems

These are systems where the tree and crop components grow at the same time and in close enough proximity for interactions to occur. Major categories based on management units include:

a) Field-Based Simultaneous Systems

As with sequential systems, field-based system boundaries are at the edge of the cultivated field, and all off-site activities are external to the system itself. Two examples of these systems are:

Field-based strip systems:

These are the types of systems most commonly associated with the term "agroforestry", including such well-known examples as alley cropping, contour hedgerows, boundary plantings, and live fences. When used on sloping lands, contour strips are used to reduce erosion and increase water infiltration. Competition between trees and crops near strip interfaces is a major on-site issue associated with productivity and profitability of these systems. Competition can occur below-ground for water and nutrients, as well as above-ground for light. Dynamics of the effects on weeds, pests and below-ground biodiversity are also topics of current research. How to maximize complementarities and minimize competition are major challenges in designing this type of system. Contour strips face additional on-site issues, such as loss of fertility due to "scouring" effects, whereby topsoil moves from upslope portions to accumulate behind the vegetative strip *(D.Garrity and M.van Noordwijk, 1995)*; boundary issues, such as accelerated erosion that can occur at edges of a field where strips are not coordinated to be contiguous with similar strips in neighboring fields *(F.Turkelboom, et.al., 1995)*; as well as issues related to off-site activities, as in other field-based systems, such as uncontrolled fire or grazing.

Field-based mixed systems:

These are more complex field plantings that utilize complementary ecological niches for different types of plants. Examples include home gardens, complex agroforests (such as "jungle rubber" in Indonesia), or silvopastural systems. In their extreme forms, these systems begin to mimic the structure of complex mature natural tropical ecosystems, but they are composed almost entirely of plants that are useful to the human managers of the system. A considerable range of these systems have been observed in Southeast Asia, but their complex dynamics (*e.g.*, competition, weed and pest control) have been the subject of relatively little research or extension activity. While commonly associated with

subsistence production, there are many examples of systems producing marketable outputs. Although productivity per unit area for a particular product may appear low, productivity is more appropriately evaluated in terms of total value of system output. Like other field-based systems, their viability can be affected by a variety of local but off-site factors, such as uncontrolled fire or grazing, *etc.*

b) Landscape-Based Simultaneous Systems

Although landscape unit scale could vary according to circumstances, this type of simultaneous system incorporates individual fields as components of a broader landscape management system, and moves beyond individual households to include management functions at a community level. The following initial example within this category is developed from observations regarding land use management in sequential rotational forest fallow systems *(see above),* combined with relatively recent experience from pilot watershed development efforts such as the Sam Muen Highland Development Project *(S.Limchoowong and U.Oberhauser, 1995).*

Community watershed mosaic systems

In this type of system, the boundary is drawn around the perimeter of a small highland sub-catchment. The landscape within the system is then categorized, in a manner somewhat analogous to the government's watershed classification system, into a mosaic of areas zoned for various types of land use, which may include appropriate simultaneous combinations of protected natural forest, managed natural forest, field-based agroforestry, boundary plantings, annual crops, paddies (where possible), *etc.* Zones for field agroforestry, annual crops and paddies can be managed by individual households, subject to necessary conditions imposed by the community (*e.g.*, coordination of contour strips, fire or grazing control), while protected and managed natural forest areas and any irrigation facilities are managed through multi-household or village level arrangements. Inter-village relations can be managed through a watershed management network, which may be authorized by the local sub-district (*tambon*) council. This qualifies as an agroforestry system because the landscape unit includes forest, tree and crop components which interact, for example, through on-site watershed functions, control of fire and grazing, allocation of investments and benefits at household and community levels, and perhaps through nutrient concentration and cycling, weed and pest dynamics and/or other ways that we do not yet even understand. Indeed, it has already even been proposed that tenurial arrangements for such systems in the highlands should be made in terms of land use rights at the community level that are conditional on maintenance of the landscape management system.

