THE ROLE OF AGRICULTURAL EXTENSION SERVICES ON RICE PRODUCTION EFFICIENCY IN LAOS

- A CASE STUDY ON BOLIKHANH DISTRICT, BOLIKHAMXAI PROVINCE -

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By

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LIST OF ABBREVIATION

ADB	= Asian Development Bank
DAFO	= District Agriculture and Forestry Office
DEA	= Data Envelopment Analysis
FAO	= Food and Agriculture Organization of the United Nations
Lao PDR	= Lao People's Democratic Republic
LEAP	= Laos Extension for Agriculture Project
LR	= Likelihood Ratio
MAF	= Ministry of Agriculture and Forestry
MLEs	= Maximum Likelihood Estimates
NAFES	= National Agriculture and Forestry Extension Services
NAFRI	= National Agriculture and Forestry Research Institute
OLS	= Ordinary Least Square
PAFO	= Provincial Agriculture and Forestry Office
SFA	= Stochastic Frontier Analysis
VDF	= Village Development Fund
WFP	= World Food Programme

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ABSTRACT

Lao economy is primarily based on agriculture. It accounts for 30% of the GDP and 80% of total population is engaged in this sector. Rice is the most important staple food crop for Lao people with its consumption of 202 kg per capita (2010). Lao rice productivity was very low (1.60 t/ha) compared to Vietnam around 3.50 t/ha and China with 4.60 t/ha. Lao agricultural extension was unproductive in providing technical services; and farmers are lacking of agricultural skills and technology, leading to low rice production.

The objectives of this research are to estimate the technical efficiency of rice farmers and to investigate the impact of agricultural extension services and to examine other factors influencing on technical inefficiency on rice production. The data were collected by using structured questionnaires, face to face interviews and group discussions with heads of villages and agricultural staff from September 12th to October 6th, 2011 in Bolikhanh district, Bolikhamxai province, central Laos. 112 randomized farmers were selected from 6 villages. The Frontier Version 4.1c as Software Program based on Cobb-Douglas Stochastic Frontier Production Function was applied to estimate the technical efficiency and inefficiency.

The results of this research indicated the variables on Labour, seed and machinery were positive and significant at 5% and had effect on rice production. Agricultural extension services, education level and improved rice seed variety were negative and statistical significant at 1% in the technical inefficiency model. The mean of technical efficiency was 53%.

Based on results, some policy implications are in order. The quality of agricultural extension services should be improved especially, dealing with how effectively to reduce the risk of outbreaks of pest and diseases as well as the merits of adopting improved rice seed varieties. Moreover, an increase of the number of farm visits and 26% of surveyed farmers still do not have an access to extension services should be taken into account.

CHAPTER I

INTRODUCTION

1.1 Economy in Laos

Laos has been one of the fastest rates of economic growth in South-east Asia in the past five years, with an average annual rate of 8%. The economy estimation of Laos has increased by 8% in 2010 and is expected to rise by 11% in 2011. This growth mainly reflects higher world prices for Laos' exports, namely copper and gold.

International investment has continued to flow into Laos, with Chinese and Vietnamese state-owned companies channeling funds into the mining and agricultural sector. In 2008, an average inflation was a four-year high of 7.6%, owing to rising global commodity prices and rapid money supply growth, consumer prices are estimated to have remained flat in 2009. In April 2008, Laos had an experience that the deflation with consumer prices dropped by 0.2% years on year. On the other hand, inflation has continued to have been strong since then following the continued economic growth and the expansion of the capital supply in accordance to increase inflows of foreign investments. It estimated to increase on an average of 5% in 2010 (FAO and WFP, 2011).

1.2 Agriculture in Laos

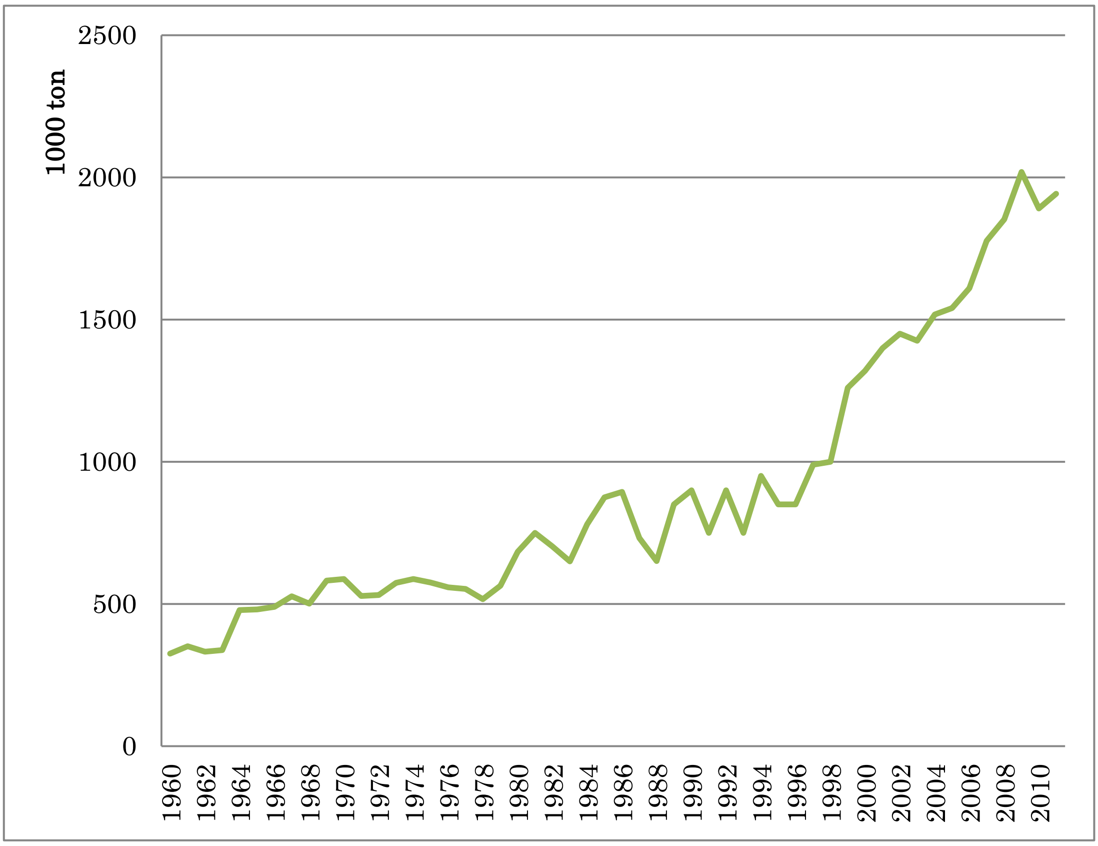
In 2010, approximately 4% of the total land in Laos was arable, and permanent crops covered about 0.35%. Agriculture accounted for around 30% of the country's Gross Domestic Products (GDP). 80% of total population is engaged in this sector. Principal agricultural products are rice, vegetables, maize (the grain being used principally for livestock feed) roots and tubers (cassava, taro and sweet potatoes), sugarcane, bananas and watermelons. The important cash crops include coffee, tobacco and tea. A very large area of rubber trees will bring huge production within the next two years. Geography and lack of infrastructure mean that access to markets in Myanmar, China and Cambodia were still limited, while major transit points to Vietnam are far from both sources in Laos and destination in Vietnam. On the other hand, the country has a long border with Thailand and has ample access to Thai markets. Although historically there has always been a significant cross-border movement of commodities, this has become more formalized in recent years with the granting of concessions to other countries, particularly China. Currently, there are approximately 300 000 hectares of rubber plantation, mostly planted in the last five years under foreign investment in one form or another (outright ownership, part ownership by the community, share-cropping, contracted community labour etc.).

Other important concessions consist of sugarcane, eucalyptus, teak and jatropha. The area under maize, which is grown almost exclusively for livestock feed and mainly for the export market, has increased recently to more than 200 000 hectares in the northern Laos. Attractive contract from neighbouring countries, including provision of seed and the collection of the produce by traders, have encouraged the expansion. National average maize yields are generally between 4.5 and 5 tons/ha. The Ministry of Agriculture is currently involved in discussions and negotiations with foreign governments such as Mongolia and some Middle Eastern countries, regarding the possible leasing of Laos' land to those countries for food-crop production. The foreign countries would be responsible for installing irrigation systems and other infrastructures and would then produce for their own requirements (FAO and WFP, 2011).

1.3 Rice Production in Laos

Rice is the most important staple food crop and one of the main sources of protein intake. Rice is the most important crop and rice cultivation takes place on 65% of the total cultivated areas (FAO and MAF, 2010). In 2010, rice production in Laos attained more than 1.89 million tonnes with total harvested areas of 870,000 ha. The rice consumption per capita was 202 kg in year 2010. Although, self-sufficiency in rice was reached for the first time in 1999 (FAO, 2001), rice was not evenly distributed across the country. Indeed, remote and mountainous areas often encountered food shortages because of a deficient infrastructure.

The Figure 1.1 shows the total rice production in Laos from 1960 to 2010. It indicated that rice production was increased from year to year. In 2010, the total production was 1.89 million tons which dropped from 2.02 million tons in 2009 due to natural disaster “a strong flooding” in 2010.



Source: Shoichi ITO, World Food Statistics and Graphics, http://worldfood.apionet.or.jp

Figure 1.1 Rice Production in Laos from 1960 to 2010

Rice yield of three countries (China, Vietnam and Laos) from year 2010 to 2012 is presented in the Table 1.1. Lao rice productivity was 1.60, 1.76 and 1.75 tons per hectare in 2010, 2011 and 2012 respectively. It was very low in year 2010 compared to Vietnam around 3.50 ton/ha and China with 4.60 ton/ha. Therefore, the research study was necessary to be carried out to find out the factors influencing low rice productivity.

Table 1.1 Rice Yield in Laos and Neighbouring Countries

Country	Milled Rice basis t/ha		
	2010	2011	2012
China	4.59	4.68	4.68
Vietnam	3.47	3.48	3.49
Laos	1.60	1.76	1.75

Source: Shoichi ITO, World Food Statistics and Graphics, http://worldfood.apionet.or.jp

1.4 Agricultural Extension Services

Agriculture has been changing in Laos. More and more Lao farmers are turning a transition from subsistence farming, where they produce food for their own consumption in the family to commercial farming, where they produce commodities for the market-oriented base. The Ministry of Agriculture and Forestry (MAF) supports the transition to commercial farming, as part of Government's aim to develop a market-oriented economy within a socialist framework. The socialist framework means that all sections of the community should benefit from commercial farming.

Laos can learn from the mistakes made in other countries where the transition to commercial farming is beneficial and has a limited number of big producers and companies while many small farmers remain poor. These are the reasons why the government of Laos has decided to develop human resources which should be the engine for economic growth. As part of the Sixth Five-Year Plan, economic development will be harmonized with social development and environmental protection. Agricultural extension has a key role to play in terms of transferring agricultural knowledge and skills to farmers in the human development process. Farmers who are changing their production system from subsistence to commercial farming need to learn many new ideas, technologies, and new mechanisms of organising their works. The role of agricultural extension staff is to facilitate the learning style in a way that reaches farmers' requirement and benefits all sections of the community (NAFES/LEAP, 2006).

1.5 Problems in the Extension Sector

Lao agriculture is fragile and dependent on climate condition. Regions along the Mekong River are affected by flood almost every year during rainy season. In addition, the Lao population has a high growth rate with a subsistence farming system and predominantly is based on rice farming. Indeed, the diversification of agricultural production is very limited. Nearly 85% of rice production in Laos is characterized by farm technologies which use low levels of inputs, low application of agricultural knowledge and skills; and farm mechanization (ADB, 2001). Transferring of agricultural knowledge and skills, and technologies to rural farmers is limited due to low farmers' education, insufficient knowledge and skills of extension workers and the contents of extension services do not meet the farmers' demand. Moreover, the number of extension staff is limited and the fund for extension sector is also limited (NAFES' Annual Report, 2010).

According to NAFES (2005), the problems that can be directly addressed by agricultural extension include:

- Farmers have low educational levels including a lack of basic scientific concepts which are relevant to agriculture;

- Inadequate access to suitable technology and limited knowledge of productive techniques and the skills to apply all those;
- Limitation of exposure to examples of successful farmers, which might improve confidence and enthusiasm for change;
- Limited organizational development and information flow among farmers and a lack of collective plan and action;
- Lack of market information and product standardization including knowledge of prices;
- Limited knowledge about agricultural policies and regulations.

In order to more productively produce rice, agricultural extension services are essential for transferring agricultural techniques and technology to farmers, so that the government has strong commitment to an extension approach that is decentralized, demand-driven and pro-poor. According to Schroeter and Sisanonh (2005), Laos did not have an effective agricultural extension services. Technology transfer to farmers was carried out by related technical departments within the Ministry of Agriculture and Forestry (MAF). In August 2001, the National Agriculture and Forestry Extension Service (NAFES) was established as a department of MAF. This was a fundamental step in the development of a national extension system.

Not all problems can be solved by agricultural extension services. For example, the extension system cannot improve the condition of roads or change market prices. But agricultural extension will help farmers to examine their problems and find the best way to manage their resources in any particular situations.

Under these circumstances and evidences of the facts and figures discussed above, there are three possible methods to increase rice production, namely expand the crop cultivated areas, develop and adopt new production technologies and apply available resources more efficiently. The first two options may need to be time considerable and costs, so that production efficiency improvement is appropriate for individual rural farmers. Therefore, this research study was carried out with the objectives and hypotheses as followed:

1.6 Research Objectives

Many previous studies examine the impact of technical efficiency of crop production at the household level with two sets of indicators, namely economic and social indicators in both developing and developed countries. However, such studies have not been widely conducted in Laos. Therefore, the objectives of this paper are to investigate the role of agricultural extension services on rice production efficiency in Laos, especially in Bolikhanh district, Bolikhamxai province. This study will also address the important technical and economic factors in order to suggest strategies of sustainable agriculture to improve the standard of living of farmers. In order to achieve the main objectives, this research study will identify the following issues:

1.6.1 To estimate technical efficiency of rice farmers;

1.6.2 To investigate the impact of agricultural extension services and other factors influencing on technical inefficiency effects of rice farmers.

1.7 Methodology

The study comprises of qualitative as well as quantitative research. In the first phase literature is collected through the available secondary sources to gather the qualitative information about the agricultural extension services, technical efficiency and rice productivity. In the second phase a quantitative "statistical survey" was conducted to interview one hundred and twelve (112 samples) rice farmers in six villages in Bolikhanh District, Bolikhamxai Province. Hence, the research is a combination of quantitative and qualitative methods (secondary analysis of data and statistical survey) and both of these methods are utilized to find the answers to the research's hypotheses and to reach the research's objectives.

The variables were used in the research study and defined, included production inputs such as: total labour input in man-days, seed used in kg, chemicals used in LAK, hired machinery services in LAK and total rice cultivated areas in ha for stochastic frontier production function. Variables on agricultural extension services (dummy) and experience in rice farming (years), age of family head (years), farmers' education level (dummy), irrigation availability (dummy), and improved rice seed variety (dummy) were used for the inefficiency models to analyze all those mentioned data, stochastic frontier production function was applied based on Coubb-Douglas production function.

