Catch-Up Programme

Comprehensive Analysis of Trajectories of CHange in the Uplands

Impact of maize expansion on traditional rice production systems in Northern Lao PDR

A case study in Xiengkhor district, Huaphan province

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1 Introduction

1.1 Geographic situation and study site

Huaphan is a northeastern province of Laos. For a long time independent from both the Lao and the Thai governments, the province became attached to Laos during French colonization. During the civil war, Huaphan was at the heart of the revolutionary movement because of its remoteness and mountainous landscape. Huaphan is the only Lao province that does not belong to the Mekong watershed. The province's main rivers, the Sam river and the Nam river, flow on the Vietnamese side directly into the Gulf of Tonkin.

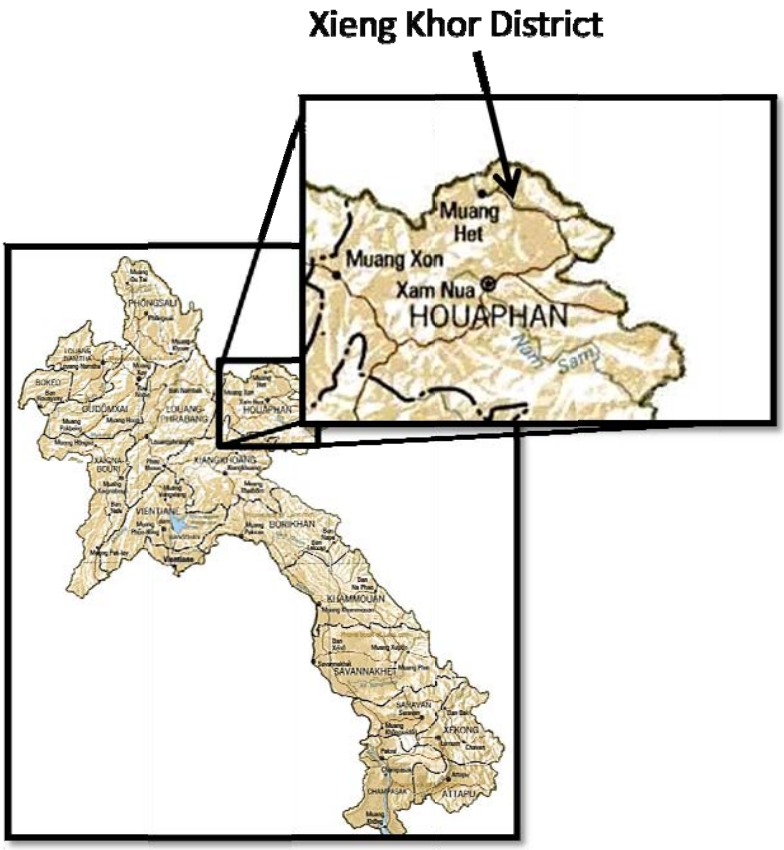


Figure 1: Location of Xiengkhor district in Lao PDR

Xiengkhor district is 119 km from Sam Neua, the provincial capital. It borders Vietnam and has one border crossing point, although another border crossing point is located in Aed, less than 20 km away. The district has 59 villages with a total population of 26 000. Like the other six districts in the province, Xiengkhor is one of Laos' 47 poorest districts. Inhabitants of Xiengkhor district belong to the Tai Dam, Yao, and Ksing Mool or Lao Mai ethnic groups.

The Nam river crosses the district from west to east. This river lies in a large valley; the average altitude at the river level is 300 m and the highest mountain peaks reach 1300 m. Xiengkhor's elevation is lower and the weather warmer than in other mountainous areas in Laos. This natural environment (large valleys and warmer climate) has helped farmers to develop an important paddy production, in some cases with two-season cycles.

The village cluster (*kumban*) is the newly created administrative level between district and village. The **Natong** cluster includes nine villages. The five villages in this study, **Natong**, **Nanong**, **Xiengdaene**, **Nadeua** and **Phuk**, are situated in the western part of the **Natong** cluster; the other four villages, Sopin, Tensan, Piengsan and Soplup, are in the eastern part, 10 km from the study area. In this report, we use the term **Natong** cluster to refer only to the five villages we surveyed, even though, administratively speaking, this term refers to all nine villages.

1.2 Fieldwork methods

This diagnostic study was sponsored by Oxfam Hong Kong as part of a development project aimed at supporting the government's poverty eradication policy. Because Oxfam HK targeted only four villages in the **Natong** village cluster; namely **Natong**, **Xiengdaene**, **Nadeua** and **Phuk**, we did not work initially in **Nanong** village, located in the center of the study area, which encompasses all of the five villages. Resources and time constraints meant we were not able to conduct the same detailed study in **Nanong** as in the other four villages. Instead, we conducted several focus group discussions and an exhaustive survey to extrapolate to **Nanong** the results generated from its bordering villages. The study was conducted between January and April 2009.

1.2.1 Exhaustive survey of households in the five target villages

We first implemented an exhaustive survey of the households in the five target villages (no = 360 households). Every household (HH) head was asked about simple livelihood and economic indicators, such as household composition, age of the HH head, livestock, and house equipment. Questions on agriculture production covered areas for upland rice, maize and communal and individual paddy fields. We also asked about the quantity of seeds sown for each crop.

These data provide general information on each village. They were used for household sampling for a more detailed survey conducted on a limited number of households. These data were used for comparing villages and for statistical analysis. We also applied the typology criteria to this exhaustive survey to estimate the proportion of each household type across the whole study area.

1.2.2 Detailed economic and livelihood survey of households

We interviewed 30 households each in **Natong** and **Phuk** and 20 each in **Nadeua** and **Xiengdaene**, for a total of 100 households. Households were selected using quantitative criteria in an attempt to capture the diversity in farming systems across the whole study area. This survey focused on household livelihood systems. It was also used as support for individual discussions to understand the household history. We analyzed the economic performances of all cropping systems (return to labor, return to land, workload, labor calendar) and studied their agronomic characteristics (yields, sowing density, fallow length, etc.). A specific part of the questionnaire was dedicated to the maize dynamics, i.e., year of introduction, evolution of the production patterns, relationships with traders, thoughts about main problems encountered.

Every household was asked about its current livestock composition and number of animals sold or consumed during the previous two years. Farm and nonfarm income, including Non Timber Forest Products (NTFP) gathering, fishing and hunting, was also analyzed. Other data were collected on livelihood systems, especially on household equipment, house quality and management of rice shortage periods.

In addition to this questionnaire, we mapped individual land use by farmer in 2008 and during the previous three years. This map was used to focus farmers' answers on the year 2008 (i.e., to avoid general responses) and to generate a land use map at the cluster level that captures individual households' land management practices.

Photo 1: Household interview

Interviews generally ran for one hour and took place in the farmer's house, whenever possible in the presence of both husband and wife.

The household typology and economic analyses are based on the dataset generated through this survey.

1.2.3 Thematic focus groups

In each of the five target villages, we started our diagnostic work with participatory mapping with members of the village council. We drew the village borders, delineated the forest areas and main landscape characteristics and collected general information about the village. This map was checked by direct landscape observation and then cross-checked with other villages' headmen during a village cluster meeting.

Photo 2: Participatory mapping and landscape analysis

In each village, following the completion of the household surveys, we organized five thematic focus groups. The five topics were: paddy rice cropping system, upland rice cropping system, maize cropping system, livestock management, and gathering of NTFP. Participants were selected depending on the topic; for example, livestock owners participated in the livestock management focus group. The NTFP gathering and garden focus group was conducted with a group of women.

Each focus group discussed the topic generally, and the facilitator tried to crosscheck the information obtained during the interviews. Focus groups were also used to discuss the topic at the village level and to try to determine a general view accepted by the majority.

Photo 3: Focus group in Phuk village

1.2.4 Validation and final workshop

After analyzing the data and finalizing the report, we organized a two-day workshop in the district capital Xiengkhor. The objectives were (i) to share our findings with the local villagers and (ii) to discuss with farmers scenarios and possible interventions in their villages to tackle any actual or future problems identified. The workshop was attended by 26 farmers from the five villages, including five women (one from each village). Those selected to take part were the traditional village leaders (headman and deputy) along with three middlemen who are closely involved in the maize trade.

Photo 4: Final workshop in Xiengkhor

2 Changes in land use and livelihood systems

2.1 How national policies reshaped the interaction between lowlands and uplands

2.1.1 The traditional land use and tenure system before 1975

The **Natong** cluster is home to four different ethnic groups: the Tai Dam, Ksing Mool, Khmu and Yao. Before 1975, these ethnic groups were distributed among 11 villages, as follows (Figure 2).

The Tai Dam lived in four villages: **Natong** (60 households), **Nanong** (37 households), Nakiu (31 households) and old **Phuk** (27 households).

The Yao community lived in Phokang (11 households), situated in the north.

The Ksing Mool lived in three villages: Natia (8 households) near **Natong**, Ban Bui (15 households) and Ban O (25 households) near **Phuk**.

The Khmu lived in three villages situated along the Dea, Hit and Niup rivers in the north (total 20 households).

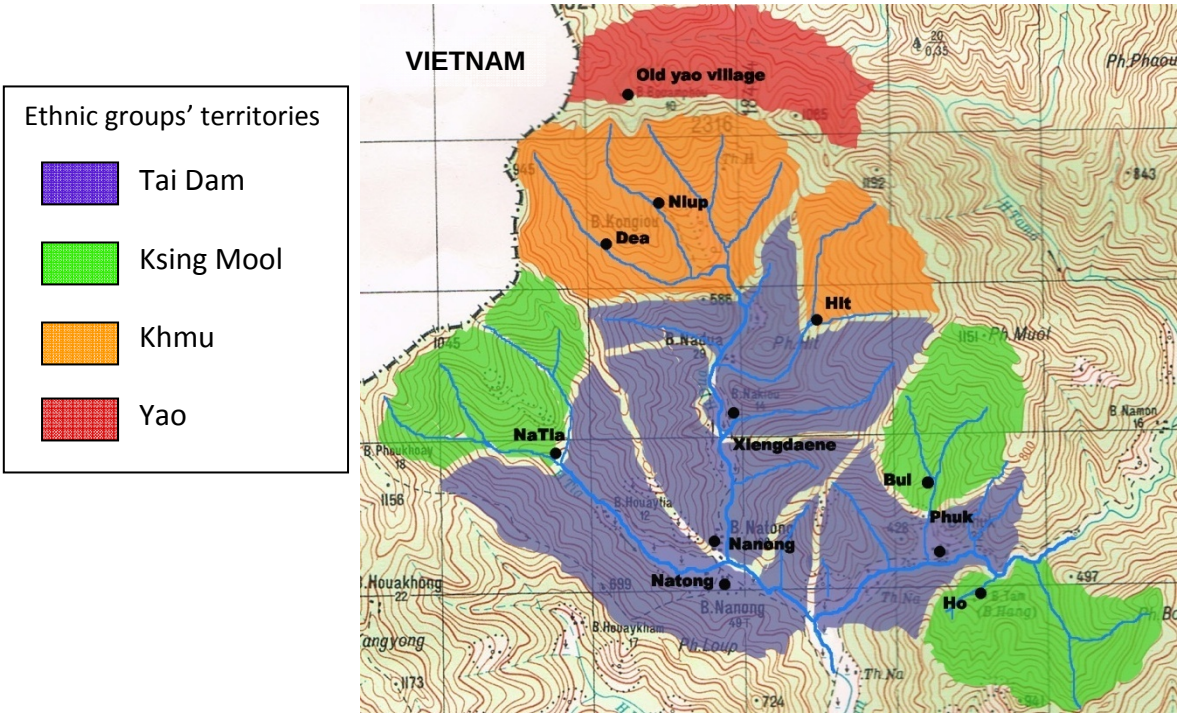


Figure 2: Location of villages in the Natong cluster before 1975

This pattern of human settlement followed the classic tier-wise geographic organization of the different ethnic groups.

The **Tai Dam** people are Lao Loum, which means farmers from the bottom, i.e., the valley. They speak a Tai-Kadai language and are culturally close to the Lao and Thai people. Their main production is paddy rice but they also grow upland rice to complement production from the paddies.

The **Ksing Mool** and **Khmu** belong to the Lao Theung group. They depend on upland fields for they livelihoods but their settlements are located near streams and rivers. They speak an Austro-Asiatic language, from the same linguistic family as Khmer. They were exclusively upland rice producers and practiced slash-and-burn farming with a long fallow period (more than nine years).

The **Yao** belong to the Lao Soung group. They more recently arrived in Laos from southern China. They generally settled above the other villages. They grew non-glutinous rice in upland fields with a

long fallow period following the slash and burn but involved more livestock in their production system.

In the **Natong** cluster, there was both a tiered ethnic spatial organization and a concentric distribution between the center (Tai Dam villages) and the periphery (Lao Soung and Lao Theung). This spatial separation prevented conflicts between the communities over land use on upland fields.

Originally, Tai farmers were the only paddy producers in the cluster. Under the Tai traditional system, lowland fields are a common asset and so are managed at the community level. This system is called ***Na Muong***, the term "Muong" referring to the traditional Tai social and politic unit that included different Tai ethnic villages paying tribute to the same leader. In accordance with traditional rules, the division was discussed between villages. In the case of demographic changes between two periods, areas of paddy fields were transferred from one village to another. After this first division had been made, the village area was divided and distributed among the households belonging to the community according to their size. The household's size was calculated by counting one share for each member older than nine years and 0.5 of a share for a child aged nine years old or younger. The village area was then divided by the total number of shares and lent to the households until the next division five years later.

Nowadays, "Muong" refers to the community at a village level. Every five years, all the paddy fields are divided into shares, which are distributed among the members of the community.

Photo 5: *Na Muong* area around Natong village

Apart from the communal area, which was built collectively, farmers built individual paddy fields (*Na Ti*), which were not included in the collective management of the land.

Also in all the villages where the communal system applied, young families received new paddy land, rather than a piece of their parents' land. This system prevented powerful families from keeping the best paddy fields and accumulating land.

This community system of paddy land management creates a buffer against social and land ownership disparities. Because of the importance of the paddy production in food security, the *Na Muong* plays an important role in upland field production. This system avoids the concentration of lowland fields among a minority of farmers and so the creation of a separate class of poor farmers. However, as the total paddy area is not sufficient to meet rice needs, all the farmers have to produce upland rice to meet their daily needs or to produce a harvest surplus.

The land use system for upland fields follows traditional rules. Uplands can belong to one of the two land tenure systems, i.e., the "private usufruct" and the "common pool" lands.

For a limited period, a farmer has the right to use the last field he cropped. At the end of that period, the field is returned to the common land.

Fields that farmers do not use for a certain number of years return automatically to the common area. A farmer keeps his rights to his last field for five years. This period of time is expressed by a social rule. A farmer can refuse another farmer's request to use his fallowed land no more than three

times. In reality, however, nobody will ask to use land that has been fallowed for less than three years, because of the poor quality of the young fallows.

Although common land can be used by any farmer, in reality only young couples, who have to find new land, use this area. This land is often the most remote.

These rules are not fixed; during our fieldwork we did not identify major changes but we can presume that they have evolved over time with changes in the availability of natural resources.

The villages were affected by the First Indochina War. French soldiers passing through the villages forced the Khmu community to resettle; they also killed one farmer in **Xiengdaene** (formerly named Nakiu). This action forced some of the villagers to live in the forest for a while. The troubles stopped with the end of the decolonization war in 1954. Until 1975, the area was under the control of the communist revolutionary movement; however, as it was away from the main battlefields, the area was quiet and the only effect of the war during this period was the enlistment of the youth in the communist military forces.

2.1.2 Resettlement of highland villages to the lowlands – 1975

After the end of the war in 1975, one of the ruling Communist Party's first policies sought the national integration of the highlands communities by relocating them close to the valleys and agricultural intensification in lowland areas.

In highland provinces, the topography limited the area suitable for paddy rice production. Because of this lack of lowland space, communities traditionally used sloping land to produce upland rice using a slash-and-burn cultivation system. Paddy production was seen as a modern way to grow rice, to increase production and to escape from poverty. The Lao government encouraged highlands communities to terrace new fields and, if there were no suitable areas for terracing in their territory, to migrate to the lowlands. This national policy led to the resettlement of Khmu and Ksing Mool communities to the lowlands where Tai Dam farmers traditionally lived (Figure 3).

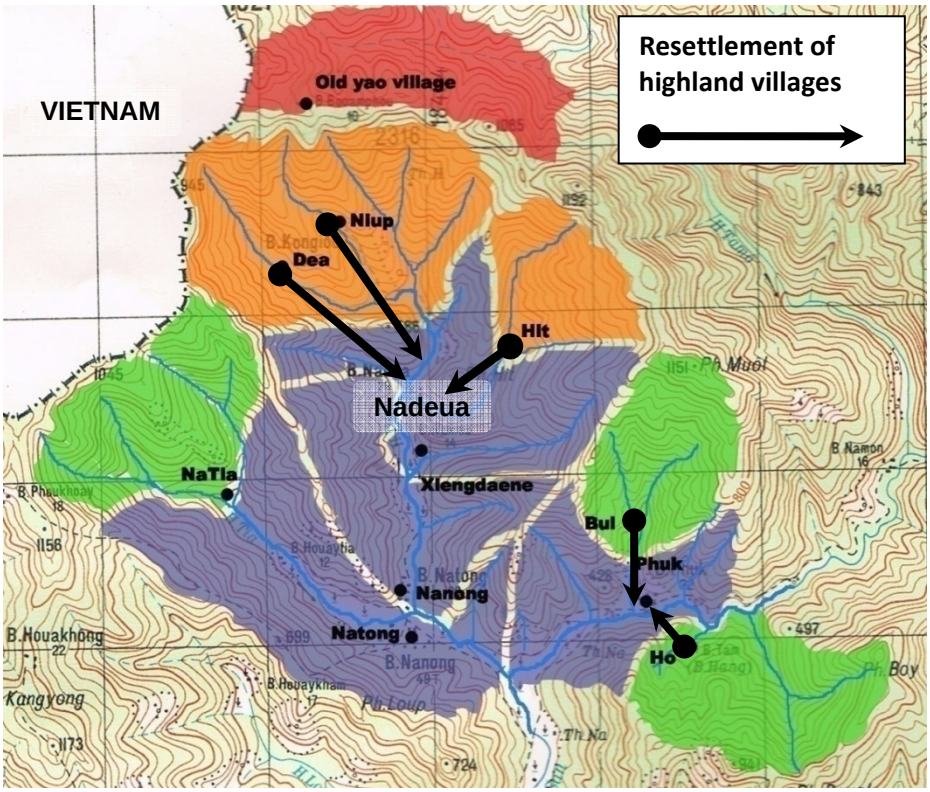


Figure 3: Resettlements of highland villages to the Natong village cluster after 1975

In 1975, the three Khmu communities that lived along the Dea, Niup and Hit rivers moved to settle together in a new village named **Nadeua**. The settlement was surrounded by paddy fields from the Tai Dam villages and an area previously used as gardens by the local farmers. As part of the *taseng* of **Nanong** (an old administrative division - village cluster - that included **Nanong**, **Xiengdaene** and the three Khmu villages), **Nadeua** received an area from the Tai Dam *Na Muong* given by the other three villages (i.e. **Natong**, **Xiengdaene**, **Nanong**). They applied the traditional rules, which allowed the redistribution of the lowland areas between villages. In a social process that may be likened to a form of acculturation, they created a communal paddy field as the Tai Dam would have done. Despite this generous gift, the area was smaller than it would have been if the same rules of division had applied to all the villages. Furthermore, this area was located above the others and therefore faced more water shortages.

Photo 6: Nadeua village

During the same year, the new **Phuk** village was created by merging the old Tai Dam village of **Phuk** and two Ksing Mool communities (Figure 3). Because of the small size of their *Na Muong*, the new communities extended this area to its current size to create a multi-ethnic *Na Muong*. In total, 40 households were resettled to the lowland areas and started to produce paddy rice. However, the extension of paddy fields was limited and this resettlement increased the pressure on the lowlands.

Photo 7: Phuk village

During the same period, farmers started to produce dry season rice in irrigated paddies in response to this population pressure on lowland production. However, irrigation was not possible in all terraced fields. In **Xiengdaene**, the communal area was suitable for two cropping cycles; all households could harvest rice twice a year in the communal paddy fields (*Na Muong*). In **Phuk**, **Nanong** and **Natong**, however, the irrigated area was limited. The Tai Dam communities in **Nanong** and **Natong** negotiated new *Na Muong* rules. In conjunction with the five-year field allocation to individual households for the rainy season, they created a different five-year division for the dry

season. This new system grants every household access to irrigated fields and so to produce in the dry season. As a consequence of this system, the same households do not necessarily crop the same fields during the dry and the wet seasons. Every five years, all the communal lowland plots are redistributed among the families according to their demographic composition.

2.1.3 Failure of collectivization and its impacts on land use – 1980s

At the end of the 1970s, the government of Laos launched farmers' cooperatives; cooperatives had been created in our study area. They consisted of working groups, each with 10 people, for upland rice and paddy rice production. However, because of poor economic results and threats to national rice production, the Lao government stopped this policy in early 1980s. In the **Natong** cluster, this policy had a very limited impact on the farming system. As community management of the paddy fields and labor sharing for weeding or transplanting already existed, the collectivization policy did not really change their local institutions. The *Na Muong* system survived the sudden policy change.

However, the end of this collectivization policy had two effects on the traditional land use rules.

During the period of cooperatives, former individual paddy fields had been combined as communal land. With the end of the policy, rather than farmers claiming their old paddy fields, a community decision was made to turn all the *Na Ti* into *Na Muong*. As a result, the *Na Muong* area suddenly increased during this period.

Some of the farmers who had enough labor and capital, especially in **Natong**, **Nanong** and **Xiengdaene**, began building individual paddy fields again by terracing a small area with a small private irrigation system, which they then extended each year. This extension stopped in **Xiengdaene** in 2000 but continues in **Natong** and **Nadeua**. The main limitation to the expansion of irrigated paddies is the lack of suitable areas, as irrigated paddies require moderate slopes and a source of water.

The reemergence of individual properties in paddy fields led to the creation of a land market. Paddy fields, fruit gardens and fishponds were the only plots that farmers could trade among themselves. Debts, migration and the need for cash pushed some *Na Ti* owners to sell their fields. These sales occurred in the beginning of the 1990s between farmers from **Nadeua** (vendors) and farmers from **Nanong** and **Natong** (buyers). As their fields were small, the vendors from **Nadeua** usually experienced difficulties in managing the rice production there. Buyers usually purchased a small area, but succeeded in improving the irrigation system and in expanding the paddies over the years. With the development of individual paddy fields, sometimes far from the village, farmers started building secondary houses near their paddy fields. This phenomenon appeared in **Nadeua**, especially for farmers from other villages who bought paddy fields in the **Nadeua** territory.

The second indirect impact of the end of the cooperatives was the disruption of the *Na Muong* system in the Tai Dam villages.

The Khmu community was forced to move from the periphery of the village cluster to the center. This move disrupted the traditional *Na Muong* system that had worked in the past in all Tai Dam villages. The Tai Dam communities first granted a paddy area to the incoming village, but they then stopped dividing the whole lowland area among villages, possibly because Tai farmers refused to share their paddy fields with members of a different ethnic group. The first division in 1975 was possible because of the political context that forced local compliance with the policies from the central government. However, in the absence of strong government pressure, Tai farmers could not see any benefit in sharing their land. When the cooperative policy changed in the mid-1980s, in both Vietnam and Laos, land was given back to the former owners. In the Tai villages, however, the collective paddies were maintained. Somehow, the de-collectivization process was used as a pretext to change the traditional rules and avoid sharing the paddy fields with the Khmu community.

As a result, the population of **Nadeua** increased over the years, while still relying on the same limited communal paddy area. The pressure on the land was so great that farmers decided to discontinue the system and to stop redistributing the communal area every five years. Even though

farmers still call the land "*Muong*", i.e., communal, the land is owned individually and young farmers have no access to this area.

