AN IMPACT ASSESSMENT OF FARMERS' ACCEPTABILITY 0F FARMING SYSTEMS RESEARCH ACTIVITIES IN NAMO DISTRICT, UDOMXAY PROVINCE, Lao PDR.

By

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ABSTRACT

Lao-Swedish Upland Agriculture and Forestry Research Program (LSUAFRP) was launched in the Namo District, Udomxay Province, Lao P.D.R. in 2002, which is continued until to date. This study was focused on the assessment of the impact of LSUAFRP on knowledge generation and adoption of recommended technologies, and to identify communication gaps in order to rectify them and also to apply such experience for the other non-project participating villages. The data collection was mainly base on key information survey and household field survey in the project and non-project areas.

The farming systems in the study area are diverse. Rice and vegetables in the lowlands and upland rice and perennial crops (rubber, fruits and agro-forestry) in the mountainous areas have been widely promoted. Higher cropping index and increasing households' gross income were evidence in the project villages compared to non-project villages. Mostly rice was combined with duck or fish in lowlands and perennial crops combined with maize or upland crops was introduced to uplands in the project supported areas. In the non-project areas, lowlands occupied by lowland rice, and uplands by either rubber or upland rice and some extents of maize. There was no difference in livestock types and systems between the two areas. There were many additional crops introduced (lychee, mango, pineapple, tangerine) and growing in the project area.

Most of the farmers in project participating villages had better understanding on recommended farming practices and activities compared to that in the non-project area. There were gaps in knowledge and technology dissemination in the non-project areas, and the farmers in the project area received farmer training, study tours and information. Some recommended technologies by the project with on-farm experiments were not adopted by participating farmers in project area, while some abandoned and old technologies are seen still being used in these farms indicating that farmers select suitable technologies that match with their needs and resources.

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ABBREVIATIONS

As well, do not use many technical terms in this research, some few following abbreviation were use in the thesis writing.

ALU	: Average Livestock Unit
DF	: Degree of freedom
FSA	: Farming Systems Analysis
FAO	: Food and Agriculture organization
FSP	: Farming Systems Perspective
FSR	: Farming Systems Research
FSR&D	: Farming Systems Research and Development
FSR/E	: Farming Systems Research and Extension
Lao. PDR.	: Lao Peoples' Democratic Republic
LSUAFRP	: Lao-Swedish Upland Agriculture and Forestry Research Program
LDCs	: Lest Developing Countries
MAF	: Ministry of Agriculture and Forestry
NAFRI	: National Agriculture and Forestry Research Institute
NFTPs	: Non-timber Forest Products
NGO	: Non Government Organization
NPEP	: National Poverty Eradication Program
R&D	: Research and Development
SD	: Standard Deviation
UNDP	: Unitated Nations Development Program
UXO	: Unexploded Ordnance
WAI	: Weight Average Index

CHAPTER 1
INTRODUCTION

1.1 General background

In developing countries farmers with limited resources often do not adopt advanced technologies because the conditions are not resembled to those countries where the technologies were developed, lack of capital to purchase the technologies and other limitations. The knowledge of such technologies is also scanty so that such technologies are not often applicable on their farms. In some situations development of new technologies leaves small farmers worse off than before and this happens when large farmers adopt new technologies and small farmers do not (Shaner *et al.*, 1982)

Agriculture is one of the most important economic sectors of the Lao PDR. It currently contributes 50.3% (2003) to gross domestic product (GDP) and 85.5% of the total labor force, reported by (Phoumi, 2005). Among the agricultural sub-sectors, rice production is the most important activity in the country. The more important roles are played by rice, maize, Job's tear (*Coix lacryma-jobi)*, cassava, mung bean, soybean and sweet potato in Lao PDR (Linkham *et al.*, 2004).

In 2003, rice area harvested was approximately 756,000 ha which 73% of the total cropped land area was. It has been reported that 620,000 households in Lao PDR depend on agriculture and that 79% of these households relies on subsistence farming. Farming systems throughout Lao PDR have immensely changed over the last 15 years due to numerous reasons. In some remote areas shifting cultivation systems have been changed towards more conventional high-input agricultural systems where market forces are prevalent,. In more remote areas, the traditional Swidden systems along with long cropping rotations have been adopted under pressure primarily due to modified land access and increased population pressure (Bounthong *et al.*, 2005)

In the northern region of the Lao PDR, only 6% of land area is with slopes of less than 20% compared to 50% areas with more than 30% slopes. The soil depth of these sloping lands is very low and often prone to erosion (Bounthong *et al*., 2005).

Cropping systems in upland and mountainous areas are highly diversified in comparison to lowland rice-based systems. Upland agriculture thrusts up on combinations of Swidden agriculture, livestock, wood and non-timber forest products and legal and illegal cash crops. In Lao ethnic minorities are predominantly living in remote areas and their livelihoods are predominantly coupled with highly diversified farming systems (NAFRI, 2004)**.**

The sustainability of hill and mountain farming systems has become an issue for serious global concern as increased population intensifies the pressures on land and forest resources to meet the daily needs of the people. This has also accelerated environmental problems such as soil erosion, landslides, and flooding (Shrestha, 1994).

The Lao-Swedish Upland Agricultural Farming Systems Research Program (LSUAFRP) was developed as a support for the *Government's Strategic Vision for the Agricultural Sector*. The Program has given priority on the uplands of the country and for which diverse farming systems have been developed and introduced to target farming

communities. People living in these project areas come from different ethnic groups and most of them practice crop/fallow systems of various types and lengths combined with a few years of cropping using mixtures of annual crops, which are dominated by upland rice and Job's tears. Many of them have a range of livestock, both large and small, and raised with free ranging and scavenging. A majority of people in these areas lives in periodic or severe poverty. The Farming Systems Research and Extension (FSR/E) approach originally arose out of the failure of conventional, reductionist /positivist science and technology oriented thinking to fully address the problems of complexity in risk-prone, diverse environments and in particular, to develop appropriate ways of combining indigenous knowledge and current and applied scientific methods to mitigate the prevalent problems faced by the farmers. Other factors which led to the change of the approach included the need to focus on poorer, subsistence-oriented farmers and to understand the mechanisms which drive and sustain their farming systems (David , 2002).

1.2 Statement of problem

Agricultural development has never been easy to implement. Its development is often constrained not only by the limited availability of funds and qualified human resources, but also by the suitability of land for agriculture. Most of the land surface (80%) in Lao P DR consists of hills and mountains. These lands are not so suitable for rice. Cultivating rice on these types of terrain not only result in high production costs, but also lead to severe soil degradation (Linkham and Bounthong, (2005).

Implementation of the on-farm research is frequently constrained by organizational and managerial factors, as well as a lack of adequately trained personnel. These constrains have always been common problems in large and heavily funded on-farm research projects and also cause to suffer from uncertainties in their long-term funding projects (Stoop, 1987).

A positive process of economic transformation and diversification of both livelihood and national economy is the key strategy to address poverty reduction. However, it is the agricultural growth that enables poor regions and poor countries, ultimately poor households to enter into the first step in this process (OECD, 2006). Outstanding agricultural technologies developed in research stations do not necessarily perform similarly under farmers' fields, where environmental conditions are highly variable and normally not within the control of farmers. In addition, the interplay of socio-cultural, economic, policy and institutional factors affect the actual performance and adoption of such technologies. Therefore instead of developing technology packages in research stations and transferring them through extensionists to farmers, current trend has been the development and fine-tuning of potential technology options in farmers' fields and with active participation of farmers, and this is in fact the essence of On-Farm Research programs (NAFRI, 2004).

The farming households have three types of inputs: land, labor, and capital. Management often involves optimum allocation the above inputs among activities or processes, that is, in both on-farm (i.e. crops, livestock, etc.) and off-farm enterprises. The farmers have to make critical decisions in allocating their inputs in producing one or more products. These decisions will involve the use of the farmers' knowledge to come as close as possible for fulfilling the goal(s) for which they are striving. However, these goal(s) may vary from farmer to farmer, but many of them target to increase their incomes, once t

realized enough food is produced for their families and other societal obligations are met. The resulting combinations of products (i.e., crops, livestock, and off-farm enterprises) are produced with their inputs as a result from the farming system adopted (Norman *et al.*, 1995).

1.3 Rational of study

The area-based development (focal area) approach, which is at the basis of the Government's rural development strategy, places a high priority on improving services, sustainable land use, and increasing incomes among the rural poor. Investment on rural development needs to be greatly intensified, especially in the poorest districts of Lao PDR (NGPES, 2000).

A national policy to stop all upland rice cultivation under slash and burn/shifting agriculture is in place with the understanding and it is understood that shifting agriculture will be abandoned by the time at which people receive better options. Research on improved land use systems and mobilization of an effective extension system are key components of the government's strategy for supporting upland farmers during the transition period of the project (Bounthong *et al.*, 2005). Yet hunger is still prevalent in many developing countries, especially in South Asia and Africa, and Lao PDR is of on exception. Smallholder farmers produce much of the developing world's food, yet they remain usually much poorer and less food secure than the rest in these countries. The challenge for developing countries is to identify specific agricultural and rural development needs and opportunities, and to focus investment in areas where the greatest impact on food insecurity and poverty will be achieved (John *et al.*, 2001).

Farming systems research in Lao PDR has received great emphasis and funding over last two decades. As a result, national programs have been encouraged to introduce an adaptive, mostly on-farm research component. The major objective of these efforts through which feedback information about farmers, conditions and needs can be channeled and new technologies can be tested and adapted, with emphasis of eventual transfer to farmers. Because of its holistic approach and its environment specificity, many different activities and approaches to Farming Systems Perspective (FSP) have involved. Many institutions have often limited their efforts to those components of the farming system in which they have special expertise (Stoop, 1987).

When extension in alternative farming was practically implemented, the great lack of information on these farming became apparent. Technical and economic information was badly needed. The objectives of the separate farming systems were then recapitulated as follows.

1. Current farming: Maximization of financial return by growing a limited number of high-value crops with the application of modern technology to produce high and stable crop yields.
2. Integrated farming : Farming adaptation for optimization of multiple goals such as (1) maintenance of farm income and employment, (2) protection of environment, landscape and vulnerable habitats, (3) improvement of well-being and health of consumers by providing high-quality food, and (4) prevention of pollution and contamination (Zadoks, 1989).

Most recent experiences in technology transfer in selected regions and research on environmentally friendly agricultural practices show that efficiency of production with external inputs can be improved and profits to farmers increased (John, 1993). On the other hand the goals of Integrated Farming System projects are to help farmers develop and adopt more-sustainable farming practices and systems, and and their communities to identify and overcome the barriers to sustainable agriculture (John, *et al.*, 1998).

It is argued by Julen, (1998) that the empirical evidence indicates that regenerative and low-input (but not necessary zero-input) agriculture can be highly productive. The effects are positive and sustainable, provided that farmers actively participate in all stages of technology development and extension. The evidence also suggests that agricultural and pastoral land productivity is as much a function of human capacity and ingenuity as both are govern by biological and physical processes.

1.4 Hypotheses

The following hypotheses were formulated to indentify and assess farming systems farmers' adaptability of the technologies and out comes of on-farm research activities in the project area in comparison to without project:

1. There is no difference among different farming systems between the project and non-project villages
2. The contribution of the farming systems with technologies towards farm productivity remains unchanged between project and non-project villages.
3. The extent of generation, translation and adoption by farmers in project and non-project villages remained unchanged.
4. There are knowledge translation gaps and constraints for agricultural production between project and non-project villages.

1.5 Research objectives:

The overall objective of the study was to assess the contribution of the farming systems project LSUAFRP in terms of acceptability generation of technology adoption and integrated farming systems research and its out comes by the farmers and its impact on the farm productivity in the project and non-project villages.

Specific objectives are as following:

1. To identify, characterize and compile the types of existing and introduced farming systems in the project supported and unsupported villages.
2. To compile the type of technology generation and their contribution to farm productivity in both project supported and unsupported areas.
3. To determine the degree of effectiveness of the farming systems project in terms of technology generation, and translation and also the adoption of such technologies by the farming communities.
4. To identify gaps in knowledge translation and existing constraints in order to develop appropriate measures to enhance the overall farm productivities with farming systems research project and to come up with further study needs and recommendations.

1.6 Scope of Study and Constraints

This study was designed to address and develop an appropriate approach for farmers' adoptability of introduced technologies in farming systems activities in the project supported villages and information in applied to promote to other villages. The FSR project was implemented with three major categories of the research activities (a) crop-animal systems; (b) integrated annual crop-based systems; and (c) integrated perennial crop-based systems, for improving the farm productivity, household income and sustainability of the production systems in Namo District, Udoxay province of Lao PDR. Therefore this study was targeted to highlight the current status, benefits and short comings for assisting both the project and government to facilitate under lying objectives. As constraints, there were difficulties in communication with different ethnic groups when responding to the questionnaire based interviews for collection of information. Therefore additional information had to be collected, and there was no access to digital communication systems to recapture of missing data.

CHAPTER 2
LITERATURE REVIEW

2.1 Definition and Objective of Farming Systems Research

A farming systems is the result of a complex interaction among interdependent components of environment, socio-economic and policy. To achieve it, an individual farmer allocates certain quantities and qualities of the four factors of production-land, labor, capital and management- to which he had access, three processes – crop, livestock, and off-farm enterprises- in a manner which, within the knowledge he possesses, will maximize the attainment of the goals he is striving for (Norman, 1978).

Farming Systems Research is a method that truly focuses on farmers' circumstances and that seeks to integrate farmers into the farming level research process. Of particular relevance are the perceptions and expectations of smallholder farmers and the constraints encountered by them daily. Essentially, FSR adopts a farmer-centered and problem solving approach to agricultural research through appreciation of these production systems of farmers, their farm-household interactions, and their environmental variables – ecological, biological, socio-cultural, economic and political – which influence farmers' decision making. FSR recognizes the fact that it is dynamic and involves not merely the interaction of physical forces, but also expressions of free ideas arising from the purposiveness of farmers' behavior (Dillon and Hardaker, 1993).

A Farming Systems in a developing country is a unique and reasonably stable arrangement of farming enterprises which are managed by household according to well-defined practices in response to its physical, biological, economic and socio-cultural environments and in accordance with the household's goals, preferences and resources (Shaner *et al.,* 1982).

Farming Systems Research comprises a study of the agricultural systems of groups of farmers, and of the various factors-socioeconomic as well as technical that influence farmers' decisions (ICRSAT, 1986).

Within the past ten years an approach to agricultural research and development of technology aimed at helping farmers with limited resources in the lest developing countries (LDCs) has gained considerable attention and support. This approach, called Farming Systems Research and Development (FSR & D), brings various disciplines to bear on farmers' problems in a systematic way by identifying problems and conducting research on the farmers' fields in collaboration with farmers. While many of these characteristics are present in other approaches to agricultural research in the LDCs, the combination and systematization on procedures sets FSR & D apart from the orther (Wilson and *et al*., 1986).

Enhancing the growth of small farms and achieving a more equitable distribution of income among farmers are paramount objectives of Farming Systems Research. Farming Systems Research is an interdisciplinary and farmer oriented with a system approach to research problems (Lighfoot and Backer, 1988).

The interested objective of Farming Systems Research is to develop research programs that are cost-effective in generating technologies appropriate to increasing the

productivity of the Farming Systems within the context of specific microenvironments. What makes technology appropriate is that it must complement the production and consumption objectives of farm households (Davidson, 1987).

2.2 Justification and Necessity of Farming Systems Research

It is indicated that smallholder farming systems have evolved over many centuries. Their technological and socio-economic features have come as a part of the indigenous knowledge (FAO, 2000).

An important aspect in the initiation of Integrated Farming Systems was the identification of characteristics of farming systems that diverse array of stakeholders would find desirable and could use as part of their common vision, such as resource efficiency, productivity, profitability, protection of the environment and of personal health, support for rural communities, and increased economic opportunities (John, *et al.*, 1998).

Farming systems analysis (FSA) is the initial and crucial stage of FSR &D and comprises the above step (i) and partly (ii). FSA is the understanding of the structures and functions of farming systems, the analysis of constraints on agricultural production at farm level and ways to translate this understanding into adaptive research programs (Stroosnijder and Van rheenen, 1991).

Multiple cropping is a salient feature of agriculture in many parts of the tropics. By growing more than one crop in a field in a year, farmers can gain a number of benefits, including better utilization of limited resources and reduction in the risk of low yields (Caldwell and Hansen, 1991).

Base on NAFRI, (2002) study findings, highland rice is clearly and important livelihood assets for farmers. In natural flat lands and valley bottoms there is a little investment requirement for converting to paddy, and hence there have been intensive cultivation in many Asian highlands with high population density. In northern Laos, the large flat lands have already been developed into rice tracts, which have been assisted largely by government and aid projects. Much of the remaining area where paddy can be developed is limited to relatively small areas. Under the current conditions, farmers have already developed additional paddy lands by constructing terraces. The data indicated that the development of paddy lands is increasing in the highlands of the Lao PDR.

Graef *et al.* (2006). Found that crop rotations help control pests, diseases and weeds, and thus can reduce pesticide use. If well planned, they help minimise the overall cropping risk and enhance whole-farm crop yields.

It has been found, for example, that pigeon pea has shown promise for rotational cropping with rice (NAFRI, 2005) as pigeon pea is not a host for nematodes and, if planted properly, can limit the growth of other weeds which may be alternative hosts. In addition, stylo and rice bean have are also being examined as potential crops to rotate with upland rice (NAFRI, 2005).

The cost production analysis of two crop establishment methods was indicated that ploughing, production costs ranged from US$ 40 to $150 per ha depending on the slope, distance from the main road, and amount of stones and/or stumps in the field. In

comparison, the cost of land preparation with DMC systems is about $30 per ha. Production costs can therefore be reduced by 30%-100%, representing a gain of $35-$100 per ha (CIRAD, 2005).

2.3 On-Farm Trial

Some reasons for On-Farm Experiment mentioned by Ann and Roger (1999):

1. To rigorously test technology developed on-station or elsewhere under a more representative range of environmental and human conditions
2. To understand new technical relationships relevant to client' conditions, for example interactions between crop varieties and low soil fertility
3. To enhance farmers to evaluate technology under their conditions using their criteria, including social-economic factors
4. To identify new researchable problems perceived by farmers, to understand their compromises on technical optimal management and to use these in refining other diagnostic information
5. To seek and apply farmers' knowledge in all stages of the research process
6. To improve farmers' capacities for experimenting.

On-farm research with a farming systems perspective which is complementary to on-station research and should be directly link to it. This type of research assumes that products are increased more likely to be achieved by stepwise changes in the components of the farming systems than a revolutionary in the entire system (Stoop, 1987).

It was suggested, the principal playoffs from on-farm research are likely to come through strengthened institutional capacity to diagnose and solve key problems within existing farming systems, rather than attempts to change whole systems (Horton, 1986).

It was commended, establishing pasture ob rice bunds will helps farmers to overcome the cattle feeding problem. This will benefit especially the small scale crop-livestock farmer who is unable to allocate land for forage production commends (ICRA, 1990).

The field experiment in China, for example found, that the traditional paddy field layout has no trench or pond in the rice field and the water storage capacity is limited. Fish growth is more directly affected rice crop management, and the result is a low and unstable yield. The trench-pit is an improved design with a small, shallow pit (1-2 m^2) in the center of field. Crossing trenches are dug to connect the pit all side trench. Increased water storage capacity offers a better refuge for the fish, this design raise rice yield by 10 percent and 1-2 times as many fish can be raised as compare with the traditional design. The trench-pond design is a further improvement with a larger, deeper pond at one end of the field. Crossing trenches are also dug to connect the pond to all sides. This design significantly increases the water storage capacity and provides a better environment for fish. It raises and stabilizes the yield of both rice and fish (FAO, 2001).

2.4 Monitoring and Evaluation Concepts of Farming Systems Research

Effectiveness of the technology determines its acceptance. A farmer will adopt a technology if it is likely to increase the farms income within its labor and capital constrains (Lai; 1987).