IV. Potential Contributions of Agroforestry Toward Sustainability, Productivity, Stability and Equity

Organizers of this discussion forum have asked how agroforestry can contribute to the goals of increased sustainability, productivity, stability and equity in the highlands. Given the dynamics and tensions that are of critical importance in North Thailand, the following discussion examines these issues according to six themes related to protective and productive roles of the highlands:

1) Watershed Regulation.

If the primary objectives of land use regulations are to insure that watershed functions of an area remain stable and sustainable, agroforestry may be able to play a significant role. Much depends, however, on the nature of the agroforestry systems established, and on the realistic expectations of the alternative land use systems that would otherwise exist. For example:

- Where natural evergreen forest is the major alternative, agroforests may well consume less water, but may provide less soil stability on very steep slopes; where slopes are less steep or even-aged monocultured evergreen forests are the contemplated alternative, the difference may be negligible.

- If alternative vegetation is deciduous forest, agroforests may use more water, depending on species and the amount and type of any dry season agroforest irrigation. Differences in soil retention may be variable, depending on the amount of fire, grazing and degradation in the deciduous forest.
- When year-round intensive irrigated vegetable crop production is the most likely alternative, agroforestry has potential for reducing both water use and soil loss.
- Relative to lands under imperata or other aggressive grasses, agroforests may consume more water and offer relatively little improvement in soil stability, except where deep-rooted trees can protect against landslides, but both forestry and agricultural production gains would be lost under grass.

Infiltration. Effects of agroforestry systems on water infiltration rates may vary according to the species and cultivation practices involved, relative to alternative use. Since primary issues are maintenance of soil structure and slowing runoff, where agroforestry increases perennials, permanent cover and/or contour strip plantings, infiltration is likely to be increased.

Erosion. Coordinated field contour strips, complex agroforests and community watershed mosaics all appear to offer substantially more protection against soil erosion than many of the degraded swidden and semi-permanent fields found today in the highlands. Even in terms of commercial forest plantations that are in principle allowed in class 2 watershed zones, if they are even-aged monocultures of forest species, it is at least questionable whether protection offered by well-implemented agroforestry systems would not be just as effective, or better. In class 1 watersheds, especially in the "1B" zones where small high elevation valleys are already "disturbed", it might be appropriate to ask whether in many situations we can realistically expect that permanent natural forest can be effectively re-established. In these and many other small sub-catchment areas, landscape management through community watershed mosaic agroforestry may well be the most effective alternative.

Pollution. In addition to sediment load, other major watershed issues related to water quality are levels of pesticides, soluble fertilizers and b.o.d., although the latter two have not yet entered public debate. While chemical substances are associated with agricultural production, including components of some agroforestry systems, danger to downstream areas should be manageable though proper and judicious application, and research and development on cultivation practices that minimize their use.

2) Nutrient Capture and Retention.

The role of agroforestry systems in increasing productivity and sustainability through nutrient cycling has been one of the key justifications for promoting its use, especially in preference to degraded shifting cultivation and annual crop monocultures. Key elements of agroforestry systems that can provide distinct advantages under some conditions include:

- addition of nitrogen into the system through incorporation of nitrogen-fixing species and deep capture of various nutrients by tree roots, which are delivered to other crops in the system through leaf fall, prunings, *etc.*
- increased on-site retention of nutrients through reduction of soil erosion
- decreased losses of nutrients by leaching, through their incorporation into increased on-site biomass and their subsequent slow release through processes of decomposition.

The degree to which these processes are sufficient to increase productivity and maintain the sustainability of agroforestry systems depend on two key factors:

