THE USE OF CROPPING SYSTEMS AND TECHNIQUES SUITABLE TO THE ENVIRONMENT OF THAI, KHOMU AND HMONG PEOPLE IN DIEN BIEN DISTRICT, LAI CHAU PROVINCE

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Swidden cultivation is not new to researchers and policy makers on sustainable development in mountainous areas. The relationship between ecological and cultivation systems on sloping lands were dealt in many studies and surveys made by scientists. However, it has been rarely mentioned on the relationship of cropping systems and cultivating techniques with primary and secondary ecosystems, with various terrains and humidity as well as relationship between every ethnic group's cultivation systems and comparable ecosystems.

This paper presents the above relationships in swidden farming of Thai, Khomu and Hmong people in Muong Phang commune, Dien Bien district, Lai Chau province.

1. Natural ecosystem of swiddens on food crops

- Land covers:

There are two main categories of land cover. The first is tree forests, bamboo forests and mixed forests of trees and bamboos. The second is moors of *imperator cylindrical* and broom grass. The first land cover could be regenerated after swidden, if the duration of cropping was one or two years, and then if this land was fallowed over 8 to 10 years or more. If the duration of land use and fallowing is repeated regularly, forests can still regenerate. Various bamboo forests regenerate more rapidly than tree forests. Khomu ethnic groups usually live in bamboo forests or mixed forests areas, therefore after their swidden cultivation the forests regenerated rather rapidly. Later when the population has increased, people could not have enough primary and secondary forests for swidden farming, they have to cultivate on slopping lands for longer time, so forests can not regenerate after that. Most of *imperator cylindrical* and *chromolaena odorata* grow. If the soil pH is low (acidic soil), the most popular species are *mel stoma* spp. *and rhodomyrtus* spp.

In the moors of *imperator cylindrical*, after swidden cultivation, none of trees could be regenerated, except land along high tree forests in the top of Pu Huot mountain where the mixed vegetation of imperata cylindrica and scattered plants existed before cultivation, after farming period the forests could develop well.

The different kinds of vegetation regenerated after swidden cultivation have impacts on the land quality and land erosion as well. In the fallow land covered by imperata cylindrica the soil is not fertile so its roots have to grow deeply into the earth. In the second kind of land where chromolaena odorata grows and its vigorous roots make the land fertile. Moreover, the year round leaves fall make the quantity of phosphorus higher contributing to soil fertility. The landcover also can protect the soil against erosion.

From above reasons people prefer to cultivate in land covered by *chromolaena odorata* to that of *imperata cylindrica.*

- Terrains:

+ Upland rice swidden terrains:

The upland rice swidden terrain is considered by landcovers. On moor of *imperata cylindrica* the people like to cultivate in gentle sloping lands or in the top of mountains and hills. On the contrary, when in the mountains the land is wet and humid, they grow crops on sloping sides. If there are not forests on the slopes, they will slash and burn forests in the top of hills or mountains because the humidity is low and the soil is harder on sloping sides.

+ Maize swidden terrains:

Maize is fond of wetness and there are not lots of maize varieties suitable to various ecosystems. Therefore people have to choose wet soil for maize cultivation. As the forests on hills and sloping sides are generally wet, they are the best place for cropping maize. The areas, where wild bananas grow on soil in rock hollows, are suitable for planting maize, because the humidity is high and the soil is not very eroded.

+ Cassava's terrains:

Cassava has been cultivated in Muong Phang from 1960. Cassava is suitable to dry soil and hot areas so that the best place for cassava is on the top of hills or sloping sides.

- Comments

Ecosystems of every cropping system on sloping lands, such as upland rice, maize and cassava, are very different. Especially, the ecosystems of upland rice are rather various that a part of them is similar to the natural ecosystem of maize and cassava. These differences and similarities require researchers to pay attention to conducting research on the shifting cultivation relations between the above mentioned three crops in order to avoid considering them as a general formulation for every location, every ethnic group or every ecosystem.