When considering systems analysis for agricultural development, we should relies that soil is only one part of the overall system. Climate, crop, hydrology and pests and diseases are important components of the complete agricultural system whish need to be modeled as well (Bouma *et al.*, 1991).

Within FSR itself, process and scope have evolved dramatically. In the early days on-farm research developed as an adaptive research step, modifying technologies developed on the local research station, to make them more compatible with the circumstances of local farmers. There remains a need to clarify the scope of FSR and the implication of the different applications in order to maintain interest, commitment and momentum. FSR focused on interdependencies and interrelationships between technical and human elements. It borrowed theory from rural development, farm management economics, systems thinking and agronomist on-farm trials. It blended economist perceptions with agronomic concerns to identify small-farmers unique qualities and build on thee by working with them, not only in identifying research priorities, but also in developing potential solutions to their problems. On-farm experimentation becomes an important initiative to generate technologies useful to small farmers in an efficient manner and as a complement to on-station research (Collinson, 1999).

The findings of agricultural research conducted in laboratories that have potential economic significance are not fully appreciated by farmers unless they are demonstrated on-farm. Farmers usually do not easily adapt these research findings into their farming systems – not because they are unaware of the information, but rather because they are skeptical (Arboleda, 1987).

Various impact indicators are measured: socioeconomic, environmental, and institutional. At the farmers' level, we examine changes in productivity and welfare (income, health, nutrition and food security). New technologies invariably affect (for better or worse) the natural resource base; we address the issue of agricultural sustainability, including the effects of new technologies on soil fertility, soil structure, and water quality (Bantilan, 1994).

2.5 General Issues of Farming Systems Research

According to FAO, (2001) study mentioned that the analysis of farming systems and their future development within a framework that is broadly comparable between systems and across different regions, the above key biophysical and socio-economic determinants have been grouped together into five categories:

1. natural resources and climate;
2. science and technology;
3. trade liberalization and market development;
4. policies, institutions and public goods; and
5. Information and human capital.

In the opinion of a range of experts, these categories represent the major areas in which farming system characteristics, performance and evolution are likely to be significantly affected over the next thirty years.

The majority of farmer in Africa and Asia are smallholders, how lack the education and resources to use the benefits of modern agricultural technology. Therefore, research priority must be given to the production constrains of smallholder farmer. Humid tropical regions are at present characterized by nutrient-deficient soil and lack of essential inputs, credit facilities, and access to commercial market (Lal *et al.*, 1987).

Linkages between different research sections and between research and its various clients are vital efficient technology development and technology transfer processes. An adequate understanding diverse technical, biological, and socioeconomic conditions of major groups of farmers can often be clamed for unrealistic assumptions about the needs and scope for improved technologies and subsequently for poorly conceived research programs. Consequently, most NARS will have two conflicting requirements: a) for decentralized on-farm activities to serve diverse production environments; and b) for concentrating the scares human and financial resources. Implementation of on-farm component is, however, frequently constrained by organizational and managerial factors, as well as a lack of adequately trained personnel. Obviously the successful organization of on-farm research depends most critically on the ability of a sizeable and competent staff (Stoop, 1987).

It was found that for the most part, farmers in Namo and Phonexay districts access information on rubber through informal exchange with other villages and through their relatives as there are little information available through DAFEO and other local agencies. Farmers and others also claim that they began to take interest and learn ways to produce rubber seedlings from their relatives in Luang Namtha Province and also from Nambak district (Luang Prabang Province). Some of these relatives (particularly Hmong) had gained experience working on the State Farms in China (NAFRI, 2007). In the same situation, there are no formal systems that provide market information to the stakeholders in Oudomxay province. Market policies in Oudomxay Province do not seem to discourage competition among traders. In order to benefit from the advantages the free market should be accessible to complete market information. This study indicates, however, that farmers in LSUAFRP villages generally lack such information. Some farmers get information from the District Commerce Office (DCO) about prices. Information of the total buying capacity of the traders is lacking (NFRI, 2006).

2.6 Nature of New Technology

The case for newness is better when genes or machines foreign to the farm are embodied in the changed technology. We find it instructive to categorize new technologies in three ways: notional (quarter-baked), preliminary (half-baked), and developed (full-baked). Technological change in the agriculture of developing countries has tended to have little effect on small farmers. The problem at hand is how to design new technology that will have a high probability of acceptance and utilization on small farmers. For the design of this technology, research administrators and physical scientists need some guidelines and specific suggestions its potential components (John and Antonio, 1979).

Contrary to popular belief, many new technologies are not neutral to scale; different group of farmers often require different technologies. For example, event farms of the same size may differ significantly in “effective” size because of differences in soil quality, water availability, etc. Specific technologies are important particularly for small and marginal farmers who lack crucial resources and are risk averters, and therefore do

not easily adopt new technology. Adoption lags among such groups may be as long as 8-10 years (Singh and Bantilan, 1994).

2.7 Indigenous Technologies

Local communities have their indigenous technologies of food production, processing, management, etc. There are also technologies related to other off-farm production oriented activities. Innovation of indigenous knowledge system must be encouraged, so those individuals can find new opportunities to mitigate the unfavorable changes. Adoption and appropriate adjustments of indigenous technologies can help in keeping a farming system socio-economically sustainable. Upland farming system can thus benefit from ethnobotany (Alam, 2002).

2.8 Contribution of Modern Technology to Productivity and Family Income

Ruth (1985) found that, for example, to increase productivity trough the introduction modern technology for traditional crops and introduce new agricultural products, using all available and appropriate inputs and technology. In similar, Gupta (1985) stated that, the rise in agricultural production in the state can be attributed to reclamation of land, expansion of irrigation facilities and intensive cultivation along with an increase in the used of chemical fertilizers, improve seeds, modern technology and , above all, the hardworking nature of the peasantry.

Technological changes have usually several direct and indirect effects on farms which are regarded as systems where several activities interact closely and sometimes complete for limited resources. These interactions are particularly pronounced under smallholder conditions where crop and animal production activities are combined. The relationships within Farming Systems, as well as the relation with the environment, are in most cases expressed in economic terms, because farms are regarded as economic units. It is evident, that an understanding of how a system works and what factors influence production should guide actual research efforts (Jahnke *et al.*, 1986).

2.9 Integration of Technology Testing and Transfer

'Technology transfer' is a broad concept which includes the efficient transfer of agricultural innovations to the farmer and the provision of prerequisites needed to make adoption possible. Adoption of a new technology must be preceded by technology diffusion, e.g. the act of making new technology know to the potential adopters. Diffusion is therefore the link between R & D and adoption. Effective diffusion is an essential but not sufficient condition for adoption. The farmers of a given "target category" must nit only be made aware of an available technology, they must also be convinced that adoption is in their best interests and above all they must be able to adopt the proposed technology. Many of the factors that limited the ability of subsistence farmers to adopt improved technologies also affect rural women, only more so (Arnon, 1989).

Additionally, FAO (1994) indicated that technology transfer approaches vary according to technology packages and target groups. Recognizing the gaps in technology transfer under certain systems, re-evaluation of the technology transfer needs and approach would help bring the extension methodologies into practice of the producers. Under complex

and variable settings of rainfed agriculture, straight-jacket approaches would be rather unsuccessful, and thus recommending that farming systems and participatory approaches should be followed under such settings.

Most government agricultural institutions are concerned with achieving greater integration of technology generation and transfer. The NGO, equipped and mandated to undertake both, in the absence of viable government agencies, are unequally positioned to achieve this integration. With close contacts with the rural households, bottleneck identification, in situ technology testing/adaptation and final transfer all can be accomplished by the same team (James *et al.*, 1998).

The area of technology transfer in agriculture is a delicate one especially when we think of million of farmers in developing countries who have little education in the formal sense, but depend largely on agricultural extension services for receiving advice on agricultural technology (Kalim, 1999).

A study of the effectiveness of this model showed that research results were adapted by only a specific minority of farmers and that for the majority; it was not a viable strategy for agricultural development (David and Ruymond, 2000).

The promotion of technology in farming community is only a means to achieve the objective which is the development of human resources. One should concentrate on the development of people in farming and those who are working in farming community so that they can be effectively involved and participate in the development process (Asian Productivity Organization, 1994).

It was reported that in Namo, rubber area has increased rapidly since its inception. Due to its location close to the Chinese border and to Luang Namtha, farmers are becoming more engaged in rubber and cash crop production. According to the latest figures, there are approximately 630 ha of rubber planted in more than 13 villages of the district of which two thirds were planted in 2006. This is an increase from seven villages in 2004 totaling less than 100 ha. The rapid expansion of rubber in 2006 was partly prompted by a Chinese company (Ying Jiu Pa Company Ltd.) which was officially approved in 2006 to promote contract farming with local villagers in the district (NAFRI, 2007).

As for example, organization of farmers through groups is crucial for the adaptation and adoption of Direct-Seeding Mulch-Based Cropping Systems (DMC) systems, which modify mostly conventional agriculture. Farmers groups were organized for a total of 42 families in southern Xayabury (six villages) for the purpose of validating technical options aimed at decreasing production cost and labor, and limiting rainfed area erosion. DMC systems are implemented for cash crops such as maize, Job's tears and rice-bean. A few modifications to cropping systems is proposed to smallholders in order to set-up, adapt and validate each step using current crops and cultivars. DMC systems for crop residues can exhibit very good results in terms of net income, yield and labor productivity (CIRAD, 2005).

2.10 Testing the Technologies

To try and ensure acceptability, representative farmers must be include not only in the initial design but also in testing activities. Farmer groups--both research –and extension-

oriented – can be used to implement testing of technologies by farmers on their own. The options of these farmers need to be carefully considered, and, if necessary, the technology should be modified before it goes to the dissemination phase.

Table 2.1 Relationship between types of required technology and land/labour ratios

Land/labour ratio	Technolgy required	Productivity of	
		Land	Labour
High	Labor saving	I+ or I-	D+
Low	Yield increasing	D+	I+ or I-
D = Direct impact + = Positive impact		I = Indirect impact - = Negative impact	

(Source: Norman, 1995).

2.11 Applying farming systems concepts to technology development

The opposing school, which contains a much broader spectrum of disciplines including many from the social sciences, is more concerned with the application of the technology to meet a range of development objectives. It is more aware of social and political factors and believes that development is for people and by people; the important of farmers' knowledge and experience is stressed, together with the need for technology to "fit" a particular farming system (FAO, 1992).

Effective technology development and transfer depends on an interactive, holistic system. The system includes: a research subsystem; a dissemination subsystem; a user subsystem. The system must perform six basic functions in other to ensure the initiation and continuation of the information flow process: (a) identification of problems at the producer level; (b) generation of information; (c) validation under farms' conditions; (d) dissemination; (e) utilization; and (f) evaluation (Arnon, 1989).

2.12 Farmer knowledge generation

The knowledge is generated and transferred through a systematic process of observing local conditions, experimental solutions, and readapting previously identified solutions to modified environment, socioeconomic and technological situations. Now it is also recognized that indigenous knowledge can research and development cost significantly (Alam, 2002).

Knowledge on agricultural practices, their attitudes and behavioral pattern, infrastructural facilities, natural of the land ownership, irrigation methods, financial and credit facilities, economic conditions of farmers and the degree of use of new technology are the major factors varied from farmer to farmer. Among these, technology and extension services are the most prominent determinants of the productivity. In a Kanyan study, results elucidate that the technological innovations with close research-extension-farmer linkages, timely availability of credit to purchase inputs, sound mechanisms for loan recovery, guaranteed output market, etc provide success stories (Jayamanne *et al.*, 2002).

Since the contact point between the extension system and the farmer is the village extension worker (VEW), it is essential that the VEW, as a first-hand information source, be "better" than other second-hand or non-personal source of the information (Gershon *at*

al., 1986). And also the need for FSR and Training and Visit to be more complementary is increasingly recognized and reflected in the relatively recent interest in Farming Systems Research and Extension and in research and extension linkages (Dorward, 1986).

It was stated that FSR without extension is an incomplete process. Information transfers from farmers to researchers through studies of representative farmers and farmer participation in the technology generation process, but technology does not move from researchers to farmers very well unless there is a method for educating farmers. Including extension completes the circular process of FSR by moving information from research and farmers that have participated in technology development, to other farmers in the population originally sub-sampled at the beginning of the FSR process (Malcolm *et al.*, 1986).

2.13 Livelihood Strategies

Most of the rural people in remote areas practice a multi-livelihood strategy. This typically involves a mixture of direct subsistence and income-earning activities. To real with multiple situation and economic uncertainties, most rural households engaged in a wide variety of on-farm and off-farm activities, combining hunting and gathering with agriculture, animal husbandry and forest products for living (UNDP, 2001). The primary elements are farming systems and depended on non-timber forest products (NFTPs).

Farming system	Farming system in Lao PDR characteristic	Livelihood problems
Lowland Lowland rained farming system	Single cropping of traditional glutinous paddy rice varieties (80%), 2-4 varieties of different buffaloes and cattle for draft, cash income and meat, free ranging during the dry season, confined in the rainy season. Pigs, poultry, fish and NTFPs importance for food and cash income	Rice shortages of 1-4 months and low household income.
Lowland irrigated farming system	Agriculture productivities in wet season yields 1-3 tons, dry season 2-4 tones/ha. Dry season vegetables grown in areas near their house along diver for home consumption. Dry season livestock freely grazing land, buffalo use to plough small livestock for meat and cash income.	Better off than un-irrigated farms, but lack cash, especially for investment.
Upland farming system	Shifting cultivation of rice, chilies, taro, sesame, etc. on sloping land with fallow periods of 2-10 years. Other crops such as sweet potato, ginger, cassava, groundnut, soybean, cotton and sugarcane, papaya, coconut, mango, tamarind, banana, and citrus. Pigs, cattle and poultry are the basic livestock. High dependence on NTFPs for income to	Rice shortage of 3-4 months, low income, poor health, lack of access to roads, communication, education & social services.

	purchase rice, etc. Adoption of paddy cultivation is progressing rapidly where possible.	
Highland farming system	Similar to upland farming activities, but with high-altitude crops. Sometimes intercropped with lettuce and mustard, and temperate fruit trees, such as plum, peach and local apple.	As above.
Plateau farming system	Tree plantations have largely replaced shifting cultivation, supplemented by fruit trees and timber-commercial tree	villagers have adopted and learning from Experian

(Sources: UNDP, 2001).

Food and Agriculture Organization (1998). found that only 50% has access to lower secondary education whereas tertiary training is inadequate because of poor information technology and accountancy. The main cause for low enrollment and even lower completion rate is poverty and deficiency especially for those persons living in rural areas.

2.14 National policy for Upland agriculture

A national policy to stop all upland rice cultivation under slash and burn/shifting agriculture is in place and it is understood that shifting agriculture will be abandoned when people get better options. Research to develop land use systems and mobilization of an effective extension system are key components of the government's strategy for supporting upland farmers during the transition period.

Regional and national agricultural development priorities in Lao PDR are shown below -
• Land use zoning;
• Participatory land allocation;
• Community based natural resource management;
• Farming systems diversification;
• Expansion of small-scale irrigation systems;
• Sustainable land use management;
• Rural savings mobilization;
• Competitive rural finance systems;
• Strengthening the legal capacity of state-owned commercial banks; and
• Improving communities' access to markets.

National priorities
• Food production;
• Stabilization and reduction of shifting cultivation;
• Commercial production;
• Infrastructure development;
• improved socio-economic management and foreign economic relations;
• Rural development;
• Human resources development; and
• Services development.
(Bounthong *et al.*, 2005).

CHAPTER 3
METHODOLOGY

3.1 Research Design

This study was aimed at understanding the impact of farmers' acceptance and adoption on recommended technologies of the farming system research project in Namo District, Odomxay Province. Therefore, with project situation was compared with without project areas during the same research period to indentify the changes of agricultural systems and their productivity and contribution to farmer incomes and sustainability of agriculture due to the LSUAFRP.

3.2 Selection of the Study Area

The LSUAFRP operates in two of the ten prioritized poorest districts classified under the National Poverty Eradication Program in Lao PDR (NPEP, 2003). These are Phonxai District in Luang Prabang Province and Namo District in Oudomxay Province, and both are located in Northern Laos where 45% of the poorest people of the country inhabits.

In Namo District, there are five villages currently being served, i.e. Namo Neua, Saysamphan, Mixay, Pangdou and Pangthong. The project has proposed to expand the research activities to neighboring villages in the District. It is therefore necessary to assess the benefits and constraints of the project and lessons learned so that important decisions on modes of operations, rate of dissemination of technologies, extra-participatory needs could be determined. Therefore, the study of this research was conducted in these two project supported villages and two villages where project support was not given. The two project in supported villages were selected in the vicinity of the project area that were included in the plan of the project to extend farming systems research activities in the future.

3.3 Location and Characteristic of the Study Area

Namo District is located in the Northwest part of Oudomxay Province and about 60 kilometers from the provincial capital. This district is accessible to main linking road running to Luangnatha Province and two bordering sites passing point to China. The area is characterized by moderate to rugged mountain slopes and small valley bottoms. The lowland rice cultivation is possible in the latter. Vegetable gardening and annual cropping are usually practiced along stream banks and riverbeds. The steep slopes are generally subjected to shifting cultivation which has led to receding forest cover, increasing soil erosion and declining soil fertility. The soils consist of heavy clay to clay loam of medium to high fertility.

3.4 Survey design farmers selection and collection techniques

It was required to gather a wide range of data to determine and characterize the productivity and contribution, effectiveness, generation and adoption technology knowledge gaps and constraints of the farming systems research activities. Both primary and secondary information were collected to fulfill the objectives given. However, the information of the study was mainly based on primary data and some secondary data.

Figure 3.1 Map of location of the project area

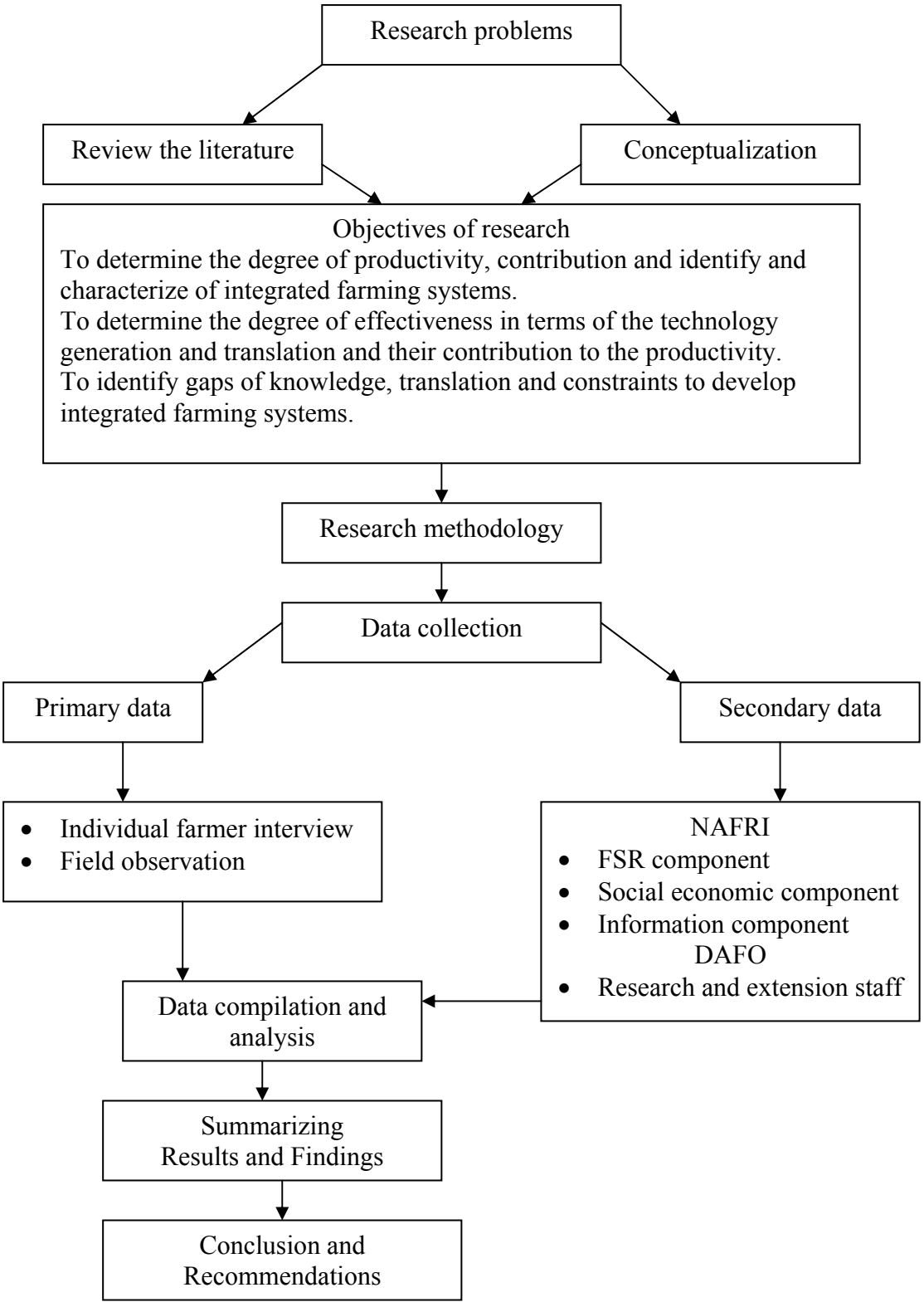

Figure 3.2 Conceptual framework of research

3.8 Time Period of the Study

The data collection was carried out during April to June 2007.The study was during May, 2002 to April 2006 which covered four years of the on-farm research implementation .

