

**PROMOTION OF AGRO-FORESTRY IN SWIDDEN CULTIVATION AREA:
A Case Study of Tay Community in Northwest Vietnam**

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Abstract

The upper Da river watershed in Northwest Vietnam plays a significant role in protecting the Red river delta, including the Hanoi capital, from flooding. In recent years, deforestation has assumed alarming proportions in this area. Shifting cultivation, still prevalent among ethnic minority groups in the area despite government efforts, significantly contributes to this deforestation.

To ensure the successful transition from shifting to fixed cultivation, the features and driving forces of shifting cultivation need to be well understood, before an alternative can be introduced. This study explains the dynamics of shifting cultivation and agro-forestry practices among farmers of the Tay ethnic group (one of the largest in the region) in Tat hamlet and recommends measures to replace shifting cultivation by agro-forestry as the livelihood base. The analysis is mainly quantitative.

The study concludes that the main cause of continued shifting cultivation in this area is the poverty associated with food shortages. Population pressure, inadequate agricultural land for cultivation, limited access to credit and extension services, low educational levels, land tenure insecurity, faulty policy planning, implementation without popular participation, and lack of coordination among government organizations influence the farmer's decision to continue with shifting cultivation. Nonetheless, most farmers wish to switch over to agro-forestry.

Finally, agro-forestry systems can be promoted as an alternative to shifting cultivation only if initial support comes from government and NGOs.

Key words: agroforestry, shifting cultivation, sustainability.

I. INTRODUCTION

A large part of Hoa Binh province belongs to the watershed of the Da River where a majority of the population is subsistence farmers from ethnic minority groups. Shifting cultivation is still dominant and commonly practiced. Many other farmers with settled cultivation are still planting local varieties with no fertilizer application. This poor land-use practice and environmental degradation due to population pressure lead to low productivity of cultivated land. Hence, production is insufficient even to serve their subsistence and contributes to poverty and unsustainable lifestyles.

Many efforts of the Vietnamese government as well as NGOs have been put into the promotion of fixed cultivation and sedentarisation for ethnic minorities in high mountainous areas. However, the results have been limited due to insufficient information on shifting cultivation and the absence of analysis of its relation with highland development problems. Hence, information and analysis are needed for more practicable policy responses to the problems.

Furthermore, policy executors in the regions where shifting cultivation is in disequilibrium and causes detrimental effects, are anxious to know about a more productive and environment-friendly land use system that can promote the transition from shifting to fixed cultivation. Agro-forestry may be such a system; its analysis is necessary in order to give insight into the promotion of agro-forestry systems in areas of shifting cultivation.

II. RESEARCH OBJECTIVES

General objective

The broad objective is to study the shifting cultivation and agro-forestry practices in order to reduce shifting cultivation and strengthen agro-forestry as an alternative livelihood for shifting cultivators.

Specific objective

- 1) To study the existing status of shifting cultivation,
- 2) To identify livelihood patterns of shifting cultivators,
- 3) To examine shifting cultivator's perceptions and participation in ongoing agro-forestry activities,
- 4) To identify factors influencing the shifting cultivators for adopting agro-forestry practices, and
- 5) To give recommendations for strengthening agro-forestry projects in shifting cultivation area.

III. RESEARCH METHODS

Both secondary and primary data source was used in this research, and five major techniques were used as key methods in data collection including reconnaissance survey, standardized questionnaire, key informants interview, group discussion, transect sketch and field observation. However, standardized questionnaire is dominant technique applied. Data entry and processing were done through the application of the Statistics Package for the Social Science (SPSS) and Micro Soft Excel for graphic presentation of data. Regarding Landsat TM image, processing was done by using EDARD and Arc view package.

III. RESEARCH RESULTS

1. Profiles of study area

To date, Tat hamlet has a population of 475, distributed among 104 households, mainly of the Tay ethnic minority. Recently, the population growth rate at Tat is said to have

decreased significantly. Most houses are located near Provincial Road 433. This road runs through the hamlet for about 8 km from Hoa Binh town to the Da Bac center district and Tan Minh commune, and on to Muong Chieng.

The main economic activities in Tat hamlet depend on crop farming, animal husbandry and forest exploitation. Ninety-seven percent of working age people between 15-59 report “farming” as their primary occupation. Farm activities include wet rice growing, cultivation of swidden rice, corn, canna, and ginger, planting of tree gardens, and homestead.

Agro-forestry is not very popular in the hamlet. The most widespread application is home gardens, 21 households have spontaneously adopted tree gardens.