1.8 The Structure of Research Study

This research study is consisted of 6 chapters and it is organized as followed: chapter 1 presents the introduction which describes the background of Lao economy, agriculture, rice production and the situation of agricultural extension services. This chapter also covers problems statement, research objectives and methodology. Chapter 2 outlines a literature review and previous studies applying stochastic production function to estimate technical efficiency and inefficiency. In this chapter, it will be discussed the matters of agricultural extension services, mainly the concepts, roles and responsibilities and activities for extension sector. Chapter 3 discusses the methodology, especially: data sources and collection, data analysis methods, stochastic frontier production function and its empirical procedures. Chapter 4 introduces the selected study area. It will focus on the background of study area, District's agricultural extension services, rice production and some agricultural activities in Bolikhanh District. Chapter 5 presents the results and discussion. In this chapter, socio-economic characteristics, summary statistics and results from the model analysis will be explored and some significant variables related to stochastic frontier production model will be explained. Finally, chapter 6 summarizes the overall conclusions, draws some policy implications and limitations of research.

CHAPTER II

LITERATURE REVIEW

In this chapter, section 1 outlines the theory of agricultural extension services, principles and role and responsibilities of different levels in the agricultural sector. Section 2 defines the technical efficiency. Section 3 indicates the concepts of production function and technical efficiency. Section 4 describes the technical efficiency approaches to estimate the production efficiency of firms. Final section discusses previous studies conducted to analyze the agricultural production efficiency in different countries and in Laos.

2.1 Agricultural Extension Services

FAO (1997) expressed that agricultural extension work has a venerable and albeit largely unrecorded history. It has a significant role for social innovation, a crucial force in agricultural change that has been created and recreated, adapted and developed over the centuries. Its evolution has been continued over nearly four thousand years, although its forms are largely a product of the past two centuries. Currently, the organizations and personnel engaged in agricultural extension comprise of a diverse range of socially sanctioned and legitimate activities which are encouraged to expand and improve the abilities of farmers to adopt more appropriate and new agricultural practices and to adjust to changing conditions and societal needs.

2.1.1 Definitions of Extension

NAFES (2005) summarized the definitions of extension from a number of books on extension published over more than 50 years but there is no widely accepted definition of extension. Ten examples given below will describe the concepts of extension starting from 1949 to 2004. They are defined as below:

- **1949,** the central task of extension was to assist rural families by applying science, whether physical or social, to the daily routines of farming, homemaking, and family and community living.
- **1965,** agricultural extension was described as a system of out-of-school education for rural people.
- **1966,** extension personnel had the task of bringing scientific knowledge to farm families in the farms and homes. The objective of this aim was to improve the efficiency of agriculture.
- **1973,** extension was a service or system which helped farm people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living and lifting social and educational standards.
- **1974, e**xtension involved the conscious use of communication of information to help people form sound opinions and make good decisions.
- **1982**, agricultural extension was an assistance to help farmers to identify and analyse their production problems and be able to know the opportunities for improvement.

- **1988,** extension was a professional communication intervention deployed by an institution to induce change in voluntary behaviours with a presumed public or collective utility
- **1997,** extension was the organized exchange of information and the purposive transfer of skills.
- **1999,** the essence of agricultural extension was to facilitate interplay and nurture synergies within a total information system involving agricultural research, agricultural education and a vast complex of information-providing businesses.
- **2004**, extension was a series of embedded communication interventions which were meant among others, to develop and/or induce innovations which supposedly help to resolve (usually multi-actor) problematic situations.

2.1.2 Principles of Agricultural Extension Services

Sisanonh, (2004) mentioned that principles of agricultural extension services focus on:

- Building farmer’s capacity to help themselves and enable them to apply technologies suitable to their situation and available resources;
- Transferring agricultural techniques and technologies based on research and other crosscutting information sources;
- Providing consultation and technical services to solve farmer’s problems.

2.1.3 Role and Responsibilities of Extension Staff at Different Levels

According to Schroeter and Sisanonh (2005), role and responsibilities of extension sector (Details of roles and duties for different levels shown in Appendix 3) within the ministry of Agriculture and Forestry are described in following:

At the department's level: National Agriculture and Forestry Extension Services (NAFES) have responsibilities to assist the Minister in organising and encouraging extension in the fields of agriculture and forestry. Under the NAFES is comprised of Technical Division that coordinates and links with research, education and the technical departments at MAF, and manages extension implementation and the technical division has some units. One of those is Central Extension and Training Development Unit and its duties are:

- To develop methods and curricula;
- To coach staff in all provinces and districts;
- To train provincial and district extension staff in pilot areas;
- To facilitate information flow between village and central levels;
- To supervise extension activities with the provincial level on a regular basis;
- To maintain a network with national and international institutions and a knowledge database.

At the provincial level (Agriculture and Forestry Office=PAFO), it is necessary to manage provincial agricultural and forestry activities and technical sections in the PAFO and to provide advice on particular production systems. Provincial Agriculture and Extension Service (PAES) is existed in the PAFO and has the following functions:

- Training and coaching of district extension generalists;

- Identifying training needs of DAFO staff and farmers;
- Monitoring, preparing reports and conducting the impact assessments;
- Coordinating between DAFO and Technical Sections;
- Developing extension materials for specific agro-ecological situations.

At the district level (District Agriculture and Forestry Office=DAFO), some jobs and tasks are assigned, mainly: regularly maintain contact with farmers, reports of implemented activities, problems and farmers' needs to the PAFES and connecting farmers with Subject Matter Specialist (SMS), funding institutions and private sectors (among others). DAFO's extension generalists have to accomplish following tasks:

- To train and coach the Village Extension Workers (VEW);
- To set and follow up learning projects;
- To apply (recurrent) Training Needs Assessments;
- To facilitate (initially) farmers COPs and VEW COPs;
- To assist identifying basic agricultural and livestock problems.

Finally, the Village Extension Workers (VEW) have to participate in VEW-COPs, initiate and facilitate learning projects, share knowledge and skills with production groups. They are compensated by the villagers in cash, kind or labour and the village extension workers have to extend learning projects to non-learning-project-members.

Ajakaiye (1978) indicated that extension staff should have a comprehensive description of job requirements. The seven main functions of extension workers are defined as followed:

1. To be conversant with the latest developments and research in their subject-matter area and related disciplines.
2. To develop programmes which are relevant for solving the problems.
3. To be an effective liaison or link between the university, college and other research institutions and the government's extension services and the general public.
4. To be able to do some consulting work as may be required by the government organizations or individuals, or their representative, approves in certain circumstances where the normal duties of the specialist will be unduly disrupted.
5. To be a problem-solver as often as they may be called upon to be by the government or institutions.
6. To improve the capabilities of the extension staff by the systematic or continuous provision of educational programmes.
7. To contribute to the overall effectiveness of extension.

The above mentioned functions are not easy for any individuals without a mature and wide range of experience in extension programming. The extension specialist or staffs have to be competent professionally and have a good background in extension methodology, to be able to perform these different functions effectively and with a high degree of efficiency.

2.2 Technical Efficiency

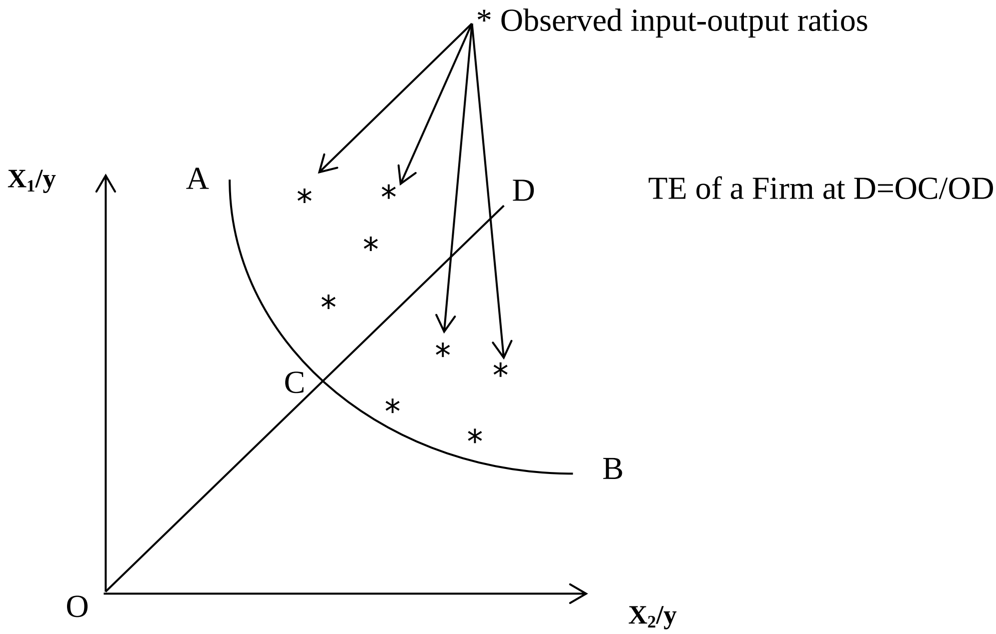
Farrell (1957) defined that technical efficiency is the ability of a firm (farm) to produce a maximum possible output with a minimum of inputs by given technology.

Oluwatayo, *et al.*, (2008) indicated that production is the process of transforming inputs mainly, labour, capital and land into an output including services or products. These production resources can be organized into a farm-firm or producing unit. Its final objectives can be profit or revenue maximization, physical maximization, cost minimization or utility maximization or a combination of four objectives. In the possible way, a manager or entrepreneur or the firm may be concerned with the efficiency in terms of using input resources in order to achieve their goals. The economic efficiency appears when the cost of production of output is as low as possible.

The concept of productive efficiency composes of two components such as technical or physical efficiency and allocative or price efficiency. The technical efficiency is the ability of a firm to obtain the maximum attainable level of output from a given set of inputs, on the other hand allocative efficiency is the ability to use the production inputs in the optimal combination by given respective prices and given production technology. Economic efficiency or overall efficiency is the product of technical and allocative efficiency. In order to have economic efficiency, a farm has to have both technical and allocative efficiency. Based on Coelli, *et al.*, (2005), mentioned above terminologies for respective efficiency are applied in recent papers.

Farrell (1957) indicated that the measurement of technical efficiency can be gained by using inputs and output quantity without giving any prices of these inputs and outputs. Technical efficiency can be comprised of three components mainly: scale efficiency, congestion and pure technical efficiency.

Farrell (1957) and Battese (1992) used a graphical diagram to explain the concept technical efficiency as outlined in Figure 2.1, indicating that production function estimation had constant returns to scale, Farrell (1957) mentioned that input per unit of output values of a firm is above the so called isoquant which is defined as in the Figure 2.1.



Source: Reproduced by Battese (1992).

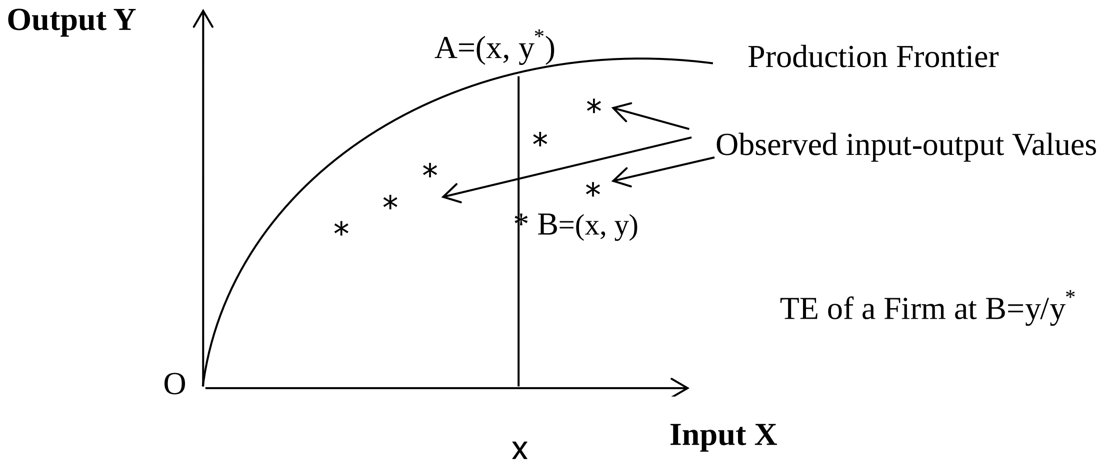
Figure 2.1 Technical Efficiency of a Firm in Relationship with Input Space

This means that two input factors, X_1 on the horizontal axis and X_2 on the vertical axis are used to produce the output “Y”. Therefore, the input per unit of output ratios (X_1/Y and X_2/Y) is called the unit isoquant curve, representing AB. The unit isoquant is the input per unit of output ratios in relation with the most efficient use of the production inputs to obtain the output. The deviation of observed inputs per unit of output ratios from the isoquant unit was considered due to the firms’ technical inefficiency. For an example, a farm is producing at a point D. At the point D, the farm is producing the same level of output as producing on the unit isoquant AB. Now, it can be seen from O to D that explains the technical efficiency of that farm. The line OD passes through the point C indicating that it has the same level of output produced by X_1

and X_2 at the point C. This reflects that the observed firm produces technically inefficient, since the equality level of output needs additional inputs produce at point D compared to point C. Therefore, Farrell (1957) expressed that the ratio (OC/OD) is the technical efficiency of the firm with an input per unit of output values at point D. A value of one shows that the firm has a full technical efficiency. An example is at the point C where is technically efficient because it is on the efficient isoquant due to Coelli, *et al* (2005).

2.3 Concept of Production Function and Technical Efficiency

In microeconomic theory, firms can produce a maximum output with a specified set of inputs by given the existing technology available. Figure 2.2 describes that the horizontal axis X represents the input and the vertical axis Y is a representative of output. The observed input-output values are below the production frontier, indicating that a firm does not obtain the maximum output possible for inputs involved by providing the technology available. A measurement of technical efficiency of a firm is defined that a firm produces an output (y) with inputs (x) at the point B, indicating that y/y* where y* is the frontier output related to the inputs level at the point A. This is a measurement of technical efficiency, indicating that it is conditional on the input levels involved.



Source: Reproduced by Battese (1992)

Figure 2.2 Technical Efficiency of a Firm in Input-Output Space

2.4 Technical Efficiency Approaches

According to Coelli, *et al.* (2005), three technical efficiency approaches have been applied to measure productive efficiency namely, productivity indices based on accounting growth and index theory principles, parametric (deterministic and stochastic) and non-parametric based on Data Envelopment Analysis (DEA). Stochastic Frontier Analysis (SFA) and (DEA) are frontier production functions which are the most extensively used to predict the levels of technical efficiency or inefficiency. SFA is an alternative way for frontier production estimation in relation between an output and various inputs. Therefore, SFA has more computationally demand than DEA. DEA is used in the linear or mathematical programing methods by constructing a non-parametric piece-wise surface or frontier over the data. The efficiency measurement can be calculated based on this surface. The advantage of applying the DEA method is that it does not need to have the knowledge of algebraic formulations or forms of relationship from an output and inputs.

2.5 Previous Studies by Using Stochastic Frontier Analysis

The main point of this section is to express the previous studies by using stochastic frontier production model to estimate production technical efficiencies in different countries including Laos. There is a wide range of literatures on technical efficiency studies applying stochastic frontier analysis model. The previous studies are as bellowed:

According to Battese, *et al*., (1996), a single stage model of stochastic frontier production function model was applied to analyze panel data on wheat farmers of selected districts in Pakistan in order to estimate technical inefficiency of wheat production. The technical efficiency of wheat farmers indicated that the variation was considerable over time within each district and the mean technical efficiency accounted from 57 to 79% in the four districts.