2. Use of sloping land cropping systems in accordance with ecosystems and the change of environment in Muong Phang commune

- Regulations of shifting cultivation:

+ Shifting cultivation and fallow regeneration of forests:

These shifting cultivation regulations were used in the past, when the local population density was low. Only Khomu and Hmong people depended on swidden cultivation. At that time forests were abundant. Every household had at least two plots for upland rice and the same areas for maize. Local people cultivated in every plot just for one crop and shifted to the next plot in the next year and they did the same to the their last plot. After cultivating in the last plot, people moved to the first plot so the second cycle of land use was repeated and the process continued. The table 1 shows Khomu and Hmong people's shifting cultivation regulations.

Table 1: **Shifting cultivation regulations of Khomu and Hmong people in Muong Phang Commune before 1970**

Subject	Unit	Khomu	Hmong
- Number of lots for shifting cultivation			
+ Rice	lot	2	2
+ Maize	lot	2	2
- Number of swidden plot per a lot			
+ Rice	lot	4	5
+ Maize	lot	4	5

- Number of crop per plot			
+ Rice	crop/ lot	1	1
+ Maize	crop / lot	1	1
- Duration of fallowing land			
+ Rice	year / lot	4	5
+ Maize	year / lot	4	5
- Cycle of land use for a plot			
+ Rice	year / cycle	8	10
+ Maize	year / cycle	8	10

Source: Field work in 2001

The cycle of land use of every plot is from 8 to 10 years as in table 1. This can diminish the vacant spaces in every area, protect land from erosion and distribute soil's fertility regularly, help the trees to grow quickly and the forests to regenerate better.

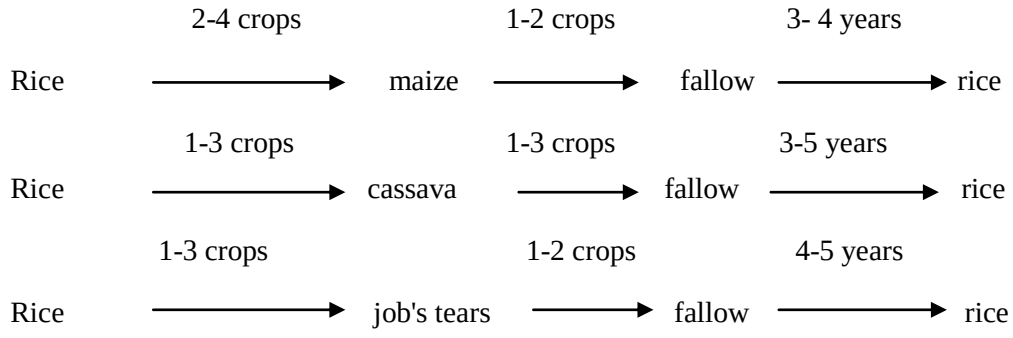
The shifting cultivation in plots has resulted in moors of *imperata cylindrica*. And local people named this shifting cultivation as slash and burn. Some researchers named it closely to nomadic farming (Bui Minh Dao, 2000: 108).

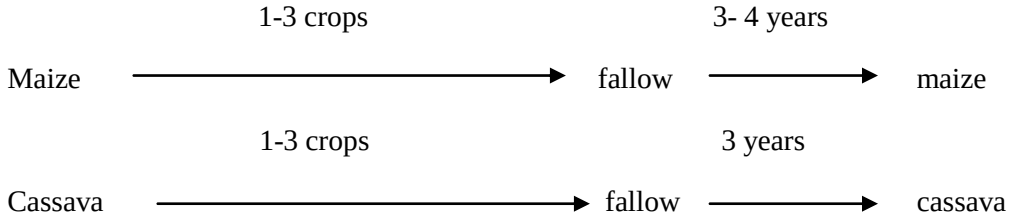
In this farming, the average area cultivated by a household with 6 or 8 mouths to feed was 2 ha (Dang Nghiem Van, 1972: 106-107). The whole cycle of shifting cultivation needs 16 ha (Khomu people) or 20 ha (Hmong people).