2.1.4 Land use planning implemented by the village communities – 1997

After successive government policies regarding the access to and use of lowland fields, in the mid-1990s, the uplands became a major concern for the Lao government and also for the international community, for two reasons. First, biodiversity conservation and forest protection were seen as major challenges to be tackled promptly. Examples of deforestation in other Southeast Asian countries were used as repulsive scenarios to be avoided. Second, poverty tended to be concentrated in upland areas. Policies directed toward increasing incomes in upland areas were seen as the best way to alleviate poverty at the national level. For officials, slash-and-burn agriculture used natural resources, especially forests, in an unsustainable way and this degradation could then lead to more poverty. The goal of these new policies was to break the vicious circle of the poverty trap–environment degradation by shifting from subsistence to commercial agriculture. Commercial crops were supposed to increase farmers' incomes and alleviate poverty, and with the eradication of shifting cultivation through slash-and-burn practices, it was believed the forests could regenerate and be used sustainably for timber production.

To fulfill these objectives, the Lao government, with the support of the international community, initiated a development program for the uplands. This program included a new wave of resettlement to ensure good livelihood conditions for the most remote villages, which would get closer to the focal development areas, and land use planning at the village level.

This resettlement policy had the same objectives as the one in 1975: to move communities from the uplands to the lowlands so they could gain access to markets and health infrastructure. In the **Natong** cluster, the Yao community and the Ksing Mool from **Natia** were moved.

The Yao community settled in a small area between **Phuk** and Sobsane. In contrast to the 1970s context, they were not granted any paddy fields. Their new land area was too small to ensure sustainable production of rice through slash-and-burn cultivation. The district government pushed them to plant longan trees, which they did. While the orchards developed as planned, they did not generate any income as no traders in the district were interested in the product. The community then had no choice but to continue growing upland rice without rotations. For them, the resettlement policy was a total failure as it significantly decreased their real income and livelihood conditions.

The Ksing Mool in **Natia** moved to the **Natong** settlement, although some kept a second house in their old settlement. Surprisingly, they abandoned their original ethnicity and became Tai Dam. As a result, they officially gained access to the communal paddy area and so could share the village *Na Muong* with other households. More than 10 years later, the majority of them no longer exercise their rights over the paddy fields. During interviews (in the presence of the headman), they explained this situation by their preference for upland rice production and their lack of small tractors or buffaloes to plough their paddy land. However, we can presume possible pressure from the Tai Dam majority to restrict their access to the village *Na Muong*.

Together with the focal area development policy, land use planning was to be implemented at the **village level**. With the help of the District Agricultural and Forestry Office (DAFO), villagers had to delimitate different areas in the village territory and adopt specific land uses according to each area's suitability. Forest and agricultural areas had to be delineated within the village territory, and then the agricultural land had to be divided according to different categories of subsistence and cash crops. The land allocated to upland rice cultivation was purposely limited to an area (three plots of 1 ha each per family) smaller than that necessary to practice shifting cultivation in a sustainable manner (i.e., 5–10-year fallow period depending on soil quality). Farmers' access to the uplands was artificially restricted to force them to stop the slash-and-burn system. The next step in the land use

planning and land allocation process (LUPLA) was to grant official land rights certificates to individual farmers to secure their investments in their commercial crops and to increase their return to land.

In the Natong cluster, however, farmers applied their local version of the LUPLA policy.

Since the resettlement of **Nadeua** in 1975, farmers from different villages used upland areas with no defined territories. **Nadeua** faced the greatest difficulties, as the community used the most remote areas and had to deal with Tai Dam farmers in their own territory, who used this area to produce their upland rice; they also had to deal with the recent increase of the population in **Nadeua** (20 to 30 households from 1975 to 1997). Therefore, access to old fallows became a major priority. In these conditions, land use planning could not be applied within the territory of each villages. The communities decided therefore to negotiate land use planning during an intercommunity meeting; i.e. village sub-cluster meeting. Headmen and representatives from five villages (**Phuk**, Yao village, **Natong**, **Nanong**, **Xiengdaene** and **Nadeua**) met in **Natong** to discuss and negotiate the villages' boundaries – in the absence of DAFO's intervention. This is an endogenous initiative; the land use policy was used as a pretext to open negotiations to resolve the tensions on land use between the villages.

Every community arrived in this meeting with their own objectives. For **Nadeua** farmers, the main objective was to eject the Tai Dam farmers who used their area, as their removal would release some fields for the **Nadeua** community. The three Tai Dam villages, with the biggest population, wanted to increase their influence over the village cluster. The negotiations ended in a compromise. The **Nadeua** farmers officially received the territory around their settlement that was not suitable for crop production. In exchange for the departure of the Tai Dam farmers from this area, **Nadeua** agreed to give the west side of the Dea valley to **Natong** and **Xiengdaene**. Knowing that this area was the former location of one of the old Khmu villages, **Natong** and **Xiengdaene** made a real territory gain to the detriment of the **Nadeua** community.

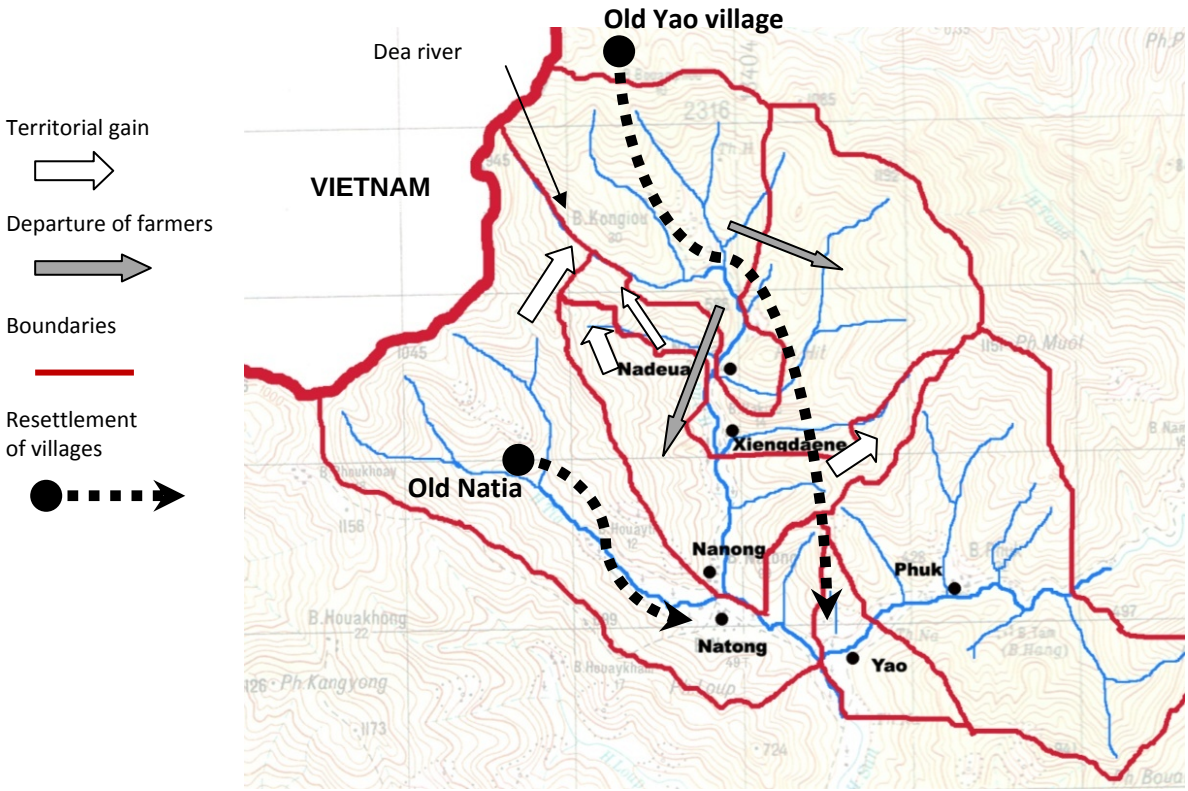


Figure 4: Village boundaries & land use planning outcomes

The result of this meeting was a new distribution of the uplands between villages. Even though **Nadeua** succeeded in reaching a compromise, they are now locked into their small territory without suitable means to ensure their food security, a situation that shows their lack of negotiating power.

The villagers did apply the following step in the LUPLA process, i.e. land allocation to individual farmers. Land is still under community management. There is no private property on upland fields. Land pressure is still high, but without economically viable alternatives, farmers continue to produce upland rice with a 3–4-year fallow rotation. The protected forest areas are limited to small rocky areas.

2.1.5 Shift from subsistence to commercial agriculture because of new roads – 2003

In 2003, Xiengkhor district entered the list of the 47 poorest districts in Laos. This list was made so funds could be concentrated in the poorest areas, especially in the uplands. Following the strategies of the 1990s, the main approach of this program is to invest in public infrastructure (education, health and transportation) and information in these areas. The PRF (Poverty Reduction Fund), a national agency that is partly financed by the World Bank, is in charge of implementing these programs. The PRF uses a participatory method. Farmers discuss the issue at the *kumban* level (the newly created administrative level between the village and the district), and choose one of the projects proposed by the PRF. Between 2003 and 2008, the PRF improved road access, making the roads accessible for trucks, built water supplies, built schools, financed nurses' formation, financed concrete irrigation and built a bridge across the river (which can be crossed on motorcycle only). This infrastructure dramatically changed local livelihoods. Children can go to school in the village up to the M3 level (third year of middle school - approx. 13 year old). Services (market, health dispensary, secondary school, gas station) in the district capital Xiengkhor can be reached in 30 minutes by motorcycle; previously, it took half a day.

Infrastructure investment is not the only external factor. The district government decided to improve market access by reducing taxes on exports to Vietnam and by exempting Vietnamese traders from paying a specific tax on foreign investment. However, more than that administrative move, regional trends in commodities and the cheapness of Lao commodities are responsible for the introduction of cash crops in the **Natong** cluster.

Farmers started to produce cash crops on a large scale. Previously, cash crops such as maize, vegetables or even cotton were grown in very small quantities. The possibility of finding traders who could buy directly in the village allowed farmers to focus more on cash crop production. The first attempts were made with soya bean production between 2003 and 2004, followed by maize in 2005; at this point, every household started to shift their production system from subsistence to commercialization.

2.2 Unequal access to natural resources as a source of disparity between villages

2.2.1 Current production system: Combination of upland rice, paddy and maize

Traditionally, farmers were paddy growers or upland rice producers. There was a clear distinction between those who produced only upland rice (Ksing Mool, Khmu and Yao) and those who produced both paddy and upland rice (Tai Dam). As we have seen previously, this ethnic and geographic separation was disrupted by various policies, resulting in the current situation. Farmers use a combination of two cropping systems, paddy and upland rice for their own consumption, depending on their access to lowland fields. The third cropping system is the only cash crop still grown in the **Natong** cluster. This is also the only cropping system used by every household, because some farmers have stopped upland rice production and others do not have access to paddy fields.

The paddy cropping system

Paddy rice is grown in terraced fields. Production during the dry season is limited by lack of irrigated fields. Farmers start to prepare the seeds in a nursery 20 days before transplantation. They use this time to plough, prepare the fields and renew the terraces. Then they weed generally once only. They do not use herbicides or chemical fertilizers. In the past, they used to plough with a buffalo but with the introduction of small tractors, they have tended to stop using buffaloes in paddy production.

The upland rice cropping system

Until recently, all farmers in Natong village cluster grew rice in upland fields. Upland rice was used either to ensure food security because the area of paddy was not sufficient or as cash crops for households with individual paddy fields. Fallows are usually for three years; farmers slash just scrub and bamboo. In general, farmers weed three or four times after sowing. No chemical fertilizers or herbicides are used in the production. Rice is planted together with a diverse range of products in upland fields, including watermelon, sugar cane, chili, pumpkin, eggplant and traditional maize.

The maize cropping system

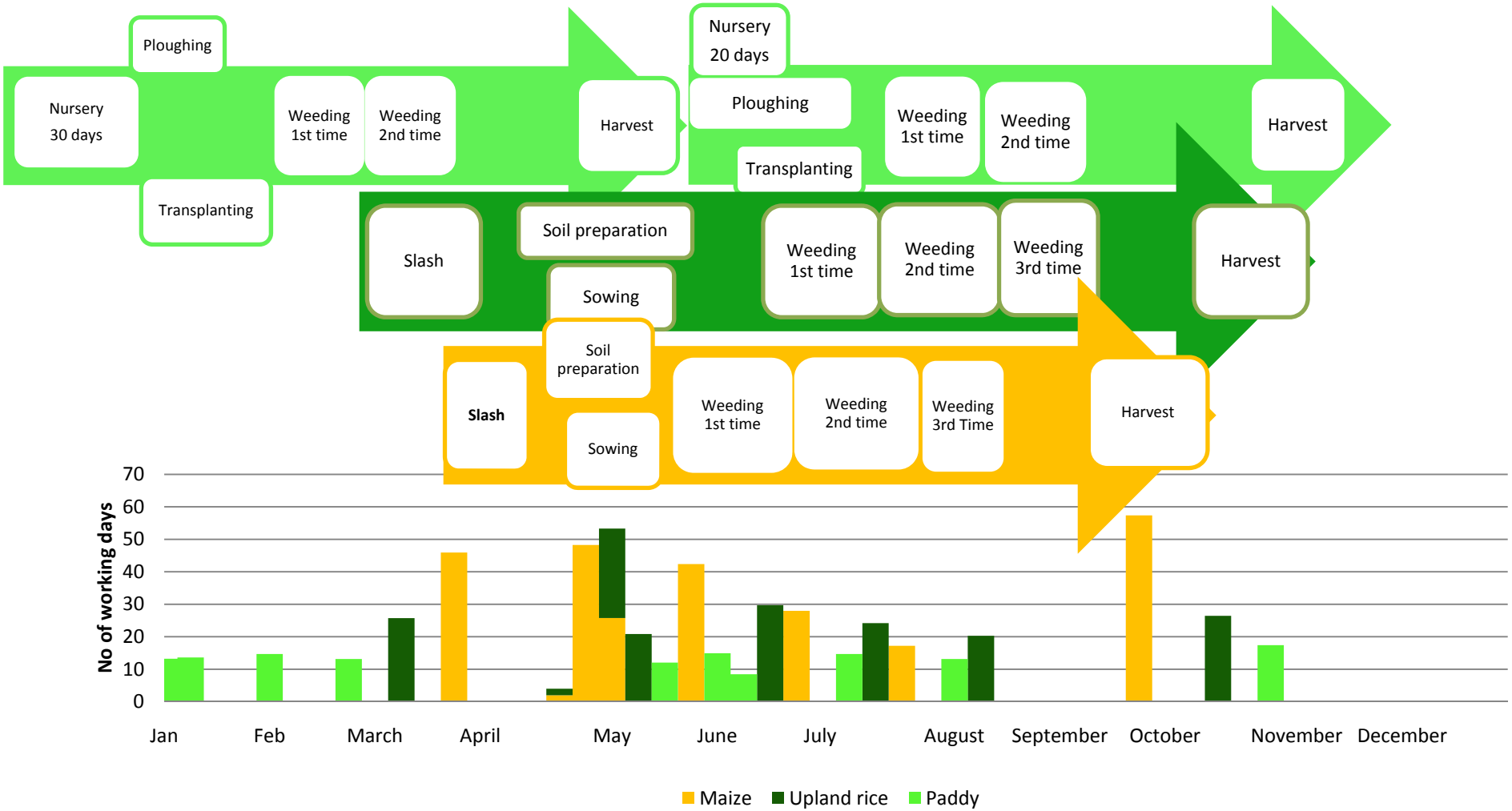
Maize production is now the most important production in the five villages, as every household produces maize in one, two or three individual fields without rotations. Slashing occurs at the end of March; depending on the field, farms can slash scrub or simply clear small grass if there is no fallow. Sowing is done with a stick without rows. Farmers generally weed twice. No herbicides or chemical fertilizers are used in the production. Harvesting takes place in September and October. Sometimes pumpkin or chili are also grown in the maize fields but only for family consumption.

In the uplands, the labor cropping season starts with the slashing of rice fields in February and ends with the harvest of rice in November (see Figure below). Maize is prepared after upland rice and harvested before, in October. Paddy production in the rainy season starts in June and ends with the harvest in November. The dry season completes this calendar, with the preparation of the seedlings starting in mid-December. The second season of the paddy production sees an intensification in the labor calendar as there are no months “free” of work.

The labor peak occurs during May and June, with the preparation, sowing and first weeding of upland crops and the transition between the two seasons of production in the paddy fields.

The management of buffaloes and cattle is directly linked to the crop calendar. The pressure on land and the insecurity over the fallow management have pushed farmers to move their livestock out of the cropping space. Pigs do not wander freely but are kept in cages in the village and fed with cassava and vegetables throughout the year. Cattle and buffaloes are kept in a limited area from April to November, while the crops are growing. These restricted areas are fenced by the livestock owners (in **Nadeua**, **Phuk** or **Natong**) or by the farmers near the area (**Xiengdaene**). There is no pasture in those areas but only young forests and water. Livestock owners have organized themselves to take turns to tend the cattle. Farmers decided to create those areas: 2003 in **Natong**, 2006 in **Nadeua** and **Phuk**, and 2007 in **Xiengdaene**. The creation of these areas occurred in conjunction with the emergence of cash crops and the additional pressure on land use. **Nanong** is the only village in the **Natong** area where livestock are kept near the house during this period, because of the lack of free space. For the rest of the year, from December to April, the livestock wanders freely in the village territory eating crop residue.

The labor calendar



2.2.2 Upland production strategies are influenced by access to lowland fields

The five villages included in the **Natong** cluster differ from each other in several aspects because of their history and environment.

The five villages have a total population of 2212 distributed among 360 households, comprising 226 Tai Dam, 115 Khmu and Ksing Mool and 19 Yao households.

The five villages are of different demographic sizes. **Natong** is the biggest village with a population of 720, followed by **Phuk** with 591 inhabitants (458 excluding the Yao community). The three other villages are far smaller. Only 199 people live in **Xiengdaene**. A village's demographic size is important; it is partly because of their size that **Natong** and **Phuk** have better public facilities (school, medical clinic). They also have more negotiating power especially during cluster meetings. The size of the workforce follows the same pattern.

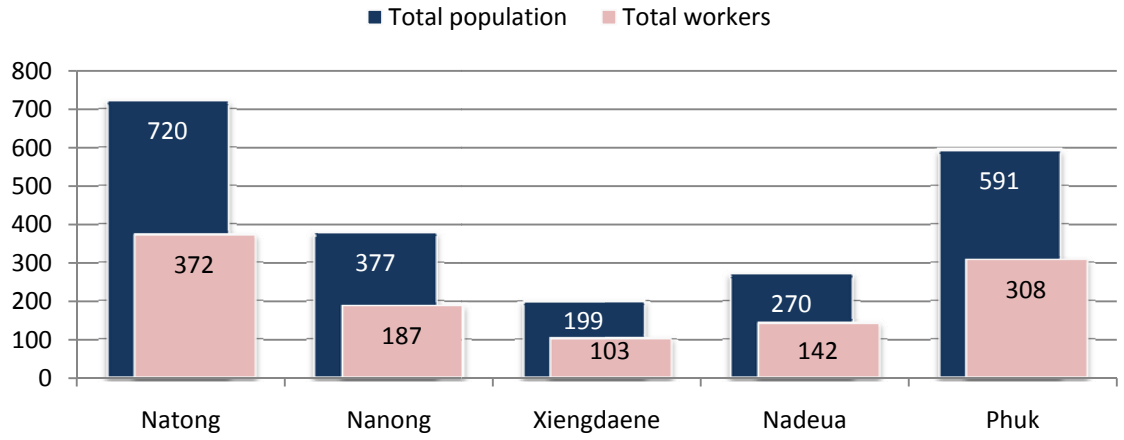


Figure 5: Demography of the villages

The result of the *Na Muong* system, resettlement, collectivization and expansion of the *Na Muong* area and privatization of the new paddy fields is a real patchwork of land ownership in the lowland area (Figure 6).

First, the traditional Tai Dam *Na Muong* is located in lowland areas near the villages where it was easier to build, around each village, along streams. Communal paddies are generally all in one piece and the irrigation system services a large area of the *Na Muong*. Those areas were extended to their current area during the collectivization, when individual paddy fields were incorporated.

The **Nadeua** area was used in the past to minimize differences in the *Na Muong* between **Nanong**, **Xiengdaene** and **Natong**, which explains why we found communal fields from those villages in the **Nadeua** area.

After the mid-1980s, farmers built individual paddy fields around the *Na Muong* and along the neighboring rivers. Those individual paddy fields possess independent irrigation systems. Some have since been sold and as a result the land ownership is heavily fragmented, particularly around **Nadeua**.

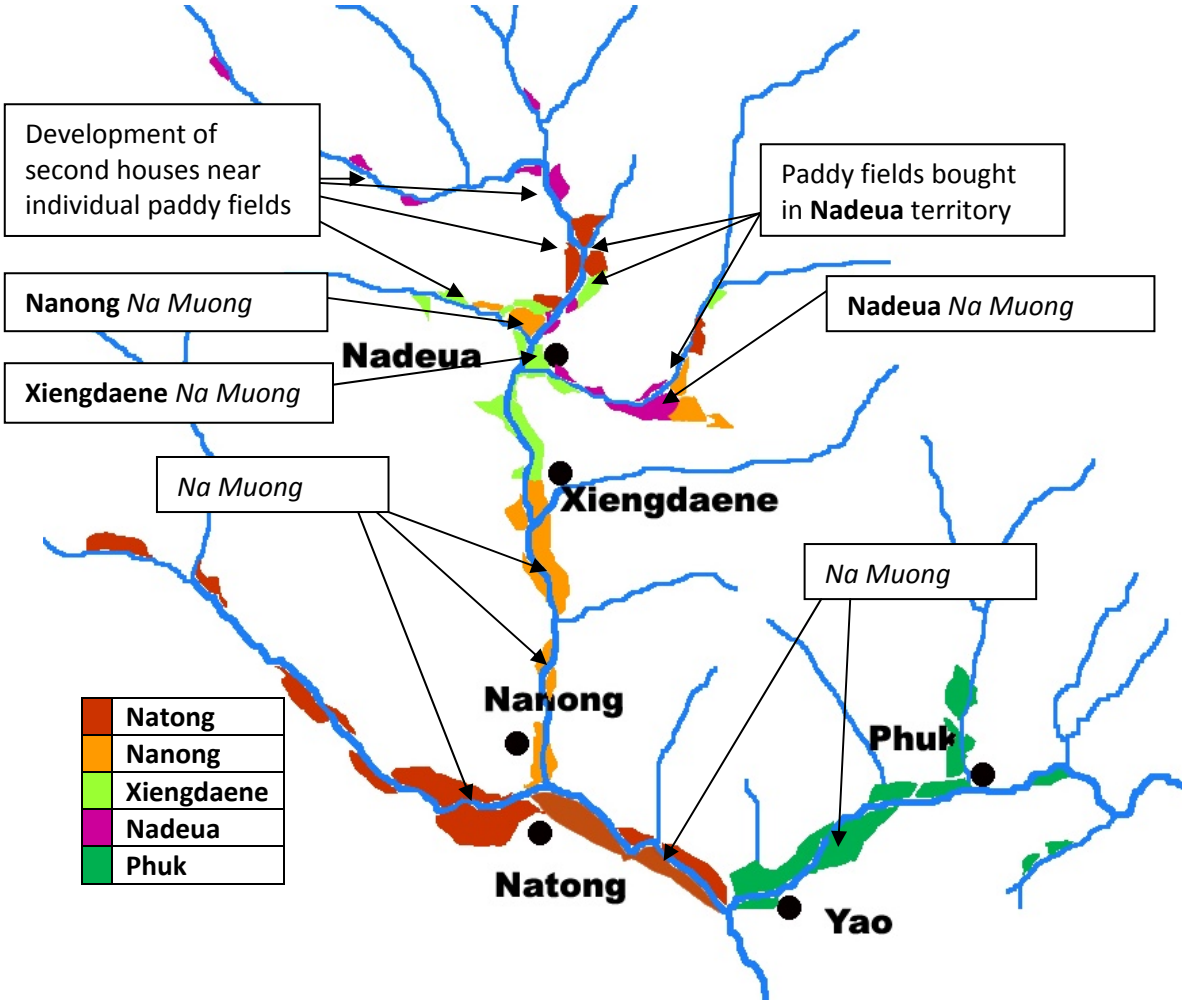


Figure 6: Land use on lowland fields

In 2005, farmers realized the most recent division of the *Na Muong*, as follows. In **Natong**, one share equals 300 m^2 in the rainy season, in **Nanong** 220 m^2, in **Xiengdaene** 500 m^2, and in **Phuk** 262 m^2.