Stochastic frontier production function was applied by Bravo-Ureta and Pinheiro (1997) in the form of Coubb-Douglas functional model in order to estimate technical, allocative and economic efficiency of peasant farming in Dominican Republic. The results of the research study showed that the technical efficiency has a range from 42 to 85% with its mean of 70%. The average of allocative efficiency of the sample was 44%, with a minimum of 9.5 and a maximum of 84%. The combination between technical and allocative efficiency ranged between 5.3 and 62% and its mean of economic efficiency was 31%. Contracted farmers with agribusiness firm had a positive and highly significant impact on economic and allocative efficiency. The results indicated that farmers with the age below twenty five years had higher level of technical, economic and allocative efficiency. Moreover, younger farmers are likely to have formal education. Therefore, they might have more encouragement of success in terms of collecting information and understanding new methods and practicing styles, which in turn will be improved their economic efficiency through higher technical and allocative efficiency levels.

Abdulai and Eberlin (2001) conducted a research on technical efficiency during economic reform in Nicaragua by applying a translog stochastic frontier model to investigate technical efficiency of maize and bean farmers in two selected regions in Nicaragua using farm-level survey data. The results of this paper work showed that the mean technical efficiency levels were 69.8 and 74.2% for maize and beans, respectively. These results recommended that farmers could raise their technical efficiency and output through better use of existing resources by given the state technology. The findings from maize and beans translog frontier production function also indicated that farmers' human capital such as education level, farming experience, access to formal credit and family size are significant variables in order to improve the technical efficiency.

Kebede (2001) conducted a research on the assessment of various distributional assumptions made on the estimation of stochastic frontier production models and compared the estimated results of technical efficiencies. Based on his research, the maximum likelihood estimates of technical efficiency were analyzed from the half normal stochastic frontier model. The mean technical efficiency of paddy farmers was 71%. This indicated that there is a room to improve the resources efficiency. The result of production function model showed that the variable on labour had an important role in paddy production and large elasticity of labour was highly statistical significant. In terms of technical inefficiency, farming experience and education level of farmers were found to be significantly improved. The variable on credit was an important factor to determine the efficiency level. Geographic location had to be taken into an account for measuring the technical efficiency levels.

According to Hassan and Ahmad (2005), both used stochastic frontier production function to estimate the technical efficiency of wheat farmers in the mixed farming system of the Punjab in incorporating technical inefficiency effect model. The representative data were adequate for Cobb-Douglas production function to estimate wheat farmers' output by given specified corresponding translog frontier model. The results were summarized that technical efficiency of wheat farmers lied between 58 and 99% with its mean of 94%. The technical inefficiency among those wheat farmers could be minimized such as sowing crops by drilling them in time, encouraging more farmers have enough education and accessing to credit agents for having adequate capital.

Idoing (2007) applied a stochastic frontier production function model to estimate farm level technical efficiency in Smallschale Swamp Rice Production in Cross River State of Nigeria. The stochastic frontier production function model in incorporating inefficiency factors by using maximum likelihood estimation techniques were estimated to achieve farm's technical efficiency and its determinant factors. The cross-sectional data were collected from small scale rice farmers in Cross River State of Nigeria. The research work showed that rice farmers in the study area were not fully technically efficient. The mean technical efficiency was 77%. This means that 23% should be improved in order to make more productivity. Moreover, the variables on farmers' education level, membership of cooperative or farmer association and access to the credit have positive and significant distribution to the technical efficiency.

The general form of the extended flexible translog stochastic frontier production function model was applied by Sanzidur, Rahman and Mizanur Rahman (2008) to investigate the impact on land fragmentation of productivity and technical efficiency of rice farmers in Bangladesh. The results of this research paper found that land fragmentation had a significance of detrimental effect on productivity and technical efficiency. The mean technical efficiency of rice production was 91%. This means that there is a small scope (9%) to improve rice production per se by using existing rice seed varieties.

Dlamini, *et al.* (2010) studied the technical efficiency of the small scale sugarcane farmers in Swaziland: A case study of Vuvulane and Big Bend farmers by using the stochastic frontier production function. The stochastic production frontier function model of the Cobb-Douglas type was applied to incorporate a model for the technical inefficiency effects. Farm-level cross-sectional data were collected from 40 sugarcane schemes and 35 individual sugarcane farmers. The results of this research work showed that some technical efficiency levels of the sample farmers are varied widely. The efficiency ranged from 37.5 to 99.9% with a mean of 73.6% for the Vuvulane sugarcane farmers while the sugarcane farmers in Big Bend had the efficiency from 71.0 and 94.4% with a mean value of approximately 86.0%. The sugarcane farmers in Vuvulane over-utilized land. Thus, an appropriate amount of land utilization could increase the sugarcane production for Vuvulane sugarcane farmers. For both groups of farmers, the technical inefficiency decreased with increased farm size, education and age of the sugarcane farmers, but it was increased when small scale sugarcane farmers engaged in off-farm income earning activities.

Inthavong (2005) researched on factors influencing rice production efficiency in Ban Home, Laos. The main purpose of research work was to analyse technical and socio-economic factors that influence rice production and estimates the level of technical efficiency of individual rice farmers. The author applied a Cobb-Douglas frontier production function to estimate deterministic and stochastic approaches of rice farmers in wet and dry season in 2003. The results showed that the average technical efficiency of farmers in dry season was higher than wet season. Based on Coubb-Douglass production function, the average technical efficiency was 72% ranging between 29 and 91% in the wet season (rainy season) in the target region.

CHAPTER III

METHODOLOGY

3.1 Data Sources and Collection

The research study applied both primary and secondary data from different sources. The rice production data used in the econometric analysis were primary surveyed data which were basically collected from rice farmers in the rainy season of Bolikhanh District, Bolikhamxai Province, Laos. This study used rain-fed rice household data 2010. The rice production period was from May to November 2010. The survey was conducted from September 12th to October 6th 2011. Rice farmers were selected by using randomized sampling method from six villages in the target district. The main target in choosing villages was that rice farmers who had an access and did not have access to agricultural extension services. 112 households were interviewed for rice production at the farm level.

Primary data was collected from the target area based on a household survey. The questionnaires[1] were outlined and constructed in order to obtain general information such as farmers' name, age, main cultivated crops and the wide range of production activities information including total labour input for soil preparing, rice seedlings pulling, transplanting, weeds managing, and general management for the whole production systems, harvesting and transportation. Before conducting this survey, the questionnaires were presented in the Food and Agricultural Policy Laboratory's

[1] **Appendix 1** Questionnaire for households survey (Rice Farmers)

seminar and obtained valuable comments and suggestions in order to achieve adequate data and information for analyzing. The questionnaires were approved by academic supervisors (professors) and then they were translated from English language to Lao version. The questionnaires were sent to staff who would assist me in conducting the survey in Bolikhanh District's Agriculture and Forestry Office. By doing this, two staff could read them in advanced before the survey started in order to help them better understand the whole contents of questionnaires and know how to procedure face-to-face interviews. The production input and output data were obtained for analyzing the dependent variable and independent variables in the process of technical efficiency estimation. The social characteristics are included namely: age, education level, family size, family member labour, hired labour and access or no-access to agricultural extension services. Farming practices are farm size, rice seed varieties used (traditional and hybrid varieties), amount of seed rate used (kg), rice farming experience, chemical inputs (included fertilizers, pesticides and herbicides), hired labour, hired machinery services and quantity of obtained rice production (rice output) in kilograms or tons.

Secondary data were compiled from relevant publications and government organizations such as annual reports from Bolikhanh District of Agriculture and Forestry Office, Bolikhamxai Province Agriculture and Forestry Office, Ministry of Agriculture and Forestry including Department of Agriculture, Department of Planning, National Agriculture and Forestry Research Institute and National Agriculture and Forestry Extension Services; Lao National Statistics Center and local administrative authority offices before, during and after the survey.

3.2 Data Analysis Methods

3.2.1 Descriptive Analysis

Descriptive analyses were applied to discuss and compare the socio-economic situations, demographic characteristics, existing rice producing practices, rice production (output), input variables and technical efficiency distributions among rice farmers. Percentage, frequency tables and figures; and farmers' opinions were used in the discussion of farmers' problems related to agricultural extension services and rice farmers' opinion about agricultural extension services.

3.2.2 Stochastic Frontier Production Function

Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977) indicated that the stochastic production function was independently and originally proposed in many developing countries, since the crop production operates under different uncertainties. The present study applied a stochastic frontier production approach which is an appropriate model for a general production function of the i^{th} production unit is as followed:

$$Yi = f(X_i; ß_i) + \varepsilon_i \; (\varepsilon_i = V_i - U_i) \quad \text{..} \; (1)$$

Where,

Yi is the production of i^{th} farmer,

X_i is the inputs used by i^{th} farmer,

$ß_i$ is unknown parameter to be estimated,

ε_i is an error term which is made up of two components (V_i and U_i)

V_i denotes two-sided error term (outside the farmer`s control such as climate, measurement errors and other statistical $(0, \sigma^2)$ noise. V_i is assumed that it is independent and identically distributed random error as N $(0, \sigma_v{}^2)$ and independent of U_i.

U_i is a non-negative random variable related to specific factors affecting technical efficiency in the production. U_i is supposed to be independently and normally distributed as truncation at zero with a mean (μ) and variance $(\sigma_u{}^2)$.

On the other hand, U_i could have other distributions mainly half-normal, exponential or gamma referring to Aigner, *et al.,* (1977), Meeusen and Van den Broeck (1977) and Kebede (2001). U_i was originally half-normal distributed (N $(0, (\sigma_u{}^2)$ and has been applied over years. Coelli (1996) mentioned that FRONTIER 4.1 Program could not accommodate exponential or gamma distribution.

Battese, *et al.,* (1996), Battese and Coelli (1995), Dey, *et al.,* (2000) and Idiong (2007) indicated that U_i is to be distributed as truncation (at zero) of the normal distribution with the mean (μ) and variance $(\sigma_u{}^2)$ as (N $|(\mu_i,\sigma_u{}^2)|$):

$$\mu_i = Z_i \sigma_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where,

Z_i is a vector of farmer specific variables which causes technical inefficiency.

σ_i is a vector of unknown parameters to be estimated and maximum feasible output (Y_i^*) based on stochastic frontier production function can be obtained as:

$Y_i^* = f\,(X_i;\beta_i)\,\exp\,(V_i)$ ……………………………………………………… (3)

Y_i^* is the highest output predicted and the equation (1) can be rewritten by using equation (3) as:

$Y_i = Y_i^*\,\exp\,(-U_i)$ ………………………………………………………… (4)

The technical efficiency of the i[th] farm can be estimated as followed:

$TE_i = Y_i/Y_i^* = Y_i^*\,\exp\,(-U_i)/\,f\,(X_i;\beta_i)\,\exp\,(V_i) \;= \exp\,(-U_i)$ ………………. (5)

This is important to note that the differences between observed and frontier output are embedded in the U_i. If U_i is equal to zero (0), Y is equal to Y^* and the production is on the frontier and the farm has a technical efficiency. If the U_i is bigger than zero (0), the production will be under the frontier and the farm has technical inefficiency due to the studies of Dey, *et al.,* (2000) and Idiong (2007).

Battese and Coelli (1993) expressed that technical efficiency is predicted by using the predictor based on conditional expectation of exp ($-U_i$). Coelli and Battese (1996) also mentioned that technical efficiency of a farm lies between zero (0) and one (1), and it is inversely related the technical inefficiency.

The coefficients (ß andσ) are to be estimated together with variance parameters which are defined as followed:

$\sigma_s^2 = \sigma_v^2 + \sigma_u^2$

$\gamma = \sigma_u^2/\sigma_s^2$

According to Abedullah, *et al.,* (2006), the Maximum Likelihood Estimates (MLEs) of equation (1) indicates the consistent estimators for ß, γ and σ_s^2 parameters, where:

σ_s^2 is the total variation in the dependent variable,

σ_v^2 is random shocks and

σ_u^2 is technical inefficiency

Refer to the researchers Coelli, *et al.*, (2005), Idiong (2007), and Abedullah, *et al.*, (2006), gamma (γ) parameter is a representative of the inefficiency share of overall residual variances valuing in interval between zero (0) and one (1). If γ is equal to zero (0), all deviations from the frontier production function are noise while γ is equal to one (1), indicating that all deviations are technical inefficiency based on the theory of Coelli, *et al.*, (2005).

3.2.3 Empirical Procedures of Stochastic Frontier Production Model

According to Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977), stochastic frontier production models were the most popular applications in the literature, mainly the Cobb-Douglas and translog production function. However, Cobb-Douglas model is commonly used in the empirical procedures of frontier production function. It is an attractive and a simple application. Coelli (1995) mentioned that a logarithmic transformation is a linear in the logs of inputs and it hence lends itself to econometric estimation.

In the production function, five production input variables mainly: total human labour, seed used, chemicals used, hired machinery services and total cultivated farm areas. The total human labour represents the quantity of family members and hired labour for rice seed pulling, transplanting, harvesting and weeding accounted in man-days. The seed used is in kg for total area of each farmer. The chemicals used including fertilizer, pesticide and herbicide were measured in LAK for total area of each farmer (LAK stands for Lao Kip. It is Lao Currency; 1US$=8000Kip due to National Bank of Laos, 2012). The hired machinery services were comprised of costs for ploughing; threshing and transporting. All expenditures are paid by each farmer in LAK. The total cultivated farm size included own and rented land is in hectare.

Therefore, the stochastic frontier production function for rice production is defined as followed:

$lnYi=ß_0+ß_1ln\ X_1+ß_2\ ln\ X_2+ß_3\ ln\ X_3+ß_4\ ln\ X_4+ß_5ln\ X_5+\ (V_i-\ U_i)$……………………..(6)

Where,

ln is the natural logarithm.

Y_i is rice production tons of the i^{-th} farm in ton (variables for production function model, i = 1,2,3.....N; N = 112)

$ß_0$ is constant

β_i is the parameter to be estimated each input (i =1-5)

X_1 is the total labour input: seedling pull, plant, harvest and weeding (man-days)

X_2 is seeds used (Kg)

X_3 is chemicals used included fertilizer, pesticide and herbicide (LAK)

X_4 is hired machinery services included plough, thresh and transport (LAK)

X_5 is the total cultivated farm size (hectare)

V_i is two-sided error term (outside the farmer`s control, measurement errors and other statistical $(0,o^2)$ noise. It is assumed to be independent and identically distributed random error.

U_i is one-sided error term or technical inefficiency effects, if $U_i > 0$, that means the farm is technical inefficiency.

After analyzing rice farm technical efficiency, the technical inefficiency variables were identified by choosing appropriate analysis method. In addition, examining the technical inefficiency sources is interesting for researchers who are analyzing the technical efficiency of crop production. On the other hand, Coelli and Battese (1996) said that the expected outcome of δ-parameters are not clear in the inefficiency models. Researchers provided an example as the age of farmers could be positive or negative in the model. The older farmers tended to have more rice farming experience and hence have less inefficiency in terms of high aged people have low physical capability while rice farmers are based on daily labour; they also are more conservative and not motivated to adopt new farming practices.

The previous studies mentioned that socio-economic and demographic characteristics of farmers including rice farming experiences, educational level, irrigation availability, improved rice seed varieties and agricultural extension services would determine the technical efficiency or inefficiency. The following model will be used to investigate the relationship between the explanatory variables and the technical inefficiency level.