*i) **The initial levels of nutrients in the system*** will help determine the limits of system productivity per unit of land area. When initial levels are low, as appears to be the case in many degraded swidden systems, integration of nitrogen-fixing plant components may help re-establish reasonable levels of nitrogen. For phosphorous and other nutrients, the only intra-system process for increasing nutrient stocks would be through deep capture of additional nutrients by deep-rooted trees -- if the nutrients are present and available in the sub-soil. In virtually all other cases, however, productivity will be limited without input of nutrients from outside the system. The key question, then, is whether productivity

levels are sufficient without additional inputs, which is largely an economic question of whether returns per unit of land, labor and/or capital are greater than their opportunity costs. Where productivity is too low, nutrients can be added through nutrient-rich organic materials, such as manure, compost, mulch or crop residues; through natural inorganic substances, such as rock phosphate; and/or through commercial fertilizers. Addition of nutrients from an appropriate combination of these sources, up to the level of the system's ability to retain them against losses from leaching, erosion and surface run-off, can be viewed as a "capitalization" of the agroforestry system that can pay for itself through increased productivity.

ii) The level of nutrients that are exported from the system will be a loss that the system will obviously be unable to retain. The extent to which nutrients in exported plant materials can be re-cycled back into the system through compost, manure, *etc.* can help limit net losses, but those lost through marketing of agroforestry products have little chance of returning to the system. Since there is no "free lunch" when it comes to nutrient budgets, when export losses exceed inputs, sustainability will be unachievable. In such situations, debate over whether to use organic materials or commercial fertilizers may often be counter-productive. In many cases, the optimal approach may be to mix organic materials, natural inorganic substances and judicious amounts of commercial fertilizer, thereby raising or maintaining the nutrient levels of the system, while simultaneously enhancing the system's ability to retain nutrients.

One of the interesting aspects of a landscape-based agroforestry approach is that the above discussion applies to both individual component elements of the system, as well as to the overall system. Thus, interaction among components of the system can include flows of nutrients and organic matter within the system boundary, for example by concentrating nutrients in particular component fields. This does not, however, eliminate the need to consider nutrient stocks and budgets required to maintain the function and productivity of each component.

3) Biodiversity

Reducing biodiversity losses. Perhaps the most important biodiversity-related hypothesis of proponents of agroforestry is its potential role in enhancing long-term sustainability by preventing further losses of biodiversity. This hypothesis is based on the assumption that relatively intensive agroforestry systems will allow households and communities to meet their production needs with less land area, and that remaining land will then be maintained in, or returned to, natural forest ecosystems in which biodiversity tends to be maximized. In the highlands of North Thailand, different agroforestry approaches would appear to have different potentials for verifying or rejecting this hypothesis:

i) With a ***field-based*** agroforestry approach, the fate of land not used directly for agroforestry is external to the system. What we have seen in some areas where agroforestry systems appear to be successful, especially in terms of commercial production, is a "magnet effect" that both encourages expansion by local farmers and attracts further migration into the area by others wishing to participate. The preventive role of agroforestry in enhancing biodiversity is of questionable value in such situations.

ii) A ***landscape-based*** community watershed mosaic approach to agroforestry, on the other hand, incorporates areas for natural forest ecosystems into the system boundaries. Since local communities share management responsibility for both elements of the landscape (and security of their tenure could even be made dependent on their doing so), there appears to be a greater probability of success -- if the government will assist communities in enforcing their authority against outside encroachers.

Domestication of threatened species. A second prevention-related role of agroforestry in maintaining biodiversity relates to the potential of the system to incorporate domestication into its approach. Where high-value native species are being depleted through excessive harvest in natural forests, there may be significant potential for them to be propagated and integrated as domesticated components of agroforestry systems. As such species become more difficult to find and harvest in natural forests, especially when increased demand is associated with rising urban incomes and/or new export markets, enforcement of forest use regulations could combine with forces of economic scarcity to make this approach even more attractive.

Agro-diversity. Another biodiversity-related aspect of agroforestry systems relates to their complexity, relative to other forms of agriculture. While most focus of biodiversity discussions is on natural ecosystems, it is still important to understand and monitor agro-diversity within human-structured agroecosystems. Although agroforestry systems can be quite simple, with as few as two plant species, the spectrum of agroforestry systems also extends to highly species-rich systems, such as homegardens and "jungle rubber", that functionally mimic complex natural tropical forest ecosystems. Such systems appear to have been successful under various circumstances, including where a range of products are desired for subsistence, for spreading seasonal labor demands, or for buffering effects of market fluctuations in specific commodities. Various more complex systems remain relatively poorly understood by researchers and development agencies looking for one or a few "magic bullet" solutions to agricultural development problems. A few examples of many aspects that are still poorly understood would include: i) trade-offs and/or complementarities between increased complexity and the ability to control weeds, pests and diseases of agricultural crops; ii) variations in below-ground biodiversity and how it affects nutrient availability, plant pests and diseases, release of greenhouse gases, *etc.*; iii) "edge effects" on wildlife (and pest) populations at the interfaces of strips or mosaic elements.

