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Agrarian Transition in Lowland Southern Laos: Implications for Rural Livelihoods

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Abstract

Despite being a low-income, agriculture-based country with a subsistence orientation, Laos is in the early stages of a major economic transformation whereby rural households have been experiencing rapid change in their farming and livelihood systems. Some households have begun to engage in semi-commercial farming while others have adopted labour-oriented or migration-oriented livelihood strategies. This study explores livelihood strategies of rural households in lowland rice-based farming systems in Southern Laos in relation to government policies for agricultural development and the agrarian transition occurring in Laos and the region.

The analytical framework used for this study draws on farming systems economics, agrarian systems analysis, and rural livelihoods analysis. Data were obtained from six villages in the lowlands of Champasak Province in Southern Laos through key informant interviews, village group discussions, household surveys, and household case studies. Survey and case study data were supplemented with project and historical agronomic trial results in order to construct model budgets for various input scenarios of rice production. To allow for the production and market risks facing farmers, the budgeting analysis was supplemented by the techniques of sensitivity analysis, threshold analysis, and risk analysis.

The study shows that Lao farmers in areas such as the lowlands of Champasak are caught up in, and contributing to, a much larger regional process of agrarian transition. Despite the selective adoption of improved technologies, rice production in all the study villages was primarily a low-yield, subsistence-oriented activity, or at most a semi-commercial activity. Most farmers appeared to view rice production as a platform on which to construct a diversified livelihood strategy in which the use of family labour within and beyond the farm was the key element.

An economic analysis of rainfed rice production suggests that, given current conditions, we are likely to continue to see the adoption of low-input, labour-efficient, and relatively stable rice production systems for most households, with small areas of high-input, commercially-oriented systems in favourable situations. Price fluctuations due to supply shocks and government responses have created a further disincentive to the intensification of rice production systems.

With rice production providing a subsistence base, rural households in the study area were engaged in a range of other agricultural and resource-based activities, including cultivation of non-rice crops, livestock-raising, and forest- and river-utilisation. Water resources were extracted from streams, ponds, and groundwater, as well as irrigation systems. The diversification of cropping systems

through cultivation of non-rice crops was one alternative for improving the productivity and profitability of farming systems and the productivity of water use in the irrigation areas.

In all villages, off-farm and non-farm activities, particularly long-term migration of younger household members to neighbouring Thailand, have come to play a large role in household livelihood strategies. In some cases this is necessary to meet the household's consumption requirements; in most, it is part of a diversified strategy in which rice farming still plays a significant role, though still largely for subsistence. The diversification of household livelihoods through wage migration has reduced farm labour availability and increased farm wages, further limiting the incentives for rice intensification.

Research and extension efforts should recognise this diversity of production systems and household livelihood strategies. There remains a need to improve the productivity and stability of rice production as a subsistence-oriented activity to enhance the capacity of rural households to engage in both farm and livelihood diversification. The level and reliability of returns to household labour (rather than land) should be central to the assessment of new agricultural technologies and practices, as well as the evaluation of agricultural policies.

While rainfed rice will likely retain its role as the subsistence base for some time, the main agricultural trajectory is towards activities that provide higher returns to the household's labour and capital resources. Hence the clear trend is towards diversification away from both sole dependence on rice and sole dependence on farming – that is, a trajectory of farm and livelihood diversification.

Declaration by author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

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Publications during candidature

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Keywords

agrarian transition, migration, remittances, livelihood strategy, rural poverty, Laos

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ACMECS	Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy
ADB	Asian Development Bank
AFTA	ASEAN Free Trade Agreement
ALRC	Agricultural Land Research Centre
ASA	Agrarian systems analysis
ASEAN	Association of Southeast Asian Nations
CD	Cumulative distributions
CIMMYT	International Maize and Wheat Improvement Centre
DAFO	District Agriculture and Forestry Office
DLSW	Department of Labour and Social Welfare
DPI	Department of Planning and Investment
DS	Dry season
EC	European Commission
EU	European Union
FAO	Food and Agriculture Organization
FDI	Foreign direct investment
FLEGT	Forest Law Enforcement, Governance and Trade
FMD	Foot-and-mouth disease
FSD	First-degree stochastic dominance
FTE	Full-time equivalent
GDP	Gross Domestic Product
GDS	Global Development Solutions
GI	Gross income
GM	Gross margin
GMOs	Genetically modified organisms
GoL	Government of Laos
GR	Green Revolution
ha	hectare
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
ICEM	International Centre for Environment Management
IFPRI	International Food Policy Research Institute
IRRI	International Rice Research Institute
LAFE	Lao Agricultural and Forestry Extension

LAK	Lao Kip
Lao PDR	Lao People's Democratic Republic
LC	Labour cost
LDC	Least Developed Countries
LECS	Lao Expenditure and Consumption Survey
LSB	Lao Statistics Bureau
LT	Land title
LUP/LA	Land Use Planning and Land Allocation
MAF	Ministry of Agriculture and Forestry
MIC	Ministry of Industry and Commerce
MINC	Ministry of Information and Culture
MNR	Marginal net return
MOU	Memorandum of Understanding
MPI	Ministry of Planning and Investment
MRG	Mekong Research Group
MRR	Marginal rate of return
MSCP	Meteorology Station of Champasak Province
MV	Modern varieties
NA	National Assembly
NAFRI	National Agriculture and Forestry Research Institute
NBCAs	National Biodiversity Conservation Areas
NEM	New Economic Mechanism
NGOs	Non-government organisations
NI	Net income
NSC	National Statistic Centre
NTFPs	Non-timber forest products
PAFO	Provincial Agriculture and Forestry Office
PBCAs	Provincial Biodiversity Conservation Areas
PFO	Planning and Finance Office
PPCO	Provincial Planning and Cooperation Office
SAFReC	Southern Agriculture and Forestry Research Centre
SPSS	Statistical Package for Social Scientists
SRI	System of rice intensification
SSD	Second-degree stochastic dominance
t	tonne

THB	Thai Baht
TLUCs	Temporary land use certificates
TV	Traditional varieties
TVC	Total variable costs
UNDP	United Nations Development Programme
USD	US Dollar
VIC	Variable input costs
WDR	World Development Report
WFP	World Food Programme
WS	Wet season
WTO	World Trade Organisation
WUGs	Water-users' groups

1 INTRODUCTION

1.1 Research problem

Throughout Southeast Asia, formerly subsistence-oriented rice farmers have been caught up in the economic transformation that has swept the region in the past two to three decades, even in marginal environments and in the poorest countries. Laos is categorised as one of the Least Developed Countries (LDC) with a Gross Domestic Product (GDP) per capita in 2007 of USD 701 and a ranking of 130 out of 177 countries in the International Human Development Index (MPI and UNDP, 2009). Laos is a largely rural country where over 70% of the population lives in rural areas and largely depends on subsistence rice agriculture (NSC, 2005a). Despite being a low-income, agriculture-based country with a subsistence orientation, Laos is in the early stages of a major economic transformation whereby rural households have been experiencing rapid change in their farming and livelihood systems. Some households have engaged in what the World Bank (2007) classifies as market-oriented farming while other households have adopted labour-oriented or migration-oriented livelihood strategies.

Though the national economy has been growing in recent years and the incidence of poverty has been reduced from 46% in 1993 to 27% in 2008, regional inequalities have increased (MPI and UNDP, 2009). Many areas have chronic rice deficits even though rice self-sufficiency has reportedly been achieved at the national level (WFP, 2007). Concerned with the problem of rice insufficiency, the Government of Laos (GoL) is focusing on increasing the productivity of rice-based farming systems in the lowlands through the use of high-yielding varieties, increased use of fertiliser, and improved management practices (measures that have been successful in the densely-populated rice bowls of neighbouring Vietnam). The emphasis is on irrigated districts, but only a small part (13%) of the total area is irrigated. Hence increased yield and output targets have also been set for rainfed lowland areas, which make up around 70% of the total rice area (Eliste and Santos, 2012).

The rapid change from a subsistence-based economy to a more market-oriented economy is happening in both uplands and lowlands, but especially the latter. The main factors contributing to the agricultural transition in lowland Laos are the improved domestic economy, the increased integration with regional and international markets, and the government policy of agricultural commercialisation. The Lao economy has grown significantly during the past two decades at an annual rate of 6-7% and the nominal GDP per capita increased from USD 207 in 1990 to USD 701 in 2007 (MPI and UNDP, 2009). This has increased people's purchasing power, boosting demand for agricultural products – including not just rice but a diversity of non-rice crop and livestock products – as well as non-agricultural goods and services. The continuing economic growth in the region and the increasing integration with regional markets has accelerated the demand for farmlands and agricultural produce from Laos. As a result, agricultural investment, mainly by foreign investors through land concessions and contract farming schemes, has increased substantially in recent years (Setboonsarng et al., 2008). The increase in foreign direct investment (FDI) is welcomed by the Lao Government, believing that this FDI will support the commercialisation of the agricultural sector, which is one of the government's priorities (MPI, 2010a). The accumulated FDI in agriculture in Laos, mainly from China, Thailand, and Vietnam, increased from USD 18.6 million in 2001 to over USD 1,155 million in 2009, mostly in plantation schemes under large-scale land concessions (MPI, 2010b).

However, increasing numbers of farm workers from Laos have migrated to work in Thailand in recent years. Economic growth and industrialisation in Thailand have increased employment opportunities, attracting labour from rural areas as well as the neighbouring countries of Myanmar and Cambodia (Thongyou and Ayuwat, 2005), while skilled Thai workers have migrated temporarily to work in higher-paid employment in other countries, especially in the Middle East (Rigg and Salamanca, 2011). The influx of migrant labour from Laos to Thailand has resulted from fewer employment opportunities and lower relative wage rates in Laos (Deelen and Vasuprasat, 2010). Labour migrants draw on their social networks of relatives, friends, and other villagers with experience of working in Thailand to find jobs, accelerating the flow of workers to Thailand (Thongyou and Ayuwat, 2005). The key issue, then, is whether the intensification of rice production, as envisaged by the GoL, or diversification into non-farm crops and livestock, can provide the returns to labour to compete with the alternative employment opportunities in Thailand.

The agricultural transition underway in Laos and the wider Southeast Asian region raises important issues related to food security, local livelihoods, and farming systems. How are rural livelihoods and income affected by the agricultural transition? How do rural people adjust their livelihoods or make a living during the transition? What kinds of changes in farming systems are occurring or needed during the transition? What are the economic returns of different rice-based farming systems in the lowland environment? How do rural households in an agriculture-based and subsistence-oriented country like Laos move rapidly down a number of market-oriented pathways out of poverty? How effective are government policies for the rice-based lowlands, singly and in combination, in achieving productivity improvement, commercialisation, and poverty reduction? What are the implications for the GoL's rice intensification strategy? What are the trajectories or pathways out of poverty for rural households in lowland Southern Laos?

1.2 Research objectives, framework and methods

The overall aim of this study is to explore livelihood strategies of rural households in lowland rice-based farming systems in Laos in relation to government policies for agricultural development and the agrarian transition occurring in Laos and the region. The specific objectives are to

1) examine the effects of the agricultural transition on farming systems and rural livelihoods,
2) investigate rural household strategies during the period of agricultural transition,
3) identify factors affecting the adoption of, and appraise the economic returns to, different innovations in rice-based farming systems,
4) explore the effects of government policies for lowland agriculture, particularly the tension between the government policy of rice intensification and the rapidly emerging trend towards livelihood diversification, and
5) identify trajectories of rural households in lowland Southern Laos, in particular, those which constitute pathways out of poverty.

As the research is focused on rural households in the context of agrarian transition, the main conceptual framework employed was agrarian systems analysis. However, some elements of the rural livelihoods framework, in particular, the concept of household livelihood strategies, were incorporated into the analysis in order to understand the diversity and complexity of the evolving production systems and rural livelihoods of lowland farmers in Southern Laos. Underpinning both these perspectives were the concepts and tools of farming systems economics.

Champasak Province in Southern Laos was selected as the study area as this province has been experiencing profoundly the different dimensions of the agricultural transition outlined above. A total of six villages in two contrasting lowland districts were chosen for detailed study. Both primary and secondary, and qualitative and quantitative data were collected during fieldwork, which was conducted throughout 2011 and in May 2013. Primary data were collected through key informant interviews, group interviews, direct observation, household surveys, and case-study interviews. Secondary data were reviewed and collected from different sources. Relevant reports, both published and unpublished, were collected from government agencies, non-government organisations (NGOs), and projects at the national, provincial, district, and village levels.

Information about the study villages was obtained from the village authorities during reconnaissance surveys.

As farmers are transitioning towards commercial production and livelihoods are diversifying, the economic returns of different production systems and various livelihood activities become progressively more important to them. Hence particular attention was given to conducting an economic appraisal by applying the tools of enterprise budgeting, partial budgeting, and whole-farm analysis. To allow for the production and market risks facing farmers, the techniques of sensitivity analysis, threshold analysis, and risk analysis were also used in the budgeting analysis. The software programs used for analysing the quantitative data were Microsoft Excel, Statistical Package for Social Scientists (SPSS), and @RISK. Data from farm household interviews were entered into SPSS and a range of functions and statistical modules available in the SPSS software program were applied to analyse various dimensions of the information and relationships among variables. Spreadsheets in Microsoft Excel were developed to facilitate the budgeting analysis as well as the sensitivity analysis of yields, product prices, and labour costs. In addition, the software program @RISK was incorporated into Microsoft Excel to generate a probability distribution of outcomes for risk analysis. These techniques are described in detail in the relevant chapters of the thesis.

1.3 Thesis overview

The thesis is organised into ten chapters. The next chapter reviews the nature of the structural transformation associated with economic growth, with particular reference to the agrarian transition and the potential pathways out of poverty for rural households. It then elaborates various dimensions of the agrarian transition, followed by a discussion of the different types of rural livelihoods that emerge during the transition process. The chapter concludes by placing the agrarian transition in the context of lowland Laos.

Chapter 3 describes the farming systems and agricultural transition occurring in lowland Southern Laos. It first gives an overview of the physical and socio-economic environment of farming in Laos. It then discusses the farming systems practised in Laos with emphasis on rice-based farming systems. This is followed by a sketch of the agricultural transition occurring in the lowlands of Southern Laos.

Chapter 4 describes the methodology and the study area. It first presents the theoretical framework used for this study. It then outlines the methods used for data collection. Finally, the chapter provides an overview of the study area to give an understanding of the general context in which agricultural transition has occurred.

Chapter 5 investigates rice cropping systems in the study area, with particular emphasis on the all-important wet-season crop. An account is given of cultivation practices and the adoption of improved technologies, with the main focus on the comparison between households in different village types and districts. The chapter then describes rice farming in the dry season for those villages with access to irrigation. Finally, household rice status is examined, with particular reference to household strategies related to producing rice for home consumption and for sale.

Chapter 6 explores other resource-based farm and forest activities pursued by rural households in the study area. It starts with a discussion of the access to and management of water resources, a major determinant of what types of crop activities can be pursued. It then describes these other crop activities, as well as livestock raising. The utilisation of forest resources is also examined.

Chapter 7 presents an economic appraisal of lowland rice production and other non-rice crops in the study area. The aim of this analysis is to assess the profitability of a hectare of rice production in the conditions faced by a typical farmer in the study area and to compare this with intensified rice production to achieve the government's yield targets. The chapter then assesses the economic returns of non-rice crops grown on paddy land in the dry season, as an alternative option to irrigated rice production. Attention is given to the appropriate valuation of various indicators and comparison of economic performance, derived from enterprise budgeting, sensitivity analysis, threshold analysis, and risk analysis. Finally, the chapter elaborates options for rice intensification.

Chapter 8 turns to the activities undertaken by household members in the study area beyond their farms, including off-farm work, non-farm employment, and especially labour migration to Thailand. The chapter analyses the types of work undertaken, the characteristics of the household members involved, and the importance of these sources of income to the household.

Chapter 9 pulls together these different strands to examine the different types and trajectories of rural households in the lowlands of Southern Laos. It first identifies the evolving household types, based on the dominant livelihood activities. It then outlines the features of these types, drawing on detailed case studies that were selected to be representative of each type. This is followed by a discussion of the various strategies and trajectories of these different types of rural household.

The final chapter highlights the findings of the study and outlines the research and policy implications.

2 AGRICULTURAL TRANSITION IN SOUTHEAST ASIA

2.1 Introduction

The agricultural growth and development underway in Laos needs to be seen as part of a general agricultural transition or transformation, which has occurred in many countries of Southeast Asia in recent decades. This chapter reviews the structural transformation and the potential pathways out of rural poverty that it provides. Various dimensions of the agrarian transition are then elaborated, followed by a discussion of the different types of rural livelihoods that emerge during the transition process. The chapter concludes by placing the agrarian transition in the context of lowland Laos.

2.2 Structural transformation and pathways out of rural poverty

The overall pattern of economic development in most countries has involved growth in agricultural production due to a prolonged rise in agricultural productivity by applying new, more intensive production technologies such as high-yielding seeds, chemical inputs, and mechanisation; the relative decline of agriculture in terms of its share of GDP and the labour force as the economy grows and labour moves out of agriculture; culminating in structural change from a primarily agriculture-based economy to a primarily industrial- and service-oriented economy (Tomich et al., 1995, World Bank, 2007). The World Bank in its *World Development Report 2008* (WDR 2008) has reiterated this focus on agricultural development as the crucial engine for economic transformation, highlighting the importance of this process for accomplishing the Millennium Development Goals (World Bank, 2007).

Based on the contribution of agriculture to economic growth and poverty reduction, the WDR 2008 classifies countries into three categories – “agriculture-based”, “transforming”, and “urbanised” (World Bank, 2007, p. 29). The agriculture-based countries are in most of Sub-Saharan Africa where the agricultural sector plays a key role and represents a large proportion of the nation’s economy – on average 32% of GDP during 1993-2005. Most of the population lives in rural areas and poverty and food insecurity are their main problems. The transforming countries include most of South and East Asia, the Middle East, and North Africa. In these countries the agricultural sector is declining in its relative importance, representing on average 7% of GDP over 1993-2005, and the economy as a whole becomes more industrial and service-oriented. Even though the economies have been growing and the incidence of poverty has been reduced in many of these countries, poverty is still the foremost problem among rural people and the income gaps between rural and urban areas are widening. The urbanised countries cover most of Latin America, Europe, and Central Asia. Agriculture is only a small part of the economy and contributed on average only 5% to GDP in the period of 1993-2005, while industry and service sectors support most of the economy. Poverty is concentrated in urban areas. The World Bank (2007) argues that many developing countries are moving from "agriculture-based" to "transforming" and then to "urbanised" status and that most Southeast Asian nations are in the transforming phase.

Other writers agree that agricultural and rural communities in the Southeast Asian region have undergone a remarkable change in the past few decades. The region has seen its traditional agricultural and subsistence-based communities transformed into modern industrial and market-oriented communities (De Koninck, 2004, Johnston et al., 2009). Rural livelihood structures have also changed, shifting from a focus on farm production to non-farm activities and from rural areas to towns. Farming has declined in significance to become a supplementary activity in household livelihoods, which are characterised by diversifying activities and income sources and increasing levels of labour migration (Rigg, 2006). Some countries in the region such as Thailand and the Philippines have experienced this transition to a greater degree, in which the contribution of farming to household income has decreased remarkably and, correspondingly, the share of non-farm income sources has risen (Rigg, 2005a).

The WDR 2008 outlined three strategic pathways out of poverty for rural people. The first pathway is through commercial agriculture – the diversified farming of cash crops, vegetables, and livestock and greater integration with markets. The second pathway involves agricultural wage employment and/or non-agricultural self-employment. The third pathway is through out-migration from the rural economy to work in urban areas or other countries. The WDR 2008 makes the point that, in some circumstances, rural households incorporate all three pathways out of poverty into their livelihoods strategies at the same time, that is, they follow a diversified pathway.

The WDR 2008 also states that these three pathways often support each other. For example, in the Philippines farmers who engaged in commercial farming were able to support their children to higher schooling levels and later these educated people obtained higher-paid non-farm jobs in urban areas and sent money back to their parents to invest further in farming. The WDR 2008 suggests that poor and landless farmers have to engage in farm or non-farm wage employment or even leave rural areas to find wage work in towns since in most developing countries the growth of agricultural employment cannot absorb the growing number of rural workers. However, the WDR 2008 acknowledges that there is a challenge to make rural wage employment a successful pathway out of poverty, and migration too is not an assured means of poverty alleviation.

Some scholars have criticised the view of agricultural development and poverty reduction given in the WDR 2008, with particular reference to Southeast Asia. Hall (2009) argues that there is difficulty in placing the on-going agricultural growth and development in the Southeast Asian region into the WDR's framework. Hall refers to many studies in Southeast Asia showing that farmers have lost interest in farming, see no future in farming, and want to leave agriculture. He disagrees with the WDR 2008 which claims that agriculture can significantly contribute to development and poverty alleviation in the Southeast Asian region. Similar comments are made by Oya (2009), namely, that the WDR 2008 did not adequately consider the linkage between agriculture and industry. Oya further argues that the WDR 2008 emphasises self-employment in rural non-farm enterprises as a pathway out of poverty more than wage employment, whereas the latter is more visible in Southeast Asia. Moreover, the WDR 2008 focuses more on large farms with commercially-oriented enterprises than on small farms. Li (2009) disagrees with the optimistic picture presented in WDR 2008 regarding the exit from agriculture of smallholding farmers who fail to engage in commercial agriculture, the engagement of landless farmers in wage employment in rural or urban areas, and the possibility of a return to agriculture for urban workers suffering from "urban shock", such as in the Asian economic crisis of the late 1990s. She argues that, without appropriate mechanisms and social safeguards for labour mobility, advising farmers to leave the farm is not a pathway out of poverty; rather it makes them poorer and the option of returning to agriculture only applies to wealthy farmers with large farms, not the poor. Rachman et al. (2009) totally disagree with the three pathways believed by the World Bank to help farmers out of poverty. They argue that, in the Indonesian context, those pathways are likely to make "new poverty" due to poor farmers facing the unfavourable conditions and risks associated with engaging with global markets, and rural poor who migrate merely becoming part of the urban poor.

2.3 Dimensions of the agrarian transition

The process of agrarian transition in the transforming countries of Southeast Asia has involved simultaneous change in various dimensions. According to De Koninck (2004), the agrarian transition in Southeast Asia involves the following dimensions or themes as driving factors in the overall process of the transition – agricultural intensification and territorial expansion; market integration; urbanisation and industrialisation; population mobility both domestically and internationally; intensification of regulation; and environmental change. These dimensions of agrarian transition are often closely interrelated.

2.3.1 Agricultural intensification and territorial expansion

Historically, farmers in Southeast Asia practised low-intensity, subsistence-oriented agricultural production. With growing population, these farming systems have been intensified, moving from "forest-fallow cultivation" to "bush-fallow cultivation" to "short-fallow cultivation" to "annual cropping" and in some areas to "multi-cropping" (Boserup, 1965, pp. 15-16). The early intensification of agricultural production has been mainly driven by population growth without the use of modern technology. Later, agricultural intensification has been associated with modern technology leading to much more rapid increase in agricultural productivity, in particular of rice, giving rise to the so-called Green Revolution (GR). The remarkable yield increases have been achieved through the use of modern, high-yielding varieties with the complementary uses of chemical fertilisers and pesticides, water from irrigation, and mechanisation (World Bank, 2007). The GR in Southeast Asia centred on lowland rice production (Runge and Runge, 2010, Estudillo and Otsuka, 2006). From the 1960s there was a substantial increase in rice yields through the adoption of high-yielding rice varieties associated with the application of chemical fertilisers, and an intensification through double cropping based on access to water for irrigation. This intensification increased rice production and food security in the region (Otsuka and Kalirajan, 2006, World Bank, 2007). Indonesia and the Philippines became self-sufficient in rice, and even rice exporters during the 1980s, while Thailand and Vietnam progressed to be the world's top exporters of rice during the same period (Dufumier, 2006).

There have been debates over the effects of the GR. DeGregori (2004) asserts that the GR led to reduction in the prices of food-grains, increase in the returns from land and smallholding farmers' incomes, and decline in the incidence of poverty. Hossain et al. (2006) insist that a significant increase in rice yields in Bangladesh resulting from using modern high-yielding varieties has helped the country achieve national rice self-sufficiency in 2001, in spite of population growth and declining agricultural land area. Using data collected in three rural villages of the Philippines in 1985 and 2004, Estudillo et al. (2006) contend that the GR has helped reduce the incidence of rural poverty in such rice-growing villages. They argue that the rising incomes from yield increases enabled farmers to support their children to higher education levels and later these children were able to earn higher income from non-farm employment. They further argue that landless farmers benefited as well through the increasing rural wage rates and opportunities for non-farm employment. The contribution of the GR to the rise in wages in India is also claimed by Das (1998), who maintains that wages were likely to be higher in the areas where the GR was more successful. According to the World Bank (2007), the poverty incidence in India reduced significantly from 64% in 1967 to 50% in 1977 to 34% in 1986 as a result of the dramatic rise in agricultural production and farmers' incomes brought by the introduction of high-yielding varieties of wheat and rice during the 1960s and 1970s.