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 \text{ .... } (7)$$

Where,

U_i is the technical inefficiency predicted by model itself (variables for inefficiency model)

δ_0 is constant

Z_1 is agricultural extension services and defined as dummy (if farmers access to agricultural extension services, Z_1 =1 and otherwise, Z_1=0).

Z_2 is ice farming experiences (years).

Z_3 is age of family head (years).

Z_4 is education level of farmers and defined as dummy (if farmers completed elementary school or higher, Z_4 = 1 and otherwise, Z_4=0).

Z_5 is availability to irrigation and defined as dummy (if farmers use irrigation system, Z_5 = 1 and otherwise, 5_4=0).

Z_6 is improved rice seed variety and defined as dummy (if farmers use hybrid seed, Z_6 =1 and otherwise, Z_6=0).

In this research study, the parameters of the stochastic production frontier and inefficiency effect models are together estimated in a single stage by using the maximum likelihood estimation method according to Battese and Coelli (1995). The researchers claimed that a two stage analysis is existed of the specification and estimation of the stochastic frontier production function and the effects of technical inefficiency prediction. These effects are identically distributed. The specification of regression model for the predicted technical inefficiency effects in the second stage is contradicted comparing to the assumption in the stochastic frontier production model. Coelli and Battese (1996) and Rahman, S. and Rahman, M. (2008) also applied the single stage approach in their stochastic frontier analysis.

CHAPTER IV

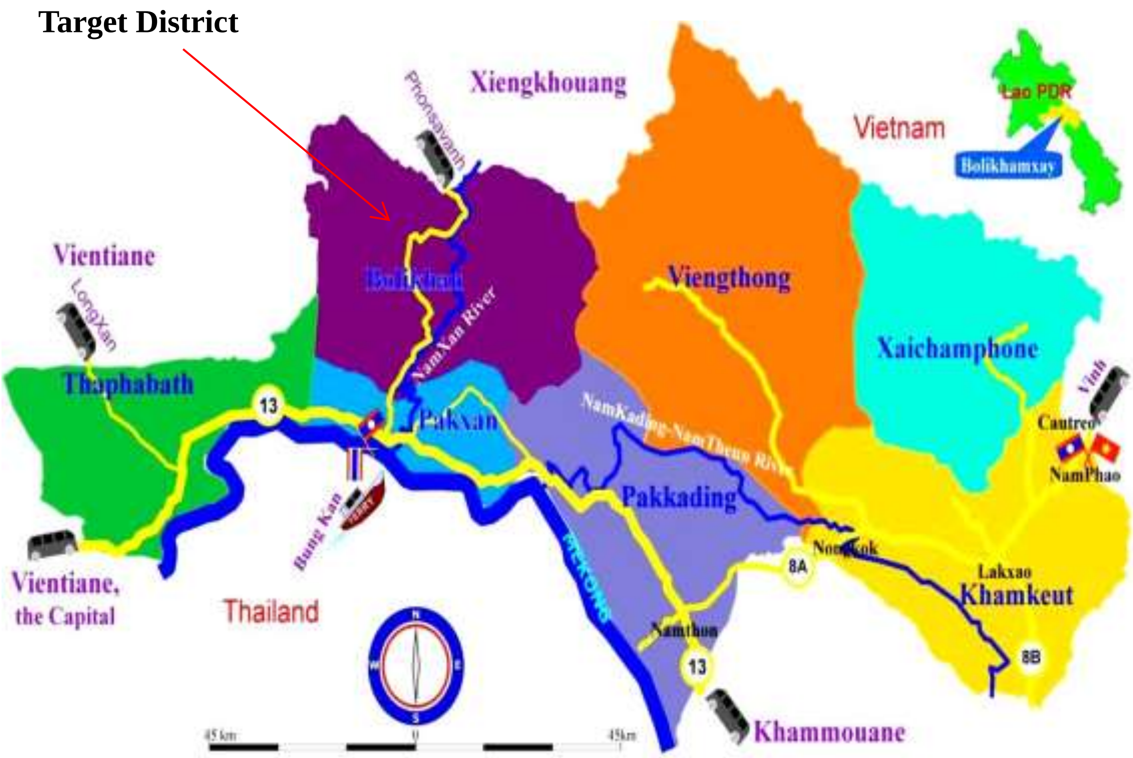
SELECTED STUDY AREA

This chapter will describe the background of the study area, basically general information such as: location, population and number of households. It follows by rice production situation in the target villages. The final section of this part will discuss agricultural extension services within Bolikhanh District and how this organization is functioning.

4.1 Background of Study Area

Bolikhanh district is one of seven districts in Bolikhamxai Province. It locates in the south-east of Xiengkhouang Province, east of Vientiane province; has borders with Viengthong District (east), Pakkading (south-east), Pakxan (south) and Thaphabath (south-west) within Bolikhamxai Province, central part of Laos. The Figure 4.1 shows the location of Bolikhanh District where the research study was carried out. This district is composed of 46 villages and has 7,226 households with a population of 44,684 inhabitants (21,286 females). The survey was conducted in 6 villages, namely Namtek, Hin Ngone, Pakphouay, Nalong, Somseune and Phonkham which are 94km, 77km, 74km, 22km, 15km and 5km far from district center, respectively. The geographic characteristics of Bolikhanh District are equally mountainous and plain. The weather is tropical and its average temperature is 26.5° C and average annual rainfall is 3389.2 mm.

Based on data survey dated from September 12^{th} to October 6^{th}, 2011, 112 randomized rice farmers were interviewed included 83 households access to agricultural extension services and 29 households do not have the extension services because they do not know that there is a such service existing and the another reason is that these farmers are living individually far from each other with limited infrastructure, especially road conditions are very bad , indicating that travelling with vehicles is not possible in rainy season and communication systems among these farmers are limited. For example in rainy season, people travel from the rural area to the markets in town on foot and some have to do by boat. The travelling time among these villages is very high time consuming.



Source: http://www.tourismlaos.org/web/show content.php?contID=406

Figure 4.1 Bolikhamxai Province's Map

4.2 District's Agricultural Extension Services

The government is implementing many types of services such as: Vegetable Producing Group (VPG), Poultry Raising Group (PRG), Village Saving Fund (VSF), Village development Fund (VDF) and etc… These are basic organizational body which is not strongly functioned. It also has inadequate fund in order to effectively operate. According to the deputy director of Bolikhanh Agriculture and Forestry Office (PAFO), the extension work is playing an important role in terms of providing farmers the agricultural skills and technology and it operates with other agricultural field activities together. Due to inadequate number of total employed agricultural staff, agricultural extension sector cannot work separately from other sectors. This means that agricultural staff within Bolikhanh District of Agriculture and Forestry Office does not work only as extension workers but they also have other tasks.

Agricultural extension service is one of PAFO's tasks to be prioritized and implemented in order to help farmers. The total permanent staff is 35 people who graduated in different fields of specialization included 4 in agronomy, 4 in livestock, 1 in veterinary, 22 in forestry, 3 in irrigation and 1 agricultural economics. The duty director also expressed that their qualification is still low, so their skills and knowledge need to be improved or upgraded in order to meet current situation's demand and farmers' requirement. Moreover, the annual fund from the Lao government is quite limited (Data Survey, 2011/09/12-10/06). Some tasks and duties for DAFO's extension generalists have to be taken into an account, mainly: providing advice of agricultural knowledge and skills:

- How to select rice seed variety, prepare soil and do sowing.
- Pest and diseases management; water and weed management.

- How to apply different fertilisers, pesticides/ herbicides in a proper way.
- Maintenance of agricultural machinery and management of postharvest.

4.3 Rice Production in the Study Villages

The rice farming in these study villages is mainly based on rain-fed rice system. There are no on-farm operations which are mechanized. 54 % of farmers have hired labour for rice seed pulling, transplanting, harvesting and weeding while these kinds of activities do not have machinery operations yet. Therefore, intensive human labour is necessary to accomplish this job which is very much time consumed. 46% of farmers who use their own family members or unpaid labour for rice production are organized as followed. For an example, during transplanting and harvesting time, farmers who do not have enough funds to pay for the labour, they help each other. For instance: 2 people from family A help family B for 2 days in the transplanting activity and family B will bring 2 people to do rice transplanting for family A with the same amount of days. This operation will also operate for rice seed pulling, harvesting and hand threshing. The soil preparation is done by mini-tractors (walking tractors). 69% of interviewed farmers used their own tractors for soil ploughing and 31% used machinery services.

The total rice growing area covers 4,137 ha, including rain-fed rice 3,651 ha with rice yield of 3.50 tons/ha (paddy rice) and irrigated rice 486 ha with the yield of 5.65 t/ha. The total rice production was 15,523 tons (paddy rice) in 2010. The rice consumption was 350 Kg/capita/year (Paddy rice). Based on rice farmers' response, they keep their rice for their own consumption. Only few farmers sell their rice to the middle men within the district. Beside rice production, farmers have grown many types of vegetables, cassava, banana, fruit trees and industrial trees such as rubber etc… They also raise some animals (buffalos, cows, pig, and poultry) and collect non-timber products in order to earn additional incomes.

CHAPTER V

RESULTS AND DISCUSSION

In this section, results from summary statistics of output and input variables included rice farmers' characteristics in the Cobb-Douglas stochastic frontier production function and the inefficiency function models will be presented and discussed. Problems and opinions related to rice production and agricultural extension services from respondents are also drawn and discussed. It is essential to recall the main objectives of this research study are to estimate the technical efficiency among rice farmers, investigate the impact of agricultural extension services and examine other factors influencing on inefficiencies in the target area of Bolikhanh District by applying stochastic frontier production function based on Cobb-Douglass production function.

5.1 Descriptive Results

Table 5.1 shows the summary statistics of output and input variables included in the Cobb-Douglas stochastic frontier production function model and in the technical inefficiency model. The detailed results indicate that the maximum rice production (paddy rice) was 11.52 tons (with cultivated area of 4.00 ha) and minimum of rice production was 0.72 tons (with cultivated area of 0.19 ha), which their mean rice production was equivalent to 3.33 tons of paddy rice per hectare. The yield was low compared with the national average yield of 3.71 tons per hectare for rain-fed rice in 2010 (DoA, 2010). The mean of total labour input (included family member labour and hired labour) for soil preparation, rice seedling pulling, transplanting, weeding, harvesting, threshing and transporting was 86 man-days ranged from 17 to 318 man-days per total area of individual farmer. The amount of seed used lied between 15 and 250kg with its mean of 78 kg. Only 21% of interviewees applied chemicals which included fertilizer, pesticide and herbicide valued 152,670 LAK on its average. Hired machinery services were based on the payment for ploughing, threshing and transporting fees. The mean of total expenditure of these services were up to 1,233,800 LAK ranged from 162,000 LAK to 5,834,000 LAK. The average farmers' total cultivated areas (included own or/and rented land) was from 0.19 to 4 ha with a mean of 1.21 hectares.

The values of variables for inefficiency function models are also presented in the Table 5.1. Agricultural extension services are a dummy variable that plays an important role to provide knowledge and skills to rural farmers. 74% of interviewed farmers had an access to the agricultural extension services and 26% of respondents did not participate in the extension's activities (Detailed information was described in the section 4.1 background of study area). The experience in rice farming of farmers ranged between 1 and 46 years. They have worked on rice farm of 18 years on an average. The age of family head lied between 27 and 72 years with an average age of 47 years. The average household size was 4 people (ranged from 2 to 7 people). Based on the survey data, 70% of family heads completed primary school, followed by 15% of secondary school and 5% of high school. However, 10% of interviewed farmers are uneducated (they could not read and write). Only 29% of interviewees used irrigation systems or pumped water from rivers for their rice production while 71% of others used natural rainfall. According to (Bolikhanh DAFO, 2010-2011), the average rainfall per year is 3389.2 mm in Bolikhanh District. The amount of water is sufficient for rice production in whole year around. Therefore, the majority of farmers did not use irrigation system.

The surveyed data was recorded that 95% of rice farmers used the traditional rice seed varieties and only 5% used hybrid varieties. The traditional variety brings lower yield than the improved varieties. The results indicated that the average yield of traditional variety was 2.70 tons/ha and 3.03 t/ha (paddy rice basis) for improved rice seed variety. Based on face to face interviews, farmers claimed that hybrid rice seed varieties were high demand but they were provided not on time for rice production season due to shortages of available hybrid seed, high cost and bad road condition to access to rice producing areas.

Table 5.1 Summary Statistics of Variables in Stochastic Frontier Model

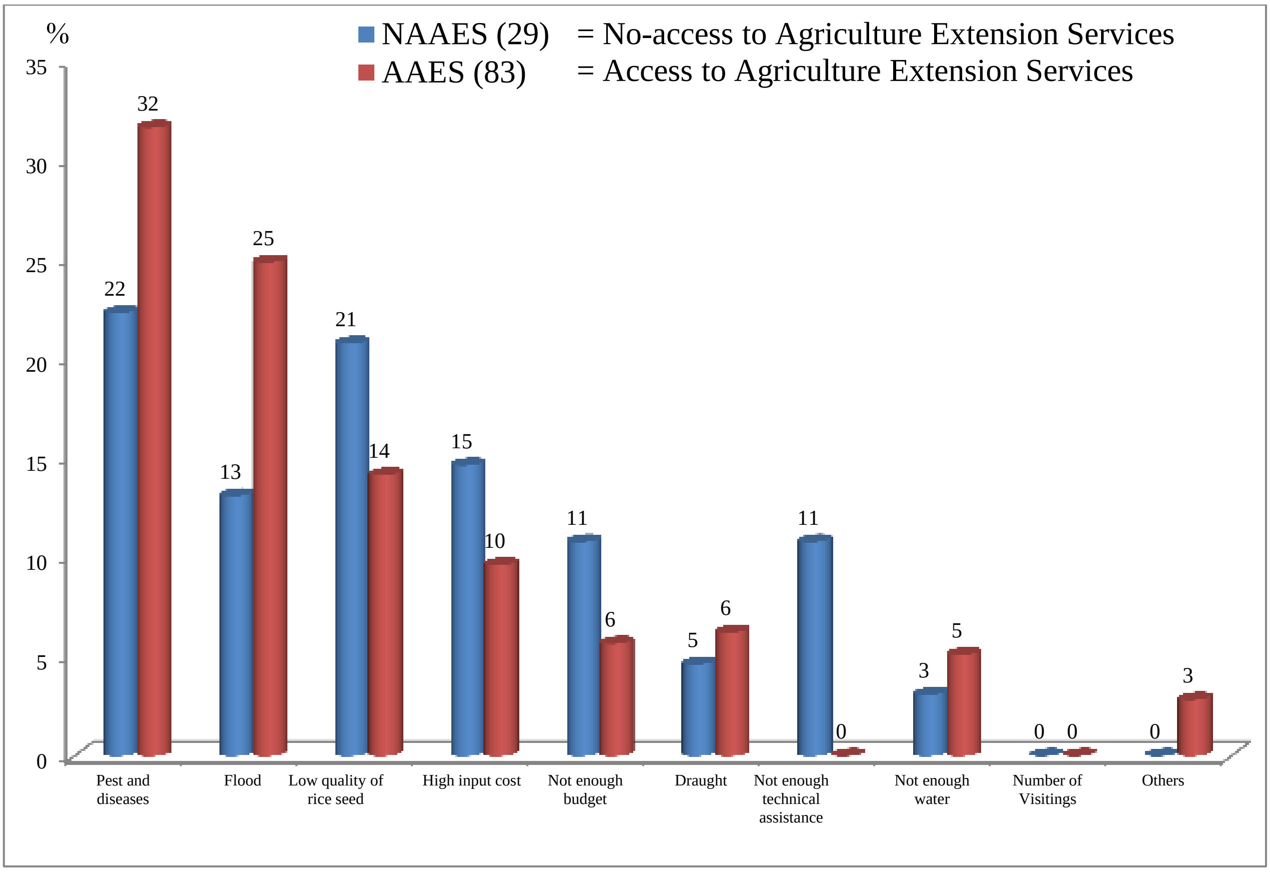
Variables	Units	Ratio %	Mean	Standard Deviation	Maximum	Minimum
Variables for Production Function						
Rice production	Ton	-	3.24	2.05	11.52	0.72
Total Labour input	Man-days	-	86.00	49.47	318.00	17.00
Seeds used	Kg	-	78.00	44.29	250.00	15.00
Chemicals used	LAK ('000)	-	152.67	226.90	870.00	-
Hired machinery service	LAK ('000)	-	1,233.80	832.00	5,834.70	162.00
Total cultivated areas	Hectare	-	1.21	0.72	4.00	0.19
Variables for Inefficiency Function						
Agricultural extension services	1	74.11	-	-	-	-
	0	25.89	-	-	-	-
Experience in rice farming	Years	-	17.64	10.09	46.00	1.00
Age of family head	Years	-	46.67	9.14	72	27
Household size	Person	-	3.78	1.03	7.00	2.00
Education level of farmers	Primary S.	69.64	-	-	-	-
	Secondary S.	15.18				
	High S.	5.36				
	Technical	-				
	Higher Diploma	-				
	Bachelor	-				
	Master	-				
	Others	9.82				
Irrigation Availability	1	29.46	-	-	-	-
	0	70.54	-	-	-	-
Improved rice seed variety	1	5.36	-	-	-	-
	0	94.64	-	-	-	-

Source: Data Survey (2011)

According to the face to face interviews of rice farmers and group discussions with head of the villages and agricultural extension staff during conducting survey in Bolikhanh District, Bolikhamxai Province from September 12^{th} to October 6^{th}, 2011, the Figure 5.1 shows the rice farmers' problems related to extension services. 22% of farmers' no-access and 32% of farmers' access to the agricultural extension services faced the difficulties of pest and disease outbreak.