3.7 Sampling selection

A list of households was obtained from each village selected for the study (Table 3.1) and the required households were selected using a random procedure. The total number of respondents of the sample was determined to be 50 % of the total of farming systems research participating farmers in both villages.

Table 3.1 Distribution of the respondents in the two study areas

Mane of village	Status of village	Number of respondent
Namo Neua	Project supported	23
Nakham	Non- Project supported	23
Pangthong	Project supported	16
Kiewlan	Non- Project supported	16
Total		78

(Source: Field study, 2007)

3.5 Secondary data

The secondary information collection was emphasized for involved subcomponents of the LSUAFSRP, i.e. farming systems research component, socio-economic research component and information service component in the NAFRI, provincial extension workers and village council in the study areas. These data were gathered from case study documents and previous annual research reports and also by discussions with senior officers and farmers. Therefore, the information collection from project supported farmers was much more intensive than those in the non-project villages. There was more information available with project supported farmers than those in the unsupported villages. In non-project villages, the information was mainly gathered from farmer groups, village leaders and district extensional officers.

3.6 Primary data

The sample of the farmers for primary data collection from both with project supported and non-project supported areas was identified on a random basic from the total households of each village.

The primary data were collected by interviewing the farmers in the project supported villages and also in the project unsupported villages. In each household, decision maker was interviewed for information. The primary data were divided into three types. First, general household information of overall social conditions such as family size and composition, age group distribution, level of education of the farmer and land holding size used for agricultural production were gathered. Second, the information of existing farming practices, crop grown and productivity, agricultural diversification, f technology use, farmers' adoption of the recommended technologies with and without farming systems research project approach were collected. The translation of knowledge and its

gaps and constraints, sources of related information for farm production activities, awareness to farm practices and accessibility of training and study tours for the farmers were gathered in the third part. The questionnaire was pre-tested with 10 non-participating farmers close to the projected area prior to actual data collection and some questionnaires that were not appropriate were modified according to the deferent ethnic minority groups of the study areas. The structure of the questionnaire was also modified with the information received from local agricultural officers. To identify technology generation and knowledge translation to farmers from research activities group discussions were made. Information on technology support and transfer from research to farmers was collected from district level researchers and extension officers. The direct observations in the field level and group discussions and key information survey were carried out to gather additional information.

The cropping index was calculated from four cropping patterns which were the most common farm practices in the project supported and non-supported villages exited.

Gross income in each household in both project supported and non-project villages was computed taking into account the income and other opportunities available for generating income per year. In this calculation, total production in the villages obtained during the survey were multiplied by the price of each commodity ad added over, which eventually gave the overall gross income for two project supported and non-supported villages.

Furthermore, overall activities available to the households were examined and lists were prepared.

3.9 Data Analysis: Tools and Techniques

The data comprised of both primary and secondary data, and were given appropriate coding. Both descriptive and quantitative analysis were adapted this data. The quantitative data were processed using simple statistical analysis, such as frequencies and percentages and results were presented in tables, graphs and figures. T-test was used to compare farming systems, their productivity and tangible benefits. Technology generation and knowledge translation gaps of two category farmers were also compared using Chi-square test. The productivity was compared using t-Test. The descriptive information was used to compare production systems and to illustrate characteristics of farming system practices. Quantitative analysis was used for determining productivity, adoption of technology and knowledge generation.

Weighted Average Index (WAI) was used for analyzing the perception of the farmers' in participating in research approaches adopted by Miah (1993). The values were calculated based on frequency of responses, which are divided into three scales namely agree, disagree and neutral. The response values were scored in 1.0, 0.0 and 0.5 for agree, disagree and neutral, respectively.

$$WAI = \sum Fi\ Wi / \sum Fi$$

Where: WAI = Weighted Average Index
Wi = Weighted Value at i^{th} group
Fi = Frequency of i^{th} group

agree	Neutral	Disagree
1.0	0.0	0.5

$$WAI = [f_a (1.0) + f_b (0.0) + f_c (0.5)]/N$$

Where: WAI = Weighted Average Index
f_a = Frequency of agree
f_b = Frequency of neutral
f_c = Frequency of disagree
N = Total Number of respondents

CHAOTER 4
RESULTS and DISCUSSION

This chapter explains the household composition, age distribution, sex ratio, education, occupation, land size holding, market accessibility, soil characteristic and climate in the study area, cropping and farming systems and productivity, technology introduction, dissemination and adoption as well as constraints faced by farmers in the project supported and unsupported villages.

4.1 Demographic characteristics of the selected households

4.1.1 Household composition

Douangsavanh (2006) classified household composition for poverty status in three categories as poor, middle and well-off household. The classification of these categories was based on the number of members in the household (i.e labor availability for farm activities), land holding size available for agriculture especially for food production and also inherited from their parents, small trading and the number of new immigrant households in the village. Well-off households are always secured with food and other needs through out the year and possess larger fertile paddy fields compared to other two other categories. Further more, these well-off households have other avenues such as animal husbandry, small shops etc in the village for additional income generation.

Middle category of households are not stable in terms of food security. This category of households frequently faces deficits of rice for consumption for a few months in a year. These households mainly raise pigs and poultry, whereas well-off households raise goat, buffalo, cattle along with pigs and poultry.

Poor category of households is always suffered from food scarcities through out the year. These households usually raise chicken for their home consumption. Poor economic condition restricts raising cattle. In addition, these households also have limited lands for agriculture. They usually practice upland rice cultivation which requires high labor use, and longer seasonal production cycle. The rice yield is low because of fluctuation of the annual rainfall.

4.1.2 Household member size

In remote areas of Lao PDR, more than one family lives in a household. Therefore three groups of households were considered in this study: one family, two- family and three-family households. In the project participating villages two family households are dominant with a average of 43.6% , while non-project villages have64.1% of one-family households (Table 4.1). The weighted average number of members per family was 1.9, in the project participating villages, while that was 1.3 in non-project villages (Table 4.1).

Table 4.1 Distribution of project participating and not participating households based on the number of families living in a single household.

Character	Project participating/village						Non- project participating/village					
	Namoneua		Pangthong		Total		Nakham		Kiewlan		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
One family	8	34.8	6	37.5	14	35.9	15	65.2	10	62.5	25	64.1
Two family	11	47.8	6	37.5	17	43.6	8	34.8	6	37.5	12	30.8
Three family	4	17.4	4	25.0	8	20.5	-	-	-	-	-	-
Weighted Average	1.8		1.9		1.9		1.3		1.3		1.3	

Fr. = Frequency
(Source: Field study, 2007)

The number of members in a household is shown in Table 4.2. The number of members per household varied from 4 to 7 in both project and non-project areas. In the project area, Pangthong had 11 households whereas in Namo neua had 14 households with 8-11 member per household with an overall percentage of 48.7% and 46.2% for Pangthong and Namo neua villages, respectively. There were two households with more than 11 members. In the non-project villages, Nakham had 18 households with 4-7 people each which accounted for 78.3% while Kiewlan had 8 households with 8-11 people (50%). Still there was one household with more than 11 members only in kiewlan (2.6%). This shows that the overall household size was relatively smaller in the non-project area compared to project area, where as within the project area there is no differences between 4-7 and 8-11 members per households, with percentages of 48.7 and 46.2, respectively.

Table 4.2 Household size in both project and non-project areas

Number of member	Project participating villages						Non- participating villages					
	Namoneua		Pangthong		Total		Nakham		Kiewlan		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
4 – 7	8	34.8	11	68.8	19	48.7	18	78.3	7	43.8	25	64.1
8 -11	14	60.9	4	25.0	18	46.2	5	21.7	8	50.0	13	33.3
>11	1	4.3	1	6.3	2	5.1			1	6.3	1	2.6
Weighted Average	8.1		7.2		7.7		6		8.4		7	

Fr. = Frequency
(Source: Field study, 2007)

4.1.3 Age and sex distribution

The age structure of the people in a household varied in both project participating and non participating in villages (Table 4.3). The adult group, i.e. between >15 to 50 years, was the highest among all the age groups, with 49.3% in the project area and 43.9% in the non-project area. The group between 1-8 years was also much higher than the other age groups, i.e. >8-15 and >50. Except in Pangthong in the project area, the rest had reasonable number of households with children of age group >8-15 in both areas, where as in the non-project area, the elders (>50 years) were found only in 8 households in each

of the two villages. The highest percentage of households age group between >15-50 in project and non-project area, yet this value was higher in the project area. This may be attributed to the higher family size in a household in the project participating villages. As observed during survey most of the people are young and separated from their parents. This also explains why the age group 1-8 is higher and 8-15 is lower in the area. The females dominate among overall sex ratio dominates with in the project area with 50.7% and 49.3% of females and males respectively, in the non-project area with male dominance having 54.5% and 45.5% male to female proportion.

Table 4.3 Household distribution based on age and sex

Character	Project participating						Non- project participating					
	Namoneua		Pangthong		For area		Nakham		Kiewlan		For area	
	Fr. 1/	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
(a) Age												
1 - 8	38	20.3	33	28.7	71	23.5	32	23.0	47	35.1	79	28.9
>8-15	41	21.9	8	7.0	49	16.2	31	22.3	27	20.1	58	21.3
>15-50	87	46.5	62	53.9	149	49.3	68	48.9	52	38.8	120	43.9
>50	21	11.2	12	10.4	33	10.9	8	5.8	8	6.0	16	5.9
(b) Sex												
Male	92	49.2	57	49.6	149	49.3	71	51.1	73	54.5	73	54.5
Female	95	50.8	58	50.4	153	50.7	68	48.9	61	45.5	61	45.5

1/ Fr. = Frequency
(Source: Field study, 2007)

4.1.4 Education and occupation

The literacy is an important indicator for social economic development in the country. In the both project participating and non- participating areas of this study, farmers still have low level of education and of which a greater number of them is illiterate. Almost all the literate farmers completed primary school but can only read and write Lao. As far as the literacy within different areas was concerned, Pangthong village in the project area and Kiewlan village in the non-project area had the lowest rate of literacy with 27.5 and 27.1 percent, respectively (Table 4.4).

In Namo neua, Pangthong and Kiewlan, there is only one primary school with grade 1 and 2. The school in Namo neua village was started in 1994 and in Pangthong and Kiewlan villages in 2003. Nakam village there is a primary school and a higher level school with 1-5 grades. This explains why the level of literacy in each village is low.

There is an occupational difference among the villages in the project participating and non-participating villages. In the project participating villages a greater number of households (103) has farming (37.7%). The results show that the people in the non-project supported area explore other income generating opportunities, whereas in the project supported area the is a higher tendency towards farming.

Table 4.4 Household distribution based on occupation and literacy among people

Character	Project participating villages						Non- project participating villages					
	Namoneua		Pangthong		Total		Nakham		Kiewlan		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Literacy												
Literate	41	55.4	14	27.5	55	44.0	33	60	13	27.1	46	44.7
Illiterate	33	44.6	37	72.5	70	56.0	22	40	35	72.9	57	55.3
Occupation												
Farmer	74	39.6	51	44.3	125	41.4	55	39.6	48	35.8	103	37.7
Handicraft	-	-	-	-	-	-	1	0.7	-	-	1	0.4
Officer	-	-	1	0.9	1	0.3	3	2.2	2	1.5	5	1.8
Student	66	35.3	39	33.9	105	34.8	54	38.8	41	30.6	95	34.8
Elders and children	47	25.1	24	20.9	71	23.5	26	18.7	43	32.1	69	25.3

Fr. = Frequency
(Source: Field study, 2007)

4.2 Farm practices and farm size holding

4.2.1 Annual monocroppinp

Paddy field is the most important land resource in the sample villages by in the study area. Mostly large paddy land size holders with more than 1 ha is owned by medium and well-off households. Of the households, 21.7% was in Namoneua village in the project area and 22.6% in Kiewlan village which is in the non-project area (Table 4.5). The highest percentage of households with rice lands is between more than 0.5 and 1 ha with 64.9%and 64.5% in project participating and non-participating villages respectively. There is no difference in the number of households with rice extent of >0.5 to 1 ha between project supported village and non- supported villages. These differences are mainly due to the land availability rather than the project and its contribution.

The results also show that there are a lower number of households engaged in upland rice cultivation in the project supported villages (13 households) than in the project non-supported villages area (19 households). Similarly there is lower number of households cultivating maize in the project area (5 households) than the non-supported villages (12 households).

Table 4.5 Annual monocropping farm size holding by respondent households

Crop and Extent	Project participating						Non- project participating					
	Namoneua		Pangthong		For area		Nakham		Kiewlan		For area	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Low land rice												
<0.5-0.5 ha	4	17.4	4	28.6	8	21.6	6	27.3	3	33.3	9	29.0
>0.5-1 ha	14	60.9	10	71.4	24	64.9	16	72.7	4	44.4	20	64.5
>1 ha	5	21.7	-	-	5	13.5	-	-	2	22.2	2	6.5
Average	1.03		0.69		0.86		0.72		0.66		0.71	
Upland rice												
<0.5-0.5 ha	6	83.3	1	16.7	7	53.8	3	75	2	13.3	5	26.3
>0.5-1 ha	1	16.7	5	83.3	6	46.2	1	25	7	47.7	8	42.1
>1 ha	-	-	-	-	-	-	-	-	6	40	6	31.6
Average	0.42		0.88		0.63		0.53		1.1		1.2	
Maize												
<0.5-0.5 ha	2	66.7	-	-	2	40	3	100	5	55.5	8	80
>0.5-1 ha			1	50	1	20	-	-	4	45.5	4	20
>1 ha	1	33.3	1	50	2	40	-	-	-	-	-	-
Average	0.8		1.2		1		0.3		0.7		0.6	

Fr. = frequency
(Source: Field study, 2007)

4.2.2 Perennial crop base cropping

The upland farming in the project area is more diversified than the non-project area (Table 4.6). There are three types of farming systems in the project supported villages: a) rubber cultivation combined with upland rice or with maize as a catch crop in the first and second years, b) fruit trees integrated with pineapple, c) non-timber forest product trees integrated in form of agro-forestry systems, eagle wood (*Dbergeasia hypoleca*) integrated with Toodtiang (*Aquilaria spp*), bitter bamboo (*Indosasa cinica*) or banana. In the non-project villages rubber is grown alone or mixed with maize. With respect to land size distribution households the number of adopting rubber cultivation in both project villages and non-supported villages is similar. However, the fruit and agro-forest systems are found only in the project area with a weighted average extent of 1.7 and 0.8 hectare, respectively.

Table 4.6 Household distribution in the project and non-project villages based on perennial cropping

Crop and Extent	Project participating						Non- project participating					
	Namoneua		Pangthong		For area		Nakham		Kiewlan		For area	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Rubber												
<0.5-0.5 ha	3	37.5	-	-	3	18.8	5	38.5	-	-	5	29.4
>0.5-1 ha	3	37.5	5	62.5	8	50.0	5	38.5	3	75.0	8	47.1
>1 ha	2	25.0	3	37.5	5	31.3	3	23.1	1	25.0	4	23.5
Average	0.9		1.6		1.2		0.8		1		0.9	
Fruit												
<0.5-0.5 ha	-	-	2	50	2	22.2	-	-	-	-	-	-
>0.5-1 ha	3	42.9	1	25	4	44.4	-	-	-	-	-	-
>1 ha	4	57.1	1	25	5	55.6	-	-	-	-	-	-
Average	0.8		0.6		1.7		-		-		-	
Agro-forestry												
<0.5-0.5 ha	2	28.6	1	50	3	33.3	-	-	-	-	-	-
>0.5-1 ha	4	57.1	1	50	5	55.6	-	-	-	-	-	-
>1 ha	1	14.3	-	-	1	11.1	-	-	-	-	-	-
Average	0.9		0.7		0.8		-		-		-	

Fr. =frequency
(Source: Field study, 2007)

Group discussion with village council and key persons from each village revealed they reported that there are three ways to own the land for agriculture of the villagers:

1. the land acquisition by inheritance,
2. New lands allocated by District authorities, and
3. From purchases between nearby villages.

4.3 Marketing structure and accessibility

Local market structure

Based on the discussion with the farmers and from field observations during the study, it was revealed that both local and distance markets exist. The agricultural and other non-forest timber products are sold in the local market. The major agricultural goods include fresh vegetables and crops and live animals of cattle, pigs, chicken, ducks. The main non-forest timber products exported from Udomxay province are bitter bamboo “No kom” (*Indosasa cinica*) “Peuak meuak” (*Dbergeasia hypoleuca*), cardamom “Mak neng” (*Amomum spp*), “Peuak bong” (*Notaphoebe umdellifera*) and “Khem” (*Thysanolaena masima*) as main items in both project supported and non-supported villages, according to Provincial Agriculture Office.

Generally, farmers come to sell agricultural products in the district market early in the morning and sell their goods even along the road side in the day time. However, some goods produced in bulk are sold in provincial market, which are exported to China. Water melon and sugarcane are produced in exported category. These two crops are planted in a

larger area than others with partnership investment by both Lao farmers and Chinese farmers. Once the local authorities in Lao PDR provided an assurance Chinese farmers enter into an agreement for the supply of inputs and buy back of the produce indicating even the price. The Chinese farmers support with seeds, fertilizer, pesticides and crop production techniques, while Lao farmers are responsible of land availability and all the growing activities with labor use.

