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Improved pastures and DMC-based upland rice cultivation: Two solutions to intensify land-use in Pek district

The agro-ecology of Pek district is characterised by a vast altitude plain (The Plain of Jars) with particularly acid and infertile soils. The farming systems of this region are essentially based on extensive livestock production and lowland rice cultivation with yearly manure application. With limited opportunities for agricultural expansion in the lowlands (i.e. most of the lowland areas have already been converted into paddy fields), increasing rice production represents a key challenge for the subsistence farmers of the plain of Jars. Yet, in the quasi-absence of chemical fertilization, the productivity of lowland agriculture is strongly linked to upland cattle breeding and the availability of manure. For many years, farmers have thus been raising increasingly larger cattle herds primarily as a means of savings and, to a lesser extent, as a way to sustain manure production and paddy fertilization. However, the increase in the number of cattle is constrained by forage supply during the dry season. In order to overcome these constraints and to improve local production systems, two main alternatives have been introduced and supported by PRONAE.

Improved pasture and upland rice production: Patterns of diffusion and constraints to adoption

Improved pasture

In line with provincial policy and the activities of other projects in the province, a first alternative has involved establishing and/or regenerating pasturelands – through initial mineral fertilization and introduction of more productive grass species (e.g. Bracharia ruziziensis) – in order to increase quantity and quality of forage supply. From there, with the development of cattle fattening, traditional saving activities are transformed into cash generating activities enabling further investments to settle improved pastures and raise larger cattle herds. The regeneration of the pasture after three years of grazing is financed by one cycle of commercial crop (upland rice or soybean) under DMC. As shown in Table 1, improved pasture has been widely adopted in Xoy Nafa where village authorities have long supported the intensification of livestock production. Adoption has been less important in My and Pouhoum. Finally, although PRONAE did not intervene in Nahoy, Dong and Khay, a significant number of farmers from Dong and Khay have developed improved pastures with the support of other development projects and following different techniques (e.g. ploughing, absence of fertilization).

As reported by the villagers, the main constraint to adoption is linked to the important financial investment that is required for establishing improved pastures and fattening activities (Table 2). This initial investment can be either self-financed through the sale of cattle or provided through credit contracted with a bank. The sale of cattle heads, however, tends to be seen by farmers as mortgaging the future fattening activities. With limited guarantees to support their demand (e.g. land titles), farmers also encounter difficulties in gaining access to bank loans that are, in any case, subject to high interest rates (i.e. from 10% to 14% per year). In addition, the refund period is generally not adapted to the time frame of fattening activities. Indeed, fattening periods can be relatively long depending on forage supply and can vary importantly as a function of the age, sex and growth capacities of the animals raised. If the refund date of the loan comes before the cattle reaches its highest weight, the profitability of the fattening activities is not optimal.

Upland rice production

A second alternative proposed by PRONAE has involved upland rice cultivation through Direct Mulch-seeding Cropping (DMC) systems (also considered as an important stage in the regeneration of improved pasture every three years)[1]. DMC systems involve no tillage and the maintenance of a permanent plant cover on the soil. The latter plant cover can be dead mulch (crop residue or dead cover plants) or live mulch associated with the main crop. As developed in the study area, this system involves the use of chemical fertilizers to compensate for nutriments deficiencies of the soil along with two types of herbicides (i.e. total herbicides sprayed on the natural grass to establish the mulch and selective herbicides for post-emergence

Table 1: Adoption of improved pasture (% of households per village)

	2003	2004	2005	2006	2007	2008	2009
Dong	10%	10%	7%	13%	13%	13%	13%
Khay	3%	3%	7%	27%	30%	30%	30%
My	0%	0%	0%	13%	13%	13%	10%
Nahoy	0%	0%	0%	0%	0%	0%	0%
Phouhoum	0%	0%	3%	13%	13%	10%	7%
Xoy Nafa	3%	3%	3%	20%	30%	27%	23%
Pek District	**3%**	**3%**	**3%**	**14%**	**17%**	**16%**	**14%**