4) Carbon Sequestration

Preventing release of carbon. Since this relates to processes inducing global warming, the issues involved relate to long-term sustainability at a global, as well as a local level. It is widely believed that the greatest amount of carbon that can be sequestered in an area will be manifest in the climax vegetation native to the area. Thus, perhaps the most important role that agroforestry can play in reducing carbon-based gases in the atmosphere will, like biodiversity, depend on the validity of the "prevention hypothesis". The potential of different types of agroforestry systems to confirm this hypothesis would be the same as those discussed above for biodiversity.

Enhancing carbon stocks. Also as with biodiversity, the potential role of agroforestry in increasing the amount of carbon that is sequestered in areas where natural forest is not likely to have an opportunity to regenerate, will depend on its ability to lock up atmospheric carbon, relative to alternative forms of land use. Since agroforestry emphasizes integration of trees and perennial plants, it is probably not unreasonable to assume that it would be relatively more effective than annual crops, although the significance of the difference remains an empirical question. Another poorly understood factor is the effect of various agroforestry systems on greenhouse gas-releasing processes in the soil.

5) Household Incomes

The dynamics of the highlands during this period make this is a difficult issue to deal with, especially in terms of sustainability, because: *i)* both subsistence and cash income (from a range of sources), and interactions among them, must be considered; *ii)* population levels are still increasing; and, *iii)* rising expectations imply that rising incomes will be a necessary component of sustainability, thereby making it a "moving target". Nevertheless, agroforestry seeks to increase and stabilize incomes.

Increased income levels. In terms of the prospects for agroforestry offering improved levels of income for those able invest in them, one significant step has been increased enforcement of laws against production of opium poppy, which was lucrative enough to outbid most other commercial crops in a free market situation. However, agroforestry must still be able to outbid the net benefit flow from alternative forms of agriculture, including monocropped vegetables. Moreover, farmgate prices of some species that are currently important components of various highland agroforestry systems, such a temperate zone fruit trees, may face serious fluctuations in the not too distant future, while some of the sub-tropical fruits, such as longan, are notorious for their alternate bearing characteristics.

Improved income stability. Thus, for many commercially-oriented agroforestry systems, stability may be a key element for helping to increase incomes over the longer term. Indeed, an important aspect of attempts to increase income is the avoidance of over-accumulation of debt. This is particularly important for households who have no land title to use for collateral, and are thus often forced to borrow money for investments to improve production on the high-interest informal market.

More complex agroforestry systems can help stabilize household incomes in an environment of fluctuating individual commodity prices, by providing a mix of commercial, or subsistence and commercial products. This can help the many households with rather small capital endowments to even-out their cash flow, help buffer impacts of market fluctuations, and improve options for barter transactions with other communities when cash is scarce. This approach also appears to fit rather well with the complex livelihood patterns that are already traditional in most highland households and communities *(K.Rerkasem and B.Rerkasem, 1995)*. Indeed, an interesting potential aspect of agroforestry that does not yet appear to have been explored to any significant extent is its potential for integration with other supplemental sources of income, such as various types of crafts industries.

