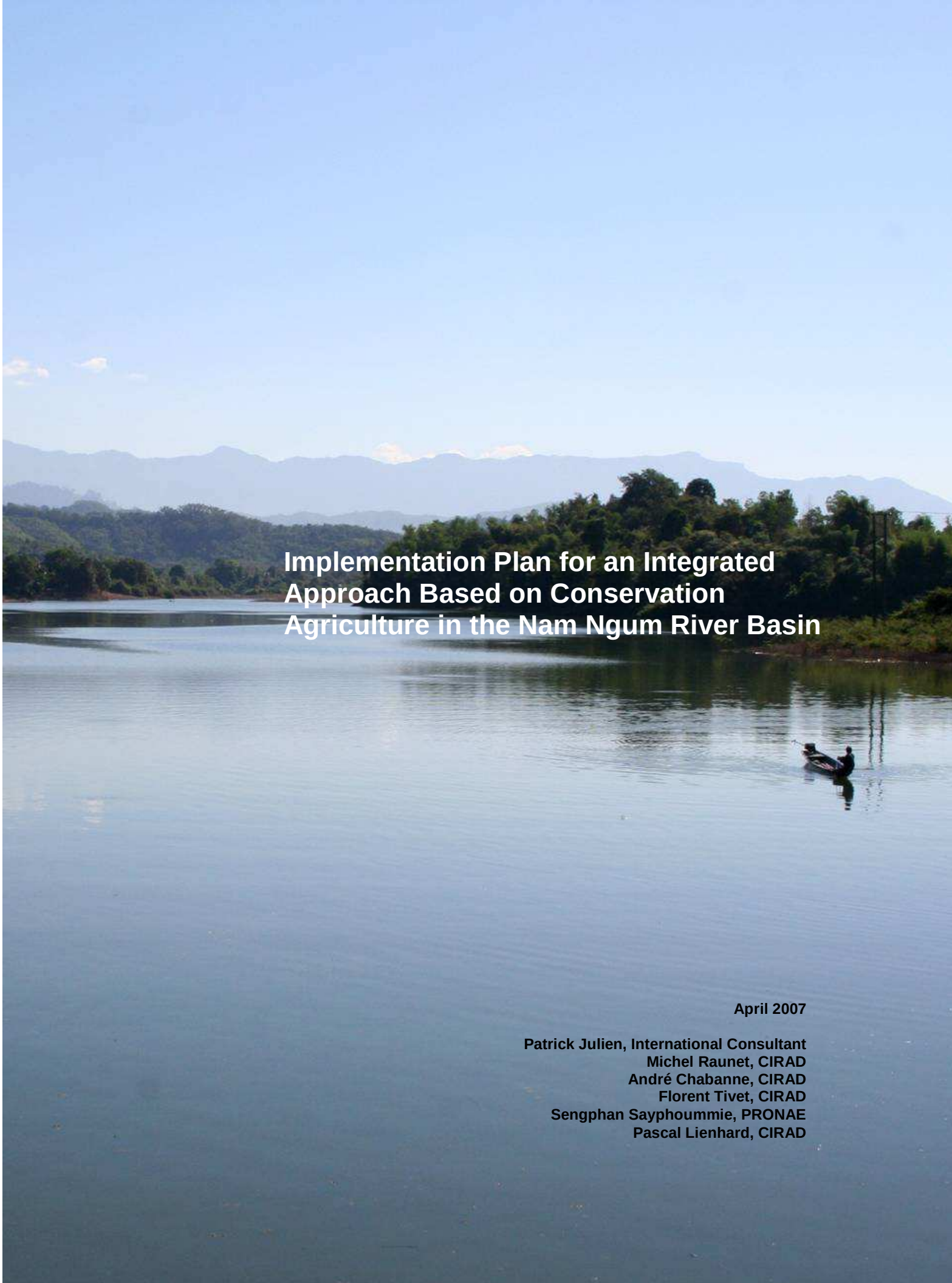

Implementation Plan for an Integrated Approach Based on Conservation Agriculture in the Nam Ngum River Basin

April 2007

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GENERAL REMARKS ON THE STUDY

The implementation plan presented here is the result of negotiations and discussions conducted by the programme team as they worked with district and provincial authorities to arrange, readjust and approve activities during this mission. This task was undertaken to provide the best possible conditions for the work planned for 2007 in case the Ministry of Agriculture and Forestry (MAF) and the Nam Ngum project approved the 'fast track' proposals (04/01/2007).

A specific programme for every district has been thoroughly discussed with the Nam Ngum project coordinators for each province. The basic premise of agro-ecology and SCV was not new to them, with the suggested production systems having already been in development (training and trial plots were set up during 2006 under PRONAE) in a certain number of project districts.

It is expected that this implementation plan will adjust all Nam Ngum rural development project activities through component 3b around an integrated strategy that takes into account existing human and financial resources. These actions will, moreover, be backstopped by other programmes (PCADR) and projects (PASS, PRONAE) under the MAF, which can already make use of support from the Sectoral Agro-Ecology Programme (PROSA) in coordinating and supervising these activities at national level.

Regarding the actions and strategy for the Nam Ngum project, it would at this stage appear necessary to consider that all decisions on redirecting human and financial resources to optimise these resources will taken by the Ministry of Agriculture and Forestry. This will thus ultimately depend on a political and strategic decision.

In the current context, with no decision having been made so far, activities will be limited to the first plans made in 2006 - the initial training of a team of 20 DAFEO technicians plus support to the establishment of training centres in the provinces of Xieng Khouang and Vientiane. Through this work a more precise diagnosis can be made for each district and then integrated into the training, so that time will not be lost in the long term.

Although the training modules could not be included in this document, the appendices contain some technical files. These will be made available to the DAFEO technicians during the training.

ACKNOWLEDGEMENTS

The authors are extremely grateful to the French Agency for Development for financially supporting this study and the Conservation Agriculture programme.

Special thanks goes to Dr Phouanparisack Pravongviengkham, permanent secretary of MAF, Dr Bounthong Bouahom, director general of NAFRI, Mr Anonth Khamhung, director general of NAFES, Mr Soulivanthong Kingkeo, deputy director of NAFRI, Mr La Thongkham, national director of NNRBDSP, Mr Khamsone Sysanhouth, Dr Thatheva Saphangthong, Chris Flint, Charles Alton and the staff of NNRBDSP for sharing information and experience with the team.

The consultants would also like to thank Aiden Glendinning for the translation and editing of this document and Jeremy Ferrand (GIS specialist) for editing the maps.

Finally, the PRONAE team extend their gratitude to the provincial authorities of Xieng Khouang and Vientiane for their efficient contribution to this study.

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1. STUDY OBJECTIVES AND PROCESS

1.1. BACKGROUND

NAFES and NAFRI developed a plan and signed a contract to design an integrated development programme for the whole Nam Ngum catchment area. The programme is to be based on the work already undertaken by PRONAE in the provinces of Xayabury and Xieng Khouang.

The contract is divided into three components to be conducted during 2007: i) an implementation plan to define and set up the 2007-2010 technical and financial programme, which will redirect districts towards agro-ecology; ii) foundation training for 20 DAFEO technicians who will be trained within PRONAE (general training on all components of production systems and environmental safeguards); and iii) setting up demonstration sites that will be the basis of an extension programme for 2008-2010.

The original terms of reference for the study were adjusted after a meeting held with NAFES on Monday November 27, 2006. In line with the requirements of the Ministry of Agriculture and Forestry (MAF), this realignment mainly specifies the need to:

- To present a full scale agro-ecology development programme that will be integrated into ongoing activities in the two concerned provinces (Xieng Khouang and Vientiane) by the Nam Ngum project, funded by its own financial resources;
- To re-examine the provisional 2007 objectives planned for Xieng Khouang in the areas already assisted by PRONAE in Pek district, and integrating the districts of Phoukhouth and Phaxay;
- To harmonise this programme with the other districts of Xieng Khouang not included in activities financed by the Nam Ngum project, using human and financial resources from PRONAE, which has been working in Nonghet, Pek and Kham districts since 2003.

It has been noted that Nam Ngum River Basin Development Sector Project presented a financial plan for 2006–2007 of US$9,559,888 representing 46.5% of the total budget of the

project. This plan was approved by ADB and AFD[1] during the review mission conducted in October 2006 and through this budget 37% was allocated to component 3b (NAFES, Xieng Khouang and Vientiane Provinces). It was therefore difficult for the team to design an implementation plan that followed the updated objectives of NNRBDSP and the expenditure level for 2006–2007. The team decided not make a thorough review of the existing plan but rather to focus on designing a development programme that integrates activities already scheduled by NNRDSP.

1.2. MISSION PROCESS

This mission ran from November 23, 2006 to February 28, 2007 in three distinct phases:

Phase 1, two main themes were treated:

- ✓ Morphopedologic identification across all the sub-catchment areas covered by the Nam Ngum project in the two provinces of Vientiane and Xieng Khouang and the nine districts selected (Pek, Phoukhouth, Paxay, Kasi, Vang Vieng, Hin Heup, Feuang, Hom, and Xaysomboun), encompassing 294 villages and 23,707 families. This identification has made it possible to produce a morphopedologic sketch of all 18,000 km^2 of the Nam Ngum watershed.
- ✓ Identification of the development potential and the agro/socio-economic particularities of these districts.

During this phase, discussions were held with provincial and district authorities, extension agents and farmers. These exchanges and the expectations of all these partners have made it possible to define an outline of the cooperation framework and of implementation.

Following this first phase, a document entitled *Mission Notes, December 2006* was presented to MAF at a meeting on Thursday January 4, 2007. This document lays down a broad outline of the technical intervention framework, the objectives and the financial resources required. It also presented, at the request of the NAFES, the fast track decisions and funds that had to be committed immediately in order to make the 2007 activities possible before the final study was available.

Phase 2

This was used to revisit all the study districts with the DAFEO and PAFO representatives. The villages, intervention zones, demonstration sites and training centres planned for 2007 were identified. This ground work continued with detailed technical and financial programming elaborated for each province.

Review workshops were held with the PAFOs and DAFEOs, allowing the re-examination of certain objectives.

[1] Asian Development Bank, Agence Française de Développement. AIDE MEMOIRE. Project Review Mission, 6-14 November 2006 for the Nam Ngum River Basin Development Sector Project.

The more thorough programming for 2007, integrating the envisaged PRONAE interventions in the financing of this study – the training of 20 DAFEO technicians and set up of the demonstration sites – emphasised certain pre-requisites. These concern the capacity of the Nam Ngum project to mobilise the necessary financial, technical and staffing resources needed for activities over 2007.

Due to the existence of unknown variables, several scenarios were presented. Selection from these could depend on other decisions not yet made and on the resources made available. The factors involved in this extend beyond the Nam Ngum project and must also include events in Xayabury province so that PRONAE can be involved even if the proposed Nam Ngum programme is postponed.

MAF, NAFES and NAFRI, over the course of the talks held during this mission on the subject of the work undertaken by PRONAE, expressed a desire to extend this mode of intervention to all the districts involved with the Nam Ngum project (with financing from the GoL, BAD, AFD, and JFPR) while continuing this technology transfer, at the same pace, in the districts already covered by PRONAE (with financing from AFD, FFEM and MAE) in the provinces of Xayabury (Pak Lai, Botene, Kenthao, and Thongmixay districts) and Xieng Khouang (Pek, Kham and Nonghet). The general objectives will concern:

- Structuring the extension and development agencies around a programme that integrates the agricultural, social and economic environment in a sustainable dynamic.
- Strengthening the organisational, technical, and programme management capacities, and their capitalisation at the provincial, districts and village levels.
- Development of integrated production systems adapted to the initial agricultural situations and the social conditions of the actors concerned (improvement and diversification of income).
- Watershed protection.

While being based on existing structures and the experience gained through PRONAE, this programme, as desired by MAF, would cover 15% of national territory (Xayabury, Vientiane, Xieng Khouang) and it should be possible to later extend the strategy across the whole country in line with the current decentralisation policy. The suggested upscaling is designed to allow realignment of all these activities in phase with the Lao government's five-year plan for 2006-2010.