These differences between villages are important and are linked to the availability of the total lowland fields. We cross-checked this information by comparing the villages' total paddy areas.

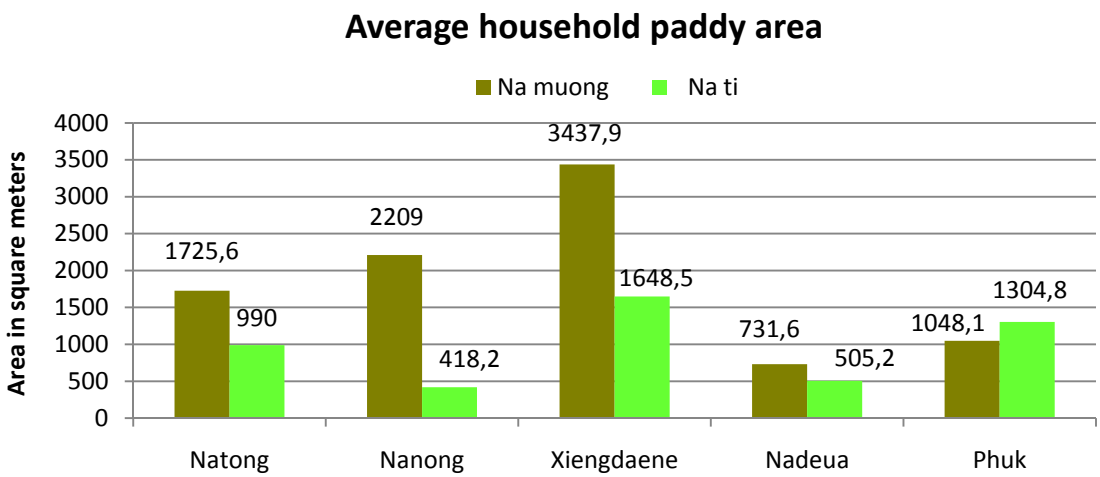


Figure 7: Lowland composition & distribution among villages

In terms of land size, there is a huge gap between **Xiengdaene** (3437 m^2 of *Na Muong* and 1648 m^2 of *Na Ti*) and **Nadeua** (only 731 m^2 of *Na Muong* and 505 m^2 of *Na Ti*). We see also that the farmers have invested differently in individual paddy fields. **Xiengdaene** and **Phuk** lead with 168 m^2 and 1304 m^2, respectively. By contrast, two similar villages, **Nanong** and **Natong,** do not have the same distribution of lowland fields, as lack of space meant **Nanong** farmers were unable to build new individual paddy fields.

These differences in access to lowland fields led to different strategies in upland fields (Figure 8).

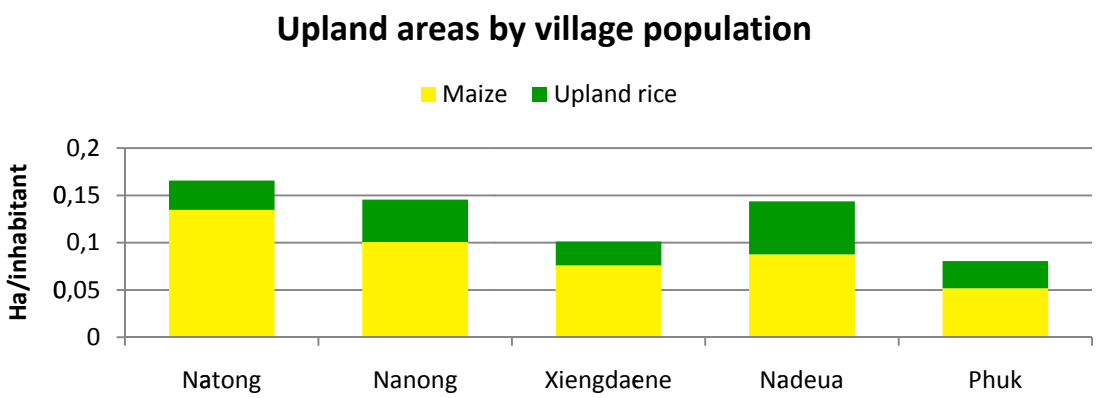


Figure 8: Upland crop composition & distribution between villages

Xiengdaene has the smallest distribution of upland area with only 0.1 ha/inhabitant; **Nadeua** has 0.15 ha/inhabitant. However, as they have a similar distribution of maize area, differences are due to the larger amount of upland rice, widely produced in **Nadeua** because of the lack of lowland fields, as previously noted. In **Natong**, the distribution is more than 0.15 ha/inhabitant, which is used mainly for maize production.

The case of **Phuk** seems the worst in the **Natong** cluster with 0.08 ha/inhabitant, but this misrepresents the reality of situation, as it overlooks the significance of the Yao community being caught in independent territory and using part of the Sobsane uplands (a village south of **Phuk** and **Natong**).

Households' production strategies depend on the availability of land. We clearly see that in villages with the larger lowland areas, such as in **Xiengdaene**, farmers use less of the uplands; by contrast, in **Nadeua**, farmers have a small lowland area and use a larger uplands area (0.14 ha). The same reasons can explain the differences between **Natong** and **Nanong**. In **Natong**, farmers have slightly less lowland area than in **Nanong** and they use more upland area. However, this upland area is mainly used for maize production, because the paddy fields are quite sufficient to ensure food security.

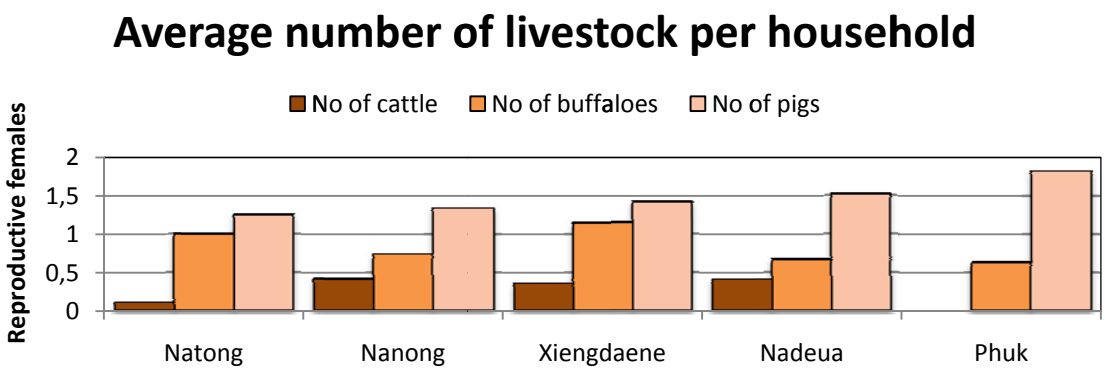


Figure 9: Composition & distribution of livestock in villages

Differences in livestock capitalization are closely tied to farmers' wealth. In Tai Dam villages (**Natong**, **Xiengdaene**), farmers used to employ buffaloes in their paddy field production, which could explain the relatively high numbers of buffaloes in those villages. The villages have different uses for cattle. For reasons that are not completely clear, farmers in **Phuk** own no cattle; apparently, some farmers' failure in raising cattle discouraged others from trying. In **Natong**, a small minority of farmers keep cattle. By contrast, cattle seem very important to the production systems in **Nanong**, **Xiengdaene** and **Nadeua**. Especially notable is the case of **Nadeua**: although other indicators seem to present this village as the poorest in the **Natong** cluster, surprisingly it has the same level of livestock capitalization as in the other villages.

The number of pigs does not seem to be a differentiating factor among villages, as nearly all households breed pigs; we could expect to find the same result with poultry. These smaller animals are mostly used as a subsistence breeding system to provide capital during the hunger gap and for ceremonies.

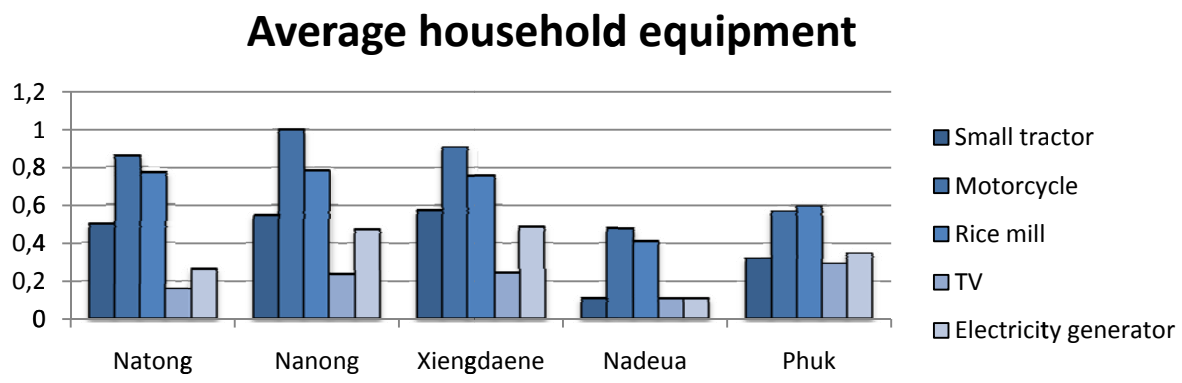


Figure 10: Distribution of household equipment in villages

The level of household equipment can also be used to compare the villages' wealth (Figure 10).

Small tractors (hand tractors made in China) account for the largest investment (6.6 million kip). Small tractors are used in lowland fields for paddy production. We see that the level of small tractor ownership is similar for the three Tai Dam villages (**Natong**, **Nanong** and **Xiengdaene**). Farmers began purchasing these small tractors in 2003. Small tractors are a sign of wealth but are directly linked to paddy production; this partly explains the differences with **Nadeua** and **Phuk**, where paddy production is less important. In reality, the majority of the farmers use small tractors in their paddy fields; those who do not own one use family connections or rent a small tractor from someone else (150 000 kip/day).

Motorbikes are sold by traders in Xiengkhor; farmers began purchasing them with the first incomes from the maize production. Again, farmers in **Natong**, **Xiengdaene** and **Nanong** are well equipped. Only 50% of farmers in **Nadeua** own a motorbike. Use of motorcycles has reduced travel time to Xiengkhor from half a day to 30 minutes, which saves considerable time for administrative applications, medical consultations and access to secondary school and market places. The purchase of rice mills follows the same trend.

2.2.3 Upland fields at stake with the rapid expansion of cash crops

Before the introduction of cash crops, the major source of tension was the lowland area. Communities either have managed to keep their areas from other villages' expansion or have faced difficulties. All those tensions resulted from the basic observation that access to lowland areas was clearly the source of wealth. Thanks to the redistribution system, inequalities within communities were minimized; significant inequalities are observed only between the villages.

With the slight increase in paddy areas in the 1980s and 1990s, farmers reached a geographic limit. The increase in production, and therefore in income, could no longer come from lowland

production. As a result, the upland areas became the new source of wealth. Farmers' ability to increase their incomes in upland fields determines a new differentiation scheme.

Recently, the uplands have become the major source of tension between the villages. First, in 1997, land use planning was an opportunity for the villages to re-deal the cards. At that time, upland rice production areas were at stake. However, with the recent shift in the use of the uplands, those areas have become the major source of wealth. Tensions between the villages have escalated because of the relative increase in income for every household. When pressure on the land heightens, boundaries in the uplands could become a new source of tension. For now, every village community produces in its own territory and upland fields cannot be sold. We believe that, in the future, following current trends, this situation could evolve. Farmers will find ways to get around the rules. There is a possibility of the development of contracts between poor and rich farmers, where poor farmers might choose to sell their produce before growing it in exchange for the rice needed during the rice shortage period. Although such contracts do already exist between some traders and farmers, we can presume this scheme will be extended with the widening in income disparities.

2.3 Understanding the various livelihood systems

2.3.1 Different farming systems based on access to lowland fields

The different production systems are the result of both environment and history. As maize production was only recently adopted by every household, it cannot be used as a criterion to define the typology; rather, maize production is an indicator. Neither can the livelihood level of capitalization be used as a criterion because of the large variety in household situations and strategies.

As we have seen previously, rice sufficiency is a key factor in the diversification of production. We have considered how different strategies to ensure food security are closely linked to the farmer's ability to get access to lowland fields. As a result, access to lowland fields, which means ownership of an individual paddy field, personal situation within the village and diversity among villages structure the typology.

Following these criteria we have identified five farming systems (see Table below). The first four farming systems (A, B, C, D) have been classified according to their different levels of access to lowland fields.

Farming systems A, B, C and D all have access to the communal paddy fields.

However, farming system D faces difficulties in getting access to the *Na Muong* because these farmers live in a village with a small communal area (**Phuk**, **Nadeua**) or they are independent young couples waiting for the next division of the *Na Muong* to get a paddy field.

D2 is a variation of farming system D, in which difficulties in getting access to the lowland fields are linked to the unique situation of the Yao community. This system differs to D because of the impossibility of gaining access to lowland fields by waiting for the next division of the *Na Muong* and the upland rice cropping system without rotation.

Farming systems A and B involve ownership of individual paddy fields. Farming system C uses only the communal area, but this area is quite sufficient (C farmers live in **Xiengdaene**, **Nanong**, **Natong** and **Phuk**); in contrast to D farmers, C farmers do not experience great livelihood difficulties.

We use a second criterion, upland rice production, to separate farming systems A and B: A farmers stopped upland rice production to grow only cash crops in upland fields. This is a clear change in household strategy.

	Typology criteria			Other information				
Type	**Common paddy field**	**Individual paddy field**	**Upland rice**	**External income**	**Rice shortage period**	**No of people / worker**	**Household equipment**	**Maize area**
A	Yes	Yes large area	No	Some have official responsibilities or own a shop	0.4 months	2.18	Small tractor Motorbike Rice mill TV	2.12 ha
B	Yes	Yes moderate area	Yes	Some have official responsibilities or own a shop	1.5 months	2.35	Small tractor Motorbike Rice mill TV	1.3 ha
C	Yes	No	Yes	Some work in the fields if they face a long rice shortage	1.3 months	2	Motorbike Rice mill	1.6 ha
D	Yes small area or none	No	Yes	Paid farm work during the rice shortage period	4.7 months	2.45	Motorbike	1 ha
D2	No	No	Yes	Paid farm work during the rice shortage period	2.8 months	2.21	None	2.11 ha

2.3.2 Diversity of farmers' strategies to secure food sufficiency

In the subsistence production system, food security is the main objective of the household strategy. In commercialized agriculture, the household objective is to maximize potential income. Currently, farming systems in this area are in transition to commercialized agriculture, but this transition is not occurring as a single movement. Some farmers are more advanced in this transition, some have already passed it, and others have just begun to commercialize their production. These intervals create diversity and sometimes complementarities of objectives between farmers within the same community.

The easiest way to characterize food security is to study the duration of the rice shortage period, when the household has run out of rice they have produced.

Figure 11 compares the duration of the rice shortage period for the farming systems. This chart sets out two sets of information: the length of the average rice shortage in months for all the households in the sample, and then the average duration of the rice shortage period for the households who experience one. If the two averages are almost the same, then the majority of farmers in this type experience the greatest rice shortage.

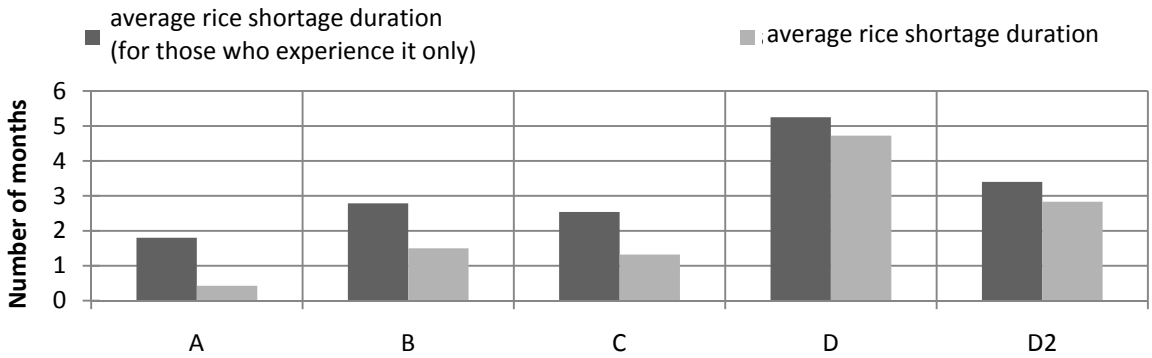


Figure 11: Rice shortage periods by household type

Farming systems D and D2 face the longest rice shortage periods. For those farming systems, a rice shortage lasting more than six months is common. This is in contrast to the other farming systems, A, B and C, which experience, on average, less than two months without rice. This situation can be easily overcome by households with income from livestock.

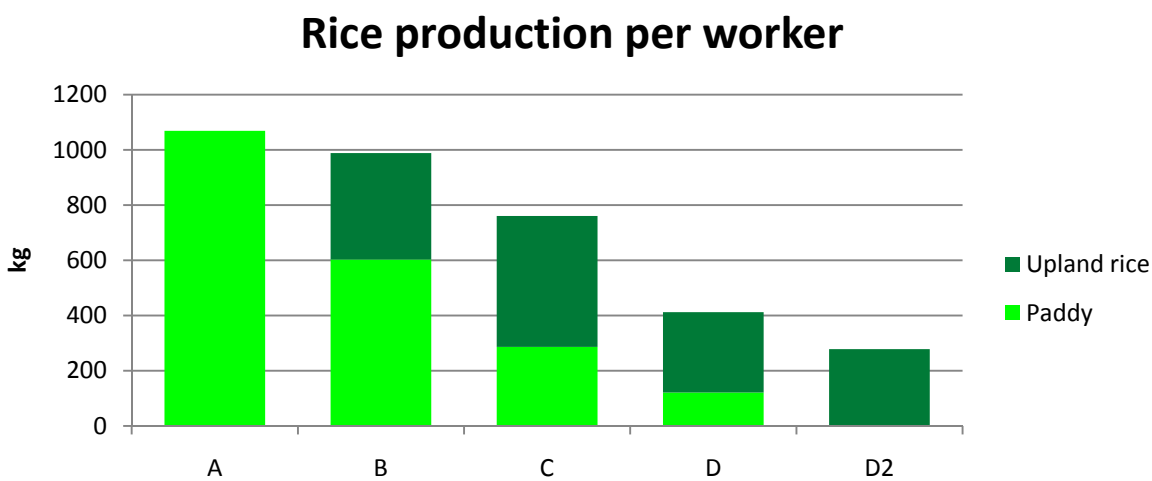


Figure 12: Composition of rice production by household type

We find the same differences between farming systems in their total production of rice. Farming systems A and B produce about 1000 kg of rice per worker, compared with 400 kg for D and 300 kg for D2. Farming systems A and B achieve the same level of food security but by different means: Farming system A produces exclusively paddy rice and B farming system produces just 600 kg of paddy rice complemented by a production of 400 kg in upland fields. Differences in paddy production stem from the importance of individual paddy fields, because both types have access to the same communal lowland fields.

Farming systems D and D2 experience great difficulties in meeting their daily needs, especially during the rice shortage period, because of their small amount of rice production. However, to fully understand the ramifications of this chart, we have to delve into the decision-making processes behind households' strategies.

One important question is why D farmers differ from C farmers. Based on the typology criteria, these two farming systems are very similar, as they generally have access to a small common paddy field, have no livestock capital or individual paddy fields, continue upland rice production and produce maize. However, D farmers produce 450 kg less rice than C farmers. Although access to the lowland areas is a key factor of differentiation, why is their upland rice production smaller than that of C farmers?

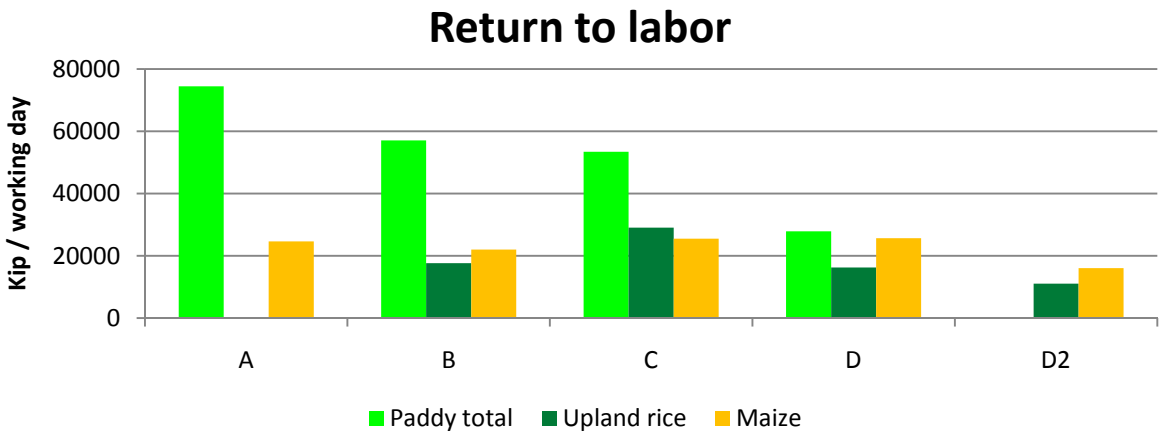


Figure 13: Return to labor by household type

The answer is labor competition, not between two different cropping systems but between agriculture production and farm work. One of the characteristics of farming system D is the importance of paid farm work in the total workload. D and D2 farmers use an average of 30 working days for paid farm work. For this labor, which occurs during the cropping season, they are paid 20 000 kip to 25 000 kip a day. These farmers choose to work in someone else's field to get paid in rice (6 kg/day) or cash, instead of investing their labor in their own production. This choice is not a mark of laziness, as we heard suggested during our fieldwork. If we look at the return to labor, many farming systems do not achieve a level of 20 000 kip/working day. For farming systems D and D2 especially, return to labor is around 20 000 kip/working day. If we remember that the main objective of those households is to secure their food sufficiency, then we understand clearly their strategy. It is of greater economic benefit to them to get the necessary rice directly instead of investing in their own fields, borrowing the rice with interest and assuming the potential risks of production. This is the concept of opportunity cost.

A simple calculation demonstrates this. If a farmer borrows the rice he needs instead of working in someone else's field, he will have to repay his debt during the harvest, at the equivalent of his wage plus 25% interest: 20 000 x 1.25 = 25 000 kip. His average return to labor with maize is about 23 000 kip/working day: 23 000 – 25 000 = –2000 kip

The result of the operation is negative. The farmer has lost 2000 kip by choosing to invest his labor in his own production instead of working for wages. This result ignores the fact that 25% is the lower interest rate in the villages; in general, they borrow at 50%. As a result, upland crop production is less important than for the other farming systems.

