3.4 A FARMER-GROUP BASED APPROACH LINKING RESEARCH AND DEVELOPMENT FOR THE PROMOTION OF CONSERVATION AGRICULTURE IN THE LAO PDR

An essential base where systems and supports are designed to evolve alongside the market, and in line with agricultural constraints and developments

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Abstract

Over the past fifteen years, farming systems have changed drastically in southern Xayabury province, Lao PDR. Rotational cultivation systems and fallow periods are disappearing, being gradually replaced by a 'resource-mining' agriculture that has serious environmental costs, including increased soil erosion, loss of soil fertility, and chemical pollution of the environment. Under the Programme for Capitalization in Support of Rural Development Policy (PCADR)[1] , and its components PASS[2] and PRONAE[3] , alternatives were sought to the degradation of the physical environment, and to the reduction in income and work productivity in these rainfed cropping systems, based on the use of direct seeding mulch based systems (DMC). The aim of this article is to present and discuss the approach taken to promote the dissemination of these innovations, centring research and development actions on farmer groups. This study discusses the results obtained and details the constraints for launching such an initiative and ensuring its perpetuation over the long term.

Keywords
Research and development, farmer group-based approach, promotion of conservation agriculture and DMC systems, adoption of innovations, dissemination process, Xayabury Province, Lao PDR.

Introduction

Xayabury province (17o30' to 20o N, 101o35' to 100o20' E), which is located on the right bank of the Mekong river, is delimited to the south by the Nam Heuang river, which forms the border with Thailand, and to the north the Mekong marks its separation from the provinces of Oudomxay and Bokeo.

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[1]Programme funded by Agence Française de Développement and Fonds Français pour l'Environnement Mondial
[2]PASS: Application Site for Southern Xayabury Province, technical support by Lao Consulting Group
[3]PRONAE: National Agroecology Programme resulting from a partnership between Institut National de Recherche Agronomique et Forestière (NAFRI) and Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)

Three distinct geographical zones can be described from North to South: i) a northern mountainous zone where slash and burn systems predominate, ii) a central zone (Xayabury and Muan Pieng districts) which correspond to the rice granary of the province and the largest production area for the provinces of northern Laos, iii) a southern zone grouping the districts of Kenthao, Botene, Paklay and Thong Mixay. It is the richest agricultural zone in the province due to the quality of its soils and its integration on the Thai domestic market.
The district of Kenthao has long been the crossroad between Laos and Thailand; it became the trading hub between these two countries, with the opening of the international border in 2006. These four districts, geared towards the international market (case of Paklay with daily exchanges by river with Vientiane) and regional market (Thailand, China), are major trading poles.

Following the introduction of new economic mechanisms (1986) promoting trade, cash crops underwent a considerable boom and occupied a predominant role in the farming systems of the region. The arrival of mechanization (tractors, walking tractors, hullers, threshers) was a result of increasing trade with Thailand over that period.
Today, a constant flow of products can be seen along the major trading routes, namely the Mekong (Vientiane), the Kenthao – Paklay – Xayabury road and the Nam Heuang border crossing (Kenthao district).

The transposition of a Thai semi-intensive scheme, characterized by heavy mechanization and use of numerous inputs (pesticides, improved bottomland rice seeds, maize seeds, groundnut seeds, and mineral fertilizers) gradually occurred in these three districts. The absence of fallow periods, the systematic removal of crop waste and repeated mechanical activity rapidly weakened the rainfed ecosystem, leading to a degradation of downstream rice growing and road infrastructures. Some initial soil analyses have revealed a 50% loss of the organic carbon stock over the last 15 years. That loss is linked to the erosion of cultivated plots and rapid oxidation of organic matter after tilling. Wooded zones, serving as a biological filter on riversides, have globally disappeared from these environments (Photos 1).

Photos 1: «Open fields» situation in southern Xayabury province, with the disappearance of gallery forests and wooded zones

Although these agricultural practices benefit from an exceptional soil potential when compared to the other provinces of northern Laos, a diagnosis reveals massive degradation of the physical environment. This means that, even in these zones that have benefited from major growth, the natural environment can be degraded very rapidly (5 to 10 years of practices), with negative economic and social consequences.