In this dynamic we have retained a structure of working with local groups at village, district and provincial level to comply with the national policy of decentralisation. Particular focus is placed on the district and village cluster levels through[2]:

- Support to local planning and resources management;

[2] Source: Ministry of Agriculture and Forestry, New Organisational Set-up, 2nd Joint Sectoral Working Group on Agriculture, Rural Development and Natural Resources Management, Vientiane Capital, 22 May 2007.

- Data flow and information management on extension;
- Extension delivery (including training and linking production to markets);
- Kumban extension centres (permanent);
- Linkages with NAFRI and other relevant agencies (e.g. banks, services providers).

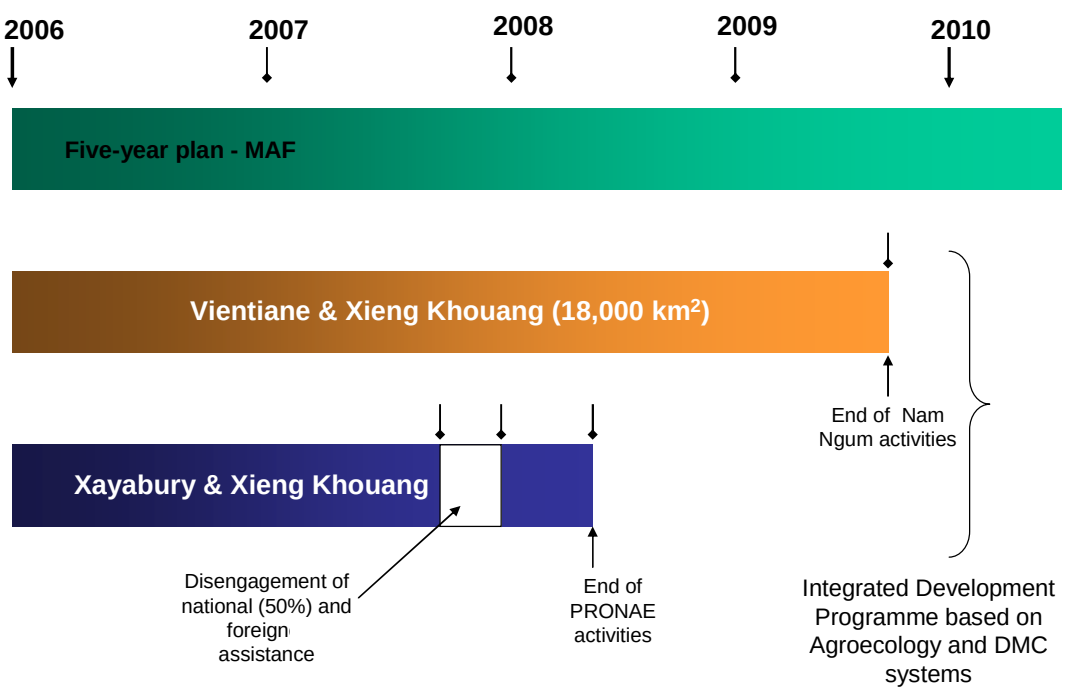
At the end of this phase final notes on the mission were presented to MAF, then discussed with NAFES and Nam Ngum project management.

Phase 3: final study report and review workshop

See appendix 2 for mission schedule and a list of people met.

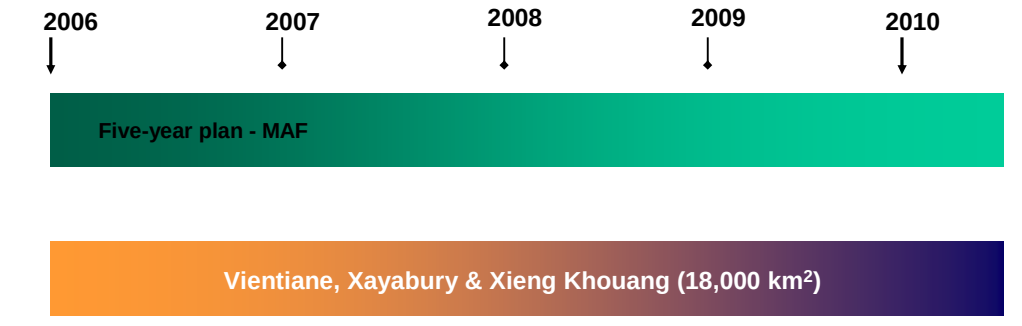
1.3. CURRENT MAF PROJECTS WITH PRONAE & NAM NGUM

The two figures below highlight the need for consistency across donor projects. Indeed, during the meetings held with MAF to realign this mission, it became clear that a technical programme fixed on the current five-year plan was needed.

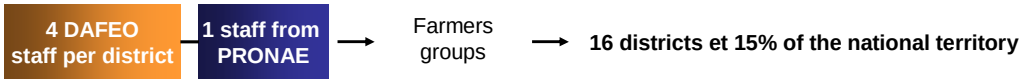


The suggested dynamic and possible reallocation of funding for these two programmes would make it possible to consolidate development efforts conducted by NAFES, starting with the National Agro-Ecology Programme's existing skills in agro-environmental matters.

Dynamic of the programme



Integrated Development Programme based on Agroecology and DMC systems using resources and means of NNRBDSP and PRONAE



Following redefinition of the objectives and current financial means of PRONAE and the Nam Ngum project (GoL, AFD, FFEM, ADB), and with redeployment of its expertise in agro-ecology, the MAF should have the means of developing this programme.

2. NATURAL CAPITAL AND RURAL DEVELOPMENT

An essential part of this work involves creating awareness - among donors, political decision-makers and project managers - of the importance of including environmental protection measures in rural development policies.

Appendix 3 contains an article on the suggested approach[3] by Pierre-Noël Giraud (Cerna Industrial Economy Research Centre, École Nationale Supérieure des Mines de Paris) and Denis Loyer (AFD). This chapter also provides references from "Millennium Ecosystem Assessment, Rapport de Synthèse de l'Évaluation des Écosystems pour le Millénaire", published by the UN in 2005.

The article provides a good summary of the context which development activities should be conducted in. **Agro-ecology through SCV (the French abbreviation for plant-cover systems) should be regarded as just one of the integral elements of this new approach, already adopted in Laos, rather than as the defining element.**

2.1. GENERAL CONTEXT

*Investments made by **overseas development assistance** (ODA) to encourage pro-poor growth are generally of three different types: (1) infrastructure (**technical capital**), traditionally financed by ODA; (2) health and education funding, often including the building of **human capital** and strongly promoted by the Millennium Development Goals (MDGs); and (3) 'governance' (institutional and social regulation and the rule of law) to build **social capital**.*

*This is why most **Poverty Reduction Strategy Papers** (**PRSP**s), the reference documents for donor assistance, do not take natural resources into account or do so only cursorily. **Natural capital** is still largely regarded as a constraint that must be observed to earn the label 'sustainable development' and not as productive capital like the other elements.*

[3] The following text in italics is taken from "Capital Naturel et Développement Sustainable en Afrique" by Pierre-Noël Giraud, Centre de recherche en économie industrielle (Cerna), École Nationale Supérieure des Mines de Paris, and Denis Loyer, AFD.

However, several positive trials and some very instructive recent exercises to measure the total Wealth of Nations (Hamilton)[4] show that:

- *Natural capital is a directly productive capital or is indirectly essential for a great number of the poor.*
- *Excessive consumption of natural capital can create poverty traps.*

On the other hand, natural capital is central to the question of the ***Global Public Goods****, or* ***Local Environmental Public Goods (GPG*** *and* ***LEPG****). It acts as the second economic axis of justification for certain development assistance policies: those which contribute to the production of GPG (in particular climate and biodiversity) are economically fully justified.*

The Millennium Ecosystem Assessment[5] published on the initiative and under the guidance of the UN in 2005, affirms that the degradation of ecosystems is such that it will hinder countries from attaining the MDGs. As an economic calculation, this report underlines the need to re-examine analysis of the value of ecosystems within their local context, so that the political decision makers can become fully aware of the consequences of their development choices.

From an operational point of view, three types of effect can be distinguished when preserving or increasing natural capital through development:

- Production of ***GPG*** *and* ***LEPG****;*

- Development of a primary export sector, stimulating growth;

- Reduction of poverty trap, particularly in rural areas.

2.2. RELATION BETWEEN NATURAL CAPITAL AND GROWTH/DEVELOPMENT

Some of the characteristics of renewable resources are still not properly accounted for by growth models. Two characteristics are often neglected because of the technical difficulty of building them into models:

- ***The existence of threshold phenomena that cause irreversible change****, e.g. disappearance of key species, no Gulf Stream, or a very long period of time to rebuild the productive capacities of the natural environment: deforestation, desertification, exhaustion of fish stocks, lowering and pollution of water tables.*
- ***The importance of positive and negative externalities on the other types of capital****. These can be considerable, especially when the thresholds mentioned above are being approached. Defining policies without taking these into account can lead to serious failures.*

[4] Available at the sites http://www.worldbank.org/sustainabledevelopment and http://www.worldbank.org/environmentaleconomics
[5] See http://www.greenfacts.org/fr/ecosystemes/index.htm

Degradation of natural capital does not evolve in a linear fashion but rather through a succession of critical points that lead to situations of quasi-irreversibility and have very strong negative effects on the other forms of capital.

It is generally considered that in Laos the 'irreversibility' threshold has not yet been reached but that degradation of natural capital is often serious enough to limit the efforts made towards rural development.

2.3. INVESTING IN NATURAL CAPITAL THROUGH AGRICULTURE

Investing in natural capital *obviously involves physical actions to preserve the environment, such as establishing protected areas, restoring forest cover and so forth, but also requires* ***the creation of institutions and regulations*** *to manage resources sensibly. It can also necessitate infrastructure and awareness raising. Thus, this model initiates a framework for sustainable development which rebalances sectoral financing contributions to the four forms of capital.*

Priority should be given to ***renewable capital****: natural resources, water, biodiversity, soil, fish stocks.*

Development must be regarded not simply as dependent on technical (infrastructure) and human (health and education) capital with environmental and social constraints, but rather as relying on the effective management of ***capital with four components****: physical - human - natural - social.*

To take matters beyond the current trials, five types of action must be initiated. They are presented below from the most conceptual to the most political:

1. ***To give natural capital its rightful place within development concepts***
2. ***To improve knowledge of natural resources***
3. ***To subject the results of past and current trials activities to thorough and comprehensive evaluation.***
4. ***To accelerate North-South and South-South (especially from Brazil) technology transfer.***
5. ***To mobilise the relevant decision-makers***

Policies must bear in mind the many functions of conservational agriculture. Good cultivation methods are based on agro-ecology and more specifically on the technique of direct seeding with plant cover, restarting natural ecosystem functions which should be further developed. By supporting the natural regulatory functions of biogeochemical cycles, conservational agriculture provides the following functions:

- Supply of goods to society: food, fresh water, wood, fuel, genetic resources and biochemical products.

- Regulation: regulation of climate, soil erosion and degradation, protection against flooding and disease, purification of water.
- Cultural: aesthetic landscaping, leisure and ecotourism, education, cultural heritage.

At present only goods supply functions are paid for. The other functions, neglected in their financial value, are unaccounted for even though they make a substantial contribution to the overall well-being of society. These agro-environmental measures should thus not be regarded simply as aid assistance, subsidies or donations - ideas that do not hold much value for farmers - but rather as **payment for environmental services (PES)** provided to society. Only agriculture based on the ecosystemic functions of biogeochemical cycle regulation can provide these services. **The agro-ecological management of cultivated ecosystems by direct seeding and plant cover fully satisfies these objectives.**

2.4. SETTING UP AND FINANCING PES

The most important general policy decisions affecting ecosystems are often made by agencies, and in political arenas, that are not directly concerned with protection of ecosystems. For example the PRSPs prepared by the governments of developing countries for the World Bank and other institutions are very effective in developing priorities at the national level, but do not generally take stock of the importance of ecosystems in improving the basic human capacities of the poorest.