Critics of the GR argue that only better-off farmers in better-off regions have benefited. Janaiah et al. (2006) claim that the GR happened mostly in irrigated environments in the northern region of India and later spread to the rainfed environment. In the same manner, Tran and Kajisa (2006) mention that in Vietnam the GR took place firstly in irrigated areas then extended to other less favourable areas. Estudillo and Otsuka (2006) found that the modern rice varieties were grown in all three rice-growing ecosystems in the Philippines – irrigated, rainfed, and upland – but the yield responses were obviously highest in the irrigated environment, followed by the rainfed environment, and very limited in the upland environment. Runge and Runge (2010) argue that the income gaps between rich and poor farmers are widening. Better-off farmers with larger farms tend to get more benefits than poor farmers with less land because the former can access new technologies (high-yielding varieties, fertilisers, and mechanisation), irrigated water, and credit. Jacoby (1972) observes that the GR innovations stimulated increasing economic inequality in rural areas of India. Based on time-series data over four decades, Niazi (2004) claims that the GR did not contribute to a reduction in poverty and an increase in employment in rural Pakistan, but stimulated income and asset inequality.

There have also been arguments over the environmental effects of the GR. Some argue that the GR saves many forest areas which would have been converted into farming areas in the absence of the GR technology, leading to further environmental impacts (DeGregori, 2004, World Bank, 2007). On the other hand, it has been pointed out that the intensification of production itself causes environmental degradation – the overuse of fertilisers and pesticides causes polluted water and declining soil fertility, the intensive use of water pumped for irrigated farming leads to decreasing groundwater levels, and the focus on only a few high-yielding crops and varieties results in the loss of genetic diversity (IFPRI, 2002, IAASTD, 2009).

Bradon (2008, p. 25) argues that "genetically engineered foods and industrial monoculture are not the answer to feeding the world or to promoting sustainable agriculture" and highlights potential alternatives through technologies that integrate both traditional knowledge and modern sciences, e.g., organic, small-scale, and traditional agricultural production. Rosset et al. (2000, p. 55) also suggest the solution is "alternative agriculture" based on small-scale, agro-ecological farming which can potentially increase yields, reduce costs, and save the environment, arguing that this has proved successful in India and Cuba. According to the World Bank (2007), a possible intermediate solution is the promotion of diversified farming and integrated pest management, which can help spread the risks of pest invasion and price volatility, and reduce the amount of fertilisers and pesticides needed. The World Bank (2007) also emphasises a need to extend the GR to lower potential and less-favourable areas.

The process of agricultural transition has also entailed the expansion of farmland. Agricultural expansion is an alternative to agricultural intensification, but sometimes the two occur simultaneously. For example, in Malaysia, rice-bowl areas were undergoing GR intensification at the same time as forests were being cleared for rubber and oil palm expansion (Cramb et al., 2009). More recently, investment in land acquisition for agricultural expansion has not only occurred within a county's borders, but has spread from countries with intensive land use to other countries with relatively abundant land. There has been increasing global interest in and demand for agricultural land, in particular in developing countries. A recent report by the World Bank (2010) estimated approximately 45 million hectares of large-scale farmland acquisition worldwide in 2009, compared with an average rate of expansion in cultivated land of less than 4 million hectares a year between 1961 and 2007.

The World Bank report cited three main factors driving the expansion of cropping land – demand for food and manufacturing raw supplies, demand for bio-fuel crops, and shift of the commodity production base to regions with abundant land (World Bank, 2010). The area of cultivated land is expected to increase in the future to produce food crops in response to growing population, rising incomes, and expanding urbanisation. The expansion of cultivated land is predominantly in Sub-Saharan Africa, Latin America, and Southeast Asia. In Southeast Asia the cropland expansion has mainly involved the planting of tree crops or other perennials, for example, rubber and oil palm under large estates in Malaysia and Indonesia, rice under smallholdings in Thailand and Vietnam, and recently rubber under large land concessions in Laos and Cambodia (Johnston et al., 2009, World Bank, 2010). Increasing food prices accelerate the process of land acquisition by food-importing countries to ensure their food supplies from abroad. Rising interest from investors in agricultural lands has been spurred by the spike in food prices in 2008.

2.3.2 Market integration

The agrarian transition involves processes by which subsistence farmers enter into production for the market, i.e., the commercialisation of farming. According to Myint (1973, pp. 35-36), the transition from subsistence to commercial production consists of two stages. The first occurs when farmers use the larger proportion of their resources of land and labour to produce for their own consumption needs, but use their spare resources to produce for the market. The second stage is reached when farmers allocate almost all of their resources to cultivate for the market and rely on purchasing commodities and services. In other words, farmers change from "part-time" to "full-time" producers for the market. The shift is accelerated by the improvement of infrastructure – especially transportation and communications – and the availability of markets.

In a similar analysis, Fisk (1975, p. 53) classifies the transition from subsistence to commercial systems into four stages – "pure subsistence in isolation", "subsistence with supplementary cash production", "cash orientation with supplementary subsistence", and "complete specialization for market". The first stage is when all farmers' consumption comes from their own production and the final stage is when the producers depend on the market for all the goods and services they need. The two stages in between correspond to Myint's two stages. Farmers may produce for their household consumption but undertake supplementary production to get access to goods and services not available from their own resources. As commercialisation proceeds, they may produce mainly for the market to earn cash income, but still produce a substantial part of their basic food and other requirements. In reality there is rarely if ever a stage of "pure subsistence" or "complete specialisation for the market". Farmers are normally somewhere in stages two and three. For instance, although farmers may only focus on subsistence production, they tend to cultivate cash crops to increase their income if they have spare time or land. On the other hand, despite producing mainly for the market, commercial farmers may still produce crops and livestock for subsistence because this will help reduce the risks they face from market fluctuations.

Farmers in the Southeast Asian region have engaged with commercial production in response to higher demand for agricultural produce created by economic growth in the region (Johnston et al., 2009). In addition, increasing access to regional and international markets through the implementation of the ASEAN Free Trade Agreement (AFTA) and accession to the World Trade Organisation (WTO) has encouraged farmers to produce for markets and further accelerate the change in agricultural production systems to be more intensified and diversified (Dufumier, 2006). There is also new market potential for exporting agricultural products to respond to changing consumer demands for high-value and organic products, and rising demand for bio-fuel production due to the increase in fuel prices (World Bank, 2007). Consequently, farmers' livelihoods and their farming systems are more dynamic and increasingly integrated with markets.

2.3.3 Urbanisation and industrialisation

The urban population in the Southeast Asian region has been growing rapidly, with around 63 million people now living in cities. The surrounding suburbs and industrial areas are expanding as well, in places encroaching on productive agricultural land, as in the Red River delta in Vietnam. The growth in urban areas and the industrial sector increases the demand for agricultural products as food and inputs for agro-processing (Johnston et al., 2009), requiring more intensive utilisation of labour and natural resources, including land, water, and energy. As incomes grow there has also been a change in food preferences with a shift from cereals to meat products, fruit, and vegetables, and this in turn leads to more diversified farming patterns (World Bank, 2007, IAASTD, 2009).

2.3.4 Population mobility

Migration has long been one of the livelihood strategies available to rural households. It is often combined with other strategies, thus contributing to livelihood diversification and risk mitigation. Ellis (2000, pp. 70-71) classifies labour migration into four types. "Seasonal migration" refers to temporary migration occurring in response to the agricultural calendar or seasons, with individuals normally moving out during the lean period and returning during the peak period. "Circular migration" refers also to temporary migration but occurring in response to the demand for labour and not necessarily associated with agricultural seasons. "Permanent migration" (rural-urban migration) is when household members move to work in urban areas for a long period of time and transfer money back home (remittances). "International migration" involves household members migrating either temporarily or permanently to work in foreign countries.

There are many reasons behind the movement of rural labour. Ellis (2000) highlights that migration can occur due to "pull" or "push" factors, or a combination of both. Differences in income are the major pull factors, while the risks associated with seasonality, market failures, resource scarcity, and disasters are the key push factors. The relative importance of these two sets of factors varies between regions and individual households. The World Bank (2007) argues that labour migration occurs mainly in response to "income gaps between the origin and the destination", that is, a pull factor. Similarly, Rigg (2007) suggests the main cause of labour migration in Southeast Asia is the opportunity for higher income or higher wage rates and the ability to transfer money home. However, Li (2009) cautions that labour migration may not be a "pathway out of poverty" but a temporary stop-gap for the extreme poor, who find themselves ejected when they become surplus to requirements, without necessarily having the option to return to their home villages and resume farming, particularly in densely populated regions such as much of Indonesia. Likewise, in analysing youth migration from Central Laos to Thailand, Barney (2012) argues that decisions to migrate cannot be disconnected from broader issues of agrarian change. For example, the allocation of large areas of village land to powerful outsiders effectively coerces members of dispossessed households to migrate as a survival strategy. Moreover, remittances can enable some farmers to plant up some of the village commons with permanent crops such as rubber, thereby facilitating the emergence of new intra-village inequalities.

Labour migration has affected rural livelihoods and the agricultural sector in various ways. A crucial issue is the linkage between migration and agricultural intensification (Scoones, 2009). Out-migration causes a shortage of labour in the agricultural sector when rural people, especially young workers, go to work in non-farm activities in other areas of the country or even in other countries (Rigg, 2007). Migration may thus limit agricultural intensification, which normally requires increased labour input per hectare. According to Rigg (2005a), many villages in Southeast Asian countries such as Thailand, Indonesia, the Philippines, and Malaysia have become "de-agrarianised" in that most people who live in the village earn their livelihoods through non-agricultural employment in towns.

On the other hand, the remittances from migrant family members can help reduce the capital constraints of poor households. Migration may therefore encourage agricultural intensification if remittances can be used to hire labour or purchase agricultural inputs such as seeds, fertilisers, livestock, and labour-saving equipment (McDowell and de Haan, 1997). Rigg (2007) found that households who receive remittances are able to invest more in agricultural production or even engage in new investment activities, especially when migrant family members return home with skills and money. However, one of the key issues is whether remittances are available for agricultural investment or are needed for buying food and other consumption needs to meet the shortfall in the household's income and food supply.

In countries experiencing labour mobility, the labour shortage in agricultural production can sometimes be filled with labour from more remote areas within the country, where wage rates are lower. The labour shortage can also lead to absorbing labour from other countries. For example, Malaysia obtains workers from neighbouring countries such as Indonesia, the Philippines, Thailand, and Bangladesh while, as noted already, Thailand obtains cheap labour from Laos, Cambodia, and Myanmar (Rigg, 2006). It may be that outmigration from more productive areas of Laos, namely the irrigated and partly-irrigated lowlands of Southern Laos, may draw in labour from poorer areas, such as the rainfed lowlands or remote uplands.

Over time, labour migration leads to change in the demographic structure such that old people are left with responsibility for farming activities. This has already occurred in East Asia – more than half the agricultural labour-force in South Korea was aged over 50 in 1990 and over 65 in Japan in 2000 (Rigg, 2006). In Southeast Asia this pattern is appearing in countries like Thailand. Those remaining farmers have to adjust their farming patterns by hiring additional labour, or applying labour-saving production technology, especially farm machinery. Another scenario is that they may simply produce less or even leave their land unproductive. Rigg (2006) cites Bangladesh as an example of farmers' adaptation to the labour shortage where the availability of remittances from rural-urban (including international) labour migration has created the capability to use more farm machinery and increase agricultural productivity.

This trend to mechanisation is associated with increasing average farm size. In "transforming countries" such as Thailand and Vietnam, smallholding rice farmers have gradually increased their farm sizes because land tenure security encourages them to expand the cropping area in response to market demand and their access to improved agricultural technologies enables them to increase productivity (World Bank, 2010). However, as argued by Rigg (2005b, p. 177), there is also a "de-link" between rural livelihoods and poverty on the one hand and access to land on the other. In the Philippines and Thailand, households with large land areas are not always better-off than those with less land. Even some landless farmers can increase their income by engaging in non-farm activities. Thus the conventional notion of agrarian differentiation as "a cumulative and permanent … process of change … based on … increasing inequalities in access to land" (White, 1989, p. 20) has become less relevant; rather, differentiation between rural households is now more the product of differences in "human capital" (numbers and capabilities of household workers), affecting access to non-farm sources of income (though note Barney's (2012) observation above on the potential role of remittances in generating unequal access to land).

2.3.5 Regulation intensification

There has been an increase in global concern and consumer awareness about environment and health leading to the intensification of regulations affecting agriculture. Various regulations endorsed by international organisations, local governments, and private firms have affected farmers' access to natural resources, particularly land, and their farming practices. At the international level, the most widespread regulations are for the certification of food and other natural resource products, showing that they are produced justly, sustainably, or organically. For example, in 2003 the European Union (EU) adopted the action plan for Forest Law Enforcement, Governance and Trade (FLEGT) to tackle the rising problem of illegal logging and deforestation, highlighting that the timber products which can enter the EU markets have to come from legal logging and that evidence or certification is needed (EC, 2003). For agricultural produce, according to the EU regulation for organic production No. 834/2007, in order to be able to export the produce to European markets, farmers have to farm in an organic and environmentally-friendly manner without the use of "genetically modified organisms (GMOs)" and chemical inputs, and to certify their agricultural produce with accredited bodies (Radics et al., 2007, EC, 2007, p. 2). Despite farmers having to adapt their farming practices and sometimes face problems with the various procedures and high cost of certifying their produce, in terms of the production requirements set by the EU regulation for organic production, some smallholder farmers may be advantaged as they are short of funds to invest in chemical inputs and instead use local resources such as livestock manure as fertiliser.

At the national government level, regulation has also been a factor affecting agricultural change. In particular, relocation and land allocation programs have been initiated, aimed at moving people to places deemed more appropriate by the government and allocating land to achieve greater governmental control over the use of natural resources and encourage farmers to intensify their land use (Dufumier, 2006). However, these regulations have often limited farmers' access to land, with adverse consequences for rural livelihoods. For example, in a case study of the Vientiane Plain in Laos, Sacklokham and Dufumier (2006) showed that the majority of farmers in the study area had less access to agricultural land due to a combination of the land allocation program and population growth due to resettled migrants from upland areas. Consequently, farmers had to intensify their farming by shortening rotation periods, or even farming without rotations, and family members had to engage in off-farm wage labour for additional income. As well as such relocation and land allocation programs, there has been a growing awareness of environmental threats, particularly to biological diversity, resulting in the declaration of an increasing number of protected areas in the

Southeast Asian region (ASEAN, 2010). This has also limited farmers' access to land and forest resources, particularly in the uplands.

As mentioned earlier, there has been an increasing interest in agricultural land globally, and large-scale land concessions have been granted to private investors in several countries in Southeast Asia, further reflecting the state's regulatory control over land and its uses. The World Bank (2010) observes that the large-scale expansion of agricultural land can create major risks to local communities through the loss of their land and livelihoods, particularly if it is not well managed. Farmers, as a result, have limited landholdings and have to intensify their farming systems to increase production, or migrate to seek non-farm employment.

2.3.6 Environmental change

Environmental problems are also contributing to the process of agricultural development in Southeast Asia. As discussed earlier, growing urbanisation and expanding markets are inducing the intensification of agricultural production with the greater use of improved varieties, chemical fertilisers, and irrigation, and these changes can lead to water pollution, groundwater depletion, and soil degradation (IAASTD, 2009). The rising demand for agricultural production is also associated with bringing more land under cultivation, often at the expense of the forest (World Bank, 2010).

The precise impacts of climate change on agriculture are still uncertain; however, some areas are already facing the consequences of climate change. Dewi (2009) claims that the areas most affected by climate change are in the tropical region, where most of the Southeast Asian countries are located. Dewi further asserts that climate change will lead to increased rainfall, a rise in temperature, and a rise in humidity in Southeast Asia by 2020, causing a drop in rice production of up to 10%. Johnston et al. (2009) also report that agricultural productivity in the Greater Mekong region is estimated to drop between 2% and 30% over the next 20-30 years due to climate change, which is forecast to become the most powerful factor driving agricultural change in the region beyond 2050.

2.4 Rural households and livelihoods

As the agrarian transition proceeds in the transforming countries of Southeast Asia, farm-households are also transformed from their initial subsistence orientation, but not all in the same way or at the same pace. Households have different capabilities and have adopted different livelihood strategies, giving rise to a diversity of farm-household types. A number of different typologies have been developed to describe where farm-households are located within the transformation process. One of the most widely discussed typologies has been put forward by Rigg (2005b, pp. 178-180). He categorises farm-households in the context of the agrarian transition in Southeast Asia into six types – "subsistence", "semi-subsistence", "pluriactive (post-peasant)", "professional", "pluriactive (post-productive, neo-peasant)", and "remnant smallholder" (Table 2.1). This means farmers are changing from farming as a "way of life" to farming as a "business" or from "full-time" farmers to "part-time" farmers. Rigg further argues that few cases of Type 1 farmers persist apart from in remote rural areas of Laos, and that Type 5 farmers can be found in Europe where farmers revert to their traditional production systems (termed "re-peasantisation"). It can be argued that Type 5 is not likely to happen (yet) in the Southeast Asia region, unlike in Europe where there are government subsidies and support for such farmers. The first three types are most relevant to Laos, and Type 6 (remnant smallholder). The fourth type can be applied to large-scale plantations, but these have not emerged from Type 3 in Laos; rather they have been imposed from outside.

Table 2.1 Generalised typology of agrarian transitions in Southeast Asia

	Type	Agrarian type	Characteristics
Past	1	Subsistence	Farming and village focused; some barter and sale of surplus.
Present	2	Semi-subsistence	Combination of subsistence with commercially oriented agriculture; livelihoods remain farming and village focused.
	3	Pluriactive (post-peasant)	Combination of subsistence and commercially oriented agriculture with various non-farm activities, both on-farm and off-farm. Migration and the delocalisation of work are increasingly significant.
	4	Professional	Professionalisation of farming and the emergence of agrarian entrepreneurs. Larger-scale, commercial enterprises utilising high levels of inputs, a tight integration into national and international markets, and technology-intensive. The size and level of production allows farmers to make a living from farming alone.
	5	Pluriactive (post-productive, neo-peasant)	Return or adaptation of pluriactivity as part-time farmers make a lifestyle choice and combine farming with other occupations, trading higher income for a better quality of life.
Future	6	Remnant smallholder	Rural households who remain tied to the land and to traditional production systems. Production is low, subsistence orientation still significant, and poverty high.

Source: Reproduced from Rigg (2005b, p. 180)

Bouahom et al. (2004), modifying Rigg's general typology for the Lao context, separate the livelihood systems in Laos into four systems, moving from subsistence to pluriactive livelihoods (Table 2.2). With growing population, land scarcity, state involvement, and market integration, households move from System 1 of subsistence-based farming with low external input use to System 2 of more market-oriented farming with increasing use of external inputs. Here the production has been intensified with the use of new technologies and farmers become more specialised. Then when the economy grows, local wage labouring increases, and the non-farm sector emerges, households progress to System 3 where livelihoods are diversified between farm and non-farm livelihoods. Finally, with growth in the non-farm sector and modernisation, households move to System 4 where livelihoods become pluriactive, market-oriented, and highly mobile. However, it can be argued that rural households in Laos may not always move from Systems 1 to 4 or from subsistence or semi-subsistence to commercial agriculture, in a linear transition. While some farmers may successfully progress to System 4, others may not be able to move from their current systems and are left behind. Indeed, the very success of some households may limit the opportunities for others, perhaps locking them into wage labour or other low-productivity activities within the village. Moreover, they may be trapped or impoverished by the growth of large land concessions and contract farming arrangements, leaving them without the resources they need to progress as well.

The World Bank (2007, p. 75) also defines rural households, based on livelihood strategies, into five types –"subsistence-oriented farmers" who engage in farming to produce mainly for their own consumption, "market-oriented farmers" whose main incomes are from selling the agricultural products to the markets, "labour-oriented households" who rely heavily on agricultural or non-agricultural wage-employment or non-agricultural self-employment, "migration-oriented households" whose main earnings depend on the remittances from migrant household members, and "diversified households" which combine various activities including farming, off-farm employment, and migration. The relative importance of these household strategies varies across the World Bank's three types of countries. In the agriculture-based countries the farming-oriented strategies are more important while in transforming countries and urbanised countries the labour- and migration-oriented strategies are more dominant. Interestingly, the diversified household strategies are found in all three country types. It is argued in Chapter 9 that this classification is more closely related to the potential pathways out of poverty for individual households and more applicable to the context of lowland Laos.

Table 2.2 Generalised livelihood systems in Laos

System	Livelihood system	Prevailing conditions	System response
1	Village-based, farming-focused, low external input, sustainable, diverse	Population growth, land abundance	Extensification of production and migration to new lands
2	Village-based, farming-focused, increasing external input, more specialised	Population growth, land scarce, growing state engagement and market integration	Intensification of production, use of new technologies, growing specialisation
3	Village-based, divided between farm and non-farm, pluriactive but generally low returns to labour	Population growth, land scarce, growing state engagement and market integration, monetisation of local economy, growing opportunities for local wage labouring	Agricultural shortfalls met by increased local wage labouring. Distress diversification
4	Divided between village and non-village, and farm and non-farm. Pluriactive, market-oriented, and increasingly "modern"	Population growth, land scarce, high level of state engagement and market integration, growing pressure of needs connected with modernisation	Increasing role for non-farm activities, greater mobility, growing spatial fragmentation of households and activities. Distress and progressive diversification

Source: Reproduced from Bouahom et al. (2004, p. 617)

2.5 Agrarian transition in the lowlands of Laos

Laos has long been an agriculture-based country with a strong subsistence-orientation but is now in the early stages of economic transformation. The agrarian transition is happening in both uplands and lowlands, but predominantly in the lowlands (Rigg, 2009). The full intensification sequence proposed by Boserup (1965), which progressively moves to multi-cropping, is not feasible in the uplands, where tree crops such as rubber and teak offer a more viable option, but intensification through to double cropping is certainly possible in the lowlands, given adequate irrigation in the dry season. Many households now engage in market-oriented farming while others have adopted labour-oriented or migration-oriented livelihood strategies.

The main factors contributing to the agricultural transition in lowland Laos are the improved domestic economy, the increased integration with regional and international markets, and the government policy supporting agricultural commercialisation. As outlined in Chapter 1, the Lao economy has grown rapidly in the past two decades, increasing the purchasing power of especially the urban population, adding to the demand for rice and other agricultural products. Continuing economic growth in the region and the increasing integration with regional markets has also accelerated the foreign demand for farmlands and agricultural commodities from Laos, leading to sharply increased FDI in agriculture in Laos, mainly from China, Thailand, and Vietnam. However, most of these investments were in plantation agriculture under large-scale land concessions (MPI, 2010b), which have little effect on smallholder farming and can undermine the resource base of rural communities.

Regarding the intensification of agricultural production, Laos also benefits from the modern technologies of the Green Revolution but is experiencing a slower path of change compared to other Southeast Asian countries. Agricultural production and yields, in particular of rice, increased steadily during the past two decades, helping to make the country self-sufficient in rice. Lao farmers adopted improved rice varieties, some degree of chemical fertiliser and pesticide use, and mechanisation of land preparation. In addition, farmers in areas with access to irrigation have been able to intensify their rice cultivation by growing rice in the dry season. In the early 2000s the improved rice varieties covered 70-80% of the rice-growing areas in the rainfed lowlands along the Mekong River (Inthapanya et al., 2006). But the adoption of improved rice varieties was often not matched by the full application of chemical fertilisers so farmers could not achieve the full potential of those high-yielding varieties. Imported chemical fertilisers are too costly for the majority of Lao farmers to apply the recommended doses (Dufumier, 2006). Bouahom et al. (2004, p. 609) observe that in the past the Lao Government policy of increasing agricultural production focused on the "extensification" of production by increasing agricultural areas. However, more recently, with the emergence of land scarcity, the focus is on the "intensification" of production by encouraging the adoption of high-yielding improved varieties and expanding irrigation systems. Nevertheless, they argue that, with limited potential for agricultural intensification, diversification of livelihoods into non-farm activities is one promising option for rural communities.