Under the Programme for Capitalization in Support of Rural Development Policy (PCADR), and its components PASS[4] and PRONAE[5] , alternatives were sought to the degradation of the physical environment, and to the reduction in income and work productivity in these rainfed cropping systems, based on the use of direct seeding mulch-based systems (DMC). Farmers were placed at the heart of the research and development process, thereby enabling concerted construction and adjustment of innovations, with regular discussions between farmers, agronomists, researchers and extension officers, with ongoing feedback on innovations being tested under true conditions.
The aim of this article is to present the approach taken to promote the dissemination of these innovations, centring research and development actions on farmer groups. This study discusses the results obtained and details the constraints for launching such an initiative and ensuring its perpetuation over the long term.

Materials and methods

The approach

A holistic approach, based on a permanent link between research and development, was implemented by NAFRI/PRONAE, PASS, and the Sector-based Programme on Agroecology (PROSA, MAF), in partnership with the department of agriculture and forestry of Xayabury province and the districts involved in these activities (Paklay, Kenthao, Botene and Thong Mixay).
The systemic approach, designed to progressively transfer skills to farmer groups, local authorities, research and development agencies, and private operators, was organised around two main principles:

• **An iterative process.** The technological offer, the methodology and the organization were constantly adapted to the evolution of the bio-physical, socio-economic and political context …. and to the demand of the various stakeholders involved. Constant evaluation at each stage enabled real-time adjustment of activities and reorientation of programmes, and so optimized the use of all resources.

• **An integrating approach** that united research, extension, training, communication, financial and policy decisions from the very start of the activities and throughout its cycle. This required links with all actors in rural development: farmers, extension officers, trainers, researchers, the private and banking sectors, and political and financial decision makers.

Methods of intervention

This approach was constructed around four main components (Bouahom et al., 2005), focused on farmer groups, namely:
- a precise analysis of the agricultural and economic environment and a dual partitioning of the environment into cultivated entities and farm typologies,
- implementation of experimental designs encompassing a wide diversity of cropping systems but also simple technologies (species, varieties, various inputs, tools) enabling famers and extension officers to assess the evolution of the systems and their characteristics over the medium term (weed pressure, soil fertility, yield trends, work times, etc.) and choose the best innovations in relation to conditions at the outset,
- On-farm assessment and validation of chosen innovations to integrate the conditions specific to each farm (financial capacity, work load, accessibility to means of production, etc.),

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- Creation of an environment of professional training and exchanges between farmers, agronomists and extension officers organized around practical training in the field, field days and exchanges between groups from different regions, to compare the advantages and drawbacks of a given innovation,
- Dissemination of these innovations on a larger scale, with close technical support for farmer groups.

Over the 2006 – 2008 period, these different activities and work scales were implemented on the basis of concerted action between the different operators (PAFO/DAFO, NAFRI/PRONAE-PCADR, PASS-PCADR, PROSA).

Farmer groups

The farmer groups approach was used to facilitate training and regular technical support, and to structure access to agricultural inputs, enable joint use of specific equipment (planting machine) and stimulate exchanges with families (creation of structures) concerning the production systems developed. It also promoted the involvement of the private sector to supply credit and agricultural inputs and, at the same time, reinforced the position of farmers in relation to it. The approach was flexible, and evolved in line with results and indicators, and was able to structure and gear groups of producers towards service activities (e.g. supply, credit, and collection). All agronomic and economic data were recorded to evaluate the advantages and the constraints involved in adjusting innovative systems and technologies.
By forming groups, the farmers were able to avoid always finding themselves in a testing context, as tests were carried out at demonstration sites or by just one of the group members.

Proposed systems and technologies

Direct seeding systems, some of which incorporated cover crops or intercrops, or crops in succession to the main crop, were proposed to these groups. The first stages were geared towards validating a simple technology (direct seeding on residues from the previous crop) to promote gradual learning and, in particular, gain the confidence of the farmers in the ability of the research-development programme to meet their short-term expectations.