2. Shifting Cultivation at Tat Hamlet

Most of households in Tat hamlet are still practicing shifting cultivation. These figures are certainly underestimated as shifting cultivation is now considered illegal, and thus many families try to conceal it. During the survey, some interviewed households denied the fact that they were practicing shifting cultivation at first, but then admitted it after further discussion.

Each household has from 1 to 4 pieces for shifting cultivation at different places, often 4 to 5 kilometers from their home (about 3 to 5 walking hours). Some pieces are even 10 kilometers away (a half day walking). A small part of their swidden was allocated to households as fixed cultivation land by the government according to the Fixed Cultivation and Sedentarization Programme. The rest of the swidden area is illegal.

Shifting cultivation area in Tat hamlet has decreased during the last two years, with changing priority to canna. The area to upland rice is unstable, increasing in 2001 and decreasing in 2002, but the area under cassava and maize has rapidly reduced. There were many reasons for this, namely, reduced soil quality, price fluctuations, and use of local varieties of seed with have low productivity. Other important factors are prohibition by government and destruction by cattle.

Meanwhile, the area for cultivated canna is rapidly increasing as this crop is easy to cultivate, and has recently enjoyed high market demand. Hence, it yields high cash returns to the household.

3. Cause of Shifting Cultivation

From the farmers and government staff's perspective, it was found that the main factors influencing local people to continue with shifting cultivation are as follows:

- **Rural poverty**

The principal reason why most Tay in Tat hamlet practice shifting cultivation is that they are very poor and normally suffer food shortages from 2-6 months per year, with an average of 4.5 months. 53.8 percent of households are categorized as below the national poverty line. Income from other sources than agricultural production is very limited. Hence, the first priority of agricultural production is to produce foods for the family's survival. Amongst the various ways to seek more food for the family, shifting cultivation is the easiest and most habitual. 95.1% of respondents say that they do shifting cultivation due to non availability of alternative work. If they had alternative work they would stop shifting cultivation.

- **Limitation of Permanent Agricultural Land**

The results show that 92.6 % of respondents point to limitations in the paddy land, and 70.1 % lack of suitable land for crop as the reason for giving up shifting cultivation in Tat hamlet. The insufficient cultivation of land causes insufficient agricultural output which are thus sufficient to meet the family's needs. Moreover, the reclamation of barren land adoption requires a huge capital investment beyond the capacity of the Tay families already in poverty. Therefore, the best way to acquire subsistent foods is to go to cut forests and practice shifting cultivation.

- Land tenure insecurity

In principle, the insecurity of land tenure systems undermines farmer investment in sustainable farming systems and conservation measures, which cost them time, money and effort. In keeping with current economic policies, most land is supposed to be allocated to individual households to manage. In reality, the cooperative still retains control over a significant share of hill land in Tat hamlet, though this land is exploited by individual households under the loose supervision of the cooperative.

For the purposes of land allocation, land is divided into two major categories: wet rice land and forestland. All wet rice land has been allocated to individual households. Forest land is further divided into several types, of which a part has been allocated to individual households to manage, and the vast remainder is controlled by the cooperative for illegal shifting cultivation. Some forestlands have even been allocated to households but they are so far away from their home with little benefit, so the local people have no incentive to manage them. As a result, people slash and burn for cultivation. Hence, the absence of official land title affects Tay decisions on cultivation practices and long-term management.

- Lack of Technical Knowledge

Another way to improve land productivity is to use proper techniques of planting and growing. Nevertheless, the only popular cultivation technique among the Tay is slash-and-burn cultivation of upland crops with no fertilizer application. Farmers are unfamiliar with the cultivation techniques of wetland rice and other new crop species. They do not know how to grow and select seeds and seedlings, or apply fertilizers and agrochemicals in the right amount at the proper time.

At the same time, extension services are very poor. The only Department of Extension in the entire district is staffed by only 4 persons, one head and three extension workers. Three of them are Kinh with little knowledge of Tay ways of living and cultivation. Moreover, due to lack of facilities and adequate salaries, there is no extension system at the commune or hamlet level. As a result, “extension” is usually limited to delivering prescriptive messages. All the demonstration plots have been made in the fields of Kinh people in Tu Ly town for easy management and to ensure greater success. The extension workshops are seldom organized for ethnic minorities. Hence, the Tay rarely obtains extension services.

- Poor education and health care systems

The education level is low in Tan Minh, and in particular Tat hamlet. The underdeveloped education system is a constraint to both the farmers' capability of perceiving new cultivation techniques and adapting to the change in the way of living, which undermines the productivity of agricultural production. Low education also accompanies the lack of awareness of family planning, which puts more population pressure on the land. It also means low environmental consciousness.

Poor health means the low productivity of laborers and thus low crop yields. Due to the above-mentioned reasons, people do not adopt agro-forestry.