The movement of people from farm to non-farm employment and from rural to urban areas is occurring in Laos, but the process has not developed as rapidly as in other transforming countries. All types of migration listed by Ellis (2000) – seasonal, circular, rural-urban, and international – are found in Laos, and sometimes the movement falls into more than one category. People sometimes go to work off-farm in other areas within the country on a seasonal basis, e.g., in large rubber plantations, and come back to their villages to help their families in agricultural activities during peak periods (Baird, 2010, Kenney-Lazar, 2010). Some younger household members go for longer periods to work in towns, sending money home. Phouxay and Tollefsen (2011) report that an increasing number of young rural people, including a larger proportion of women, go to work in large towns, in particular Vientiane Capital, where more jobs are available such as in garment factories or the services sector. Moreover, as noted, many young workers cross the border to work in neighbouring Thailand (Rigg, 2007). According to a report by MPI and UNDP (2009), there could be up to 300,000 migrant workers from Laos in Thailand (nearly 8% of the Lao labour force). Most migrant workers leave Laos illegally but many then register with the authorities in Thailand. As the procedures in Laos relating to out-migration for work are stricter and more expensive than in Thailand, more than half of the Lao migrants are registered with the Thai authorities but less than 5% are registered in Laos. This means almost all Lao migrant workers are considered illegal in Laos while many of them have legal status in Thailand. Nevertheless, it seems clear from migrant testimonies that they are vulnerable to serious exploitation while living and working in Thailand (Barney, 2012).

Now that the larger proportion of labour migration in Laos is on a long-term basis, including both rural-urban and cross-border migration, there is a shortage of labour in rural communities, especially during the peak seasons of planting and harvesting. This has pushed up the rural wage rate in Laos in the past decade. Labour migration, however, has also offered positive returns to the economy. The report by MPI and UNDP (2009) revealed that remittances from international migrant Lao workers, mainly in Thailand, contributed nearly 7% of GDP in 2008. According to Rigg (2007), the main reason for labour migration in Laos, as in other Southeast Asian nations, is the opportunity of receiving higher wages and sending money back to support rural families. As discussed earlier, labour will move to other areas or even to other countries where higher wages are offered. This means that a country that is losing its agricultural labour force to non-farm employment can attract labour from lower-wage countries. This is clearly the case between Thailand and Laos. However, there has to be a limit to this process of “drawing in” labour, and Laos would appear to be at the end of the line in this respect.

In urbanised countries like the United States and Australia, when labour moved to non-farm employment, the remaining farmers adapted their farming operations by increasing farm size, adopting improved technology, and mechanising, resulting in increased labour productivity and incomes. In transforming countries such as Thailand and Vietnam, smallholding rice farmers gradually increase their farm sizes because land tenure security encourages them to expand the cropping area in response to market demand, and access to improved agricultural technologies helps increase productivity (World Bank, 2010). In the case of Laos, where there is limited access to land due to the intensification of regulation and the provision of large-scale land concessions, the size of farms may be constrained and, with limited access to new technology and capital for investment, farmers may remain poor.

According to Rigg (2005a, pp. 25, 29) poverty in Laos is changing to what he terms “new poverty”. “Old poverty” occurs as a consequence of lack access to markets and government services, as in the past when Laos was agriculture-based and subsistence-oriented, while “new poverty” results from the modernisation or development process itself and the policy interventions that seek to promote this process. Rigg (2005a) further argues that both types of poverty can be found, even in a single village. Some households are poor because they are unable to access markets, new technologies, and government facilities. Other households are poor because they are excluded from the opportunities offered by modernisation and market integration (e.g., left out of a contract farming scheme and so less able to sell their surplus produce than before), or are affected by the unintended results of government policies, particularly resettlement, land allocation, and land concessions.

2.6 Conclusion

The agricultural transition that is occurring in many countries in Southeast Asia involves change in various dimensions, including agricultural intensification and territorial expansion; market integration; urbanisation and industrialisation; population mobility both domestically and internationally; intensification of regulation; and environmental change. The agrarian transition is also happening in Laos, in particular in the lowlands, but is in the early stages. As the agrarian transition proceeds, farming systems and rural livelihoods are transformed from their initial subsistence orientation, but not all in the same way or at the same pace. Households have different capabilities and have adopted different livelihood strategies, giving rise to a diversity of farm-household types. It is suggested here, and demonstrated later in the thesis, that the World Bank’s classification of rural households, based on livelihood strategies, is more closely related to the potential pathways out of poverty for individual households and more applicable to the context of lowland Laos.

The agricultural transition underway in lowland Laos and the wider Southeast Asian region raises important issues related to its impacts on rural livelihoods and income; changes in farming systems occurring during the transition; economic returns of different rice-based farming systems in the lowland environment; effectiveness of government policies for the rice-based lowlands singly and in combination in achieving productivity improvement, commercialisation, and poverty reduction;

implications for the government rice intensification strategy; and trajectories or pathways out of poverty for rural households in the lowlands. The next chapter will describe the farming systems and transitions occurring in lowland southern Lao as the basis for exploring the above issues in subsequent chapters.

3 FARMING SYSTEMS AND AGRICULTURAL TRANSITION IN LOWLAND SOUTHERN LAOS

3.1 Introduction

Laos is an agricultural country where over 70% of the population lives in rural areas and greatly depends on subsistence-based farming (MPI and UNDP, 2009). However, it is undergoing significant change as it transitions to a more diversified and market-based economy. This chapter first presents an overview of the physical and socio-economic context of agriculture in Laos. It then discusses the farming systems practised in Laos with emphasis on rice-based farming systems. This is followed by highlights of the agricultural transition in the lowlands of Southern Laos.

3.2 Physical and socio-economic environment of farming in Laos

3.2.1 Geography and demography

Laos is located at the centre of the Greater Mekong Sub-region in Southeast Asia (Fig. 3.1). The land area is 236,800 km^2, the length between the north and the south is 1,700 km, and the widest and the narrowest points between the east and west are 500 km and 140 km, respectively (MINC, 2000). The country shares a border of 416 km with China in the north, 236 km with Myanmar in the northwest, 1,957 km with Vietnam in the east, 1,370 km with Thailand in the west, and 492 km with Cambodia in the south (MAF, 2010a).

Laos is a unitary nation and its administration is separated into four levels – central, provincial, district, and village. Officially three administrative regions are recognised: the Northern, Central, and Southern Regions (Fig. 3.1). In 2007 Laos had 16 provinces and one Capital City, 139 districts, and 9,113 villages (MPI and UNDP, 2009). The Northern Region comprises seven provinces, the Central Region five provinces, including the Vientiane Capital, and the Southern Region four provinces.

The majority of land in Laos is classified as mountainous, covering approximately 80% of the total land area; over two thirds of the land is classified as having slopes of greater than 30% (MAF, 2010a). The Lao topography can be divided into three separate regions – the mountainous north, the mountainous chains, and the plains region (MINC, 2000). The mountainous north is dominated by mountains with an average height of 1,500 m above sea level. The mountainous chains stretch along the border with Vietnam until the border of Cambodia. Three large plateaus are located in this region, namely, the Phuan Plateau in Xiengkhuang Province, the Nakai Plateau in Khammuan Province, and the Bolaven Plateau in the southern provinces of Laos. The plains region comprises fourteen minor plains and seven major plains (Fig. 3.2). Twelve of these minor plains are located in the Northern Region but all the major plains are located in the Central and Southern Regions along the Mekong River and its tributaries. The majority of rainfed and irrigated rice-growing areas in the country are located in these major plains, which have the more fertile soils and are the most suitable for agricultural production.

Figure 3.1 Administrative map of Laos
Source: NAFRI (2010a)

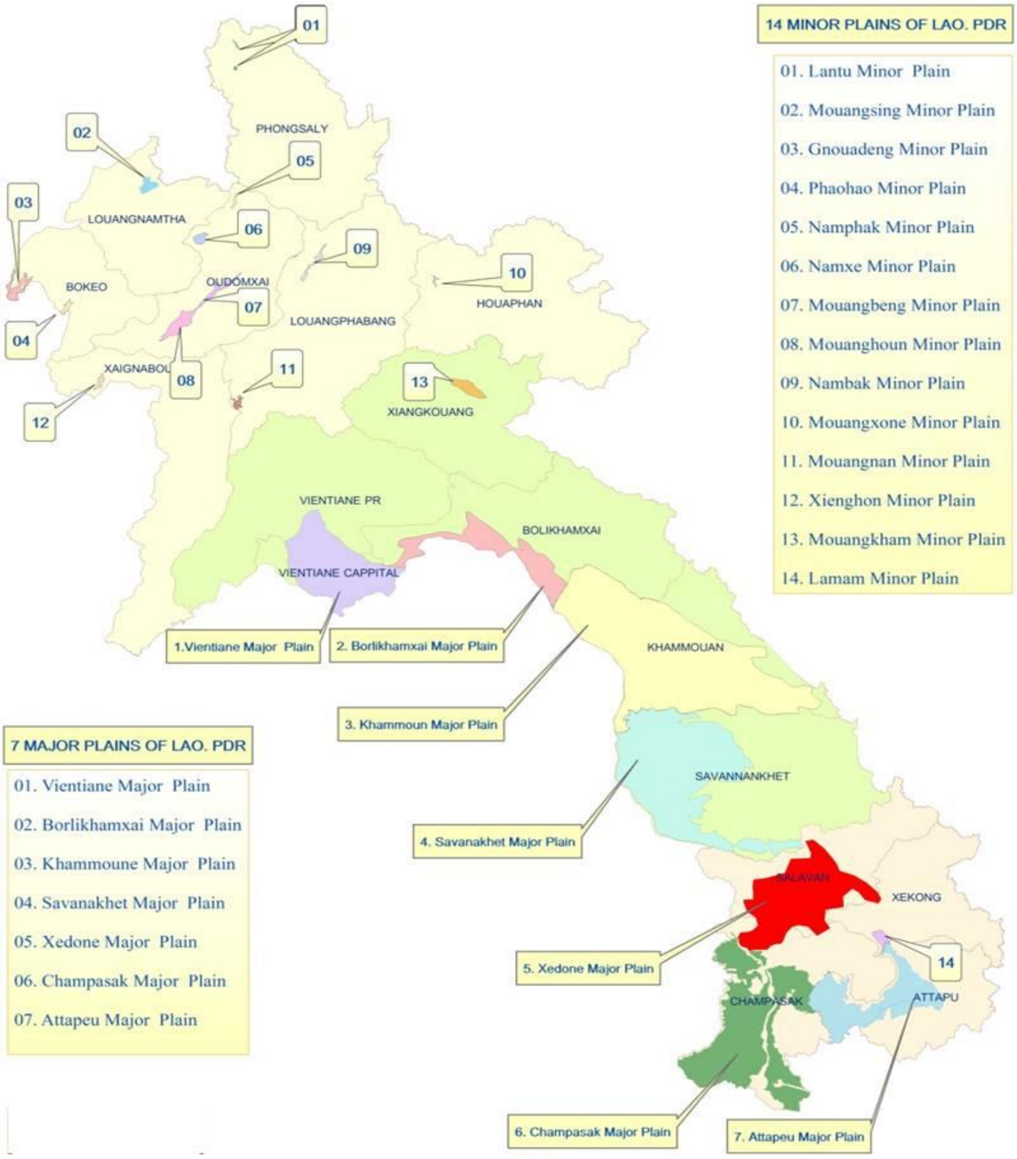


Figure 3.2 Major and minor plains in Laos
Source: NAFRI (2010b)

The climate in Laos is tropical and dominated by the annual monsoons, with about 90% of the annual rainfall falling in the wet season from May to October, while some months during the dry season between November and April may have no rainfall. The mean annual precipitation in Laos is 1,600 mm, but this varies significantly among regions, ranging from below the mean in much of the Northern Region to over 3,500 mm in the Bolaven Plateau. It is estimated that about 270,000 million m^3 of the rainfall in Laos supplies the Mekong River every year and contributes around 35% of the total flow (ICEM, 2003). Despite the weather in Laos being generally tropical, it is semi-tropical in the mountainous areas in the north and along the mountainous chains bordering Vietnam in the east. The temperature averages 25°C throughout the country and the day and night temperatures differ by 10°C. The average temperature increases to as high as 37°C in Champasak Province in the wet season, but drops to as low as 8°C in Huaphan Province in the dry season (NSC, 2005b).

In 2007 the population of Laos was around 5.8 million and the annual growth rate was 2.1%. With a total area of 236,800 km^2, Laos has the lowest population density in Asia – around 25 people per km^2. The population density ranges from 10 people per km^2 in Phongsaly Province to 185 people per km^2 in Vientiane Capital (MPI and UNDP, 2009). Approximately half of the inhabitants have settled in the flat lands along the Mekong River (NSC, 2004). The population of Laos is ethnically diverse, with 49 ethnic groups. The Population and Housing Census in 2005 reported that nearly 55% of the total population is of the Lao ethnic group, 11% is of the Khmu ethnic group, and 8% is of the Hmong ethnic group. The majority of Lao people are Buddhists, accounting for nearly 67% of the total population. Animists account for almost 31%, while only a small proportion of the population is Christian and Bahai (NSC, 2005a).

Based on the Lao Expenditure and Consumption Survey 2002/03 (LECS 3), approximately 65% of the total villages in Laos were reachable by road in both dry and wet seasons (NSC, 2004). However, road conditions are generally poor and there is a shortage of road maintenance, in particular in the mountainous areas. The road infrastructure is better in the lowland areas, with paved roads especially along the Mekong River and within the provincial towns, but most of the roads in the hilly areas are unpaved, making access to villages difficult, especially during the wet season (Yokoyama, 2003). This increases transportation costs and limits access to markets (WFP, 2007).

3.2.2 Economic and agricultural development

After decades of civil war, the Lao People's Democratic Republic (PDR), a single-party socialist republic, was declared in 1975. Two year later, the Lao Government developed the first development plan for 1978-1980 with the main focus on the development of agriculture as the fundamental base for economic development of the country. Agriculture was promoted in the form of collective production or cooperatives by increasing farm areas and supporting the use of farm machinery and irrigation facilities in order to raise production and achieve self-sufficiency in food. The number of cooperatives rose rapidly to total 3,976 nationwide by 1986 (Evans, 1988). However, as reported by several authors (Evans, 1995, Stuart-Fox, 1997), by the early 1990s most of the listed cooperatives existed in name only and in reality very few cooperatives were actually working. The unsuccessful implementation of collective production was due to top-down management, low efficiency, shortage of inputs, lack of trained staff, and farmers' reluctance to follow the strict working conditions imposed (Stuart-Fox, 1996).

In 1986 the initiative of the New Economic Mechanism (NEM) was introduced, which was the crucial breakthrough in the economic development of Laos. The NEM was adopted to transform the country from a centrally-planned economy to a market-oriented economy. The principles of the NEM were to free prices based on market demand and supply and encourage private investment from both domestic and foreign investors. The government also improved infrastructure, in particular transport and communication facilities, to support the transformation to a market economy and integration with regional and international markets (UNDP, 2002). Since the adoption of the NEM there has been considerable social and economic development. The annual GDP growth averaged 6.3% during the 1990s (World Bank, 2008) and 7.1% during 2000-2012 with a peak of 8.3% in 2006 (Fig. 3.3) (LSB, 2000-2012). GDP per capita increased from USD 321 in 2000 to USD 1,396 in 2012 (LSB, 2000-2012). The poverty incidence in Laos has reduced gradually from 46% in 1993 to 34% in 2003 to 28% in 2008 (MPI and UNDP, 2009) and Laos's ranking in the UNDP's Human Development Index increased from 137 in 2007 to 130 in 2008 (World Bank, 2008).

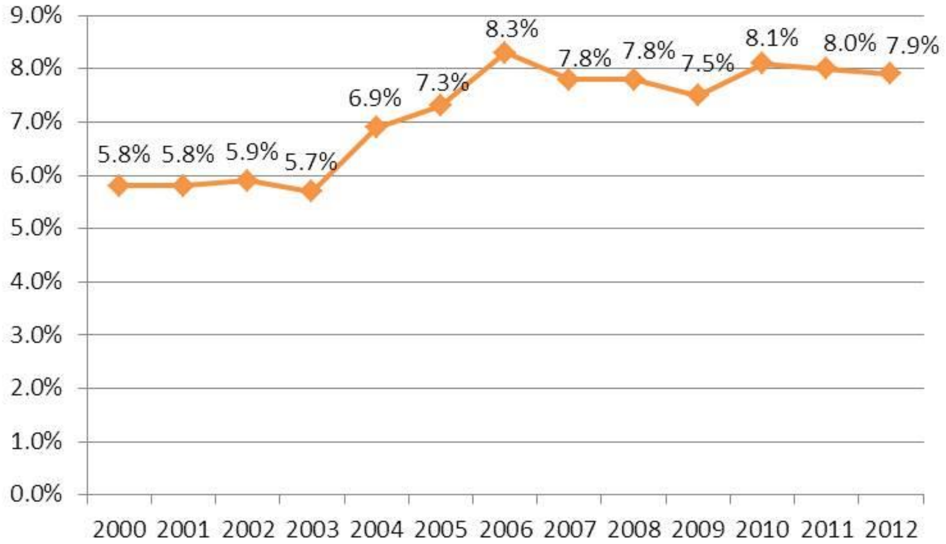


Figure 3.3 GDP growth rate in Laos between 2000 and 2012
Source: LSB (2000-2012)

The growth in the Lao economy has been accelerated by a rising flow of Foreign Direct Investment (FDI) into the country. Since the early 2000s the accumulated amount of FDI in all sectors has increased considerably, totaling almost USD 14 billion between 2000 and 2011. The highest accumulated value of investment during this period was in the mining sector, accounting for 27.2% of total investment, followed by the electricity generation and agriculture sectors, with 23.9% and 13.8%, respectively. The investment in the services sector made up 12.3% while industry and handicrafts contributed 10.4% (Fig. 3.4) (MPI, 2013a). In terms of the 51 countries investing in Laos between 2000 and 2011, Vietnam, China, and Thailand are the top three foreign investors, constituting nearly 80% of the total accumulated investment value in the period (Table 3.1) (MPI, 2013b).

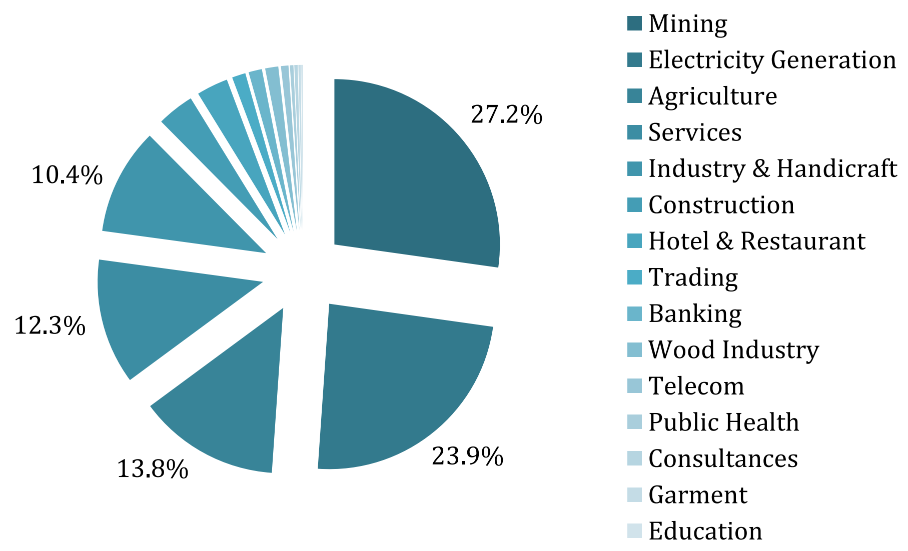


Figure 3.4 FDI by sectors in Laos between 2000 and 2011
Source: MPI (2013a)

Table 3.1 Top ten countries investing in Laos between 2000 and 2011

Rankings	Countries	Investment value (USD)	% of total investment value
1	Vietnam	4,770,379,911	34.2
2	China	3,428,341,879	24.6
3	Thailand	2,854,110,732	20.5
4	South Korea	595,847,036	4.3
5	France	474,859,420	3.4
6	Norway	357,365,000	2.6
7	Japan	347,542,321	2.5
8	India	149,760,102	1.1
9	Malaysia	138,375,226	1.0
10	Indonesia	107,000,000	0.8
	Sum	**13,223,581,627**	**94.9**
	Other 41 countries	**715,150,775**	**5.1**
	All 51 countries	**13,938,732,402**	**100.0**

Source: MPI (2013b)

In spite of the national economy growing and the incidence of poverty declining in recent years, regional inequalities have increased and the income gap between rural and urban areas is widening. Additionally, non-farm employment is still limited and cannot absorb the growing labour force (MPI and UNDP, 2009). Recognising these issues, the current government policy has placed increasing emphasis on the development of agriculture, on which the majority of the rural population relies.

The Agricultural Development Strategy up to 2020 and the 7th National Socio-Economic Development Plan for 2010-2015 have focused on transforming the traditional subsistence-oriented agricultural production to modernised market-oriented production, increasing the resilience of agriculture to climate change, ensuring food security, and creating opportunities for diversifying rural livelihoods and the incomes of smallholding farmers (MPI, 2010a, MAF, 2014). This is in line with the Lao Government's long-term development goals of graduating the country from the status of Least Developed Country by 2020 and eliminating poverty (GoL, 2004). However, as the country has two distinct rural economies – the lowlands and the uplands – the strategy for agricultural development has been pursued differently to respond to the needs and circumstances of these two contrasting environments. The strategy for lowland areas aims at maintaining the growth and the modernisation of market-oriented agricultural production whereas the strategy for the upland areas focuses on stimulating the development process in these areas to ensure food security and raise farmers' incomes while conserving the upland ecosystems (MAF, 2014).

3.2.3 Tenure system and land/forest allocation

Before 1975 all of the land belonged to the King and temporary land tenure rights were applied based on customary regulations. After the revolution and the foundation of the Lao PDR in 1975, the ownership of land was transferred to the people, represented by the state, and people were encouraged to cultivate their land collectively (Ducourtieux et al., 2005). A remarkable change in land tenure took place in 1991 when the Lao Government endorsed a new constitution incorporating the principle that "all land belongs to the State, but villages, organisations, and individuals have the rights to use land". Though land titles had not been issued, the principle of individual ownership was accepted and land markets were now in place (ICEM, 2003, p. 36). Fundamentally, two types of formal land tenure – temporary and permanent – currently exist in Laos. Temporary land tenure is given to individuals or households for the use of the land and is evidenced in the form of temporary land use certificates (TLUCs) issued by a district authority. The land under TLUCs cannot be transferred, leased, or pledged as collateral. Permanent tenure can be requested and granted with a Land Title (LT) after the land has been managed and used continually under temporary tenure during a three-year period. The land under a LT can be transferred, leased, or pledged as collateral (Fujita and Phanvilay, 2008). Up to 2005, over 400,000 plots of land had been titled and handed over to more than 300,000 households, but these plots were mainly houselots and fields located along roads (MRG, 2012).

Subsequently, in 1993, the Lao Government instituted a more formal process of defining land rights through the Land Use Planning and Land Allocation (LUP/LA) program. This is the basis for the zonation of land and forest to provide individual farmers with agricultural land use rights and village communities with access to forest products in both lowland and upland environments (Helberg, 2003). The LUP/LA has been developed with the primary objectives of stabilising shifting cultivation and using agricultural land and forest in a sustainable manner in the uplands (Soulivanh et al., 2004). Under the LUP/LA program, the area of land allocated to individual households is based on each household's available labour and resources (Thongphanh, 2004). However, the general principle for the allocation of agricultural land in the uplands is that each household is allowed up to one hectare for rice, three hectares for cash crops, three hectares for orchards, and 15 hectares of degraded forestland or grassland for pasture (Yokoyama, 2003). In order to maintain tenure rights, farmers have to cultivate their allocated land within three years, otherwise the land will be returned to the state, managed by village authorities (Thongphanh, 2004).

From the beginning of the LUP/LA program in the early 1990s up to 2003, more than 6,000 villages, about 50% of all villages in the country, had completed the LUP/LA process and over eight million hectares of land had been allocated to almost 380,000 households, around 60% of all agricultural households nationwide (Thomas, 2003). Hence the program was applied at least as extensively in the lowlands as the uplands, though with less controversy in the former case. Thereafter, there have been no official figures on the number of villages completing LUP/LA, but it is reported that the implementation of LUP/LA has declined significantly due to shortage of funds (Fujita and Phanvilay, 2008).

3.2.4 Land concessions and contract farming

Ostensibly to generate income for the country and bring benefits to local communities, as well as to increase the use of "unutilized" or "underutilized" land, in particular in remote areas, the Lao Government has been granting land concessions to foreign investors as a way to attract the inflow of FDI to the agricultural sector (Hanssen, 2007). Though the lowland areas of the Central and

Southern Regions are the prime targets for large-scale land concessions, the uplands in the North are also in demand (Zola, 2009). Fig. 3.5 shows the increasing inflow of FDI in the agricultural sector in Laos from 2001 to 2009, with its peak in 2006. Over this period, 211 foreign investment projects in the agricultural sector have been approved by the Lao Government, with a total investment of approximately USD 1.155 billion. Most of these investments are in tree crop plantations under large-scale land concessions and mainly arise from neighbouring countries – China, Thailand, and Vietnam (MPI, 2010b).