Technical support based on the sustained involvement of district extension officers

One of the essential points lay in the creation of a team of agronomists and extension officers with a great ability to integrate different work and analysis tools, thereby intervening as much on a cropping system scale as on a livestock rearing scale. Such versatility is essential for this type of programme. As a priority, there was a need to train general agronomists and extension officers; 32 extension officers (Table 1) were involved in these research-development operations over the 2006 – 2008 period.

Table 1: Number of extension officers involved in these operations at the end of the 2008 season

Districts	**Botene**	**Kenthao**	**Paklay**	**Thong Mixay**
Number of extension officers	7	10	10	5

Results and discussion

The research component

NAFRI (PRONAE) activities were geared towards setting up demonstration sites (10 ha) as a medium for designing and characterizing cropping systems and training technicians, extension officers and farmers.
Technologies focusing on agroecosystem processes such as organic matter accumulation, water use efficiency, soil biological activity, resource preservation and general enhancement of agrobiodiversity and synergisms between components, were to be promoted. A broad range of options was developed to enable farmers to adjust their systems in line with changing market demands (continual diversification and adjustment of systems). These demonstration fields, managed by researchers and extension officers, served as a basis for creating knowledge and for training. These bases were essential within a context of constant support for dissemination, where systems were designed to evolve alongside the market, and in line with agricultural constraints and developments. Agricultural and economic analyses were carried out for all cropping systems conducted under a conventional system (ploughing) and with no tillage. The first step in creating no-till systems was based on indigenous species and cash crops commonly used by smallholders.
There was also substantial biodiversity at these sites, particularly:

- all-purpose rice varieties (Sebota) developed by Lucien Séguy, Serge Bouzinac and James Taillebois. These varieties display the characteristic of being growable under varied water supply conditions, from strictly rainfed, to bottomlands (transplantation), with irrigation in the dry season, and under contrasting biophysical conditions. They have been tested in southern Xayabury province and in Xieng Khouang up to an elevation of 1200 m,
- fodder species (*Brachiaria sp., P.maximum, S. guianensis, elephant grass*),
- cover crops (*C. cajan, Crotalaria sp., E. coracana*),
- food species (*soybean, V. unguiculata, V. radiata, etc.*)

Creation of farmer groups

Farmer groups were set up for 4 districts in southern Xayabury province (Kenthao, Paklay, Botene and Thong Mixay), involving a total of 45 farmer groups by the end of the 2008 season (Figure 1).

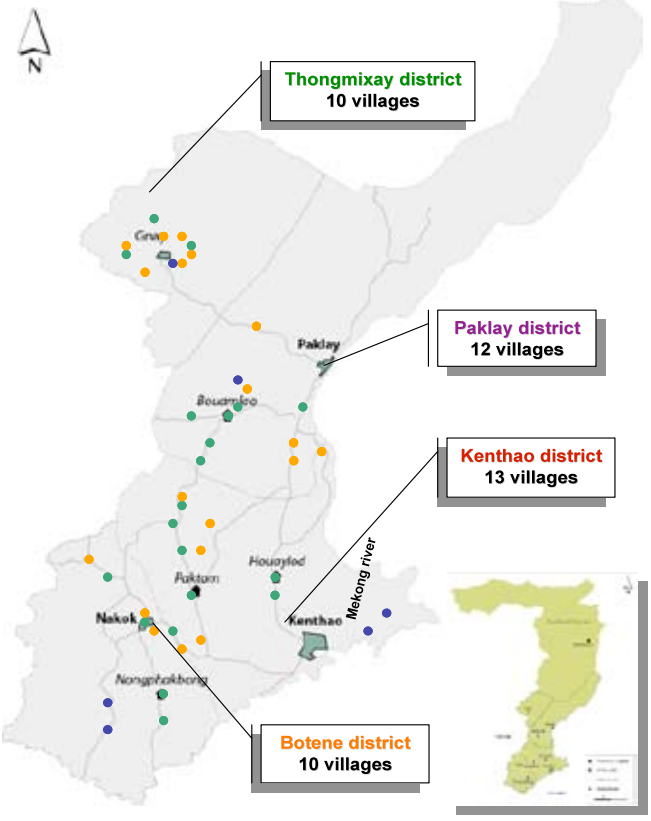


Figure 1: Distribution of the number of farmer groups over the 4 districts in southern Xayabury province (green: 21 groups in 2006, orange: additional groups in 2007 – total of 39, blue: additional groups in 2008 – total of 45).