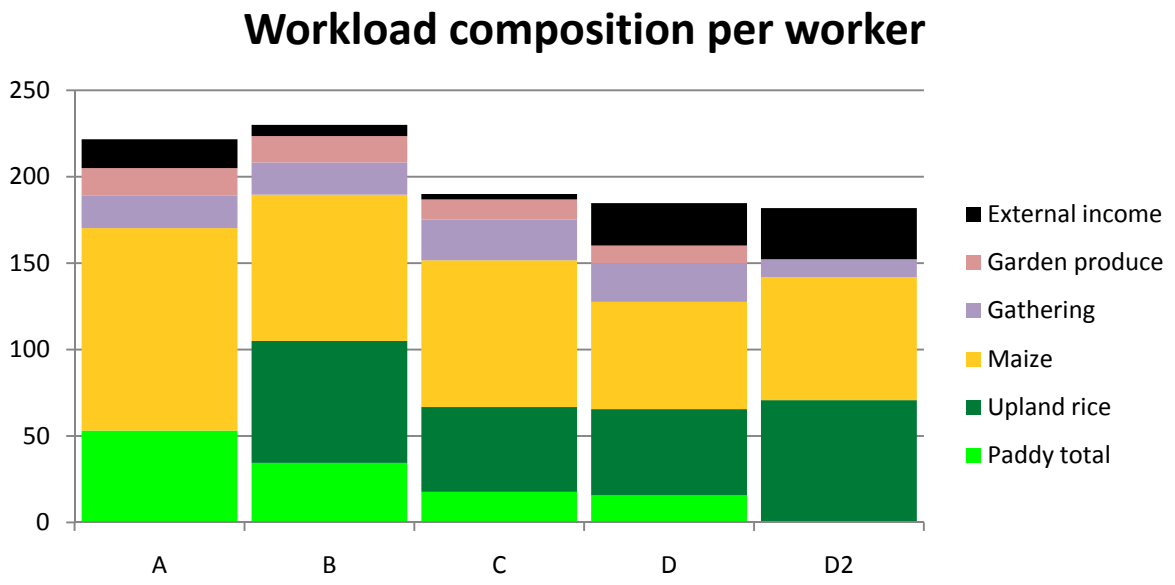


Figure 14: Workload composition per worker by household type

If we presume that this typology, based on access to lowland fields, existed before the introduction of maize, then we can estimate that the common objective for all farming systems, at that time, was to secure food sufficiency, and therefore to produce almost the same quantity of rice. However, in reality, one worker in farming system B produces 1000 kg of rice, compared with 750 kg in farming system C. They have the same access to upland fields and they both use 3-year or 4-year fallows for their upland rice production. Their differences in rice production can only come from a change in strategy. With the introduction of cash crops, farmers have reduced their upland rice production, which has resulted in decreased food security.

This trend is confirmed by a personal account. The headman in **Nadeua** estimates that in 2000, 30% of the population had insufficient rice for an average of three months. In 2008, this figure had grown to 80% of the population having insufficient rice for six months. In **Phuk**, in 2000, just 20% of the households had insufficient rice for two months, but in 2008, 85% of the households had insufficient rice for three months. This clearly shows a deterioration in food security. Some farmers suffered this drop unwillingly but others chose this situation to focus their production on the market.

Nowadays, the difference between farmers' types stems mainly from their economic strategies. Their choices were made depending on their access to natural resources, so farmers in the same social situation but in a different environment will make different choices. To illustrate this point, we consider the distribution of types across villages (Figure 15).

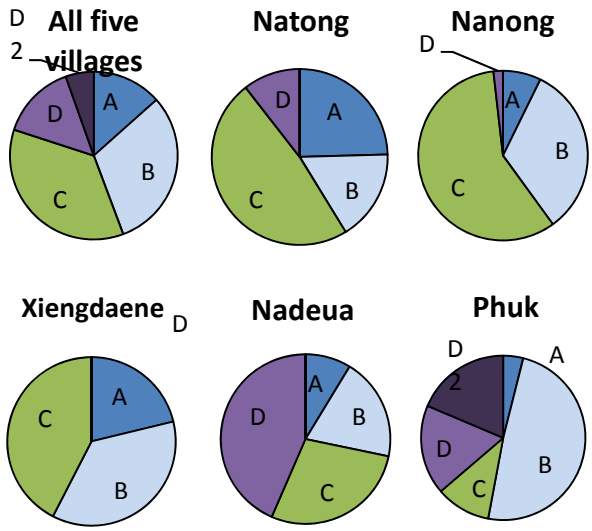


Figure 15: Typology distribution within villages

We used the exhaustive household survey and applied the criteria for the typology. A sixth distribution was made for the totality of the households in the five villages.

The diversity in access to natural resources between the villages elucidated in the previous analysis (2.2.2) results in a different social composition between the villages. **Xiengdaene** is well served with lowland fields in its territory but is also near and inside **Nadeua** territory; as a result, all households belong to farming systems C, B or A, which means everybody has access to lowland fields. Moreover, 60% of the households own individual paddy fields (farming systems A and B). In **Nadeua**, where just more than half of the population uses lowland fields, farming system D forms a simple majority (no paddy fields or very small area). **Natong** and **Nanong** are quite similar for the typology with 40% of *Na Ti* owners (A and B). The difference lies with the Ksing Mool minority in **Natong**, who have no access to the lowland fields and therefore are in farming system D. In **Phuk**, where B is in a simple majority with just over 50%, the majority of the households own an individual paddy field (A and B), but, because of lower land pressure and the delay in the introduction of maize, few people have stopped upland rice production (A). One-third of the population has limited access to lowland areas, because of the *Na Muong* rules.

When we study the same parameters at the **Natong** cluster level (five villages), we see that 45% of the households own individual paddy fields (A and B) and that more than 75% have access to lowland areas through the *Na Muong* system. The remaining 25% (D and D2) have limited access to lowland fields because of their community history (D2, Yao community), lack of lowland fields in their territory (D in **Nadeua** or **Phuk**), or because of household dynamics (members too old or too young). The *Na Muong* system plays an important role in minimizing inequality and allows the majority of the households to have access to lowland areas.

2.3.3 Economic evaluation and modeling of the farming systems

To determine the household income we used the following calculation. Data come from in-depth surveys of the 100-household sample.

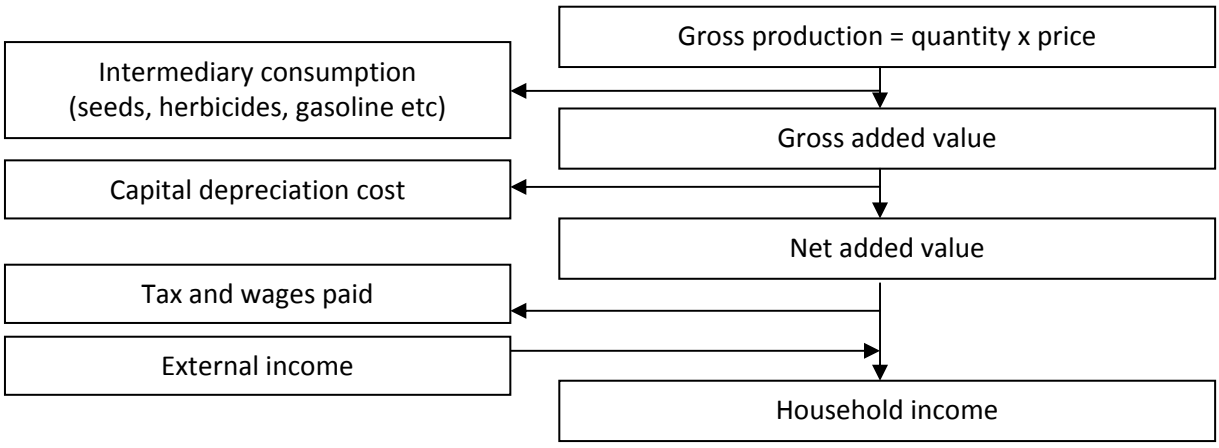


Figure 16 shows the differences in households' net income per worker for the different farming systems. A is the richest farming system with an annual income of nearly 10 million kip per worker, followed by farming systems B and C, each earning more than 8 million kip per worker. Farming system D is the poorest with only a little more than 6 million kip. D2 generates a little more, near 7 million kip per worker.

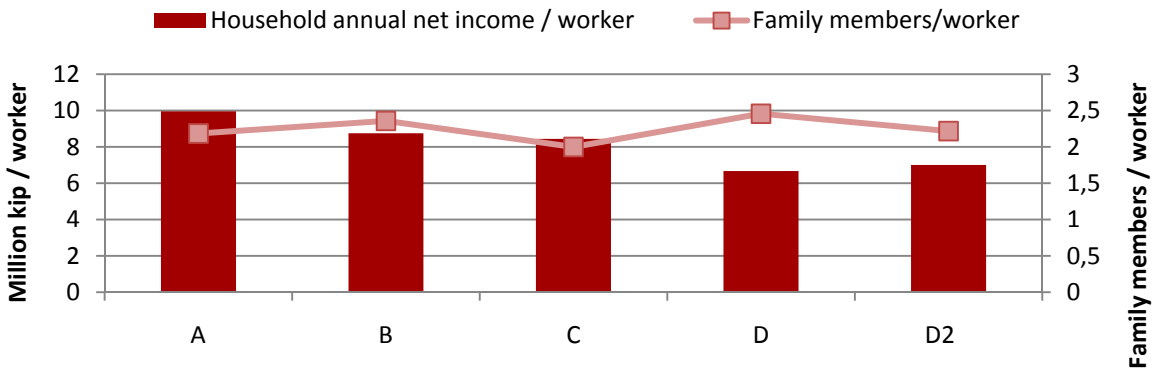


Figure 16: Household annual income by household type

The capacity to meet the entire family's daily needs is the main factor in each household's capitalization/recapitalization dynamics. A worker in farming system A produces the most (about 10 million kip annually) and has to take care to 2.2 family members, the worker included. This is less than a worker in farming system D, who has only 6.5 million kip and responsibility for 2.5 family members.

To better understand how the farming systems differ from each other, we analyze the composition of the household income. To do so we add the gross added value of each production type. Figure 17 does not consider the depreciation cost; however, this cost is limited in value as the largest investments in these villages are small tractors. We have represented the gross added value per worker.

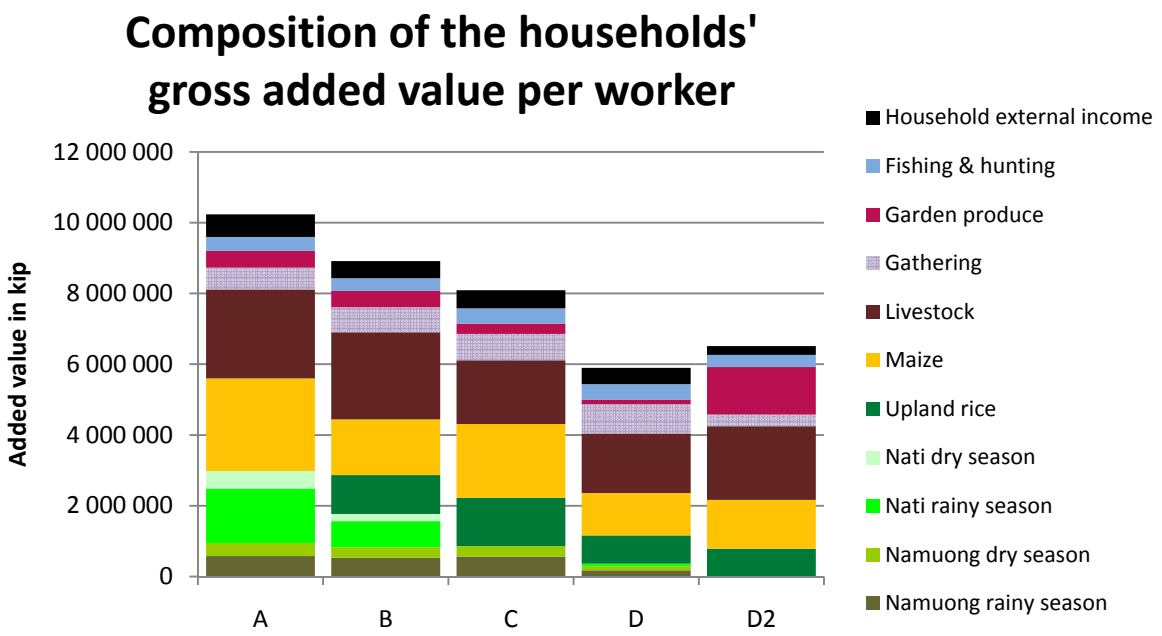


Figure 17: Composition of households' gross added value by household type

Again we find the same patterns. A has the highest gross added value per worker with nearly 10 million kip, followed by B with just under 9 million kip and C with 8 million kip. Farming system D produces only around 6 million kip.

This result confirms the structure of the typology. Households with better access to lowland fields have a better economic system and can generate more income. A, B and C produce nearly 1 million kip through the *Na Muong* system, demonstrating how communal access to those fields ensures relative equity between the households. However, access to communal lowland fields is denied to D farmers.

As this shows, what differentiates farming systems A, B and C is the ownership of individual paddy fields. A and B farmers own individual paddy fields; C farmers produce rice only in communal areas. The differences are obvious: without individual paddy fields, C farmers have to produce more upland rice (to the value of more than 1 million kip) without reaching the same level of rice production as A and B farmers. The importance of the paddy production differentiates A and B: A farmers have stopped upland rice production because of their larger individual paddy field production.

The income from maize is included at between 1 million and 3 million kip per worker. Although it is the main source of households' monetary income, maize production could be surpassed by livestock income (farming system B) or by total paddy production (farming system A). Farming systems A and C are the most "maize-oriented" systems, earning about 2.7 and 2 million kip from maize production, respectively. This parallel development of cash crops for these two farming systems is the result of two different household strategies. For A farmers, cash crop production is important because the upland fields are used only for cash crop production. For C farmers, upland fields are used both for maize and for upland rice production, but because their paddy income is low, they have to focus on producing maize to get a larger income. Workers in farming systems B, D and D2 get only about 1 million kip from maize production because of significant competition over labor and land use.

Farming systems A and B have the highest livestock income, followed by D2, then by C and D (Figure 18). A and B farmers generally own buffaloes or cattle; in their case, livestock capitalization is linked to land capitalization. The fact that in the past buffaloes were widely used in the paddy fields for all the soil preparation could explain the parallel importance in the income of both paddy and livestock. C farmers, who have no individual paddy fields, own less livestock. D farmers own only pigs

and chickens, which are used to overcome the hunger gap. D2 farmers (Yao) use an original livestock production system. After they moved, they got rid of their buffaloes because their new territory is too small. They still focus on livestock by breeding pigs, and even use part of their maize production (500 kg/household) to feed the pigs. As a result, they can earn more than 2 million kip per worker from livestock.

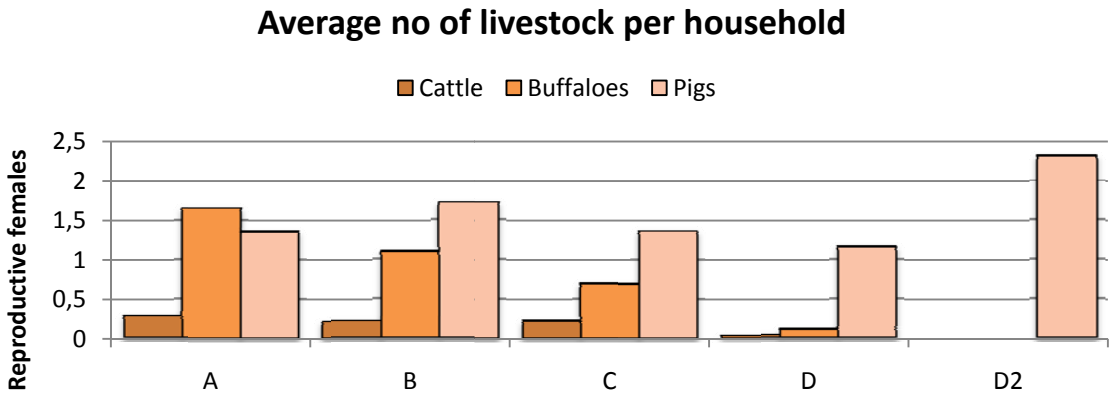


Figure 18: Composition of livestock ownership by household type

The share of income from gathering, garden produce and fishing and hunting is quite small and is constant across the different systems. Only the Yao farming system differs by the importance of their fruit tree production. However, this produce is not marketed and we could expect that a significant part of the produce is even lost. The share of forest products is quite small, with the majority of products from gathering found in upland rice fallows, river and paddy fields. The forest is used only to gather firewood and timber. This relatively small income from the forest shows its absence in the environment of the **Natong** cluster.

There are no substantial differences in the amount of external income between the farming systems. However, the sources of external income differ. For farming systems D, D2 and sometimes C, paid farm work is important. A and B farmers enjoy a good social position, which can be a source of income (headman/deputy indemnity, teacher's salary, etc.). The middleman for dealing with the Vietnamese trader usually belongs to one of these two farming systems. However, external income does not really compete for labor with the household agriculture production.

2.3.4 Impact of changes in resource availability on farming system dynamics

As we have seen previously, access to lowland fields and therefore availability of the paddy fields for the households is the main factor of differentiation. However, as also seen, the original *Na Muong* system minimizes the differences for the majority of the households (farming systems A, B and C). The actual typology is the result of both history and environment. The dynamics that created those farming systems are still working and we can anticipate their potential evolution.

Because the collective system affects part of the lowland areas, access to lowland fields is a discrete parameter that we can divide into steps.

- First step: Social position (part of the community) allows access to the *Na Muong* area. The importance of this area for the household depends on the village's capacity.
- Second step: Ownership of an individual paddy field.
- Third step: Lowland production (both individual and communal paddy fields) is sufficient to stop upland rice production.

Farming system A is the only one that achieves all three steps. B farmers reach the second step and C farmers only the first step. D and D2 farmers share difficulties in accessing the communal paddy fields because of their history, their position in the community or their ethnicity.

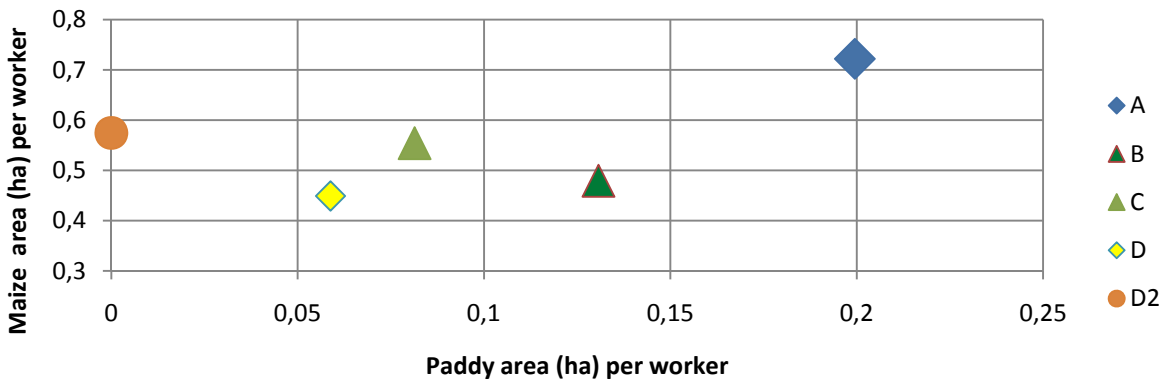


Figure 19: Land use by household type

This chart helps to understand the differences between farming systems. A is in the far top right with 2000 m^2 of paddy field per worker; this situation allows A farmers to focus entirely on cash crop production in their upland fields, where they have the largest area of maize at 0.7 ha per worker.

B farmers own individual paddy fields but obviously less than A farmers, with 1400 m^2 per worker. The area of maize is also less important with only 0.5 ha per worker; this is the result of competition with upland rice and other land uses.

Farming systems C and D are quite similar in that they own no paddy fields and use only communal lowland fields of 600 m^2 and 800 m^2, respectively. Variations stem from their social environment (*Na Muong* area in the village they live, ethnicity, personal history). However, their strategies for the uplands are different. As we have explained previously, because of the competition over labor between crop production and paid farm work, D farmers cannot use a larger uplands area. Their strategies also differ in that farming system C focuses on commercial agriculture while farming system D is still in a subsistence scheme.

The Yao community uses a unique production system because of the challenge they face over the small size of their territory. They own no lowland fields and focus on maize production to get a higher income (0.6 ha). This monetary income is then used to buy rice.

We can develop this and analyze the economic performances of the farming systems using a simple model.

We have modeled for one worker in every farming system the income depending on the agricultural area used. To simplify the calculations, following the previous results we did not take into account the income from garden produce, hunting and fishing, gathering and external income. Income disparities stem mainly from crop and livestock production.

The range of agricultural areas used is taken from our personal observations during the interviews.

We used the following calculation:

$$Income\ j = (R\ p,j \times P\ p,j + R\ m,j \times P\ m,j + R\ u,j \times P\ u,j) \times x + (Il\ j - Dc\ j)$$

$J\ refers\ to\ a\ farming\ system\ (A, B, C, D\ and\ D2)$

$p, m, u\ respectively\ correspond\ to\ paddy, maize\ and\ upland\ rice\ cropping\ system$

Pi: $Average\ land\ productivity\ (kip/ha)\ of\ the\ crops\ i\ for\ farming\ system\ j$

Ri: $\dfrac{Average\ area\ of\ cropping\ system\ i\ used\ per\ worker\ j}{Average\ total\ agricultural\ area\ per\ worker\ j}$

Il: $Income\ from\ livestock\ production\ per\ worker\ j$

Dc: $Depreciation\ cost\ of\ the\ production\ factors\ per\ worker\ j$

We applied this method to the five different farming systems.

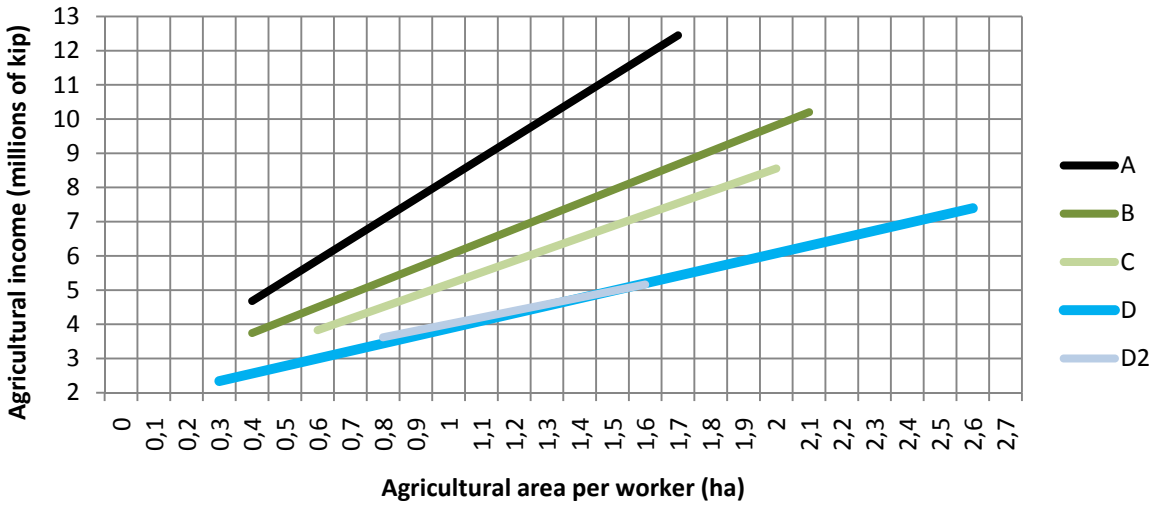
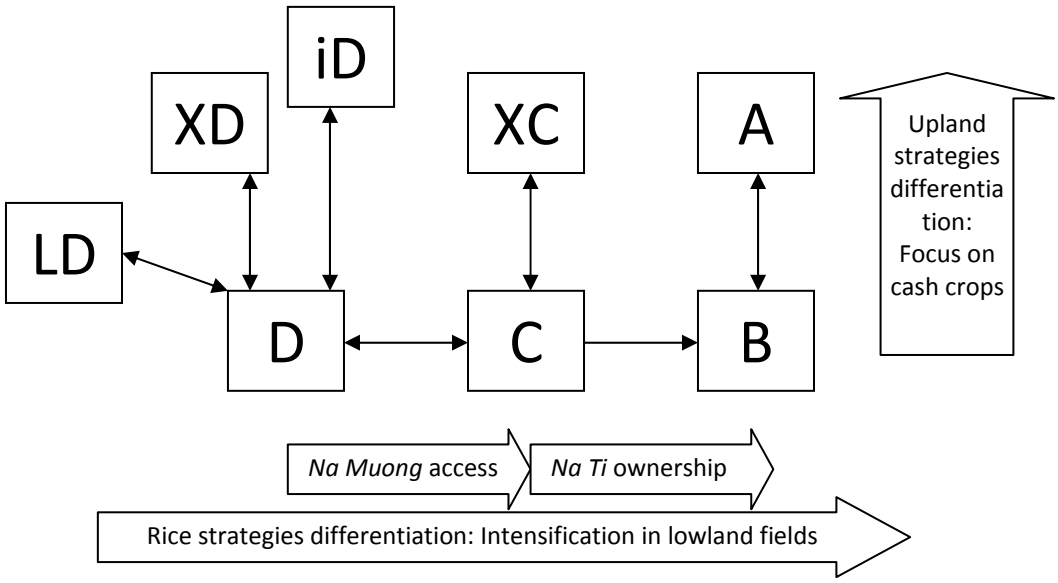


Figure 20: Model of economic results

There are few disparities in the slopes because all five farming systems are a combination of the three cropping systems (Figure 20). However, we find again the same scheme. Farming system A, the most land-intensive production system, can produce from 5 million to almost 13 million kip per worker in a range of 0.4 ha to 1.6 ha. Farming systems B and C are less land intensive with only 4 to 10 million and 4 to 8 million kip, respectively, with larger areas of up to 2 ha per worker for system B. Farming systems D and D2 have slightly different slopes, but reach the same level of agricultural income per worker. D2 farmers face land pressure in their territory; therefore, they can use only a range of 0.8 ha to 1.6 ha per worker. By contrast, system D uses more space but the economic performances are close and low with a range of 2 million to 7 million kip. This is the most extensive production system with the used area reaching 2.5 ha per worker. The outcome is obvious: the more farmers focus on lowland fields, the more they produce intensively in smaller areas.