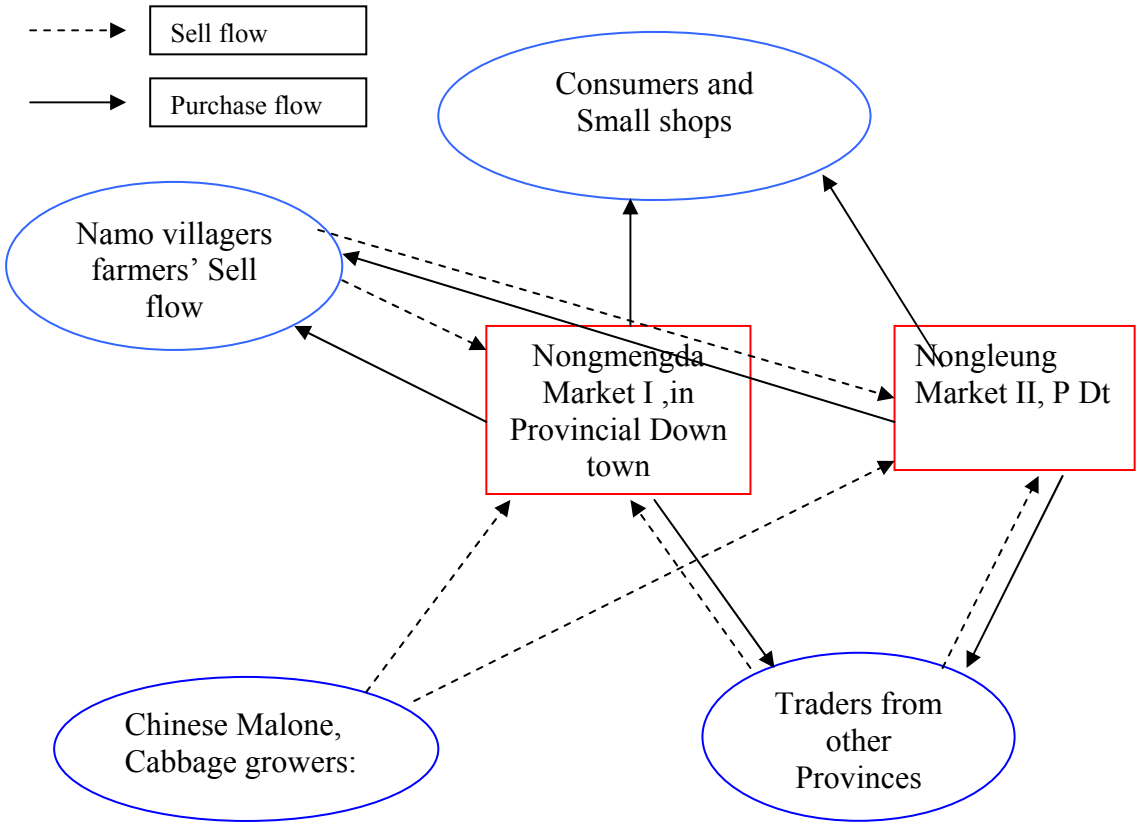

Figure 4.1 Local and Provincial level market structure

The farmers in both project supported and non-supported villages do not import very much of production inputs such as fertilizers, crops, animal breeds and other post harvest processing machineries. Due to limited finances only some households have purchased small tractors which are mainly used land preparation for rice and threshing.

The Planning Department's view is that the main export potential of Oudomsay exists for corn and livestock, especially cattle as the time taken for market is shorter than that for buffaloes.

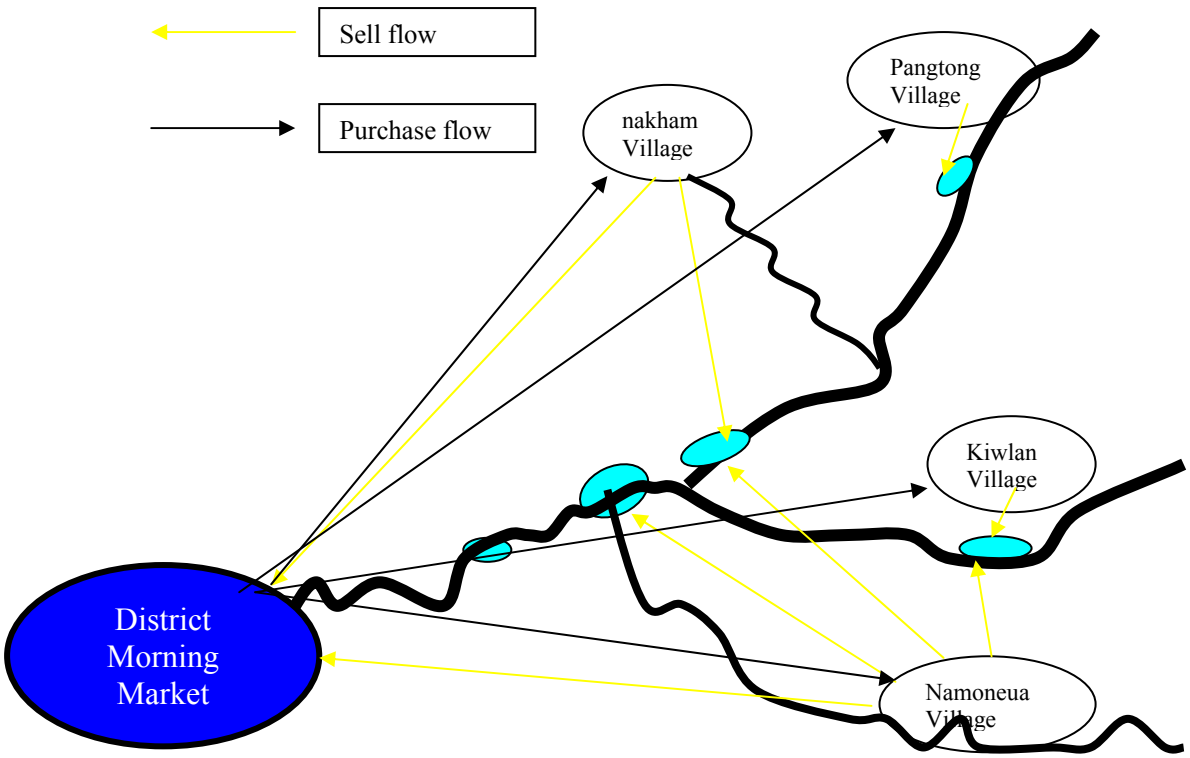

Figure 4.2 Local District market structure

4.4 Physical characteristic

4.4.1 Soil

The Land Management Research Component (2006) reported that the agricultural soils in the study area are classified as Gleyic ACRISOLS (ACg) and Haplic ACRISOLS (ACh). Soil type at depth of more than 100 cm is clay loam. This soil type is mostly in the lower flat lands and characterized as acidic with pH of 5.23. The fertility level is medium with OM content of 3.27%, soluble Phosphorus of 11.55 ppm and high Potassium with 23.5mg/100g soil.

4.4.2 Climate and topography condition

Climate: The study area has two distinct growing seasons: rainy season and dry season. Average annual rain fall is about 177.68 mm. The rainy season starts from May to September with an average rainfall of around 1036.64 mm which accounts for about 81.99% of total yearly rainfall. July and August are the highest rainfall months in the year. Dry season is the period from October to April. The average daily temperature is 22.7 ^{0}C. The lowest of 17-20 ^{0}C temperature prevails during December, whereas the highest temperature is in March with 26.08 ^{0}C (Figure 4.3). The mean relative humidity of the year is 77.7%, which ranges from around 68% in March to 84.6% in the rainy months. The moisture aspiration in the dry season is higher than rainfall in the same period of 213.3 mm per year (NAFRI, 2007)

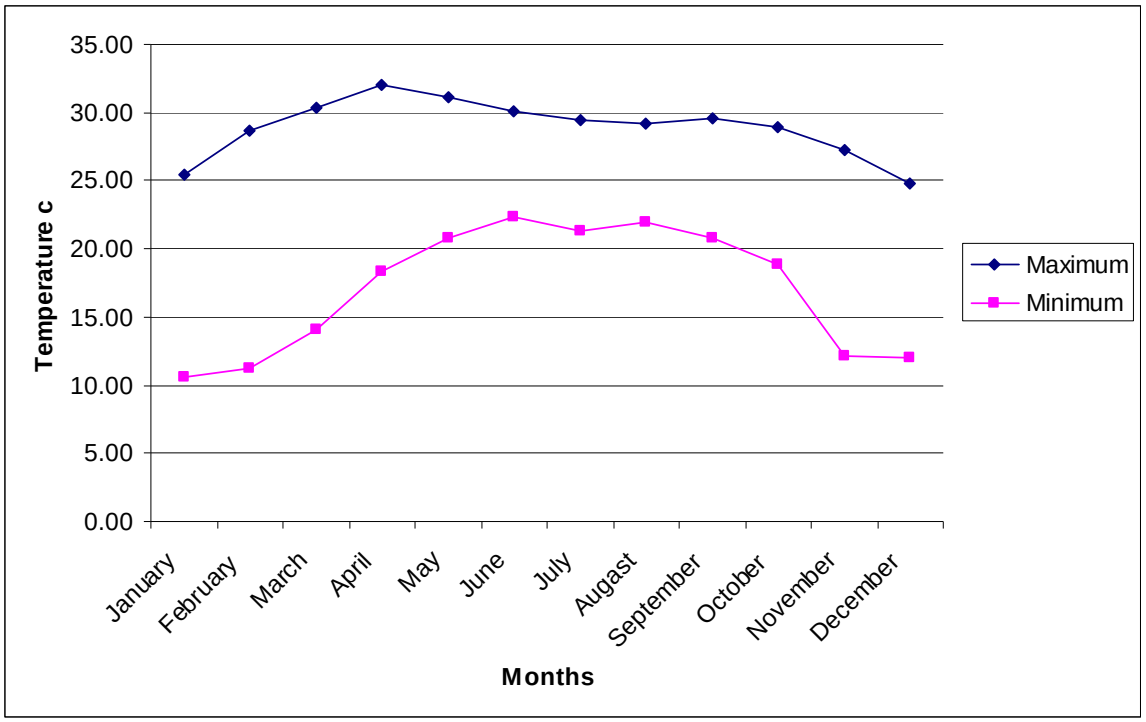

Figure 4.3 Monthly average maximum and minimum temperature of Uodomxay Province.
(Source: Hydrological and Metrological Station of Oudomxay Province, 2007)

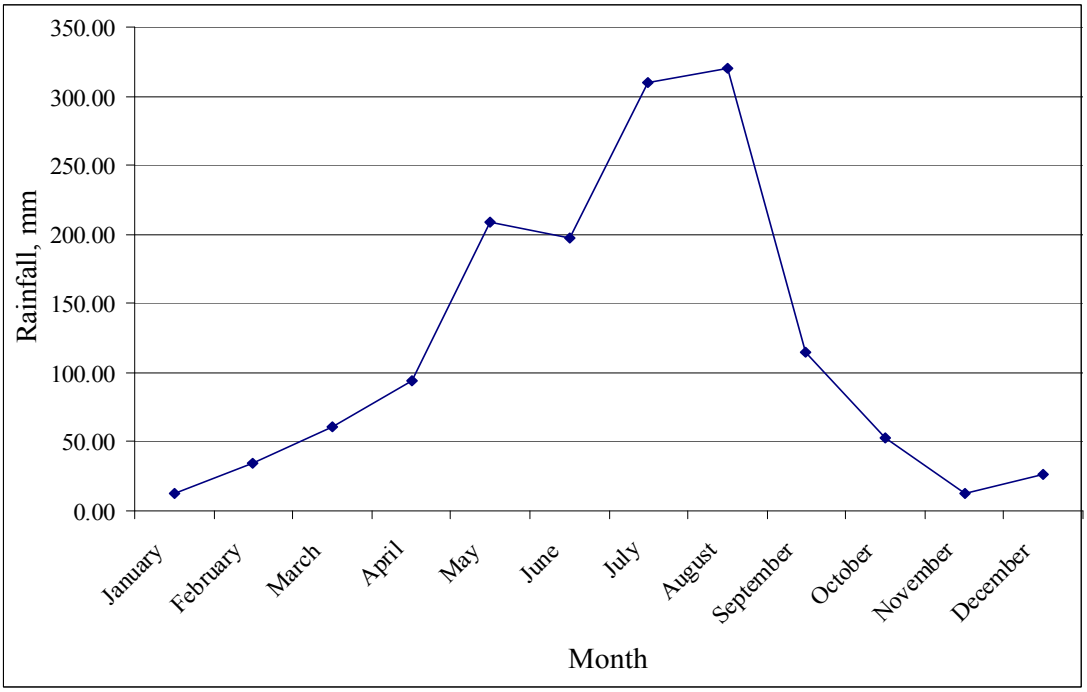

Figure 4.4 Monthly Average Rainfall (mm) of Oudomxay Province
(Source: Hydrological and Meteorogical Station of Oudomxay Province, 2007)

Topography: Project target villages are located in sloping land with an elevation of 611 – 748 m above sea level. The area comprised of mountains with majority of land having medium slopes and hills along the rivers. In these river valleys some land areas are flat and also small parcel areas in the bottom part between mountains are available for

lowland rice cultivation. Based on GIS maps with the scale 1:3000 and according to the forest watershed survey plan, the study area is classified in to 5 zones:

1) Zone 1 - Lands with slope of 0 – 2 percent along the streams.
2) Zone 2-Lands covered in hills and slopes of 2 – 8 percent along the streams.
3) Zone 3-Lands with small mountains with slope of 8 – 16% with majority classified as hills.
4) Zone 4-Land covered with high mountains with slope of 16 – 30% that connects with small mountains with medium slopes.
5) Zone 5-Lands covered with high mountains with slope more than 30 percent.

4.5 Water source received for agriculture

The majority of the project supported and non-supported villages receives water from rainfall. All farmers in the project area receive water from rainfall where as, 18 farmers in Nakham village and 3 farmers in Kiewlan village located outside the project area receives water from the streams. Consequently, a greater number of farmers in the project area were deficit water during the earlier growing season with 12 farmers in the project area compared to nine farmers in the non-project area, which accounted for 85.7% and 64.3%, respectively. However, the number of farmers with sufficient and deficient in the water use was similar in both project supported and non-supported villages (Table 4.7).

Table 4.7 Source of water use for farming in the study areas

Area/villages		Water source		Requirement		Deficient period season		
		Rainfall	River	Sufficient	Deficient	Earlier	Middle	End
Project target								
Namo	Fr.	23	-	17	6	4	2	-
	%	100	-	73.9	26.1	66.7	33.3	-
Pangthong	Fr.	16	-	7	9	8	-	-
	%	100	-	43.8	56.3	100	-	-
Total	Fr.	39	-	24	15	12	2	-
	%	100	-	61.5	38.5	85.7	14.3	-
Non-project target								
Nakham	Fr.	8	15	16	7	4	2	1
	%	34.8	65.2	69.6	30.4	57.1	28.6	14.3
Kiewlan	Fr.	13	3	9	7	5	-	2
	%	81.3	18.8	56.3	43.8	71.4	-	28.6
Total	Fr.	21	18	25	14	9	2	3
	%	53.8	46.2	64.1	35.9	64.3	14.3	21.4

Fr. = frequency
(Source: Field study, 2007)

4.6 Existing farming systems of major crops

Several types of crops are grown in the study site. The most important crops among these are rice (both lowland and upland), maize, vegetables and tuber crops (cassava sweet potato). The rubber is a new crop for the villagers in the region and in study villages as

well. Both the improved fruits and eagle wood have been also newly introduced by the project through farming systems research program in the project target villages.

Among these crops, rice is the most important crop and also the first priority in the study areas and also in the country. The lowland rice is the most single important crop that plays a major role in the livelihood of the people. Farmers with larger paddy fields are well-secured in food availability through out the year. Since land availability for lowland paddy is limited in sloping lands, the upland rice is cultivated.

Maize is the second important crop as a cash crop due to potential marketability. It is grown and produced mainly for sale and a small part of total production to be fed to animals. However, introduction of perennial crops might lead to a reduction in the upland rice and maize extents. Rubber and fruits are very much interested by farmers due to high market demand in China. The head of the Kiewland village mentioned that, according to the Government policy is to reduce upland rice cultivation and to promote planting rubber and other marketable crops and implement new technologies supported by government in neighbor villages.

Rubber has become an alternative crop and intensive cultivation requires transportation and other infrastructure of road for upland farmers. Rubber plantations have been increased dramatically in the Northern provinces including the study area as a result of diversifying upland rice lands with rubber plantation.

The other crops such as vegetables, mainly mustard, chili, egg plan, garlic, cucumber, herbs, sweet potatoes, cassava and other tubers are grown in small proportions. Generally all the households grow vegetables in the home garden along the river side and nearby houses for their daily consumption. Only a little portion of the production is sold in allocated markets. The tuber crops are not economical crops, which are usually planted in the upland rice fields. Most of the farmers complained that although vegetables are grown, marketing is a perpetual problem. In the last rainy season traders promoted the cultivation of ginger but no traders came to buy any ginger. The farmers invested own money completely for growing ginger.

The largest number and percentage of the households in both project support (94.9%) and non-project area (76.9%) engaged in lowland rice production and the next highest (43.6%) was on rubber plantation in the project area, while upland rice (48.7%) is grown in non-project area (Table 4.8). The results showed that due to the project, two villages Namo neua and Pangthong have received the knowledge and technology to grow both fruits and eagle wood.

Fruits such as lychee (*Litchi chinensis)*, mango, tangerine and longan are planted in rows with pineapple and forest ginger as under-storey crops and eagle wood trees mix with bitter bamboo ”Nokhom” “Peuakmeuak” in agro-forestry systems. In areas outside the project support have not been introduced such technologies with on-farm trials. Many households reported that some fruit crops have already been in the field since two years ago. These crops include pineapple, mango and lychee. Pineapple contributes to the farm incomes. Moreover, production increases from the second year onward, but they could not sell much of the harvest because of inaccessible markets and high cost of transportation. The farmers lack transportation facilities among themselves. Respondents also complained that weeds *(Yakha)* in fruit plantations are a problem. As benefits, the

farmers noted that the introduced species have prolific fruit production compared to local species and their own trees and production is sold to China through middleman.

Table 4.8 Distribution of households growing major crops

Crops	Project participating						Non- project participating					
	Namoneua		Pangthong		For area		Nakham		akiewlan		For area	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Lowland rice	**23**	**100**	**14**	**87.5**	**37**	**94.9**	**22**	**95.7**	**8**	**50**	**30**	**76.9**
Upland rice	**6**	**26.1**	**6**	**37.5**	**12**	**30.8**	**4**	**17.4**	**15**	**93.8**	**19**	**48.7**
Maize	**3**	**13.0**	**2**	**12.5**	**5**	**12.8**	**3**	**13**	**12**	**75**	**15**	**38.9**
Fruits	**5**	**21.7**	**4**	**25.0**	**9**	**23.1**	**-**	**-**	**-**	**-**	**-**	**-**
Rubber	**8**	**34.8**	**9**	**56.3**	**17**	**43.6**	**7**	**30.4**	**4**	**-**	**11**	**28.2**
Eagle wood	**7**	**30.4**	**2**	**12.5**	**9**	**23.1**	**-**	**-**	**-**	**-**	**-**	**-**

Fr. = frequency
(Source: Field study, 2007)

The percentage distribution of the lowland and upland rice among households in study site are shown in Table 4.9. There is a change of cultivation patterns according to villages. The percentage of farmers growing lowland and upland rice only in the two project supported villages accounted for about 69.2%, 5.1%, while in the non-project villages accounted for 51.3% and 20.5%. Both lowland and upland rice are grown by 25.6% and f 28.2% in the project and non-project areas, respectively. As the farmers find more benefits with rubber and fruit crops upland rice production may be reduced in the future according to the farmers.

Table 4.9 Distribution of households based on the type of rice cultivation

Rice cultivation	Project participating						Non- project participating					
	Namoneua		Pangthong		Total		Nakham		akiewlan		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Lowland rice only	16	69.6	11	68.8	27	69.2	19	82.6	1	6.3	20	51.3
Lowland rice+ Upland rice	6	26.1	4	25.0	10	25.6	3	13.0	8	50.0	11	28.2
Upland rice only	-	-	2	12.5	2	5.1	1	4.3	7	43.8	8	20.5

Fr. = Frequency
(Source: Field study, 2007)

4.7 Recommended farming systems

4.7.1 Annual cropping system

As reported Lao Agricultural Census in the 1998/99 approximately of 97% of rice farmers grew in the rainy season, where as the balance 3.0 % grew rice in both rainy and dry seasons.

In the study area, upland and lowland rice and maize are grown as sole crops. Since these are the most important crops supplying staple food (rice) and cash (maize), there is not much deference in the extent of cultivation between project and non-project areas (Table

4.10). Although, some other farming systems such as raising ducks and fish in the lowland rice fields are practiced by project supported villages, these activities have not been introduced and are not available in non-participating villages.