Table 2: Motivations underlying local disinterest in and disengagement from improved pasture

Reasons (disinterest)	Frequency of answer (157 respondants)	Reasons (disengagement)	Frequency of answer (12 respondants)
Not enough capital	26.20%	Not enough capital	31.60%
Not enough labour	20.70%	Not enough labour	15.80%
No cow	18.70%	Not successful in production	15.80%
Not enough land	18.40%	Wants to grow rice	5.30%
Wants to have less cattle	5.40%	Herbicides are inefficient	5.30%
Enough natural pasture	3.40%	No cow	5.30%
No technical knowledge	2.40%	No seeds	5.30%
No seeds	2.00%	Risk of low production	5.30%
No project support	0.70%	Water-soaked area	5.30%
Unsuccessful experience of neighbour	0.70%	No market for selling grass seeds (to recover initial investment)	5.30%
Never heard before	0.30%	-	-
New family	0.30%	-	-
No equipment	0.30%	-	-
Risk of low production	0.30%	-	-

Table 3: Compared agro-economic results for DMC-based and tillage-based upland rice production

	DMC	Tillage (hand-tractor)
Crop yields (tons/ha)	2.0	0.97
Gross income (LAK/ha)	5,200,000	2,522,000
Net income (LAK/ha)	3,119,000	2,203,000
Labour productivity (LAK/ha)	134,000	95,000

Note: Data derived from six household surveys conducted in 2009 in My (three farmers using DMC techniques with mechanised seeders), Pouhoum (two farmers using tillage) and Xoy Nafa (one farmer using tillage).

Gross income = Crop yields x Selling price
- *Selling price = 2,600 LAK/kg*

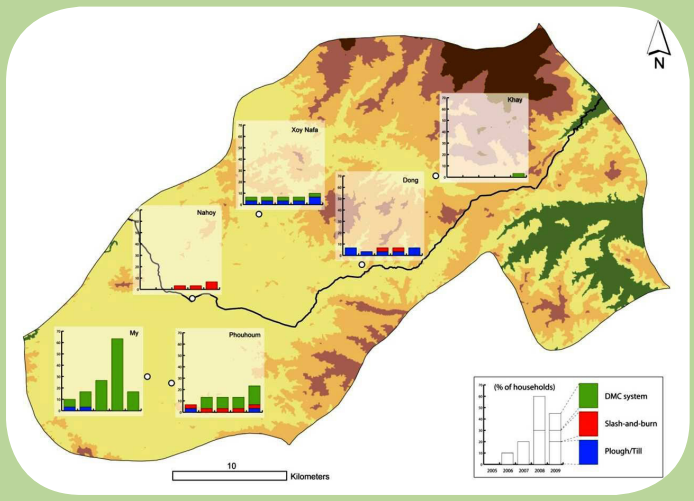
Labour productivity = Net income / Time of work
- *Time of work (man/day/ha) = 23.3 (DMC) and 73.5 (tillage)*

Net income = Gross income - Inputs
- *Sowing density = 110 kg/ha (DMC) and 104 kg/ha (tillage) and 2600 LAK/kg*
- *Glyphosate for DMC = 5L/ha and 65,000 LAK/L*
- *Fertilizer for DMC: 300kg/ha and 4,900 LAK/kg*
- *Petroleum for tillage 6.6L/ha and 7,020 LAK/L*

As illustrated by Figure 1, DMC systems were introduced with variable success in the study villages. Without project intervention like in Nahoy and Dong villages, upland rice is generally cultivated through slash-and-burn (on grass and shrub lands) and tillage-based systems. Furthermore, while DMC systems had become very popular in My, the end of PRONAE's financial and technical support, combined with the reluctance of banks to support farmers groups with their innovative system, has resulted into a neat withdraw of the villagers. As in Pouhoum, 17% of the villagers were involved in DMC-based upland rice production in 2009. In Xoy Nafa and Khay, despite the economic incentives associated with rising rice prices[2], adoption of PRONAE's alternative rice production system has remained very limited.