There seem to be two main dynamics of farming system evolution. The first is linked to the traditional strategy of securing rice production by investing in lowland fields. This dynamic leads to the redistribution, previously presented, regarding access to the paddy fields. During our fieldwork, A farmers whom we interviewed explained that they stopped their upland rice production only when they had the opportunity to market their products. In fact, for those farmers, upland rice was used as a local cash crop.



Farming system A is a new evolution of farming system B. With current trends and increasing land pressure, more and more farming systems of type B will become type A as they focus all of their upland production on cash crops. This is a two-way conversion. An economic downturn could change the marketing possibilities for the cash crops and push some A farmers to grow upland rice again.

Farming system B evolves from farming system C by the building of individual paddy fields; this is the traditional evolution. In reality, as there is little available space, this conversion is becoming rare. This is also a one-way conversion. When the farmer buys or builds a new individual paddy field and then becomes type B, there is very little risk that he could lose his investment.

Farming systems C and D are in the same situation. They have access only to the *Na Muong* area. Differences between these two types of farmers stem from the environment. Young independent couples and newcomers are generally D farmers until they get access to the *Na Muong* area at the next division in their village. If this area is sufficient, they could become C farmers; if not (as in **Nadeua**, Yao village and **Phuk**), they stay in farming system D. In the other hand, C farmers could become D farmers because of personal difficulties (health problems, lost harvest, livestock decapitalization).

During our fieldwork, we interviewed two households that did not fit this typology.

The first has access to the *Na Muong* area in **Natong**, but owns no individual paddy fields. Unlike the majority of the households from farming system C, he stopped upland rice in 2004 and started to produce cash crops (soya bean, then maize). Reviewing the information from the exhaustive survey, we found more than five households following the same strategy. However, as data were not sufficient, we could not complete an economic analysis of this farming system. Nevertheless, this farming system, called here XC, could prefigure the future evolution of farming system C. With the increase in land pressure because of the extension of maize production, some C farmers could change their production strategies by shifting to commercialized agriculture. Farming system XC is characterized by a very low rice production only in the paddy fields and the use of upland fields for cash crop production. This farming system has a low level of equipment and livestock capital.

The second atypical farmer is the only one to produce maize without any paddy or upland rice production. According to our typology criteria, he is a D farmer who had an opportunity and invested in maize production with paid farm work. He has become an agricultural investor (iD), using his annual income to invest in the following year's production.

In general, the potential evolutions of farming system D are vague. There is the traditional evolution to farming system C for households in **Natong**, **Xiengdaene** and **Phuk**. For the others, however, where the social land distribution system does not work, possibilities for evolutions are limited. Extensive production systems, possible in the past, are now limited by the competition between farmers over upland areas. Investment in lowland fields is almost impossible for those households who face significant rice shortages. Livestock breeding is also limited by the need for capital and land. Paid farm work could be a possibility to ensure food security and farmers have already increased selling their labor force. Through this way, we can imagine a downward trend for the household agriculture production in favor of paid farm work. This trend could lead to farmers without land selling their entire labor force to someone else in the village or outside. People in this dynamics could also prefer to migrate to the Lao cities or to enlist in the army. In general, if farmers follow this trend they get out of the agriculture system.

Another evolution following the current trend in cash cropping could be an intensification of production in upland fields toward exclusive commercial agriculture (XD). This change is unlikely to take place because of the many risks it involves, such as food security, breaking the debt cycle and lack of capital.

2.3.5 Statistical analysis of the household survey supports the structural typology

Using the exhaustive survey (360 households) statistical analyses were performed to understand the relations between variables. Data are divided into two classes:

- Binary data (0,1) concerning household equipment (small tractor, motorbike, rice mill, TV)
- Quantitative data concerning area under production for the three cropping systems, livestock composition (cattle, buffaloes, pigs) and demographic data (number of workers and people per household)

To understand the relations between variables taken by pairs we can analyze the **correlation table**.

By construction, the variable **HH_Member** (number of members in the household) is correlated to **Na_muong area** (coef: 0.34) because the collective paddies are distributed to families every five years according to the number of members in the household.

HH_Member is also correlated to **HH_Labor** (number of workers in the household) as the number of active people increases with the size of the family. The relation between the upland rice area and **HH_Members** may therefore be indirect. Households with a larger labor force tend to grow more upland rice than the others, as shown in the Principal Component Analysis (PCA; see below).

Buffaloes are positively correlated to the paddy area as traditional lowland rice growers capitalize through buffaloes. They tend to be replaced by hand tractors, one of the first investments when farmers get money from maize. Both **buffaloes** and **tractors** are highly correlated with the paddy cropping system (0.33 and 0.49, respectively).

Na_muong is correlated to **Na_ti** (0.32) as most of the farmers who invested in individual rice fields were already better off (significant correlation with TV) thanks to good access to **Na_muong**.

Maize is not correlated with any other variable. All villagers grew maize, regardless of their situation before the introduction of this new commercial crop.

Upland rice area is negatively correlated with **Na_ti area** (–0.31), which is consistent with the result of our surveys related to rice sufficiency. Farmers tend to reduce upland rice areas once they can increase their paddy area to a point where they become rice sufficient (more than 300 kg/person/year).

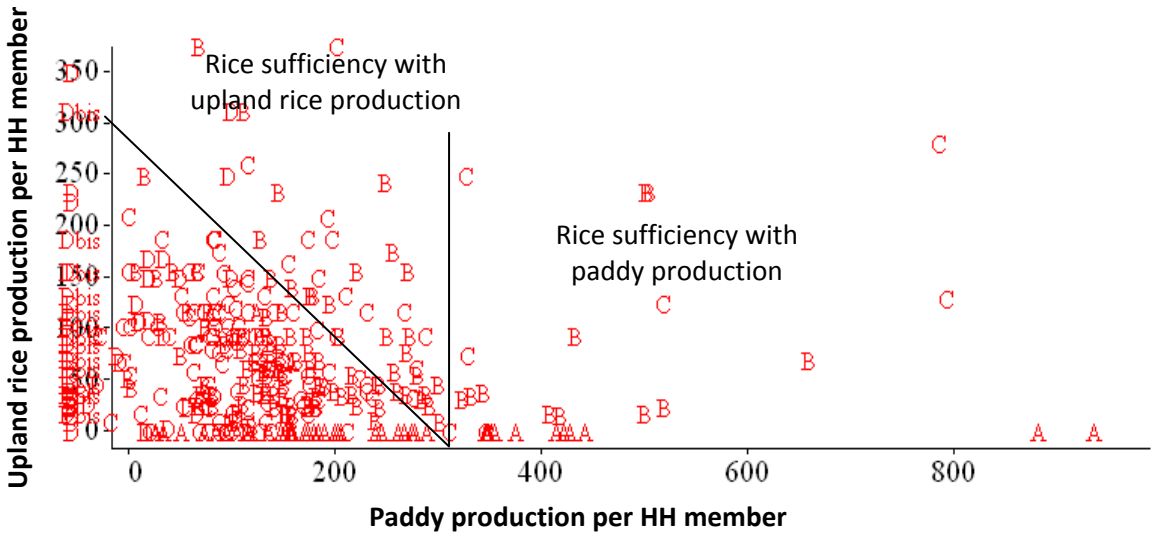


Figure 21: Rice sufficiency through association of both rice production systems

Figure 21 combines data collected in the exhaustive survey (HH members, area of paddy and upland rice) and data collected during the interviews (average upland rice and paddy harvested for 100 households). Through our fieldwork, we know that the majority of the area of *Na Muong* is in a

two-season cycle and the area of *Na Ti* is mainly in a one-season cycle. Knowing the area of both *Na Muong* and *Na Ti* for each household, we multiply those areas by the average yield to get an estimation of the rice production for each household. Then, every household is characterized by the structural typology previously designed.

The distribution of households by rice sufficiency achieves the same outcome (Figure 22). Thanks to the *Na Muong* system, the majority of the households produce more than 200 kg of rice per family member (302 households). The paddy rice production allows 261 households to produce 200 kg; the total amount is then completed by the upland rice production. We can clearly distinguish the upland rice distribution (without community management) and the paddy rice distribution (with community management, allowing more people to benefit from the production). However, this rice production is clearly insufficient; we estimate that the rice sufficiency level is 300 kg of rice per household member. Only 175 households achieve rice sufficiency (less than half of the population).

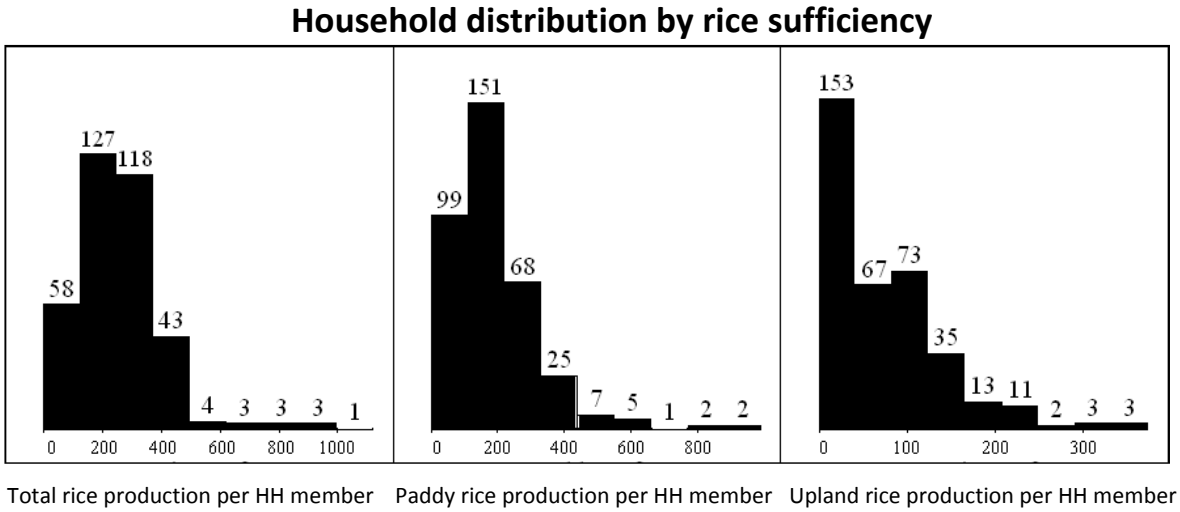


Figure 22: Rice sufficiency distribution

All equipment (binary variables), **Tractor**, **Motorcycle**, **Rice_mill**, **TV**, **Generator**, are positively correlated to the paddy area. The process of capital accumulation is clearly related to farmers' access to paddy land. This access depends on village (total lowland area), ethnicity, **HH_Member** and the **Na_muong** system, etc.

Based on the correlation table, the **relevant variables were selected for inclusion in a PCA** (Figure 23). Livestock variables were represented as supplementary variables; i.e., they do not contribute to the definition of the axes.

The first three axes represent 64.5% of the total variability. Four variables contribute to the first axis (30.8% of total variability): **HH_members**, **Na_muong**, **Tractor** and **Motorcycle**. This axis clearly opposes households that benefit from large access to collective paddies, as they have a big family in a village with relatively large area of **Na_muong**, with households with poor access to collective paddies. The former are better off than the second, which have less investment capacity (i.e., tractors and motorcycles).

The second axis (22.5%) opposes the households who developed **Na_ti** with those who rely more on **UpRice** for their rice sufficiency. This result supports the household typology that clearly differentiates the households that tend to use individual paddies (those who are better endowed in **Na_muong**) and the other households who still engage in upland rice cultivation. The second type tends to have a larger available labor force. Labor shortage may be one more incentive to invest in lowland intensification through terracing new individual paddy fields.

The third axis (11.2%) essentially represents the households' maize situation, opposing those who grow large areas and the others, independently of the rice-based strategies. This confirms the findings of the correlation table that maize expansion goes across all farming systems without discrimination.

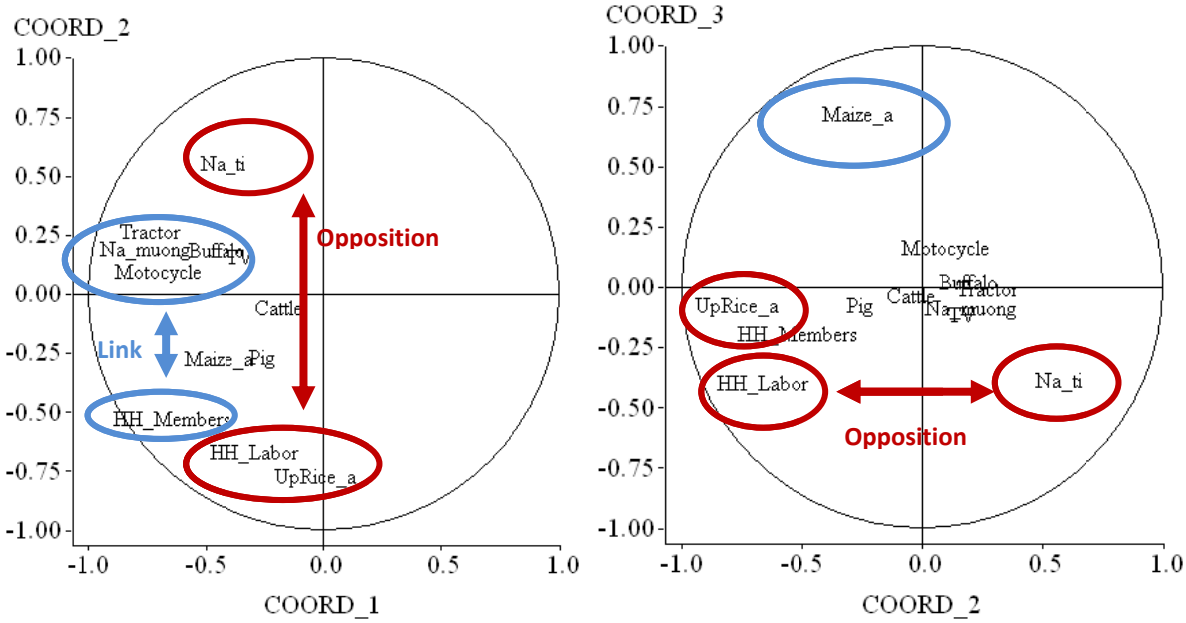


Figure 23: PCA analysis

3 Maize leads the transition from subsistence farming to commercial agriculture

3.1 The emergence of new local institutions with maize expansion

3.1.1 The success story of maize in the **Natong** area

As a prelude to the maize success, some farmers experimented with soya bean production on a large scale. Before then, cash crops were produced in gardens or gathered in the forest, and quantities were limited. Cash crops arrived with the improved roads. In 2003, the PRF (poverty reduction fund) renewed the road and widened it, making it suitable for trucks. This new access to the market allows traders to buy directly in the villages and so farmers can produce bigger quantities.

Soya beans were produced during two years, mostly in **Natong** and **Nanong**, by farmers who did not really need upland rice for their own consumption. They used one or two fields for the production of soya beans. Results were below expectations; yields were not high and farmers did not generate more income from the crop. The majority of the other farmers did not follow their example. Now farmers recount mixed memories of this period, but the perception may be altering because of the overwhelming success of maize; we do not know whether, in the same conditions, soya production could have done better.

The first attempts to produce maize were individual initiatives. Maize was already a successful cash crop on the other side of the border and there are a lot of family links between the two countries. Success stories spread by word of mouth. The headman of **Natong** purchased 40 kg of hybrid seeds from a relative in Xiengkhor and then provided 20 kg to the headman of **Nadeua**. At the same time, one farmer in **Xiengdaene** (1 kg of seed) and two in **Nanong** (respectively 5 and 15 kg of seeds) purchased a small amount of seeds and tried to grow maize. Yields were great and traders came to buy the produce directly in the villages. The farmers who tried to produce maize were rewarded by a much greater influx of money than they were used to; they started to buy consumption goods, which stirred up the other farmers. Success attracts followers, and rapidly the majority turned to producing maize.

Compared with the amateurism of 2005, the year 2006 saw the real beginning of the large-scale production of maize. The majority of the households in **Natong**, **Nanong** and **Nadeua** produced maize. The Vietnamese traders came twice a year, first to provide seeds on credit and then to collect the harvest. The seeds are mostly Vietnamese hybrid maize seeds (LVN10). To provide the seeds on credit, the traders depend on middlemen. They sign contracts with them and provide them with a large amount of seeds (1 to 2 tons); the middlemen are then in charge of providing the seeds to the farmers without any written contracts. Usually, the traders come in January to provide the seeds.

After the good harvest of 2006 and attracted by the possible income, farmers decided to build access roads (we call them “maize roads” in this report) to reach remote fields and make the harvest easier. The first roads were built in **Natong**, **Nanong** and **Nadeua**. Farmers signed contracts at the village level with one Vietnamese trader. **Natong** built two roads in Tia valley, making a total of 8.3 km of roads. The trader granted them a loan worth 10.5 million kip/km (87.15 million kip in total) to be paid back within three years. At the same time, after the harvest in 2006, **Nadeua** built 2.075 km of roads in Dea valley for a total of 23 million kip with a similar contract. This road was then extended by **Natong** farmers to reach their fields, although this was an individual initiative rather than a community decision. **Nanong** built one small road, 1.6 km at a price of 12 million kip/km with the same terms as in **Nadeua** and **Natong**.

These community decisions to invest in maize pushed every household in **Natong**, **Nanong** and **Nadeua** into maize production in 2007; following the success of this activity, the majority of farmers **Phuk** and **Xiengdaene** also produced maize.

After the harvest of 2008, **Xiengdaene** and **Phuk** invested in maize roads. With the same sort of contract as for the other villages, **Xiengdaene** built 9 km of roads for 98.4 million kip (three different roads). **Phuk** build two roads, making a total of 4.806 km at 10.5 million kip for 1 km (50 million kip). **Natong** extended its initial road by adding 8.7 km for 91.4 million kip.

The total investment for the five villages reached 370 million kip for 35 km of roads.

Photo 8: Maize road in Nadeua territory

Those successive investments were made in a context of increases in the maize price. Farmers were optimistic about this evolution and a substantial proportion of households decided to shift all their fallows to maize production and stopped upland rice production.

But in 2008, the price fell sharply. This fall halted the progression of maize production in the **Natong** cluster. However, maize prices have since returned to their 2006 level and farmers still see advantages in continuing maize production.

3.1.2 Village communities' investment in a new factor of production: maize roads

During the introduction of maize production in the **Natong** cluster, village communities invested in production infrastructure using credit. This investment was made not at the individual level or by a group of farmers but at the village level. In all the villages, the same sort of written contract for the loans applied. The contract links the Vietnamese trader and the village community represented by the headman. The trader provides the funds to build the road and any additional repairs required during the three following years. The interest on the loan is included in the price negotiated with the farmers. The village community has to pay back the loan within three years (five years in **Phuk**). The village council shared the communal debts among the farmers. Methods of calculating the amount due vary among villages. In **Xiengdaene**, every household pays according to the number of people in the family, as for the *Na Muong* system. In this way, the road debt becomes a village tax. In **Natong**, farmers' dues depend on their area and their access to the road; for example, a farmer using a field far from the roads would pay less. In this case, the road debt becomes more like a production tax.

The communities incurred substantial debts to help increase their production potential. In **Xiengdaene**, **Nanong** and **Natong**, farmers succeeded in repaying the debts. By contrast, **Nadeua** is experiencing substantial difficulties in repaying its debt. For the 2007 and 2008 amounts due, they have repaid only 2.7 million kip of the total debt of 23 million kip. At the time of our fieldwork at the beginning of 2009, negotiations took place with new traders to erase the communal debt in exchange for a monopoly over the purchase of maize in the village. At the end of 2009, nothing had been decided but this level of debt could freeze new investment and make the community vulnerable. In **Phuk**, the investment was made with a five-year loan. The road was built in 2008 and

farmers will start to pay off the loan in 2009. For now, the debt is not shared and with another fall in prices, we fear the community could be facing a substantial debt problem in future years.

Nevertheless, in **Xiengdaene**, **Nanong** and **Natong**, the maize roads are seen as a good investment. Farmers in **Natong** even extended their initial road by doubling its length. In every village, the construction of the road is a village community contract. Even when there are repayment problems, village council decisions are strong and followed by the entire community. The village council sometimes managed to provide every household with an area near the road to ensure repayment of the debt; this occurred in **Nadeua** and **Xiengdaene**. In these cases, this road access to maize fields was more the result of individual negotiations following village policy rather than an equal distribution.

Role-playing game about road construction negotiations

We organized a role-playing game with two groups of eight farmers from the **Natong** cluster. We designed the game to model the negotiations between farmers to decide where to build the road and how to handle possible land use conflicts.

The game showed the importance of leadership in the negotiation process. In one group, the leader (headman in **Xiengdaene**), with the consent of the other farmers, took on the responsibility of building the road and redistributed the land equally among the farmers. In the second group, the leadership sought to maintain its advantage (two or three fields near the future road) by finding a compromise including the majority of the players but not the totality.

In the **Natong** cluster, important community decisions have been made about maize production and investment. This process likely followed the same scheme, with strong leadership working either for the community or for its own interest but always needing the consent of the majority.

Using information collected during our interview process, we have drawn a map showing the maize roads and the location of the land held by the 100 households in our sample (Figure 25). Every field used by the farmers has been positioned on a basic map of the village territory (village location, rivers, high spots, roads and forests).

But what was behind this frenzy for building maize roads? Farmers previously produced upland rice in the same areas without needing access roads to do so. The answer lies in the production and marketing system introduced by the traders.

Maize yields are higher than upland rice yields. In our sample of 100 households, the average upland rice yield is 936.5 kg/ha compared with 4690 kg/ha for maize, meaning the maize yield is five times higher than the upland rice yield. This high level of production becomes a challenge for farmers during the harvest, as it means approximately five times as much labor for the harvest in the same conditions (harvest and transporting the produce in 40 kg bags by foot). As we have seen previously, this period is a labor peak, as the maize harvest occurs before the upland rice and paddy harvest. Farmers usually stay in the fields at nighttime during this period to protect the crops from rodents and wild pigs. They also have to harvest quickly to avoid losing their produce.

Vietnamese traders provided the perfect solution to this problem: the maize roads. Farmers simply have to build from bamboo one or two storehouses (capacity 2 tons) on their fields or near the roads. They can wait 20 days, and use this time to negotiate a better price with the trader. When an agreement has been reached, the trader comes to take the produce directly from the field using small tractors or trucks. The trader can then store the produce in the village and shuck it or take the maize back to Xiengkhor to dry and shuck it there.

Photo 9: Vietnamese traders in Xiengkhor

The gain in time for the farmer is obvious, if we consider that a farmer needs 1 h per 40 kg in difficult conditions to transport the produce to the village (4690 kg / 40 kg / 8 h = 14.6 working days/ha).

The maize roads changed the fields' characteristics, which traditionally followed the topography. The quality of access to the village became a major factor in productivity and so a major factor in the farmers' decisions.

Photo 10: Maize storehouse along maize road in Phuk

From this new road network, a new landscape has emerged. Competition over land near the roads prevents farmers from using a rotation system for maize production or from producing upland rice in this area. As a result, fields near the roads are used exclusively for maize production. The success of this crop has pushed out the traditional upland rice cropping system. The only space available is in the areas up to the maize fields or in valleys that do not have road access.