In addition, 21 % of no-accessed farmers and 14% of accessed farmers said that traditional rice seed variety had low quality and gave low productivity. Farmers, who did not access (15%) and access (10%) to the agricultural extension services also shared the same difficulties in dealing with high input costs such as high diesel price and high costs of chemicals and agricultural materials included hybrid rice seed. 11 % of no-accessed farmers claimed that they did not have enough agricultural technical assistance.

In order to solve concerned problems, agricultural knowledge and skills are key roles to be compensated by extension sector in terms of providing adequate information and trainings such as: how to make bio-pesticide by using local material resources available to spray or reduce pest and diseases and how to select rice seed varieties. This may help farmers to upgrade their skills and minimize production costs. At the same time, rice productivity may be increased.



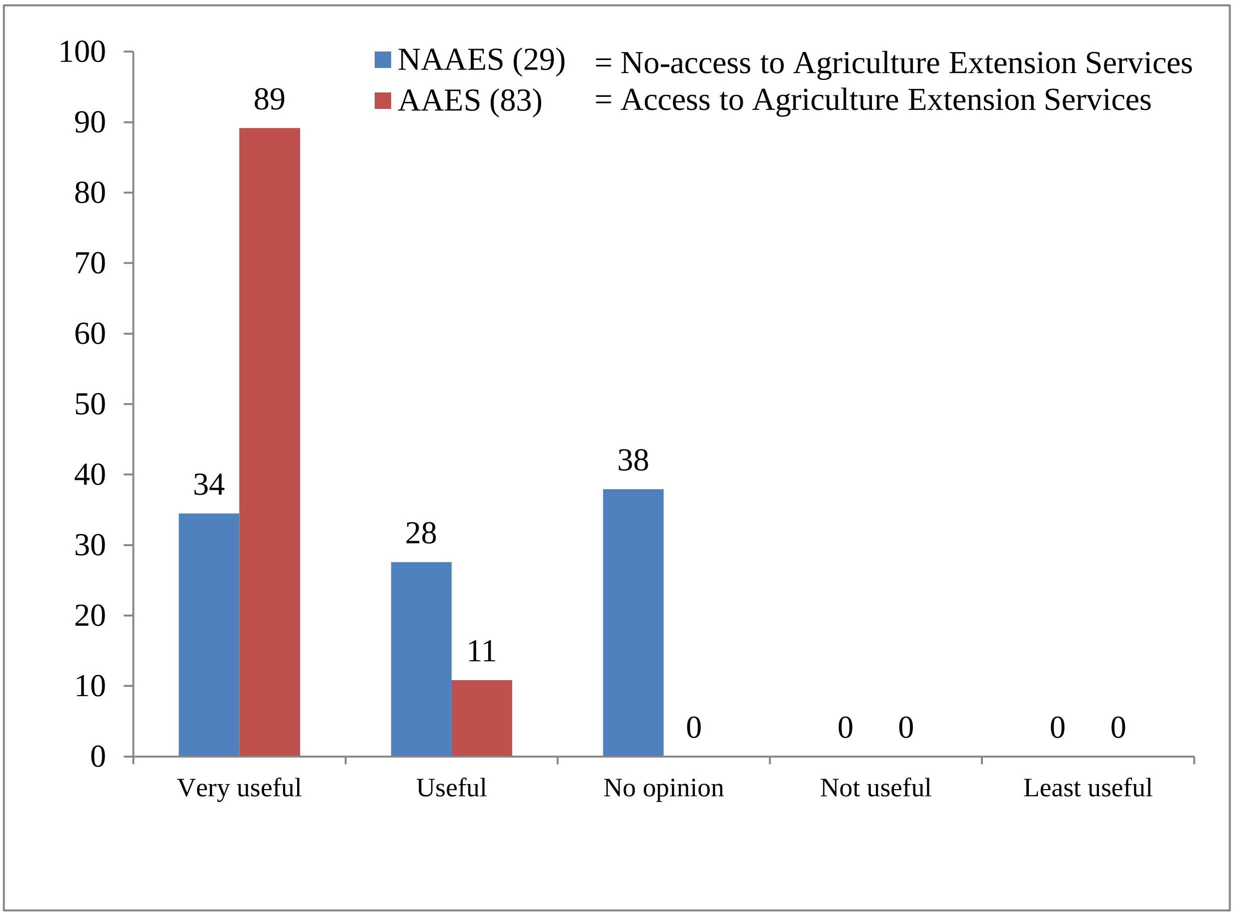
Source: Data Survey (2011)

Figure 5.1 Farmers' Problems Related to Agricultural Extension Services

NAFES (2005) indicated that some problems were found within agricultural extension sector at the province and district level. Provincial and district staff waited for instructions from the central authorities rather than planning and managing their own activities. When the instructions came, focused on targets and regulations relating to specific crops and commodities. Some of the consequences of this system were:

- The contacts between central extension workers and farmers were only made on an irregular/sporadic basis;
- The technologies and skills being promoted were not always appropriate to local conditions;

- The prioritization of activities was not always in accordance with the needs of farmers;
- The advice and recommendation given to farmers were highly generalized and not always meet the requirement and useful;
- A lack of ownership and poor motivation among Provincial and District staff;
- The weak linkage and coordination between different sectors (livestock, forestry, crops) and progress depended on the budget allocations for each sector.



Source: Data Survey (2011)

Figure 5.2 Farmers' Opinion of Extension Services

Moreover, respondents emphasized that agricultural extension services are very important and useful for rice farmers. Details of farmers' opinions about extension services are presented in the Figure 5.2. 34% of no-access and 89 of access said that agricultural extension services are very useful. 38% of no-access mentioned that they had no idea about the extension services. On the other hand, the services did not meet the requirement of farmers due to delay of services and problems handling and a low number of visiting farmers. The average of visiting farmers was 2.3 times per year. As Provincial Agricultural and Forestry Office annually planned activities, extension staff would visit rural farmers 22 times in one year on average.

5.2 Regressive Results

5.2.1 Technical Efficiency (Estimation of Frontier Production Function)

The maximum likelihood estimates for parameters of the Cobb-Douglas stochastic frontier production function for rice farmers during the cropping season in 2010 are presented in Table 5.2. The results show that variables on labour, seed used, and chemicals used, hired machinery services and total rice cultivated areas had positive relationship with rice production, indicating that these variables play an important role in the rice production.

The coefficients on labour, seed used and hired machinery services were found to be significant at 5%. This implied that higher rice production could be obtained from additional quantities use of these variables, meaning that if 3 variables on labour, seed and machinery increased at 5%, rice production will increase 0.18%, 0.48% and 0.07%, respectively. The rice cultivation in the study area is mainly based on labour intensity and hired machinery in terms of better soil preparation and better weeding management, so that more human labour and better hired machinery services are needed to increase the productivity of rice. Two variables on labour and hired machinery are in the agreement of previous work of Center for Rural Development and Self-help (CRDS) (2007), who studied the impacts of participatory extension program on technical efficiency of rice farmers in Nepal by using stochastic frontier production function.

The coefficients on chemicals included fertiliser, herbicide and pesticide were positive but they are statistically insignificant. They do not significantly affect rice production. Based on farmers' face to face interview, not many rice farmers (21% of interviewed farmers) used chemicals for their rice production because there would be some reasons behind such as high costs, late delivery, shortage and no proper ways of chemical applications. Some farmers mentioned that their soil is fertile enough (paddy rice yield could be obtained 4 tonnes/ha) but on the other hand, there is not an evidence of soil analysis available to indicate the fertilization of soil in those areas.

The coefficient on total rice cultivated areas had positive relationship with efficiency but it was not statistically significant because the larger rice fields, the more tasks with more labour input and costs; and more complexity have to be completed.

Table 5.2 Maximum Likelihood Estimates for Parameters of Production Function

Variables	**Parameters**	**Coefficients**	**Standard Errors**	**t-ratios**
Constant	β_0	-2.18**	1.04	-2.11
Labour	β_1	0.18**	0.07	2.56
Seed used	β_2	0.48**	0.22	2.14
Chemicals	β_3	0.00	0.00	0.19
Hired machinery services	β_4	0.07**	0.04	2.01
Total cultivated areas	β_5	0.32	0.21	1.59
Variance parameters				
Sigma-squared $\sigma^2_s = \sigma^2_v + \sigma^2_u$	σ^2	0.04***	0.01	7.61
Gamma $\gamma = \sigma^2_u / \sigma^2_v$	γ	0.99***	0.61	1.69
LR test of the one side error		37.49		
$X^{2\ (7,0.99)}$ (Mixed Chi-square distribution)		25.87		
No. of observation: 112				

Source: Stochastic Frontier Output 4.1 from Data Survey (2011)

Note: ***, ** and * are significant at 1%, 5% and 10% level respectively

5.2.2 Hypothesis Test

The estimated value of the γ (gamma)-parameter which is associated with the variance of the technical inefficiency effects in the stochastic frontier was 0.99 and was highly significant at 1% level. Refer to the consistent theory mentioned in the Chapter III that the γ-value has to be between zero and one. The results of this study suggested that technical inefficiency effects were a significant component of the total variability of rice output for the sample of rice farmers (Battese and Coelli, 1995). This means that 99% of variation in rice production is attributed to technical inefficiency and only 1% could be occurred by the stochastic random error. The γ is equal to zero, meaning that the technical efficiency is not present and the ordinary least square estimation will be adequate for representative data. On the other hand, the value of γ is equal to one, indicating that the frontier production model is appropriate.

The general Likelihood Ratio (LR) method was used to test the presence of technical inefficiency effects. The LR-test of the one side error of γ was defined by the Chi-square (χ^2) distribution and was applied to test the null hypothesis $H_0=\delta_0=\delta_1=\delta_2=\delta_3=\delta_4=\delta_5=0=\gamma$. The value of "LR" is equal to 37.49. This value is greater than the critical value of mixed Chi-square distribution at 1% level of the seven degree of freedom and its value is equal to 17.75 (Taken from Table1 of Kodde and Palm, 1986). This implies that the null hypothesis of no technical inefficiency effect on among rice farmers was rejected at 1%. The rejection of the null hypothesis supports the existence of inefficiency in the data set effects on the rice production of the sampled farmers. This implies that the Cobb-Douglas stochastic frontier is an adequate representation of the data.

Three dummy variables are positive to hinder the technical efficiency, indicating that experience in rice farming and age of family heads as farmers' skills and improved rice seed variety as technology existed among rice farmers. This means that the second potential hypothesis is accepted but there is a room to be improved. For instance, agricultural extension services can compensate the skills of farmers in terms of assisting them how to make bio-pesticide with low cost and how select rice seed variety.

5.2.3 Technical Inefficiency

To analyse the sources of technical inefficiency, it is necessary to examine the variation of technical efficiency among rice farmers. This study concentrated on agricultural extension services in relation with technical efficiencies. The maximum-likelihood estimates for parameters of the technical inefficiency of sample rice farmers are shown in the Table 5.3. It was explained that the mode of technical inefficiency is the variables in the technical inefficiency model. A positive sign of a parameter of the inefficiency model means that the associated variable has a negative impact on technical efficiency, and a negative sign indicates that the associated variable has a positive impact on technical efficiency. A negative sign on parameters is given the meaning that related variables decrease technical inefficiency or on the other hand, these variables have a positive sign, indicating that these parameters increase technical inefficiencies or they have a negative impact on efficiency.

The maximum-likelihood estimates for parameters of the inefficiency model for rice farmers during cropping season in 2010 are presented in the Table 4. The results showed that the coefficients on agricultural extension services, education level of farmers and improved rice seed variety have the expected negative relationship with technical inefficiency. They have a positive relation to the technical efficiency. All three variables have a statistically significant effect at 1%, indicating that if extension services, education level and hybrid seed variety increased at 1%, technical inefficiency will reduce by 0.26%, 0.04% and 0.10%, respectively. These variables tend to provide higher rice production. This may lead farmers to have better agricultural knowledge and skills in terms of better dealing of difficulties, accessing, understanding information and better farm planning and management.

Table 5.3 Maximum-likelihood Estimates for Parameters of the Inefficiency Model

Variables	Parameters	Coefficients	Standard Errors	t-ratios
Constant	δ_0	0.65***	0.19	3.43
Agricultural extension services	δ_1	-0.26***	0.04	-6.74
Experience in Rice Farming	δ_2	0.09***	0.02	3.81
Age of family head	δ_3	-0.02	0.10	0.19
Education Level of farmers	δ_4	-0.04***	0.07	-5.08
Availability to Irrigation	δ_5	0.02	0.06	0.36
Improved rice seed variety	δ_6	-0.10***	0.02	-4.39

Source: Stochastic Frontier Output 4.1 from Data Survey (2011)

Note: ***, ** and * are significant at 1%, 5% and 10% level respectively

Moreover, farmers with higher education are likely to attend trainings and be able to learn new methodology, to adopt new technology. This may lead to increase the technical efficiency. The finding on education of this research study was a conformity with researchers included Idiong (2007), Bravo-Ureta and Pinheiro (1997), Shehu et al. (2007) and Battese et al. (1996). On the other hand, the coefficients on experience in rice farming, age of family heads and availability to irrigation have unexpected positive signs (positive relation to the technical inefficiency). This means that these farmers have worked on rice field for long time with old and traditional methods and farmers' age was 47 years old on an average (survey data, 2011). Due to their high ages, these farmers may have lower physical capability compared to younger farmers. They also have low skills and education; and are hardly to learn new methodologies such as selecting rice seed, rice production system management including pest, diseases and weed management and etc… Therefore, the length of rice farming had technical efficiency disadvantage.