The intercropping of lowland rice with ducks and fish are adapted by farmers from research activities. These two farming systems are continuously expanding to other farmers too, reported by respondents who practiced in project villages.

In integrating ducks, every farmer has to return equal number of ducklings that he/she received from the project in the previous year. These new ducks are then provided to other farmers in the waiting list organized and maintained by village councils. In the similar method, the project provides finances to purchase fish stock and motivates in a removing manner however, researchers or extensional authorities help the farmers to find fish breeds.

Water melon and pumpkin are grown in sequential cropping as introduced by Chinese farmers. Farmers practiced this cropping system in the first year in rice fields. Water melon growers suggested that the new improved rice variety (TDK5) is more suitable for cultivating a second rice crop after rice harvesting the first rice crop. This variety matures earlier than other local varieties. They pointed that one advantage of using deferent rice varieties of TDK5 and local variety and watermelon is that TDK5 is harvested early and then melon grows extremely faster then others. These farmers harvest melon earlier with better quality because they could avoided rainy period that otherwise overlap during maturing and harvesting time. However, the marketing problem is not different from other agricultural products even they have contracts with Chinese farmers for buying the produce and the price before growing. Lao farmers do not have enough power to bargain with Chinese farmers because the farmer do not have any means to transport their goods for other markets.

4.7.2 Perennial crop-based cropping systems

Rubber has become a newly interested farming system in the study area. Farmers have replaced their lands allocated for upland rice with rubber. Farming system research program has initiated some activities for introducing annual crops such as upland rice and maize in polyculture. Therefore, these research activities encourage farmers in project participating villages (Table 4.10). On the other hand, the farmers in the non-project area grow rubber alone (15.4%) while in the project area the farmers have grown other annual crops such as upland rice in the first year, maize or Job's tear in the second and third years as a catch crop in rubber (Table 4.11). The percentage households cultivating rubber has increased in the project supported villages (41.0%) compared to non-project area (28.2%).

Fruits and eagle wood-based systems are also supported in the project area with on-farm trials. Fruit are planted in a model in integrated systems between tall trees, and also with rubber. In addition pineapple or forest ginger is planted in rows between fruit trees. Eagle wood is integrated with banana, and in addition eagle wood + Sesbania are grown as hedgerows in the form of agro-forestry system.

Table 4.10 Household distribution among farming systems

Cropping systems	Project participating						Non- project participating					
	Namoneua		Pangthong		For area		Nakham		akiewlan		For area	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Monocropping system												
Lowland rice	23	100	14	87.5	37	94.9	22	95.7	9	56.3	31	79.5
Upland rice	6	26.1	6	37.5	12	30.8	4	17.4	15	93.8	19	48.7
Maize	-	-	2	12.5	2	5.1	3	13.0	11	68.8	14	35.9
Fruit	-	-	-	-	-	-	-	-	-	-	-	-
Rubber	-	-	-	-	-	-	6	26.1	-	-	6	15.4
Eagle wood	-	-	-	-	-	-	-	-	-	-	-	-
Intercropping system.												
Maize+Soy bean	1	4.3	-	-	1	2.6	-	-	-	-	-	-
Upland rice +Cassava	-	-	1	6.3	1	2.6	-	-	-	-	-	-
Job's tea +upland rice	-	-	1	6.3	1	2.6	-	-	-	-	-	-
Upland rice +Maize	-	-	-	-	-	-	2	8.7	-	-	2	5.1
Lowland rice +ducks	6	26.1	-	-	6	15.4	-	-	-	-	-	-
Lowland rice +Fish	14	60.9	-	-	14	35.9	-	-	-	-	-	-
Sequential cropping system												
Lowland rice -melon	4	17.4	-	-	4	10.3	-	-	-	-	-	-
Lowland rice -Pumpking	-	-	-	-	-	-	5	21.7	-	-	5	12.8

Fr. = Frequency
(Source: Field study, 2007)

There was no difference in farming systems between project target and non-project area according to Chi-square method. The frequency of the farming systems practiced by the farmers in both project and non-project areas varied. The results have shown that the farming systems such as lowland rice, maize, rubber, lowland rice + fish, lowland rice + ducks, lowland rice – melon lowland rice – pumpkin, fruits + annual crops and agro-forestry + NTFP were different at P = 0.05. The rest of the farm practices remained in significant between project and non-project areas.

Table 4.11 Perennial + annual crop base cropping systems practiced

Cropping systems	Project participating						Non- project participating					
	Namo		Pangthong		For area		Nakham		akiewlan		For area	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Rubber	8	34.8	8	50.0	16	41.0	7	30.4	4	25.0	11	28.2
Fruit	5	21.7	4	25.0	9	23.1	-	-	-	-	-	-
Agro.forest	7	30.4	2	12.5	9	23.1	-	-	-	-	-	-

(Source: Field study, 2007)

Table 4.12 Relationship of the distribution of farming systems among households

Farming systems	DF	Observed $X^{2\ Value}$	Significant at 0.05
Lowland rice	1	4.129	Yes
Upland rice	1	1.998	No
Maize	1	5.355	Yes
Rubber	1	6.500	Yes
Maize+Soybean	1	1.013	No
Upland rice+cassava	1	1.013	No
Job's tear+upland rice	1	1.013	No
Upland rice+maize	1	2.053	No
Lowland rice+fish	1	17.063	Yes
Lowland rice+ducks	1	6.500	Yes
Lowland rice+melon	1	4.216	Yes
Lowland rice+pumpkin	1	5.342	Yes
Rubber +annual	1	1.416	No
Fruits+annual	1	10.174	Yes
Agro-forestry+NTFP	1	10.174	Yes

(Source: Field study, 2007)

4.7.3 Livestock rearing

The livestock is a main component of the farming practice in the study area. Previous household analysis on the socio-economic component of the National Agriculture and Forestry Research Institute conducted in the same research area found that, poultry and pigs are reared by almost all households (NAFRI, 2005). These two kinds of livestock are raised approximately 55 percent of the livestock holding households. Other large animals like buffalos, cows and goats are raised by about 38% of the households. The number of livestock in the two areas are similar with 23.9 and 23.3 per household. The number of pigs in both project and non-project areas varied from 2.9 to 4.3 per household respectively. The percentage of households raising pigs accounted for 74.4 and 84.6 % in the project supported and unsupported areas, respectively, while for poultry the corresponding value were 69.2 and 84.6%, respectively.

Table 4.13 Number of pigs and poultry raising in the

Type of Livestock	Project participating			Non- project participating		
	Namoneua	Pangthong	For area	Nakham	Kiewlan	For area
	Average No.	Average No.	Average No.	Average No.	Average No.	Average No.
Pigs	3.0	2.7	2.9	1.8	4.8	4.3
Poultry	56.8	7.0	23.9	23.4	23.1	23.3

(Source: Field study, 2007)

Table 4.14 Average Livestock Unit in the study areas (ALU)

Livestock	Weightage	Project area		Non-project area	
		Number	Score	Number	Score
Pig	1	84	84	99	99
Poultry	0.5	646	323	769	384.5
Total		730	407	868	483.5
ALU		1.8		1.8	

(Source: Field study 2007)

The poultry and pig are raised mainly for home consumption as the most important protein source, the main animals used for religious rituals and the major source of income generation. Poultry and pig are a source of organic manure for fruit crops, home gardens and other crops and also used as fish feed in fishponds as per the project recommendation. Buffalos are used for draft purpose for land preparation in paddy fields. The number of buffalos is declining in the study area as a result of purchasing small hand tractors and the reduction of open forest grazing lands with expanding the cultivation of rubber. Cattle and goats are always given priority for sale, which are raised with open forest grazing but the farmers' field the same problems as in buffalo raising. Further more, many households are not able to raise big animals because of limitation of the capital.

The pig and poultry are raised using traditional breeds, local feed and general sheds which are in unhygienic condition. In the project target villages on-farm research activities are carried out producing animal feed (Chicken and pig feed) using cassava, pigeon pea integrating fish and pig together, and rearing ducks in rice paddy fields. Among these opportunities introduced through farming systems research, chicken and pigs + fish integration have not been continued by farmers, but continues with raising ducks and fish in rice fields. The reasons for not adopting chicken is the chicken diseases which caused heavy motility and losses of chicken, slow growing compared to open raising system, which labor requirement for preparing feed from cassava and pigeon pea unavailability of new pig breeds after selling old ones. The farmers were reluctant to raise these animals due to the imposition of strict rules for paying back (animal or money).

For large size livestock, the research program introduced new forages and growing and grazing methods in project target villages since 2005. The grasses include Guinea (*Panicum maximum*), Brachiaria (*Bachiaria ruziziensis)* and Stylo (*Stylosanthes guinensis*). The on-farm trials were conducted with two gazing methods, cut and feed system, and free grazing. The project has given some forage seeds to the other interested farmers to grow for their own animals. These farmers reported that, it was easy to grow, growth was satisfactory and such forage types are helpful. During land preparation of the paddy buffaloes have adequate forage nearby the rice field. But many farmers in both

from project target and without project target villages are strongly interested on goat rearing using the cut and carrying grazing method. It was suggested that goats are easier to raise than both cows and buffaloes as goats do not require such a large piece of land for growing grass and less initial capital require to buy goats. Moreover, goats generate income faster than cattle and buffalos.

Livestock feed

The survey revealed that the most important feed type for pigs is rice bran, maize, cassava, forest fodders, broken rice, paddy rice and for poultry is maize which come from their own production in both categories of farmers in the study area. However, only a very few respondents used maize to feed animals, which is because maize has high market demand and almost all farmer sell maize harvest directly at the market or to the traders than feeding animals. The most common method of feeding large animals such as buffaloes, cattle and goats is the free grazing as there are no individual owned grass lands in the both areas.

4.8 Cropping pattern of the study area

The major crops of the study area are lowland rice, upland rice and maize. These crops are commonly grown by almost all households. In recent years, rubber began to replace upland rice and maize. The other crops which are grown in little extents of lands include sweet potato, cassava, legumes and vegetables. Sweet potato, cassava and legumes are mostly grown as mixed crops with upland rice or maize. Vegetables such as cucumbers, cabbage, garlic, chilly and others are grown in home gardens.

The most important determinant of the cropping patterns in the study area is the availability of water (rainfall), type of land (lowland farming, upland farming), climate, household labor market and household economic background of the household. The overall cropping patterns in project participating and non-participating villages of the study area are found similar. The cropping patterns are considered under two main categories, i.e. in rainfed lowlands and uplands. These cropping patterns show great differences.

4.8.1 Cropping patterns in rainfed lowlands

The crops grown by farmers in lowland *(Na)* along the rivers include paddy rice and vegetables (Figure 4.5). Among these crops rice is the most important and grain only in the raining season. Other vegetables are grown in small parcels of lands nearby the paddy fields throughout the year. According to farmers these vegetables are produced mainly for home consumption, but there is only a little sold which is due to lack of access to markets, and only a little is sold in the local morning market. The farmers do not have their own transportation facilities to transport to bigger markets such as Udomxay Provincial town and Luang prabang where there are many buyers coming to purchase goods in bulk. Farmers are not strong enough in bargaining with Chinese farmers and also do not receive any help from provincial or district officers to resolve this problem.

The cropping patterns introduced by farming systems research program are included green manure *(black cowpea)* - rice – soybean, off-seasonal cabbage, rice + fish, rice +ducks. Some of the cropping patterns among of these recommended have contributed to

farmers very much, which include rice + ducks and rice + fish integration. Others includes cultivation of green manure before growing rainfed rice and soybean. Off-season cabbage and cabbage with IPM have been abandoned. Therefore, the rice variety (TDK5) which was introduced with green manure-rice-soybean rotational cropping pattern continues to contribute to other farmers in both project participating and non participating villages. The reasons of abandoning cabbage is the prevalence of heavy rains during the time of planting of cabbage make soils too wet and damaging newly planted cabbage plants. Although the farmers prefer to continue with green manure, lack of seeds hinders this opportunity. The lowland cropping patterns are shown in Figure 4.5. The predominant cropping pattern in lowland is the rice – fallow system, while rice – rice, rice-vegetable (water melon and pumpkins) and green vegetables are found less predominant in the project target villages.

4.8.2 Cropping patterns in uplands

In the project participating and non-participating villages rice, maize, cassava, sweet potato, fruits and rubber are grown in uplands (Figure 4.6). Generally, rice is given the priority by households but some household have very small or no lowland paddy fields. Maize is the second important crop as well as grown mainly for cash only, but with fewer portions for feeding animals. Sweet potato and cassava are grown in intercropping with maize for additional diet. The rubber is one of the officially promoted crops as sustainable for upland agriculture. Farmers are strongly interested in the rubber crop and devoted their time heavily on the cultivation of rubber in the allocated lands which have so far grown with upland rice or maize. The cropping patterns recommended by the project include integrating of fruit and rubber, fruit with forest products such as of ginger or cardamom, rubber with upland rice or maize up to two or three years until the land is covered and shaded by rubber or fruit crops, and eagle wood in mixtures with cardamom or banana. These kinds of agro-forestry systems are highly accepted by many farmers.

4.9 Impact assessment of the on-farm trials implementation

The impact of Farming Systems Research Activities (on-farm trials) implemented in farmer fields of the project-supported area during the period of year 2002 to 2006 was assessed in a two aspects: level of productivity, production techniques received and adopted, farmers' perceptions, participation, awareness on farming activities, and farmers' knowledge gaps and training.

4.9.1 Effects on level of productivity

Various on-farm trials were implemented since 2002. Researchers with diverse technical backgrounds began FSR/E activities in project target villages. The objectives of the research were to develop and introduce productive upland technologies and to provide land management recommendations acceptable to farmers for poverty alleviation and sustainable use of natural resources. To assess the level of productivity the following factors were considered.

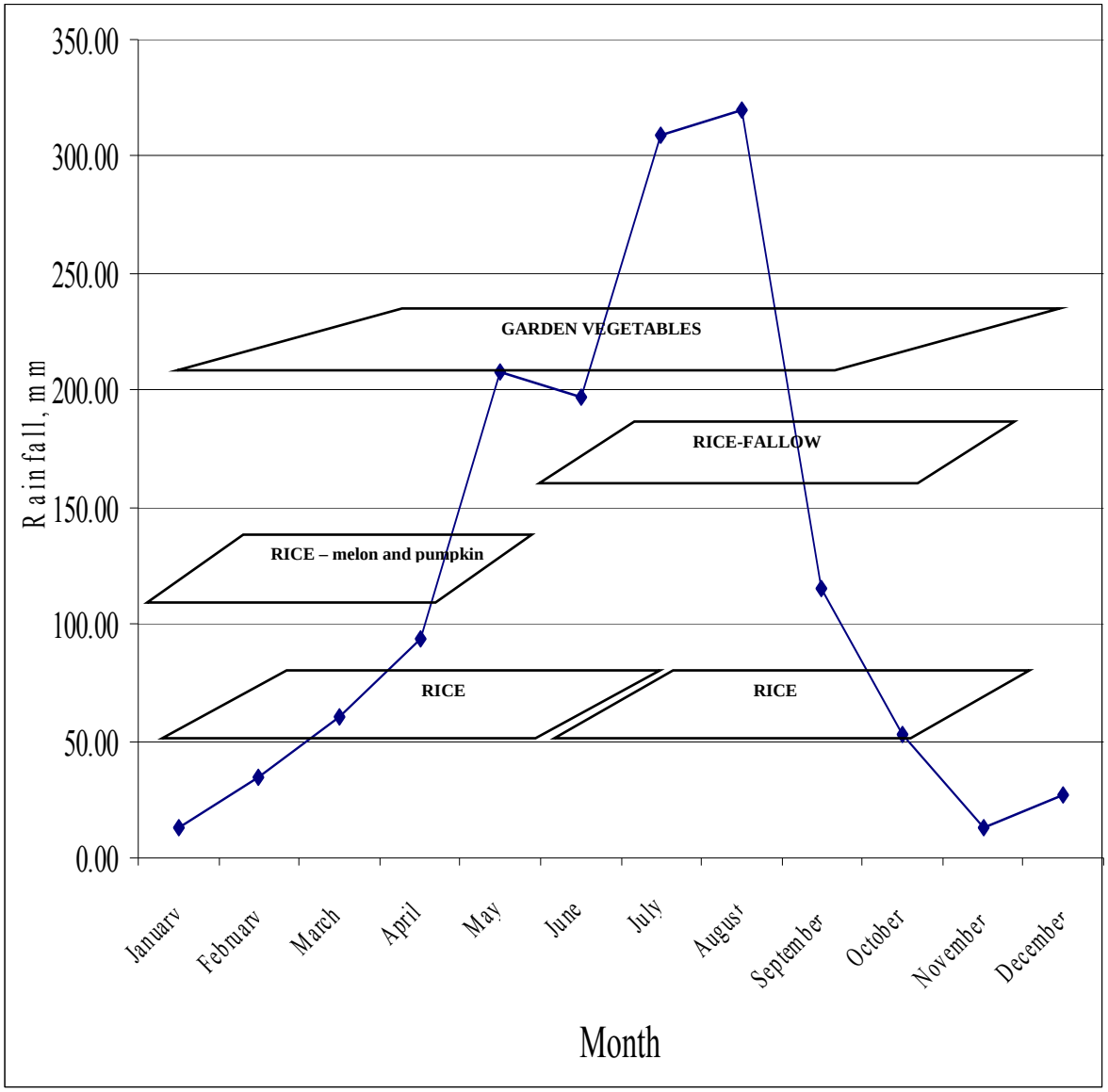

Figure 4.5 Annual cropping patterns practiced on rainfed lowlands in both project and non-project villages

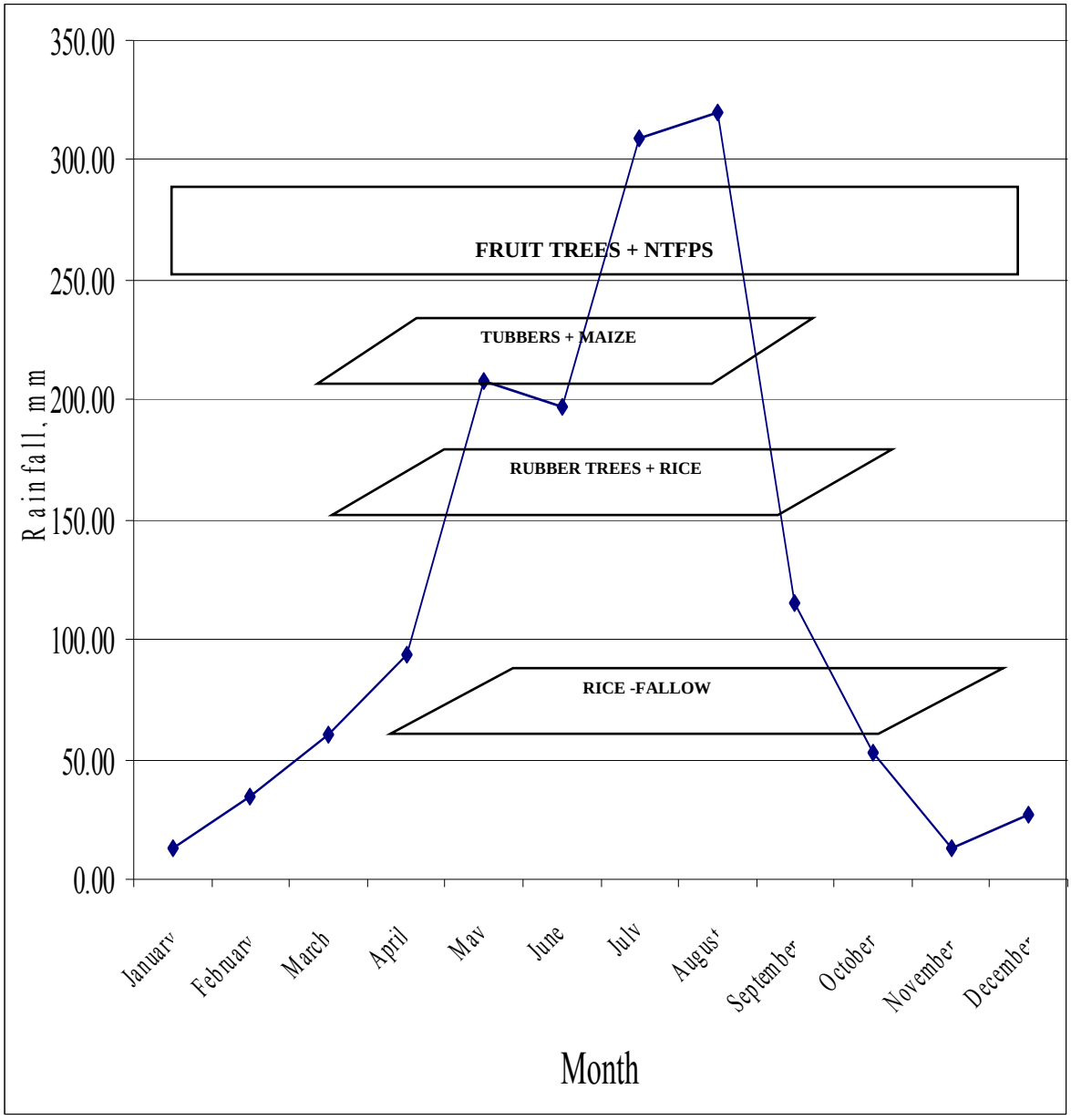

Figure 4.6 Cropping patterns practiced on rainfed uplands in both project and non-project villages

4.9.2 Land use for major crops

Distribution of farm size among the respondent households is presented in the Table 4.5. The farm size is classified in to three categories: <0.5 – 0.5 ha, >0.5 – 1 ha and >1 ha. The most important crops for the household economy in the study areas are lowland (paddy) rice, upland rice, maize, fruit, and rubber and non-timber forest product plants. Among the lowland rice farm size of >0.5 – 1 ha is found to be the highest in both project and non-project areas with 64.9 and 64.5 percent of the households, respectively. In the project support villages upland rice is grown in areas of <0.5 – 0.5 ha while in the non-project area upland rice is grown in large farm size of >0.5 – 1 ha. About 42.9% households grows rubber in >1 ha category of lands followed by >0.5 -1 ha category by 35.7% . In the non-project area 47.1% of households planted >0.5 – 1 ha category and of <0.5 – 0.5 ha had 29.4% of the total households. Fruits and eagle wood have not been disseminated for neighboring villages including two villages considered for the study.