According to Voladet (2009), between 2001 and 2007 more than 165,000 hectares of land nationwide had been planted with different types of tree crops under large-scale land concessions, and nearly two-thirds of these plantations were located in the lowlands of the Central and Southern Regions. Rubber and eucalyptus were the most widely planted crops, covering 40% and 20% of the total planted areas, respectively (Fig. 3.6). It should be noted that these figures do not include the small- and medium-scale plantations as there is no available information at the national level on investment projects with capital of less than USD 3 million and production areas of less than 100 hectares, since they have been approved at the provincial level.

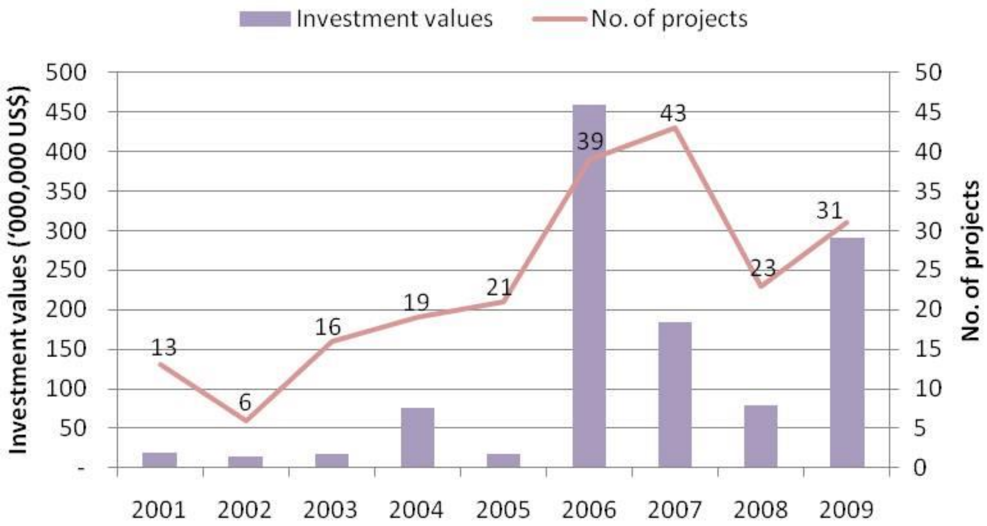


Figure 3.5 FDI in agricultural sector in Laos between 2001 and 2009
Source: MPI (2010b)

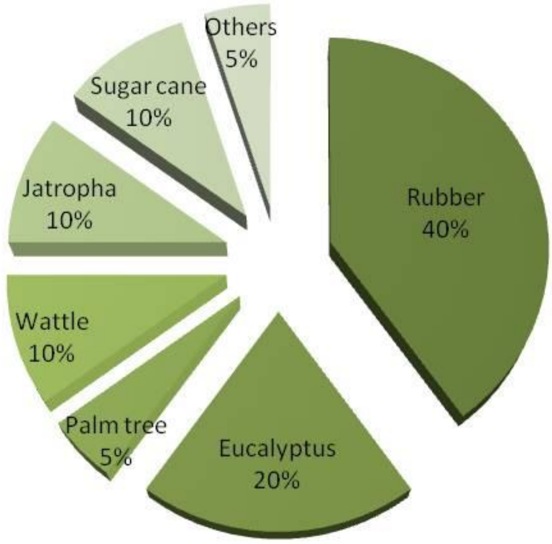


Figure 3.6 Shares of planted areas under large-scale plantations in Laos between 2001 and 2007 by types of tree crops

Source: Voladet (2009)

There has been mounting concern over the negative impacts of land concessions on local livelihoods, particularly where farmers have lost access to their land, and on local environments, where forests and protected areas have been encroached upon. Therefore, the Lao Government has recently suspended new land concessions with areas of above 100 hectares and alternatively encouraged investment under the contract farming scheme (Vientiane Times, 2009). According to MAF (2008), contract farming in Laos is associated with five inputs – land, labour, capital, technology, and marketing. MAF further proposed that the suitable model of contract farming for Laos is "2+3", in which "2" refers to the two inputs of land and labour provided by farmers while "3" refers to the three inputs of capital, technology, and marketing provided by investors. Farmers and investors then divide the profits according to the initial contracts or agreements made, normally based on the proportion of their inputs contributed. The "2+3"model of contract farming has been approved by the Government in order to promote investment in the agricultural sector as well as to ensure benefits accrue to farmers and they maintain secure access to their farmlands. However, in practice, in the case of contract farming in rubber, the "2+3" model is sometimes transformed into "1+4", in which "1" refers to land, because farmers cannot wait for the returns to their labour and renegotiate the payment of wages (Wright, 2009, Manivong and Cramb, 2014).

3.3 Farming systems, rice-based farming, and food security in Laos

3.3.1 General farming systems

Agriculture in Laos is conventionally subsistence-oriented and broadly classified into three major farming systems located in lowland, upland, and plateau environments. Table 3.2 shows subcategories of these three major farming systems based on crop combinations. In the lowlands, rainfed and irrigated farming systems are practised. In the sloping uplands, people have relied heavily on shifting cultivation. In the plateau environment, cash crops and fruit trees are extensively grown, replacing shifting cultivation (UNDP, 2002). Noticeably, apart from the cultivation of the staple food (rice), a variety of home-garden vegetables and different types of livestock appear in almost all farming categories to serve daily household consumption needs and play a key role in household saving and income generation.

It has been said that farming in the upland areas is more subsistence-based cultivation and that, in contrast, farming in the lowland areas along the Mekong corridor and in the plateau areas is in transition to a more commercial orientation (UNDP, 2002). However, there is considerable evidence that farming in the more accessible uplands is now also highly commercialised, with extensive cultivation of cash crops such as maize, bananas, and tree crop like teak, rubber, and *yangbong* (an indigenous tree crop) (Manivong and Cramb, 2008, Newby et al., 2012, Southavilay et al., 2013, SADU, 2010).

3.3.2 Rice ecosystems

Rice production is the main farming activity in Laos, accounting for over 80% of the total cultivated area (Bestari et al., 2006). Rice in Laos is grown under three main agro-ecosystems, namely, rainfed lowlands, irrigated lowlands, and rainfed uplands (Table 3.3). Rice cultivation in the rainfed lowlands normally commences at the beginning of the wet season in May or June (Table 3.4), depending on the arrival of the rains, with land preparation involving two passes of ploughing and one harrowing. Rice seed is sown in the nursery seedbed and one month later the young seedlings are transplanted to the main field. The harvesting period is in October or November, depending on the maturity of the varieties planted. It should be noted that in the areas with access to water from irrigation, rice fields are also supplemented with irrigation water during a drought period in the wet season. In the areas with access to irrigation, farmers grow rice in the dry season as well. After harvesting the wet-season crop, rice fields are irrigated and land preparation begins. The nursery is sown in December and the seedlings are transplanted by early January. Harvesting is completed in April or May. Traditionally, the cultivation of rainfed upland rice starts with the slash-and-burn method of land preparation between January and April. Planting is done in May, weeding between June and August, and harvesting in September or October.

In the lowland rice environment in the past, land was prepared with the use of buffaloes; however, there is now an increasing trend of using hand-held tractors for land preparation. In the same manner, threshing is now done with threshing machines, though manual threshing either by hand or small machines is also practised, especially in remote areas. Many farmers have their own hand-held tractors or threshing machines, while those who do not have their own can access the services provided by others for a fee. Many farmers have sold their livestock, especially cattle and buffaloes, to buy their own tractors. Mechanisation has brought some significant changes into the farming systems in the lowlands but is very limited in the upland rice production system, e.g., the threshing of upland rice is still done entirely manually.

Table 3.2 Three main farming systems in Laos with sub-types

Farming systems	Characteristics
Lowland	
Lowland rainfed farming system	Single cropping of traditional glutinous paddy rice varieties. Buffaloes and cattle for draught, cash income, and occasional meat, free ranging during the dry season, confined in the wet season. Pigs, poultry, fish and non-timber forest products (NTFPs) important for food and cash income.
Lowland irrigated farming system	Double cropping of traditional photoperiod-sensitive paddy rice varieties, with higher use of improved varieties, fertiliser, and other inputs for the second crop which is mainly for cash. Dry-season vegetables grown in areas near urban centres. Relatively few livestock due to shortage of grazing land, buffaloes used for ploughing, small stock for meat and cash income.
Upland	
Upland rainfed farming system	Shifting cultivation of rice intercropped with a variety of cash crops on sloping land. Fruit tree species also grown in lower attitudes. Pigs, cattle and poultry are the principal livestock. High dependence on NTFPs for income to purchase rice, etc. Adoption of paddy cultivation is progressing where possible in small inland valleys.
Highland farming system	Similar to upland rainfed farming system, but with high altitude crops such as maize and (formerly) opium, sometimes intercropped with lettuce and mustard, and temperate fruit trees such as plum, peach and local apple.
Plateau	
Plateau farming system	Coffee, tea and cardamom have largely replaced shifting cultivation, supplemented by fruit trees and vegetables in home gardens. Cattle important as savings and enterprise, pigs & poultry also kept.

Source: Adapted from UNDP (2002, p. 76)

Table 3.3 Three major agro-ecosystems of rice cultivation in Laos

Rice agro-ecosystems	Characteristics
Rainfed lowlands	Rice is grown in bunded fields flooded for at least part of the season. Water comes from rainfall.
Irrigated lowlands	Rice is grown in bunded fields flooded for at least part of the season. Water comes from irrigation and rainfall.
Rainfed uplands	Rice is grown in unbunded fields on sloping land under shifting cultivation system. Water comes from rainfall.

Source: Adapted from Linquist et al. (2006, p. 29)

Table 3.4 Seasonal rice cropping calendar for different agro-ecosystems in Laos

Agro-ecosystems	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Dry season				Wet season						Dry season	
Rainfed lowlands					LP	Sow	TP			Harvest		
Irrigated lowlands	TP			Harvest								LP, Sow
Rainfed uplands	Slash		Burn, Fencing		Plant	Weeding			Harvest			

Note: LP = Land preparation, TP = Transplant

Source: Adapted from Linquist et al. (2006, p. 32)

3.3.3 Trends in rice production

During the past two and a half decades there has been a steady growth in the Lao rice sector in terms of area, production, and yield. Fig. 3.7 presents these figures for the period 1985-2012. Rice production rose substantially over this period with marginal fluctuations between years. The increase in rice production made the country self-sufficient in rice in 1999, with the total rice production of approximately 2.1 million tonnes, compared to only 1.5 million tonnes in 1990. Since then the production has continued to grow to around 3.5 million tonnes in 2012. The area devoted to rice is also on an upward trend, with an average growth rate of 1.9% per annum. Rice yield increased as well over the period, from about 2.2 t/ha in 1985 to around 3.5 t/ha in 2012, representing a rise of about 58%, with an average annual growth of about 1.9% (MAF, 2005, MAF, 2007, MAF, 2010b, MAF, 2013).

Trends in rice area, production, and yield for the three main rice ecosystems are shown in Figs. 3.8, 3.9, and 3.10. It can be seen that rainfed lowland rice accounts for by far the largest area and output and that these parameters have increased substantially since 1996. The yield of rainfed lowland rice rose from 2.5 t/ha to 3.9 t/ha in the same period, so the growth in output has been attributable to both area and yield growth. Irrigated lowland rice has also increased in area and production; between 1990 and 2000 these parameters increased almost eight and ten times, respectively. The yield of irrigated rice also rose sharply from 2.7 t/ha in 1985 to over 4.5 t/ha since 2007. However, irrigated rice production continues to be overshadowed by rainfed lowland rice. In the case of rainfed upland rice, area and production decreased considerably, whereas the yield increased marginally to just under 2 t/ha over the period (MAF, 2005, MAF, 2007, MAF, 2010b, MAF, 2013). The remarkable fall in both area and production of rainfed upland rice is a consequence of the government's policy of "stabilizing" shifting cultivation.

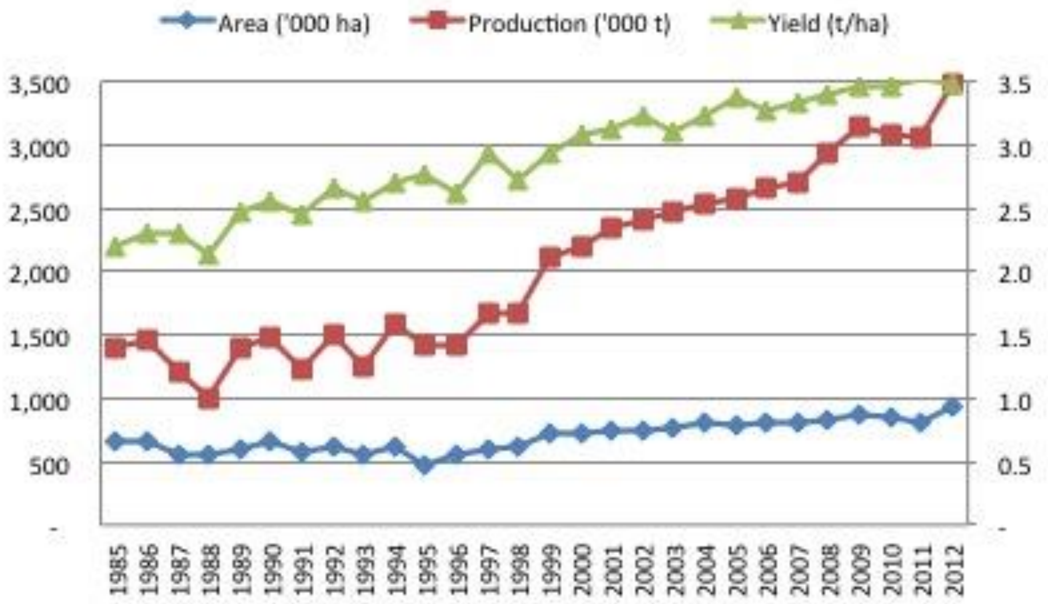


Figure 3.7 Rice area, production, and yield in Laos between 1985 and 2012
Sources: MAF (2005, 2007, 2010b, 2013)

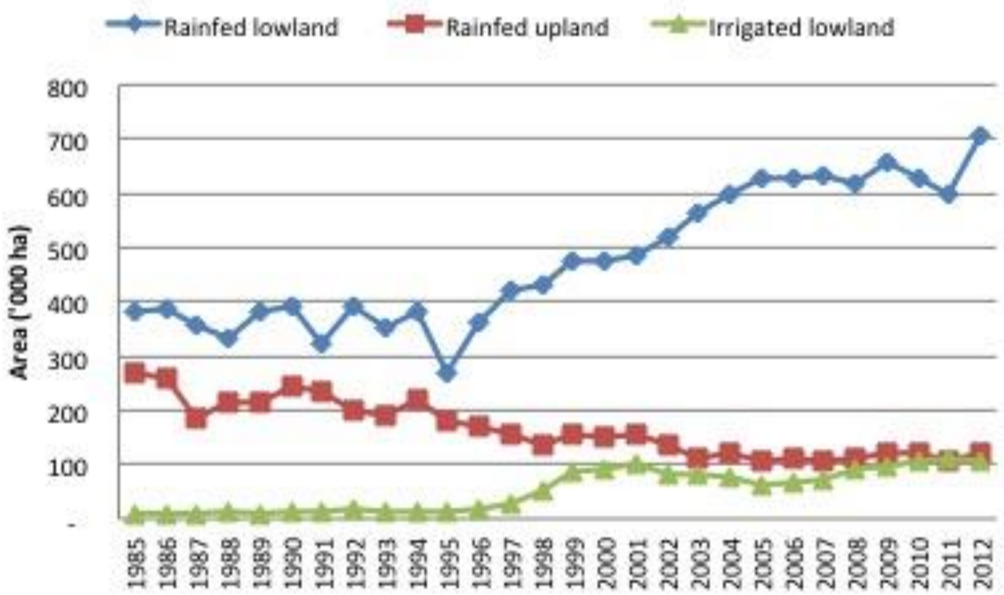


Figure 3.8 Rice area for different ecosystems in Laos between 1985 and 2012
Sources: MAF (2005, 2007, 2010b, 2013)

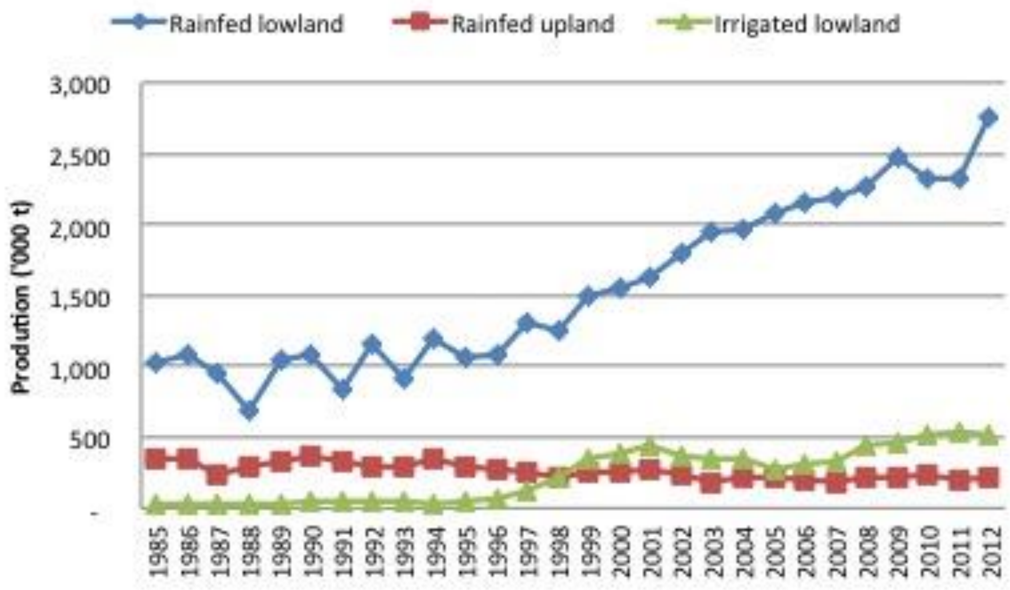


Figure 3.9 Rice production for different ecosystems in Laos between 1985 and 2012
Sources: MAF (2005, 2007, 2010b, 2013)

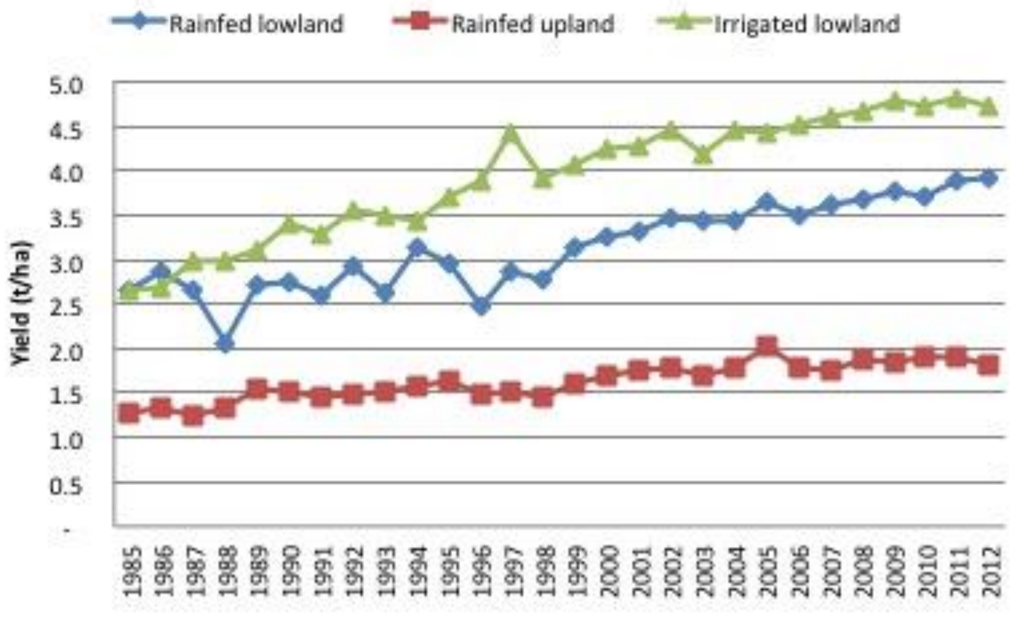


Figure 3.10 Rice yield for different ecosystems in Laos between 1985 and 2012
Sources: MAF (2005, 2007, 2010b, 2013)

In terms of the contribution of each rice ecosystem to the total rice area and production, the rainfed lowland ecosystem dominated, accounting for over 60% of total rice area and 70% of total rice production (Figs. 3.11 and 3.12). However, irrigated rice has increased its contribution since 1996 as a result of the government's investment in irrigation schemes, driving the substantial increase in rice area and production in the dry season. The share of the irrigated rice area to the total rice area rose noticeably from just under 2% in 1990 to nearly 12% in 2012 and the share of irrigated rice production in total rice production rose from about 3% to around 15% in the same period. However, the shares in both area and production of irrigated lowland rice have dropped slightly between 2002 and 2005, mainly due to the poor maintenance of irrigation infrastructure. In contrast, the contribution of rainfed upland rice to total rice area and production has steadily decreased, owing to the Government's policy of restricting and eventually eliminating shifting cultivation. The share of rainfed upland rice in total rice area fell from about 41% in 1985 to around 13% in 2012 and the share of rainfed upland rice production in total rice production fell from nearly 25% to just over 6% in the same period.

As Fig. 3.7 shows, the growth in rice production in Laos over the past three decades has resulted mostly from yield improvements, in particular for rainfed lowland and irrigated lowland rice. This is attributable to the widespread use of improved cultivation technologies including improved rice varieties and management practices among rice-producing smallholders in the lowland areas (Schiller, 2008). In the early 2000s improved rice varieties covered 70-80% of rice-growing areas in the lowlands of most provinces located along the Mekong River (Inthapanya et al., 2006).

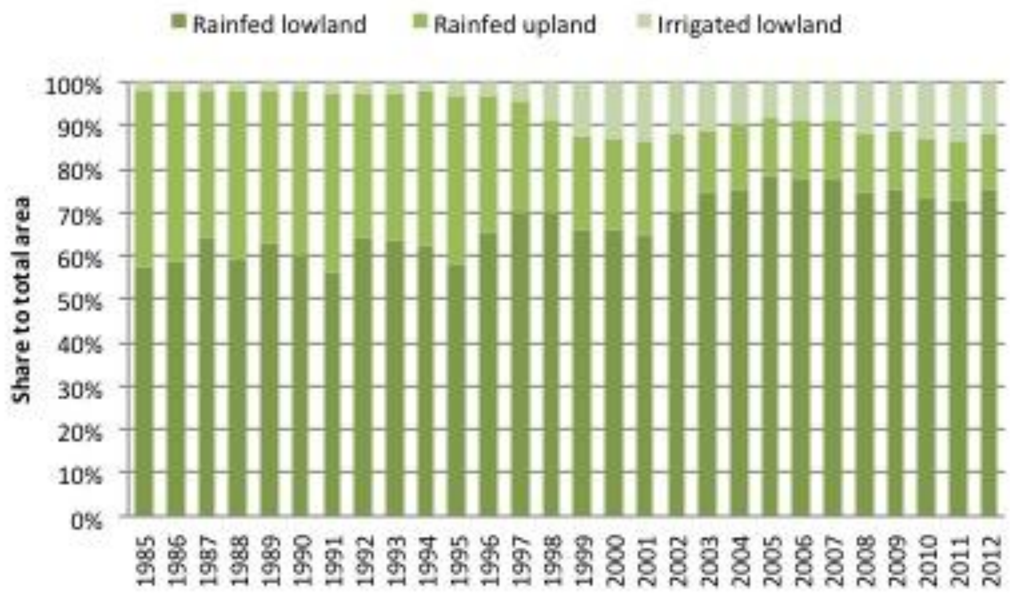


Figure 3.11 Percentage share of rice area for different ecosystems to total rice area in Laos between 1985 and 2012

Sources: MAF (2005, 2007, 2010b, 2013)

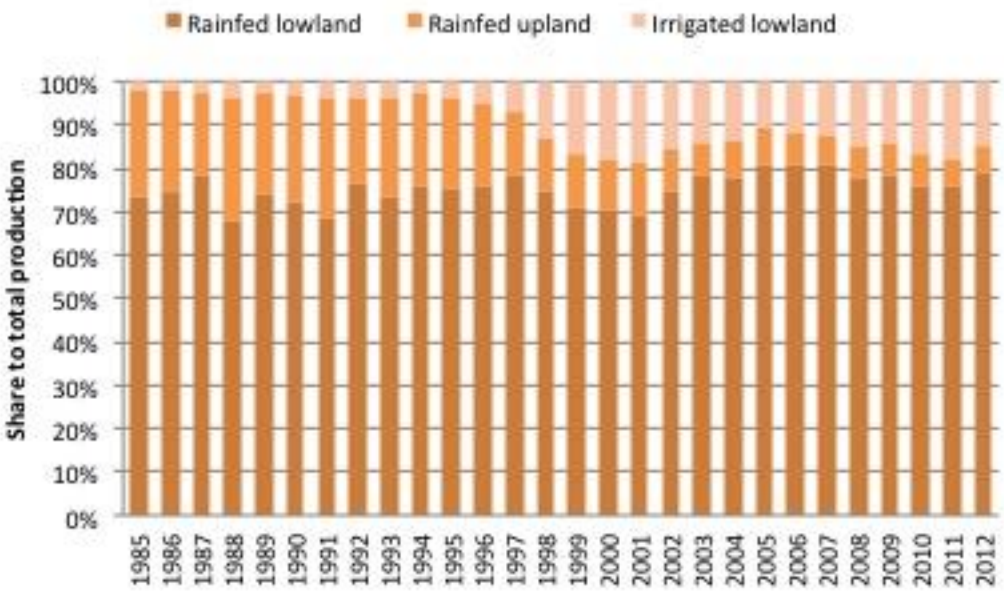


Figure 3.12 Percentage share of rice production for different ecosystems to total rice production in Laos between 1985 and 2012
Sources: MAF (2005, 2007, 2010b, 2013)

3.3.4 Rice trading

Despite rice production contributing about 39% of the agricultural gross domestic product, only 5% of total rice production is traded (Bestari et al., 2006). The marketing system for rice in Laos involves various participants, including private sector and state enterprises; however, the State Food Enterprise dominates and controls the rice trade, with over 70% of the market (Setboonsarng et al., 2008). The other participants involved with rice trading are farmers, assemblers, millers, traders, exporters, retailers, processors, institutional buyers, and consumers. Milled rice flows from the provinces with high levels of rice production, such as Champasak, Savannakhet, and Vientiane, to the provinces with high population, in particular Vientiane Capital, and those with low levels of rice production, such as Oudomxay, Luangprabang, and Huaphanh. In addition, some provinces sharing borders with Thailand and Vietnam sometimes import rice to fulfil local demand, especially during periods of rice shortage in those provinces (Sengxua et al., 2009). Rice is normally sold in bulk in retail shops in fresh markets or along the streets, but is also available in mini-marts in limited quantity.