+ Shifting cultivation of crops and moving on lots of swidden cultivation:

Since early years of the 1970s, when high-ranking cooperatives were formed, cooperative production has declined, especially in the early years of the 1980s. Thanks to the "Decision 100" every household could take more initiative in production. Muong Phang forests have been exploited violently by Dien Bien forest workers, that made the forests become exhausted very quickly. It created favorable conditions for local people, especially the Thai who were the co-op members and were thirsty for developing their own household economy. They destroyed the remaining forests for cultivation. Since then the regulation of shifting cultivation on plots and lots ceased to exist in Muong Phang commune. Every household has got 2 - 3 lots for swidden cultivation for rice, maize and cassava. Every kind of plots were far from each other.

For every crop farmers use different varieties of rice to suit the soil fertility level. When the soil becomes not suitable for cropping rice, they plant maize or cassava instead, depending on the position of swidden fields and soil humidity. The mode of shifting cultivation between cropping systems of rice, maize and cassava can be seen as follows:





Mode of shifting cultivation is usually summarized up by researchers as follows:

Rice → maize → cassava → fallow

In fact, the mode of shifting cultivation has not been seen because maize is fond of wetness but cassava is suitable to dry soil. May be, two kinds of crops are different, because of their roots. The shifting cultivation from rice into maize / cassava can be implemented, because there are many varieties of rice that suitable to different types of soils and different humidity, in which some places are suitable to rice and maize and the other places are good for rice and cassava.

Thus, every household with 6-8 mouths to feed cultivates two ha for every crop according to the mode of rotational crops. The average duration of land use is from 3 to 5 years and the duration for fallow is too short (3 or 5 years) which decreases the cycle of land use from 8 / 10 years to just 2 years per cycle.

Due to too short time for land fallow that makes land degraded rapidly, there is no extensive solution to enrich the soil fertility.

The above reality shows the shortage of land for shifting cultivation, the crisis of sloping agriculture, and the shortcomings of irrigated rice agriculture to assure the living conditions of local people. To solve these problems, many solutions for developing irrigated rice agriculture have been implemented (irrigation, new and improved varieties of rice, fertilizers, intensive farming). Thanks to these solutions, Khomu and Hmong people who relied mainly on shifting cultivation in the past and were not interested in cooperative work, became ardent to get involved in agricultural development programs of Dien Bien district and in foreign assisted projects carried out in their commune.

- Techniques of using distinctive crops suitable to different wet land ecosystems:

+ Techniques of using different rice varieties for shifting cultivation exploiting the different ecosystems.

Khomu and Hmong people have a traditional habit of cropping cereals on sloping lands for a long time, but Thai people, only in the 1960s, especially from the end of the 1970s started growing rice, maize and cassava on the swidden fields. For that reason, Khomu and Hmong people have more experience in upland production than Thai people.

Traditionally, Thai people in Muong Phang commune cultivated only peanuts, sesame and peas in the feet of hills and cottons upon bamboo ecosystems. Therefore, Thai people didn't have enough experience of shifting cultivation in forests and moors of *imperata cylindrica*, even the selection of location and techniques for cultivation as well. They had to learn new knowledge of cultivation from other ethnic groups.

They already learned from Khomu people how to cut down trees in dense forests for cultivation and they also learned experience from people in other locations.

The different ethnic groups in Muong Phang Commune have different experience in using rice seeds for cultivation (Table 2)

Table 2: **The upland rice varieties used by ethnic groups in Muong Phang Commune formerly and presently**

Ecosystems	Thai	Khomu		Hmong	
	Imported varieties	**Local varieties**	**Imported varieties**	**Local varieties**	**Imported varieties**
1. Slash-and-burn cultivation in forest lands	- From Thai people living in another communes: khau ta bong, khau te lau; cay lau, lang phang, lam	Ngo mat, el, duan, con poong, clooc, kgiooc, dzri, giac.		Ple trang, trau, chai, tlang, ang, tla, da	
2. Fallowed old swidden without forests and old swidden shifting cultivation of crops.	From Thai people living in other communes: khau lanh, khau pe, pu lau. - From Hmong people: ordinary rice, Thailand rices	Ngo prang, ngo tla	From Thai people living in other communes: khau pe, pu lau. -From Hmong people: mong si, ma cha, Thailand rices.	Ple phua, ple trang, mua chua	From Thai people living in other communes: lang phang, khau pe, khau ta bong. From Hmong people living in other communes: ple tri, mong si, Thailand rices, ma cha rice.