6) Equity

Technologies are seldom completely neutral in socioeconomic terms, and agroforestry is unlikely to be an exception. Thus, there are likely to be important equity issues related to which types of systems are accepted by which types of households and communities, as well as to how equity is locally defined, since it implies a certain acceptable or desirable degree of "fairness" rather than equality *per se*. While research indicates that behavioral responses are increasingly similar among various communities and ethnic groups *(K.Rerkasem, et.al., 1994)*, research already indicates that there are differentials among households within communities *(C.Thong-Ngam, et.al., 1995)*. Although agroforestry cannot be seen as a panacea for addressing all the equity issues of the highlands, its proponents need to understand how proposed innovations may affect equity at several levels of the systems hierarchy:

Intra-household level. At this level, particular attention needs to be given to equity among different age and gender components of the household. This is largely an issue of the distribution of costs and benefits, and needs to be evaluated according to the particular components of the agroforestry system and other household enterprise.

Inter-household level. Differences among households within a community relate to their resource endowments (land and capital), the stage of their life cycle (and thus the type and magnitude of their labor and consumption forces), and their managerial and entrepreneurial skills (related to knowledge, education and experience). If we are willing to assume that local community institutions help assure relatively equitable resource allocation within the community, then an interesting aspect of landscape-based community watershed mosaic agroforestry is the option of continuing to use local community-level institutions and social processes for resource allocation (and re-allocation as necessary), regulation and enforcement -- through the use of community-level tenurial arrangements.

Inter-community level. Other than ethno-cultural differences, some obvious differences among communities relate to access. There is little that agroforestry itself can do to improve distribution of access to roads, markets, credit, information and education, all of which can affect the likelihood of adoption, the viability, and the degree of economic success of agroforestry systems. Agroforesters can help promote equity, however, by understanding influences of such factors, by developing a range of alternatives for communities and households in different circumstances, and by providing policy makers with information that will help them understand likely effects of decisions related to infrastructure and government services, as well as of policies influencing markets and the private business sector.

Highland-lowland level. Discussions of equity in the highlands frequently focus on the need to give more consideration to local communities. This is understandable, since their needs are often the last to receive attention. Moreover, most justification of constraints government and lowlanders want to place on highland land use is based on the value of benefits that lowland society believes it will receive. While needs of local communities are clearly important, needs of the larger society and of future generations cannot be ignored. Agroforestry seeks to develop systems that help achieve the major aims of both highland and lowland communities.

Livelihood transitions. Discussion of push and pull factors inducing livelihood transitions in the highlands inevitably brings up some complex issues related to equity. An explicit objective of agroforestry development is to reduce rural poverty by increasing productive opportunities that are both sustainable and equitable. Yet, we need to also be aware that, in addition to perceived attractions of

opportunities in urban areas, especially among younger people, projections of at least one recent study indicate some households can be expected to fail in their agricultural enterprise during the transition underway in the highlands, and will probably withdraw to other enterprise or employment, perhaps in urban areas *(C.Thong-Ngam, et.al., 1995)*. While many research and development workers cite these as important problems to be solved, it may also be useful to examine the underlying assumptions. Surely everything possible should be done to develop agroforestry opportunities that are accessible by these groups of people. But given population growth rates, resource scarcity, and growing conflict in the highlands, and growing economic opportunity in the lowlands, should we assume that all movement to urban, commercial, or industrial environments is necessarily bad and to be avoided? What are the opinions of the people involved? Would it be unreasonable to ask questions such as: *i)* how can society help equip people who want to enter such environments with the knowledge and skills that would allow them to do so with dignity and increased probabilities of success? *ii)* how can attitudes and prejudices of lowland society be improved so that mountain people can be accepted as colleagues and fellow citizens, rather than as "objects" of welfare and social engineering programs? The answers to questions such as these could at least indirectly affect how we seek to design, promote and evaluate agroforestry systems.