- Lack of capital

The land shortage can be partly offset by increases in land productivity. This can be achieved by increasing the investment in the production inputs or in the development of more intensive farming systems. However, poor Tays do not have enough money even for their subsistence, while access to credit is not easy. Most interviewees complained about the difficulties in credit application procedures and the short term for repayment. 45 of 82 households surveyed asked for credit for investment in agricultural production and animal husbandry, but they could not get it. Among them, 35 households had never accessed any kind of credit.

With the lack of capital, most Tay farmers never apply fertilizers or other agrochemicals for annual crops and some even do not apply such inputs on paddy rice. This results in very low productivity of their crops.

- Underdeveloped markets

Tay farmers usually have to sell their crops at low and unstable prices, which undermine their incomes. The low prices are caused by the low quality of the products and the absence of adequate markets, logistics and processing facilities in the region.

The absence of formal markets perpetuates subsistence agriculture for two reasons. First, there are no alternative sources of food supply other than production by farmers themselves. Second, there are few opportunities for off-farm jobs. Subsistence farming has to face the risk of food shortages. Shifting cultivation becomes a solution to ensure food security.

- Traditional cultivation customs

Shifting cultivation is part of Tay traditions. It is not easy to leave a cultivation habit that has already been practiced for generations. The Tay also used to live in the surrounding forest. Therefore, they have the tendency to retreat further to be near the forests and practice shifting cultivation.

- Construction and implementation of government development policies without people's participation

The government has implemented a series of programmes to stabilize and improve the life of ethnic minorities in the highlands. However, these programmes are imposed with no concern for the traditions, cultural features or cultivation practices of each ethnic group. Therefore, ethnic minorities passively participate in the change of their life as if they are objects of exterior interference, but not actors.

- Lack of coordination among government organizations

One of the main reasons for the limited success of government efforts to establish fixed cultivation and improve the living standards ethnic minorities is the lack of coordination in actions among different organizations. Substantial investment has been made in land reclamation for ethnic minorities in Tan Minh. However, without accompanying credit and extension services, farmers do not know the proper techniques for permanent cultivation on allocated lands, and even when they do not have money to invest in their application. Most of them, therefore, apply the traditional techniques of upland rice plantation with no agrochemicals that they had used in shifting cultivation on their permanent lands.

4. Livelihood Pattern of Shifting Cultivators

Very few households earn income from non-farm activities. In the study, on-farm production refers to production aspects including crop production, livestock production; while non-farm production relates to agro-processing industries, trading services and other non-farm production. Off-farm activities include those activities without investment of capital. In the study site, off-farm activities consist of forest extraction, hiring out labor, working as a government cadre and receiving a pension.

4.1. On-farm Activities

In the study area, farm production plays a very important role of local livelihood. It provides food, cash, and material for other activities and creates employment for household members. This section highlights the way local people earn money from on-farm activities through crop and livestock production.

4.1.1. Crop Production

a) Paddy

Wet rice is an important source of food for local people. Village statistics in 2002 show that Tat hamlet had 8.4 ha of wet rice, or 396.7 m² per person. Wet rice cultivation is concentrated in the two areas along the Tat stream. It is grown on terraced fields, which begin at the stream bank and proceed up the hill side. Two crops per year are grown in low fields, which cover 8.2 ha (97.6 percent of total paddy area), while only one crop is grown in higher fields which cover 0.2 ha (2.4 percent).

In the past, Tat villagers only used manure from cattle, water buffalo, and pigs to fertilize their paddy fields but in recent years they have started using chemical fertilizer as well.

The area of paddy land has increased slightly in recent years because the villagers have begun to utilize the foothills and land along the stream to build new terraces. Still the average amount of paddy land per person is actually decreasing due to population growth.

A number of rice varieties with short growing season were recently introduced to the hamlet. These new varieties have a high yield and are pest and disease resistant. Most of the rice fields are rain-fed, so in dry years the crop fails. When this happens the villagers some time plant sweet potatoes as a substitute for the lost rice. Because the Tat stream is shallow and narrow, and is fed by many tributaries flowing through areas with poor vegetation cover, paddy close to stream is easily flooded by heavy rains. The hot, dry southwest winds of the winter often kill rice plants in their flowering stage. The crop is vulnerable because of the narrowness of the valley and the absence of effective forest wind barriers. So villagers often suffer heavy crop losses at this time.

Most of households are engaged in paddy cultivation, and nearly fifty percents have gross income 2-3 millions VND per year. The figure is higher in the shifting cultivation (SC) group, while the percentage of households earning more than 3 millions VND per year is higher in the agro-forestry (AF) group.