Rice from Laos is also exported, but mainly across the borders to neighbouring countries such as Thailand, Vietnam, and China. Rice exported to Thailand is mostly glutinous rice while to Vietnam and China it is largely non-glutinous rice (Bestari et al., 2006, Sengxua et al., 2009). Over 85% of the rice grown in Laos is glutinous and this limits the export opportunities to international markets.

Glutinous rice accounts for less than 2% of the global rice market and is mostly traded in northeast Thailand and Laos, and among migrants from these two regions (GDS, 2005). Poor marketing infrastructure also constrains the export competitiveness of Laos compared with the two major rice exporters, Thailand and Vietnam (Sengxua et al., 2009). Therefore, the Government is focusing on developing a niche market for rice in which Laos has a comparative advantage, such as organic rice, black rice, or geographic indicator (Lao) rice. Recently, a small quantity of organic rice from Laos has been exported to Japan under a contract farming scheme (Setboonsarng et al., 2008).

3.3.5 Food security

As defined by the World Food Programme (2007, p. 18), food security is "the condition when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". In Laos, however, food security is generally taken to mean "rice security" since almost 80% of the daily calorie and protein intake of most rural Lao comes from rice (Schiller, 2008). Therefore, national food security is interpreted by the Government to mean ensuring national self-sufficiency in rice.

One of the current government priorities for agricultural and rural development is to ensure food security and improve rural livelihoods by increasing rice production/productivity to achieve rice self-sufficiency and export the surplus, as well as amplifying crop diversification to reduce risks and raise income. As stated in the 7th National Socio-Economic Development Plan (2011-2015), the target is to increase rice production to 4 million tonnes with an average rice yield of 3.9 t/ha (MPI, 2010a). The plan further sets the target to expand the irrigated area to 500,000 hectares by 2015 to increase dry-season production. To achieve the target of increasing rice output, there is a need for further improvements in production systems by adopting high-yielding rice varieties and chemical inputs and overcoming some of the production constraints such as low soil fertility, insects and pests, weeds, drought, flooding, and labour and capital shortages (Schiller, 2008).

As discussed earlier, the rapid increases in rice production in the past decades has helped ensure national rice self-sufficiency (MPI and UNDP, 2009). However, many areas throughout the country, especially in upland and remote areas, still face the problem of rice deficits. A recent study by the World Food Programme (2007) reported that only one third of the rural population in Laos is self-sufficient in food whereas the rest of the population is susceptible to food insecurity due to various types of risks and shocks. Further increase in rice production only cannot solve the problem of food insecurity in Laos. According to the World Bank (2007), food security can be achieved by having sufficient availability, access, and use of food. Being able to access and use available food is the most important for the poor. The increased access to food could be through increased purchasing power, e.g., by earning more income from tree crops and livestock, or non-farm activities, not necessarily from increased rice production.

3.4 Agricultural transition in the lowlands of Southern Laos

3.4.1 Overview

Rapid change from a subsistence-based economy to a market-oriented economy is underway in Southern Laos. The Southern Region of Laos shares a border with Thailand in the west, Vietnam in the east, and Cambodia in the south (Fig. 3.1). The Region has three distinct topographic zones – the Annamite mountain chain, the Bolaven Plateau, and the lowland plains. The Annamite chain defines most of the border with Vietnam and supports dense forest and rich biodiversity. Here upland communities practise swidden agriculture and cash cropping and utilise forest resources. The Bolaven Plateau is located in parts of Champasak, Sekong, and Saravane Provinces, and has high rainfall and fertile soils suited for commercial agricultural production, notably coffee. The lowland plains are mainly situated along the Mekong River and its tributaries and constitute the main rice-producing areas (Cornford, 2006, Messerli et al., 2008). Three major plains and one minor plain make up the lowlands (Fig. 3.2). The Champasak plain is the largest major plain, located along the Mekong River between the Thai and Cambodian borders. Parts of this plain close to the Mekong have irrigation schemes in place.

3.4.2 Farming systems

Farming systems in Southern Laos vary widely. The factors influencing this variation include the biophysical environment (slope, soils, water sources, and rainfall), ethnicity and culture, access to markets and extension, and government policies and priorities.

The distinct agro-ecological zones in the region – irrigated lowlands, rainfed lowlands, and uplands – can be found even within a single village. For example, a village with access to irrigation may also contain households that rely on rainfed lowland rice production or have access to upland cropping systems. Moreover, a single household may have access to resources in more than one of these land types, engaging in both lowland and upland cropping activities and managing livestock within the mosaic of land uses.

In addition to this biophysical variation, a range of distinctive ethnic groups occupy the region, including members of the Tai-Kadai (Lao, Phutai) and the Mon-Khmer (Katang, Makong, Tri, Souay, and Taoy) ethno-linguistic families (Chazée, 2002). The variations in farming systems mirror this socio-cultural spectrum – the Lao and Phutai commonly cultivate lowland rice while the Katang and related groups mainly practise upland farming.

Villages within the region also have varying access to roads and markets, from those located along major roads linking them to regional markets within the Greater Mekong Sub-region, to those located several hours from the district centre for which travel by vehicle is difficult during the wet season. At the same time, villages face varying degrees of external pressure, such as plantation concessions that reduce access to land formerly used for livestock grazing or collection of forest products, and have different opportunities for off-farm and non-farm employment.

These farming systems are not only diverse but dynamic, with households continually adapting to constraints and opportunities arising from the rapid development occurring within Laos and the wider region. However, the ability of households to embrace these opportunities varies widely. Some households can readily adopt new practices while others may struggle to do so and may in fact experience a "backwash effect" as others progress (e.g., when some households establish commercial crops on communal farming land, depriving other households of the use of that land).

3.4.3 Livelihoods

Similar to the whole country, about 80% of the population in Southern Laos resides in rural areas (NSC, 2005a). Southern Laos has diverse ethnic groups; however, the region is dominated by the Lao ethnic group who have mainly settled in lowland areas along the Mekong River and its tributaries (Chamberlain, 2001). According to Cornford (2006), Southern Laos comprises two economic systems – a customary, subsistence-based economy and a contemporary market-oriented economy. In Cornford's (2006) view, most households are still in the first category but many are moving into the latter one.

Rural livelihoods in lowland Southern Laos involve a variety of activities; however, they are dominated by rice cultivation. Apart from rice, people also engage in activities such as cash crop and vegetable production, livestock-raising, fisheries, collection of NTFPs, handicrafts, and non-farm activities.

Rice in lowland Southern Laos is grown in both rainfed and irrigated environments where irrigation infrastructure is in place. Glutinous rice (the preferred staple) is grown more than non-glutinous rice. Rice is planted primarily for household consumption, but the surplus is sold. A variety of non-rice crops is grown in small home gardens. Villages located along the Mekong River or its tributaries also grow maize, vegetables, and other crops in “river-bank gardens”. Some farmers in irrigated areas grow non-rice crops in part of their rice fields in the dry season. Some proportion of these crops is consumed by the household while the rest is sold.

Livestock is one of the major sources of household income in the lowlands of Southern Laos. Large ruminants, especially cattle and buffaloes, also play a vital role as a store of wealth for the household. They are sold when there is a need for cash, e.g., to buy a two-wheeled tractor or in case of an emergency such as production loss due to flood or drought. These large livestock used to play a key role in providing draught power for land preparation but are now being widely replaced by tractors. Small livestock such as pigs and poultry (and their eggs) are raised for household consumption, but sometimes for sale as well. As the province is drained by the Mekong River and its tributaries, fishing is widely practised and provides a crucial source of protein intake for the household as well as a source of income.

Rural households in Southern Laos also collect timber and NTFPs such as bamboo shoots, mushrooms, and wild vegetables, both for direct consumption and for sale. Hunting wild animals is also still practised but these are difficult to find now due to the decline in their numbers. Handicrafts such as baskets, mats, and woven silk and cotton textiles are well-known products in the province. Raw materials for making baskets, such as rattan and bamboo, can be collected from the forest. Sale of handicraft products provides additional cash income to many households.

While rural households in Southern Laos typically still grow rice as their main livelihood activity, their livelihoods have become increasingly diversified as the economy of the region develops and opportunities for off-farm and non-farm employment increase. Young people seek non-farm employment in towns or in neighbouring Thailand. As the Thai economy has developed, there has been increased demand for workers in agriculture, construction, transport, and other sectors. Wages in Thailand have increased compared to wages in Laos, creating a strong incentive for Lao workers to migrate.

3.4.4 Rice production and food security

Rice production in 2012 from the southern provinces of Laos, including Champasak, Saravane, Attapeu and Sekong, was approximately 0.94 million tonnes, contributing around 27% of total rice production countrywide (Table 3.5) (MAF, 2013). Among the southern provinces, Champasak had the largest area and production of rice in 2012, constituting about 49% and 56% of the total rice area and production in the Southern Region, respectively. This was mostly from the rainfed lowland environment.

Table 3.5 Rice production statistics for the southern provinces of Laos in 2012

	Province/Region					
	Champasak	**Saravane**	**Attapeu**	**Sekong**	**Southern Region**	**Laos**
			Area (ha)			
Rainfed lowlands	104,813	70,727	21,667	7,528	**204,735**	**706,028**
Rainfed uplands	-	6,011	2,126	2,784	**10,921**	**119,772**
Irrigated lowlands	13,241	10,235	408	767	**24,651**	**107,967**
Total	**118,054**	**86,973**	**24,201**	**11,079**	**240,307**	**933,767**
			Production (tonnes)			
Rainfed lowlands	459,180	242,000	65,485	29,370	**796,035**	**2,763,150**
Rainfed uplands	-	9,171	3,760	5,463	**18,394**	**216,140**
Irrigated lowlands	66,490	53,950	1,140	3,135	**124,715**	**509,920**
Total	**525,670**	**305,121**	**70,385**	**37,968**	**939,144**	**3,489,210**

Source: MAF (2013)

Despite the high level of rice production from the southern provinces, accounting for about one quarter of the total rice production in the country, food insecurity in the Southern Region still exists. According to the survey by the World Food Programme (2007), Saravane and Sekong Provinces are two of the four provinces countrywide with the largest proportion of food-insecure households. About 30% and 24% of households are classified as food-insecure in Saravane and Sekong Provinces, respectively (compared with 41% in Bokeo Province in the Northern Region and 25% in

Xiengkhuang Province in the Central Region). The high level of food insecurity is predominantly in upland areas where ethnic minorities exist. Despite the continuing increase in rice production from this region, the rice insufficiency in the upland communities is likely to persist in the future, unless there is support for income-generating activities through diversified farming with livestock and tree crops and non-farm employment, so that households have sufficient income to purchase additional rice for household consumption (Schiller, 2008).

3.4.5 Agricultural commercialisation

The transition from a subsistence-based economy to a market-oriented economy is underway in Southern Laos (Cornford, 2006). With improvement of transport infrastructure and the connection with regional markets through neighbouring countries, farming in the lowlands along the Mekong corridor and in the plateau areas is increasingly oriented to commercial production of cash crops, livestock, and other agricultural products. Here the market demand for agricultural products is growing, improved agricultural technologies and farm machinery are increasingly used, and a proportion of farm production is regularly sold in the domestic markets or exported to neighbouring countries.

Increasing opportunities have been opened for Lao farmers to export their crops to neighbouring countries, in particular Thailand. Thailand has recently agreed to assist cross-border trading with Laos under the Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS). This is a collaborative agreement between Thailand, Myanmar, Cambodia, Laos, and Vietnam to promote balanced development in the Mekong Region by allowing imports with zero tariff of all approved agricultural products produced in the member countries (Setboonsarng et al., 2008). Under the ACMECS scheme, since 2004 Ubon Ratchathani Province in Thaliand and Champasak Province in Laos have signed an annual Memorandum of Understanding (MOU) to facilitate the export of the approved agricultural products from Champasak to Thailand; these products are produced under contract farming arrangements with Thai investors. So far five MOUs between Ubon Ratchathani and Champasak have been signed from 2005 to 2009 and the number of approved crops has been increased in each annual MOU, from eight crops in 2005 to 25 crops in 2009 (Table 3.6). Moreover, since 2008 the contract farming scheme under the ACMECS has been expanded to cover the provinces of Saravane and Sekong, with 14 crops authorized for each province, most of them the same as those for Champasak. It is planned that, in the near future, this kind of contract farming will spread to suitable areas in other provinces of Laos, in particular those bordering Thailand (Zola, 2009). Additional to the contract farming scheme, the Provincial

Commerce Office of Ubon Ratchathani has promoted other types of business to be jointly invested in by Thai and Lao investors in Champasak Province (Table 3.7). Again, this kind of joint-venture business has also been extended to Saravane and Sekong Provinces (Zola, 2009). The accelerating cross-border trade with Thailand under the ACMECS has the potential to benefit smallholders and the local economy of Southern Laos by increasing agricultural growth and commercialisation.

Table 3.6 List of approved crops in the MOU between Champasak and Ubon Ratchathani Provinces in 2009

No.	Crop	No.	Crop
1	Cabbage	14	Mustard greens
2	Bananas	15	Lettuce
3	Tamarind	16	Carrots
4	Chinese cabbage	17	Sweet peas
5	Cotton	18	Asparagus
6	Kapok seed	19	Chili peppers
7	Job’s tears	20	Tomatoes
8	Soybeans	21	Ash gourd or wax gourd
9	Fodder maize	22	Mushrooms
10	Castor bean	23	Strawberries
11	Sweet radish	24	Avocado
12	Ginger	25	Turnips
13	Groundnuts (peanuts)		

Source: Reproduced from Zola (2009)

Table 3.7 List of promoted business categories in the MOU between Champasak and Ubon Ratchathani Provinces in 2009

No.	Business categories	No.	Business categories
1	Construction materials	9	Agricultural production inputs
2	Tourism	10	Consumer goods
3	Hotels	11	Fresh and dried foods
4	Cosmetics	12	Health and medical facilities
5	Spas/Massage facilities	13	Equipment/air conditioning
6	Restaurants	14	Furniture
7	Vehicle repair and maintenance	15	Interior decorating
8	Agricultural equipment		

Source: Reproduced from Zola (2009)

3.5 Conclusion

The farming systems in lowland Southern Laos are undergoing a transition from subsistence-based to market-oriented production. Rice-based farming systems are both diverse and dynamic, with households continually adapting to constraints and opportunities arising from the rapid development occurring within Laos and the wider region. Rice production is dominated by the rainfed lowland system and is still predominantly for subsistence, with only a small proportion marketed and even less exported. However, the cultivated area and especially the yield of both rainfed and irrigated rice have been increasing, contributing to the achievement of rice self-sufficiency at the national level. Moreover, rural livelihoods have become increasingly diversified as the economy of the region develops and opportunities for off-farm and non-farm employment increase. However, the transformation occurring in the lowlands of Southern Laos is not necessarily the same as in other countries of Southeast Asia. In the next chapter outline the methodology used to study the specifics of agricultural change in the lowlands of Champasak Province and describe the particularities of the study area.

4 METHODOLOGY AND STUDY AREA

4.1 Introduction

As discussed in the previous chapter, agricultural change is clearly evident in Southern Laos, especially in Champasak Province, which is also experiencing an expanding cross-border trade with neighbouring countries, in particular Thailand. Some areas of the province are undergoing an agricultural transition in which a variety of crops are grown and a large proportion of output is produced for the market, non-farm activities are growing in significance, and there is an increasing labour shortage for agricultural production due to out-migration to work in towns or neighbouring Thailand. Hence Champasak Province was a suitable site for in-depth study to explore the socio-economic aspects of the transformation of lowland rice-based farming systems. This chapter first presents the analytical framework used for this study. It then describes the methods used for data collection and analysis. Finally, the chapter provides an overview of the study area to give an understanding of the general context in which agricultural transition has occurred.

4.2 Analytical framework

The analytical framework used for this study draws on three interrelated approaches – farming systems economics, agrarian systems analysis, and rural livelihoods analysis. Farming systems economics arises out of farm management approaches developed in the UK, US, and Australia and subsequently applied to small farm development in low-income countries, as described in texts by Yang (1965), Makeham and Malcolm (1986), Dillon and Hardaker (1993), and others(Upton, 1996, Dillon, 2003, McConnell and Dillon, 1997, Roberts and Swinton, 1996). Its focus is on the whole farm as a unit since small farms normally tend to use family resources to engage in diverse farming systems with both subsistence and commercial components. Agrarian systems analysis has been derived in continental Europe and while it incorporates the budgeting approaches of farming systems economics, it also considers the wider agrarian system, including its evolution over time and the relations between different types of farmers (FAO, 1999, p. 11). Finally, the rural livelihoods approach attempts to take greater account of the increasingly important non-agrarian dimension to rural households (e.g., Ellis 2000). This thesis draws to some extent on all three frameworks and associated methods.

4.2.1 Farming systems economics

Farm management economics provides numerous appraisal tools for assessing the profitability or desirability of changes to farming systems, based on the key elements of economic theory relevant to farm management decision-making. These are summarized by Dillon and Hardaker (1993) as the principles of comparative advantage, diminishing returns, substitution (between methods and resources), cost analysis (as between fixed and variable costs), opportunity cost (which says that the cost of any choice is given by the value of the next best alternative foregone), enterprise choice (the principle that an enterprise or activity should be undertaken if the net income it generates is greater than the opportunity cost of the resources it uses), and goal tradeoff (recognizing that farm households have multiple goals – economic and non-economic, short-term and long-term – that often compete and must be weighed up against each other in terms of their contribution to household well-being).

The three main methods that were considered appropriate for this study were enterprise budgets, partial budgets, and whole-farm budgets. In whole-farm analysis, the perspective is that of the farm household, hence it takes account of the use of farm-household resources in the entire crop and livestock production system, as well as any off-farm or non-farm uses. The budgeting analysis of the whole farm is undertaken by considering all income and expense items and resource utilisation during the farming year and over longer periods, such as the development of a tree crop plantation. Whole-farm budgeting analysis is normally undertaken in terms of gross margins, with the levels of farm activities and the gross margins per unit of each farm activity used to compute the total gross margin. The net farm earnings are then obtained by subtracting fixed expenses from the total gross margin. In the case of long-term crops such as oil palm or rubber where costs and benefits are spread over more than one year, cash-flow budgets for the whole farm may be drawn up (Dillon and Hardaker, 1993). The concept of whole-farm budgeting analysis can be further extended to determine the economic well-being of farm households by taking account of household non-farm income and household non-farm expenditure (McConnell and Dillon, 1997).

Partial budget analysis, on the other hand, is conducted to estimate the results of changes in farming practices affecting only a particular part of the farm. The distinguishing aspect of partial budgeting is that only the factors which contribute to the change in whole-farm performance are incorporated in the budget (Dillon and Hardaker, 1993). Thus, partial budgeting analysis requires less data and can be done more quickly and easily than the budgeting analysis of the whole farm (Dillon and Hardaker, 1993, Upton, 1996). Partial budgeting is more suitable to estimate the effects of relatively small changes in farming organisation or practices such as purchasing a handheld tractor for land preparation and transportation or a shift from one crop to another, whereas in the case of larger changes, e.g., a major reorganisation in the farming enterprise, whole-farm budgeting is necessary. Partial budgeting can make use of the concept of gross margins, as discussed in the case of whole-farm budgeting. Also, cash-flow budgets can be undertaken on a partial basis as well. Partial cash-flow budgeting is concerned only with the cash flows that will be changed as a result of some anticipated change in the farming organisation or practices in the future (Dillon and Hardaker, 1993). A form of partial budgeting (or input-output budgeting) that measures the returns to incremental changes in input use (e.g., fertilizer levels), expressed as the marginal rate of return (MRR) and compared to different thresholds, has been outlined by CIMMYT (1988) and Dillon and Hardaker (1993, ch. 6) and widely used in farming systems research.

Enterprise budgeting is used to estimate costs and returns for a given enterprise (i.e., a single production activity such as wet-season rice). It estimates the gross returns, variable costs, and other requirements of the enterprise (Roberts and Swinton, 1996, Dillon, 2003). A range of indicators was used to capture the criteria for farm-household decision-making with regard to enterprise choice, including gross income (GI), gross margin (GM), gross margin per number of days of household labour (GM/day), and net income (NI) – obtained by deducting the estimated opportunity cost of household labour from the GM. In a semi-subsistence farm household for which labour is the key limiting resource, the productivity of household labour, as reflected in the GM/day, was one of the most important criteria. In enterprise budgeting, considerable detail is obtained on expected yield, commodity price, input requirements (e.g., fertiliser and herbicide), and input prices. This entails defining the machinery complement in specific detail as well as the timing of operations and the amount of inputs required. Moreover, enterprise budgeting can be incorporated with statistical evaluation techniques in appraising the relative economic performance of cropping systems using methods such as analysis of variance, whereas other techniques prohibit this kind of analysis (Dillon, 2003).

Uncertainty and risk can be accommodated in enterprise budgets with sensitivity or break-even analysis and risk analysis. Sensitivity analysis brackets a baseline enterprise budget with more and less favourable scenarios. It shows the stability of an outcome under a range of plausible assumptions about risky, uncontrollable factors such as prices and yields (Upton, 1996). Break-even analysis identifies the yield, price, or cost threshold at which enterprise revenues would just equal costs (including opportunity costs). Risk analysis, a type of simulation modelling, evaluates the probability distribution of outcomes arising from the uncertain factors (Dillon and Hardaker, 1993) and identifies which of the uncertain inputs contributes most to the riskiness of the outcomes (Hardaker et al., 2004). Risk associated with farming enterprises is most likely to arise from variability in yields and prices. Hence risk analysis is used to estimate the probability distribution of outcomes based on these stochastic variables (Dillon and Hardaker, 1993).

While the study of farm enterprises should ideally incorporate a detailed analysis of the economic risk associated with each system, a full risk analysis is often difficult to achieve. Net returns are stochastic and uncertain. Stochastic dominance analysis provides a relatively simple form of risk analysis that can be used alongside enterprise budgeting with only minimal additional data required. Stochastic dominance analysis aims to assess the dominance or superior performance of one option over another in a probabilistic logic. It reduces hundreds of alternatives and diverse categories of risk attitude to a reasonable set, with the simple assumption that the farmer is risk averse (aiming to reduce risk while maximize net returns) (Dillon, 2003).