5.2.4 Distribution of Technical Efficiency

A frequency distribution of the farm specific technical efficiency is presented in Table 5.4 for rice farmers in the study area.

Table 5.4 Frequency Distribution of Efficiency of Rice Farmers in Bolikhanh District

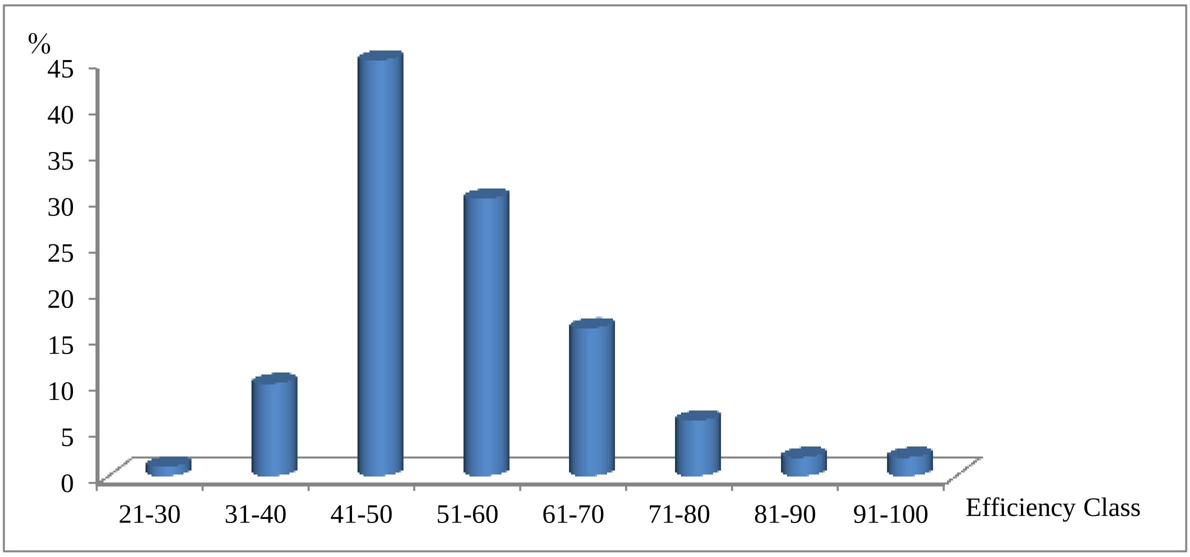
Efficiency Class	No. of farmers	Percentage (%)
0.20-0.30	1	1
0.31-0.40	10	9
0.41-0.50	45	40
0.51-0.60	30	27
0.61-0.70	16	14
0.71-0.80	6	5
0.81-0.90	2	2
0.91-1.00	2	2
Total	**112**	**100**
Mean	0.53	
Minimum	0.26	
Maximum	0.99	

Source: Stochastic Frontier Output 4.1 from Data Survey (2011) and author's calculation

A technical efficiency measurement is 100 which indicate that the fully use of inputs is completely efficient in the frontier function specification. The table 5.4 indicates that randomized samples had a wide range of technical efficiency (Details see

Appendix 2). The best practice farmers operate at 99% efficiency while the least farmers operate only at 26% and with its mean technical efficiency estimated to be 53%. The average technical efficiency of this research study was found to be low compared to Idoing (2007) who estimated technical efficiency and its determinants small scale rice farmers in Nigeria with the mean technical efficiency of 77%.

Thus, indicating that 47% is a huge volume to increase rice production. The other words are that 47% of technical inefficiency should be minimized. It is really necessary to effectively use available resources, current technology and to improve input variables such as labour with agricultural skills, improved rice seed varieties, higher quality of machinery service and better agricultural extension services.



Source: Stochastic Frontier Output 4.1 from Data Survey (2011) and author's calculation

Figure 5.4 Frequency Distribution of Efficiency of Rice Farmers in Bolikhanh District, Bolikhamxai Province

Figure 5.4 showed a frequency distribution of technical efficiency in Bolikhanh District, Bolikhamxai Province. The results indicated that 10% of farmers have below 40% of technical efficiency while efficiency class 41-50 attained 40% of technical efficiency level. These groups had a big gap to be fulfilled and to be improved their technical efficiency in order to productively rice produce. Approximately, 50% of interviewed farmers had technical efficiency more than 50%. This implies that a large number of rice farms in the sampled villages faced some technical inefficiency problems.

CHAPTER VI

CONCLUSION AND POLICY IMPLICATION

6.1 Conclusion

Researchers recently have completed many procedures of empirical analysis of technical efficiency. Beside this, technical efficiency measurement is one of the most important issues of farming business in terms of efficient use of resources namely: land area, labour and capital. The efficiency measurement of researchers' goal is to predict the farmers' efficiency levels involving agricultural activities, to introduce appropriate suggestions and propose useful policy applications. This study was carried out to estimate the technical efficiency of rice farmers and investigate the impact of the role of agricultural extension services and other influencing on technical inefficiency effects of rice farmers and to express difference in technical efficiency among rice farmers by identifying agricultural practices, socio-economic and farm characteristics through stochastic frontier production function based on Cobb-Douglas for 112 rice farmers.

The findings indicated that all sample farmers cultivated rice on their own land in rainy season from May to November, 2010 with the planted areas ranged from 0.19 to 4 ha. The coefficients on total input labour, seed used and hired machinery services were found to have positive and significant effects on rice production. Human labour (in man-days) is highly demanded for rice farming, especially during rice seedling pulling, transplanting and harvesting time. An increase of amount of rice seed application will raise the rice production. Factors on hired machinery services play an important role by using machinery for obtaining better soil preparation, so increase these input variables would increase rice production. The chemicals including fertiliser, herbicide and pesticide were positive but they are statistically insignificant. They do not significantly affect rice production. Based on the results, 21% of interviewed farmers applied these chemicals for their rice production.

Rice farmers' level explanatory variables were used to describe inefficiency determinants. The technical inefficiency effect model indicated that agricultural extension services, education level of farmers and improved rice seed variety were found to be negative and significant at 1% in the model, indicating that they have a positive effect on technical efficiency. On the other hand, experiences in rice farming and availability to irrigation have a positive relationship to the inefficiency. It was explained that although rural farmers had worked on rice field for long time, they had low physical capability with their high age to increase high rice productivity. The variable on irrigation system had no effect while rainfall was sufficiently available for rice production in the rainy season in the study area.

This research study derived the technical efficiency indices for rice farmers in Bolikhanh District, Bolikhamxai Province, Laos by using the stochastic production frontier model. The least farmers operated only at 26%; however the best practice farmers operated at 99% efficiency. The technical efficiency of farmers was 53 % on an average. 47% of inefficiency needs to be minimized in order to increase rice production.

6.2 Policy Implication

The Government of Laos has a very strong commitment to an extension approach that is decentralized, demand-driven and pro-poor. The agricultural extension sector is playing an important role for transferring knowledge and skills to rural farmers to improve technical efficiency and with its assistance to increase productivity. In order to improve the quality of agricultural extension services, so it is recommended that agricultural extension sector needs to be improved in terms of enhancing rice farmers access to information via the provision of better agricultural extension services including: training programs; assisting farmers to solve problems such as outbreak of pest and diseases, selecting seed variety and managing rice production. Agricultural extension staff and services should improve their contents, methods of trainings and services. Raising a number of visiting farmers is an important task to be taken into account. At the same time, more rice farmers are encouraged to participate in the extension service’s activities through different mass Medias such as television radio programs, newspapers, magazines, posters, leaflets and so on. The policy implications may propose to strengthen the extension services, bridge the gap between efficient farmers and inefficient farmers because rice farmers can only obtain agricultural knowledge and skills through this service. Therefore, improvement of this sector has to be taken into an account.

Other recommendations are to introduce such as providing literacy campaigns, on field trainings and field demonstration. The best farmers may help inefficient farmers. The improved seed varieties could be a better choice than traditional ones because their properties may be more interesting and they are known to be more resistant to various diseases. A free trial of new varieties coming from a research center could encourage farmers to adopt these varieties. Therefore, hybrid rice seed variety should sufficiently be provided on time and introduced in a wide range of rural communities.

6.3 Limitation of Research

Not many literatures are found in the research of agricultural extension services which have affected on rice production efficiency in Laos, especially in the target areas. This study focused on the role of agricultural extension service that has the impacts on rice production efficiency among rice farmers within 6 villages in Bolikhanh District, Bolikhamxai Province, Laos. These farmers are not the representatives of the total farmers in the district, although these farmers share some similarities but the operation is different in terms of available of input resources, access to services and markets, etc. Therefore, the results of this study cannot be generalized but they will be important and useful for rice farmers themselves and some policy makers in order to improve their responsibilities and services.

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APPENDIX 1

Questionnaire for Households Survey (Rice Farmers)

All obtained information from you is for research purpose only. My research topic is "The role of agricultural extension services on the rice production efficiency in Laos: "A case study in Bolikhanh District, Bolikhamxai Province".

I. General Information

- Village name:__________________Date___________Interviewer name:___________________
- Farmer's name:____________ _______________________Age:_____Gender: Male or Female.
- What other crops do you grow? ____

  Vegetable, fruit and others____
- What is the main income? Or where is the main income from? _______________________
- Rainy season starts from ….…..to ……………, dry season starts from …………. To ………

II. Information of Farmer's Land

How many ha/lai do you have? Or How many ha/lai do you rent?

No. of Plot	Own land (ha or Lai)	Rented land in (ha or Lai)	Rented land out (ha or Lai)	Total cultivated area (ha or Lai)	Remarks
1.					
2.					
3.					
4.					
5.					
Total					

Note: 1 Lai=40m*40m

III. Information of Agricultural Extension Services

1. Do you get any agricultural extension services? Yes ◯ No ◯

– **If answer Yes**. What kind of services did you get? Please tick the relevant answers.

No	Types of Agricultural Extension Services	Please tick
1.	Providing advice of basic agricultural knowledge and skills such as pest and diseases management; water and weed management…	◯
2.	Providing advice how to prepare soil, seed and sow	◯
3.	Providing advice how to select rice variety	◯
4.	Providing advice how to use different fertilisers	◯
5.	Providing advice how to use different pesticides/ herbicides	◯
6.	Providing advice how to do maintenance of agricultural machinery	◯
7.	Providing advice how to manage postharvest	◯
8.	Providing advice how to deal with facing problems	◯
9.	Attending seminar or trainings in Extension Center	◯
10.	Others____	◯

2. How often do you meet extension workers? ______/week; _______/month; _____/year

<table>
<tr><th>No.</th><th>Question</th><th colspan="6">Answers</th></tr>
<tr><td rowspan="11">1.</td><td rowspan="11">What do you think about extension services?
①. Very useful
②. Useful
③. No opinion
④. Not useful
⑤. Least useful
Please circle the number</td><td></td><td colspan="5">Your opinion(1-5)</td></tr>
<tr><td>1. Providing advice of basic agricultural knowledge and skills such as pest and diseases management; water and weed management…</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>2. Providing advice how to prepare soil, seed and sow</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>3. Providing advice how to select rice variety</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>4. Providing advice how to use different fertilisers</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>5. Providing advice how to use different pesticides/herbicides</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>6. Providing advice how to do maintenance of agricultural machinery</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>7. Providing advice how to manage postharvest</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>8. Providing advice how to deal with facing problems</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>9. Attending seminar or trainings in Extension Center</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>10. Others___________________________________</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>2.</td><td></td><td colspan="6"></td></tr>
</table>

- If answer No. Where did you get those agricultural knowledge and skills? Please tick relevance.

Neighbouring farmers, ◯ trained farmers ◯ Others ◯

No.	Question	Answers					
1.	What do you think about extension services? ① Very useful ② Useful ③ No opinion ④ Not useful ⑤ Least useful *Please circle the number*		**Your opinion(1-5)**				
		1. Providing advice of basic agricultural knowledge and skills such as pest and diseases management; water and weed management…	**1**	**2**	**3**	**4**	**5**
		2. Providing advice how to prepare soil, seed and sow	**1**	**2**	**3**	**4**	**5**
		3. Providing advice how to select rice variety	**1**	**2**	**3**	**4**	**5**
		4. Providing advice how to use different fertilisers	**1**	**2**	**3**	**4**	**5**
		5. Providing advice how to use different pesticides/herbicides	**1**	**2**	**3**	**4**	**5**
		6. Providing advice how to do maintenance of agricultural machinery	**1**	**2**	**3**	**4**	**5**
		7. Providing advice how to manage postharvest	**1**	**2**	**3**	**4**	**5**
		8. Providing advice how to deal with facing problems	**1**	**2**	**3**	**4**	**5**
		9. Attending seminar or trainings in Extension Center	**1**	**2**	**3**	**4**	**5**
		10. Others_______________________________	**1**	**2**	**3**	**4**	**5**

IV. Information of Farmer's Association Membership

No.	Question	Answer
	Are you a member of any associations?	1. ◯ Yes ◯ 2. No
1.	If yes, please provide name.	1. Village Development Fund 2. Water using Group 3. Name:______________________________ 4. Name:______________________________ 5. Others _____________________________
	What kind of activities do they offer?	1…………………………………………… 2…………………………………………… 3…………………………………………… 4…………………………………………… 5……………………………………………
	How many times did you join those activities in a year?	____________/year
2.	If no, why?	1. Not interested in, 2. Do not know 3. Others______________________________

V. Capital Sources

No.	Questions	Answers
	What is your capital source?	◯ Own finance ◯ Loan ◯ Others_______________
	If loan, – Where is the loan from? – How much? – What is the interest rate? – For how long (years)? – When will you pay it back?	(see sub-table below)
	If no loan, Why?	◯ 1 Sufficient own finance ◯ 2 Difficulty to get loan/do not know how to obtain it ◯ 3 Others_____________________________________

	Amount (Kip)	Interest rate (%)	Loan period (year)	When
◯ Bank				
◯ Village development fund				
◯ Government fund				
◯ Relatives/friends				
◯ Others__________				

VI. Yield and Production Marketing

No.	Items	Variety	Harvested area (ha or lai)	Total production kg	Consumption Kg	Price Kip/kg	
						Paddy	Milled
1	Seasonal rice	Traditional					
		Improved					
2	Irrigated rice	Traditional					
		Improved					

➢ If sell

No.	Question	Answer
1.	To whom did you sell your rice? *Please circle the numbers*	1. Same villager 2. Traders in the village 3. Traders from district, provinces or others 4. Others ______________________________
2.	How did you know the price? *Please circle the numbers*	1. Neighbours 2. DAFO 3. TV 4. Radio 5. Newspaper 6. Traders 7. Others ____________

VII. Information of Farmer's Rice Production Inputs

– What kind of rice seed varieties did you use for each season? ◯ Traditional Variety; ◯ Improved Variety

1. Rice seed (Variable Xi2)

No.	Items	Variety	Total use (kg)	Price Kip/kg	Variety
1	Seasonal rice	Traditional			
		Improved			
2	Irrigated rice	Traditional			
		Improved			

2. Land Tax

No. of Plot	Own land (ha or Lai)	Kip/(ha or Lai)	Remarks
1.			
2.			
3.			
4.			
5.			
Total			

Note: 1 Lai=40m*40m;

3. Rented Land Cost/Income

No. of Plot	**Rented land in or out (ha or Lai)**	**Kip/(ha or Lai)**	**Remarks**
1.			
2.			
3.			
4.			
5.			
Total			

Note: 1 Lai=40m*40m;

4. Labour Input

No	Name	Male	Female	Age	Education	Experience	Work h/day	Total days	Off-farm Work h/day	Total days
1.										
2.										
3.										
4.										
5.										
6.										