Source: Field work in 2001

** Meaning of the rice varieties names:*

Conpoong = tigrime dove; kgiooc = banana; dzri = banyan tree; giac = cane brake; tla = sugar cane; ma cha = the dogs dislike.

Table 3: **Upland rice varieties used by ethnic groups in Muong Phang Commune depending on soil quality in the old swidden fields**

Crops	Thai	Khomu	Hmong
The first	Ta bong, te lau, Thailand rices	Ngo prang, khau pe, mong si, Thailand rices	Ple trang, ple phua, trau, Thailand rices.
The second	Lang phang, te lau, Thailand rices.	Ngo prang, khau pe, mong si, Thailand rices.	Mua chua, khau pe, Thailand rices
The third and the fourth	Mong si, khau pe	Khau pe, mua chua, mong si.	Khau pe, ma cha, mong si.

Source: Field work 2001

The above table shows that:

Firstly, all sorts of rice seeds for slash-and-burn cultivation were imported. At the time forests were nearly exhausted, people have to carry out shifting cultivation of upland rice varieties that ethnic groups have not used. The local people use other sorts imported from neighboring communes, such as Na Tau, Muong Ang, Pu Nhi.

Secondly, sorts of rice seeds are changed in every crop in order to adapt to the soil quality and to squeeze the fertility of soil before fallow. Such kind cropping system is quite different from stable cropping systems on the irrigated rice fields. The differences between cropping system on the upland plots and on the fields showed the stability of irrigated rice agricultural ecosystem and unstable conditions of shifting cultivation ecosystems. The main reason for this change is the shortage of forests. That's why the solution used by people for stable cultivation on sloping lands is one crop cultivation and then fallow to make forests regenerate, the solution for intensive farming could not be applied on sloping fields as in irrigated rice fields.

The changes in upland rice varieties per crop to exploit soil fertility have caused soil degradation. Is there any other reason that makes the soil degradation except the population density? or is there any other humanity reason ?

Thirdly, in old swidden (slash-and-burn) their own rice are used in first crop, but from the next crops the imported rice varieties are mainly used, especially varieties from Hmong and Thai people. Rice of Khomu ethnic group are not disseminated to other ethnic group. This showed that Khomu people did not exploit soil fertility by using varieties which are suitable to over - cropped soils like Hmong people. So, could forests after swidden farming regenerate in shorter time than the ones among Hmong and Thai people that could be seen on the map of actual forest resources in Muong Phang commune? And which ethnic group has the largest cycle of land use?

+ *Techniques of using maize and cassava varieties to exploit the potential of sloping lands:*

- In the history of food crop development in Muong Phang commune, cassava was introduced into this commune in 1965 by Kinh migrants. It was developed rapidly and occupied a big portion of cereals areas, although the cassavas for sedentary farming and co-op members are forbidden.

Early in the 1960s cassava was ranked second on cereals areas in Muong Phang commune, higher upland rice, however, land for maize only expanded slowly, probably before 1980 area for maize belonged to cooperatives, therefore, it was difficult for co-op members to develop maize. Meanwhile Khomu and Hmong people, who were individual farmers at that time, have advantages in developing upland rice (land for this kind of rice occupied 80 percent of total cropping areas), thus they did not pay attention to maize.

In Muong Phang, during the last four decades, the area for maize was larger than that for irrigated rice and less than that for upland rice, cassava and edible canna.

Why could not maize be expanded as cassava while its price is higher than cassava?

May be cassava could be kept in swidden earth for three years, providing a good solution for fallow and for erosion control (An Van Bay, 1998: 60). According to local people opinions their choice of any cropping system is based on its effect to their farming system as well as to enrich their household economy. The illustrations can be seen below.