4.2.2 Agrarian systems analysis

To understand the diversity and complexity of rural change in the study area, agrarian systems analysis (ASA) was also used to analyse farm households in the context of their ecological, social, and economic circumstances. In broad terms, an agrarian system can be defined as "a mode of exploiting the environment that is historically created and sustainable, a system of production forces adapted to the bioclimatic conditions of a given space and responsive to the social conditions and needs of that moment" (FAO, 1999, p. 11). Another definition of an agrarian system is "the way farmers exploit the environment by using the relations and interactions that occur between all of its social and physical components and also taking into account the limits of the environment and its ability to reproduce" (Sacklokham and Baudran, 2005, p. 222).

ASA focuses on "the interactions among system components at different levels and moves from the general to specific, using a holistic method, which respects a hierarchy of processes and determinants" (FAO, 1999, p. 12). According to Sacklokham & Baudran (2005), the methodology of ASA involves examining the agro-ecological, technical, social and economic elements and their interactions; investigating a limited number of different situations or case studies; scrutinising different scales from the international to the plot level or from a general to a local level; reviewing the evolution or trend of farming systems at different times; employing tools such as landscape observations, discussions with farmers, and farm-household interviews; and applying an iterative approach to crosscheck and validate the information collected so hypotheses can be tested and adapted.

ASA is normally undertaken at three levels. Beginning at the regional level, the aim is to identify a limited number of homogenous zones or sub-regions, to characterise the different agro-ecological and socio-economic circumstances of these zones, and to trace changes over time such as landscape transformations, technical adaptations, and socio-economic trends. This analysis is done through observations in the field to observe the agricultural landscape along transects and through discussions with experienced farmers and others. The next level of analysis, at the zone level, is to understand the organisation and functioning of agro-ecosystems and the different types of farming system within each zone, again through observations and discussions with different types of farmers who undertake similar activities with similar means of production. Finally, at the farm level, the analysis aims to understand the main characteristics of each farming system and scrutinize their potential and problems through semi-structured interviews with sampled farm households from each category of farmers (Sacklokham and Baudran, 2005).

Traditional concepts that are generally applied in ASA include “technical itinerary”, “cropping or livestock pattern”, “production system”, and “agrarian system”, many of which are consistent with farming systems economics. The *technical itinerary* relates to the plot level and is defined as “the logical and ordinate sequence of cropping operations, applied to a vegetable or animal species” (FAO, 1999, p. 9). At a higher level of complexity, the *cropping pattern* is described as “a surface of land managed in a homogeneous way through different crops with their sequential order and the technical itineraries which have been applied to them”. Several different cropping patterns are often found in a farm and these cropping patterns together constitute a *cropping system*. A similar distinction is employed for a *livestock pattern* and a *livestock system*. At a higher array of the structure, a *production system* is “the combination of all cropping and livestock systems, and the other activities of a farm household (such as collecting, hunting, fishing, craft industry, and off-farm incomes), set within its immediate ecological, social and economic environment”. Finally, many production systems together and their interactions form an *agrarian system*. The agrarian system is “the sum of relationships between the production systems and the general social and economic organisation of the whole society” (FAO, 1999, p. 10).

4.2.3 Rural livelihoods analysis

Consistent with both farming and agrarian systems analysis but broader in its scope, the sustainable rural livelihoods framework shows how, in different contexts, rural livelihoods are achieved via access to a variety of livelihood resources or assets, including natural, physical, human, financial and social capital. Access to these assets is mediated by institutions and social relations. Individuals and households build on these assets to pursue various livelihood activities or strategies, to cope with and recover from stresses and shocks, and to maintain or enhance their capabilities and assets, without undermining the natural resource base (Scoones, 1998, Ellis, 2000). Rural people in different circumstances engage in a variety of livelihood strategies which have been grouped into three main types – agricultural intensification, livelihood diversification, and migration. These strategies are interrelated – households may pursue them alternately or they may combine different strategies simultaneously (Hussein and Nelson, 1998).

According to Ellis (2000, p. 111) agricultural intensification is "the utilization of a greater amount of non-land resources for a given land area". Extensive agricultural production refers to "low resource use combined with lots of land to produce low output per hectare", while intensive agricultural production means "high resource use combined with a small land area to produce high output per hectare". The foremost factor stimulating agricultural intensification is the increase in demand for outputs resulting from population growth, immigration, or income growth requiring high-value products. Nevertheless, even if demand does not increase, agricultural intensification is still needed when there is a decline in the availability of prime resources such as land and water (e.g., through urban expansion or the granting of large land concessions). Agricultural intensification is associated with an increased frequency of cultivation, an increase in labour inputs, or a development in technology. In past decades agricultural intensification in Asia has taken the form of the Green Revolution, leading to yield increases through the use of high-yielding crop varieties with the complementary use of chemical fertilisers, pesticides, irrigation, and mechanisation (Carswell, 1997). Some other examples of the intensification of agricultural production in different contexts are mixed-cropping, alley-cropping, inter-cropping, and crop-livestock production systems.

Rural households in developing countries increasingly have to diversify their livelihoods to make a living. On-farm or agricultural diversification is described as "the maintenance of a diverse spread of crop and livestock production activities that interlock with each other in various ways" (Ellis 2000, p. 15). Livelihood diversification is "the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and to improve their standard of living" (Ellis, 2000, p. 15). Rural households engage in a diverse set of activities including both on-farm and off-farm activities (the integration of crop and livestock production and wage employment), non-agricultural activities, and other activities in order to generate income and then accumulate the surpluses to invest in a range of activities, including investment in agricultural production. However, the possibility of using income derived from livelihood diversification for investment is likely to depend on the wealth status of households. Poor households are likely to use additional income for supporting household consumption rather than investing in agricultural intensification or diversification (Hussein and Nelson, 1998).

Migration is regarded as a third major livelihood strategy that is often combined with other livelihood strategies. Migration forms a central part of rural people's risk mitigation strategies and the remittances from migrants can help reduce consumption deficits and credit constraints of poor rural households. However, one important issue is whether remittances are used for agricultural investment such as purchasing fertilisers, hiring labour, buying agricultural materials, and investing in livestock, or only for buying food to secure the household's food supply. Another issue is the linkage between migration and other livelihood strategies, especially agricultural intensification and livelihood diversification. Migration, which generally leads to labour shortage, may limit agricultural intensification, which normally needs more labour. On the other hand, migration may aid agricultural intensification if remittances can be used to employ more labour or purchase agricultural inputs such as equipment, seeds, and fertilisers. A livelihood diversification strategy may also benefit migration. For example, new knowledge and skills acquired by migrants may be used to improve current agricultural practices or even pursue new activities (McDowell and de Haan, 1997).

4.3 Study sites and methods of data collection

4.3.1 Study sites

Based on the level of accessibility and incidence of poverty, two districts in Champasak Province were selected as the study sites (Fig. 4.1). Soukhouma District represents remote and poor districts (one of 47 officially-designated "poor districts" in Laos). Phonethong District represents more accessible and better-off districts; the district is directly connected to the provincial capital, Pakxe, via a bridge across the Mekong River. In addition, the selected districts were ones in which rural households have been experiencing rapid change in their farming and livelihood systems (market-oriented farming, labour-oriented, or migration-oriented livelihood strategies). Phonethong has a border checkpoint with Thailand; Vungtao-Chongmek is the main entry and exit point for imports from and exports to Thailand. Visas-upon-arrival are issued here. Large duty-free shops are also present at this border point. Soukhouma also has a border crossing with Thailand. The customary border market is open three days a week, with only certain goods permitted to be imported and exported. In addition, the two districts have been involved with research projects (including ACIAR-funded projects) aimed at improving the productivity of rice farming systems, including the promotion of modern varieties and the use of inorganic fertilisers, and this provided the opportunity to draw on some agronomic and other data for economic analysis.

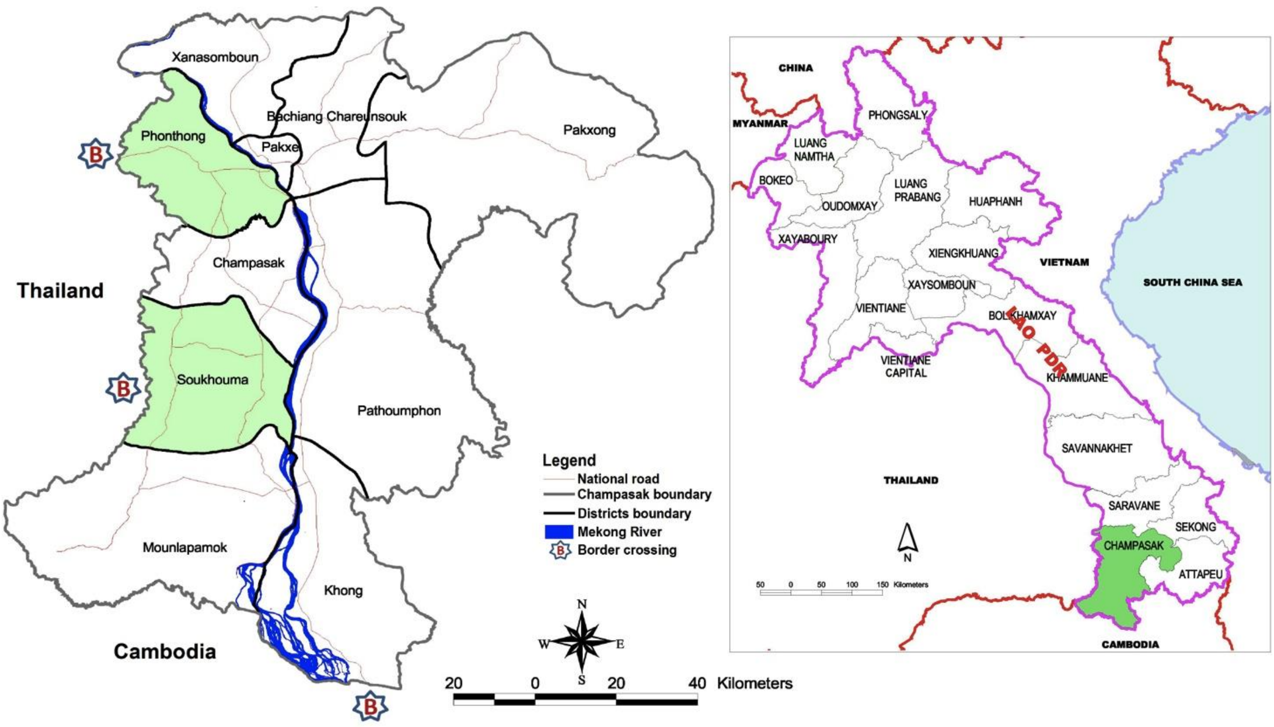


Figure 4.1 Location of the study areas
Source: NAFRI (2010c)

4.3.2 District-level consultation and village zoning

Consultation was carried out with the District Agricultural and Forestry Offices (DAFOs) of Phonethong and Soukhouma to identify the main agro-ecological zones and farming systems within their districts. Staff members from each DAFO were asked to identify key zones within their district and representative villages for each zone. At the same time the DAFO staff identified key characteristics, constraints, and priorities in each zone. This often related to promoting plantations, livestock, or cropping activities in particular areas.

Based on the consultation, Phonethong and Soukhouma Districts were classified into three distinct agro-ecological zones (irrigated villages, supplementary-irrigated villages, and purely rainfed villages), largely based around access to water and village accessibility (Fig. 4.2 and Table 4.1).

The research design involved selecting one village from each zone in each of the two districts. In other words, three villages were selected in each district to represent the three agro-economic zones (or village types), making a total of six study villages. The selected villages were Phaling, Oupalath, and None Phajao in Phonethong District, and Boungkeo, Khoke Nongbua, and Hieng villages in Soukhouma District. The codes representing the districts and villages which will be used throughout this thesis are shown in Table 4.2.

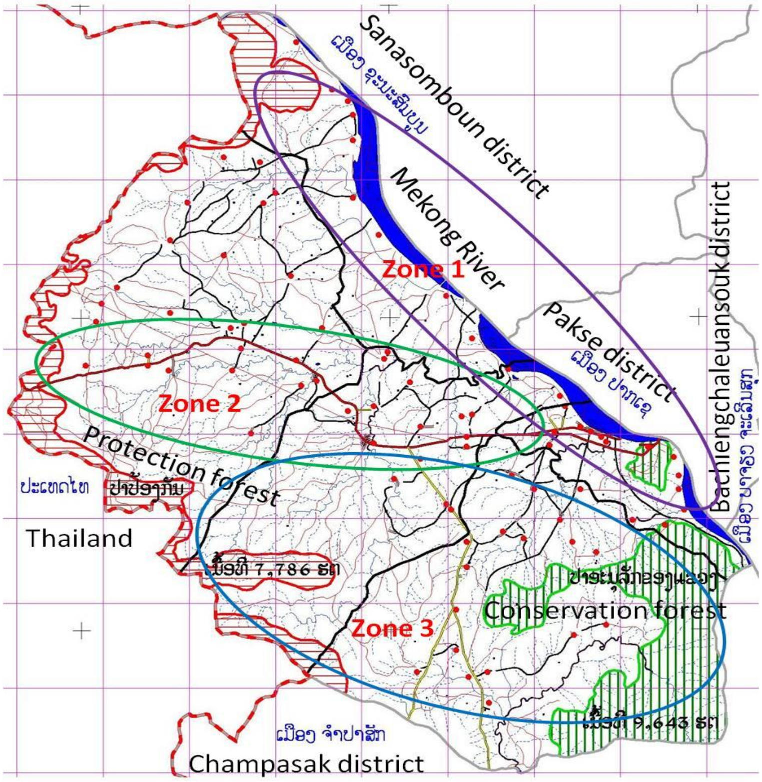
4.3.3 Village reconnaissance survey

A reconnaissance survey was conducted in January 2011 in the six villages in order to gather basic information for designing and undertaking formal surveys or more in-depth investigations. Such surveys help in developing an understanding of farming systems and ensure that a formal questionnaire is understandable and relevant to farmers' circumstances and sensitive to local issues.

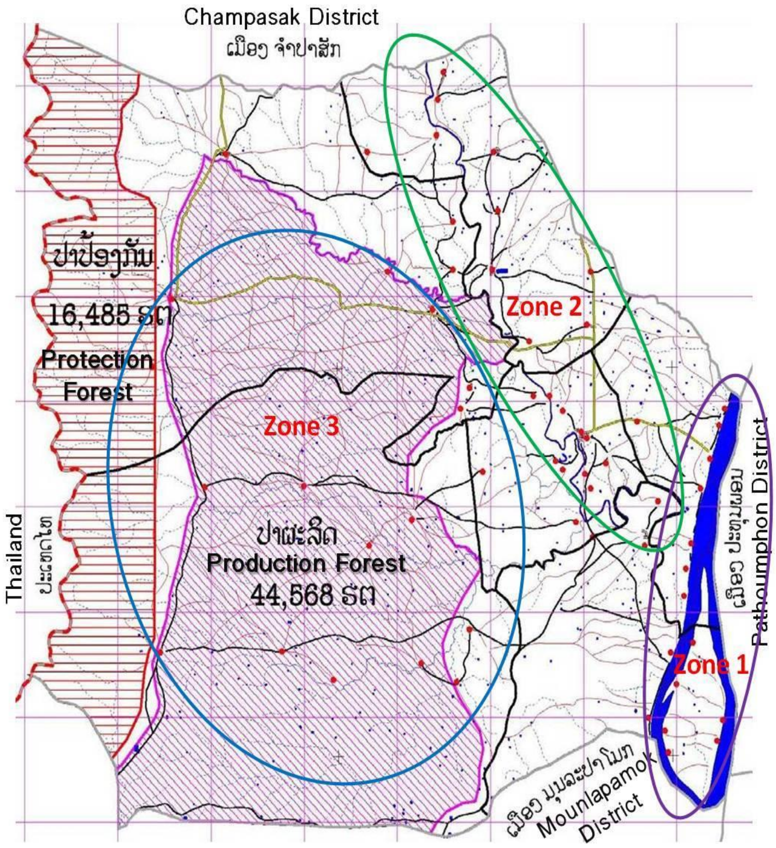
I carried out semi-structured group interviews in the Lao language, supported by DAFO staff in both the logistics and interview process. The village headman and members of the village committee were present during the interviews. The data collected included villages statistics and history; cropping system; livestock system; forest collection, fishing, and hunting; off-farm and non-farm activities; water management; access to capital; access to information and extension; farmer organisations; and ranking of village needs and priorities. Village transect walks and photography were also used to assist understanding and recording the variation in land-use within the village.

4.3.4 Household survey

A single-visit household survey was undertaken in May 2011 in those six villages. Thirty households were selected at random from each village, making 180 respondents in total. The objective of the surveys was to understand and characterise farming systems and rural livelihoods along a transect that traversed the three agro-ecological zones in Champasak. This required data on the household's assets, the factors influencing access to these assets, and the various activities that make up household livelihood strategies.



(a)



(b)

Figure 4.2 Agro-ecological zones in (a) Phonethong District and (b) Soukhouma District
Source: NAFRI (2010d)

Table 4.1 Characteristics of villages in different agro-ecological zones in study districts

Zone	Agro-ecological zones	Main characteristics of villages
1	Irrigated lowlands	▪ Located along or nearby Mekong River ▪ Accessible by all-weather road and river ▪ Village provided with canal irrigation system ▪ Rice grown in both wet and dry seasons ▪ Non-rice crops also grown in paddy land in dry season ▪ Vegetables grown in riverbank gardens in wet season and in small home gardens in wet and dry seasons
2	Rainfed lowlands with supplementary irrigation, or semi-irrigated lowlands	▪ Located along or nearby all-weather road ▪ Individual access to water from streams for supplementary irrigation ▪ Rice grown only in wet season ▪ Vegetables grown in small home gardens in wet and dry seasons
3	Rainfed lowlands	▪ Located near forested mountains* along Laos-Thailand border ▪ Access by dirt road ▪ Small streams ▪ Rice grown only in wet season ▪ Vegetables grown in small home gardens in wet and dry seasons ▪ NFTP collection ▪ District officials regard villages in this zone as poorer than villages in other two zones

Note: * The forested areas are important for livestock-raising and NTFP collection

Source: Consultations with DAFO staff of Phonethong and Soukhouma, 2010

Table 4.2 Study villages by district and agro-ecological zone

	D1 = Phonethong	D2 = Soukhouma	Village types/zones
V1	Phaling	Boungkeo	Zone 1 - irrigated village
V2	Oupalath	Khoke Nongbua	Zone 2 - supplementary-irrigated village
V3	None Phajao	Hieng	Zone 3 - purely rainfed village

A structured questionnaire was designed to obtain information regarding household composition and assets, cropping practices, livestock practices, off-farm and non-farm employment, migration and remittances, forest collection and hunting activities, access to water, access to credit, group membership, information sources, and rice security. Before conducting the actual household survey, the questionnaire was pre-tested and further revised. The objective of the pre-test was to check the translation of the survey and whether households could understand the questions and provide meaningful answers.

Three staff from the National Agriculture and Forestry Research Institute (NAFRI), one staff from the Southern Agriculture and Forestry Research Centre (SAFReC), and two staff from the District Agriculture and Forestry Offices (DAFOs) (one from each district) were recruited to be enumerators. Training of NAFRI enumerators was conducted at NAFRI headquarters on 26 March 2011 before departing for the fieldwork. A second training was conducted in Pakxe District on 6 May 2011 for enumerators from SAFReC and DAFO. The training involved going through each question and the possible responses so that the enumerators fully understood each question. Suggestions were also provided on how to appropriately approach the interviewees to maximise the chances of willing cooperation and obtaining reliable information. As part of the training process, the enumerators were also given a chance first to observe an actual interview conducted by me, to better understand how to ask the questions and interact with the interviewees.

As noted above, in each village 30 households were randomly selected to participate in the survey and all agreed to do so. Interviews generally required about one hour. Each enumerator completed three interviews per day, hence the team typically spent three days in each village. I reviewed the completed questionnaires at the end of each day to make sure each question had been answered or completed, as well as to verify the consistency and reliability of the information recorded.

4.3.5 Household-case studies

A case-study approach lends itself to understanding the complex relationships that exist between the biophysical environment, farming households, and the various socioeconomic conditions that influence resource-use decisions over time (Yin, 2009). Case studies were used to capture the detail of household production activities and livelihood strategies. In total, 18 farm households were selected for case-study interviews in September 2011, representing various types of household in the household survey. Different types of household were grouped according to their foremost livelihood strategy. Interviews with the selected case-study households were semi-structured and provided more detail than that allowed by the structured interviews in the household survey. The semi-structured interview allowed both spatial and temporal dimensions to be included in the analysis. In addition, direct observation was undertaken of the household's crop and livestock activities. The case studies could thus be used to build reliable whole-farm budgeting models for the different household types to be used in assessing the impacts of technology adoption, changing market conditions, and policy interventions.

The semi-structured case-study approach helps avoid an overly rigid definition of household types and to better capture the dynamics of livelihood trajectories. It allows understanding of how livelihoods change and develop in response to opportunities, constraints, and unexpected shocks. Indeed, many households transition between household types over time, and not necessarily in a linear fashion. For example, a household selected to represent a market-oriented type of farming system (and which was participating in a cropping trial) switched to being a migration-oriented household when two sons moved to Thailand to work, limiting the labour available for on-farm activities (hence the household dropped out of the trial).

4.3.6 Small-group interviews

In addition, interviews with small groups of farmers in the irrigated villages (V1 in each district) were conducted in May 2013. The purposes of these interviews were to present the enterprise budgeting for both rainfed and irrigated rice production, developed from the household-case studies, for validation and/or alteration; discuss upper and lower bounds for yields and prices to enable risk analysis; discuss various scenarios with farmers, including minimum prices required to be interested in dry-season rice production; develop budgets for alternative dry season options such as watermelon; conduct case-study interviews with farmers growing corn using water from ponds; and conduct a case-study interview with a farmer growing forages.

4.3.7 Data analysis

Data from the household survey were entered into the IBM SPSS Version 20 statistical package and a range of functions and statistical modules available in the SPSS were applied to analyse various dimensions of the information and relationships among variables. The results from the household survey are mostly presented in Chapters 5, 6, and 8 and throughout these chapters attention is given to a comparison between districts and between village types within districts.

Where applicable, statistical tests were undertaken for key variables to find out whether there were significant differences between districts (D1, D2) and between villages (V1, V2, V3) within each district. Chi-square tests were performed to explore the relationship between a categorical dependent variable with only two groups (e.g., a migrant household or a non-migrant household) and a categorical independent variable with two or more groups (i.e., district type (D1, D2) or village type (V1, V2, V3)). Independent-sample t-tests were conducted to compare the mean values of one continuous dependent variable (e.g., rice yield) for one categorical independent variable with only two groups (i.e., district type (D1, D2)). One-way Analysis of Variance (ANOVA) was performed to compare the mean values of one continuous dependent variable (e.g., income) for one categorical independent variable with three or more groups (i.e., village type (V1, V2, V3)). It was considered appropriate to perform one-way ANOVAs separately for each district to compare the mean values of various continuous dependent variables between villages *within* each district. It should be noted that only results that were found to be statistically significant are reported in the chapters that follow. Multiple regressions were also undertaken to explore the relationship between one continuous dependent variable (e.g., rice yield) and a number of independent variables or predictors. Logistic regression was performed to assess how well a set of independent variables predicts a categorical dependent variable (e.g., migrant or non-migrant households) (Pallant, 2011). Data from case-study households and field observations were also used to describe and assess the similarities and differences between districts or between villages within the same district, to interpret the results from regression analyses, and to construct enterprise and whole-farm budgets.

4.4 Overview of the study area

4.4.1 Champasak Province

The total area of Champasak Province is 15,350 km^2, making it the third largest province in the country. It shares a border of 233 km with Thailand in the southwest, 135 km with Cambodia in the south, 140 km with Saravane Province in the north, and 180 km with Sekong Province and Attapeu Province in the east. Champasak Province has a humid tropical climate with an average temperature of 25^{o}C and an annual rainfall of about 2,200 mm. Over 90% of the annual precipitation occurs in the wet season (MSCP, 2010). The rain normally falls from June to November, with the peak rainfall in July and August (Fig. 4.3); however, in recent years rainfall has become less predictable and more unevenly dispersed. Stretching from the north to the south of the province, the Mekong River contributes significantly to the livelihoods of people living alongside in terms of fish resources and water for agricultural production, as well as transportation. The province is renowned for its tourist attractions, especially Vat Phou temple – a UNESCO World Heritage Site, Khon Phapheng waterfall – Asia's biggest waterfall, and Si Phan Don – the four thousand small islands (DPI, 2009).