4.9.3 Cropping Index

The cropping index was calculated from four cropping patterns which were the most common farm practices in the project supported and non-supported villages exited. The cropping index in the project supported villages was greater and that contribution was found with the new introduction and adoption of new technologies (Table 4.15). In the non-project area had a greater cropping index of 400% only for monocropping situation, but project area had greater cropping index for integrated cropping, sequential cropping and perennial based cropping combined with annual cropping. This indicates that the project area had greater benefits due to introduction of many new opportunities, and which were not found in the non-project area.

4.9.4 Crop productivity

Previous annual reports mentioned that the concept of the farming systems research program is a farmer participatory research. The technologies recommended to farmers are based on the problems, weaknesses, opportunities and threats of social and physical condition in the area (NAFRI, 2005). The farmers' existing indigenous technologies are tested for their suitability and adaptability under local conditions. However, the current project do not bring full technology package to change whole farmers' existing farming systems and practices completely.

Table 4.15 Cropping index distribution based on cropping patterns in the study areas.

Cropping system	Cropping index, %	
	Project area	Non-project area
Monocropping	300	400
Annual crop integrated	500	100
Sequential cropping	100	100
Perennial and annual cropping	300	100

(Source: field study, 2007)

The level of productivity of crops and some livestock of the respondent households of project area has not come from complete and systematic use of recommended production

techniques introduced by on-farm research project. However, for these farms various improved techniques were introduced through on-farm trials: new rice varieties, cropping techniques, integration of lowland rice with fish and duck culture, application of animal manure in fruit crops, etc. The average productivity of lowland and upland rice and maize in project participating and non-participating villages is shown in the Table 4.17 and for livestock in Table 4.21. The maximum and minimum productivity between two category areas varied. For secondary crops such as upland rice and maize are grown in perennial cropping systems, the average productivity was different between project area and non-project area (Table 4.120).

Table 4.16 Percentage distribution of households with different farm size assigned for major crops

Area	Villages	Land size	Crops											
			Lowland rice		Upland rice		Maize		Fruit		Rubber		Eagle wood	
			fr.	%	fr	%	fr	%	fr	%	fr	%	fr	%
Project area	Namo	<0.5-0.5	4	17.4	5	83	2	66.7			3	37.5	2	28.6
		>0.5-1	14	60.9	1	17	-	-	3	42.9	3	37.5	4	57.1
		>1	5	21.7	-	-	1	33.3	4	57.1	2	25	1	14.3
	Pangthong	<0.5-0.5	4	28.6	1	17	1	50	2	50	-	-	1	50
		>0.5-1	10	71.4	5	83	1	50	1	25	5	62.5	1	50
		>1	-	-	-	-	-	-	1	25	3	37.5	-	-
	Total	<0.5-0.5	8	21.6	7	54	3	60	2	22.2	3	18.8	3	33.3
		>0.5-1	24	64.9	6	46	1	20	4	44.4	8	50.0	5	55.6
		>1	5	13.5	-	-	1	20	5	55.6	5	31.3	1	11.1
Non-Project area	NaKam	<0.5-0.5	6	27.3	3	75	3	100	-	-	5	38.5	-	-
		>0.5-1	16	72.7	1	25	-	-	-	-	5	38.5	-	-
		>1	-	-	-	-	-	-	-	-	3	23.1	-	-
	Kiewlan	<0.5-0.5	3	33.3	2	13	5	55.6	-	-	-	-	-	-
		>0.5-1	4	44.4	7	47	4	44.4	-	-	3	75	-	-
		>1	2	22.2	6	40	-	-	-	-	1	25	-	-
	Total	<0.5-0.5	9	29	5	26	8	66.7	-	-	5	29.4	-	-
		>0.5-1	20	64.5	8	42	4	33.3	-	-	8	47.1	-	-
		>1	2	6.45	6	32	-	-	-	-	4	23.5	-	-

Fr. = frequency
(Source: field study, 2007)

In the project area farmers have more advantages when compared to non-project area with respect to crop production. The farmers harvest not only crop product but also additional products such as fish and ducks which are raised in the paddy fields. Farmers in project area have more rice varieties with yields ranged from 2,700 to 3,300 kg/ha. Farmers reported that these varieties have a short maturity time, better yields and good milling quality. Ducks raising was also increasing in households. The duck breed was introduced by the project; farmers have accepted it as a better breed with good egg laying and ability to find natural feed in the rice field than local ones.

The perennial crops are rubber, fruits and eagle wood. Among of these crops, fruits and eagle wood were introduced by project in the form of integrated systems and agro-forestry system. Growing of upland rice and maize as secondary crops in between perennial crops offered additional benefits with crop products in the first and second years.

Table 4.17 Household distribution in average level of productivity of major crops

Area	Villages	Farm size Category	Productivity of crops, Kg/ha					
			Lowland rice		Upland rice		Maize	
			Fr.	Average	Fr.	Average	Fr.	Average
Project area	Namo	<0.5 – 0.5	4	4,088	5	1,780	2	3,350
		>0.5 – 1	14	2,789	1	900		
		>1	5	2,110			1	2,083
	Pangthong	<0.5 – 0.5	4	2,875	1	1,333		
		>0.5 – 1	10	2,871	5	1,420	1	4,00
		>1					1	643
	Total average		2,947		1,358		2,025	
	Maximum		4,088		1,780		3,350	
	Minimum		2,110		900		643	
Non project area	Nakham	<0.5 – 0.5	6	1,969	3	889	3	2,611
		>0.5 – 1	16	2,887	1	3,000		
		>1						
	Kiewlan	<0.5 – 0.5	3	1,933	2	3,100	5	2,217
		>0.5 – 1	4	4,448	7	1,554	7	2,711
		>1	1	5,000	6	1,574		
	Total average		3,247		2,023		2,513	
	Maximum		5,000		3,100		2,711	
	Minimum		1,933		889		2,217	

Fr. = frequency
(Source: field study, 2007)

The project supported villages have more additional farm productions than non-supported villages. These are fish and ducks which were raised in the lowland rice paddies, pineapple and NTFP (galangal seed). The total gross income in the project supported villages was 17,567,120 kip while in the non-project supported villages was 14,479,600 kip (Table 4.19).

Table 4.18 Distribution average productivity of secondary annual crops in perennial base cropping systems.

Crop	Project area kg/ha	Non-project area kg/ha
Perennial crop + (upland rice)	780	799
Perennial crop + (maize)	929	1,353
Fruits	500	-
Agro-forestry+ (NTFP)	13	-

(Source: field study, 2007)

4.9.5 Gross Income

There was no significant difference in the gross income based on the T-test (p=0.05) (Table 4.19). However, there was about 3 million kips higher gross income in the project supported villages compared to that of non-project villages. The contribution by the

project appears to have not reached so far the farmers in the project area, and this is because the perennials either have just begun to give their yields or still not reached the production stage. This takes time and hence the gross income will remain low until the perennial crops reach their full capacity of bearing. However, the gross income after five years of the project shows positive benefits compared to non-project villages.

Table 4.19 Gross income of the farm weight average productivity

Produce	Gross income					
	Project area			Non-project area		
	Yield (kg/ha)	Price (kip)	income (kip/ha)	Yield (kg/ha)	Price (kip)	income (kip/ha)
Lowland rice	2,947	2,500	7,367,500	3,247	2,500	8,117,500
Upland rice	1,358	2,700	3,666,600	2,023	2,700	5,462,100
Maize	630	1,500	945,000	600	1,500	900,000
Fish	84.31	17,000	1,433,270	-	-	-
Duck	56.48	25,000	1,412,000	-	-	-
Fruit(pineapple)	428.5	1,500	642,750	-	-	-
NTFP	84	25,000	2,100,000	-	-	-
Total gross income	17,567,120			14,479,600		

(Source: field study, 2007)
Note: Equivalent of exchange rate 9,500 kip/1$

To the differences in productivity of two study areas 'T- test' was employed. The results of the analysis are shown in Table 4.20. The productivity of lowland and upland rice and maize in different cropping systems was not significantly different between the project and non-project areas ($p = 0.05$). This shows that is no different in productivity of these farming systems between project and non-project areas. The values indicate that the non-project area has higher yields of lowland rice, upland rice and maize grown between perennial crops, except rice grown with perennials, although different was no significant.

Table 4.20 Comparison of annual crop yields among cropping systems

t-Test for crops	Project area	SD	Non-project area	SD	DF	t-value	level significant
Lowland rice	2803	1028	3011	1324	51	2.00	0.459
Upland rice	1960	1540	1999	1779	23	2.06	0.954
Maize	2931	1586	2527	1044	4	2.77	0.712
Perennial+rice	780	431	799	201	2	4.3	0.941
Perennial+maize	929	591	1353	708	16	2.12	0.201

(Source: field study, 2007)

4.9.6 Livestock productivity

The FSR Program has introduced some small livestock raising systems and feed production systems such as growing cassava + pigeon pea to maintain pig and poultry feed. The project introduced the integrated ducks raising for integration in paddy fields.

As observed during bench mark survey, production of cattle and goats is hindered by lack of natural fodder of the driest months, i.e. the period from November to May of the following year. It was suggested to grow new fodder plants and to set up a fodder bank for additional feed in those crisis months as a solution. However, some of the introduced techniques were not adopted by participating farmers, for example suggested growing of cassava and pigeon pea was no practiced due to difficulties to process cassava and pigeon pea in making feed which requiring a great amount of household labor and lack of lands. The ducks, fish raising and growing fodder for cattle and goats are hence seemed to be effective activities.

Table 4.21 Average number of pig and poultry per household

Description	Project area				Non-project area			
	Namo		Pangthon		Nakam		Kiewlan	
Village level	Pig (kg)	Poultry (kg)	Pig (kg)	Poultry (kg)	Pig (kg)	Poultry (kg)	Pig (kg)	Poultry (kg)
village	1,585	997	1,145	59	1,607	856	2,530	402
household	83.4	52.5	104.1	9.8	80.4	37.2	194.6	40.2
head	25.6	1.7	30.9	1.5	44.6	1.6	40.2	1.7
Area level	Pig		Poultry		Pig		Poultry	
area	2,718		1,056		4,137		1,258	
head	28.9		1.8		41.8		1.6	

(Source: field study, 2007)

However, activities such as level of productivity were not analyzed separately since it was quite difficult to measure and also there was not a control sample to compare with. Therefore, the production of animals was calculated by assuming average weight reported by respondents. The number of the pigs and birds in poultry in the study areas as gathered during the study is shown in Table 4.19. The production of poultry was found in Namoneua village in the project area with 997 kg per village and about 52.5 kg per household, it was due to having more duck rearing households than other selected villages. However, the pigs production was grater in non-project participating villages than project participating villages.

The production of pigs and poultry had no significant difference between project and non-project areas Table 4.20).

Table 4.22 Livestock mean product comparison between two study areas

Livestock	Project area	SD	Non-project area	SD	DF	t-value	Level of significant
Pigs	93.5	67.60	127.72	116.24	51	2.01	0.17
Poultry	31.3	39.02	39.0	23.44	39	2.02	0.95

For the cattle and goats grazing method trials shows that was an increase in the growth of both cows and goats through out the year. The body weight fluctuated in some months depending upon grass availability as (Figure 4.7).

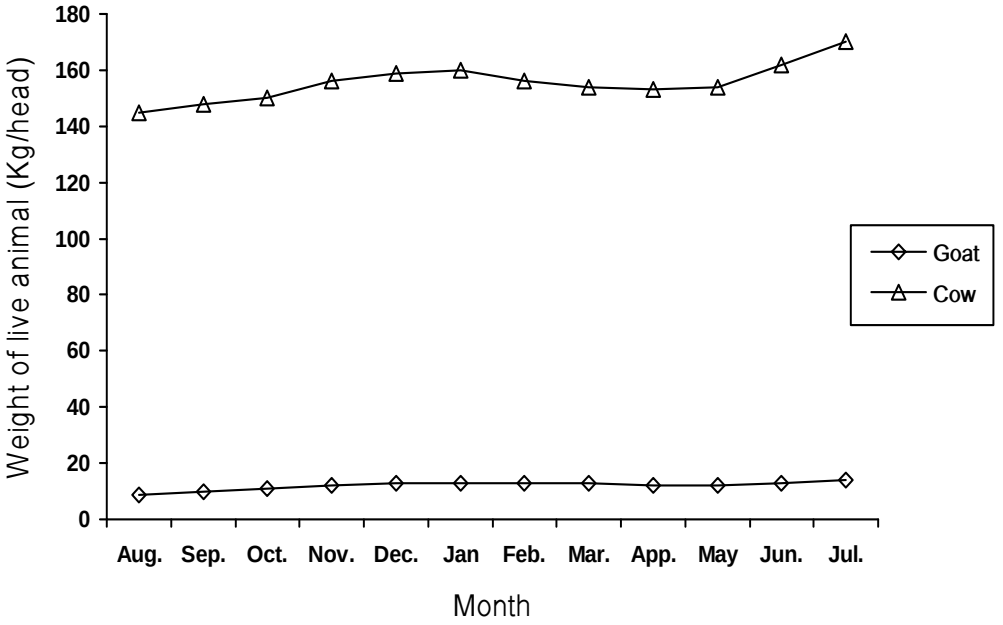

Figure 4.7 Weight of cows and goats at different months in new grazing trials in project Area (Source: Farming Systems Research component, 2007)

The number of animals rapidly increased, since on-farm research began up to 2007, and the number of goats increased nearly 50%. However, the report has not mentioned the control animals with which the comparison was made (NAFRI, 2007).

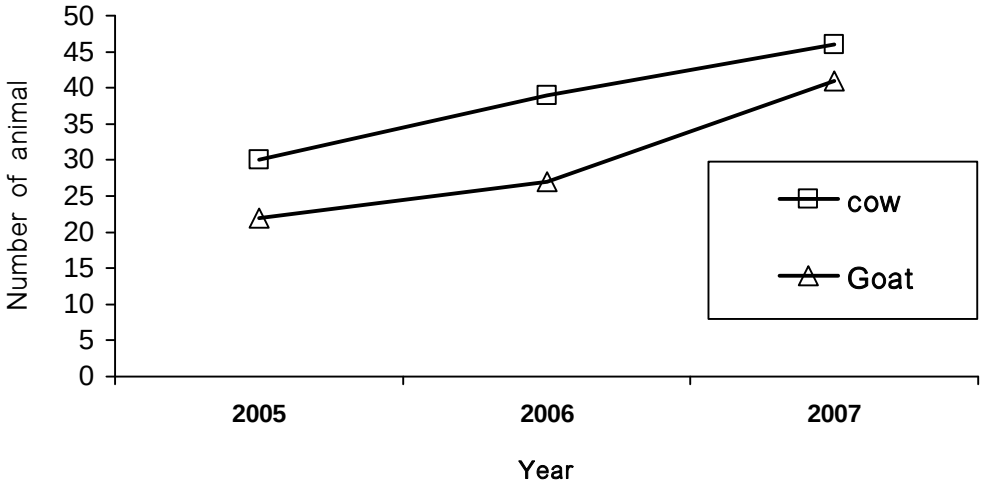

Figure 4.8 Number of cows and goats during 2005 to 2007 in the project area (Source: Farming Systems Research component, 2007)

With respect to farmers' preferment towards to grazing system and adoption of livestock rearing techniques, neighboring farmers in the village were interested in providing their

allocated lands for grazing in the second year. There fore grazing land area for cows and goats raised more than half when compared to the initial year of the on-farm research.

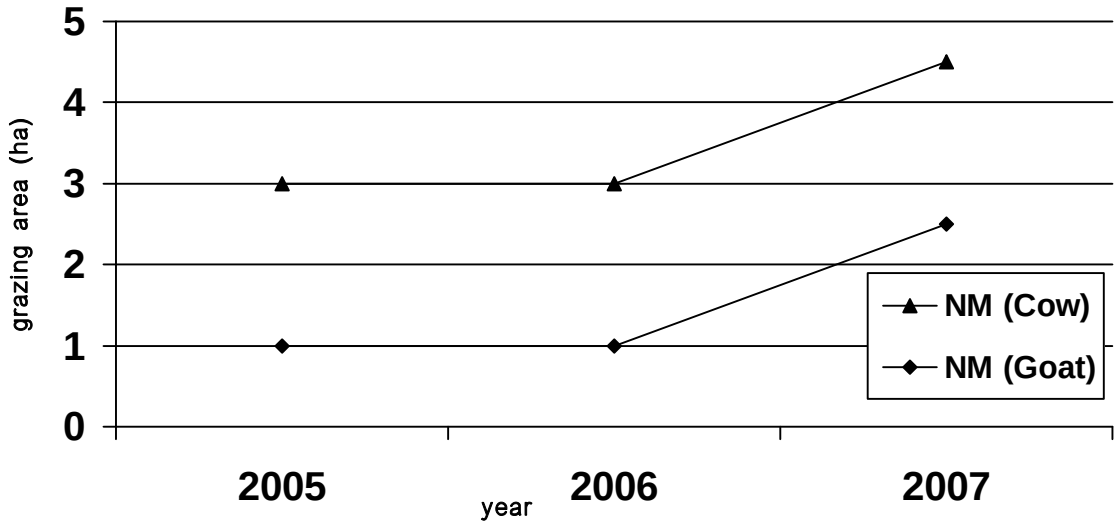

Figure 4.9 Expansion of grazing lands during project in the project area
(Source: Farming Systems Research component, 2007)

4.9.7 Technologies received and adoption by farmers

The FSRP has so far introduced various agronomic techniques to project support villages since initiation on-farm research activities. The technologies that farmers received and their adoptions showed that many of the recommended technologies were effectively adopted by farmers. First, was the adoption adaptation of lowland rice seedling technique. This agronomic technique introduced was the cropping rotation composing green manure – rice – soybean in lowlands. Another technique was the integration fish and ducks in lowland rice. Fish and ducks raising in the lowland rice fields were completely a new package in farming systems which was adopted by the widely. They were able to harvest 8 to 14 kg per household of fish and in addition eggs and meat from ducks. Third, introduction was the fruit culture. Farmers have already harvested pineapple two years and other fruits for the current year (2007), i.e. lychee and other fruits with the recommended techniques the crop showed rapid growth and produced fruits faster than their local trees. In addition, farmers adopted the new crop varieties of rice and maize. The farmers noted that these rice varieties and maize are shorter in maturity with higher yield potential, more over, rice has a good milling quality and good taste as well. Lastly, planting techniques and cropping patterns were accepted.