Below are various avenues of action to support agro-environmental measures:

- ***Taxes or usage fees for activities that generate 'external' costs*** (compensation not accounted for by the market). These can include taxes levied on destructive farming methods (ploughing or excessive use fertilisers and pesticides) or fees from ecotourism.
- ***Promotion of technologies*** that allow an increase in crop yields without having negative impacts linked to land use, water use, fertiliser or pesticides.
- ***Restoring original ecosystem services***. However, the cost of restoring services is generally extremely high when compared to the cost of preventing degradation of the ecosystem. Not all services can be restored and it can take considerable time to rehabilitate those which have suffered heavy damage.
- ***Promotion of technologies*** that provide an opportunity for underused natural ecosystem services to develop in a reasoned manner that respects the environment: e.g. by giving agricultural value to vast 'empty' spaces such as the Plain of Jars.
- ***Promotion of technologies designed to increase energy efficiency***, by reducing greenhouse gas emissions and increasing carbon sequestration. This will also involve starting up and developing support institutions, plus policies to remove barriers to the spread of these technologies across markets and to increase public and private funding for research and development and effective transfer of technology.

- ***Mechanisms facilitating response to consumer preferences across markets***. For example, the current profiles for certifying sustainable fishing and efficient forestry practices provide an opportunity to promote sustainability through consumer choices. Certification based on geographical origin alone is not sufficient: the quality of the methods used must also be taken into account.

On a practical level, and for sustainable 'extra-project' financing of activities, taxation of practices with strong environmental impacts will be researched. This could affect:

- Arable practices stimulated by the demands of export markets, as for instance in Xayabury province, where high demand and strong support (credit, mechanisation) for the growing of maize for export to Thailand has resulted in serious social, environmental and health impacts such as soil degradation, water pollution, and heavy use of pesticides. A tax on agro-industrial practices that destroy the environment (as in Xayabury) would make it possible, through PES, to support **the conversion of conventional agriculture into SCV**. Farming practices in both the private or state sector (developments projects) are currently unsatisfactory. Feasibility studies should be conducted on the adoption of the following practices:
    - Monitoring of environmental impacts (pre-project studies and monitoring/evaluation in real time);
    - Funding of a component to support and track the adoption of best practices. To do this, a structure will be needed that **provides specialist services in conservational agriculture through agro-ecology**.
- Taxation of activities exploiting non-renewable natural resources, with strong environmental impacts. Such activities include gold and copper mines and hydroelectric dams (landscape degradation, water pollution, social upheaval). Taxes so collected should be used, through PES, to support projects that opt to promote agro-ecological techniques. This can be done by setting up credit funds, supplying inputs or mechanisation services, providing seeds or technical support, and so on.

3. MORPHO-PEDOLOGICAL SURVEY OF THE NAM NGUM BASIN

3.1. INTRODUCTION

This survey was conducted through ten days of field work in December 2006 by traversing all navigable roads. In the absence of reliable geological maps, 1/100.000 scale topographical maps from the National Geographical Service were, in spite of their age, an essential aid in defining the morphopedological cartography.

The Nam Ngum catchment area has a surface area of 18,000 km² (13% of the territory of Laos). Excluding the plain of Vientiane and the plains of Phonsavanh, it is essentially mountainous, with peaks that exceed 2,500 metres above sea level.

The geological structure and nature of the rocks do much to explain the formations and extreme complexity of the hydrographic network. The 'structures' of the natural environment are more differentiated by geomorphological criteria than by pedological criteria. Overall, the nature of the soils does not vary so much. They are, in the majority, 'acrisols' (FAO classification), which are beige, yellow or ochre coloured soils that are very acidic (and sources of aluminium contamination in crops), loamy-clay, not very permeable and thus often waterlogged (in spite of the slopes) in the top stratum (bleached, with a clear grey colour) after rainfall; they are very low in phosphorus and exchangeable cations (except aluminium). The major types differentiated on the map are as follows:

- **High mountains:** significant variations in relative unevenness (500-1,100 metres), very steep slopes, high altitudes, complex hydrographic network.
- **Medium mountains:** relative unevenness ranging from 200-500 metres, steep to average slopes with averages, average altitudes.
- **High hills:** relative unevenness of 40-200 metres, steep to averages slopes. Average to low altitudes.
- **Low hills:** with unevenness of about 10-40 metres, slight to average slopes.
- **High terraces** (old alluvial terraces) with slight slopes, unevenness of 5-20 metres.
- **Low terraces** (recent and current alluvial bottoms on the plains and valleys), slight unevenness (2-5 metres) and very slight to no slope.

Within these major types rocks and formations were differentiated (geomorphological units): granite, sandstone, argillaceous schists (shales), pelites (very fine sandstone), limestone, mudstone, alluvia. These rocks do not all have the same weathering properties or resistance to erosion. The fold strata (primary era) are not all assimilated well and rise at varying levels across the landscape. Formations from sandstone, granite and limestone dominate the landscape. Schists and pelites are at medium level and the mudstones are rather lower down. Elsewhere these same mudstones have been eroded into 'half-orange hills' or 'inverted bowls'.

We have avoided using specialist terms and jargon and, as far as possible, have employed the 'morphopedological' units defined and represented on the map, which are quite easily recognised in the field.

3.2. GEOLOGICAL CONTEXT

Geologically speaking, the Nam Ngum basin is located at the junction of two large orogenic systems: **the Annamese Cordillera**, running NW-SE, and the **upper-western Lao range** running NNE-SSW. The former runs through the upper basin of the Nam Ngum, the latter through the basin of the Nam Lik tributary.

3.3. THE AGRONOMIC CONSEQUENCES

In the majority of cases, except for in the areas with limestone colluviums, production systems run for no more than three years of cropping after clearance of long-duration fallows. Overall these soils have fragile structures and are very sensitive to erosion.

Given the experience already gained on the soils which present the most serious constraints (Plain of Jars, Xieng Khouang), where in a short period of time the land could be used to grow crops following investment in plant cover systems (SCV) alone, the overall development of these areas need not pose a major constraint. The most important factor is good management of organic matter and the capacity of the systems to strengthen this.

These soils should therefore be **disturbed as little as possible** in order to conserve their current qualities: no burning of vegetation, no tillage and, in principle, no levelling of the land into terraces. The agronomic practices used should aim at **increasing the organic matter content** through direct sowing, crop rotations, diversification (multipurpose species) and livestock integration.

The selection and development of the land must, of course, take into account physical constraints (steep slopes), the level of environmental degradation, and the farming method to be used (e.g. short fallow) so that the initial systems can begin with management of corrective action such as use of phosphorus, calcium and magnesium. The use of these can be reduced as the soil quality evolves due to the increase in organic matter through the SCV systems.

In all cases careful intensification of fertility must be accomplished by integrating the two possible approaches:

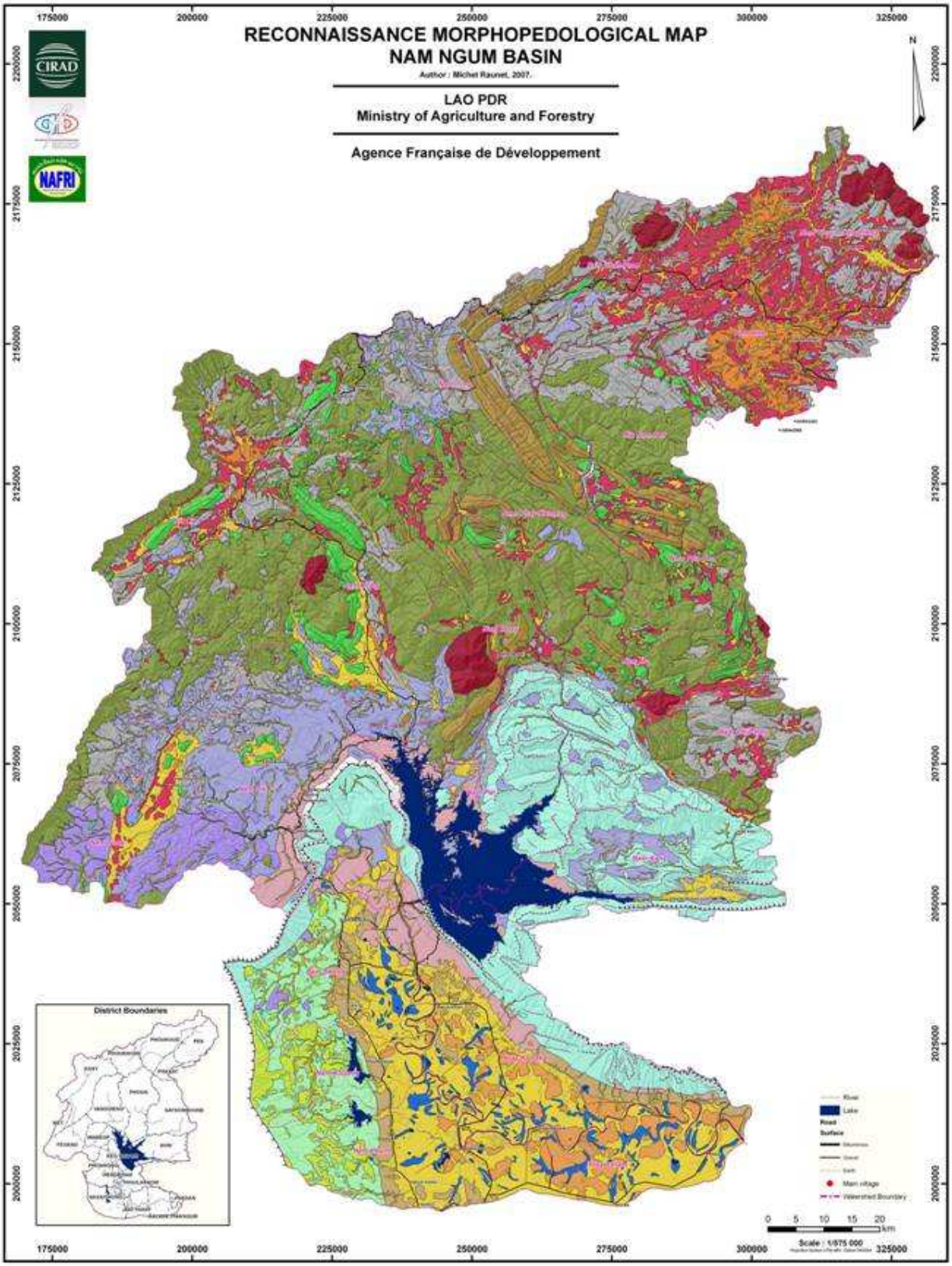
- Organic, through the maximum transfer of fertility possible under animal raising (manure and compost), restoring phosphorus and calco-magnesium, while also balancing the acidity with thermophosphate and introducing forage species with a strong capacity for soil restructuring (high biomass production rate above and within the crop horizon, leading to improved fertility in the widest sense: chemical, physical and biological);
- Chemical: complementing the organic approach through careful application of nitrogen, potassium, phosphorus, oligo-elements and the use of specific inputs in small doses (herbicides, insecticides and fungicides).

Applying mineral fertilisers reduces the regeneration time required through increased biomass production, and improves overall fertility (chemical, physical and biological) within a short time frame.

In this dynamic, with effective plant cover systems, it would be advantageous if development projects, the banking sector and aid donors subsidised the mineral and organic fertilisers, in order to accelerate the biological process, so increasing the productivity of systems and leading to greater stability for smallholder farming families. The economic risks associated with these innovations must be assessed before the techniques are transferred to the development structures and to groups of farmers.

This stage of agronomic and socio-economic validation has been integrated within the scope of DAFEO, which works in partnership with NAFRI–PRONAE in the provinces of Xayabury and Xieng Khouang. These teams have effected a gradual launch based on three main principles:

- A good comprehension of ‘conventional’ systems;
- Improvement within this stage of these systems in relation to the starting point with these farmers;
- Monitoring and constant evaluation by the farmers and technical teams.