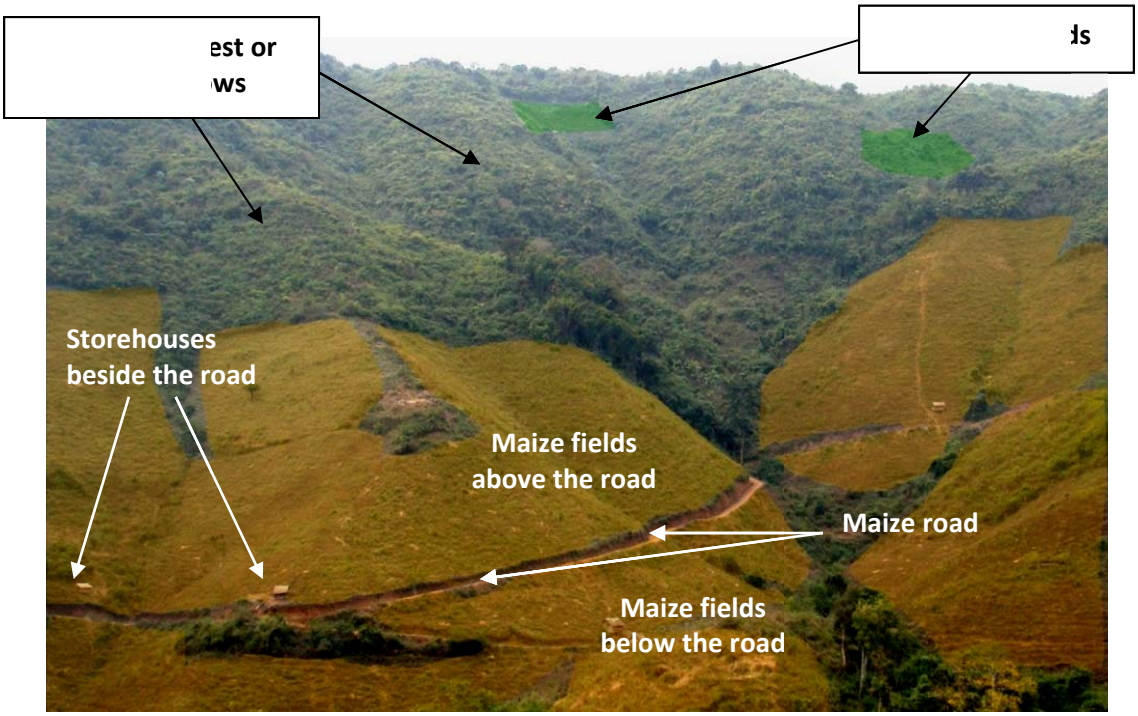
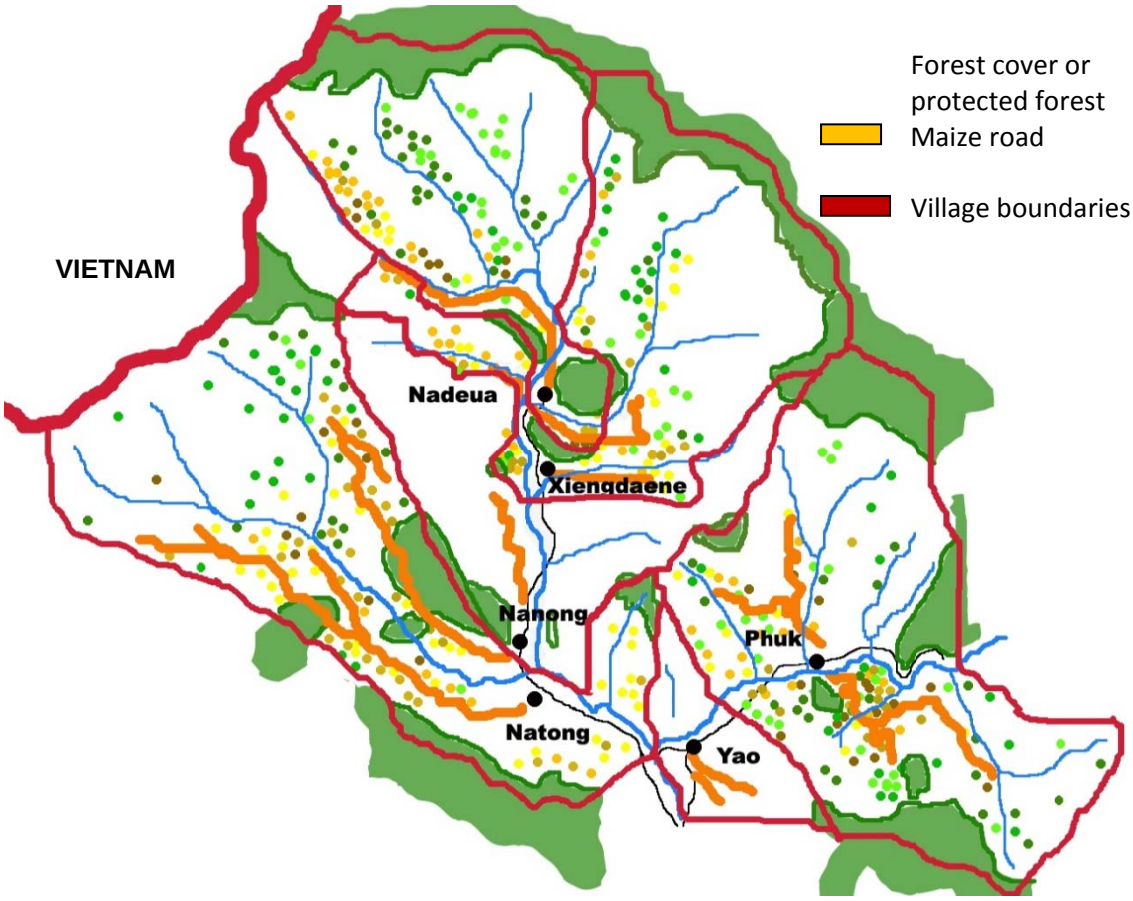


Figure 24: Maize roads and land use



Farming system	A	B	C	D
Fields included in upland rice rotation	.	.	.	.
Maize fields (current use)	.	.	.	.

Figure 25: Land use map

We drew the above map during the household interviews (Figure 25). Fields were located on a basic map according their position relative to features such as rivers, forests, roads and mountains. There are various findings.

First, maize fields lie in the areas newly served by the roads or in the old well-served areas (old roads or near the village). Upland fields are pushed to areas away from the village. In **Natong**, the only area left for upland rice production is in the north of the valley. In **Nadeua**, the Niup and Fat valleys (two rivers to the east) are used mainly for upland rice production because of the absence of maize roads. The Dea valley (river to the west) is clearly maize oriented with almost all the village production. In **Xiengdaene**, the far end of the river Hit is used for upland rice production; maize fields lie in other areas served by maize roads.

We also see clear differences between the villages. The **Natong** space is mainly used for maize production; in **Phuk**, farmers are focusing more on upland rice production; maize fields lie around the village and just near the road.

3.1.3 Changes in social networks and emergence of new stakeholders

The major change in the social network is the arrival of external or foreign investors. In this area, they are mostly Vietnamese. They speak a little Lao, because most of them are from Tai ethnic minorities in Vietnam. They usually stay in the district capital and during the harvest period they may stay in the villages. Vietnamese traders have been attracted by districts' favorable policies (tax reductions and visa facilitation). They usually do not compete for the same production area. During our study, we were not able to determine who decided this division, but the main traders (who invest in roads and provide seeds) each work in only one or two villages.

Before the introduction of the cash crop debts, family links between farmers were predominant. Another kind of link is debts, mostly of rice, between farmers with a harvest surplus and farmers in difficulties. With the influence of the *Na Muong* system, those debts links were limited. The only farmers who were able to provide credit in rice or in money owned individual paddy fields or could get an external income. Generally, they enjoyed a very good social position in the community. However, the introduction of maize production disrupted this traditional social network.

The Vietnamese traders usually came twice a year to collect the harvest and to provide the hybrid seeds. However, the construction of the roads meant they had to come to the villages more often and needed middlemen to help them in their work. These middlemen are farmers from the villages with some skills in Vietnamese and/or with initiative. They help the trader to gather the produce, to bargain with farmers and to translate during negotiations on the road contracts; they also extend credit to farmers for the seeds. Any external income they get depends on their results and relationship with the traders.

Middleman for the Vietnamese trader in Natong

The middleman in Natong village, who is Tai Dam, was born in Sopit, a village in the Xiengkhor district. He moved to **Natong** with his parents in 1982. They built an individual paddy field in 1991. He then enlisted in the army and stayed in Vientiane. He went back to the village in 1994 and got married the following year. He moved to live with his parents in 1997 (at the same time, he got an individual paddy field).

In 2006, he started to work for the Vietnamese trader.

In 2007, he started to hire other people to work in his fields as his job with the trader needed more and more time.

In 2008, he extended his own area of maize (from 32 kg to 52 kg of seeds) and hired more workers than in the previous year.

His work for the trader involves three different activities: providing the seeds, translating during the road negotiations and helping to collect the harvest.

First activity: Providing the seeds

The trader gives the seeds to the middleman on credit. A contract is signed. He is the only person officially responsible for the debt. The middleman then provides the seeds to the farmers on credit without written contracts. He gets a commission for each bag of seeds. However, when farmers have difficulty repaying their debts, the middleman must repay the trader with his own money. Through this activity, he earned 1.2 million kip in 2007 and 1.2 million kip in 2008.

Second activity: Translating during road contract negotiations

This occasional activity consists of helping the Vietnamese trader to negotiate a contract with the village council and also to discuss where the road will be built. In 2006, he earned 2.1 million kip from this activity, and in 2008, 0.9 million kip.

Third activity: Bargaining on behalf of the trader and helping gather the harvest

The middleman helped the maize trader to gather the produce in exchange for a salary of 70 000 kip per day. When he reached an agreement with a farmer at a good price, he earned a commission of 20 000 kip/ton. For this third activity he earned a total of 3.5 million kip in 2007 and 4.2 million kip in 2008.

In total, in 2008 Natong's middleman earned **6.7 million kip** for his work with the Vietnamese trader. He used this money to hire workers for his own fields and to extend his production every year. In 2008, he also started using chemical fertilizers in his paddy and maize fields. In 2009, he plans to buy livestock and invest in his house.

Middleman and businessman in Phuk

Phuk's middleman is Tai Dam and was born in **Phuk**, where he got married in 1996. He is an important middleman for the Vietnamese trader in **Phuk**. Like his colleague of Natong village, he provides seeds to the farmers (4.6 million kip for every 2.2 tons sold), worked as a translator during the road negotiations (2.5 million kip) and helped the trader with bargaining and gathering during the harvest (12 million kip). However, **Phuk**'s middleman has another three activities.

First additional activity: Providing rice on credit

In **Phuk** only, the Vietnamese trader provided rice to farmers on credit in exchange for a large part of the maize production. However, as there are taxes on rice at the Lao border, the trader prefers to buy the rice in Laos. **Phuk**'s middleman was in charge of finding and providing the rice to the farmers who accepted the contract. In 2008, he provided 32 tons of rice in **Phuk**. The rice was bought at 2800 kip/kg and sold to the farmers at 3000 kip/kg. Through this activity, he earned 8.7 million kip.

Second additional activity: Providing credit to farmers

He also worked as a middleman for the trader to provide credit to farmers who wanted to buy a motorbike or small tractor or who simply needed cash. In 2008, 90 households borrowed 120 million kip, which they repaid by selling their maize to the trader at a lower price. Through this activity, he earned 1.2 million kip.

Third additional activity: Middleman in livestock transactions

Phuk's middleman found farmers who wanted to sell their buffaloes and worked as a middleman in those transactions with the Vietnamese traders. In 2008, he found 20 buffaloes and earned a commission of 200 000 kip for each sale (total 4 million kip).

In total, in 2008 he earned **33 million kip**. He is obviously the richest man in the village, as he shows through his beautiful new house, the only house with painted walls in the village. More interesting is his next step. In 2009, he plans to invest and start his own business. He will purchase 1 ton of seeds by himself. He will then provide the seed to the farmers on credit; they will repay him with their maize, which he will sell at a higher price to the Vietnamese trader. To achieve this, he will build a storehouse in the village and hire five or six villagers to help him to collect the produce.

Photo 11: Middleman's house in Phuk village, the only house in the village with painted walls

There are a dozen such middlemen in the **Natong** cluster, most of who have the same activities. However, some have developed personal businesses using the capital earned. They create new debt links with the farmers and so new unequal exchanges. To offset the working time given to the traders and to increase production, they hired paid workers. The result is the creation of a new position in the village that is supported by those new social links. The middlemen generally come from the traditional social elite, but they did not have high social responsibilities (they were generally not part of the village council). Their wealth is directly linked to the maize industry and its spread within the

community. They are great supporters of maize production and will support any actions that could lead to maintaining or expanding maize production.

The main risk they face is insecurity of repayment by some farmers. This problem could reduce their income but could also give them greater power among the farmers.

3.2 Is maize a sustainable option for the development of the **Natong** area?

3.2.1 Environmental sustainability of the maize cropping system

In the **Natong** cluster, maize is generally produced without rotations or associated crops. Pumpkins are the only other produce found in the maize fields. This new system of production is taking over the shifting cultivation for upland rice. The upland rice production system uses 3- or 4-year fallows, mostly scrub (grass, scrub, bamboo). We fear the new crop may inflict a different form of environmental damage.

Without rotations, soil is exposed every year to erosion, which is particularly fierce in subtropical regions. The soil could lose such physical qualities as its ability to hold water, an important factor for growing plants. The loss of the soil's physical quality could also lead to a decrease in soil cohesion and so to more landslides, which is destructive not only for crop production but also for human settlements. With a reduction in the soil's ability to retain water, farmers could experience more flooding in lowland areas. Erosion also means a loss of fertility as nitrogen, potassium and phosphorus, which are highly soluble ions, could be washed away. Shifting cultivation faces the same problem of erosion but only one year out of four. Hence, the impacts are more limited.

Another potential form of environmental damage is the loss of fertility caused by the production system. Farmers use hybrid seeds, which can achieve a high level of production. The average maize cob yield is 4.7 tons/ha compared with 940 kg/ha of grain for upland rice. Therefore, almost 4 more tons of biomass is taken out of the field in maize production than in upland rice production. This biomass is removed from the field and the crop residue is usually burned, which is another quantity of biomass removed from the field. Currently, farmers are not compensating for this loss with the application of organic or chemical fertilizers. As a result, the organic substance capital of the soil is being reduced year on year, affecting the soil's fertility and physical quality.

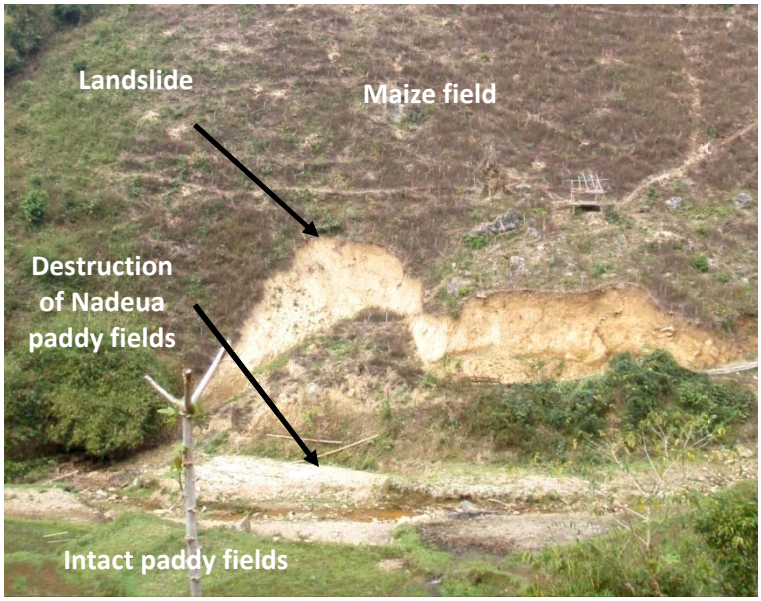


Figure 26: Example of environmental damage (landslide)

Biodiversity is also at stake. The landscape created through shifting cultivation is a complex mosaic. In our study area, farmers use individual fields, so every field adjoins another at a different stage (1, 2, 3 or 4 years old). Each stage hosts diverse biodiversities (grass, scrub or bamboo fallows).

Although biodiversity is not as high as in a long-fallow landscape, there is still greater biodiversity than in a monoculture system. This is a determinant factor. Biodiversity is not just a problem of diversity of species. For farmers' livelihoods, biodiversity means additional income through the gathering and hunting of small animals. Bamboo shoots are a prominent example; households can earn an average of 1 million kip by gathering bamboo shoots (taking into account the price of the produce and their own consumption of the produce). This amount is not insignificant compared to the income of 5.7 million kip from maize production.

Linked more closely with crop production, homogenization of the environment through the monoculture of hybrid seeds could lead to increased risk of maize diseases. This is also a perfect environment for the spread of pests such as insects and small mammals. Rodents are now a significant threat to production. Farmers have to place traps in the fields and sometimes stay in the fields during the night to ensure their harvest is not entirely eaten by rodents.

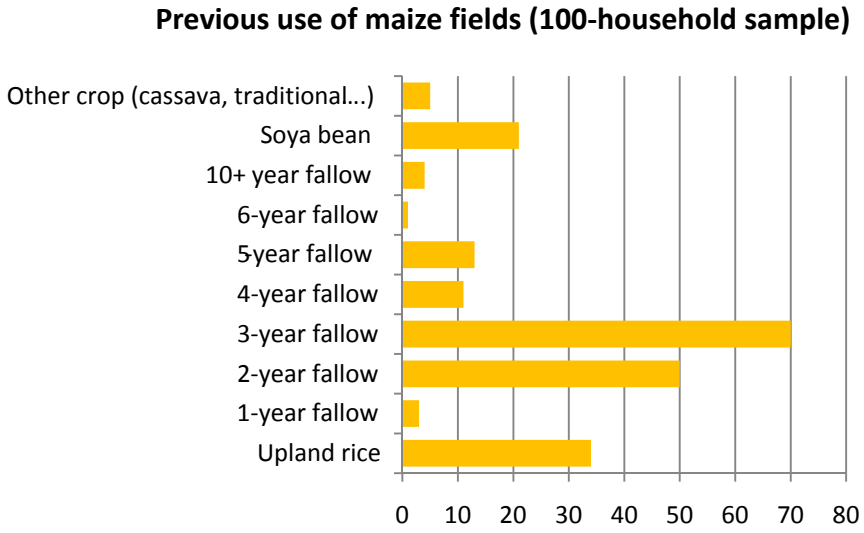


Figure 27: Previous use of current maize fields

The assumptions made through comparison with scientific models have a great impact because of the scale of the maize expansion. The previous chart shows how fields currently used for growing maize were used before the introduction of maize. Most farmers used their upland rice fallows for maize production. In the sample of 100 households, 70 three-year-old fields, 50 two-year-old fields and 35 fields just after the rice harvest were converted to maize monoculture. In 2008, the maize area for the five villages reached 416 ha, compared to 166 ha for upland rice production (580 ha if we add the fallow areas).

Moreover, maize fields are concentrated along the roads. As we have seen previously, a continuous area is used for the same production system. This concentration of fields in one area heightens the environmental damage and increases both the probability and the impacts of flooding and landslides.

3.2.2 Economic evaluation and viability of maize production

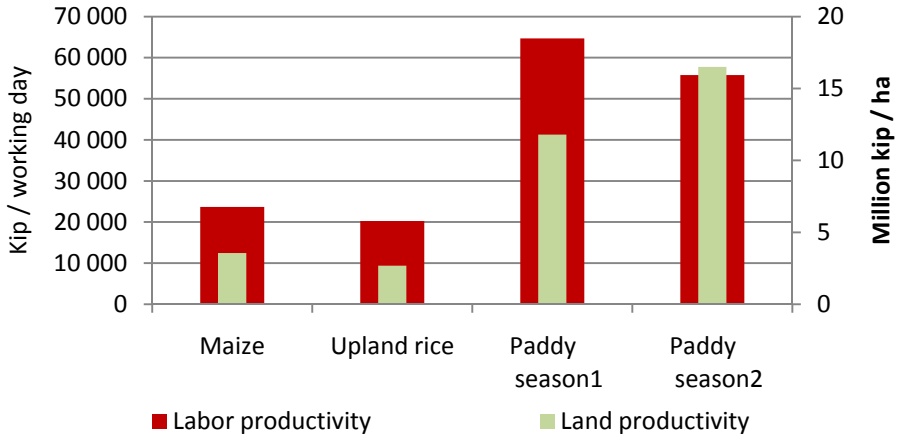


Figure 28: Comparison of returns to labor & land for maize and upland rice

In terms of returns to both land and labor, the maize cropping system has better economic results than upland rice.

The average return to labor is 23 500 kip per working day for maize, compared with 20 000 kip per working day for upland rice. The difference in return to land is more substantial: 1 ha of maize has a return of 3.6 million kip compared with 2.7 million kip for upland rice. This calculation was not made for the whole upland rice rotation system, but for the cultivation year. If we consider three-year-old fallows, the annual return to land falls to 675 000 kip/ha, and for two-year-old fallows 900 000 kip/ha.

The economic results of the maize cropping system are better than for the upland rice cropping system. However, the upland crops are far less economically efficient than the lowland crops. Return to labor reaches 65 000 kip per working day for one season and 55 000 kip per working day for two seasons in the paddy fields. Return to land is also higher with 12 million kip/ha annually for one season and 16 million kip/ha for two seasons.

In comparison with the lowland production system, differences in the economic results for the upland cropping system (upland rice and maize) for return to labor are small (less than 3000 kip/working day). Moreover, this return to labor does not take into account the income from associated crops, which is more important in upland rice production.

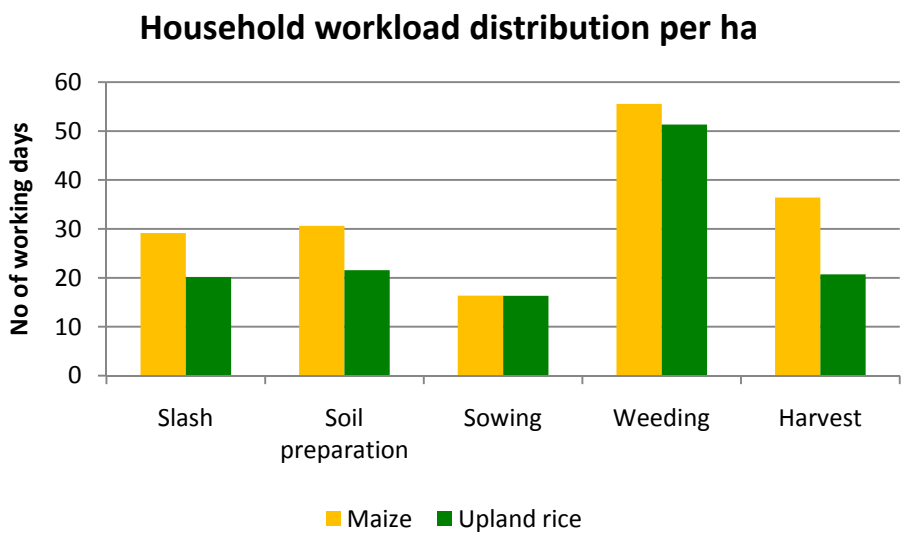


Figure 29: Maize and upland rice household workload distribution per ha

This small difference is moderate even by the analysis of the workload distribution for each cropping system. The calculation was based on the 100-household sample for 1 ha (Figure 29).

At every step of production, maize needs more labor than upland rice. For weeding, upland rice needs 50 working days of weeding for 1 ha, and maize 55 working days/ha, even though upland rice generally needs to be weeded three or four times, compared to twice for maize. The harvest is also a major step in production regarding the workload, with 35 days per ha. The effects of having roads near the fields, as previously described, are included in this result.