A Thai farmer in Co Man village said that price of cassava is less than edible canna (200 VND per kg of cassava in comparison with 400 VND per kg of edible canna). If it can not be sold, it can be stored in swidden earth for 2 or 3 years and every day it can feed animals or be distilled for producing alcohol. Cropping edible canna is not as useful as cassava, moreover it must be harvested in a certain time (from the early December to the middle of January), because traders only buy at that time, then process edible canna into powder and sell it in Dien Bien town. The ability for harvesting them is rather slow (one person can harvest only 30 kg in a half day). It must be harvested in a very short time when the household has many other things to do. Furthermore, children can sell edible canna to buy clothes for themselves so that parents can not control them.

- Used varieties of maize and cassava.

Table 4: **Varieties of maize and cassava used in Muong Phang Commune**

Varieties	Maize	Cassava
- Local varieties	White glutinous and red non-glutinous maize	
- Imported varieties : + Varieties from other locations	-	Non-glutinous cassava with red bark and glutinous one with white bark.
+ New varieties	Bioseed, VN10, technical maize.	

Source: Field work 2001

The above table shows that the number of maize and cassava varieties cultivated in Muong Phang commune were small, not as various as upland rice and irrigated rice. There were new varieties of maize, but no new varieties of cassava. Why do cassava and maize have few new varieties suitable to the different ecosystems like rice? This question is interesting in point of view from cultural anthropology.

- Techniques for cultivating grain crops in sloping lands and Muong Phang's ecosystems.

Techniques of shifting cultivation consist of considering sites, slashing and burning, planting, weeding and harvesting. Every stage of cultivation corresponds with the farming calendar. The cropping season is the most important component that determines the productivity of crops and labor efficiency. Farmers harvest upland rice in the dry season so they are not in a hurry as to harvest irrigated rice. Thus, they can pull up ears of rice by hands or cut every ear of rice by a knife (named *nhip*).

Techniques for cultivating grain crops, maize and cassava mainly are the same, but different in cropping seasons. However, researchers always pay attention to techniques and seasonal calendar of rice crops. Perhaps, it reflects on the importance of rice in the peoples' lives.

Due to natural conditions in the same area, the planting season for plants of every ethnic group is also the same. For example, rice seasonal crop of four ethnic groups living in Muong Phang basically is the same, but the early rice crop is different from the main rice crop and late rice crop.

Table 5: **Farming calendar for the main crops of ethnic groups in Muong Phang commune (according to solar calendar)**

Work	1	2	3	4	5	6	7	8	9	10	11	12
1. Dry rice:												
- Slashing : + New swidden (forests or primary imperata cylindrica) + Old swidden			x		x							
- Burning: + New swidden + Old swiddden					x						x	
- Ploughing or hoeing up old swidden's soil for aeration			x									
- Pricking holes and putting seeds / sowing seeds					x							
- Weeding: + New swidden + Old swidden						x	x	x				
- Harvesting										x		
2. Maize:												
- Slashing : + New swidden + Old swidden		x							x			
- Burning: + New swidden + Old swidden											x	
- Hoeing up for aeration and loose of old swidden's soil		x										
- Putting seeds			x									
- Weeding					x							
- Harvesting							x					
3. Cassava												
- Slashing: + New swidden + Old swidden		x									x	
- Burning and cleaning, hoeing holes' digging		x										
- Putting cassava's cuttings				x								
- Weeding						x						
- Harvesting + One year cassava + 2 or 3 year cassava	x	x	x	x x	x	x	x	x	x	x	x	x

Source: - Dang Nghiem Van, 1972
- Cam Trong, 1978
- Field work 2001

The above table shows that farming work is not distributed evenly on months of a year. Uneven distribution of farming work leads the household to mutual help in agricultural production, especially in cultivation.

+ *Techniques* on swiddens and environments in Muong Phang.

● Cropping techniques on new swiddens :

New swidden means a new one which is situated on primary forests (local people call it ***swidden on high forests***) or on secondary forests (local people call it ***swidden on new forest)*** or on the soil of primary *Imperata cylindrica*. Local people call the above swiddens as slash-and-burn fields.