RECONNAISSANCE MORPHOPEDOLOGICAL MAP
NAM NGUM BASIN
Author : Michel Raunet, 2007.
LAO PDR
Ministry of Agriculture and Forestry
Agence Française de Développement
CIRAD
NAFRI
N
175000
200000
225000
250000
275000
300000
325000
2200000
2175000
2150000
2125000
2100000
2075000
2050000
2025000
2000000
District Boundaries
Road
Lake
Road
Surface
Main village
Watershed Boundary
0 5 10 15 20
km
Scale : 1/375 000

BROAD UNITS		GEOLOGICAL MATERIALS	LANDFORM	SOILS
HIGH MOUNTAIN (Variations in height: 500-1100m.)	1	INTRUSIVE GRANITES	Well defined massives in prominent position, without prevailing orientation. Very strong slopes (30-70%)	Silty-clayey to sandy-clayey very acidic soils: acrisols (albic, alumic, or plinthic)
	2	PALAEOZOIC FOLDED SANDSTONES	Dominating orientated massives, with long prevailing crests. Very strong slopes (40-60%)	
	3	PALAEOZOIC FOLDED SHALES AND SANDSTONES	Sharp broken relieves, with multiple crests. Very high slopes(40-60%)	Reworked colluvial materials deriving from acrisols or weathered rocks
	4	JURASSIC UNFOLDED SANDSTONES AND CLAYSTONES	Sharp relieves with long valley-sides. High slopes (30-70%)	
	5	JURASSIC SANDSTONES	Rocky escarpments	Sandstone outcrops Colluvial sandy material
MID MOUNTAIN (Variations in height: 200-500m.)	6	PALAEOZOIC FOLDED LIMESTONES	Sharp stony karstic well defined massives	Limestone outcrops. Pokets of calcaric cambisols
	7	PALAEOZOIC FOLDED SHALES, CLAYSTONES AND SANDSTONES	Intricated sharp reliefs, with convex crests slopes 20-40%	Silty-clayey albic alumic acrisols, very acidic
	8	PALAEOZOIC OR JURASSIC CLAYSTONES	multi convex " half - orange " landform. High Slopes (30-50%)	
HIGH HILLS (Variations in height: 40-200 m.)	9	PALAEOZOIC FOLDED SHALES AND CLAYSTONE	convexo - concaves high hills bordering and dominating main plains and valleys. Moderate slopes (10-30%)	Acrisols (albic, plinthic, ferralic), very acidic
	10	PALAEOZOIC OR JURASSIC CLAYSTONES	Multi convex "half orange" landform. Strong slopes (20-40%)	
	11	JURASSIC UNFOLDED SANDSTONES	Structural valley-sides according to the dip of sandstones. Weak to moderate slopes (10-20%)	Sandstone outcrops Sandy bleached acrisols
LOW HILLS (Variations in height : 10-40 m.)	12	TRIASIC OR JURASSIC UNFOLDED CLAYSTONES	Multi - convex "half orange ' landform. Dense small valley bottoms, slopes 20-40%	Albic, stagnic or plinthic acrisols (very acidic)
	13	JURASSIC UNFOLDED SANDSTONE AND CLAYSTONES	Long " structural " valley-sides conforming to the dips. Weak slopes (5-10%)	Sandy - loamy bleached, ferric or plinthic acrisols (very acidic)
	14	JURASSIC UNFOLDED CLAYSTONES	Low flattened domes (Plain of Vientiane) Weak slopes (2-5%)	
HIGH TERRACES (Variations in height: 5-20m.)	15	PLEISTOCENE FLUVIO-LACUSTRINE DEPOSITS	Sub - horizontal topography (Plain of Phonsavan)	Albic, gleyic, plinthic or alumic acrisols (very acidic)
	16	PLEISTOCENE FLUVIATILE DEPOSITS	Low flattened domed, (Plain of Vientiane) Weak slopes (2-5%)	
LOW TERRACES (Variations in height: 0-5m.)	17	HOLOCENCE AND CONTEMPORARY	Sub-horizontal alluvial floors of valleys and plains	Silty - clayey gleyic or plinthic fluvisols
	18	FLUVIATILE DEPOSITS	Floodable basins (Plain of Vientiane)	Clayey, stagnic gleysols.

4. AGRICULTURAL, SOCIAL AND ECONOMIC ENVIRONMENTS – SITUATIONS, CONSTRAINTS AND OPPORTUNITIES

Four main agro-ecological and socio economic zones were analysed during this study:

- The upper part of the Nam Ngum river basin with Pek, Phoukhouth and Paxay;
- Market based farming systems with high agricultural potential - Kasi and Vang Vieng;
- Hin Heup and Hom, characterised by 'conventional farming' and agro-industrial development mainly based on rubber and 'agarwood' (*Aquilaria crassna*);
- Xaysomboun, where subsistence farming still prevails but rapid change is occurring due to the involvement of the private sector.

4.1. SITUATIONS, CONSTRAINTS AND OPPORTUNITIES - UPPER PART OF THE NAM NGUM RIVER BASIN (PEK, PHOUKHOUTH AND PAXAY)

Pek, Phoukhouth and Paxay typify the agro-ecological conditions of the elevated plains (800–1,200 m asl). Other than the low lying land, these areas are under used by smallholders due to low soil fertility. Open settlement can be observed on the Plain of Jars where there is lowland access.

New economic opportunities have recently appeared across the high plains of Xieng Khouang province following road construction, increasing urban consumption and relocation closer to roads and trade structures. The UNDCP-IFAD Xieng Khouang Agriculture and Development Programme supported improvements to the provincial road and track network from 1991 (Bountong & Boualy, 2002). The tarring of two main communication axes (national roads 7 and 6) was completed in 2002 and these roads are maintained annually, allowing easy transportation of goods and people from Xieng Khouang to the national capital Vientiane, to more northern provinces such as Houapanh, and to Vietnam.

Village relocations started in Xieng Khouang in the early 1980s, motivated by several factors (Goudineau, 1997): insecurity related to anti-revolutionary threat; the slash-and-burn

eradication policy of relocating excess population from overcrowded areas; and the overall provincial development strategy of defining focal zones where health and education structures are provided to people who settle there. Between 1990 and 2005, the population of Phonsavanh city increased from 15,472 to 34,634 inhabitants (Provincial Department of Statistics, 2005).

As agreed by many authors (Hacker et al, 1998; Gibson et al, 1999), this area is mainly covered by acidic, infertile savannah grasslands with pine trees. In Pek, only 5% of the total surface is cultivated, with rice paddy land representing 80% of this cultivated area (PAFO, 2004). Surveys conducted by NAFRI (1997) and NGD/JICA (1999) showed a total area of approximately 48,000 ha of savannah grassland. These two studies give an overview of the land use in the three watersheds over a total area of 228,000 ha.

Three types of highland household were differentiated according to land access (Lienhard et al, 2004). On these high plains (altitude 800-1,100 m above sea level) farming systems are mainly based on lowland rice and extensive livestock production.

This section summarises the procedures that are indispensable to quality performance in this environment. The principles outlined below are currently being applied by the technical teams (DAFEO and contractors) from PASS and PRONAE. This approach allows extension agents and agronomists to innovate, continuously enhance the process, and support the environmental restructuring through constant analysis of the evolution of production systems and the proposed systems. This method brings the various actors and rural development bodies together around an effective and proven innovative base, founded on agro-ecology and SCV.

As highlighted previously **agro-ecology through SCV should be regarded as just one of the integral elements of this new approach, already adopted in Laos, rather than as the defining element**.

The main principles of this mode of operation are as follows:

- Identification of dominant and emerging systems;
- Helping farmers adjust to these systems in order to anticipate market needs and integrate them into their production systems;
- Frame these interventions within an environmental approach that revolves around preservation of natural resources;
- Create a clear and professional structure across the whole agricultural sector (farmers, extension agents, agronomists, traders, decision makers) with integrated networks (agriculture, livestock, fertility transfer, food and forage resources);
- Immerse the teams in the field so that they work among, with and for the farmers;
- Conduct constant evaluation of innovations and of the evolution of the agricultural, economic and social environment.

Given the experience and the monitoring role of PRONAE, the development initiatives in Pek, Phoukhout and Paxay districts should be focused on production of large ruminants with a fully integrated programme of animal health, forage resources (dry season and rainy season)

and genetic improvements in accord with the productivity of this system and the rate of adoption by farmers.

Given that the 'animals' component, under traditional management techniques, contributes a large part of agricultural revenue, it may be predicted that improved livestock systems will bring substantial economic benefits at the family and provincial level.

Results obtained over two seasons are presented in an analysis of the economic and technical viabilities of cattle fattening. The income generated by this fattening programme in 2006 was equivalent to what could be earned by a paddy rice yield of 1.8 tonnes per hectare, which is unlikely in this ecology. In 2006, without taking into account seed production, bull fattening provided a gross income of $804, covering all expenses and generating a net income of $362 per ha and a labour productivity of $10.4.

Improvement of road and track networks has increased the commercial rate of cattle export to Vietnam (Onekeo, 2005; Syphanravong et al, 2006) and the recent experiences of the Forage for Smallholders Projects (FSLP, CIAT-NAFRI) and the Small Agro-enterprises Development Upland project (SADU, CIAT-NAFRI) show increasing commercial opportunities in places where smallholders are growing forages for cattle feeding. However, different constraints remain. First, it seems difficult for smallholders to carry out this kind of livestock production without technical support for land preparation, pasture growing and cattle management. The local ecologies on schist and granite present low mineral contents with high deficiencies of N, P, K, Ca, Mg and micronutrients (Zn, Bo, Mn). Thermophosphate addition is thus essential, to provide reasonable quantities of Ca, Mg and P and to allow implementation of efficient livestock production and cropping systems. A market channel for such fertiliser is already operational in Xieng Khouang province through Vietnamese traders. Moreover, the soil does not need to be disturbed by mechanical action and land preparation is based on direct sowing of forage species after control of natural pasture land. Specific equipment adapted to local economic conditions (sowing machine for hand-tractor) must be promoted to decrease labour inputs for land preparation and sowing. The second limiting factor could be that the system was first perceived as requiring an initial cash investment. On these elevated plains, innovative farming systems based on Conservation Agriculture could be stable and profitable if, at the same time, economic incentives (access to market, inputs, credit, agriculture and livestock product processing) are promoted. Thirdly, further work is required to estimate the maximum stocking rate of heifers on improved pasture during the dry season, and in producing additional fodder resources (hay and silage) for this period.

Forage seed production does not seem to be problematic in this ecology. Development of specific market channels for seeds could indirectly improve pasture management, avoid high stocking rates and generate new income that could be invested in fertiliser and animal care.

This programme based on raising large ruminants provides the following benefits:

Bio-physical aspect

- Quantitative and qualitative improvements in cattle;

- Watershed and biodiversity protection through the ceasing of brush fire setting during the dry season, as currently occurs in order to increase the productivity of these areas;

Economic and social aspect

- Augmentation of trade flow at the national and regional level with Vietnam;
- Improvement of living conditions for rural communities;
- Use of land.

This system of improved pasture must be conceived as a first stage in establishing annual cropping systems. First of all "chemical and organic improvements" from the use of forage species and inputs (thermophosphate) are needed to implant SCV with rice as a base crop. In this dynamic, the farmers will have the opportunity to adapt their production system (livestock and/or crops) according to market trends and their own situation (i.e. financial and human resources, access to specific equipment, food self-sufficiency).

Initial rice systems, established on a cover of *B ruziziensis* after one or two years of regeneration, produced 1.2 and 1.8 t/ha of rice respectively, with a first investment that is limited in comparison to that of setting up rice terraces in the valley bottoms, the cost of which approaches $1,000 per ha even without counting an irrigation system.

In conclusion, a holistic approach involving credit availability through national banks and VDF (Village Development Funds), with technical and political support, should be defined in order to develop productive and efficient systems within this ecology. This poses a great challenge which, if grasped, could yield great benefits in the upper part of the Nam Ngum river basin.

4.2. SITUATIONS, CONSTRAINTS AND OPPORTUNITIES (KASI AND VANGVIENG – MARKET BASED AGRICULTURE)

The lower parts of the Nam Ngum river basin are highly diverse in terms of biophysical and socio economic characteristics, and different areas require different strategies and farming systems.

Farming systems in Kasi and Vang Vieng are characterised by three points:

- High level of diversification (cash crops, horticulture, and market gardening),
- Overall strategies are conditioned by national and regional demand. The tendency is to turn diversified production systems into monocultures, which leads to dependence on markets and risk;
- Private sector involvement in agro-industrial crops (maize, rubber and *Aquilaria crassna)* and a need for environmental impact assessments.