The main finding of this chart is that maize needs more labor per ha at every step of the production process (Figure 29). How do farmers overcome the competition for labor between maize and upland rice? One way is the relative separation in the times for each activity, as upland rice fields are prepared just after maize and are sown in the same time, so those activities need little labor. However, weeding and harvest are done at separate times. Weeding in maize fields starts at the end of May and in upland rice fields in mid-June. This slight time lag allows the farmers to manage their workload more efficiently.

This observation leads to the conclusion that the recent increase in household incomes stems from the expansion of the area under production and is not a real increase in return to labor, even though farmers have increased their investment in the labor force. The maize cropping system is a new economic model that allows farmers to extend their area under cultivation and so to increase their income. This extension has been made to the detriment of the traditional upland rice shifting cultivation system. As we have seen previously, the current maize fields were mainly used as fallows for the upland rice cropping system. With the concentration of maize fields near the roads, there are substantial land pressures on the upland rice cropping system, pushing more and more farmers to reduce or stop their upland rice production.

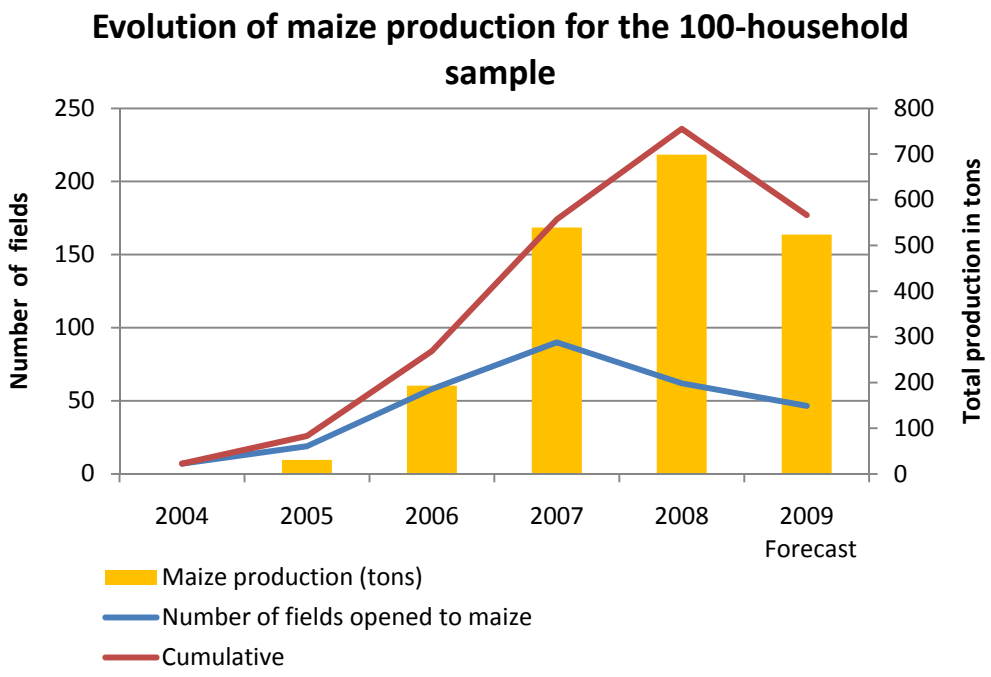


Figure 30: Maize expansion for the 100-household sample

We measured this maize extension for the 100-household sample. We reported all the fields used in 2008, and, for every field, asked the year of the first maize harvest. Figure 30 shows the rapid expansion in maize production. In the 100-household sample, 50 fields were opened in 2006 and 90 in 2007. These data do not take into account the fields relinquished by farmers. This extension is closely linked to the increase in production for the sample, from less than 20 tons in 2005 to 200 tons

in 2006, more than 500 tons in 2007 and 700 tons in 2008. This is due to the better economic results for maize than for upland rice. However, as noted previously, these improved results stem from an increased return to land and not from an increased return to labor. Therefore, it is by the expansion of the area used for maize that farmers managed to increase their incomes.

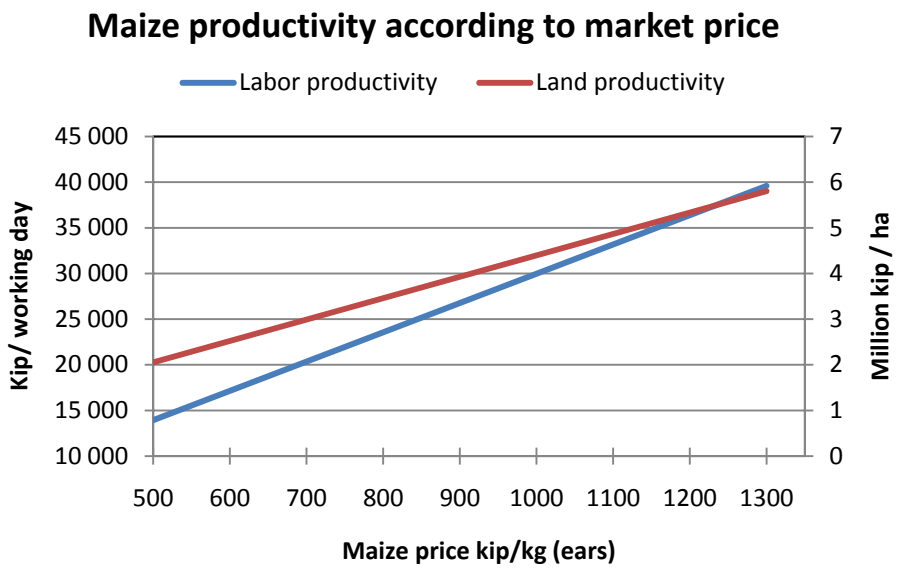


Figure 31: Maize productivity in relation to market price

Unlike rice production, the economic results of the maize cropping system are closely linked to the market price, because all of the produce is marketed. Previously, we compared the productivity of maize for farmers in 2008. However, as maize is an international commodity, its price is subject to considerable fluctuations. If we study this productivity in relation to the market price of maize, we see significant variations. To do this, we take from the previous chart the average return (to labor and land) depending on the maize price.

For example, in November 2007, some farmers succeeded in selling their produce for more than 1300 kip/kg; at this price, return to labor reached 40 000 kip/kg, which is not very different to the lowland production system. By contrast, in November/December 2008, the price of maize for some farmers fell to 750 kip/kg. At this price, productivity was at just 20 000 kip/kg, which means that the return to labor is at the same level as the upland rice cropping system or paid farm work (daily wage is 20 000 kip to 25 000 kip and the average return to labor for upland rice is 20 000 kip). For the same variation in price, a farmer growing 1 ha of maize could get 2 million kip (price at 500 kip/kg), 4 million kip (price at 900 kip/kg) and 6 million kip (price at 1,300 kip/kg). The return to land and labor for maize are thus very closely linked to the market price. At less than 700 kip/kg, the return to labor of maize becomes lower than that for upland rice. However, regardless of fluctuations in the price of maize price, return to land is higher in the maize cropping system than in the upland rice production system.

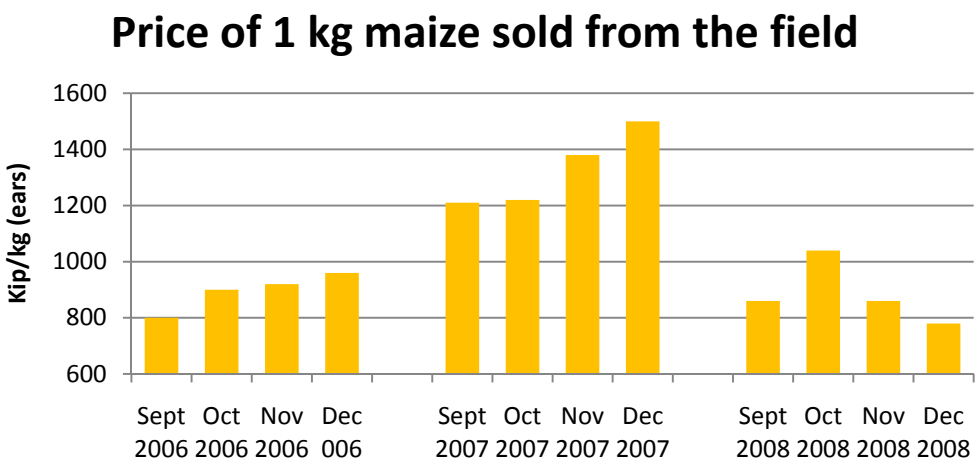


Figure 32: Changes in the price of maize in the Natong village cluster

To show the importance of maize price fluctuations, we asked in every village the general evolution of the maize price during the harvest period for the past three years of production. We then calculated the average for the five villages (Figure 32). In 2006 and 2007, the maize price followed the same pattern, with an increase month on month during the harvest period. For example, in 2006, the price rose from 800 kip/kg to 950 kip/kg. This evolution heightened in 2007, as price broke previous records with more than 1,400 kip/kg in December 2007. In 2008, the maize price followed the same pattern until November, when the price crashed to 750 kip/kg. The average 2008 price we encountered during our interviews of the 100-household sample was 810 kip/kg (ears).

Those variations are linked to fluctuations in international commodity prices. Maize bought by Vietnamese traders is sold in Vietnam to the chicken- and pig-breeding industries. These companies find the maize they need on various markets, whether local (in Vietnam), regional (Laos, China) or on the international market through the industrial shipyard of Haiphong. As those prices follow the same trends, any variations in the international price affect local prices. If we study the evolution of the American corn price, we see the same fluctuations (**Erreur ! Source du renvoi introuvable.**).

The price rose at the end of 2006 and the end of 2007 as the maize price followed the commodity bubble (along with wheat, petrol, natural gas, etc.). There are various explanations regarding the causes of this bubble, including financial speculation, success of corn-made ethanol and severe droughts in South America and Australia. However, when the bubble burst, prices returned to the high level of 2006.

This fall in prices in 2008 had various impacts both on the community and beyond. First, farmers who expected to sell their 2008 produce at the same level as in 2007 may have incurred debts that they have had difficulties in repaying. Some experienced even greater difficulties if they waited, as in previous year, to sell their produce at a better price. Even though the price was at the same level as 2006, farmers used the capital earned in 2007 to buy equipment (motorcycle, small tractors, rice mill) and to buy rice to meet their needs because of the reduction in their upland rice production. Some spent too much the previous year and could be in difficulty. However, although prices fell in 2008, it was to the 2006 level. In early 2009, farmers were quite optimistic.

The impact of the drop in price was much more significant for the Vietnamese traders. Most of them bought substantial quantities of maize in early 2007 at a high price, expecting the same evolutions to occur. However, when the price fell sharply in November 2008, to minimize losses, Vietnamese traders stockpiled the produce, sometimes in poor conditions, as they waited for the price to recover. During our fieldwork we noticed that some traders' storehouses in Xiengkhor (the district capital) were still full in March 2009. That the Vietnamese traders suffered substantial losses after the 2008 harvest was confirmed by their change in attitude toward farmers; instead of providing the seeds on credit and trying to get the greatest amount of produce, traders did not arrive

until the beginning of April, when they asked farmers to pay for the seeds in cash. This could create problems as some farmers were already experiencing difficulties repaying their communal or individual debts; by reducing their maize production, they will reduce their monetary income and therefore experience even greater difficulties.

Photo 12: Storehouse full of maize near Xiengkhor at the end of January 2009

This example shows the risks of commercial agriculture directly linked to the market. When farmers earn their monetary income mainly from one kind of produce, even the slightest fall in price can have significant effects on household income, strategy, debt repayments and investment.

Role-playing game exploring farmers' attitudes toward maize price fluctuations

We designed a role-playing game for a group of five farmers during the final workshop to better understand farmers' attitudes toward market price fluctuations.

From the game, we learned that farmers tend to increase their production when the price is high. They also stop this increase when price falls. However, during our experiment, nobody chose to reduce maize production by going back to the upland rice system even when the maize price fell to 400 kip/kg.

3.2.3 Adaptation to economic and social changes caused by commercial agriculture

Credit, mostly for seeds and the maize roads, has reshaped social relationships both within communities and with outsiders.

The debts for the maize roads are substantial and equally distributed among households. This equality shows strong community leadership, but ability to repay varies. **Nadeua** is a good example of this problem. Even though the debt is shared equally, only a minority of the farmers have repaid their dues. The community is now in a bad position; the trader has lost confidence and his only thought is to retrieve his investment. This problem of repayment overshadows the relationships between the community and the traders. To honor their debts, farmers in difficulties, if they can, will have to de-capitalize, which could lead to the departure of the investors and make investment more difficult in the future.

Individual debts are smaller but the pressure to repay is different. For the maize roads, pressure regarding repayment is applied by the village council, which wields substantial influence over the community and has strong leadership. By contrast, individual debts are contracted between two farmers. There are two kinds of individual debts. In traditional debts for rice, the creditor is the

farmer with a harvest surplus and the borrower is the farmer who needs rice. In the communities, the new sort of individual debts are the seed credits. As we have already explained, those debts are managed by the trader middleman, who is responsible for the repayment. Middlemen complained about the problems with repayment they are experiencing.

The year 2009 was difficult for the farmers. The fall in maize prices made it more difficult for farmers to repay their debts. The **Phuk** community was in a difficult position, as they had just built the roads and had to start repaying that debt. The other difficulty already overcome by the farmers is the tightening of credit. The Vietnamese traders have been financially affected by the maize price fall. Before, when the maize price was inexorably increasing week on week, their strategy was to secure their purchases and so invest in farmers' production by providing credit for the seeds. However, when the price of the maize fell back to its previous level, and after suffering big financial losses, the financial benefits of the operation vanished. As a result, the traders did not arrive in the village to provide seeds. This tightening of credit pushed some farmers to buy seeds directly using cash, although only a few farmers could afford to do this. To continue maize production, farmers had to somehow find credit for the seeds. The solution came from the middlemen who negotiated with the Vietnamese traders to get the credit for the seeds, or who could directly provide the credit. However, to secure their investments, middlemen could extend credit only to solvent households. As a result, the headmen of **Natong**, **Xiengdaene**, **Nadeua** and **Phuk** expected a reduction in the maize production area and therefore in production of 25% in 2009. This could be a problem, as some farmers are already experiencing difficulties in repaying their communal or individual debts; by reducing their maize production, they will reduce their monetary income and therefore face even greater difficulties.

For now, households are combining the maize cropping system with the paddy and/or upland rice cropping system. Only one farmer in the area specialized in cash crops.

An agricultural contractor in Nadeua

Mr Pan is Tai Dam, born in **Natong**. After the failure of his first marriage in Sobsane, he got married in **Nadeua** and settled in the village in 2006. He arrived with capital worth 700 000 kip.

Mr Pan found himself in a difficult position, as in **Nadeua** there were no communal paddy fields available or individual paddy fields. His only possible solution was to produce maize and/or upland rice on slopes. However, unlike the other villagers, he decided to produce only cash crops. In the first year, 2006, he produced 1.5 tons of maize and 2 tons of soya beans. With the cash from sales, he directly bought 3.5 tons of rice, which he used for his own consumption, and also hired workers and increased his production. In 2007, with 40 kg of seeds, he produced 8.5 tons of maize, which he sold at 1200 kip/kg. With this cash, he bought 6 tons of rice, invested in a shop in the village and bought one pig.

Mr Pan repeated this scheme in 2008; from 60 kg of seeds he produced 15 tons of maize. He bought one buffalo. In 2009, Mr Pan sowed 100 kg of seeds and he went to Vietnam to buy directly the hybrid seeds he needed. However, he had to find suitable fields to increase his production. In 2008, because he had bought a buffalo, he became a member of the livestock management group in **Nadeua**. Through this membership, he asked the group if he could use part of the livestock area for his own production; he succeeded in getting the space he needed.

In the future, he plans to increase his production of maize, and if necessary will use chemical fertilizers to maintain his production level. He is not scared by the 2008 fall in the maize price; as long as this activity is profitable, he will continue. Mr Pan fixed the lowest limit at 450 kip/kg.

He is the only farmer in the **Natong** cluster who does not produce his own rice. Although he would like to buy paddy fields, there are none available in the **Natong** cluster. He enjoys a substantial income, but he feels insecure and is considering leaving the area in search of better livelihood conditions.

With current trends, Mr Pan could become an example for many farmers. However, this production system, based on paid farm work, needs starting capital or family security. In the case of Mr Pan, he used his 700 000 kip capital to start his cash crop production. For now, he is the only farmer to do so because in other villages, young independent couples have access to food security through the *Na Muong* system. However, if in the future this system is disrupted because of high pressure on land tenure, many farmers may choose to follow the "Mr Pan way" using a small amount of capital (livestock or wedding gifts).

This example also shows the importance of paid farm work in the villages. Because this paid farm work is not external labor but agricultural work, more paid farm work means less household production and more dependency links. Between 2000 and 2008, according to the **Nadeua** headman, in his village, the percentage of households working for someone else increased from 30% to 50% of the community. **Nadeua** is the most vulnerable village because of its low food sufficiency. As we have explained previously, maize needs more labor than upland rice production. The shift from one system to another explains the recent increase in paid farm work.

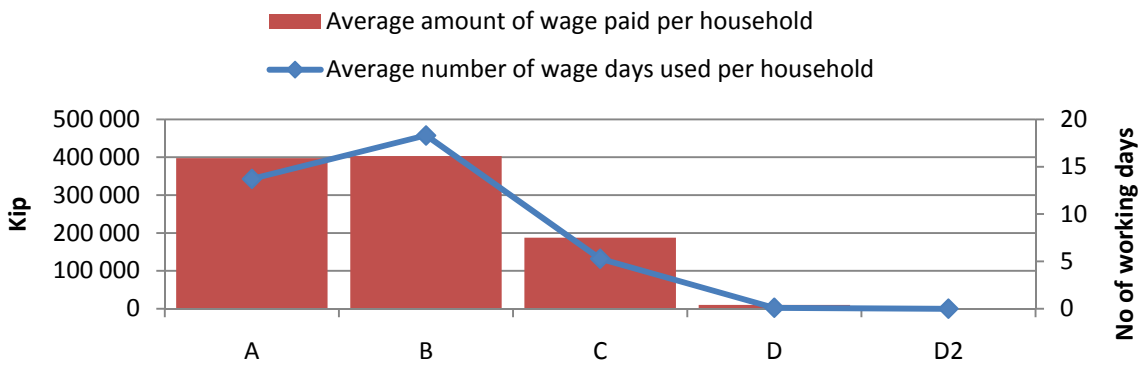


Figure 33: Use of paid farm work by household type

In the **Natong** cluster, paid farm work is done by the poorest farmers, mostly from the Yao community and from **Nadeua**. If we study the distribution of paid farm work across the farming systems, we can see this unequal relationship between farmers. Farming systems A and B use 400 000 kip to pay wage earners for 15 days (Figure 33), mainly for their maize production. Farmers in these two farming systems own individual paddy fields and their maize income differs greatly (difference between A and B is 1 million kip per worker per year). We could easily assume that *Na Ti* ownership allows farmers to hire workers and so to increase their potential production. Farming system C, which has no individual paddy fields, uses less than 200 000 kip to hire workers for an average of only five working days.

If this trend continues, there will be an increase in the exchange of labor and capital between poor workers (D) and rich farmers (A, B).We fear farming system D could evolve to a new farming system of being without land and working to expand A or B farmers' production. This concern is based on the fact that the current maize cropping system offers few opportunities to quickly return to the traditional subsistence system because of the disappearance of fallows.

In general, even if every household engaged in maize production, debts, paid farm work and other dependency links could lead to greater disparities among farmers. Traditionally, the strength of the community lay in the *Na Muong* system, which forced people to work together and minimized any differences. However, with the introduction of cash crops, differentiation follows the strategies in upland fields. Greater differentiation means a divergence of interests, and therefore weakening of community decisions.

3.3 Exploring potential interventions to ensure sustainable development

3.3.1 Improvement of maize production and marketing systems

- One of the most important considerations for maize production is the sustainability of the current cropping system. As we mentioned previously, maize is produced without fallow rotations, thus increasing the area without vegetation. This could lead to soil loss and therefore more landslides in the uplands and flooding in the lowlands. Erosion and monoculture lead also to fertility loss, which could be partly compensated for in the future by the use of chemical fertilizers. To deal with these problems there are already some agronomic solutions, namely conservation agriculture. This term refers to various different technologies that have the common goals of increasing the proportion of organic matter in the soil composition (factors for good physical structure and good water retention) and increasing soil cover to prevent erosion. These goals can be achieved using different techniques, depending on the situation: management of crop residue, production of crops during the intercropping period or association of different crops during the growing period. Objectives should be specified; most of the time, agroecological techniques are designed to prevent soil degradation in a production system with tillage. However, in the **Natong** cluster, soil preparation is not important and the soil structure is not disrupted by mechanical means. When a new technique has been chosen, there will still be challenges in introducing the new processes into the farmers' production systems:
    - Crop residue management or intercropping period crops need serious consideration of livestock management. Most of the time, large livestock are left in the fields during the intercropping period (November to April) to eat the crop residue. With the new techniques, farmers have to prevent livestock from eating all the crop residue or associated crops. This is a real challenge, because livestock are now managed extensively and there is no feeding management during this period. The response could be individual (fencing) or collective with fenced areas for livestock and feeding management.
    - To succeed, a new production system will need technical support, which could provide the knowledge, experience and materials needed. The main challenge in this remote area is to ensure constant and reliable technical support for the farmers.
    - As a mid-term solution, conservation agriculture needs to provide short-term results to ensure acceptance by farmers, such as by finding a market for associated crops or indirectly by securing the production for farmers willing to try the new system.
- Access to market information is a key to success for household strategies. Income varies according to the price of maize. Currently, however, people have no market information; the only price they know is that given by different farmers and they do not fully understand the issues in maize production. One activity would be to introduce some basic information about the maize value chain in Vietnam and northern Laos. A trip by village representatives to Vietnam may support such a process, including meetings between traders and Vietnamese officials, as well as a visit to a feed-processing factory. The objective would be to give the communities the tools to understand the production that has recently become the farmers' primary activity. Those tools could be rounded off with a basic pricing information system to let them know about substantial fluctuations in prices and so to help them in their negotiations and upland strategies.
- One way to improve the maize production system could be to organize farmers groups in the **Natong** cluster. These groups should be small and include only trustworthy people who can rely on each other. These groups would have various objectives. First, farmers could organize themselves to resolve the credit crunch, especially for seeds. Instead of negotiating the contract with a trader in the village, they could manage to get credit from larger stakeholders in Vietnam. This would allow them to get better contract terms and could remove their

dependence on the current trader. This would be easy to implement – people have already started to organize themselves in this way but around middlemen. After this first step, and if the experiment succeeds, we could attempt other activities:

- Maize drying and/or storage to increase the farmers' share within the maize value chain.
- Farmers group negotiating with larger quantities of maize and so increasing their bargaining power.
- Creation of a larger credit and savings group to provide cheaper and more reliable credit in the event of health problems or a hunger gap.

The success of these activities will depend on the contribution of both social elites (headmen, deputy, etc.) and the trader middlemen who already secure a part of the maize added value but for their own profit.

3.3.2 Crop–livestock interactions: Toward a viable solution?

Interaction between livestock and crops is a fundamental challenge. The expansion of cash crops and the reduction of the fallow areas lead to a conflict between livestock and agricultural space. Traditionally, cattle and buffaloes breed extensively. Animals are free to find by themselves any feed in the fallow areas. In good conditions, there is plenty of space and livestock wandering is not a problem for the farmers' cropping systems. However, with the rapid expansion in the agricultural area, land has become a rare resource and an important source of wealth. Farmers prefer to allocate most of their land to crops, leaving the poor areas to the livestock. This shift is illustrated by the creation of small fenced areas in four villages (**Natong**, **Nadeua**, **Xiengdaene** and **Phuk**) when people started to grow cash crops. The case of **Nanong** is a good illustration because, of the five villages we surveyed, it was the only one without a fenced area for the livestock because of the lack of space to locate such an area. Farmers therefore have to individually manage this activity, which is time consuming.

Pigs and chickens are kept out of the cropping areas as they are kept near the houses. Pigs are caged near the village; they cannot wander freely and are fed every day. The production system is already intensive, with limited space and feed control. Cheap feed is used, such as banana trunks or leaves, cassava and rice bran. Usually, half of the litter is sold at six months without feeding, and half are kept to sell or eat at two or three years old. Vietnamese traders regularly come to the village to purchase pigs. Because pigs are important to the household income and in the strategy to ensure an income throughout the entire year, improvement in pig production could be one approach for improving farmers' income.