Specific techniques of slash-and-burn swidden are pricking holes and putting seeds, that needs not ploughing or harrowing the soil up for aeration . Thanks to this technique physical texture of soil is not mixed up, that reduces erosion. In spite of good points of this technique, people only cultivate one crop, then allow land to lie fallow in order to make forests regenerated, and to prevent over-cropping of land. When the population increases, the area of forests decreases, farmers start to do 2 crops a year in a plot.

In the slash-and-burn systems, the season, sowing seeds, weeding are paid special attention. Though the hierarchical role of cultivating methods to the development of cultivated crops are not summed up by farmers as Viet people usually do ("the first is cropping season, second is well-wrought", “labors for planting is nothing but labors for weeding is for harvesting”), the farmers here also summed up the relationship between cropping seasons and ecosystems, the relationships between technical stages and the development of cultivated crops. For example: ff they do slashing late, the trees and bushes are still wet and it is difficult to burn all, or when they cut down the trees, if all branches are not chopped, they are not dry so that after burning there will be less ashes but more weeds, then farmers have to spend more time for weeding; or while burning the trees, if there is sudden rain, it is difficult for trees to be burned and it can bring bad crop and people can get poor.

To ensure crop season and effective harvest, people devote much labor to slashing and burning as well as weeding work. The number of labor for slashing and burning occupies 30% of total labor work; sowing - 9%; weeding - 22% (Dang Nghiem Van, 1972: 62).

● Cropping techniques on old swiddens:

As it is shown in the farming calendar, techniques for old swiddens now have some changes compared to those on new swiddens as follows:

Firstly, there are no more forests for them to do slashing and burning or farmers are not allowed to cultivate in the forests. Instead, they have to clean the grass very soon before cropping (in September of previous year) and they do burning very soon in the new swiddens (in November of previous year). One or two months before planting, farmers again hoe soil up, upset weeds for drying aerating them. Early slash-and-burn techniques aim to increase organic fertilizers : Slash-and-burn grasses create ashes, then the new grasses grow again and they can be hoed up. In fact, it is a type of intensive farming on swiddens, owing to these techniques farmers can do 3 or 5 crops in old terrace field, before fallowing. Until now local people in Muong Phang commune did not plant trees to prevent erosion as well as green-manure plants to make land more fertile, therefore the productivity of crops could not be increased.

Khomu people learned new kinds of techniques from Hmong people in Pu Nhi and Na Tau communes, but Thai people learned

these experiences from their compatriots in Dien Bien Dong district, where the percentage of swiddens are very high.

Secondly, instead of pricking holes and putting seeds, farmers have to harrow (on the gently sloping lands or on top of hills) or they have to upturn and break the earth before cropping. These techniques make the land porous, then they clean all grasses away by steel rakes to prevent grasses grow again. At last they sow seeds or prick holes on the porous earth, or hoe up to put seeds, then fill holes.

Thirdly, the old swiddens need more labors for weeding, because weeds grow very fast; then the fallow duration becomes shorter. Moreover land is exhausted by new varieties of rice suitable to poor soil (as mentioned above) so that it is difficult for the forest ecosystem to be restored.

Comparing the influences of techniques used in old swiddens with ones in new swiddens, a Khomu person as village chief said that: after slash-and-burn cultivation, then fallowed bamboo could grow faster, but in the fields disturbed by hoeing or ploughing then bamboo could not grow.

So far, we can affirm that techniques for slash-and-burn cultivation on sloping land of Khomu people are more extensive than those of Thai and Hmong people. Therefore, forest ecosystem where Khomu people are living and working now are less bare than that in cultivation areas of the two other ethic groups.

Conclusion

Through the results of systematic and specific research on shifting cultivation of some ethnic groups in Muong Phang Commune, it can be seen that every crop system and cultivation technique must be suitable to a certain ecosystem. On the other hand, each ethnic group has its own experiences for sustainable cultivation; one ethnic group used cropping systems and cultivation techniques to make soil exhausted; another ethnic group use rice varieties that select special soils. Cultivation techniques by pricking holes and putting seeds still remain, as they restrict erosion and degradation of soil. However, when the number of population is higher than the capacity of the environment, all ethnic groups used the same intensive cropping systems and cultivation techniques to squeeze the soil fertility so that sustainable development is threatened.

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