However, some technologies were not adopted by farmers following on-farm trials. First, frog raising was fully abandoned and this was due mainly to the unavailability of natural feed for the frogs in the village. The farmers had to spend longer time or high labor hours to drill the soil to find earth warm to feed frogs. In addition the farmers were not in a position to maintain warm condition during cold months (December – February). Off-season cabbage was an interested option used in on-farm trials but not adopted by farmers. The farmer group participating in on-farm trials realized that heavy rain damage

during planting and young plant stage of cabbage. The farmers have suggested the need to adjust planting time by advancing the planting date to avoid heavy rain effect on newly transplanted and young plants. Another rejection was the growing legume (black cowpea) as green manure before rice and growing soybean after harvesting rice. This was due mainly to the unavailability of legume seeds in the local area and very low productivity of soybean. For soybean, the planting has to be delayed as the farmers have to wait for the harvesting of long maturing period of local rice varieties. In addition, there was an inappropriate planting technique.

Table 4.23 Technologies received and adapted

Techniques	Project area						Non-project area					
	Namo		Pangtong		Total		Nakam		Kiewlan		Total	
Farming systems	Fr	Ad/Ab	Fr	Ad/Ab	Fr	Ad/Ab	Fr	Ad/Ab	Fr	Ad/Ab	Fr	Ad/Ab
Rice+fish	8	8/0			8	8/0						
Rice+duck	8	8/0			8	8/0	1	1/0			1	1/0
Green manual-rice-soybean	4	0/4			4	0/4						
Agro-forestry	3	3/0	3	3/0	6	6/0						
Integrated fruit	2	2/0	8	4/4	10	6/4						
Cabbage	3	0/3			3	0/3						
Rice-pumpkin							5	0/0			5	0/0
Crop establishment												
Fruit planting	10	10/0	7	7/4	17	17/0						
Rubber planting	8	8/0	9	9/0	17	17/0	14	14/0	6	6/0	20	20/0
Rice seedling	8	8/0	1	1/0	9	9/0						
Maize planting									5	5/0	5	5/0
New crop variety												
Rice	8	8/0			8	8/0						
Fruit plants	10	10/0			10	10/0						
Maize	1	1/0	4	4/0	5	5/0	7	7/0	4	4/0	11	11/0
Livestock rearing												
Cassava+peagiopi			2	0/2	2	0/2						
Fodder			5	4/1	5	4/1			1	1/0	1	1/0
Pig+fish			1	0/1	1	0/1						
Chicken rearing			2	0/2	2	0/2						
Pesticide use									2	0/0	1	0/0

Fr. = frequency, Ad/Ab = adopted/abandon
(Source: field study, 2007)

The farming system research technologies were grouped as farming system, crop management, livestock rearing and use of crop variety to compare the project impact with that of non-project area. The results indicated that the technology groups of farming systems, crop management and livestock raising are significantly different in technology received and adopted between project and non-project areas, according to Chi-square test at $p = 0.05$, except the use of crop varieties (Table 4.22). This indicated that the farmers in the non-project area also the same improving varieties. The results showed that there is no a difference in the generation of the technology and contribution to productivity of the project area compared to that of non-project area. Because, crop seeds are available in the local markets especially maize seed.

Table 4.24 Comparison between project and non-project areas for technologies received and adoption

Received technologies	DF	Observed X^2 value	Significant at P = 0.05
Farming systems	1	22.675	Yes
Crop management	1	14.182	Yes
New crop varieties	1	1.013	No
Livestock rearing	1	5.014	Yes

4.9.8 Farmers' perception on farming systems research

The FSRP during 2002 to 2007 has introduced many Cropping systems with some agronomic techniques and livestock raising systems in the project target villages. Hence it is essential to understand how the farmers perceive the research activities introduced by the project. The perception was analyzed using Weight Average Index as suggested by Miah (1993).

Seven different type of understanding among the farmers on farming activities in separate villages were used (Table 4.23). Most of respondents agreed that they received benefits from FSR activities of in project in the target villages and the highest index value was in project supported farmers with appropriate uses of research topics, knowledge on research activities and ability to understand the researchers' explanations in the project area with WAIs of 0.96, 0.99 and 0.99, respectively. All respondents from village Kiewlan had WAI values lower than 0.5. This indicates that these farmers have not yet understood the new farming systems concept activities and most of them were neutral in their responses.

Table 4.25 Weight average index (WAI) for selected activities and perception among the respondents on farming systems research

Activity	Project area			Non-project area		
	Namo	Pangtong	Total	Nakam	Kiewlan	Total
Research topics area appropriate	0.55	1.0	0.96	0.82	0.43	0.67
Benefit knowledge of research activities	0.98	1.0	0.99	0.67	0.44	0.58
Understand on researchers' explanation	0.98	1.0	0.99	0.67	0.44	0.58
Can adapt new techniques	0.56	0.69	0.6	0.43	0.31	0.31
Techniques are not difficult	0.65	0.72	0.68	0.6	0.34	0.5
New farming systems are not complicated	0.74	0.75	0.74	0.63	0.34	0.5
Can manage new farming systems	0.95	0.81	0.87	0.67	0.41	0.56

(Source: field study, 2007)

4.9.9 Farmers' participation on research activities

This section presents the ethnicity of household participation, continuity of household on on-farm research and number households participating in on-farm trials.

Ethnicity participation of on-farm household in Namo District

In the project target villages consisted of tree ethnic groups, i.e. Lao Lum, Lao Toeng and Lao Song. Each ethnic group has different behavior in farming practices. Lao Lum is mainly based on lowland farming systems, where as Lao Toeng and Lao Song have more preference to upland farming activities than the lowland.

In order to understand the ethnicity participation in on-farm trials and their contribution to farming systems research project has initiated the research activities during 2002 to 2006 and the ethnicity of on-farm trials was analyzed (Figure 4.10). The results show that through out the FSR period from 2002 to 2006 the participation of households of Lao Toeng and Lao Song ethnic groups was greater than Lao Lum. This shows that research activities were more diverse in upland agricultural systems than lowland.

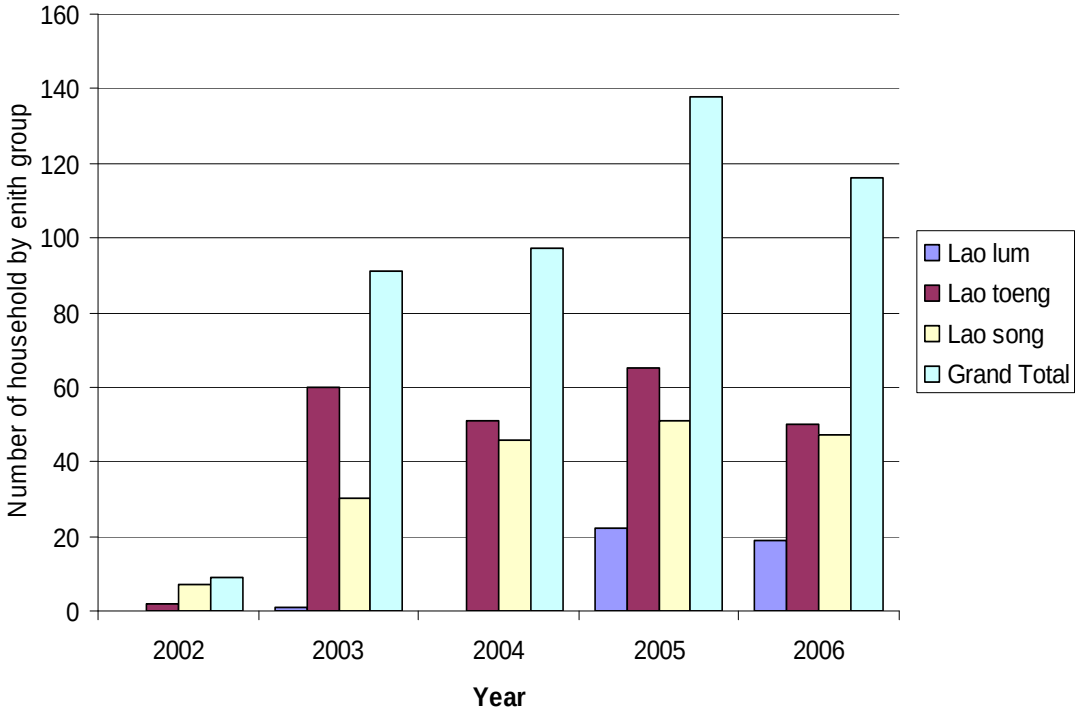

Figure 4.10 Ethnicity participation in terms of number of households in each ethnic group in on-farm trials of the farming systems research project (Source: NAFRI, 2007).

Continuity of households on on-farm trials

Farmers' participating in various number of on-farm trials is one important ways to translate new knowledge and technologies. Duangsavanh (2007) indicated that lack of supporting research activities affected farmers' learning on application of alternative technologies in their farms. The Figure 4.11 shows that most of the households participated with one on-farm trial, and the participation has increased every year. In contrast, the number participating households with two and three research topics decreased. Only a very small number of households participated in activities with four on-farm trial topics, moreover, this group disappeared in 2006. According to (farmer profile survey, 2006) the limitation of lands and number of labor are main reasons participating with only one topic of the on-farm trials and un participating households.

Number households participating in different on-farm trials

The household participation in different farming systems research components are shown in Figure 4.12. The participatory research on perennial crops has risen and the trend of annual crops and livestock trials has decreased after four years of the implementation of research program. According to topographical information lands are more appropriate for perennials than annual crops and small livestock production. In addition, lowland areas are limited, and water resources are in adequate for whole lowlands for rice production. It was also seen that some of the technologies recommended with on-farm experiments were already used in the extension activities of the development of agriculture.

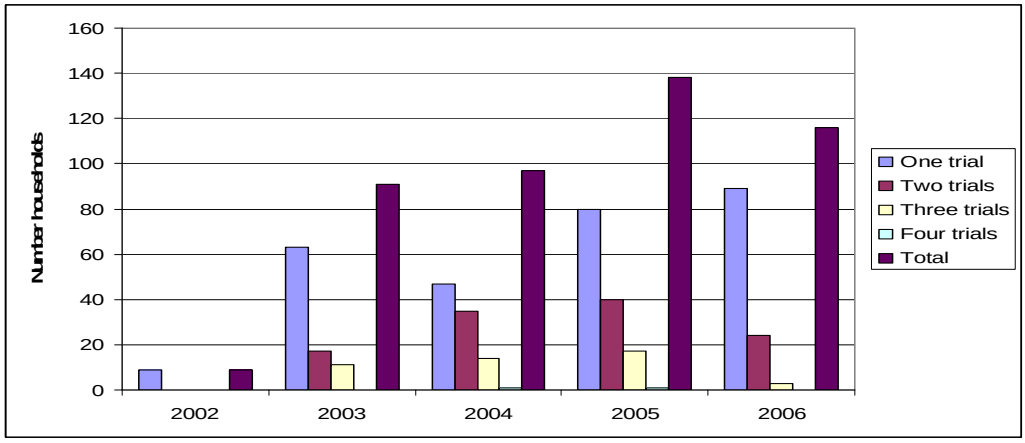

Figure 4.11 Household participation in number on-farm trials of the farming systems research topics. (Source: NAFRI, 2007)

4.9.10 Gaps and constraints in knowledge translation

The assessment of the farmers' knowledge translation gaps and constraints existing between two category of farmers, i.e. project and non-project areas, was made using awareness on recommended farming systems, related information sources accessed by farmers and training participation and study tour opportunities.

Awareness on recommended farming systems

The Lao-Swedish Upland Agriculture and Forest Research Program (LSUAFRP) that was initiated in the year of 2002 conducted the farmer participatory on-farm trials, various agronomic techniques and new farming systems with crop and livestock as well as agro-forestry production by introducing to project target villages. It was therefore necessary to assess the farmers' acceptability of recommended technologies. In order to assess the contribution by farming systems research program with various on-farm trials, introducing several new agronomic techniques, the frequencies of the awareness of the farmers to farming systems activities, accessibility to information, training knowledge gaps opportunity were used to.

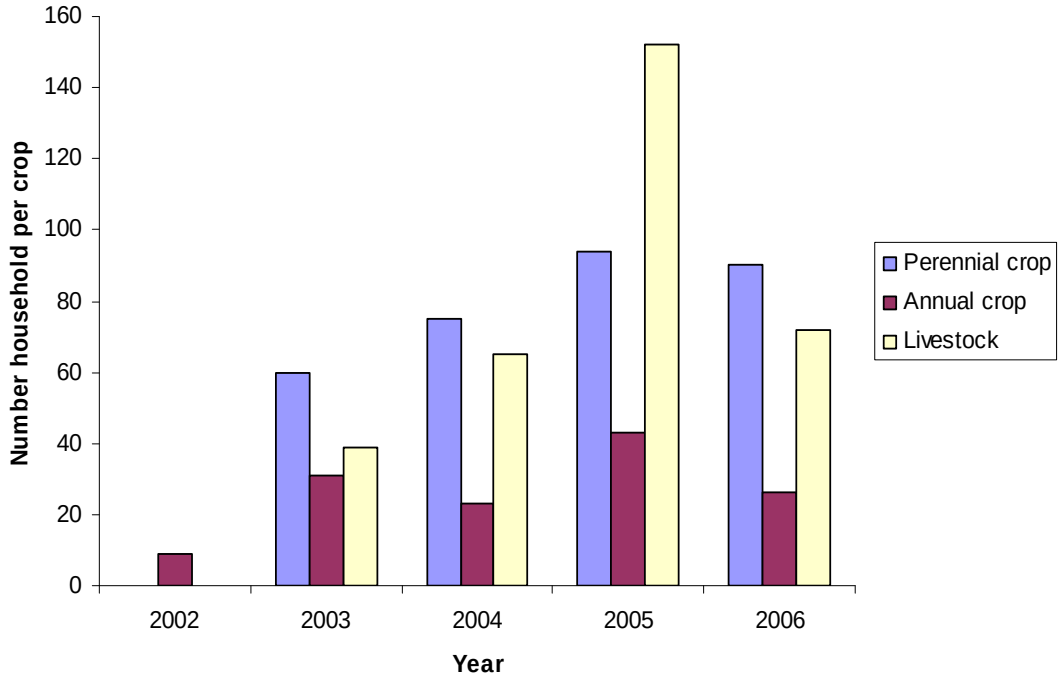

Figure 4.12 Number households participating in different on-farm trials in the project area. (Source: NAFRI, 2007)

According to farmers' awareness of farming systems activities, the proportion of the respondents of the project participating farmers was higher than 70% in four of the six activities targeted (Table 4.24). All these activities in the non-project area were lower than 70%. This highlights the fact that the awareness of the farmers on the farming practices in project participating villages has been improved. However, many farmers in Pangtong village were neutral in their response, which indicates that either farmers were not certain of the technologies or they may have had some difficulties in adopting some recommended activities. Some farmers, however, reported that weed control was difficult in integrated fruit tree plantations.

Information sources

Access to sources of agricultural information is one of the ways to enhancing the capacity of many other farmers. Farmers' knowledge, experiences and technologies can be transferred directly or indirectly to their neighbors, family, extensions, researchers and traders.

The most of the farmers of the project target area have obtained the information from traders followed by neighbors and researchers (Table 4.25). In the non-project area, almost all the farmers receive information from their neighbors on technologies and production materials, and only a very few received from the extension workers. However, many farmers noted that receive information by listening to extension workers or traders. They requests that practicing the recommended techniques in the field by advising of researchers or extension workers be included in the knowledge transfer rather than lectures watching a video showing new technologies.

Table 4.26 The farmers' awareness of farming system activities in two study areas

Activity	Project area						Non-project area					
	Namo		Pangtong		Total		Nakam		Kiewlan		Total	
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	Fr.	%
Integrated production	17	73.9	13	81.25	30	76.9	11	47.8	7	43.8	18	46.2
Crop-animal integration	15	65.2	13	81.25	28	71.8	10	43.5	4	25	14	35.9
Integrated water use	11	47.8	1	6.25	12	30.8	7	30.4	-	-	7	17.9
Integrated farming is practicing through the year	18	78.3	13	81.25	31	79.5	8	34.8	3	18.8	11	28.2
Integrated farming diverse food kinds	18	78.3	1	6.25	19	48.7	18	78.3	9	56.3	27	69.2
Labor use in integrated farming	20	87	14	87.5	34	87.2	12	52.2	8	50	20	51.3

Fr. = Frequency
(Source: field study, 2007)

Table 4.27 Source of information and the number farmers receiving such source

Type of information	Project area				Non-project area			
	Neighbor	Extension workers	Researcher	Trader	Neighbor	Extension workers	Researcher	Trader
Crop variety	14(36)	2(5)	9(23)	14(36)	32(82)	1(3)		3(8)
Fertilizer			7(18)	8(21)	5(11)	1(3)		8(21)
Chemical insecticide	6(15)	-	4(10)	13(33)	-	2(5)	-	10(26)
Cropping systems	1(3)	4(10)	16(41)	16(41)	17(44)	1(3)	-	5(13
Crop seed	15(39)	2(5)	1(3)	15(39)	35(81	-	-	4(10)
Animal breed	3(8)	1(3)	9(23)	12(31)	36(92)	-	-	2(6)
Grassing			12(31)	15(39)	1(3)	-	-	
Production inputs	7(18)	3(8)	1(3)	12(31)	17(41)	1(3)		5(13)
Rubber planting	19(49)	-	-	6(15)	19(49)	-	-	8(21)
Total	65(19)	12(3)	59(17)	111(32)	162(46)	6(2)	-	45(13)

(Source: field study, 2007)
Note: The number in parenthesis is percentages of the frequencies

Training participation and study tour opportunities

Training, study tours or field visits are effective methods of learning new farm practices to farmers. The training areas of crop, livestock and fishery production were used in the assessment. The results show that no farmer in the non-project area has had any opportunity to participate neither of any training nor in a study tour. In the project areas farmers have had many opportunities to attend training courses regional study tours etc.

Table 4.28 Training and study tour participation available to the farmers

Training/ study tours	Project area 1/			Non-project area		
	Namo Village	Pangtong Village	total	Nakam Village	Kiewlan Village	Total
Training						
Crop	9(39.1)	9(56.3)	18(95.4)	-	-	-
Livestock	5(21.7)	2(12.5)	7(34.2)	-	-	-
Fishery	3(13.0)	-	3(13.0)	-	-	-
Study tour						
Crop	4(17.4)	2(12.5)	6(29.9)	-	-	-
Livestock	2(8.7)	2(12.5)	4(21.2)	-	-	-
Fishery	-	-	-	-	-	-

1/ The number in parenthesis is the percentage of the frequencies
(Source: field study, 2007)

Table 4.29 Statistic analysis of the knowledge gaps and constrains of farmers in the two study areas

Activities	DF	Observed X^2 value	Significant at 95%
Integrated production	1	4.639	Yes
Crop-animal integration	1	2.494	No
Integrated water use	1	0.092	No
Integrated farming is practicing through the year	1	13.256	Yes
Integrated farming diverse food kinds	1	0.041	No
Labor use in integrated farming	1	5.334	Yes
Crop production training	1	23.400	Yes
Livestock production training	1	7.690	Yes
Fishery culture training	1	3.120	No
Crop production study tour	1	6.500	Yes
Livestock production study tour	1	4.216	Yes
Fishery study tour	-	-	No

(Source: field study, 2007)

The hypothesis that the effects of the project on knowledge gaps, translation and constrains of the farmers were equal was tested using by Chi-square test. The results show that most of the activities tested were significantly different at 0.05. The study tours for fishery component were not available in both areas of the study. Therefore, it is a technology that both the project and non-project area received for dissemination in order to enhance the farm productivity and livelihood of the farmers. It should not also be ignored the fact that many agricultural technologies have been introduced to all agricultural areas by the department of agriculture, and the current state of productivity and production is a result in the non-project area. Therefore farmers in the project area not much benefits from the project.