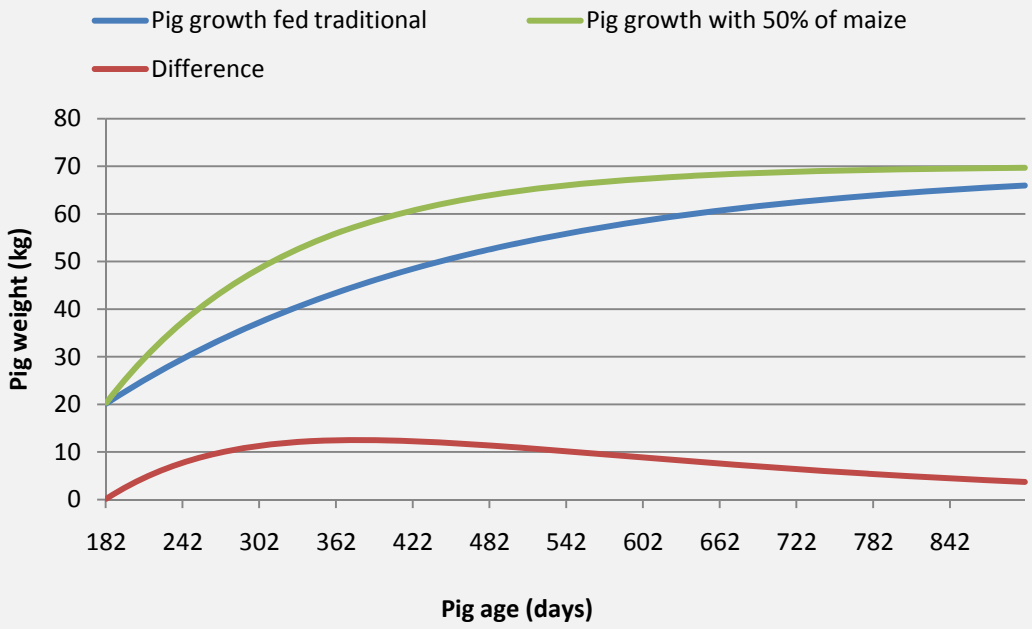
One alternative that is emerging rapidly is the possibility of breeding pigs by feeding them maize. After all, the maize produced in those villages is sold to supply animal-feed factories, which then supply the Vietnamese breeding industry. Therefore, could these farmers do the same and increase the added value of their maize production by using it to feed new pigs? Does this proposal have economic worth? To partly answer to this question, we designed a small model.

We designed a evolutionary model for the kg price of live pigs and the weight of pigs. The objective of this methodology is not to model the potential income but to provide material for the decision-making process.

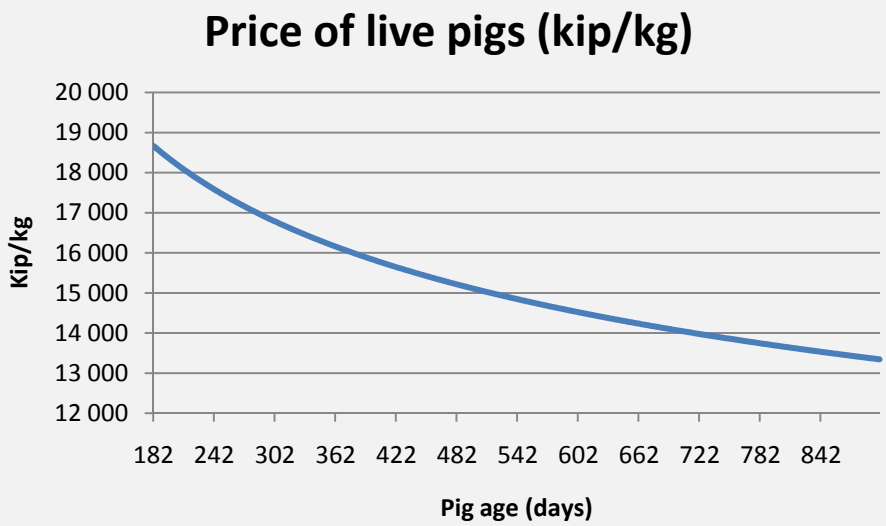
During the focus groups, we collected some information regarding the breeding of pigs. Farmers use the native breed “molat”, which has an average mature weight of 70 kg.

We designed a model for the growth of a pig fed a traditional diet (banana leaves and trunks, cassava and vegetables); the average daily growth is 110 g/day up to 50 kg, after which growth slows until the mature weight of 70 kg.

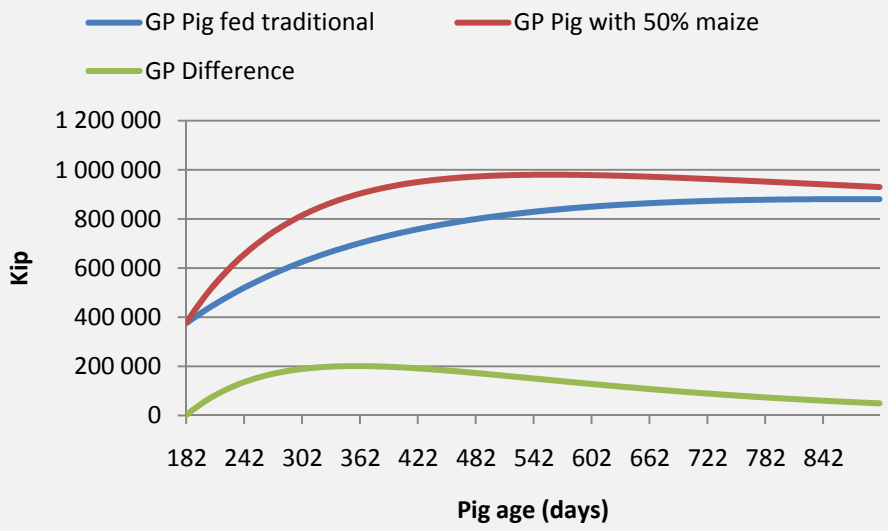
The second model uses an improved diet with maize accounting for 50% of the daily ration. If the farmers choose to change their breeding system to fattening pigs with maize, they could expect higher growth rates, especially during the first year of growth. The average daily growth is 220 g/day up to 50 kg, after which growth slows to the mature weight of 70 kg.



With the information collected during our survey, we also designed a model of evolution for the price for live pigs, which falls as the pig ages.



The result of the two models is the evolution of the direct value of the pig (pig weight x kg price).

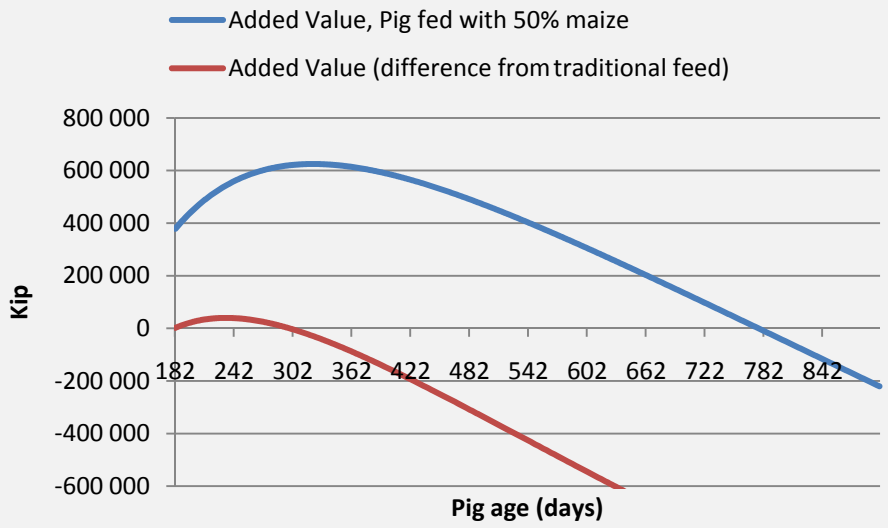


The marginal gain becomes very small after one year (difference in gross product – GP). Farmers should therefore focus on short-term breeding (less than one year) when the growth rate and price are higher, if they want to improve their income. However, their choices could be easily explained by a different household strategy using pigs as a saving asset because they cannot afford large livestock.

We consider a daily ration of 2 kg of maize per pig in the improved diet. The rest of the ration is composed of low-energy produce (banana leaves/trunks, cassava and vegetables). Maize used in the pig feed could be sold at a market price of 800 kip/kg (data collected); because there are no real market prices or product values are low, we will not take into account the opportunity costs for cassava and banana leaves/trunks. Because both diets use those products, at least for half of the amount, an estimation of the produce value is not necessary.

Now, we estimate the change in the added value of one pig depending on the market price.

$$Pig\ added\ value = weight \times pig\ price - cumulative\ maize\ quantity \times price\ of\ maize$$



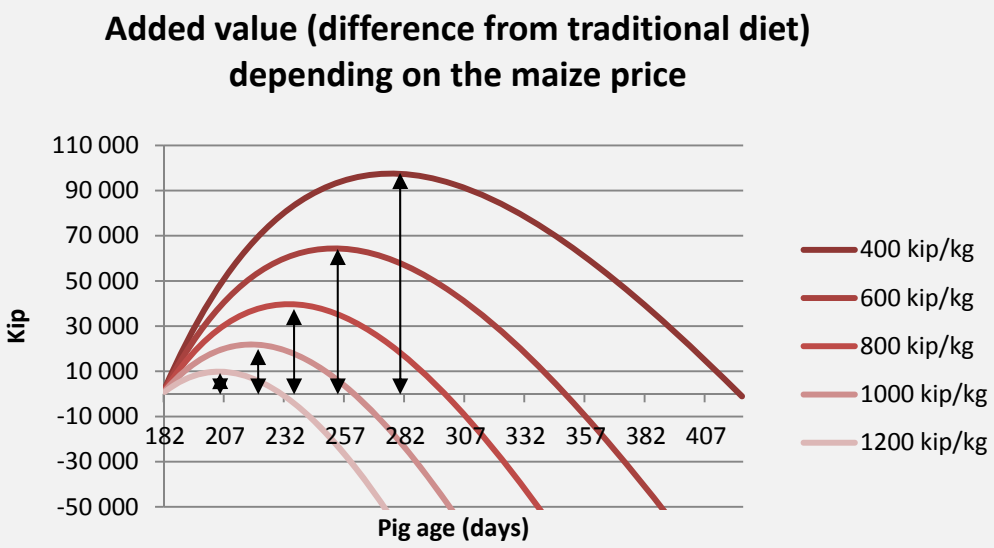
The first information we get from this model is that the maximum income is 624 000 kip for a 330-day-old pig. After this age, feeding costs exceed weight growth, so the pig added value is reduced after this time limit.

As a result, farmers should focus on selling young pigs (younger than one year) to get higher income, especially if they use costly materials in the pig feed.

However, in our case, we would like to compare the economic results of the two diets. To do so, we have to take into account the economic results of feeding pigs the traditional diet. We subtract the Gross Product (GP) of one pig on a traditional diet from the added value of the pig on the improved diet. (We ignore feeding costs for the traditional diet). The result is the "added value (difference from traditional diet)" seen in the above chart. Through this new comparison, we can really understand how much farmers gain from the new diet compared with the previous one.

Results are small. This added value is positive only before the 300th day, and reaches a maximum of only 39 000 kip at 230 days old.

We could also work on the maize market price to estimate the evolution of the added value depending on market price fluctuations.



The previous chart presents the added value of one pig fed 2 kg of feed every day. The different added value has been calculated depending on the maize price (ranging from 400 to 1200 kip/kg).

Farmers have to focus on the maximum added value to get the greatest profit from this system. As this maximum change depends on the maize price, it is also reached faster if the price is higher. For example, with a price of 800 kip/kg, the maximum added value is about 40 000 kip when the pig is 235 days old. With the lowest price, 400 kip/kg, the maximum added value is 95 000 kip when the pig is 245 days old. With a higher price, 1000 kip/ kg, the maximum added value is 25 000 kip when the pig is 220 days old. At a fixed price, farmers have to sell their pigs before exceeding the maximum added value.

Even if the maize price stays low (400 kip), the added value could reach only 100 000 kip (compared with 1 200 000 kip, the price of a mature pig). This alternative does not seem to have economic value even when the maize price is low. Even if the pig growth rate is twice as high, the economic results of the new diet are not interesting, as the feeding cost is too high compared with that of the traditional diet (which has a very low feeding cost). For farmers in these areas, pigs are a way to improve the value of low-value products such as cassava, banana leaves and trunks and vegetables. Trying to use pig breeding to add value to the maize does not seem to be possible in these conditions. Farmers prefer to sell their maize and then use the low-value products to feed their pigs, which is a rational choice in their situation.

This new system has other challenges to overcome. To feed pigs with maize, farmers have to manage to store and dry part of their harvest in good conditions. This is quite difficult and they could

expect losses during the process. Farmers have also to find ways to cook maize and to make it appetizing (a regular concern for farmers).

Regarding the rapid and easy income derived from selling the harvest directly, feeding pigs maize does not seem to be the easiest solution. Nevertheless, in some conditions, farmers could really improve the added value of their production but also secure their income. Further work needs to be done to establish some clear projections, especially regarding the impact a change in diet has on pig growth and the management of the storing and drying of maize.

Figure 34: Model of pig–maize interaction

3.3.3 Potential intervention in lowland intensification

From a comparison of productivity, paddy rice production is the most efficient cropping system, in terms of both return to labor and land. Access to lowland and irrigated fields is the main factor of differentiation. Improving production by intensification and extension of irrigated fields could have a great and visible impact on food security, livelihood and upland strategies, especially in villages such as **Nadeua** or **Phuk**.

- Improvement in paddy rice production is possible during the rainy season, as farmers already have good yields (4 tons/ha). However, some farmers in certain areas face flooding or degradation of the terraces. Improvement of irrigation and river containment could reduce vulnerability to such weather events.
- By contrast, more could be done during the dry season. Yields are far lower (1.7 tons) for various reasons. Weather conditions, particularly the low temperatures in December, are the most significant constraint for farmers. They usually have to try two or three times to grow seedlings in their nursery before they can be transplanted. For example, this year in **Nadeua**, lack and mismanagement of seeds meant only half the area was transplanted. Improved nursery techniques could facilitate production. Farmers also experience water shortages before the harvest (March to April). Depending on the severity of the drought, harvest loss could be substantial.
- As only parts of the lowland fields are irrigated, extension and improvement of the irrigation system are possible. For example, with the help of the PRF, **Phuk** is improving its own irrigation system to shift all of its *Na Muong* to a two-season cycle. Where irrigation is impossible, we could promote new crops that are less water dependent to grow during the dry season and thereby intensify production in lowland fields. Some farmers already use their lowland fields to grow onions and vegetables, but the challenge is finding a market for that produce and then pushing farmers to improve those cropping systems.
- The adoption of improved varieties with new management techniques could facilitate production especially during the dry season when farmers experience greater difficulties.
- Some farmers have expressed their difficulty in using their paddy fields even if they have been granted an area by the community, generally because of a lack of small tractors and buffaloes. If they had enough money they could rent a small tractor. However, some of them (in **Nadeua** and **Phuk**) cannot rent a small tractor, instead having to pay someone else to plough their fields (minimum 150 000 kip/day). We could imagine a collective management system providing shared small tractors to encourage those farmers to cultivate their paddy fields. This system could be built around the *Na Muong* system.
- The most significant limitation in paddy rice production is the lack of available space. The most accessible terraced areas have been already shifted to individual or common paddy fields. In some villages, especially **Phuk** and **Nadeua**, the shortage of lowland fields is a significant constraint on farmers' income diversification. If rice sufficiency is not partly achieved, farmers will continue to focus on short-term strategies and extensive production. Although there is still some space available to build dry terraces (without irrigation, suitable

only in the rainy season), farmers who have access to those fields (C, D and D2) lack the necessary capital and labor to invest in such considerable work. By contrast, better-off farmers in villages such as **Nanong** and **Xiengdaene** would like to build new paddy fields but have no more space available in their territory. This solution has to be analyzed in more depth. However, regarding the social aspects, the *Na Muong* system should not be forgotten. The *Na Muong* system creates a community link and embodies the collective management. Any intervention in the village *Na Muong* area (extension, irrigation, etc.) would be welcomed by all farmers.

3.3.4 Diversifying farmers' income

Diversification of farmers' income could be an option for two types of farmers: farmers with food security guaranteed by substantial lowland production and farmers struggling to meet their daily needs. However, as they have different objectives, they need different solutions.

For the better-off farmers, diversifying income is not an obvious solution. As seen in developed countries, the trend is not toward diversification. Nevertheless, in their situation, with very little capital, being dependent on only one cash crop for their monetary income is a significant weakness.

Diversifying income could help those farmers to balance maize price fluctuations but also to ensure an income at different times during the year and so to reduce risks.

There are many possibilities that could be swiftly implemented using local knowledge.

Better-off farmers usually possess a fruit garden growing fruit such as bananas, pineapples, tamarind and mangoes. This produce is mainly consumed within the family or the village but we could imagine introducing a new species that is easy to market; we could also find market opportunities for the existing produce. Better management, especially use of manure and green fertilizer management, could increase production. The same intervention could be realized with vegetable gardens.

Better-off farmers own also fishponds, in general producing more than 100 kg a fish a year. Small fish are bought in Vietnam and fish from fishponds are an important source of protein in the villages. Better management and feeding solutions could be found to improve the production of those fishponds. Some areas with regular water problems could be turned into fishponds. We could also imagine collective management of those fishponds.

These solutions could all be applied to all farmers except that, for some of them, the objective is not to gain a regular income but to find the food immediately needed. For this category of people, diversifying income has to be a way to diversify food security.

Bamboo shoots are one of the most important gathered products in the bamboo forest. Shoots are gathered in the summer before the maize and rice harvest. Some families eat only bamboo shoots for more than one month. Increasing production of the bamboo forest is a possibility, by such means as introducing a new variety, managing the bamboo plantation and protecting it from pests. The only problem with the plantation in the scrub is the definition of ownership. Investing in those areas without slashing and burning them is not the traditional way of production in those villages. If farmers choose this solution, they will have to decide how to manage the plantation, either collectively or individually, by sharing the bamboo forest among everybody or just a few people.

Similar problems will arise with other systems of improved fallows management.

Handicraft production does not seem possible because of the remoteness of the area, the large production of cheap products in neighboring Vietnam and the nonexistence of tourism in the province.

4 Conclusion

Until the beginning of the 21st century, the **Natong** cluster was quite isolated; it lacked proper transportation infrastructure and was remote from the main cities. The community still plays an important role in the farmer's life.

These strong community ties are embodied in the *Na Muong* system. Despite successive policies, farmers have maintained this collective management of the lowlands and were able to adapt it to a new environment. This *Na Muong* system plays a central role for the community for two reasons.

First, the *Na Muong* system is a social rule of the Tai Dam minority. This ethnic group is traditionally proud of its culture and, even though they are well adapted to contemporary Lao society, they cultivate their own traditions. In these villages, the Tai Dam are the majority and play an important leadership role in all five villages. Because the population is now a mixture of ethnicities, there is a convergence movement of the other ethnic groups to adopt the Tai Dam way of life (Ksing Mool acculturation and Khmu creating a *Na Muong* system).

Second, the topography in the area allows farmers to easily terrace lowland areas. This is evident along the Nam river, which crosses Muong Et, Xiengkhor and Sobao districts, three districts in the north of Huaphan province. With a substantial disposable paddy area, land pressure on those fields is high but sustainable and people could maintain the collective land management.

Because of this large paddy area, food security strategies are unlike those found in other remote places in northern Laos. Production in the lowlands is intensive, with high yields (reaching 4 ton/ha in the rainy season) and two seasons. The return to land and labor of the lowland cropping system are far higher (two or three times) than those of the upland cropping system (maize or rice). With this substantial difference in economic performance between the two cropping systems, differentiation between farmers obviously stems from access to lowlands.

Even though the *Na Muong* system minimizes those differences, there are still disparities in *Na Muong* areas between villages, and the total area is not sufficient. As a result, some farmers with additional individual paddy fields have rice sufficiency with paddy production. Others, who do not have access to collective fields, whether because of their personal situation or ethnicity, could struggle for half the year without rice.

The traditional production system on the slopes was an upland rice shifting cultivation system. Farmers used slash-and-burn practices on old fallows to increase soil fertility and to avoid weed competition. Upland rice was used for food security, for families without enough paddy areas, or as cash crops for better-off farmers. However, because of natural demographic growth during the past 30 years and land use planning policies at the end of 1990s, the upland rice shifting cultivation system was in crisis. Pressure on land was high and rotations were shortened to only three years. As a consequence, yields and return to labor decreased because of loss of soil fertility and increase in weed competition.

To overcome these difficulties, farmers started to test new crops, first with soya bean and then with maize. The shift to commercial crops was made possible by the investment and the involvement of the Lao government, which through development agencies and trade-favorable policies pushed the spread of cash crop production. The commodities market and Vietnamese traders pulled the introduction of cash crops.

Considering the objectives behind cash crops, maize seems to be a complete success. The majority of farmers have experienced a substantial increase in their incomes. They used this capital to invest and increase their productivity by using hybrid seeds and purchasing small tractors. Maize income has improved livelihood conditions, as it has enabled farmers to build concrete houses and purchase electricity generators. Farmers have also saved part of this money to pay for their children's educations. At the same time, with the help of the Poverty Reduction Fund, three schools have been built and children can now study in **Natong** until M3 (third year of middle school – approx. 13 year old). This new crop has achieved better economic results than upland rice. Farmers are able to

extend their areas under cultivation and they get very good yields (5 tons/ha). Maize allows farmers to convert fallows to productive field without substantial reductions in yield.

The increase in incomes comes from the extension of the area under cultivation. This land extension was made possible by the farmers' investment in production roads – "maize roads" – with the financial support of Vietnamese traders. Negotiations to build those roads and especially land redistribution along those roads have proved an ingenious combination of individual interests and community decisions. However, in general, village councils have managed to find a compromise allowing all farmers to gain access to the roads. We can presume that communities' strength in those negotiations was derived from the *Na Muong* system.

However, this overall success hides substantial disparities between the villages, although maize is not the cause of these disparities. Rather, it is the only crop produced by every farmer. Disparities arise because of the old differentiation patterns. Because of preexisting disparities in upland strategies, farmers do not derive the same benefits from maize production. For some, maize income is entirely used to purchase goods; for others, it provides a means to buy rice and ensure food security. Because of the size of the income increase, maize is a factor in widening the gaps.

After four years of rapid expansion, sustainability of the production system is now the main issue. Expansion of the agricultural area on slopes has had significant impacts on soil structure and fertility. Biomass exportation is now three to four times higher than for rice production.

Maize income is directly linked to the international commodities market. Price fluctuations (such as in 2008–2009) have a tremendous impact on farmers' livelihoods.

Farmers are highly dependent on credit to invest in roads and to buy seeds for their production. With the reduction of upland rice production, farmers are also borrowing more to buy rice. In a period of dropping prices, the economic situation could be disastrous.

Increased income, debts and disparities within communities have led to the appearance of middlemen who capture an important part of the maize income and gain new social and economic power in the villages. At the bottom of the social scale, farmers without access to lowland fields are becoming day laborers, thereby reducing their own production.

In the coming years, farmers will have to adapt their production system to the new economic and environmental situation. Technical solutions exist for upland fields ranging from conservation agriculture to tree plantation. These upland solutions could help overcome the challenge of sustainability, but because of disparities in lowland access, upland solutions alone will not alleviate poverty. Maize production needs more labor and other upland solutions, such as strip cultivation, conservation agriculture or tree plantation, need even more. Therefore, there is a great risk of seeing the poorest farmers becoming day laborers for the better-off or choosing to migrate to the cities if they have a high enough education level.

The main finding of our study is the importance of the *Na Muong* system to farmers' livelihoods. Further interventions should focus on improving this system by improving irrigation and extending the area through terracing. Intervention through the *Na Muong* system could benefit everyone and be accepted by the entire community, thus giving more strength to collective decisions.

5 Table of figures