The result of t test shows that there is a statistically significant difference at the 99% confidence level in the average gross income from paddy between the two groups, the agro-forestry group being much higher than shifting cultivation group.

b) Swidden

According to statistics compiled by Tat hamlet leader, in 2002 there were 54.22 ha of swidden (of which 7.4 ha of rice swidden fields occupying 13.6% of the total swidden). There are many difficulties involved in swidden agriculture. Villagers are not allowed to clear new areas for rice swidden fields, and most of the forest land has been allocated to households to protect. Because swidden fields have been used continuously for many years, soil quality is poor, there are many fast growing weeds, and other problems come from pests, especially stem borers, leaf rollers, and especially stink bugs and rats. The problems are aggravated by the lack of fertilizer and inadequate methods of pest prevention.

The area of shifting cultivation is fallen in the last couple of years, due to various reasons; namely, the land allocation process by the government to households; the prohibition of shifting cultivation by government; and the development of more favorable economics condition, so that farmers have a chance to shift to other sectors for supplementary jobs.

Shifting cultivators realize that rice swiddening is hard work and that productivity is not as high as it used to be before population pressure forced the shortening of the fallow periods. Nevertheless, they say that they have no choice but to do it if they are not to go hungry. The main crops grown in swidden are upland rice, cassava, canna, ginger and corn. Rice, cassava and ginger swiddens are monoculture but canna is often intercropped corn. Most of rice swiddens are planted with rice only in the first year after clearing and then used for other crops (cassava and canna) in the second year. Each household has some pieces of swidden land location at difference places, so that it is hard to develop swidden farming.

It is found that forty percent of households have gross income from swidden of more than 1.5 millions VND per year; this figure is higher in shifting cultivation group. The number of households having income less than 1.5 millions VND is higher in the agro-forestry group.

The results of t-test show that there is a statistically significant difference in gross average income from swidden between the two groups at the 95% confidence level, with the figure in the shifting cultivation group higher than the agro-forestry group.

c) Agro-forestry

Agro-forestry is not very popular in either Tan Minh commune or Tat hamlet. The most widespread application is home garden; only 21 households in the hamlet have established tree garden on their own.

- Home garden

Small home gardens are located around the home; the area is exceedingly small, averaging 73.9 m² with maximum size of 130 m² and a minimum size of 70 m² to various kinds of fruit tree, herbs, spices, vegetables, and ornamentals grown, mainly for home consumption.

- Fruit tree

Fruit trees and industrial crops are less developed in the Tat hamlet faming system. The few fruit trees to be found in Tat are either those invested by Project 327, or wild varieties. The yield is not significant enough to sell and usually sufficient only for home consumption

- Tree garden

Only 21 households in the hamlet have established a tree garden. The area of tree gardens varies from 2,000 m² to 25,000 m², with a mean of 15,400 m². Commonly planted tree species are Melia, Palm, Styrax and Bamboo, with Media the most common. Media is grown for use in home construction and for sale. Palm trees are grown to provide leaves as a roofing material. Media is planted at the same time as the first rice year rice crop. Later, cassava is planted between the small trees. Thereafter, people stop cultivating agricultural crops as trees become big and their canopy shades the spaces between the tree rows. Media takes about 7-8 years before it can be cut. According to computations from the survey data, the gross income from tree gardens varies from 1.400 VND millions to 4.300 millions VND, with a mean of VND 2.450 millions per year.

4.1.2. Livestock

In the study site, livestock are an important element of household income. Most households keep at least some livestock. Fifty percent of the households raise buffalo with most having one animal. Buffalo are kept for land preparation (95%), manure (90%), and sale for cash (52%). Cattle are kept in smaller number of households (45.2%), but the number of cattle per household is higher. Cattle are raised mostly to sell (80%), for land preparation (47%) and for manure (42%). Some households consider cattle as a "living bank account". They are sold when the household needs cash to build a new house, for a wedding, or for other major expenditures. The number of households raising cattle has been increasing recently, because cattle sell easily for a higher price (1-2 millions VND/head). Cattle are freely raised in the forest and on fallow fields. The households usually give salt to the cattle to train the cattle to return to their owners. When they are sick or crave salt, they will return to the household. When the weather changes (heavy rain, for example) they will return to the household.