Production is mainly based on cash crop production, with crops varying according to climate, soil potential and market access. DAFEO and NNRBDSP staff should focus their support to farmer groups on:

- Generating DMC systems for annual crops (maize, legumes, rice);
- Supporting existing diversification (e.g. fruit trees, cabbage);
- Improving livestock systems (fodder resources and breeding).

Extension services need to provide technical advice to support the extension of present cropping systems while promoting systems that conserve soil, water and nutrients. There is a danger that this situation could mirror the 'resource mining' seen in southern Xayabury, where mechanical preparation (ploughing) and increased use of pesticides (weedkiller and insecticide) have been introduced into new production zones. In Xayabury, notable changes in agricultural practices have included the adoption of heavy mechanisation and use of pesticides. To supply traders, maize is now widely sown throughout the region (25,000 ha) and is spreading to more areas every year. With this intensification, rotational cultivation systems and fallow periods are disappearing. The serious social and environmental costs that ensue include increased soil erosion (leading to destruction of roads and paddy fields), loss of soil fertility, and chemical pollution of the environment. It is vital that preventative work is undertaken with the private sector (companies and service providers) and the farmers to ensure that they integrate in to their cycles soil conservation techniques based on SCV.

Two main work themes will be pursued by DAFEO with the support of NNRBDSP:

- Generation of a large range of DMC systems and technologies at Training Centres (e.g. pigsties, improved pastureland, mechanisation, use of inputs);
- Validation of DMC systems with farmer groups.

The team will follow an iterative approach, advising incremental changes to the conventional systems in use. This is likely to be more acceptable to farmers than risky and drastic modification. Given the potential of this area (karst colluviums) and the crops grown, it would be easy to develop such systems building on PRONAE's and PASS's experiences. Advice must be based on an understanding of the agro-ecological and socio-economic conditions under which alternatives are adopted and implemented at the local level. Farmer groups will be constituted in different villages to ensure localised conditions and farmer strategies are taken into account.

This programme will bring the following bio-physical and socio-economic benefits:

Bio-physical

- Soil protection and improvement of soil fertility and potential through DMC systems;
- Watershed protection.

Economic and social components

- Increased diversification;
- Stabilisation of smallholder farms;
- Generation of income and improved well-being in rural communities.

4.3. SITUATIONS CONSTRAINTS AND OPPORTUNITIES (XAYSOMBOUN, HOM AND HIN HEUP)

It has been noted over the last year or two that with the opening up of certain districts (Hin Heup, Xaysomboun, Hom) agro-industrial crops - mainly rubber, teak, *mai khetsana* (*Aquilaria crassna*: agarwood for essential oil), and *jatropha* (biofuel) have started to proliferate. The techniques needed to start these crops growing (clearance, burning, ploughing, and mini-terraces) are very expensive and are detrimental to these fragile soils and to natural resources in general. Loss of fertility, erosion, and pollution of rivers is already perceptible. Private loans from outside sources with high interest rates are accompanying these agricultural developments.

Environmental assessment has to be carried-out to evaluate the impacts of this development of perennial plantations (rubber and *Aquilaria crassna*) and to analyse the socio-economic viability of such systems for households. In Hin Heup a low level of diversification has also been noted, with hills under-utilised by farmers.

Agricultural production in Hom and Xaysomboun is mainly based on upland rice, livestock production (cattle and pig raising), and diversification through fruit trees and multipurpose species such as cassava. Until recently these two districts had limited access to market. They are characterised by:

- High socio-economic diversity related to ethnic groupings, farmer strategies, and land access;
- Farming systems mainly based on lowland and upland rice, livestock production (cattle and pigs, 30% of cash income sources), NTFPs (10% of cash income sources) and home gardens (cassava, cana, fruit trees, pineapple). Labour and services account for 30% of cash income sources,
- Large grassland areas in Xaysomboun, suitable for livestock grazing.

DAFEO and NNRBDSP staff should focus their support to farmer groups on:

- Improving livestock systems (fodder resources and breeding);
- Supporting existing diversification (e.g. fruit trees, cabbage);
- Generating DMC systems for annual crops (maize, legumes, rice).

5. OBJECTIVES AND METHODOLOGICAL APPROACH

5.1. GENERAL OBJECTIVES AND SYSTEMIC APPROACH

5.1.1. Conservation agriculture

Taking the capital natural into consideration is the first priority fixed by the project within the plan to protect the watersheds. The main environmental and socio-economic objective will thus be to develop technical alternatives that shall enable the preservation of renewable but not inexhaustible natural resources such as soil and water, and to promote sustainable agriculture that is socially acceptable, economically profitable and environmentally sound.

First of all the project should move to restore and preserve the physical, chemical and biological fertility of the soils used in agriculture, which constitute much of the natural heritage of the area. Given the fragile condition of the soils described above, and the degradation that has already been observed, this work is essential.

Soil management is the principal integrating topic for all development activities linked to agriculture, livestock, forestry, fishing, preservation of infrastructure, water quality and the quality of life. Conservation agriculture based on the simple techniques of direct seeding and plant covers is thus proposed.

Centring the approach on soil capital also makes it possible to maintain enough diversity to allow interesting ecosystemic properties to emerge, notably with regards to the natural functions of bio-geochemical regulatory cycles. It thus enables the project to meet the environmental issues through:

- *Promotion of technologies* that can increase the productivity and socio-economic capacities of farming systems without negative affects related to land use, water use, inputs or pesticides;

- *Promotion of technologies* that can assist the careful and environmentally responsible development of the ecosystemic services of natural systems whose primary production functions are not fully exploited (e.g. the Plain of Jars);
- *Promotion of technologies that increase energy efficiency*, reducing greenhouse gas emissions and increasing carbon sequestration.

In addition to the promotion of sustainable agriculture, this approach also allows the creation of global and local ***environmental public goods*** (GPG and LEPG), which for the moment have no monetary value. The concept of ***Payment for Environmental Services (PES)*** provided to society is appropriate here.

These systems, which have already proved their worth in Laos, among other places, were the subject of a circular of the Cabinet of the Council of Ministers (Ref 554/CCM.DC, 21/4/2005) and a ministerial decree from the Ministry of Agriculture and Forestry (Ref: 0372/DF.05, 11/05/2005) and can thus be applied in all provinces of the Lao PDR.

Production systems will be designed around the broadest possible technological improvement at various levels of intensification as befits the situation in each place, the knowledge levels of the farmers, and the economic risk identified. In this work emphasising mixed agro-sylvo-pastoral production models would appear essential:

- Food and cash crops, fruit trees and market gardening;
- Animal husbandry with large ruminants, and small animals, tightly integrated into current production systems;
- Exploitation of forestry and NTFPs.

These components are structured around rainfed rice farming, which is the crux of all production systems in Laos (food self-sufficiency). From these structures, other cash crop and small livestock systems of varying levels of intensity will be developed to optimise the natural resources.

Current slash-and-burn practices, which through long fallow periods of 10-15 years allow the soils to recover, are no longer feasible due to the diminishing amount of land available. They will be replaced with SCV, in which forage crops - thanks to their above- and below-ground biomass with strong, deep roots - reproduce the natural regulatory functions of the forest's bio-geochemical cycles over a shorter time frame (two to three years). This constitutes a preliminary phase before the development of more diversified systems.

Moreover, these species contribute to improved incomes not only through their value as forages but also through sale of the seeds they produce, which offer revenue from the very start, even as the systems begin to develop.

5.1.2. A global systemic approach

This systemic approach, designed to progressively transfer skills to the local authorities, development agencies and private operators, is organised around two principles:

To develop a repeatable global solution to the constant need for information from all development practitioners, in order to improve and update in 'real time' the technological, methodological and organisational methodology to keep it in line with the evolving biophysical, socio-economic and political context, and with demand. Constant evaluation at each stage will allow real time adjustment of activities and reorientation of programmes, and so optimise the use of all resources.

To develop an integrating approach that unites research, extension, training and all processes involved with creating a structure and taking policy and financial decisions from the very start of the project and throughout its cycle. This will require links with all actors in rural development: farmers, extension agents, trainers, researchers, the private and banking sectors, and political and financial decision makers.

The solution lies in an integrating and iterative process based on components designed to fulfil activities of Diagnosis, Set-up & Trials, Training, Monitoring & Evaluation, Creating Structures and Diffusion. Each participant will thus be somehow involved in every project activity. Such involvement is essential to the success of this global systemic solution.

The single most important objective in each component is the constant safeguarding of the human, economic, cultural, technical and natural environment.

For this reason the division of responsibilities between partners (PAFO, DAFEOs, the Nam Ngum project and PRONAE) is not based on different activity themes but rather on integration of these interdependent activities. Within each activity the division of tasks is based on scale. With regards to training for example, PRONAE will train a first group of extension agents who will then themselves train new extension agents (training of trainers) and farmers, thus ensuring up-scaling through a multiplication effect.

5.2. SPECIFIC OBJECTIVES

This activity plan involves four specific objectives:

- Structuring extension and development agencies, private operators, the banking sector and farmers through a programme to integrate the agricultural, social and economic environments in a sustainable dynamic;
- Capacity building to increase the independence of local institutions;
- Diffusion of production systems integrated and adapted to the agricultural situation and social conditions of every participant (improvement and diversification of revenue);
- Policy aid for programme adjustment.

5.3. GEOGRAPHIC DIMENSIONING

Selection of the areas for the development programme is governed by the current dynamics of the Nam Ngum project. The districts already selected are:

- Phoukhouth, Pek and Phaxay in Xieng Khouang province;
- Kasi, Vang Vieng, Hin Heup, Xaysomboun, Hom and Feuang in Vientiane province.

The terrain in these various districts includes contrasting situations of elevated plains (Xieng Khouang), areas of average height, high mountains and valleys. All the ethnic minorities present in the Nam Ngum basin will be involved.

In the mountains and on the high plains rainfed rice growing remains the basis of production systems. Household income also comes from raising cows, buffalo, small ruminants, pigs and poultry, together with gathering of NTPFs, which to many people are vital to income and food self-sufficiency.

However, following new market accessibility (along the Kasi-Vang Vieng-Hin Heup axis), new crops have appeared over the last five or six years. These are mainly horticultural - citrus fruit, pineapple and market gardening at the end of the rainy season, with cabbages, cucumber, garlic, and water melon on rice fields during the dry season. Overall they show little diversity and are conditioned by national and regional (Thailand) demand. The tendency is to turn diversified production systems into monocultures, which leads to dependence on markets and risk.

The four-year programme developed for 2007-2010 will be executed in two phases:

- Work in 2007 will enable seven of the nine districts (Phoukhouth, Pek, Phaxay, Kasi, Hin Heup, Xaysomboun, and Hom) to map out a full-scale extension programme beginning with the development of production systems adapted to the various ecologies and socio-economic situations encountered.
- From 2008-2010 such programmes will be operated in all nine districts.

5.4. CREATING AN ENABLING ENVIRONMENT

5.4.1. Institutional structuring

Building partnerships

This programming should make it possible to integrate the whole agro-ecology and SCV component within the programmes underway in these nine districts within the Nam Ngum project. NAFRI and PRONAE were requested to propose a partnership agreement for each province in order to strengthen capacity within district teams (DAFEO) as a continuation of actions in progress since 2003 in Xieng Khouang and Xayabury.

A partnership agreement already exists between PRONAE and the provincial departments of Agriculture and Forestry for Xieng Khouang and Xayabury and should soon be extended to the Vientiane province department. Within this framework the capacity should be present to mobilise the necessary funds from the Nam Ngum project to develop this support programme around agro-ecology and SCV.

Supporting programme coordination and execution teams with the DAFEOs

In 2007 this component is supposed to include the training of four DAFEO technicians from each district, to be supported by a technician trained within PRONAE over the last three years. They will undergo uninterrupted general training on the creation and development of these production systems (general agronomy, feasibility and know-how). They will be also be taught basic diagnosis, plus annual technical and financial programming methods for district and village level in order to assist with management of these programmes.