As for improved pasture, the financial investment required to establish DMC-based upland rice production represents an important constraint for adoption. The purchase of chemical fertilizers and herbicides is indeed considered as an important investment by farmers - it constitutes an economic risk even if it is compensated by higher net incomes (Table 3). In addition to these economic considerations, the development of upland rice production is constrained by an important competition for access to land. Upland rice and improved pasture are indeed competing with common land-uses (e.g. cattle roaming) and, more importantly, with a growing demand for large private concessions by influent urban-dwellers and foreign investors[3]. Local demand for tree plantation and reforestation represents also another source of competition as many villagers expressed the need to increase forest cover in order to sustain water and fuel/construction wood supply. Village authorities can play an important role in arbitrating this competition. In Xoy Nafa for instance, village leaders tend to promote cattle breeding activities over rice production. In village like Khay, with relatively good availability of lowlands, there is probably less incentive to turn to upland rice production.

Figure 1: Adoption of upland rice production techniques (% of households per village, 2005-2009)



Conclusions and recommendations

In general, the households of the study area seem to limit the investments made to improve their farming system to a relatively low level. Farm investments usually come from incomes that are generated by the farm itself (e.g. hand tractors bought with the sale of buffaloes) and farming activities tend to be considered as a basis for food self-subsistence rather than as a source of revenue and accumulation. Hence, while the proximity to the district capital allows for generating important off-farm incomes (e.g. construction work, handicraft, petty business), these are rarely reinvested into the farm. Rather, they fund the studies of children or are spent to improve the standard of living (e.g. purchase of transportation means and household equipment, payment for housing improvement and access to the electric grid, etc.). In turn, this chronic underinvestment into the farm, especially for required fencing and chemical inputs, does not play in favour of the development of new techniques and the adoption of new farming systems. Measures could nevertheless be taken in order to provide higher incentives to farmers and facilitate agricultural innovation:

1. In relation to the improvement of livestock farming activities, agricultural banks should facilitate local access to credit, provide more attractive interest rates and ensure that the refund periods are better adapted to the time frame of these activities (i.e. adequate support to fencing, pasture establishment and early production would require 3 to 5-year refund periods),

2. A dedicated livestock extension system - operated by the provincial and/or district agricultural services with the support of the numerous livestock promotion projects active in the area - could promote a stepwise adoption of the proposed alternatives while encouraging livestock farmers to establish production groups that would reduce pasture protection costs and facilitate the development of hedged pasturelands,

3. In relation to DMC-based upland rice production, reducing the surfaces cultivated and/or providing adapted credit may assist in reducing the risks taken by smallholders and, thus, in making the cropping system more attractive,

4. In relation to DMC-based upland rice production, improved pasture and the labour required for establishing these alternatives, facilitating access to small equipment (e.g. hand-job and mechanised seeders, manual sprayers) through the establishment of rental service providers and associated credit for equipment purchase/rental could also provide higher incentives to farmers.

Endnotes

[1]Lienhard, P., F. Thivet, B. Bounkhampone, T. Sosomphou, S. Sayphoummie, I. Phanthavivong, and L. Séguy. 2008. Direct Seeding Mulch-Based Cropping systems for Rice-Beef Production in the Plain of Jars, Xieng Khouang Province, Laos PDR: an Example of the "Creation – Validation" Research & Development Methodological Approach. PRONAE, Vientiane.
[2]3,000 LAK/kg in Nov. 2010 against 2,300 LAK/kg in Nov. 2007 (Source: Provincial Trade Department).
[3]E.g. Cow farm and Korean cassava concession in Ban Phouhoum, Vietnamese cow farm in Ban My, Chinese potato farm project in Ban Xoy Nafa.

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