V. Conditions Facilitating or Limiting the Use of Agroforestry Systems

Analysis of current trends in land use patterns and practices, and experience with development of various types of agroforestry systems and their components has already begun to indicate the importance of several conditions that facilitate or limit adoption and use of agroforestry in the highlands. As many of these conditions are the subject of more in-depth, specialized discussions elsewhere, this section offers only a very brief listing to stimulate further discussion:

1) Land Pressure. Increasing land use pressure in the highlands, driven by factors outlined in section I, and as manifest by increasing labor to land ratios, is already facilitating change in land use patterns and cultivation practices associated with agroforestry *(F. Turkelboom, et.al., 1995; K. Rerkasem, et.al., 1994; M.Ekasingh, et.al. 1995)*. More intensive, less land-consuming, simultaneous sytems appear to be encouraged by increased competition for and conflict over land resources; planted trees appear to be important in establishing claim to untenured lands; and, contour plantings are apparently established to decrease risk of eviction from untenured lands. Where claim is well established and options for new fields are few or none, perception of negative effects of on-site erosion increases interest in contour strips. Community watershed mosaic agroforestry appears to be able to attract local interest fairly quickly in areas where land pressure is high, traditional swidden systems are degraded, and inter-household and even inter-village tension over competition for resources is increasing.

2) Resource Base Characteristics. Characteristics of the local natural resource base, including both its inherent capacity for agroforestry production and its current condition, can facilitate or constrain development of agroforestry systems. For example, relatively high soil fertility and low weed infestation make system establishment easier and cheaper, and together with availability of water for irrigation, can result in relatively high productivity with low levels of purchased inputs, as well as in minimal losses associated with competition in simultaneous agroforestry systems. Another type of resource characteristic that can facilitate development of agroforestry is availability of land for paddy development, so that subsistence rice can be produced more intensively, thereby allowing upland fields to be used for other purposes *(C. Thong-Ngam, et.al., 1995)*

3) Access and Mobility. Access to roads, markets, inputs, capital/credit, information and education can greatly facilitate development of commercially-oriented agroforestry systems, but can also help increase opportunity costs associated with less sustainable forms of commercial agriculture, as well as the opportunity cost of labor associated with work outside the local area.

4) Commercialization. Current levels of commercialization and returns to current types of agricultural and/or other enterprise help determine opportunity costs of agroforestry innovations and system establishment. Where interest in commercial enterprise is high, the market potential of particular agroforestry components, as well as commercial returns to the overall system, will likely be central issues in determining selection of component crops and acceptability of the overall system. Strong commercial orientation will also influence the general direction of future system development and adaptation. Thus, for example, if market uncertainty increases for components such as temperate fruit trees, farmer reluctance can be anticipated.

5) Local Organization and Institutions. The strength of local organizations and institutions can be an important factor in determining the viability of various types of agroforestry systems. With field-based agroforestry, local organization can affect a range of boundary and off-site issues, such as continuity of field-based contour plantings or control of fire and grazing animals. With landscape-based systems, such issues are internalized as integral processes within the system, which includes a community-level management unit component. Community organization and institutions could become even more critical if the government were to authorize conditional community-based land use rights. As highland villages become more integrated into the national system of local administration, the sub-district *(tambon)* level of organization may have potential for helping deal with these types of issues, including the multi-village level, especially since recent legislation has empowered it as a juristic person.

6) Content, Enforcement and Perceptions of Government Policy. The ambiguity and uncertainty of government policies associated with land use in the highlands is a significant constraint on the long-term investments and commitments required for various agroforestry systems. A few examples include:

- ***Park expansion***. Highland households and communities, as well as research and development programs, appear to be wasting their time thinking about agroforestry systems of any sort if the government intends to confront and negate their efforts by further expansion of parks and wildlife sanctuaries into protected watershed areas. Related policies urgently need clarification.
- ***Refining watershed maps***. Policy needs to be clarified regarding development of mechanisms that accept the principles of the watershed classification system, but develop means for implementing them with community participation at a more detailed scale of resolution. This is especially crucial for community watershed mosaic agroforestry in large class 1 watershed zones mapped to include high valleys with communities that have been resident for medium to long periods of time.
- ***Agroforestry in class 2 watersheds***. If even-aged monoculture forest plantations are permissible in class 2 watershed zones, it should be clarified whether agroforestry systems that meet or exceed similar levels of watershed protection would also be permissible.
- ***Tenurial security***. If various agroforestry systems are acceptable in protected watershed zones under at least some conditions, those conditions need to be clarified and mechanisms need to be developed to provide those households and/or communities with a reasonable degree of at least conditional tenure, on at least an initial pilot project basis.
- ***Expansion of commercial agroforestry***. If effective agroforestry systems that include commercial production can be developed and demonstrated, the government needs to clarify its position on the extent to which it will allow their expansion to areas throughout the region.