Pigs are raised by 71 percent of the households, primarily for sale (70 percent), manure (50 percent), and home consumption (17 percent). Pigs are important for ritual reasons. As well, a young man has to provide several pigs to his bride's family as a part of the wedding arrangements. Most households (85.7 percent) keep a few free-ranging poultry for home consumption (92 percent) and occasionally for sell (36 percent). The greatest difficulty

affecting livestock-raising in Tat is diseases/epidemics. Poultry and pigs are especially vulnerable, while buffalo are relative disease-free. Livestock deaths are quite common

Both buffaloes and cattle were mainly kept for sale within the duration of 1 to 2 years. The average cash income from livestock per each year is of 3.585 VND millions, the figure in AF group of 4.643 millions VND is higher than the 3.5 millions VND of the SC group.

From t-tests, it was found that there is statically significant difference in average cash return from cattle between the two groups at the 99% confident interval.

4.2. Off-farm Activities

Forest products play an important role in the life of Tay minority groups in Tat hamlet. Bamboo shoots and forest vegetables are the main foodstuffs for daily meals, especially during the time of food shortages. Fifty percent of households are still involved in timber logging; 100% collect fuel wood and other NTFPs such as bamboo shoots, mushrooms, and wildlife. These also provide indigenous people with additional sources of income.

- **Timber logging**

Although forest exploitation, especially timber logging, is restricted by the government, those activities still occur frequently. Many local people are still involved in illegal timber extraction for private traders as wage laborers. It is said that for extracting timber, a day's labor is worth about 50,000 VND and about 30,000 VND for collecting bamboo. In stark contrast, expected income from one day of labor in swidden harvests of cassava and canna is only 20,000 VND. The high wage given for forest extraction encourages people to engage in it, despite its being illegal.

It is shown that average income of timber logging was 1,221 million VND, the figure in shifting cultivation groups was 1,396 millions and that of agro-forestry group was 0.714 millions VND.

T-tests show that there is a statistically significant difference in the average income from timber logging between the two groups at the 95% confident interval.

- **Non Timber Forest Products**

The local people considered timber logging as illegal, but they believe that a different rule applies when it comes to non-timber forest product such as bamboo, firewood, etc. All households participate in collecting varieties of NTFP products. When transect walking, researchers are likely to meet people carrying firewood, bamboo, bamboo shoot in baskets or bundles of broom grass or bamboo on their shoulders. A few years ago, they would also have seen men going to the forest with guns on their shoulders and accompanied by hunting dogs, but wild animals are now so rare that few bother to hunt any longer.

The average return of NTFP was 1.140 millions VND. There is also a different statistically significant difference at the 99% between the two group; the figure was higher in shifting cultivation groups (1,252 millions VND), compared to the agro-forestry group with 0.816 million VND.

T-test results show that there is a confident level in the average NTFP among shifting cultivation and agro-forestry group.

- **Minor Occupation Income**

Minor occupations play an important role in solving the problems of population pressure on the forest, creating employment and generating income. In the study site, minors occupation are very limited; just a small percentage of households are engaged in part-time job. These include working as a cadre for the government (6 percent of the households), shop-keeping (7.3 percentage), wage labor (12 percent), driving a motorbike taxi (3.4 percent), and production of handicrafts and pension which the households earned from government.

The minor occupational incomes are presented in table 8. However, the results of t-tests show that there is no statically significant difference in average minor income between the two groups

5. Household Income and Expenditure Composition, and Saving

Most households in Tat have almost the same income sources, namely: paddy, livestock, swidden, forest and minor sources. But level of income is much different between AF and SC group in certain sources, and total average income of AF group is much higher than SC group.

All households have the same expenditure patterns on food, furniture, social events, production, education, health care and others.

Finally, the average net value in a year is slightly positive; the figure is negative in the SC group and positive in the AF group. This is a further factor in explain why poor people are still not giving up shifting cultivation. They ignore agro-forestry adoption, because they cannot look further when they are still hungry and cannot take the risk.

6. Shifting Cultivators' Perception and Participation on Ongoing Agro-Forestry Practices

6.1. Perceptions on Agro-forestry Adoption

Agro-forestry is not very popular in either Tan Minh commune or Tat hamlet. The most widespread application is home gardens, but as the area is too small to make it efficient, some households have spontaneously adopted tree gardens at the hill base of their own forestland allocated to them by government. The main incentives for tree garden adoption in some households are the prospect of higher incomes and the presence of assistance.

Most households who do not practice agro-forestry have never heard of agro-forestry as such. This is the main cause of non-agroforestry adoption in the hamlet. During the survey, farmers stated that the lack of technical assistance and knowledge and unstable price, are also main reasons for not practicing agro-forestry amongst farmers who do have knowledge about agro-forestry.

6.2. Perception on Benefits of Agro-forestry

The perception of the benefits of agro-forestry is one of the several factors that were introduced to farmers to evaluate its potential. After that, they spent a certain period of time to decide if they will adapt the practice.