Human sizing and role of extension officers

One extension officer was responsible for one geographical area and gave advice to farmer groups on all components of the farming systems (annual cropping, use of equipment, livestock). One person supervised from 2 to 3 farmer groups (50 to 120 households). Extension of DMC systems does not only require a technical message but it should be accompanied by the creation of an enabling environment based on training, communication, access to agricultural equipments, facilitating input access, and market opportunities. The yearly activities of extension officers were organized around five main components:

- training sessions intended for extension officers concerning CA practices and concepts,
- farmer group organization and elaboration of tools to exchange with them,
- setting-up of a credit system with traders,
- on-farm demonstration and extension with training session focus on implementing CA practices (use of equipment, crop management, etc.),
- monitoring, presentation and discussion of the agro-economic results obtained with farmer groups.

The promotion of new cropping systems, and innovations in general, calls for continual close support in the first two years, in order to promote the learning of farmers and create a climate of confidence between farmers and extension officers. In addition, the charisma and personal commitment of each extension officer, but also of each group leader, plays a major role in disseminating information and innovations and in the success of this approach.

Along with the technical background, extension officers were trained in farmer group facilitation and coordination. Today, 32 extension officers are involved in the south of Xayabury in this approach and they are trained in programme definition, implementation and coordination (technical and financial aspects).

Farmer group organization	Elaboration of communication tools (posters, technical sheets). Awareness-raising campaigns in villages
Setting up of credit systems	Setting up of credit systems with traders (agreement between farmer groups & traders). Project support concerning the choice of inputs
Farmer training & demonstration	Training sessions related to (i) direct seeding techniques & (ii) input use (herbicides). On-farm demonstrations with all the farmer groups.
Permanent monitoring	Permanent technical support provided by agents during the campaign. Presentation & discussion of the agricultural and economic results obtained with farmer groups

Specific themes were implemented with farmer groups, such as the use of agricultural equipment (hand-jab seeder, planting machine for hand tractor), use of fertilizer and crop diversification (particularly in the case of southern Xayabury, intercropping between maize and *Vigna umbellata, C. cajan, V. radiata*).

Relations between stakeholders

The promotion of DMC systems, and the gradual integration into the cropping systems of cover plants (additional resources, be it monetary or fodder), was not based merely on a technical message. It had to be accompanied by an improvement in the agricultural and economic environment, incorporating access to means of production (agricultural equipment, credit, inputs) and to the market, along with the provision of professional training and exchanges between stakeholders.

Extension officers also played a role in establishing relations between farmer groups and the private sector, to improve input supply chains, sales circuits and the provision of services.
Over this period, any agricultural implements and service providing that may have been linked to the initiative were not transferred to the traders in the region. Different discussions were organized on the subject, but the current sizing was, for this category of stakeholders, too limited to consider investing in this type of operations. Service provision was organized with farmers owning tractors who carried out these operations for the farmer groups established in nearby geographical zones.

Strengthening of the professional environment

An environment conducive to the dissemination of conservation agriculture was created by capacity-building, through the training of farmers, researchers and rural development players. Academic and technical training were provided and open to all who wanted to be involved. Field days were also scheduled in each province and exchanges were promoted between farmer groups involved in Xayabury and Xieng Khouang provinces.
A training strategy is not limited to the addition of sessions, days and courses, but is above all an ongoing attitude that all players must have. It results from a combination of 3 types of action:
• Promoting access to information,
• Stimulating and supporting collective deliberations at all stages of the development process,
• Organizing and taking training action simultaneously, covering all the aspects involved (technical, managerial, organizational, legal, etc.).