This programme will also be supported by the ***Sectoral Programme for Agro-Ecology (PROSA)*** in its work to strengthen the structure for training and communications in 2007 financed at ministry level by the French Development Agency.

5.4.2. Structuring farmers

The 'territory' approach helps village institutions with space management: land, infrastructure, area designation.

The territory approach focuses on the creation of farmers' groups. This framework seems essential to understanding the effects and impacts of the activities, and particularly to understanding the whole *problematique* at the village level. The provisional objectives and the technical dimensioning for the period 2007–2010 are as follows:

According to plans, over the period 2007-2010 nearly 60% of the villages will be covered by Nam Ngum project financing, with an area of approximately 12,000 ha (Table 1). In 2007, 25 target villages in the three districts of Pek, Phoukhouth and Paxay (Xieng Khouang) will be covered (400-560 families). In the province of Vientiane 22 villages, or 176 families, are earmarked.

2007 is regarded as a probationary period in which the effects of the programme should go beyond the immediate earmarked areas and set up activities according to the specificities of the production major zones in each district. This will entail the technical teams immersing themselves in diagnosis work in order to focus efforts well, and to identify the constraints and potential for each following campaign.

Table 1. Dimensioning of activities in Xieng Khouang and Vientiane, 2007–2010

Districts	2007				2008			
	Villages	Familles	Surfaces (ha)	Techniciens DAFEO	Villages	Familles	Surfaces (ha)	Techniciens DAFEO
Pek	12	260	260	7	30	1160	1160	7
Poukhouth	8	200	200	6	20	600	600	6
Paxay	5	100	100	4	15	400	400	6
Total Xieng Khouang	**25**	**560**	**560**	**17**	**65**	**2160**	**2160**	**19**
Kasi	4	32	32	4	15	300	300	6
Hinheup	5	40	40	4	15	300	300	6
Feuang	4	32	32	4	15	300	300	6
Xaysomboun	4	32	32	4	12	240	240	6
Hom	5	40	40	4	15	300	300	6
Phoukoun	0	0	0	0	5	100	100	4
Vangvieng	0	0	0	0	5	100	100	4
Total Vientiane	**22**	**176**	**176**	**20**	**82**	**1540**	**1540**	**38**
TOTAL	**47**	**736**	**736**	**37**	**147**	**3700**	**3700**	**57**

Districts	2009				2010			
	Villages	Familles	Surfaces (ha)	Techniciens DAFEO	Villages	Familles	Surfaces (ha)	Techniciens DAFEO
Pek	60	2960	2960	7	60	4760	4760	7
Poukhouth	35	1300	1300	6	35	2000	2000	6
Paxay	30	1000	1000	6	30	1600	1600	6
Total Xieng Khouang	**125**	**5260**	**5260**	**19**	**125**	**8360**	**8360**	**19**
Kasi	32	800	800	6	32	960	960	6
Hinheup	22	550	550	6	22	660	660	6
Feuang	35	875	875	6	35	1050	1050	6
Xaysomboun	22	550	550	6	22	660	660	6
Hom	25	625	625	6	25	750	750	6
Phoukoun	10	250	250	4	10	300	300	4
Vangvieng	10	250	250	4	10	300	300	4
Total Vientiane	**156**	**3650**	**3650**	**38**	**156**	**4380**	**4380**	**38**
TOTAL	**281**	**8910**	**8910**	**57**	**281**	**12740**	**12740**	**57**

Setting up farmer groups (production, credit, collection, supply)

The farmer groups approach will be used to facilitate regular technical support and exchange with families (creation of structures) concerning the production systems that will be developed. The approach must be flexible, evolving according to results and indicators, and able to structure and adapt groups of producers towards service activities (e.g. supply, credit, and collection).

Assisting management of subsidies

Support will be provided to help with management of subsidies as well as with the diversification of activities within village institutions and credit, collection and supply groups.

5.4.3. Structuring the banking sector

Support to setting up a savings and credit policy

Village Development Funds were included in the plans for the current Nam Ngum project. These consist of two components: a subsidy granted for village infrastructure and a micro-credit component to finance crop investments, current consumption and goods and equipment.

Rural credit services adapted to encourage sustainable production systems will unquestionably be a factor in determining the success of all activities proposed in this programme.

Study should be made of how to involve the national banking system, together with farmer groups and private operators, in order to encourage development on a broad, equitable and sustainable scale. Such a move would also combat the high-interest loans with which private lenders are currently exploiting farmers and hindering rural development as a whole.

Specific measures will be required; as discussed in the later section on *Assisting national debate and decision-making to support the planning of agro-environmental policies in relation to the banking sector and private operators*.

5.4.4. Structuring private operators and services

Support to credit operations

As with the approach developed in southern Xayabury province by PASS and PRONAE, private sector credit operations used in supplying inputs and collecting produce could be integrated into this programme if interest rates of not more than 1.5% per month are agreed.

Supporting supply, collection and processing operations

Market channels can be stimulated by building connections between private entrepreneurs at the local level and farmer groups. The production systems that will be proposed are all centred on broader diversification and better integration of the various system components. The role of private operators in the structuring and the consolidation of market channels will be crucial to extending the proposed systems on a broad scale.

The programme should be able to identify stable operators and to promote mutually fair contractual agreements for production and supply.

5.5. DESIGNING A RURAL DEVELOPMENT SCHEME BASED ON MANAGEMENT OF NATURAL CAPITAL

5.5.1. Assisting national debate and decision-making to support the planning of agro-environmental policies in relation to the banking sector and private operators

Consideration of agro-environmental measures

It is now essential that a structure within MAF, such as PROSA, is able to present to the decision-making authorities documented results from analyses of the impact and diagnosis of the agro-ecology/SCV programme. This would encourage redirection of funding towards development activities which best integrate environmental management in improving family incomes.

The most urgent measures to be adopted are:

- Introducing a taxation system for agro-industrial and mining projects to compensate for environmental damage. Funds raised through this would be reinjected into development activities through the PES scheme;
- Support to the conversion of conventional systems to systems based on agro-ecology and SCV by:

- Creating specific lines of credit which can be accessed by farmers (cropping and equipment credit), by private entrepreneurs and farmer groups through short-term loans for supply and collection, and through medium-term loans for produce storage and processing facilities;
- The establishment, according to the resources of the provinces and of the state, of PES schemes to encourage production systems which use agro-ecology and SCV at household level.

The agro-ecology and SCV programme could, through such credit schemes, guarantee its part in farming plans from the identification of needs through to the justifying results, and it will accompany private operators and farmer groups in these actions.

Designing credit schemes (identifying demand and developing procedures accordingly)

The support team and provincial services will need to take part, with PROSA support, in designing these credit schemes.

5.5.2. Agro-industrial projects, the mining sector and services

Identifying the environmental impacts of projects, the private sector, and the banking sector

With the development of agro industries, and the establishment of industrial projects and copper and gold mines in the provinces of Xieng Khouang and Vientiane (Phu Bia Mining Company), the environmental impacts of these innovations should be analysed so that MAF and local institutions (PAFO/DAFO) can design and position activities within these projects to prevent degradation of the natural environment.

Regarding the concessions granted to agro-industrial entities, **it is essential that the agro-ecological and SCV approach is included within these projects right at the start in order to preserve the productivity of the environment, increase diversification and improve the incomes of farmers**.

With regards to the mines and hydroelectric dams, the irreversible damage which will result should be evaluated accurately. The current compensatory measures offered by NT2, NTPC, NN2 and Phu Bia appear derisory. These companies profit from international assistance agencies (World Bank, ADB, AFD, JICA, etc.), which paradoxically also finance sustainable development and environmental initiatives.

Positioning and building the agro-ecology-SCV approach in these projects and within village institutions

Starting with impact analyses and a baseline diagnosis to be conducted during 2007, the programme should quickly move to design cropping development systems for all these operators.

5.5.3. Complementary studies (land reallocation and displacement of villages and families from the Nam Ngum 2 reservoir)

For this specific programme it will be possible to create an operations diagram for the land, the production systems and the accompanying measurements required to ensure stable and sufficient incomes.

An environmental and social impact study will be required on the displacement of the villages and the 1,200 families of Feuang district who will have to make way for the Nam Ngum 2 reservoir.

5.5.4. Transfer of programmes to the public sector

Experience from the programmes in Xayabury and Xieng Khouang has shown that this integrated development approach takes at least three to four years to train the personnel of the PAFO/DAFO system in these dynamics until they can operate independently.

With this in mind, PRONAE team support to the provinces and the Nam Ngum project has been planned for four years, 2007-2010, in order to achieve an optimal programme transfer.

5.6. CAPACITY BUILDING THROUGH TRAINING

General context: it is suggested that an environment favourable to the diffusion of agro-ecological techniques be created by capacity building, through the training of rural development actors.

Objectives:

- Raising awareness, among all development actors, of the negative environmental impacts of conventional agriculture, the limitations it imposes on rural development, and the need for alternative techniques based on direct seeding and plant cover;
- Training for extension agents and farmers on the implementation of these agro-ecological techniques;
- Helping local institutions become independent in technical and financial programme management.

These involve six activities:

- ***Awareness*** (visits, field days, conferences, media) of environmental impacts and the need for alternative techniques.
- ***Short thematic training courses:*** These revolve around reinforcing basic knowledge on general agronomy for all technicians and extension agents working with development partner projects at previous PRONAE sites and in connection with PROSA. This stage

is essential before long practical training courses on agro-ecology/SCV can be considered.

- ***Long practical training courses:*** Practical training will be arranged for all DAFEO technicians and extension agents with development partner projects. This practical training will take place at the district training and demonstration centres. Courses will run for a whole cropping season (at least seven months).
- ***Continuous training*** of all agents involved with these activities. This is combined with a permanent process of self-evaluation that allows real-time adjustment of the overall approach (technical, methodological and institutional).
- ***Capacity building on training methods for DAFEO technical teams.*** This involves the introduction of complementary knowledge, methodologies and tools (training supports) so that DAFEO technicians can build comprehensive and sustainable training courses for other extension agents and the farmers (diffusion of knowledge).
- ***Training in project management,*** on technical and financial planning, building relationships with development partners, and on monitoring-evaluation. This requires the transfer not only of technical results to local institutions but also of the methodology of establishing and managing an integrated project.

6. DEVELOPMENT OF INTEGRATED PRODUCTION SYSTEMS

Agro-ecology and plant cover systems (SCV) are the unifying elements of this integrated and systemic approach, which essentially allows the regeneration of soil fertility that is indispensable for developing diversified systems that integrate annual and perennial crops with livestock systems: **conservation of the environment is the main objective enhancing productivity, diversification and leading to greater stability for smallholder farming families.**

These two elements entail a range of activities that can be grouped into seven main themes:

- Institutional: planning, initiation, coordination and monitoring-evaluation of programmes;
- Accompanying research:
- Extension – technical support:
- Continuous training of technicians and farmers;
- Environmental structures:
- Communication and capitalisation,
- Planning (villages, districts, provinces) according to outside operators, development activities, and defining of local development policies.

6.1. METHODS OF INTERVENTION

The planning, management and coordination of the programmes based on agro-ecology and SCV will be conducted with backstopping from the Department of Agriculture and Forestry and the Nam Ngum project teams, with support from PROSA and PRONAE at national and provincial levels. **The main objective is managerial independence for these programmes on a provincial scale (decentralisation)**.

6.2. BASIC PRINCIPLES FOR ESTABLISHING DMC

The cover crops to be planted should be selected based on the ecological situation, with reference to the tests already carried out for each Variety. They must enhance and correct chemical soil functions.

6.3. ESTABLISHING SYSTEMS: ACCOMPANYING RESEARCH (SET UP AND VALIDATION – TRAINING CENTRES)

It is envisaged that within each district, and in conjunction with the already identified Training Centres, teams will be established to focus on the set-up, training and validation of production systems and simple technologies.

These centres will serve as a base for creating knowledge and for training, but they should also generate revenue by selling genetic materials (plant and animal) and/or through training people from outside the province.