According to Chundawat *et al.* (1993), the benefits of agro-forestry are three types: economic, environmental and social aspects. In this regard, farmers were asked to rate the benefits. Their ratings are shown in table 1 below.

Table 1: Shifting Cultivators' Perception for Potential Benefits of AF

Statements		Hamlet Index		Remark
		SC Group	AF Group	
Economic	1. Diversify products	0.30	1.52	0.61
	2. Reduction of risks	0.34	1.38	0.61
	3. Increase income levels	0.15	1.24	0.43
	Average	0.26	1.38	0.55
Environment	4. Reduction of surface run-off	1.03	1.43	1.13
	5. Reduction of lose forest	0.70	1.0	0.78
	6. More efficient land use	0.38	1.48	0.66
	7. Reduce shifting cultivation	0.38	1.24	0.60
	8. Increase soil fertility	0.11	1.43	0.43

	9. Reduce natural disaster	0.03	0.52	0.16
	Average	0.44	1.17	0.63
Social	10. Stable settlement	0.43	1.14	0.61
	11. Create more employment	0.16	1.29	0.45
	Average	0.29	1.21	0.53

Source: Cited in table appendix 7

The WMIs indexes presented in table 1 above show that a majority of people have replied “agree” or “strongly agree” to all statements. It means that all respondents understood well the benefits of agro-forestry. The WMIs value of environmental aspect (0.63) is slightly higher than WMIs value of economic aspect (0.55) and that of economic aspect is also higher than the WMI value of social aspect (0.53)

The result of t-test showed a statistically significant difference between the two groups, in terms of perceived on benefits of ongoing agro-forestry in the hamlet, at the 99% confident interval.

6.3. Degree of Adoption of Farmers to Agro-forestry

After the respondents learned about agro-forestry, they had to still learn more to be clear whether this pattern would be good for their farm. The persons who induce the respondents to learn and seek more information to adopt agro-forestry also play an important role in this decision-making process. There is a statistically significant difference in the percentage of respondents willing to adopt agro-forestry between the shifting cultivation group and the agro-forestry group.

Table 2: Degree of Adoption of AF

Group	Willing to adopt AF				Level of willingness to adopt AF						WMI
	Yes		No		VH		H		L		
	N	%	N	%	N	%	N	%	N	%	
SC group	61	100	0	0	29	47.5	25	40.9	7	11.5	0.78
AF group	21	100	0	0	20	95.2	1	4.7	0	0	0.98
Total	82	100	0	0	49	59.7	26	31.7	7	8.5	0.84

Sig. = 0.00 ; df = 80

Source: Field Survey 2003

The value of WMIs also shows that a higher percentage of respondents have given the opinion "very high". It means that they are very willing to adopt agro-forestry practice.

7. Analysis of Biophysical, Economic, Social and Institutional Factors Influencing on Farmers in Adoption of Agro-forestry Using Factor Analysis.

In order to identify the underlying interrelationships among thirty independent variables that influenced farmers to adopt agro-forestry in the study site factor analysis was used. These factors were selected from several biophysical, economic, social and institutional aspects that tend to affect the adoption of the agro-forestry among farmers. The aim was to find out a set of uncorrelated factors explaining a variation of degree of farmers' adoption of agro-forestry.

Factor analysis yielded altogether seven factors comprising different groups of correlated variables. Together, these factors explained 78.7% of total variation. Thus, the degree of agro-forestry adoption among farmers can be described by a relatively small number of factors.

The individual variance explained by each factor is shown by its eigenvalue and corresponding percentage. These show us how much the factor explained the total variance in the degree of farmers' adoption of agro-forestry.

Table 3 shows the analysis of variance explained by rotated factors influencing farmers to adopt agro-forestry. The first factor explained 17.7% of variance, the second 15.2%, the third 13.5%, the fourth 13.0%, the fifth 7.6%, the sixth 6.1% and the seventh 5.5%. The clustering of thirty variables into seven factors, explains 78.7% adoption of agro-forestry among the farmers in the study site.

The first factor incorporates available hybrids, following a successful farmer, training and extension programs, family labor, reduced risk, food security, and knowledge and experience. All these variables are related to the farmers' knowledge of agro-forestry, so this factor can be named "agro-forestry knowledge", these factors explained 17.7% of the total variance and all factors loadings were positive.