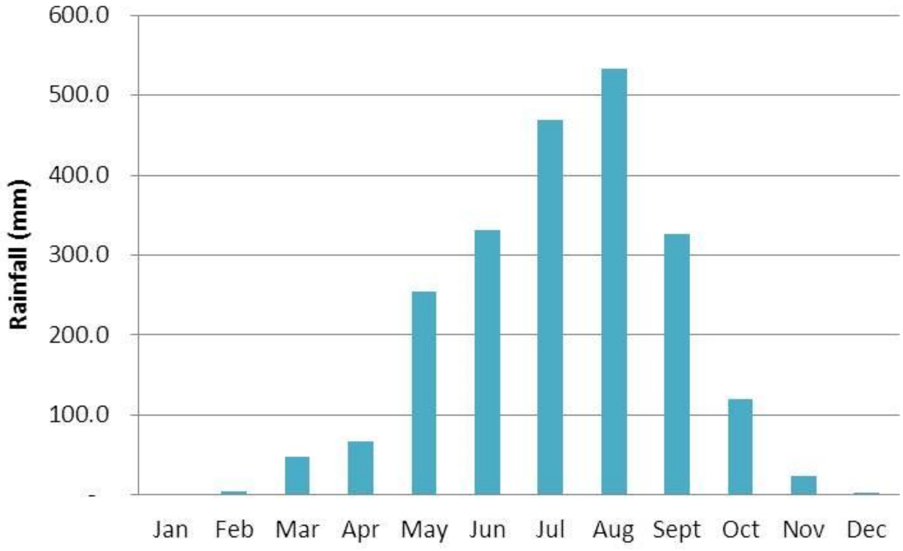


Figure 4.3 Monthly average rainfall distribution in Champasak Province from 2000-2010
Source: MSCP (2010)

Champasak Province is a commercial centre between Laos, Thailand, Cambodia, and Vietnam. Good transportation infrastructure of roads and the bridge across the Mekong River offer opportunities for domestic trade with nearby provinces and even Vientiane Capital, and cross-border trade with neighbouring countries. Moreover, the province has an international airport operating daily domestic flights to Vientiane Capital and international flights to Thailand, Vietnam, and Cambodia (DPI, 2009). The economy of the province grew strongly during 2006-2010 with an average annual GDP growth of around 10%, hence GDP per capita increased from USD 519 in 2006 to USD 1,097 in 2010. Due to what the government describes as the province's favourable investment environment – including its strategic location, incentive investment package (comprising a shortened process for investment approval, low business costs, and security of property), and strong economic growth – domestic and Foreign Direct Investment (FDI) have risen to USD 542 million in 2010. Of the total investment value, the agricultural sector represents 38%, the industrial sector 25%, and the service sector 37% (DPI 2009). The total export value over the period 2006-2010 was USD 182 million, with 56% from coffee, 21% from timber products, 17% from agricultural products under contract farming, and 6% from other sources (DPI, 2009, DPI, 2010). Nevertheless, despite the agricultural and economic growth in the province, food insecurity and severe poverty still exist in some remote areas of the province.

The province is divided into ten administrative districts – Sanasomboun, Bachiengchaleuansouk, Phonethong, Pakxong, Champasak, Pathoumphon, Soukhouma, Mounlapamok, Khong, and Pakxe, which is the capital city of the province. Pakxe is the most economically developed urban centre in the Southern Region. It has a high level of wholesale and retail business and trading connections with Thailand, as well as a growing industrial sector such as garment factories, construction companies, and vehicle assembly factories, and agro-processing enterprises for tobacco, coffee, and beer (DPI, 2010). In 2010 there were 640 villages, 100,058 households, and 642,651 inhabitants in the province. The population density was around 42 persons per km^2 and the population grew at the rate of 1.9% per annum. The labour force (15-59 years of age) was about 38% of the total population in the province.

About 77% of total households in 2010 were farm households. Approximately 80% of the population was settled in rural areas and involved in agricultural production, mainly rice cultivation. Almost all villages in the province could be accessed by road in the dry season, and about 75% in the wet season. About 81% of the total villages and 85% of the total households in the province had access to electricity (DPI, 2010). The most numerous ethnic group in the province is the Lao ethnic group (part of the Tai-Kadai ethno-linguistic family), constituting 84.8% of the provincial population, followed by the Laven (4.9%) and Souay (2.4%) ethnic groups (both part of the Mon-Khmer family) (Chamberlain, 2001). The Lao ethnic group usually resides in the plains and along the rivers, cultivating paddy rice, while the Laven and Souay normally inhabit the sloping uplands and practise shifting cultivation on less fertile soils (DPI, 2010). The Department of Labour and Social Welfare (2010) estimated that in 2010 there were about 27,594 people (14,565 females) from Champasak Province working in Thailand.

The total land area of Champasak Province is 1,535,000 hectares, of which 26% is upland and 74% is lowland. The province has abundant natural resources such as bauxite, barite, copper, iron, zinc, petroleum gas, and a wealth of forests, as well as high potential for hydro-power generation (DPI, 2009). Fig. 4.4 shows the land uses and forest types in Champasak. According to the Provincial Agriculture and Forestry Office (2010), the forest area in the province is 1,080,033 hectares, representing about 70% of the total provincial area. There are three National Biodiversity Conservation Areas (NBCAs) covering an area of 329,600 hectares, and seven Provincial Biodiversity Conservation Areas (PBCAs) covering an area of 81,940 hectares. The non-forested land, which constitutes around 30% of the provincial land area, includes agricultural land (20%), and other land (10%).

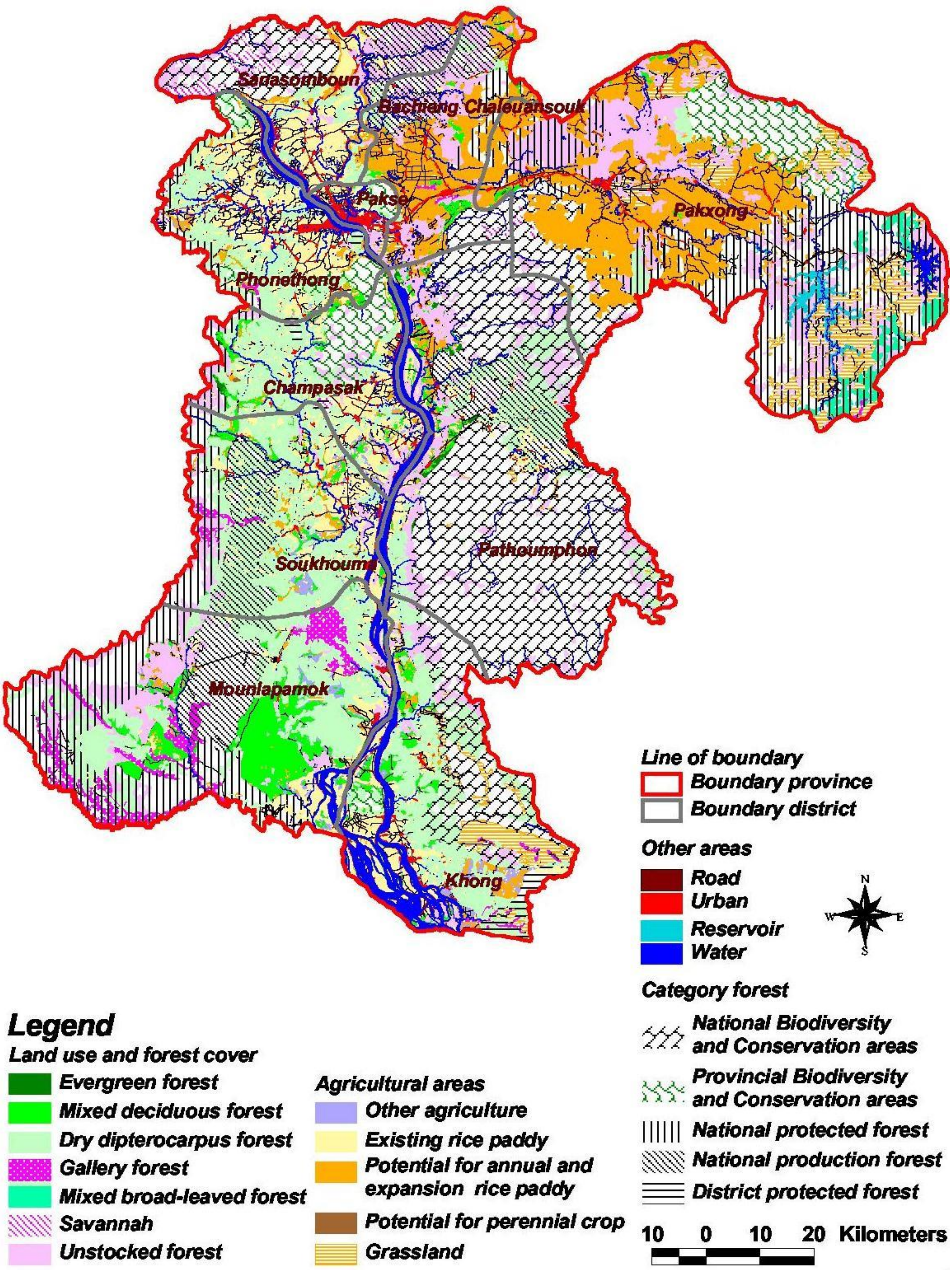


Figure 4.4 Forest and land use map of Champasak Province
Source: NAFRI (2010e)

Farming systems in Champasak Province occur in three broad zones – the lowlands along the Mekong River, the Boloven Plateau, and the uplands. In the lowlands, rice is the main crop, grown in both rainfed and irrigated environments. Lowland farmers are heavily dependent on rice monoculture, with limited scope for crop diversification (Zola, 2009). However, vegetables are grown on a small scale in home gardens or river-bank gardens during the dry season to serve household needs, with some surplus for sale. Farming in the Boloven Plateau is dominated by coffee and vegetable production. The fertile volcanic soil and good climatic conditions on the plateau are suitable for growing a variety of crops. However, the area is not suitable for growing rice due to the high elevation of over 1,500 m above sea level (Sipaseuth et al., 2008). In the uplands, swidden farming is still practised.

Rice production is the main farming activity in the lowlands of the province. The total cultivated rice area in wet season (WS) 2010 was 97,300 hectares, producing 355,145 tonnes, while the irrigated rice area in dry season (DS) 2010-11 was 10,000 hectares, producing 54,100 tonnes (PAFO, 2010). Various non-rice crops are grown in home gardens and, in villages along the Mekong or its tributaries, in "river-bank gardens". Livestock and fishing are important sources of protein and household income in the lowlands. The livestock statistics in the province in 2010 were as follows – 127,540 buffaloes; 131,720 cattle; 156,123 pigs; 10,122 goats; 4,317,460 poultry; 1,879 horses; 708 peacocks; 1,496 ostriches, 34 elephants; 881 hectares of fishponds; 2,193 hectares of natural fishpond areas; and 553 cages of fish raised in the Mekong River (PAFO, 2010). Many households also collect timber and non-timber forest products (NTFPs), hunt wild animals, and make and sell handicrafts. Many young people also seek non-farm employment in towns or in Thailand.

4.4.2 Phonethong District

Phonethong District is located in the northwest of Champasak Province and along the Mekong River. The district is 10 km from the provincial capital and shares the borders with Thailand and Sanasomboun District in the north, Champasak District in the south, Pakxe District and Bachiengchaleuansouk District in the east, and Thailand in the west. The Mekong River acts as the border (45 km long) with Sanasomboun, Pakxe, and Bachiengchaleuansouk Districts. In 2010 the district had 71 villages, grouped into five village clusters – Kaokeuang, Koudjik, Phonethong, Sukmeuang, and Dongyang (Fig. 4.5) (PFO, 2010a).

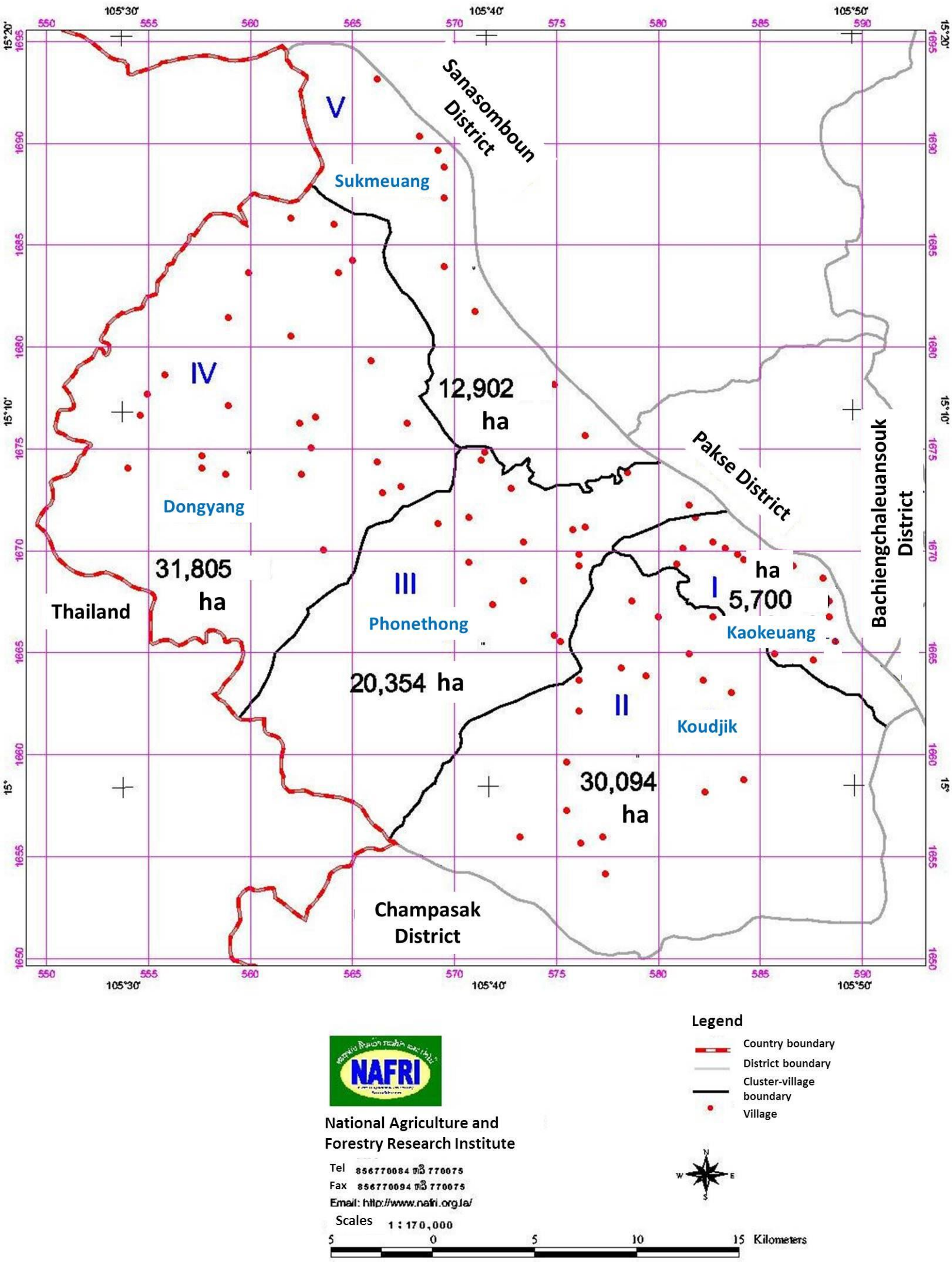


Figure 4.5 Administration map of Phonethong District
Source: NAFRI (2010f)

There were 15,975 households in the district in 2010 with a total population of 87,232 (43,811 females) of which 98.2% were of the Lao ethnic group and 1.8% of the Phakeo ethnic group (a branch of the Souay). The population of working age comprised almost half of the total population and about 85% of this labour force worked in farming activities. About 98% of the population was Buddhist and 2% Catholic. About 86% of the total villages and 76% of the total households in the district had access to electricity. Poverty incidence in the district had decreased in the past decade, with villages classified as "poor" being reduced from 14 in 2001 to six in 2010. The number of poor households dropped from 1,535 to 184 in the same period (PFO, 2010a), possibly reflecting statistical issues in updating the poverty line. According to the Department of Labour and Social Welfare (2010), the estimated number of migrants from Phonethong District working in Thailand in 2010 was about 7,772 people (4,223 females).

The road access to the district was in good condition, with a bridge across the Mekong River connecting to Pakxe District in the east and a main road (No. 16) linking to the Lao-Thai border checkpoint (Vungtao-Chongmek) in the west. In addition, a new paved road connecting with Champasak District had been constructed. However, the roads through the villages were mostly unsealed dirt roads. About 87% of the villages in the district were accessible in both wet and dry seasons, but accessibility was rather difficult in the wet season. There were four markets in the district – three local markets and a newly established central market for exporting agricultural products located near the Vungtao-Chongmek border checkpoint (PFO, 2010a).

The total land area of Phonethong District was 100,855 hectares, located in the Champasak plain. The agro-ecological landscape of the district comprised lowland along the Mekong River (in the east) and mountains with mixed forest (in the west and south). The forest area covered about 39% of the district area while nearly half of the area was agricultural land. The rest of the land was under urban or other uses (Fig. 4.6). The Mekong River and its tributaries served as a crucial water resource for agricultural production and a food source for people residing along the river. Important streams were Huay Samun, Huay Phaling, Huay Vunghae, Huay Phek, and Huay Khamuan, having potential for establishing reservoirs and spillways to supply water for crop production.

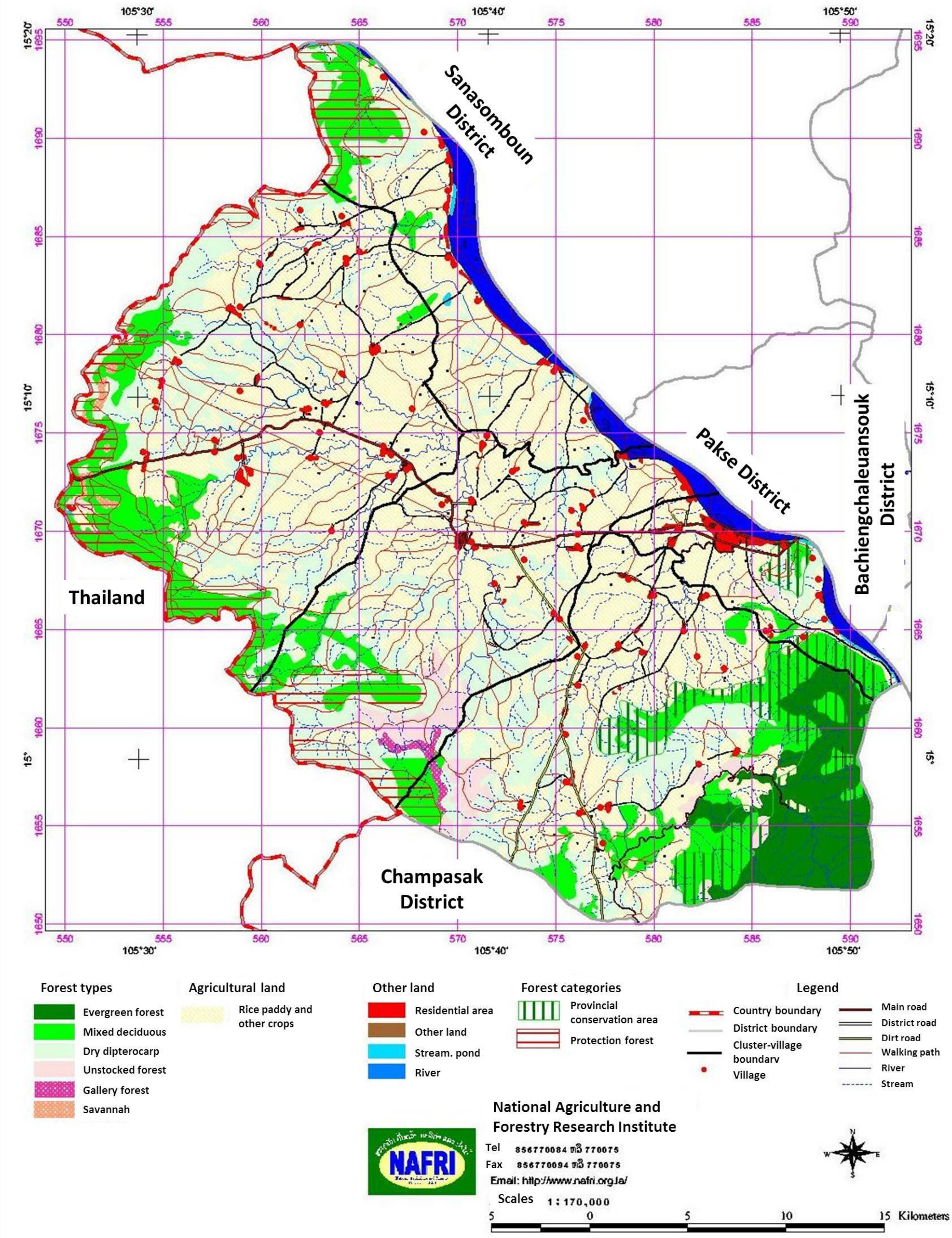


Figure 4.6 Forest and land use map of Phonethong District
Source: NAFRI (2010g)

According to the soil survey undertaken by the Agricultural Land Research Centre (ALRC) of NAFRI, there are seven soil types in Phonethong District, namely, Leptosols, Fluvisols, Arenosols, Alfisols, Acrisols, Luvisols, and Cambisols. However, the majority of the soils are Luvisols, Alfisols, and Cambisols, each constituting around 30% of the total land area. Most of the soils are shallow, sandy, and of poor quality for agricultural production (ALRC, 2007a). The average annual temperature is 28.1^{o}C, with average minimum and maximum temperatures of 23.2^{o}C and 32.2^{o}C, respectively. The wet season is from mid-April to mid-October. The average annual rainfall is 1,652 mm and the average number of rainy days is 107. Average annual evaporation is 1,285 mm, with average monthly evaporation of 46.7 mm and 118.4 mm in the wet and dry seasons, respectively. The average annual atmospheric humidity is 70%. Therefore, the climate in the wet season is suitable for crop cultivation whereas in the dry season the amount of water is insufficient for crop production (DAFO, 2010a).

The main agricultural activity is paddy rice cultivation, undertaken by about 85.7% of households in 2010. The total area of paddy land in the district was 25,000 hectares and the cultivated area in WS 2010 was 24,875 hectares, producing 40,805 tonnes of paddy rice. The main causes of low production were reported to be drought and leaf-folders. Irrigation systems using electric pumps were found in Sukmeuang, Phaling, and Thaphosy villages. The total irrigated rice area in DS 2010-11 was only 206 hectares, producing 865 tonnes. Apart from rice, farmers also grew vegetables and fruits (including taro, cucumber, watermelon, long beans, sweet corn, chilli, sour eggplant, mango, coconut, tamarind, banana, cashew nut, and dragon fruit), as well as tobacco, in both wet and dry seasons. In 2010 a total of 1,125 hectares was planted with vegetables and fruit, including 375 hectares in the WS (240 hectares for vegetables) and 750 hectares in the DS (469 hectares for vegetables) (DAFO, 2010a).

Livestock (especially large ruminants) was one of the main income sources for farm households in Phonethong District. However, livestock-raising was risky due to frequent outbreaks of diseases, and was constrained by the availability of feed, especially in the area near the Mekong River. Livestock statistics in the district in 2010 were as follows – 21,776 buffaloes; 19,583 cattle; 692 goats; 13,501 pigs; 544,145 poultry; 30 horses; 200 hectares of fishpond; and 50 hectares of natural fishpond areas (DAFO, 2010a).

4.4.3 Soukhouma District

Located in the southwest of Champasak Province and along the Mekong River, Soukhouma District shares borders with Champasak District in the north, Mounlapamok District in the south, Pathoumphon District in the east, and Thailand in the west. The Mekong River acts as the border (39 km long) with Pathoumphon District. Soukhouma is classified as one of the 47 poor districts in the country and has the highest poverty incidence in the province. In 2010 the district had 56 villages grouped into six village clusters – Banhieng, Nasumlieng, Banthad, Soukhouma, Boungkeo and Outhoummai (Fig. 4.7) (PFO, 2010b).

There were 9,224 households in the district in 2010. The total population was 53,107 (26,525 females), of which 76.9% were of the Lao ethnic group, 22.4% of the Souay ethnic group, and 0.7% of the Khmer ethnic group. The population of working age was about 32% of the total population in the district. About 70% of the villages and 55% of the households in the district had access to electricity. The poverty incidence in the district was still high, with 23 villages (41%) classified as poor villages (PFO, 2010b). According to the Department of Labour and Social Welfare (2010), the number of migrants from Soukhouma District working in Thailand was about 4,693 (2,256 females).