Proposed systems and technologies

Through its proximity to Thailand and the existence of Thai investments, production today is mainly geared towards maize growing. The level of diversification (Table 2) has rapidly fallen in the south of this province, with 90% of the rainfed cultivated area now devoted to that crop in some zones. The increase in areas planted to maize is linked to different aspects: rising sale prices linked to world market trends, limited work times, high work output and net profits. However, this situation differs depending on the production areas. The production areas displaying advanced degradation of the rainfed ecosystem (along the road between Pakkhem and Houayleuk, Kenthao district), low fertility (the case of Botene district) or remoteness from the markets or main trading routes (the case of Thongmixay district) maintain a wider diversity of cropping systems.

Table 2: Level of diversification for 45 production areas

Diversification level (%)	**Botene**	**Kenthao**	**Paklay**	**Thong Mixay**
Maize monoculture	72	80	100	82
Rotation or association	28	20	0	18

The first systems to have been disseminated are based on the management of crop residues. This system is far from efficient in terms of fertility improvement (biological, physical and chemical) and weed control, but we felt it was preferable initially only to modify part of the cropping system (soil management), in order to favour the gradual learning process rather than incorporating additional species whose advantages the farmers would not have understood and which would have involved more technical management of the system. At the same time, on a smaller scale (150 ha) some intercropping between *Vigna umbellata* (commercial species used in the region for many years and marketed in Thailand) and maize was proposed, in order

to produce two commercial crops in the same wet season, generate additional income, limit the impacts of inter-annual variations in maize prices, and take advantage of the agronomic benefits of such a species (weed control, nitrogen return to the soil).
In order to disseminate these systems on a larger scale, it was necessary to eliminate two types of constraints identified during follow-up/assessment studies (Tran Quoc et al. 2005, 2006). These were i) the laboriousness of sowing in crop residues without specific equipment and ii) the availability of inputs, including mineral fertilizers that were sought by the farmers. As part of its work, PASS removed these two constraints by facilitating access to specific direct seeding implements (Table 3) that could be used on different scales depending on the nature of the plots (topography, area). This equipment was imported from southern Brazil (Fitarelli, Knapik, Campo Novo and Rubemaq companies) which is the reference for the development and production of direct seeding equipment for small-scale family agriculture (Sefrin Kühn & Bombassaro, 2006). Dibbers, seeders drawn by hand tractors, with one or two sowing rows, and sprayers (Photos 2) were acquired by the projects.

Table 3: Nature of the equipment imported by the projects

Equipment	No.
hand jab seeder	150
1-row seeder	1
2-row seeder	14
4-row seeder	6
200-litre sprayer	16

Access to inputs (seeds and mineral fertilizers) was organized in direct relation with the private sector in order to promote exchanges between these groups of players (farmers and private sector) and try, eventually, to transfer some of the farming operations (sowing with 4-row seeders) to that sector, which already covers all «ploughing on credit» operations and maize hybrid seed sales.

Photos 2: Direct seeding equipment imported from Brazil (a: hand jab seeder, b: Knapik two-row seeder, c: Fitarelli two-row seeder, d: Knapik four-row seeder)