Note: Education level: a) Primary school, b) Secondary school, c) High school,

d) Technical e) Higher Diploma, f) Bachelor, g) Master, h) Others___________________

Do you hire labour? ◯ Yes ◯ No

– **If No,** how many people in the family are working on the rice farm? Please answer the following questions.

– How long do you and family member spend for each activity?

Farm activities	Quantity (hours)/day	Total days
1. Rice seed pulling		
2. Ploughing/harrowing		
3. Transplanting		
4. Harvesting		
5. Weeding		
6.		
7. Others		

If yes, how long do they spend for each activity?

Farm activities	Quantity (hours)/day	Wage (Kip)/hour
1. Rice seed pulling		
2. Ploughing/harrowing		
3. Transplanting		
4. Harvesting		
5. Weeding		
6.		
7. Others		

5. Chemicals

Input Items	Quantity use unit	Kip/ha or Lai	Remarks
1. Fertiliser			
2. Pesticide			
3. Herbicide			
4. Others			

Note: Unit= Kg/ha or /planted area; L or bottle/ha or /planted area

6. Machinery Services

Do you use your own machines for the farming? ◯ Yes; ◯ No

➢ **If Yes.**

- When did you buy those machines?
- How much did you pay for those machines?
- How many liters per ha is needed for each machine?

Farm Activities	**Cost (Kip)**	**When**
1. Land preparation (Ploughing &harrowing)		
2. Harvesting		
3. Threshing		
4. Transportation		
5. Spray (hand sprayer)		
6. Others		

Note: Any records of payment

➢ **<u>Please answer the following questions</u>**

Question	**Farm activities**	**Hours/day**	**Total days**	**Cost/hour**
How long do they work each activity?	1. Land preparation (Ploughing &harrowing)			
	2. Harvesting			
	3. Threshing			
	4. Transportation			
	5. Spray (hand sprayer)			
	6. Others			

Note: - Machinery service cost=machinery+labour; Any records of payment

7. Irrigation Cost

- Do you have an access to irrigation for rainy season or dry season?

◯ Rainy season ◯ dry season

- If rainy, how much did you pay for electricity/diesel?

Irrigation	Kip/ha; lai; season	Total
Electricity		
Diesel		

Note: Any records of payment

- How many litres do you buy diesel for your machines?______________________

VIII. Information of Farmer's Problems

No.	Question	Answer
1.	- What problems did you have during production period? - Please provide 3 or 4 the most serious problems	◯ Low quality of rice seed ◯ Not enough water ◯ Pest and diseases ◯ No supported fund ◯ Drought ◯ Flood ◯ Bad technical assistance ◯ High input cost ◯ Others………………..………………

Thank you very much for your time and cooperation.

APPENDIX 2

Detailed Technical Efficiency Estimates of Individual Sample Farmers

Firm	Year	Efficiency Estimates.
1	1	0.72233584E+00
2	1	0.57906300E+00
3	1	0.94069144E+00
4	1	0.43831022E+00
5	1	0.49132592E+00
6	1	0.51308511E+00
7	1	0.47495743E+00
8	1	0.48857012E+00
9	1	0.49415798E+00
10	1	0.56266951E+00
11	1	0.50586086E+00
12	1	0.45763310E+00
13	1	0.48658504E+00
14	1	0.64457319E+00
15	1	0.48880321E+00
16	1	0.67080438E+00
17	1	0.61005764E+00
18	1	0.47917356E+00
19	1	0.51082430E+00
20	1	0.42664712E+00

21	1	0.58869820E+00
22	1	0.37154814E+00
23	1	0.54867737E+00
24	1	0.54025767E+00
25	1	0.50100856E+00
26	1	0.69156174E+00
27	1	0.39110226E+00
28	1	0.45921845E+00
29	1	0.54079059E+00
30	1	0.43227614E+00
31	1	0.36371652E+00
32	1	0.54295554E+00
33	1	0.73353506E+00
34	1	0.49585960E+00
35	1	0.40688523E+00
36	1	0.55933401E+00
37	1	0.43261130E+00
38	1	0.31425660E+00
39	1	0.59097466E+00
40	1	0.44071777E+00
41	1	0.49373117E+00
42	1	0.55775011E+00
43	1	0.48330063E+00
44	1	0.42409000E+00

45	1	0.43611852E+00
46	1	0.73461981E+00
47	1	0.39642679E+00
48	1	0.51544357E+00
49	1	0.55288382E+00
50	1	0.34062197E+00
51	1	0.41047402E+00
52	1	0.44490061E+00
53	1	0.43258901E+00
54	1	0.42085963E+00
55	1	0.85924857E+00
56	1	0.34169568E+00
57	1	0.66348315E+00
58	1	0.44950141E+00
59	1	0.43690869E+00
60	1	0.59769023E+00
61	1	0.46960522E+00
62	1	0.53833365E+00
63	1	0.33706382E+00
64	1	0.42396923E+00
65	1	0.48444442E+00
66	1	0.53758191E+00
67	1	0.63410010E+00
68	1	0.62192414E+00

69	1	0.45281484E+00
70	1	0.45437276E+00
71	1	0.57111629E+00
72	1	0.38870838E+00
73	1	0.55694840E+00
74	1	0.60586263E+00
75	1	0.25686710E+00
76	1	0.59976579E+00
77	1	0.55552069E+00
78	1	0.33865616E+00
79	1	0.43125377E+00
80	1	0.76694036E+00
81	1	0.52974628E+00
82	1	0.46988678E+00
83	1	0.60692434E+00
84	1	0.77941941E+00
85	1	0.45308634E+00
86	1	0.53834775E+00
87	1	0.44831393E+00
88	1	0.50197199E+00
89	1	0.69233259E+00
90	1	0.59436008E+00
91	1	0.45244753E+00
92	1	0.58735548E+00

93	1	0.62295373E+00
94	1	0.68747453E+00
95	1	0.99667795E+00
96	1	0.50291204E+00
97	1	0.59917504E+00
98	1	0.89946763E+00
99	1	0.66796645E+00
100	1	0.55977577E+00
101	1	0.64466427E+00
102	1	0.48389763E+00
103	1	0.56861312E+00
104	1	0.51051537E+00
105	1	0.50476650E+00
106	1	0.45802330E+00
107	1	0.69139394E+00
108	1	0.48302141E+00
109	1	0.47692451E+00
110	1	0.63784626E+00
111	1	0.76794047E+00
112	1	0.50012173E+00

Mean Efficiency = 0.53454130E+00

APPENDIX 3

The National Agriculture and Forestry Service's Extension System in Laos

Somxay Sisanonh

Abstract

Until recently Laos did not have a genuine agriculture and forestry extension service. Technology transfer was carried out by the technical departments of the Ministry of Agriculture and Forestry (MAF) on a campaign promotion basis while projects and programmes conducted extension following their own individual approaches. Therefore, there was a need for a Lao extension system operating on a sustainable and independent basis, able to effectively coordinate various donors as well as operate when projects retreat. The National Agriculture and Forestry Extension Service (NAFES), with support from the Laos Extension for Agriculture Project (LEAP), has developed an efficient and effective extension service for achieving food security, improving the livelihoods of Lao farmers and alleviating general poverty in rural areas. This is called the Village Extension System (VES), and will be presented in this paper.

The main principles of the VES are:

- Village authorities organise the VES.
- Village authorities give the mandate to the Village Extension Workers (VEWs).
- VEWs work with groups of interested farmers on a particular topic (production groups).
- The VEW's task is to ensure that innovations spread throughout the village.
- District extension agents interact with the VEWs and provide technical training and information.
- All resources for the VES are organised and managed by the village authorities.

This approach had been applied successfully (e.g. In Nambak and Park ou Districts, Luangprabang Province) with particularly significant results regarding improving family income generation for upland farmers.

Introduction

The recently reformed Integrated Strategic Direction of the Lao Revolutionary Party and the Government of the Lao PDR focuses on restructuring so that:

- Provinces become socio-economic strategic planning units.
- Districts become development planning and budgeting units.
- Villages become implementing units.

This strategy aims to step-by-step liberate the nation from its position among the least developed countries of the world. To be fruitful it requires all Lao people working in all technical sectors as well as local ethnicities to join hands in order to efficiently fulfill their designated roles, rights and duties. It also clearly spells out that there is a need to change the current 'nature dependent' production society to a more developed modern production society, characterised by scientifically and technically proven high productivity, with high-quality production management models and systems. It is strongly believed that this shift will help improve the livelihoods of the Lao people and thereby achieve the Lao nation's development goal.

The National Agriculture and Forestry Extension Service (NAFES) is a technical unit with the mandate of providing extension services as well as supporting and providing leadership for farmers in agricultural production. This will secure stable food sufficiency and enable agricultural commodity production to progress at speed, but with sustainable momentum. This highly important duty requires that all extension staff actively concentrate on the implementation of their roles and responsibilities which also supports capacity building for local people in agricultural production. Furthermore, there is a need for a good coordination system among government agencies, the private sector, and international organisations in order to push, support and enable conformity between extension processes and the socio-economic development strategy of the Lao Government.

The proposed improvements of the agriculture and forestry extension system and the subsequent model presented in this document are a summary of the analysed strengths and weaknesses of extension work that have been implemented by various projects in the agriculture and forestry sector. In addition this document contains concepts and recommendations generated from two workshops on improving the extension system as well as from studies on actual implementation of extension at provincial and district levels.

Part 1: Overview of problems entrenched in agriculture and forestry extension

Core agriculture and forestry related problems in Lao PDR

Although agricultural production has been the main occupation of the Lao people and has been carried out for centuries, key agricultural associated problems remain in need of urgent solutions. Urgent solutions are essential as the biggest portion of the country's population (83%) is agriculture dependent. This is particularly relevant for agricultural production in mountainous areas where the majority of people does not have permanent occupations, face extreme poverty, and still rely entirely on production under natural conditions. The main agricultural problems can be categorised as follows:

- Education levels of farmers are still quite low and some cultural or traditional practices hinder improving their farming systems.
- Lack of appropriate inputs such as improved variety of seeds, planting materials or access to veterinary services for livestock
- Lack of appropriate extension techniques, technologies, and methodologies.
- Market associated problems.
- Inappropriate agro-credit and other support systems such as high interest rates, unstable pricing for agricultural and forestry products, etc.
- Problems associated with weaknesses in staff performance.

<u>Constraints</u>

- Provincial Agriculture and Forestry Extension Service (PAFES) is a newly established provincial extension body, which although given an extensive role and responsibility, operates with a limited number of experienced extension staff, limited vehicles, budget and other facilities.
- PAFES lacks detailed instructions and guidelines on how to implement its roles and responsibilities.
- In some years there is no budget for DAFO to conduct seasonal production extension. Fieldwork is heavily dependent on the already limited budget allocated on annual basis to DAFO for administrative purposes.
- Vehicles and extension tools/equipment are extremely limited at DAFO.
- DAFO staff has only very limited knowledge/experience in extension services.

<u>Risks</u>

- It seems, from experience, that the relevant authorities at provincial and district levels are waiting for the initial interface to come from each other. This can lead to declining trust in the vertical extension administration and decreased effectiveness. Ultimately this can contribute to delays and unimproved extension work.
- Delays in determining clear roles and responsibilities for extension services at different levels (central, provincial and district) or failure in the implementation of the existing roles and responsibilities imply a weak extension system. This certainly leads to a 'stand-still' in disseminating techniques and technologies to farmers that can cause them to lose trust in the government technical support promised to them.
- A long waiting time faced at the grassroots level plus doubts about the performance of NAFES, PAFES and DAFO most likely leads to a slow pace in the transforming process from natural or semi-natural production systems to more modernised systems. This also has a negative effect on the struggle to meet the Government's target of liberating its people from poverty and the nation from out of its position as one of the least developed countries.
- Therefore it is now time that all of us prioritise and that we join hands to develop and improve methods and systems for agriculture and forestry extension services in a tangible manner.

Part II: Alternatives to improve and develop the agriculture and forestry extension system

The principles of agriculture and forestry extension are to:

- Build farmers' capacity to help themselves and enable them to apply technologies suitable to their situation and available resources.
- Transfer techniques and technologies acquired from agriculture and forestry based research as well as other crosscutting information sources.
- Provide consultation and technical services to solve farmers' problems.

With regard to the development of production in the agricultural sector it is true to say that all relevant sectors have equal importance. However, when considering designated roles and responsibilities there is a need to raise extension work at all levels and to improve extension implementation methods in order to meet the actual needs of local farmers as well as adapt to changes that are occurring in all aspects of society. Improvement should be initiated by having a clear vision, concept and implementation methods applicable to real conditions, scientifically proven and dynamic. Only in this way, can we help Lao farmers gain knowledge and develop on a step-by-step basis.

For this reason, one of the top priorities is to provide support and staff to provincial and district authorities to enable them to develop concepts on how to improve working methodologies and implement extension in an appropriate manner that is suited to reality and meets today's demands.

Strategy and principles

Enable staff who are responsible for the management and implementation of extension to fully understand about the duties and targets of extension work in order to:

- Build farmers' capacity to identify production models that are both suitable for available resources and can maximise profits for themselves, for their communities as well as for their collectives.
- Enable the development of practical and sustainable management and coordinating networks for extension throughout the country.
- The two aspects mentioned above should be considered as an important goal for extension work or to be an important target for improving our extension systems.
- In addition, it is very important to focus efforts on how to make all parties understand the importance of improving the extension system both in short and medium term periods as follows:
- Regardless of what methodology is applied, it is most important that staff being involved in extension work have the right attitude and that they fully understand about the goals and core duties of implementing extension in order to ensure the scaling up of agriculture and forestry development policies and programmes.
- Improving implementing procedures and methodologies for extension workers from central to grassroots levels, while taking into account that capacity building, along with the provision of support and demonstrations of actual implementation, is spearheading agricultural development in the field.
- Increasing fundamental knowledge and capacity for extension training (technology transfer), monitoring, and expanding knowledge to relevant agricultural staff at all levels to develop capacity for generalists to at least meet minimum district requirements.
- Strongly pushing and closely coordinating with subject matter specialists for centralised technology dissemination regarding actual production processes (in specialised technological, educational, research and other relevant institutions).
- Improving managerial mechanisms for agricultural extension training from central, provincial, and district down to village levels.

- Enabling a rapid improvement and expansion of information distribution, extension media and campaigns.

Supporting farmers in organising themselves in production groups in order to expand and be able to manage agricultural production, as well as establish and speedily expand the VEW network.

Coordinating, supporting and facilitating the establishment of markets as well as marketing groups to supply agricultural produce.

Models/methods for the actual improvement

In order to improve management mechanisms of the existing extension system and adapt them to conditions in the short and medium term, the first step is to establish training and extension units from central to grassroots levels, before moving ahead to improve the entire structure of the extension system at PAFES and DAFO. Such improvement aims to create a simple but effective Extension Coordination and Management Unit at the provincial level in order to enable step-by-step growth in the training and extension capacity of DAFOs covering a larger range of activities within the DAFOs working structures.