Table 3: Rotated Factor Matrix of Loading on the Adoption of AF

Variables	Factors							Cum*
	1	2	3	4	5	6	7	
HYBRID	.843							0.883
FARMER	.815							0.900
OPPORT	.811							0.873
TRAIN	.789							0.896
LABOR	.691							0.779
RE_RISK	.630							0.819
FO_SECURI	.619							0.840
KNOW_EXP	.545							0.751
TT_INCOM		.891						0.749
FRE_CATT		.874						0.908
LAND		.871						0.860
INCOM		.468						0.899
INPUT		-.831						0.796
FAR_INST			.810					0.883
SOIL			.767					0.860
MARKET			.718					0.845
INFORM			.706					0.829
NU_CATT			-.538					0.753
TT_EXPEN				.706				0.546
WATER				.701				0.904
INFRAC				-.694				0.613
PADDY				.625				0.849
CAPITA				.603				0.835
IN_SUPPO				-.571				0.720
HH_MEMBE					.886			0.849
HH_ACTI					.737			0.777
SWIDDEN						.775		0.668
HH-EDUCA						-.736		0.606
FOR_AREA							.847	0.698
HOM_GA							.432	0.405
Eigenvalue	110	4.573	4.065	3.902	2.286	1.831	1.636	
% Variance	17.7	15.2	13.5	13.0	7.6	6.1	5.5	
% Cumulative	17.7	32.9	46.5	59.5	67.1	73.2	78.7	

Remark: For the analysis, loading less than 0.40 and greater than -0.40 have been omitted
 Cum* = Communality is the proportion of variance of a variable of variable in
 commune with each pattern

Table 4: Factors Influencing the Degree of AF Adoption

Variables	Coefficient	Level
Household active member	0.368**	Medium
Paddy land holding size	0.323**	Medium
Income from agro-forestry	0.706**	High
Food security	0.330**	Medium
Market availability	0.503**	Medium
Training and extension program	0.319**	Medium
Information dissemination	0.403**	Medium
Knowledge and experience	0.611**	Medium
Land tenure security	0.805**	High

Remark:

- ** Significant at 99% confident level; * Significant at 99% confident level
- Less than 0.3 is considered low level correlation; more than 0.3 to 0.7 is medium; and more than 0.7 is high level correlation

The remaining variables were entered into a stepwise multiple regression analysis to minimize the number of independent variables and maximize the level of explanation. The variables entered into the regression analysis included significant variables which are presented in table 4. Finally, three variables were included in the model:

Table 5: Regression Coefficient with Degree of AF Adoption

Factors	Coefficients	T-value	Significance
(Constant)	-0.03637	-.541	.000
LAND TENURE SECURITY	.764	9.274	.000
PADDY LAND HOLDING SIZE	-0.0000131	2.891	.005
MARKET AVAILABILITY	.125	2.497	.015

$$Y (\text{Degree of Adoption}) = -0.036 + 0.764 *(\text{Land tenure security}) + 0.000013*(\text{Paddy land holding size}) + .125* (\text{Market Availability})$$

$$R^2 = 69.8$$

The most important factor influencing adoption of agro-forestry is "land tenure security"

III. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusion

It can be concluded from this research that shifting cultivation in the study area is still widespread, but it is diminishing gradually as the fallow period shortens. Local people cultivate hill slopes as monoculture, using local varieties without fertilizer application and traditional soil protection techniques. These practices significantly contribute to the deforestation of hill land. Therefore, a transition from shifting cultivation to permanent agriculture is necessary.

The main cause driving local people to pursue shifting cultivation is poverty, which is reinforced by population pressure and constraints on agricultural land, especially paddy land.

Hence, poverty alleviation is a prerequisite in the process of transition to fixed cultivation. The other important causes of shifting cultivation include limited access to credit and extension services, low educational level, lack of participation in the planning and management processes, inadequate interaction between government organizations in policy implementation and underdeveloped markets.

In the recent past, the government has made substantial efforts to promote a transition from shifting cultivation to permanent agriculture, but the results have been limited due to insufficient information on shifting cultivation and the absence of analysis of practical policy responses to these problems. As a result, most investment has concentrated on construction of infrastructure, rather than the capacity building of local people.

Although increasing considerably, agro-forestry is still limited. The most widespread application is home gardens with very limited area. Few households have established tree gardens by spontaneous adopting area for forestland. The reasons for non adoption of large scale agro-forestry are lack of technical assistance, knowledge about agro-forestry and fluctuations in prices of agro-forestry products.

The main livelihood pattern of shifting cultivators is primarily based on farm activities and forest extraction. There is very limited employment in other occupations. Farm activities comprise animal husbandry, paddy and swidden. Farmers find less incentive in crop expansion than in livestock development, especially cattle. Indeed, the study found that the main household income for both agro-forestry and shifting cultivation groups derives from animal husbandry. The income from animal husbandry and paddy in the agro-forestry group is significantly higher than in the shifting cultivation group. In turn, the figures from forest extraction and swidden in the agro-forestry group are significantly lower than in the shifting cultivation group. The figures for minor occupations do not differ significantly between the two groups. Finally, household saving has increased slightly. The figure is negative in the shifting cultivation group and positive in the agro-forestry group.