a

b

c

d

Dissemination (2006 – 2008) of DMC systems

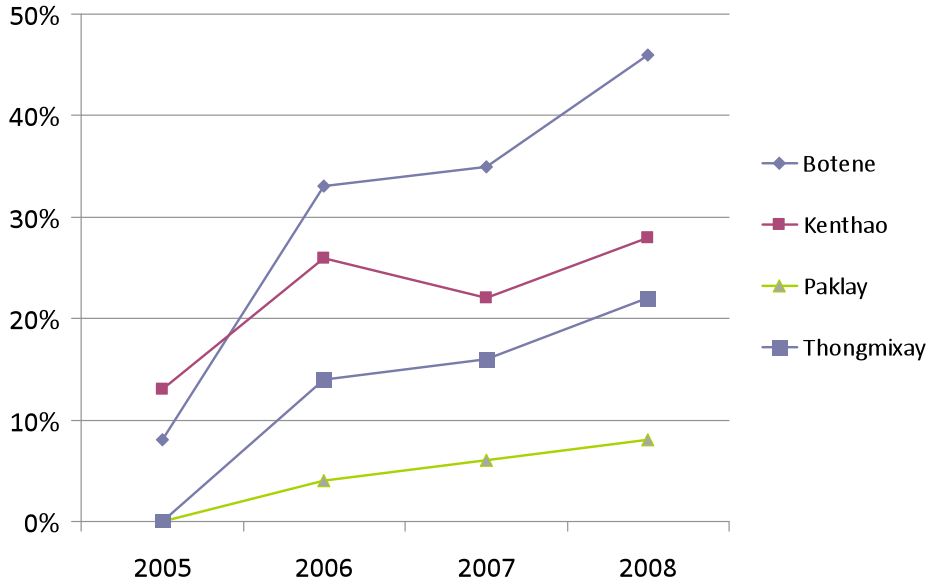
At the end of the 2008 season (corresponding to the third agricultural campaign of large scale dissemination), the area cultivated by direct seeding was estimated at 1787 ha for 1254 families (Table 4). Contrasting results were seen between districts for the increase in DMC areas and the proportion of families practising these systems (Figures 2 & 3). Several points need to be considered to explain these differences (Tran Quoc et al. 2005, 2006): i) the average size of the areas cultivated by each farmer, ii) topography, iii) level of soil degradation, iv) access to agricultural equipment, etc. The production areas displaying lower fertility and a more pronounced degradation of the rainfed ecosystem (Botene and Thong Mixay) showed greater adoption of these systems. In Botene district, over 40% of the families in the villages involved practised DMC. In the villages of Nongpakbong and Thanang (Botene district) these DMC systems accounted for 60% to 80% of the rainfed areas per family (data not shown). A similar situation, though to a lesser degree, was found in the villages of Houaypet and Houaylod (Kenthao district) where the DMC systems amounted to 20 to 30% of the cultivated rainfed areas respectively. Conversely, the production areas of Paklay district showed a limited number of adoptions and proportion of DMC areas (< 10%) compared to the other districts.

Table 4: Variation in the number of families and DMC areas between 2006 and 2008 in southern Xayabury province.

District	2006		2007		2008	
	Families	**Area (ha)**	**Families**	**Area (ha)**	**Families**	**Area (ha)**
Botene	104	82	137	151	328	574
Kenthao	173	213	287	343	464	627
Paklay	75	83	196	277	316	468
Thong Mixay	33	23	69	59	146	118
Total	**385**	**401**	**689**	**830**	**1254**	**1787**

Figure 2: Distribution of three soil management methods (tillage, slash and burn and DMC) for different production areas (khum ban) in 2008

Figure 3: Variation in families (%) practising DMC in the intervention villages between 2005 and 2008



Conclusion - Main constraints and challenges

Cropping systems

An iterative approach was adopted, trying to integrate cover crops as the process progressed, in order to diversify these cropping systems and incorporate the main functions of DMC systems (integrated weed management, fertility improvement as a whole, better water use, biodiversity). This change of systems is not yet effective, with few diversified systems, and limited use of cover plants, apart from a few farmer groups who adopted a maize – *Vigna umbellata* combination. Although better agro-economic results than with the conventional system were obtained over this period, it is worth highlighting that this first system, based on crop residue management, was not viable, since it did not allow integrated weed management, total protection of soil resources, and fertility improvement.
Based on these findings that the first innovations only provided a tiny proportion of the advantages offered by DMC systems, more efficient systems incorporating the main functions of DMC (integrated weed management, fertility improvement as a whole) will have to be proposed. Given the context of this region, a few examples are given below:

1. Biennial rotation of maize + *B. ruziziensis* / soybean + *[Eleusine coracana + Crotalaria sp.]*
2. Biennial rotation of maize + *B. ruziziensis / Vigna radiata* (mung bean) + [Eleusine coracana + Crotalaria sp.]
3. Biennial rotation of maize + [B. ruziziensis + C. cajan] / *V. umbellata,*
4. Biennial rotation of maize + [C. cajan + S.guianensis] / rice + *S. guianensis*