Proposed structure of an interim extension coordination and management system

The proposed structure of an interim extension coordination and management sys- tem is illustrated in figure 1. To be able to strongly push and raise the effectiveness of PAFES and DAFO to achieve the target of improved extension, it is essential to clearly determine, from early on, the roles and duties of the Extension and Training Unit (ETU). Detailed roles and duties of ETU are described in a separate document.

Any action performed by the ETU in accordance with its roles and duties is aimed at creating an effective working coordination system between extension, relevant sectors at the macro level and other crosscutting sectors.

Methods/mechanisms for transferring the implementation of extension work from district to village levels

It is essential that there are mechanisms to distribute specific roles and responsibilities to DAFO extension staff located in different geographical zones. This is because each district has its own specific characteristics, particularly in terms of village concentration, and number and capacity of extension staff. For example some villages are located far from the district centre, they can be very difficult to reach and require high travel costs. To solve this problem the establishment of field extension offices in each zone is deemed necessary. These offices should serve as accommodation for the ex- tension staff to be based there. It is believed that these offices will ease extension work such as recording production information, providing technical assistance to help solve farmers' problems and building closer relationships between farmers and extension staff. In the long run, if village extension workers gain sufficient experience and are capable of doing the job for themselves, DAFO extension staff will be withdrawn to serve in other districts. This is considered to be 'local self-capacity building'.

In other words, extension support from districts should be area based. This can be carried out by setting up Agriculture Extension Zone Offices (AEZO), which will provide

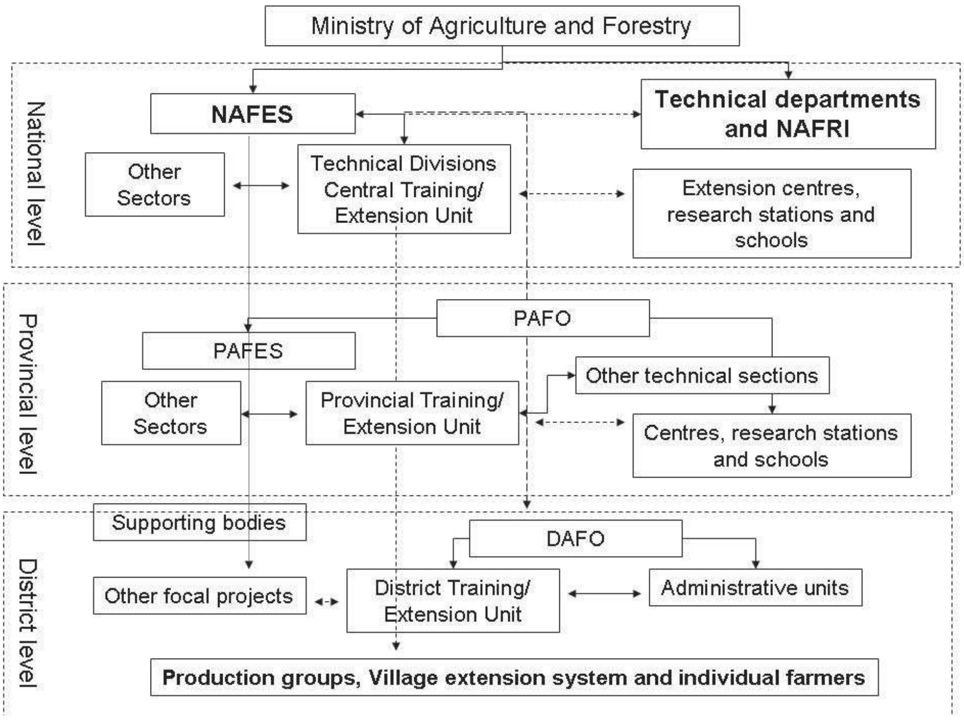

Figure 1: Structure of an interim extension coordination and management system

The base for the extension team who work in that particular zone. The tasks of the team are to build up learning process (training & coaching) in all relevant aspects throughout production seasons in line with the prescribed roles of the AEZO mentioned earlier.

In addition, the team is tasked to monitor and report to DAFO on a monthly, quarterly and annual basis. More details about the working mechanisms and methodologies are presented in figure 2.

Village Extension System (VES)

It is clearly stated in the Government's socio-economic development policy that the village is the official unit for the implementation of all village development activities. Therefore, the establishment of Village Extension Systems (VES) at the village level to support agriculture and forestry extension is essential.

<u>What is VES?</u>

VES is a model developed for organising agriculture and forestry extension work that should basically be implemented under the managerial ownership of village authorities.

Recognising the biophysical and socio-economic diversity in each village and zone, there is no doubt that methodologies and technical services (types and levels of services, methodology, including techniques, technology and other relevant inputs) suitable for the diverse local needs will differ from one place to another. It is therefore essential to develop a general set of procedures that can be modified by districts and zones in order to make them applicable to their specific needs and targets.

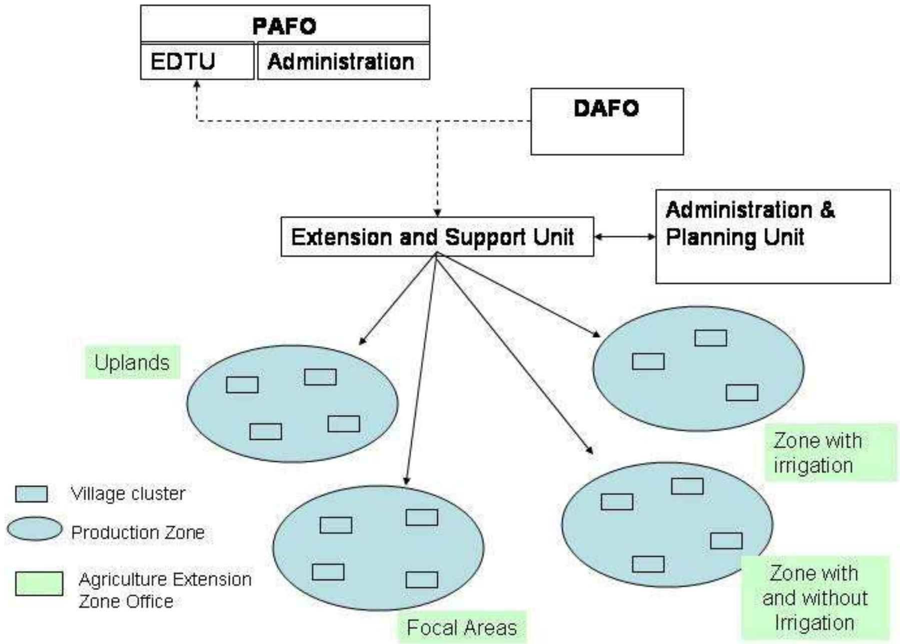

Figure 2: Working mechanisms and methodologies of Agriculture Extension Zone Offices (AEZO)

<u>Important components of VES</u>

- Village Extension Network: comprised of competent Village Extension Workers (VEWs) and robust production groups.
- Internal support (from villages): village authority with good vertical coordination.
- External support: district extension staff, development projects.
- Funds: can either come from production group owned funds or village development funds. These funds will be used to support and stimulate knowledge and experience delivery to households or new production groups. However, their use may depend very much on the decision of the production groups and village authorities.

General procedures for the development of VES

- After selecting target villages or zones, extension workers (either district or project staff), should be involved in providing support to the establishment of voluntary production groups. This can be done by involving interested households in any particular subject matter and formulating a learning process to cover at least one seasonal production cycle. The learning process should start from problem and need analysis by target groups or households, followed by determining training topics, conducting training, and providing support and regular monitoring throughout the period of applying theoretical lessons in practice. This process can help build confidence for households in applying the desired techniques and technologies at each step. In addition, extension teams will keep records and periodically prepare progress reports to inform all concerned parties about the progress and problems encountered. At the end of the training process an evaluation will be conducted.

Lessons learnt will then be used in consultation with the involved households to rectify the planning process in order to avoid problems from reoccurring. When entering into the second production cycle, extension staff will focus on group organising, including supervising production groups and VEWs on how to perform their duties. Additional technical assistance will also be provided as required.

- Providing support to production groups and upgrading dominant individuals to become official VEWs. These people will continue to deliver knowledge and coordinate with other relevant organisations. In a given village there will be different kinds of learning groups and VEWs depending on areas of interests and relevance for that particular village. These may include, for instance, livestock, crop, irrigation, forestry, etc.

- After evaluating implementation of village learning groups, if any other household is interested in participating in the process, further delivery of knowledge will be conducted by VEWs, depending on village plans, agreements and support from village authorities.

- At this stage, the main task of extension staff is to either provide new knowledge to households in the first batch of production groups or provide them with relevant information for strengthening group management capacity and improving VEW performance.

- The task of the village authority is to form production groups, build up VEWs and help them to improve their knowledge in order to increase productivity for the villagers for whom the authority is responsible.

- Exploring for resources for maintenance and expansion of the village extension network is another important task for village and district authorities. The most important resource here is available funds.

- When the learning process is over, extension staff still has to work closely with
- VEWs in order to:

- Provide training and new information on specific subjects that VEWs have not previously been aware of.
- Establish a coordination network among VEWs or among best performing households.
- Organise and facilitate exchanges of experiences between villages, well-performing households and VEWs.

Carrying out these activities can help the learning process and technology delivering system to grow.

Funding

Another deciding factor that needs to be considered when developing VES is the identification and management of funds. Taking into account that there are differences in terms of culture, customs, and socio-economic conditions in each development zone, district and village, which influence local capacity and knowledge, it is important to use an appropriate model to procure and manage funds suitable to these specific conditions. This helps identify appropriate additional training for village authorities, production groups and village technical staff to strengthen their capacity in seeking and managing funds for village extension work, particularly regarding:

- Management and utilisation of village development funds.
- Absorption of funding support from the Government Poverty Eradication Fund.
- Funding from other development projects.

Another important factor that needs to be considered is that good implementation of a VES can only be achieved if extension staff have sufficient capacity to perform throughout the whole extension process. It is therefore important for DAFO staff to develop their capacity to become generalists. More details are presented in Figure 3.

Part III: System for training and forming teams of generalists for the sage of VES

An important factor contributing to the development of an efficient extension system is training to strengthen capacity of government staff and local people. For example DAFO staff must have good knowledge on how to work with local people, taking into account that the best way to do this is to set up a strong network within the production base. This means that:

There must be a sufficient number of VEWs within villages to be able to provide extension assistance that meets the needs of people in the target villages. In addition, production groups must also be organized.

This implies that to pave the way for efficient implementation of Government Policy there has to be an emphasis on local capacity building by local people to suit their needs. In short, training has to be considered as a spearheading tool for developing the extension structure and management network. The ultimate result of this will be a sustainable increase in crop and livestock yields.

In addition, such an approach fosters innovative thinking in local society thereby helping release a heavy carrying load from the Government. *This implies that local people must be trained to know about their own duties and technologies and to be able to utilise them with good and continuous monitoring, evaluation, lessons learnt and expansion to a larger scale.*

The first step in applying this kind of training is for central trainers to build capacity for provincial and district trainers where extension work is just beginning. After Provincial Extension Trainer Teams have been formed and have gone through the whole training process, such teams should be able to expand extension work to other districts by themselves. This supports district staff and enables them to effectively perform extension duties and strengthen their extension network by themselves. On the other hand, trainers at the central level will have time to develop new extension methods that are more appropriate and suitable for situations that keep changing along with changes in development.

Basic knowledge needed for an agricultural based generalist should be diverse, covering a number of subjects and discipline as summarised below.

- Policy and direction related to agriculture and forestry extension/development.
- How to move from a concept to developing new methodologies following the community development approach.

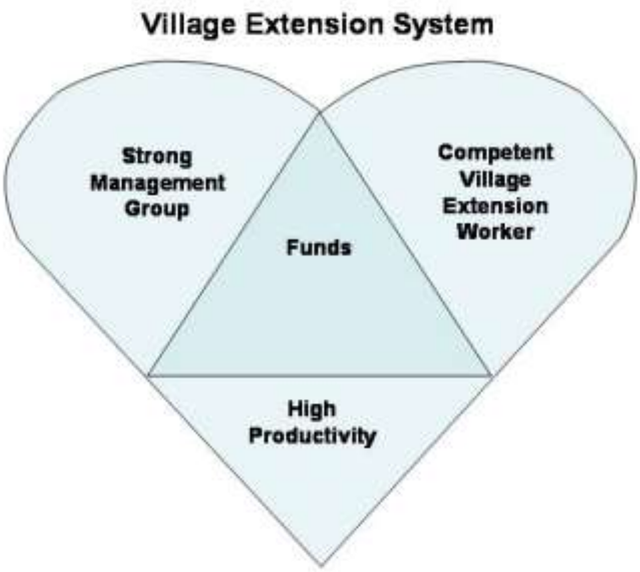

Figure 3: Diagram illustrating elements of a strong and sustainable VES

- Methodologies for developing production and service groups.
- VEWs and gender in community development.
- Participatory extension procedures, steps, techniques and training.
- Knowledge and tools for effective implementation of extension.

- Roles and responsibilities (generalist) and extension management.
- Analysis and planning methods for extension support and on-site training in target groups.
- Methodology for implementing monitoring plans (province, district and farmers)
- Evaluation, drawing out lessons and expansion of methodologies.
- Other technical aspects needed for extending processing, credit and marketing. (For each topic above there are many specific sub-topics in the actual curriculum)
- Experiences and skills that are needed by extension staff to implement the extension process include:
- Production analysis for agricultural communities.
- Relevant training needs assessment.
- Identifying curriculum, training tools and equipment.
- Ability to apply PRA tools and facilitating skills.
- Monitoring and evaluation.
- Knowledge transferring.
- Scaling up the learning process in communities.

(Training and facilitating should be carried out and improved in a continuous process depending on season and type of production).

What are the immediate challenges?

The Lao extension system has been thoroughly tested and includes experiences of all stakeholders. It seems the right strategy to approach the diverse requirements of the people in Laos. Nevertheless the approach is still quite new and only a few provinces and districts are familiar with the idea. Thus, the challenge for the future is to spread the concept throughout the country to every province, district and village. This requires a concept for the delivery mechanisms of services to the village including a model for training district generalists. Furthermore, successful examples for financing the VES are going to be explored and spread.

Three challenges have been identified in developing an appropriate extension system for Lao PDR.

- The Financial Aspects of the VES: Each village will need to have its own method of organising the required funds to run the VES. Clearly, some common features will emerge. However, we need to explore various ways villages can compensate the work of their VEWs. We must identify successful ways and network between experienced villages and those who want to learn how to arrange their finances. There is also a need to think hard on what kind of training village authorities and VEWs need in order to manage their resources. No doubt the village development funds will have a crucial role to play. All these financial aspects at the village level and the required training needs must be explored and developed.
- The delivery mechanisms of DAFO services to VES: Here there is a need to focus on the operational concerns. What are the most efficient procedures for DAFO services to be readily available for the VES? There is a need to explore what the most useful distribution of roles and responsibilities. This again will probably depend on the specific situation in each district.

Another challenge is logistics. In certain regions of Laos, it can take quite some time to get from one village to another or from a village to the district headquarters. There will be a need to find a solution to this problem of distance in remote areas. There has been discussed of sub-centres in the district, which will be located where villagers can meet the district extension generalists. These sub-centres may later be under the sole responsibility of the village clusters that are serviced by them.

- Training DAFO staff to be competent service providers to VES: This is the most serious immediate bottleneck. There is a need for capable extension generalists who can help start VES programmes and support their further activities. Training people in each and every district will be time-consuming.

Author

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