4.9.11 Livelihood status

Table 4.30 shows that project supported villages have many activities, where as the rest has a very few activities.

Table 4.30 Livelihood status based on farm activity distribution in study areas

Type of farm practice	Project supported villages	Non-supported villages
Lowlands	Wet season rice with traditional photo-period sensitive and improved non-photo-period sensitive varieties, raising ducks and fish integration in rice fields, some households growing dry season rice and vegetables.	Single sole rice cultivation with traditional 3-4 long and short mutuality photo-period sensitive varieties and home vegetable gardens.
Uplands	Rice and maize cultivation integrated with rubber and fruits plantation, integrated fruits: mango, lychee, tangerine, pineapple and galangal. Integrated agro-forestry system with eagle wood, banana, biter bamboo and other NTFPs.	Sole rice, maize vegetables. and rubber cultivation.
Livestock raising	In both project supported and non-supported villages livestock raising is important production component. Buffalos are used for draft in lowland rice planting land preparation. Cattle and goats are mainly for household income generation but not every household were hold buffalo and cattle. Pigs and poultry (chicken and duck) are raised by every household for home consumption and income generation.	
Farm activity	Lowland and upland rice, maize cultivation, rubber, fruits and NTFP in agro-forestry cropping systems. Livestock raising: pigs, poultry, buffalos, cattle and goats, fodder planting.	Lowland and upland rice cultivation, rubber plantations. Livestock raising: pigs, poultry, buffalos and cattle.
Non-farm activity	Gathering NTFPs for household food consumption and cash income generation.	

CHAPTER 5
SUMMARY, CONCLUSION and RECOMMENDATIONS

This chapter includes summary of the findings of the current research, conclusions and some recommendations for implementation and further research.

5.1 Summary of Findings

Social conditions - The households were dominated by two-family type (41.0%) in the project supported villages, while one-family type households were dominant (64.1 %) in the non-project participating villages, and the adult group (>15 to 50 years) was with 49.3% and 43.9%, respectively. The proportion of minors (1 to 8 and >8 to 15 years old) was greater in the non-project area (28.9% and 21.3%, respectively) than non-project area (23.5% and 16.2%, respectively). The majority of the respondents are farmers with 41.4% and 37.7% in project and non-project areas, respectively. Of the farmers 44/0% in the project target and 44.7% in the non-project area are literate with primary level education.

Farm practices - Land holding size for lowland rice (0.5 – 1 ha) are dominant in both project (64.9%) and non-project (64.5%) villages. The upland farming practices are more diversified in the project participating villages than in non-participating villages. In the project area: rubber is under-story cropped either with upland rice or maize in the first and second years, tall fruit crops are inter planted with pineapple, and non timber forest plants in agro-forestry systems with eagle wood trees are mixed planted with tootiang, bitter bamboo and banana. The average land size of rubber is 1.2 ha in the project area and around 0.9 ha in the non-project area, The fruit and agro-forest systems are found only in the project area with 1.7 ha and 0.8 ha, respectively. In the non project area, rubber and upland rice or maize are grown as sole crops.

Both lowland and upland rice, maize, vegetables and root and tuber crops (cassava sweet potato) are common annual crops. Vegetables such as cucumber, chilies, and egg plant, mustard, garlic, herbs, sweet potatoes and cassava and tubers are grown in small proportion. Introduction of rubber has encouraged the development of access roads and infrastructure in the project supported areas.

Pigs (74.4%) and poultry (69.2%) are common in project supported respondents, while in the non-project area the values accounted for 84.6 % for both pigs and poultry, and which are mainly for home consumption, religious rituals, income generation and manure for home gardens. Farmers in both project and non- project villages prefer goats, under cut and feed method.

Technologies and adaptation - Among the technologies introduced in the project area during 2002 to ducks and fish raising in the lowland rice has become a popular practice. The information in the project area comes from on-farm research, farmer training and regional study tours, while in the non-project area, the information comes form their neighbors and boutiques, and no opportunities to participate in training and study tours.

Farmers' perception on farming systems research activities - Most of respondents agreed that they have gotten benefits from research activities, and the highest index value was found in project supported farmers of the statements of "appropriate" for your village, have "generated knowledge" from research activities and understood researchers' explanation in average project area level of 0.96, 0.99 and 0.99.

Farmers' participation on research activities - Weight Average Index values were highest in project supported area for appropriate uses of research topics, knowledge on research activities and ability to understand the researchers' explanations with 0.96, 0.99 and 0.99, respectively. All respondents from village Kiewlan in the non-project area had WAI values lower than 0.5 which indicates that new farming systems concept and activities not reached so far.

5.2 Conclusions

In the study areas project and non-project villages upland rice, maize and vegetables remain the major practice. The rubber is the most favored crop of farmers due to high demand for rubber from neighboring countries. The lowland fields have higher capacity to diversify in both project and non-project villages compared with uplands.

Lowland and upland rice, maize and vegetables are grown mainly for home consumption and income generation. The productivity of these crops was not significant different between project and non-project areas. The rubber is the promisingly increased upland crop in the study areas. Among the animals pigs, poultry, goats and cattle are the feasible animals that could be reared with intensive feeding methods.

Some recommended technologies of on-farm research were not adopted by farmers, but adopted ones need to be disseminated to other farmers in the project villages. The project area was more diversified in farming systems than in the villages not supported by the project. However, some technologies used in the project area had already been used in the neighboring villages, which is probably through current extension systems.

Farmers in the project area had opportunities to attend farmer trainings and study tours to other outstanding on-farm research locations in the country, but that opportunity was scanty for those in the non-project area. The knowledge and awareness among the farmers were better with participating in agricultural activities than listening to researchers' views and presented at seminars alone and hence farmers in the project area appeared to be better in the adoption of technologies with on farm research activities than those in the non-project area. Therefore, on-farm trials be conducted with the farmer participation, which will improve farmers' knowledge and exposure to technologies targeted by the project.

A constraint for the continuation of promoted technologies is the non-availability of some key inputs, such as seeds, specific varieties, etc. The arrangement of these inputs in the farming areas would enable to increase agricultural productivity and farmers' incomes and livelihood.

5.3 Recommendation for research and additional support activities for future

Based on the results of the study and farmers' feed back, there are some reconsideration for the previously abandoned farming systems activities, and which are indicated below:

1. Feasibility of growing cabbage, tomatoes and other vegetables under integrated pest management during off season needs to be proven and popularized. This is because off-season vegetable production is a feasible way to generate farmers' household income.

2. Intensive crop production in the lowland rice fields with crop diversification needs to be improved with declining upland rice extents due to increasing rubber cultivated area in order to ensure the stable food production and availability.

3. With the adoption of cut and feed methods, raising larger animals may be more advantageous than pigs and poultry, provided that fodder production be promoted. This should be undertaken by the project as an on-farm research activity.

4. Seed availability has so far been a major constraint for continuation with green manuring, and will be a problem with crop production. Therefore, introducing a seed production program coupled with the on-going cropping would favor the continuous crop production.

5. Continuous adoption of on-farm trials would make a better impact in introducing and continuing with appropriate technologies rather than restricting to one or two trials. The methodology of the on-farm research should also be modified to achieve long term benefits.

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Appendix

ppendix A

Research Questionnaire

Interviewer…… Date……..

Respondent Name …….. Village……Age: ……..years

Status of respondent: in the project target, (….) yes,(….) no

Ethnic ……

1. **Household Information**

Q1. Please mention the following characteristic of your household members?

Characters	**No**
Total member of household	
Male No	
Female No	
No of married Male Female	 ……. …….
Distribution among the age group • 1 – 8 years • >8 – 15 years • >15 – 50 years • >50 years	 ……. ……. ……. ……
Education • Illiterate • Primary • Secondary • High school • Other specific study	 …… …… …….. …….. ……
Major occupation • Agriculture • Service (Trade) • Handicraft • Student • Hire labor	 …….. …….. …….. …….. ……..
Minor occupation 1. …… 2. …… 3. …….	 …… …… …….

2. Land holding and use

Q2. Extent of land for agricultural?

Land type	Lowland (ha)	Upland (ha)	Livestock (ha)
1. Total land			
2. Land owned			
3. Land rented			
4. Other(specify……)			

3. Farm characteristics and exiting farming systems

a) Cropping systems

Q3. What cropping systems do you practice?

Name of cropping system	Area (ha)	Yield (Kg)	Land type
Mono cropping			
1……	…….	…….	…….
2……	…….	…….	…….
3……..	……	…….	……
Mix or inter cropping			
Annual and annual base	…….	1:……	…….
1……	…….	2:…….	…….
2…….	……	3:…….	……
3…….			
Perennial and annual			
1……	…….	1:…….	…….
2…….	…….	2:…….	…….
3……	……...	3:……	……...
Sequential cropping			
1……	…….	1:……...	…….
2……	…….	2:……...	…….
3…….	……	3:…….	……
Rotation.			
1……..….	…….	1…….	…….
2……	…….	2…….	…….
3…….	……	3…….	……

Land type: (1) = Upper, (2) = Medium, (3) Low

Q4. When is each cropping system practiced in the year?

Name of cropping systems	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Dec	Nov
Mono cropping												
1…….....												
2…….												
3……												

Mix or inter cropping Annual and annual base 1……. 2……. 3……. Perennial and annual 1……. 2……. 3…….												
Sequential cropping 1……. 2……. 3…….												
1……. 2……. 3…….												

Q5. What are the sources of water?

(…..) Rainfall 100%
(…..) Catching from water stream
(…..) Water pound
(…..) Wells
(…..) Other(specify)……

Q6. Is water sufficient for growing crops? (…) Yes, (….) No

If No, when is the deficiency occurred? (….) Earlier , (…)Middle, (…)Late growing season

Q7. Which of the following reasons lead to practicing these cropping systems?

(....) Increase crop yield, (.....) More food type, (.....) Market available

Q8. How long have you been practicing your production systems?

(…) last 1 Year, (…) 2 Years, (…) 3 Years, (…)> 3 years

b). Animal raising systems

Name of systems	Area ha	Number of animal	Crop yield kg	Animal product	Animal feed use of crop
Crop + animal 1…….. 2…….. 3……..	……. …….. ……..	……. …….. ……..	……. …….. ……..	……. …….. ……..	……. …….. ……..
Fodder + animal 1……. 2……. 3……	……. …….. ……..	……. …….. ……..	……. …….. ……..	……. …….. ……..	……. …….. ……..

Crop + fish 1……. 2……. 3……	…… …….. ……..	…… …….. ……..	…… …….. ……..	…… …….. ……..	…… …….. ……..
Animal + fish 1……. 2……. 3……	…… …….. ……..	…… …….. ……..	Fish kg …… …….. ……..	…… …….. ……..	Feeds …… …….. ……..

Q9. What way you find feed for animal? (…)Purchase , (…) self produce,
If produce, what is/are seasonal calendar/s? (growing and harvesting)

Name of crops	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Dec	Nov
Crop + animal 1…… 2…… 3……												
Fodder + animal 1……. 2…… 3……												
Crop + fish 1…… 2…… 3……												
Animal + fish 1…… 2…… 3……												

4. Crop related information

Name of crop	improve	Tradit.	Why	Seed rate Kg/ha	Productivity Kg/ha
Lowland rice ……. ……. ……..			 ……. ……. ……..		
Upland rice …… …….. ……			 ……. ……. ……..		
Maize ……. ……. ……..			 ……. ……. ……..		
Legumes …… ……			 ……. …….		

			……..		
Vegetable …… …… …….			 ……. ……. ……..		
Fruit …… …… ……..			 ……. ……. ……..		

4. Soil fertility management

Q10. Do you use Chemical fertilizer? If yes,

Crop	Type of fertilizer/crop	B.D. Kg/ha	When DsAP	T.D. Kg/ha	When DsAP

* (B.D) = Basal dressing , (T.D) = Top dressing, (DsAP) = Days after planting

Q11. Do you use Organic fertiliser?

Type……	%	Quantity kg	Mode of production	Processing
1				
2				
3				
4				

Q12 Have you observed any differences in your crops' performances due to organic manual? If yes, what are they :

1……
2…….
3. ……..

4. **Land preparation related information and tool use**

Operation…	Household		Hire			Exchange
	Tractor	Animal	Tractor	Animal	Cost kip	
Land clearing						
Plowing						
Harrowing						

5. Receiving new technology

Q 13. What new technologies do you use in your farming activities?

New technology	Why needed	Effectiveness	Rate of adoption		
			Continue using	Abandoned	Why
1					
2					
3					
4					
5					
6					
7					
8					

Q 14. What are the currently existing technologies used in the village?

Technology	Problems

Q 15. When was the technology developed?
Q 16. When was the technology distended?.....
Q 17. Rate of adoption % ?.....
Q 18. Rate of continuation %?.....
Q 19. Any reasons for improvement or decline in the adoption and continuation
……

Q20. What are the benefits offered from new technologies?

Technologies	Benefits	How manage before receiving the technology

6. Sources of information and advice for farming practice

Q21 From where do you get information and advice new farming practices?

Type of information	Source of information								
	1	2	3	4	5	6	7	8	9
New crop variety									

Fertilizer use									
Pesticide use									
Cropping systems									
Seed production									
Seed storing									
New animal breed									
Fodder for animal									
Market price									
Input source									

(1) Neighboring/friends, **(2)**District/Provincial agric. Stuff, **(3)**Researchers,

(4) Agric. Promotion bank, **(5)**Radio, **(6)**news paper, **(7)**Formal training,

(8)NGO/Project and **(9)**Others(Explain)…….

Q 23. Did you have chance to attend any training on agricultural production? If yes, please write number times in the space box given below,

(….) Crop production, (….) Livestock husbandry, (….) Fishery, (…)Forestry, (….)Study

tour, (….) Farmer field day and other specify…….

7. Problems and constraints in the implementation of the integrated farming systems

Q24 Do you face of the following experiences problems or constraints?

Problems and constraints	Yes	No	Suggestion
Farm management			
Soil fertility maintaining			
Crop and livestock breed			
Environmental damage			
Pests: insects and weeds management			
Others			

8. Awareness and perceptions for the farming system management and activities

Q24 Do you understand regarding to the Farming Systems and its activities?

	Yes	No
Intercropping in the farm		
Crop and livestock integrated		
Rationally use water for crop and livestock		
Appropriately planed of crop type for labor use before cropping season		
Selection of suitable crop varieties for the condition of the		

fields		
The new farming systems able to practice through the year		
High labor use in the integrated farming systems		
The integrated farming systems enhances reduction for food expends from market		
The new farming systems enhances reduction for shifting cultivation		
I produce for my home consumption and remains are for sale		
Others…… ……		

Q25. Do you agree the farming systems research activities and technologies received such are listed below?

Items	Perception			
	Agree	Disagree	Neutral	Commend
The research activities are suitable for your requirement				
Can benefit knowledge from the research activities				
The researchers monitored regularly				
Could not learn well from researcher				
The technologies are too high tech				
The new farming activities are very complicate				
I can apply the new farming systems by myself				

Q26. Have you practiced the following integrated farming systems? And for without project supported respondents, which farming system is most interested regarding to your land use condition? Please, give mark by ticks in the last box of the farming systems are given below.

a. (……)Fish + lowland rice, …….years, ☐

b. (……)Duck + lowland rice…….years, ☐

c. (…….)Chicken+ cassava + pigeon pea…….years, ☐

d. (…….)Pig + cassava + pigeon pea…….years, ☐

e. (……)Goat + fodder bank…….years, ☐

f. (……)Corn + peanut/soybean intercropping + lemon grass hedgerows…….years, ☐

☐

g. (……)Green manure - lowland rice – soybean relay cropping…….years,

h. (……)IPM for off-season vegetable (Use of neem extract as bio-pesticide) …….years, ☐

i. (……)Fruit trees + hedgerows (stylo + pineapple) + upland rice…….years, ☐

j. (……)Agarwood + Sesbania + Lychee+ Banana hedgerows (stylo) + annual crops…….years, ☐

k. (……)Rubber tree + lychee + annual crops…….years, ☐

- Additional perception regarding to farming systems research implementation

What is your opinion according to the farming system activities practicing?

1) (.....)Difficult (.....)Not difficult.
2) (.....)Effective (.....)Not effective, what?.....
.....

- Do you have any new adopted techniques for next season (....)yes (.....)No, If yes what.....
- New farming systems are involved in following below
  3) Improve livelihood level, (.....)Yes, (.....) No
  4) Make easier farm management, (.....)Yes, (.....) No

Appendix B

Coordination schema for study

Parameter	Complex Variable	Simple Variable	Value
Household information	Respondent and household members	Sex	Male Female
		Age	Figure
		Marital status	Married. Single Other(Spe.)
		Education	Illiterate, Primary, Secondary, High school, Other (specify)
		Major occupation	Agriculture, Handicraft, Service, Student, Wage labor, other(specify)……
		Minor occupation	Agriculture, Handicraft, Service, Student, Wage labor, other(specify)……
Household land holding	Ownership	Total owned Owned Rented	Hectares(ha)
Farm characteristics and existing farming systems	Cropping systems	Mono cropping Mix or inter cropping Sequential cropping Rotation	Ha/yield kg Crop1Ha/yield kg Crop2Ha/yield kg Crop1Ha/yield kg Crop2Ha/yield kg Crop1Ha/yield kg Crop2Ha/yield kg

	Seasonal calendar	Type of farm land	Upper Medium Low
Farm related information	Water sources	Rainfall Water stream Ponds Wells	Area
	Water requirement	Sufficient Deficient	Early season Mid of season Lat of season heck list
	Advantage and disadvantage Type of farming systems	Good product, Easier, For cash	Kg/ha Number of labor use Kip/Kg
Reasons of practicing farming systems	Farm practice Cropping systems Livestock rearing	Crop+Fallow Crop only Crop+fish Crop+Animal	Kip, Kg, Physical evident of farming systems Check list
Farming systems	Crop varieties	Improved varieties traditional Varieties productivity:	kg/ha Check list
Crop breed diversify	Fertilizers application	Chemical fertilizer Organic fertilizer Observation of using	Kg/ha Check list
Soil fertility management	Type of power use Machine Animal Exiting technologies New technologies	Cleaning Plowing Harrowing Crop production Animal rearing	Household Hire Check list No farmer use What, how many
Land preparation related in formation and	Sources of information	Profits of Technologies	Check list

tool use Technology generation and adoption Information Accession Awareness on farming systems activities Perception of farming systems research implementation Farmer preference Training And study tour	 Farm activities Research activities Farm practices Training courses	Sources Crop management Cropping systems Animal management Benefits Advantages Disadvantages Crop production Livestock production	Check list Check list Check list

Appendix C
Pictures

Namo nuear village (Project area)

Pangthong Village (Project area)

Nakham Village (Non-project area)

Kiewlan Village (Non-project area)

Integrated fruits

Integrated fruit and non-timber forest products

Annual secondary cropping after lowland rice harvesting

Water melon

Pumpkin


Processing of feed for pigs


One of the main non-timber forest product

Working with farmers

Expression of hospitality
after completing the field study