Local perceptions and anticipation of policy. A good example of how these factors can affect land use behavior can be seen in adoption of contour vegetative strips. In and near a number of project areas, strips have been established by both lowland Thai and highland minority farmers cultivating untenured fields, most of which are near roads. Researchers found that the primary reason for the strips was because farmers perceived they would improve their chances for gaining tenure, or at least decrease risk being evicted by government officials. While this example indicates that farmers are trying to anticipate government policy even before it is made, it also indicates farmers' willingness to invest in "service-oriented" systems if they were a condition for tenurial security.

VI. Acceptance and Adoption of Agroforestry Systems

The discussion forum organizers posed the question: *Which types of agro-forestry are most likely to be accepted by farmers: "service"- oriented (erosion control, shading, moisture conservation, ...), or "market"-oriented (fruit-based) systems?*

One of the major goals of agroforestry research and development in this region is to reduce the necessity of making such choices by developing a range of systems that are both "service" and "market" oriented. Issues affecting farmer adoption are likely to center on the magnitude and distribution of benefits, costs and risk. As we have seen, however, many protective benefits accrue to downstream communities and/or larger national and global societies. If highland communities are expected to bear investment costs for these systems (including foregone benefits from alternative land use), then systems most likely to be accepted would allow for: 1) clear rights to capture direct productive benefits of the system; 2) at least partial local capture of environmental services; 3) additional local benefits provided by larger society, such as tenurial security associated with establishment and maintenance of such systems, or other mechanisms whereby beneficiaries of environmental services help pay for the costs.

Regardless of the type of agroforestry system in question, understanding farmer acceptance is not a mystical process. The main requirement is empathy, i.e., being able to ask yourself what you would do if you were in his/her position. Most likely, we would see that the farmer must:

- have the knowledge (local and external) and experience to understand the system
- have reasonable confidence that it will work under local conditions
- have sufficient access to land, labor and capital to be able to afford it
- have access to any necessary inputs, information and markets to operate it
- have reasonable expectations that net benefits will exceed opportunity costs
- find the level of risk associated with the system to be acceptable

Given the conditions in the highlands, it would not be surprising to see incremental acceptance by households and communities, as they cautiously test the viability of new systems or components and adapt them to local conditions. Indeed, this is a process that should help strengthen their skills to adapt to further changes that can be expected in this rapidly changing region.

VII. ICRAF and the ASB Program in North Thailand

The International Centre for Research in Agroforestry (ICRAF) has recently entered into a collaborative agreement with Chiang Mai University to help facilitate and assist efforts to undertake strategic multi-disciplinary research into many of the issues discussed above. A Memorandum of Understanding is now under consideration by the Royal Thai Government that would expand these collaborative linkages to include the Royal Forest Department, the Department of Land Development and other key government agencies. Preliminary agreement has also been reached with CARE-Thailand to begin extending collaboration to the NGO community.

We anticipate that efforts in North Thailand will become one part of the global Alternatives to Slash-and-Burn Agriculture (ASB) Program being conducted in key eco-regions around the world by a consortium of CGIAR international research centers, national research systems, and non-governmental research institutes. Plans for the montane mainland Southeast Asia ecoregion center on development of a regional-level analytical mechanism within local institutions in North Thailand, aimed at accelerating the learning process associated with development and implementation of appropriate agroforestry and related land use management systems. Such systems should make significant contributions toward improving the livelihoods of poor rural communities, protecting the environment and natural resource base of the region, and decreasing losses of biodiversity and contributions to global warming. We also hope to help strengthen collaborative linkages already being developed by Chiang Mai University and other Thai institutions with their counterparts in neighboring countries in Montane Mainland Southeast Asia working on similar problems, including transborder issues.

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