This approach makes it possible to combine different scales of intervention. To this end, the management of village land areasand use of multi-purpose perennial species (high added value wood, medicinal plants, fodder species, etc.), must be a priority for future campaigns. The most striking example is the change in landscape units in southern Xayabury province, with pronounced degradation of the cultivated ecosystem, the virtual disappearance of trees from the landscape, and the destruction of downstream rice growing and road infrastructures. Wooded zones, serving as a biological filter on riversides, have globally disappeared

from these environments. Thought needs to be given on a provincial and national level to (re)constructing gallery forests which should make it possible to protect water courses and recreate a natural filter limiting the risks of pollution by pesticides and suspended particles. Organization on a village land area level would also make it possible to improve the efficiency of DMC systems through better crop residue management in the dry season. Indeed, uncontrolled burning, or roaming cattle over that period, can lead to the total destruction of cover plants or crop residues.

Organization of farmer groups

The first farmer groups were set up to facilitate technical follow-up by the extension officers and encourage exchanges between farmers. Many groups exist, but are not necessarily acknowledged by the local authorities or the economic operators as a whole. Today, by way of these structures, it is a matter of enabling farmers to identify their needs (supplies, credit and sales), specify their commitment to preserving their direct environment (gallery forests to protect water courses, reforestation of hilltops, systems centred on conservation agriculture, etc.) and thereby carry weight in development decisions that could be taken on a local level.
Human and financial assistance will have to be identified to ensure the functioning and running of these groups and their gradual structuring towards farmer associations. At the same time, the groups will only be able to develop and evolve towards an associative type structure and play a clear role in future development if the State invests in that structuring. Eventually, crop processing and marketing will have to be incorporated into these structures.

Communication & Information

Whoever the stakeholders involved (farmers, extension officers, traders, decision-makers), the absence of a communication and information network, structured right from the outset of operations, is a handicap to the advancement of such an initiative. It is a matter of strengthening an existing but informal network between the different players (research – extension – private sector – farmer).

Financial considerations and provincial coordination

For many years, the south of this province has been undergoing sustained growth due to its trading relations with Thailand. The development scheme adopted is largely based on an opportunistic approach that is a very large consumer of non-renewable natural resources (soil, forests). In this process, foreign investors are making the most of existing structures in Laos (decision makers, network of extension officers, farmer and trader groups), without their making any financial contribution to the development of this region. This «mining» approach, with serious degradation of natural resources and increasingly pronounced social differentiation within communities, is partly attenuated today by the high prices for agricultural products. It is a matter of taking advantage of this situation, which combines high export volumes with rising prices, to introduce a development scheme based on natural resource management, in order to preserve the productive potential (soil, water, people) of this region and the stability of these agricultures. To that end, Patrick Julien (2007) proposed a levy on exports, taking the example of maize production with a deduction of US$ 1 per ton exported. These funds would be reinvested initially for specific Conservation Agriculture operations (support to farmer groups, funding of demonstration sites, mechanical support, resource and exchange centres, study trips, etc.) and could, after this probationary phase, feed development operations in a broad sense. This development scheme, based on natural capital management, combined with the introduction of agri-environmental measures, is beginning to take shape for this project under the impetus of the provincial authorities, the Ministry of Agriculture and Forests,

and with support from PASS and PROSA. There needs to be close consultation with all players (central level – MAF and provincial and local level – district), in order to define the institutional framework, the degree of commitment and responsibilities of the different players (State bodies, individuals and private bodies), along with technical and budgetary programmes.

As mentioned by many farmers, the lack of banking sector involvement holds back the progress of their farming systems and cultural practices. In southern Xayabury province, most credits in kind (tillage, inputs) or in liquidity is provided by the private sector. This situation generates high dependency on the private sector, which practises very high rates. These groups and farmers who commit themselves to environmental protection should be able to turn to incentive credits at reduced rates, particularly so that they can buy agricultural equipment and have access to seasonal credit.

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