These bases are essential within a dynamic of constant support to diffusion, where systems are designed to evolve alongside the market, and in line with agricultural constraints and developments. The extension of this research unit should be explored to provide development within each district backed up by technical support from NAFRI (decentralisation of research activities to local level

6.3.1. Agro-sylvo-pastoral systems: improved pasture land with forage species and DMC systems for annual crops

Two main activities have been proposed:

- Evaluation of different forage species, seed and cuttings production;
- An animal component:
  - A fattening unit based on a complete programme (improved pasture, rationed in the dry season: tedding and ensilage, disease prevention, livestock buildings, etc);
  - An improved pigsty based on a complete programme (animal health improvements, balanced diet with vitamin and mineral supplements, improved livestock housing, genetic improvement for careful intensification).

6.3.2. DMC systems for annual crops

Experimental units representative of the bio-physical (integrating soil, slope and climate) and farming system diversities will be set up in order to test a large range of cropping systems and technologies.

Kasi and Vang Vieng districts

For the districts where commercial agriculture is already well developed (Kasi and Vang Vieng) the first systems for 2007 will be based on the commercial crops already being grown

(corn, Job's tears) in association with multi-use species. It will then be necessary to develop alternative systems to increase diversity (crops and or integrated with livestock), enhance labour efficiency and reduce production costs.

Pek, Phoukhouth and Phaxay districts – the Plain of Jars ecosystem

These ecosystems of peneplains at altitude are regarded as uncultivable with traditional agricultural means: these vast areas currently yield small amounts of arable crops and livestock. Establishing annual cropping systems for this ecology will require a first stage of soil regeneration starting from the use of plants that can tolerate the acidity, current low fertility and dryness of the land.

6.3.3. Perennial crops

Fruit trees

The introduction of fruit trees has already been partly carried out by the Nam Ngum project. This should be continued with planting of a range of fruit trees at the training centres so that the adaptability of different species can be evaluated and so that there are nurseries for distributing seedlings to farmers. Before the start of this activity tests should be conducted on various local Xieng Khouang species (e.g. peach, apricot) and introduced species (from Vietnam by the Horticulture division of NAFRI at Haddokeo over the last few years).

Trees - perennial multi-usage species

With the forage species production units already established on the Plain of Jars, it can be noted that common management of the land is in full swing. The discontinuation of using fire in these areas has allowed native species to regenerate, so that trees can now be protected and integrated into these systems. This was previously impossible.

6.4. DIFFUSION OF INTEGRATED PRODUCTION SYSTEMS: ARABLE CROPS-LIVESTOCK-PERENNIAL CROPS

The main integrating element during the first season will be the introduction of forage species (e.g. *Brachiaria* sp., *S. guianensis*) which allow:

- Low-cost restoration of the physical, chemical and biological fertility of the soil;
- Cessation of fire-setting (protection of soils and watersheds), which allows development of reforestation schemes integrated with cropping and livestock systems;
- Land development, starting from use of forage species (concession and development of authorised investment: perennial crops, improved pastures etc.);
- Provision of simple systems that can be used by as many people as possible. The introduction of these systems will itself constitute a stage of SCV initiation and training for farmers and extension agents;

- Broad scope for diversification in the second phase through integration of annual and perennial cropping systems with direct seeding on these multi-use species;
- Land security and improved incomes;
- Production of forage seeds with a view to expansion of these systems.

6.4.1. Livestock systems – general principles

A major part of household incomes is derived, in all the production areas, from livestock breeding (large ruminants, pigs and poultry). It will be thus necessary, through the livestock units that will be set up in the training centres (fattening units for large ruminants and pigs, reproduction centres), to set up a programme that can help farmers develop these activities.

On top of these traditional systems and a baseline needs assessment, more intensive systems could be set up in line with the strategies and means of farmers (labour force, income, land resources, etc.). These systems will require substantial intensification and technical input. They will be integrated into family farming through:

- Transfer of fertility to fields;
- Development of arable production (fodder and grains);
- Development of by-products (e.g. rice bran);
- Work power (draught animals);
- Improved savings and assets (immediate sources of income);
- Diversification of diet (source of protein, calcium and vitamins).

6.4.2. Large ruminants

General context

The ‘raising of large ruminants’ component should receive as much emphasis as possible on account of the beneficial effects of fertility transfer, draught power and savings capacity. However, this will require intensification of fodder production, which will take time given the general strategy of conservative use of resources.

The financing of these new systems (rotational pasture and seasonally-controlled feed) could to some extent be initially covered by the sale of those cows and animals which will not be productive on improved pastures. To this end, analysis and advice should be carried out and given as fast as possible by DAFEO technicians in each district, in order to build a clear idea of the following:

- A detailed inventory of the cattle;
- Sanitation situation;
- Impact of herd reduction on family economies;
- Strategies for cattle farmers in their new conditions.

Objectives

Two main objectives have been defined:

- To develop activities vital to the regeneration of soil fertility (physical, chemical and biological), which is a prerequisite for the development of annual cropping systems;
- To intensify this component and develop local strategies to meet national and regional market demand, in order to generate regular income.

Procedure by production zone

This component will need developing according to the specific resources available in each production zone. These resources include credit from the Nam Ngum project or banking sector, the financial capacities of the farmers, and the morphopedologic characteristics of the zones.

Case study: the Plain of Jars ecology

On the Plain of Jars, the establishment of improved pastures and fattening units will require the completion of many steps, notably:

- Credit support to farmer groups and farmer investment to build fences with local materials;
- Use of specialised equipment for sowing (seeder for direct seeding with cultivator or tractor);
- Access to inputs, particularly fertiliser (thermophosphate and mineral fertilisers) and weedkillers;
- Purchase of seed production from farmers, essential for repayment of loans;
- Technical support provided for herd and pasture management (load per hectare, fertility management);
- Prevention of grazing on plots during the first year in order to ensure optimal establishment of forage crops and seed production.

The establishment of improved pastures (inputs, farming operations) will require credit support plus an initial contribution from the farmers. For the first year in-kind credit should be granted by the Nam Ngum project, pending the creation of credit schemes and management procedures. Loans should not be granted to finance the erection of metal fences, as these induce crippling costs and do not provide a fast return on investment.

If the various points presented above are all fulfilled it will be possible to ensure income for farmers from 2007 on, through the production of forage seeds. These will be repurchased by the projects or private operators to be planted from 2008.

Fattening units will be open from 2008 and will use the fodder grown on the newly-established pieces. Depending on the resources that become available , it should be possible to start development of these systems on 1.0 ha per family in 2007 in all three project districts (Pek, Phoukhouth and Phaxay) in Xieng Khouang, that is to say on 400-560 ha.

Various alternatives have been described based on use of seeding and pulverising equipment for reparation of the plots. Details of these options are given in the following table.

Table 2. Details of technical options for improved pastureland

Option	Seeder	Sprayer	Cost (US$/ha)
1	7 lines - Vence Tudo brand	300 l carried	45
2	2 lines for Fitarelli motocultivator	200 l drawn	30
3	1 line for motocultivator	20 l pulled	15

The maximum overall cost for planting a hectare of improved pasture is $340, including the cost of using specialised equipment for preparation and seeding, and assuming the farmer has agreed to some investment (Table 3, option 1).

Table 3. Funding plan for planting one hectare of improved pasture

Heading	With use of equipments		
	N°1	N°2	N°3
1- Farmers			
Fencing	60	60	60
Living fence	15	15	15
Sub total farmers	***75***	***75***	***75***
2- VDF			
Inputs	210	210	210
Sub total Credit	***210***	***210***	***210***
3- Grant of GoL			
Cultural operations	45	30	15
Reforestation	10	10	10
Sub total Grant	***55***	***40***	***25***
TOTAL (per ha)	**340**	**325**	**310**

Family labour to put up the fences ($60/ha) and plant trees ($15/ha) is included in this calculation and is regarded as an agreed investment on behalf of the farmers. Repayment of loans will from the first year be underwritten by the production and sale of forage seeds (*B ruziziensis*). The minimum yield of *B ruziziensis* will be 120 kg/ha in the first year.

General remarks

In the various areas, seed production contracts will have to be drawn up between the farmers, the Nam Ngum project and any private entrepreneurs who commit to purchasing the seeds at the rate of $1.5/kg. At village level, local institutions will need to approve procedures for setting up credit facilities and for engaging the community and farmers in reforestation operations. With national banking interest rates at 18% per annum, or 1.5% per month, it is recommended that a rate of 12% per annum be set; the 6% difference can be regarded as the GoL contribution to Payment for Environmental Services (PES). Based on a repayment schedule of nine months, the PES on a loan for the establishment of one hectare of improved pasture would be $9.45.

The total amount needed to set up these groups in Xieng Khouang and Vientiane provinces can be broken down as follows:

- Seasonal loans in kind, at a maximum of $149,100 (710 ha) for the two provinces

- Assumption of responsibility for farming operations by the Nam Ngum project as PES: $14,200 or $20/ha;
- Assumption of responsibility for reforestation (CBIF of the VDF) as PES: $7,100 or $10/ha.

The total PES contribution of the Lao government will be $39.45/ha.

6.4.3. Small livestock – pigs

General context

Semi-intensive breeding tends to be concentrated around the main district and provincial towns but in some districts local supply lags far behind market demand. For example, improved breeds of pig are regularly bought in Vientiane (in batches of 20) and sold at Xaysomboun market. General livestock conditions need improving (buildings, water supply, litter, etc) as a precondition to the technical support that will be offered.

Objective

The first objective is intensification of production and the creation of specialist groups of breeders and breeder-fatteners.

Procedure

It is suggested that two groups be set up in each province in 2007 (ten stockbreeders per group) and that credit be made available to provide:

- Four piglets per stockbreeder, supplied by the reproduction centres set up at training centre level;
- A hammer mill for each group plus other specific equipment (pipette for water supply);
- Vitamin and mineral supplements and drugs necessary for preventative health care.

An economic assessment will have to be carried out for all these fattening units. Such an assessment would provide evaluation and cross-checking of the technical and economic performance of this programme before it is expanded to a large scale.

The budget required for this activity for 2007 totals $12,000 for Xieng Khouang and Vientiane provinces.

6.4.4. Annual cropping systems

General principles

Irrespective of the production area, the first stage of setting up these systems must be based on protection of the soil and improvement of fertility in the broadest sense. The methods for establishing these systems can vary according to the initial situation. Three main situations that are representative of all the areas can be identified:

- The Plain of Jars ecosystem;

- Commercial agriculture with strong production potential in the karstic districts of Vang Vieng and Kasi, and in the 'fragile' district of Hin Heup (mudstone and shale);
- 'Mountain' agriculture where the traditional rotational slash-and-burn and fallow system prevails.

The following systems were designed with reference to the morphopedologic conditions and specific current dynamics of each area.

Ecology of the Plain of Jars

General context

This peneplain has considerable potential for growing rainfed rice and for livestock breeding in the three districts of Pek, Phaxay and Phoukhout. Many rice fields have been set up but the costs of creating and maintaining them are often very high, while at the same time poor water control and substrata with low fertility mean that yields are limited. Using a multi-purpose rice from existing genetic resources (a selection programme by Séguy, Bouzinac, Taillebois & Vales) and techniques of sowing on top of plant cover, it is now possible to develop rainfed rice growing systems that are just as productive as those used in the lowlands, but more economical in terms of water and labour use and are more diversified. It remains a major challenge to demonstrate that such rice production can evolve from the costly systems currently in use and take off in this vast area devoid of any grain crops (Séguy, 2004).

Objective

In addition to the establishment of forage species, which constitutes an essential stage in the regeneration of these plots, fields will be planted with multi-use species such as *E coracana* + *C. cajan* and *S. guianensis*. These species allow soil regeneration at low costs within an SCV dynamic. It is anticipated that these direct seeding systems can begin for rainfed rice crops in 2008, and conventional rice fields will not be used.

Procedure

This activity is planned for an area of 5 ha per village, to be financed by the Nam Ngum project in 2007 as PSE, at a total of $36,250 for Xieng Khouang and Vientiane provinces.

In 2008 farmers should benefit from technical support and credit in initiating these systems.

Commercial agriculture – Kasi, Vang Vieng and Hin Heup districts

General context

Simple first systems can be proposed based on the commercial crops present in these areas and the experience developed in southern Xayabury province by PRONAE and PASS.