Farmers get information and knowledge about agro-forestry from local organizations namely the Women's Association and the Veteran's Association. In addition, local farmers receive agricultural training and extension from Government extension workers and non government organizations. The farmers in the study area are satisfied with the potential benefits of agro-forestry, but the level of satisfaction is higher for environmental benefits, followed by economic and social benefits. They are also very much willing to adopt agro-forestry but this requires some initial support.

Seven key factors influence the adoption of agro-forestry by farmers in the area: agro-forestry knowledge, household income, social environment, government support, demography, education and land holding size. Among these, agro-forestry and household income are the prime factors influencing the adoption level envisaged, within which land tenure, paddy landholding size and available market were the most significant.

We may conclude that agro-forestry can be promoted in shifting cultivation areas in order to achieve the objective of fixed cultivation, poverty alleviation and environment protection programs.

2. Recommendation

2.1. On going development projects

The continuation of government programmes on land allocation, fixed cultivation and sedentarization, hunger eradication and poverty reduction, and five million hectares of afforestation should be implemented with concern for lessons drawn from the field experience in previous stages of programme implementation; these programmes should be mingled and implemented simultaneously. The investment should be allocated more to knowledge and technical transfer rather than just concentrated on construction of infrastructure.

2.2. Capacity building of local people

Since people are both the means and the targets of the development process, human resource development and capacity building should be given priority. Special attention should be geared to education, since it can help the poor to better manage their production activities as well as improved living condition. Higher technical perception and awareness of family planning can both be obtained with higher education.

2.3. Land Tenure

Land use planning, land allocation and the land use certificate issuance process should be sped up to ensure people's tenure security. The process should be based on the participatory approach as well.

2.4. Capital support

This support to farmers could be in both cash and kind. For the cash support, emphasis should be on the credit source, an amount of the credit, interest rate, and the period for loan repayment. The credit system should be more flexible, with simpler forms and procedures for credit application and closer monitoring. Repayment schedules should be ensured to match the household crop cycle so that repayments are due when money is available.

As for support in kind, this should focus on the supply of essential agro-forestry inputs to farmers, particularly for progressive farmers who are responsive to new technology and innovations in agro-forestry. This support may be in terms of seed, seedling, and livestock breeding.

2.5. Strengthening the promotion and Extension Program

The main suggestions are as follows:

- Increase technical staff and intensify their visits
To increase the effective promotion and extension program of agro-forestry, it is imperative to increase the number of government staff by recruiting additional officers with priority on persons from local ethnic groups, equipping the staff with working facilities, and expanding the network so that ethnic minorities can get better access to extension services.
The success of pilot projects is very important for spillover effect. Therefore, the initial investment should be concentrated in a few potential pilot projects with periodic review. Success will depend upon increasing the intensity of contacts between the agricultural extension worker and farmers as well as better performance in the provision of information dissemination and other service support.
- Training and provision of technical support
The agricultural extension department should emphasize the technical know-how to increase the benefits from agro-forestry. The prospect of successful agro-forestry is a good incentive for farmers to expand their scale of operations. For the design of training programs, it emphasis should be on marketing, planting seed, seedlings, and nursery. Grafts should be provided in order to reduce the expenditure on seedlings.
- Provision of marketing information
Marketing information was indicated by farmers of both groups as the main source that affected the degree of agro-forestry adoption by farmers in the study area. Hence, the agricultural extension department must coordinate with the Ministry of Commerce and the Provincial Chamber of Commerce to provide information regularly (daily, weekly and monthly) on the price of farm products, the availability of market places, the demand and supply of those farm products, and even the prospects for export. This can be coordinated with the local farmer's organization.

- Strengthening the Cooperation and Networking among GO, Local Farmer's Organization

Expanding the adoption level in agro-forestry needs extensive cooperation and networking with farmer's organization and NGOs in the study area to organize training programs to raise the awareness and practice of agro-forestry.

The agricultural extension department, the main government agency concerned, should cooperate and strengthen networking with local farmers' organization as well as NGOs in the study area to get their support and resources to assist in the promotion and intensification of agro-forestry. Of particular importance are indigenous knowledge, information dissemination, and technical know-how.

All of the above recommendations have implications for the promotion of agroforestry to non-adopters as well. Attention should be paid to the concerned government agencies, particularly the departments of agricultural extension and land administration, the bank of agriculture, agricultural cooperatives, and the bank for the poor to provide technical assistance and credit support to farmers.

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