Farmer groups should be set up with a minimum of six families per group. This method encourages exchanges between farmers and between groups and enables group farming operations.

Objective

To develop productive systems on diversified plant cover crops that also preserve soil resources.

Procedure

These groups will need access to credit to finance these crops ($80/ha) and the Nam Ngum project should provide access to inputs (seeds, pesticides, fertiliser) and arrange this with traders at the local level. Agricultural equipment - seeders and sprayers - will be made available to the farmer groups, which should be fully responsible for its management and use. This equipment therefore needs to be purchased and can then be rented to other farmers.

An iterative process should be retained with these groups, with a first stage based on modifying the method of field preparation, in particular with regard to dealing with the residues of the previous crop. Job's tears, common in Vang Vieng district, is an interesting crop for starting this type of system due to its high production of biomass above and within the ground. Judging from the experience in Xayabury, it is essential from the start to integrate these systems in rotation with legumes and other species that will strengthen production of biomass and limit weed growth.

In Hin Heup district, where the soils on mudstone and shale are more susceptible to erosion, systems with strong biomass production should be found to maximise the benefits of these crop rotations and cover plants from the beginning (soil protection, weed control, overall improvement of fertility).

Assuming six groups per district, the total credit required to conduct this type of activity amounts to $8,640 ($80/ha for 18 groups of six farmers).

Mountain agriculture

General context - principle of selective and conservational clearance for rainfed rice cultivation

In mountain fields the traditional system is based on slash-and-burn farming in rotation with forest fallows of varying duration. These environments are now under pressure from increasing population, from land allocation that is often restrictive, and from resultant stress caused by reduction in fallow times to levels that do not allow the renewal of natural fertility.

The proposals given hereafter refer to various components of the production system and are thus much broader than for a single annual crop system.

Objective

To stabilise and diversify the traditional slash-and-burn system and to gradually develop SCV with integrated annual and perennial crops and livestock.

Procedure

The first priority is to stabilise this system, diversify it and retain the productive potential of these environments. Thus any plot to be used for crops should be cleared according to the following procedure:

- Exploitation of valuable wood species;
- Clearance of vegetation while preserving the young trees of valuable species;
- Creation of contour hedgerows with material from the clearance (the largest pieces can be used either for fuelwood or fence posts to enclose the plots);
- Control of regrowth and weeds either through a controlled fire (after clearance and hedge-making with preservation of certain species) or by use of herbicide just before sowing of the crops;
- Application of mineral and organic fertilisers immediately after the simultaneous sowing of the crop species (rice and fodder);
- Progressive coppicing along the hedge-rows and fences using versatile species that can be used for feeding small animals or large ruminants.

The second issue concerns decreasing the fallow cycle while at the same time improving the fallow content by planting fallow species in crop fields (rainfed rice) at the end of the cycle (return to fallow). Short duration forest fallows, which are not very productive, can thus be replaced by species with direct value (for feeding large and small animals) and which also restore fertility in a very short time (three years) while providing optimal control of weeds. These improved fallows will be mainly composed of *Brachiaria* sp. and *S. guianensis*, which are sown in rainfed rice plots at the end of cycle (at the time of the last clearance) in order to ensure a return to cropping after two or three years. *S. guianensis* has the advantage of being controllable just by cutting, without the use of herbicides (organic system).

In view of the importance of the large ruminant breeding system (transfer of fertility, asset savings, draught power), the first activities should be focused on this component, which can be quickly improved by integrating the various points already described in the “Large Ruminants” section above. The communities in these areas often possess common pasturelands that can facilitate and help optimise this component.

SCV will be also proposed for the other annual crops found in these areas, especially maize and soya. It can also be used to enrich conventional cassava systems with *S. guianensis* in order to increase diversification and generate additional resources.

Perennial cropping systems

General context

Particular attention must be paid to the perennial crops being encouraged by agri-business in many districts of these two provinces, notably rubber, *Jatropha curcas* (for biofuel) and *mai khetsana* or agarwood (for essential oil).

Objective

This activity should focus on two main objectives:

- Preserving the production potential of the environment;
- Developing SCV to integrate these crops and promote diversity.

Procedure

Regarding rubber, various points should be borne in mind:

- Plot preparation must use soil conservation techniques without the mechanical preparation and/or creation of mini terraces observed in Hin Heup and Hom districts. This plantation method is very expensive and the results do not justify it;
- Certification of plants which are sold or made available to farmers;
- Diversification of this system in order to limit the length of the unproductive period (six to seven years) before the first tapping can occur;
- Protection of soil and reduction of weeding time while inter-planting lines of tropical forage legumes that can generate additional income through sale of seeds and use as pig feed. Growing forage seeds in these plantations will make it possible to pay off the establishment costs and generate additional income within the first five years, will add to the diffusion process (local and national), and will leave the soil intact so that if these plantations fail the land can be reconverted to annual cropping systems.

6.5. CREATING A SUPPORTING ENVIRONMENT FOR SUPPLY AND SALES NETWORKS (FOR INPUTS AND AGRICULTURAL MACHINERY)

This component is essential to ensuring effective development structured around existing supply and demand at the national and regional level. The Nam Ngum project should create a team that can initially ensure the supply of inputs and specialised equipment. It will later need to build relationships with the banking sector, private companies and rural communities in order to find an outlet for production and to transfer supply and collection activities to the private sector.

This team will work with the Nam Ngum project coordination unit at the provincial level and with PAFO and DAFO. It will be made up of DAFEO technicians and PRONAE contract employees. The team will also work with the farmer groups to design and organise credit procedures.

7. MONITORING & EVALUATION

The creation of a monitoring and evaluation unit is envisaged for each province, attached to the coordination-support unit. This team will be led by a PAFO agent who will work closely with the coordination-support team.

The objectives will be:

- Monitoring of the running of development and programme structures;
- Budget monitoring;
- Monitoring of the agro-socio-economic and environmental impacts of the proposed production systems;
- Development of monitoring and evaluation supports;
- Participation in the identification of specific studies;
- Recruitment of students to undertake complementary research;
- Submission of monitoring and evaluation reports and contribution to periodic management reports.

This should allow the PAFO services to:

- Set up real-time technical and financial management of the programmes;
- Supervise activities and check innovations;
- Capitalise on lessons learned;
- Communicate with all development partners: farmers, village organisations, technical development agents, project management, donors and the government.

From the beginning of activities in 2007, and in line with any adjustments that may be necessary, the Monitoring & Evaluation unit will provide indicators of results from the support documents in each district.

8. BUDGETS 2007-2010

The budget presented here, for a sum of US$7,570,000 over the period 2007-2010, was made in consideration of the technical objectives presented above. Of this sum, it should be specified that $6,230,000 has already been budgeted by the NNRBSDP for activities planned in the two provinces. Consequently, a supplementary budget of $1,340,000 is required over the period 2007-2010 in order to finance the accompanying technical support required for these programmes from NAFRI and PRONAE.

To complement this budgetary programming, a revolving fund worth an estimated $2,970,000 should be established within the framework of the VDF to promote credit operations.

This financial plan also presents the government's contribution to the PES (Payment for Environmental Services) scheme, worth $691,500.

It should be noted that from the total amount of $7,570,000, it will be necessary to subtract $535,000 at the end of the exercise, which will be repaid as the floating capital of the revolving fund.

The provisional 2007 budget is below.

thousand $US - Nam Ngum Xieng Khouang & Vientiane	2007	
	Actual	Additional Costs
1 Investments	**578 100,00**	**0,00**
2 Personnel	**41 280,00**	**337 060,00**
2,1 National technical assistance		
Technical assistance		48 060,00
DAFEO Staff	35 520,00	
Logistic, Tractor driver	5 760,00	
2,2 External technical assistance		289 000,00
3 Activities	**452 450,00**	***0,00***
4 Fonctionnement	**159 960,00**	***0,00***
TOTAL	**1 231 790,00**	**337 060,00**

It should be noted that a document on ordering the inputs required for the 2007 "Fast Track" campaign has already been provided (January 4, 2007) during the mission to assist with decision-making.

Budgets 2007-2010

Plan de Financement - Nam Ngum Xieng Khouang & Vientiane

thousand $US - Nam Ngum Xieng Khouang & Vientiane	2007	2008	2009	2010	Total 2007-2010	Actual	Additional Costs
1 Investments							
1,1 Vehicles 4*4	120000,00	0,00	0,00	0,00	120000,00		
1,2 Motorbikes	120600,00	0,00	0,00	0,00	120600,00		
1,3 Office materials	25000,00	0,00	0,00	0,00	25000,00		
1,4 Training materials	67500,00	0,00	0,00	0,00	67500,00		
1,5 Equipments (seeders, sprayers…)	125000,00	125000,00	0,00	0,00	250000,00		
1,6 Infrastructures (seed processing, pigsty...)	120000,00	0,00	0,00	0,00	120000,00		
Sous- total 1	***578 100,00***	***125 000,00***	***0,00***	***0,00***	***703 100,00***	***703 100,00***	***0,00***
2 Personnel							
2,1 National technical assistance	89 340,00	116 980,00	118 260,00	118 260,00	442 840,00		
Technical assistance	*48 060,00*	*56 820,00*	*56 820,00*	*56 820,00*	*218 520,00*		218 520,00
DAFEO Staff	*35 520,00*	*53 760,00*	*53 760,00*	*53 760,00*	*196 800,00*	196 800,00	
Logistic, Tractor driver	*5 760,00*	*6 400,00*	*7 680,00*	*7 680,00*	*27 520,00*	27 520,00	
2,2 External technical assistance	289 000,00	289 000,00	289 000,00	254 000,00	1 121 000,00		1 121 000,00
Technical assistance	*234 000,00*	*234 000,00*	*234 000,00*	*234 000,00*	*936 000,00*		
External missions	*55 000,00*	*55 000,00*	*55 000,00*	*20 000,00*	*185 000,00*		
Sous- total 2	***378 340,00***	***405 980,00***	***407 260,00***	***372 260,00***	***1 563 840,00***	***224 320,00***	***1 339 520,00***
3 Activities							
3,1 Monitoring, Evaluation and Coordination	7 000,00	7 000,00	7 000,00	7 000,00	28 000,00		
3,2 Demonstrations fields, Creation - Training and Diffusion	60 000,00	60 000,00	60 000,00	60 000,00	240 000,00		
3,3 Extension through VDF	195 100,00	591 250,00	1 122 000,00	1 062 000,00	2 970 350,00		
Livestock systems	161 100,00	501 000,00	973 000,00	838 000,00	2 473 100,00		
Annual cropping systems (SCV), maket gardening	0,00	36 250,00	125 000,00	200 000,00	361 250,00		
Nursery fruit crops and vegetables	24 000,00	24 000,00	24 000,00	24 000,00	96 000,00		
Processing and storage of products	10 000,00	30 000,00	0,00	0,00	40 000,00		
3,4 Grant GoL (reforestation and operating costs for sowing)	57 550,00	188 000,00	323 000,00	123 000,00	691 550,00		
3,5 Structuring environment (revolving funds)	127 800,00	378 000,00	20 000,00	10 000,00	535 800,00		
3,6 Communication capital	5 000,00	8 000,00	8 000,00	8 000,00	29 000,00		
Sous- total 3	***452 450,00***	***1 232 250,00***	***1 540 000,00***	***1 270 000,00***	***4 494 700,00***	***4 494 700,00***	***0,00***
4 Fonctionnement							
4,1 Vehicles	119 960,00	166 960,00	166 960,00	166 960,00	620 840,00		
4,2 Offices	40 000,00	48 000,00	48 000,00	48 000,00	184 000,00		
Sous- total 4	***159 960,00***	***214 960,00***	***214 960,00***	***214 960,00***	***804 840,00***	***804 840,00***	***0,00***
TOTAL	**1 568 850,00**	**1 978 190,00**	**2 162 220,00**	**1 857 220,00**	**7 566 480,00 #**	**6 226 960,00**	**1 339 520,00**
Village Developping Funds					**2 970 350,00**		
Paiment pour Services Environnementaux					**691 550,00**		

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