Road access to the district was poor, with only a dirt road from Champasak District to Soukhouma District, hence travel was difficult during the wet season and the district was often cut off by floods. Roads to the villages were also dirt roads and accessibility was difficult in the wet season. There was one main market in the district town, a village market at Hieng Village, and a traditional border market with Thailand (Song Ta Ou border market) located near Hieng Village, where people from nearby villages brought their agricultural products and NTFPs to sell to Thai traders (PFO, 2010b). In 2010 the main agricultural products and NTFPs exported via this border market were frogs (20.5 tonnes), shells (6 tonnes), bamboo shoots (15 tonnes), sour tamarinds (28 tonnes), Indian gooseberries (11 tonnes), resins (8 tonnes), and a kind of mushroom (*hed phor*) (8 tonnes) (DAFO, 2010b).

The total land area of Soukhouma District was 117,931 hectares. The agro-ecological landscape comprises lowlands along the banks of the Mekong River, lowlands along streams, terrace land, and hills and mountains under mixed forest. Forests cover about 76% of the district area while around 20% is agricultural land. The rest (4%) is under urban and other uses (Fig. 4.8). Apart from the Mekong River, the main stream flowing across the district from the northwest to the Mekong in the southeast is the Khamouan; there are also many small streams but most of them lack water in the dry season. The Mekong River and streams serve as crucial water source for agricultural production and food sources for local people, as well as having potential for establishing reservoirs and spillways, supplying water for crop production.

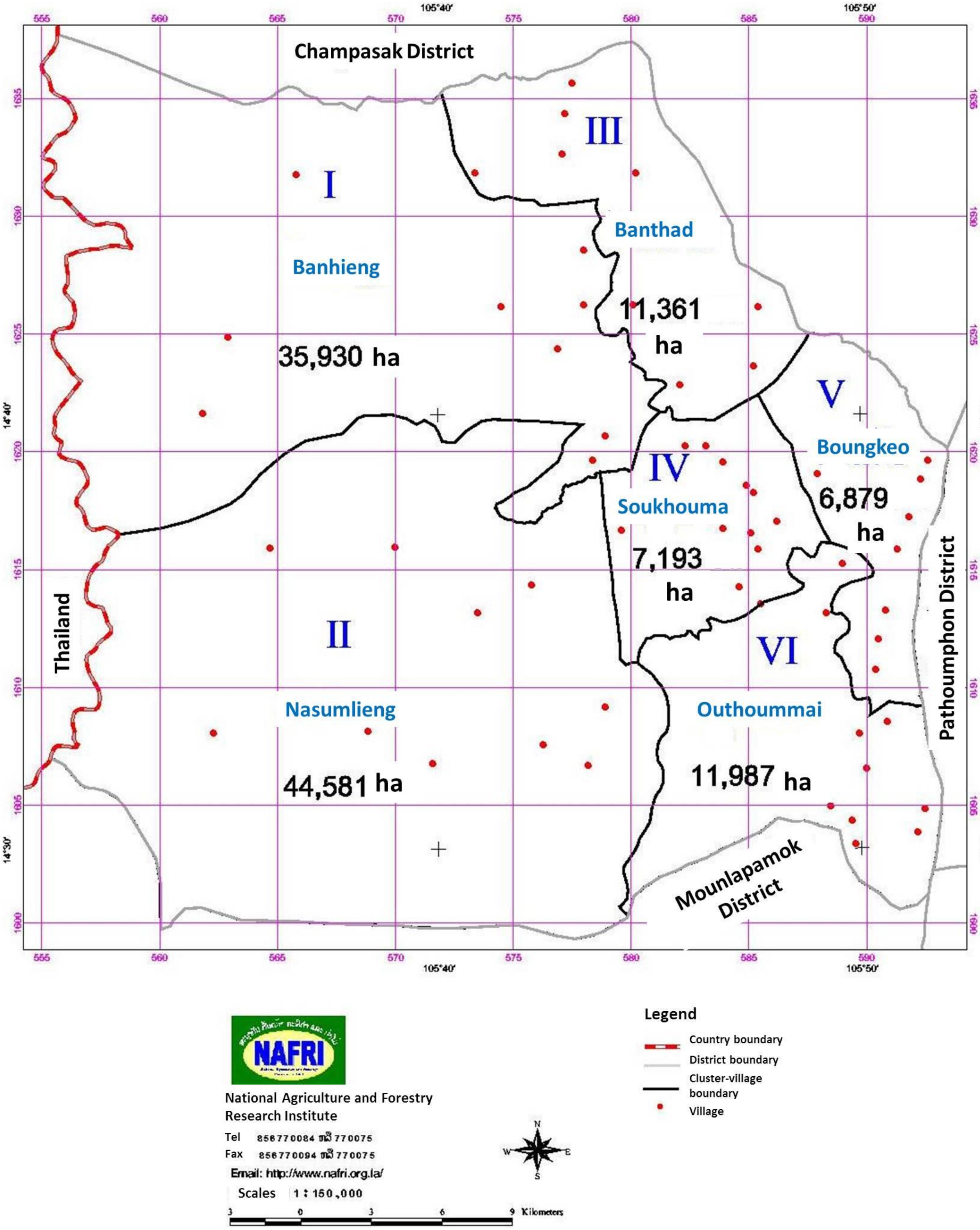


Figure 4.7 Administration map of Soukhouma District
Source: NAFRI (2010h)

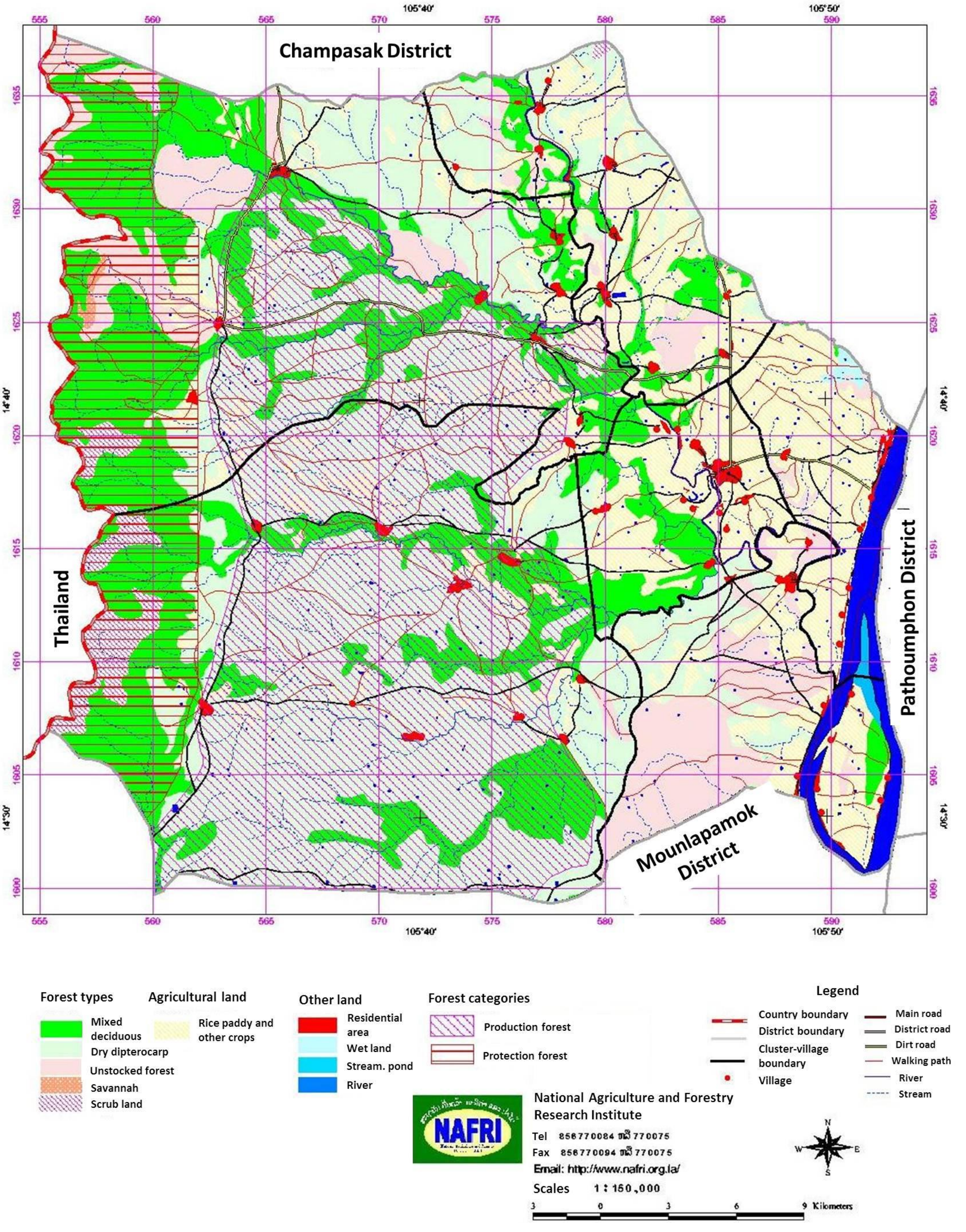


Figure 4.8 Forest and land use map of Soukhouma District

Source: NAFRI (2010i)

Based on the soil survey undertaken by the ALRC of NAFRI, there are seven types of soil in Soukhouma District, namely, Leptosols, Gleysols, Arenosols, Cambisols, Acrisols, Alfisols, and Luvisols. As in Phonetong, the majority of the soils are Cambisols, Luvisols, and Alfisols, each making up nearly 24% of total area. Again, most of the soil is shallow, sandy, and of low quality for agricultural production (ALRC, 2007b). Average yearly temperature is around 27.7^{o}C, with an average minimum of 23.2^{o}C and maximum of 32.2^{o}C. The wet season is from mid-April to mid-October. The average annual rainfall is 2,025 mm. The climate in the wet season is suitable for agricultural production whereas in the dry season the amount of water is not enough for crop production in the absence of irrigation (DAFO, 2010b).

Over 90% of the households in the district engaged in agricultural production and the main agricultural activity was paddy rice cultivation. Due to limited irrigation infrastructure, rice was mainly produced in the wet season. The total area of paddy land in the district was 11,200 hectares. In 2010 all this land was cultivated in the wet season, producing 33,959 tonnes of paddy rice. The rice area damaged by drought and flood was 783 hectares. The total irrigated rice area in DS 2010-11 was 263 hectares, producing 1,104 tonnes. Apart from growing rice, farmers also grew vegetables and other crops (such as beans, peanuts, sweet corn, watermelon, cassava, tobacco, chilli, sugarcane, oranges, mangoes, bananas, and tamarind), accounting for 650 hectares in the wet season and 553 hectares in the dry season. About 33 hectares of non-rice crops were grown on paddy land in the dry season using irrigation. There were also small areas of tree plantations – eucalyptus (9 hectares), teak (106 hectares), and others (10 hectares). Livestock (especially large animals) were one of the main income sources for farm households in Soukhouma District, but faced the same constraints as in Phonetong. The numbers of livestock in the district in 2010 were reported to be 9,353 buffaloes, 10,496 cattle, 150 goats, 8,792 pigs, and 107,880 poultry (DAFO, 2010b).

4.4.4 Irrigated villages in the two districts

As noted above, one of the selected study villages in each of the two districts had a canal irrigation system. The irrigation system in Phaling Village, Phonethong District, was constructed in 1996 and the system in Boungkeo Village, Soukhouma District, was built in 1998 (Figs. 4.9 and 4.10). Both systems used multiple large electric pumps. In Phaling the system initially used two pumps and all canals were unlined, but concrete lining of the main canal has occurred in recent years. In Boungkeo, initially there were six pumps, while now there are only four, only two of which function well. All of the canals are unlined and are not in good condition, needing repair, cleaning out, or other maintenance every year. A severe flood in the 2011 wet season damaged many sections of the canals.

The service capacity of the irrigation systems was 60 hectares in Phaling and 160 hectares in Boungkeo. However, the area cultivated with rice in these two villages varied each year, depending on production in the previous wet season and rice price. Low rice production as a consequence of severe drought in WS 2010 caused an increase in the cultivated area in DS 2010-11 in both villages. Conversely, an extremely low rice price in 2012 resulted in a sharp decrease in the cultivated area of DS 2012-13 rice – a drop from 38 hectares in DS 2011-12 to only 3 hectares in DS 2012-13 in Phaling and from 107 hectares to 32 hectares in Boungkeo.

The rules governing the use and management of the system are developed by the water-users' groups (WUGs), normally before the irrigation season in December, and approved by DAFOs and district governors. These include rules relating to the management of the pumps and channels, the release of water, the unauthorized use of water, the charging of water fees and collection system, livestock management, the washing of equipment in channels, and fines and penalties for offences.

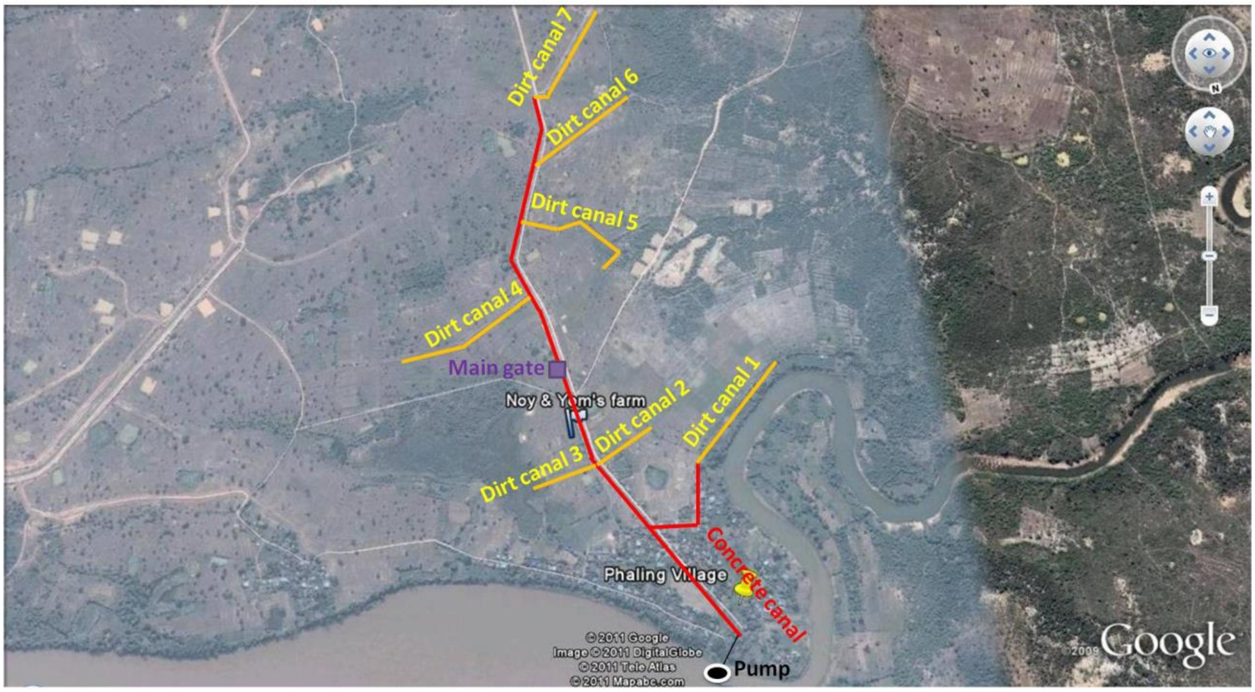


Figure 4.9 Irrigation system in Phaling Village, Phonethong District

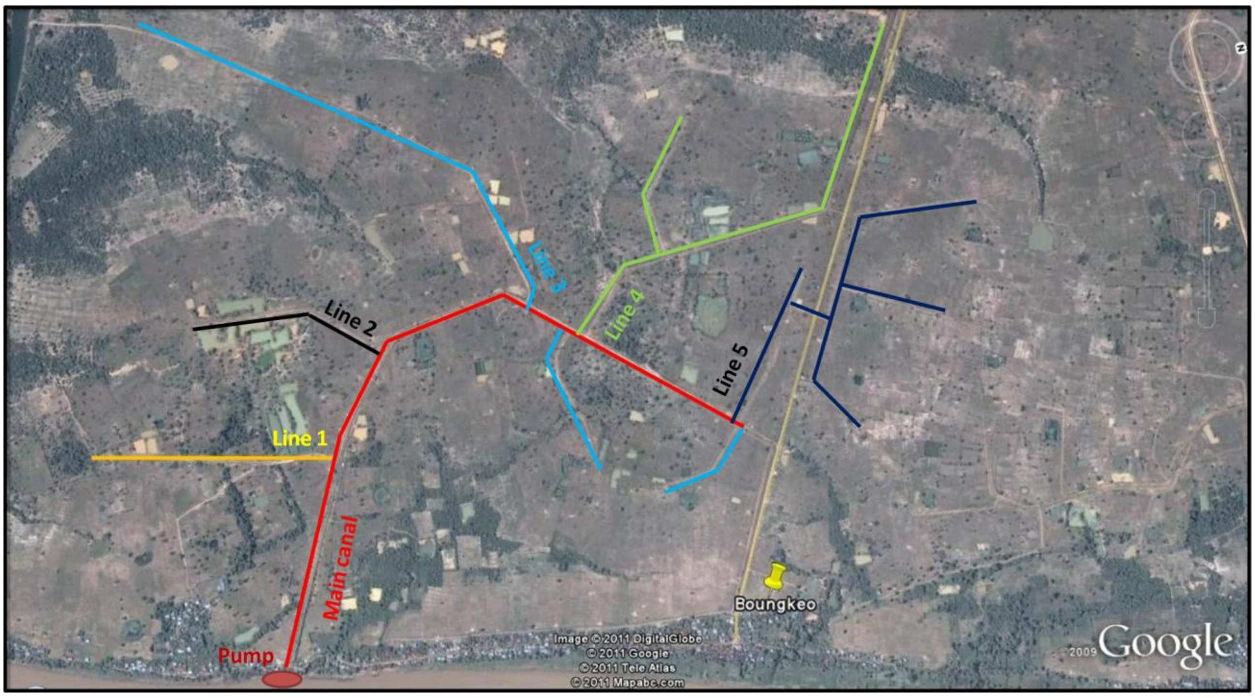


Figure 4.10 Irrigation system in Boungkeo Village, Soukhouma District

An interesting rule in both villages states that any farmer having a paddy field with access to irrigation who does not cultivate their field in the dry season has to allow other farmers to grow rice in that land. That is, irrigable paddy fields are prohibited from being left unplanted in the dry season. In Boungkeo the rule includes the sanction that the owners of those paddy fields have to pay the same fee for electricity as those growing irrigated rice if they leave their field unplanted.

The districts and WUGs were also encouraging the diversification of the irrigation system by developing a differential pricing system for rice and non-rice crops. Irrigation for non-rice crops was charged at only 15% of the water fee for growing DS rice in Boungkeo, and 30% in Phaling. Other regulations and management issues in these two irrigated villages are presented in Appendix 1 and 2.

4.5 Conclusion

The analytical framework and tools used for this study were drawn from farming systems economics, agrarian systems analysis, and the rural livelihoods framework. The study area was the major lowland plain straddling the Mekong River in Champasak Province, in particular, the two districts of Phonethong and Soukhouma that varied in accessibility and the incidence of poverty. The emphasis was on discovering how farmers in these districts constructed their livelihoods – from the technical and financial choices of seasonal farm activities, on the one hand, to broad strategic decisions such as whether to deploy household workers on the farm or migrate long-term to

Thailand, on the other. This involved eliciting quantitative and qualitative data as far as possible from the farmers themselves. The methods for data collection included district-level consultation and village zoning, village reconnaissance surveys, household surveys, household case studies, small-group interviews, and direct observation. Descriptive and statistical analyses were undertaken, with an emphasis on developing meaningful enterprise and farm budgets that reflected the strategies and circumstances of subsistence farm households undergoing an agrarian transition to more commercialised and diversified livelihoods, taking account of the variability in yields, prices, and costs through sensitivity, threshold, and risk analyses. These varying kinds of data analysis are presented in the following chapters, focusing first and in most detail on rice cropping systems in Chapter 5, on other farm and resource-based activities in Chapter 6, on the economic analysis of farming choices in Chapter 7, and on off-farm and non-farm activities in Chapter 8. Chapter 9 then assesses the contribution of these varying activities to livelihood trajectories and outcomes.

5 RICE CROPPING SYSTEMS

5.1 Introduction

The cultivation of paddy rice remains an important livelihood activity for the majority of households in the lowlands of Laos and forms the platform on which household decisions about rural livelihoods are based. Decisions regarding labour utilisation and migration, livestock management, even religious and cultural festivals, are all made with reference to the paddy production cycle. Lowland households strongly identify with paddy rice production and will typically answer questions regarding their employment or livelihood by saying they are “paddy rice farmers” (*sao na*) or they “grow paddy rice” (*hed na*), despite the diversity of farm and non-farm activities in which they are engaged.

This chapter first analyses wet season (WS) rice production. An account is given of the practices related to rice cultivation and the adoption of new technologies, with the main focus on a comparison between households in different village types and districts. The chapter then analyses rice farming in the dry season (DS) for those households with access to irrigation. Finally, household rice status is elaborated, with particular reference to household strategies with regard to producing rice for sale, producing rice exclusively for home consumption, or buying rice to cover a production deficit.

5.2 Rice farming practices and adoption of new technologies in the wet season

5.2.1 Use of paddy land

Household access to paddy land varied within and between villages. About 81% of the survey households owned paddy land (i.e., bunded fields capable of retaining water for wet rice cultivation), with a mean area of 2.4 hectares, ranging from 0.2 to 10 hectares; there was no significant difference in land ownership between districts or villages (Table 5.1). There was a high level of utilisation of this paddy land, again across all the villages. In the 2010 wet season (WS 2010), the majority of households with paddy land (71%) planted rice in all their land, while a further 10% rented additional paddy land to grow rice. About 19% of paddy-land owners rented out some or all of their paddy land or left some or all of it unplanted. The households with no paddy land had not inherited any or had sold the land they owned, but 94% of these households rented paddy land from others to grow rice while only 6% (2 households) did not grow rice.

Table 5.1 Use of paddy land in WS 2010 by households owning paddy land (% of households)

Use of paddy land	D1			D2			Total (n=145)
	V1 (n=24)	V2 (n=23)	V3 (n=22)	V1 (n=23)	V2 (n=27)	V3 (n=26)	
1. Grew rice in all own paddy land	79.1	65.3	72.6	65.1	70.4	73.0	**71.0**
2. Grew rice in all own paddy land and rented paddy land to grow rice	12.5	17.4	13.6	8.7	3.7	3.9	**9.7**
3. Grew rice in part of own paddy land and left part unplanted	-	-	4.6	4.4	14.8	3.9	**4.8**
4. Grew rice in part of own paddy land, left part unplanted, and rented paddy land to grow rice	-	-	-	4.4	-	-	**0.7**
5. Grew rice in part of own paddy land, left part unplanted, and rented out part	-	-	-	4.4	-	-	**0.7**
6. Grew rice in part of own paddy land and rented out part	-	13.0	4.6	13.0	7.4	11.5	**8.3**
7. Left all own paddy land unplanted	4.2	-	-	-	-	7.7	**2.0**
8. Left all own paddy land unplanted and rented paddy land to grow rice	4.2	-	-	-	3.7	-	**1.4**
9. Rented out all own paddy land	-	4.3	-	-	-	-	**0.7**
10. Rented out all own paddy land and rented paddy land to grow rice	-	-	4.6	-	-	-	**0.7**

5.2.2 Rice varieties

According to a recent report on rice policy in Laos, the adoption of improved or modern varieties (MV) has been the single most important factor in achieving significant productivity increases since the 1990s (Eliste and Santos, 2012). The first MVs were released in Laos in the 1970s, and over the past two decades there has been widespread adoption. Farmers in the study area have widely adopted MVs, gradually replacing the traditional varieties (TV). Indeed, the majority of households now grow at least one MV that has come out of breeding programs in Laos or neighbouring countries,[1] with the area of traditional cultivars diminishing. The adoption of MVs has occurred at

[1] Thai varieties such as RD6 were common in lowland areas of Champasak.

similar rates among different farm size classes (Fig. 5.1). The impact of various projects can be seen in years (such as 2000) where significant jumps in adoption occurred.

The number of years growing MVs varied considerably from only a few years to over 20 years, averaging about seven years. Around one-third of the households had adopted MVs for over ten years and another one-third had grown MVs only within the last four years (Fig. 5.2). Early adopters of MVs normally obtained the seeds from District Agriculture and Forestry Offices (DAFOs) or rural development projects. Most farmers reported that they obtained the MVs through exchange with other farmers within the village or in other villages, and then kept those MVs to grow each year. Growing the same rice varieties from the same seed stock for many years without obtaining new seed results in little yield improvement.

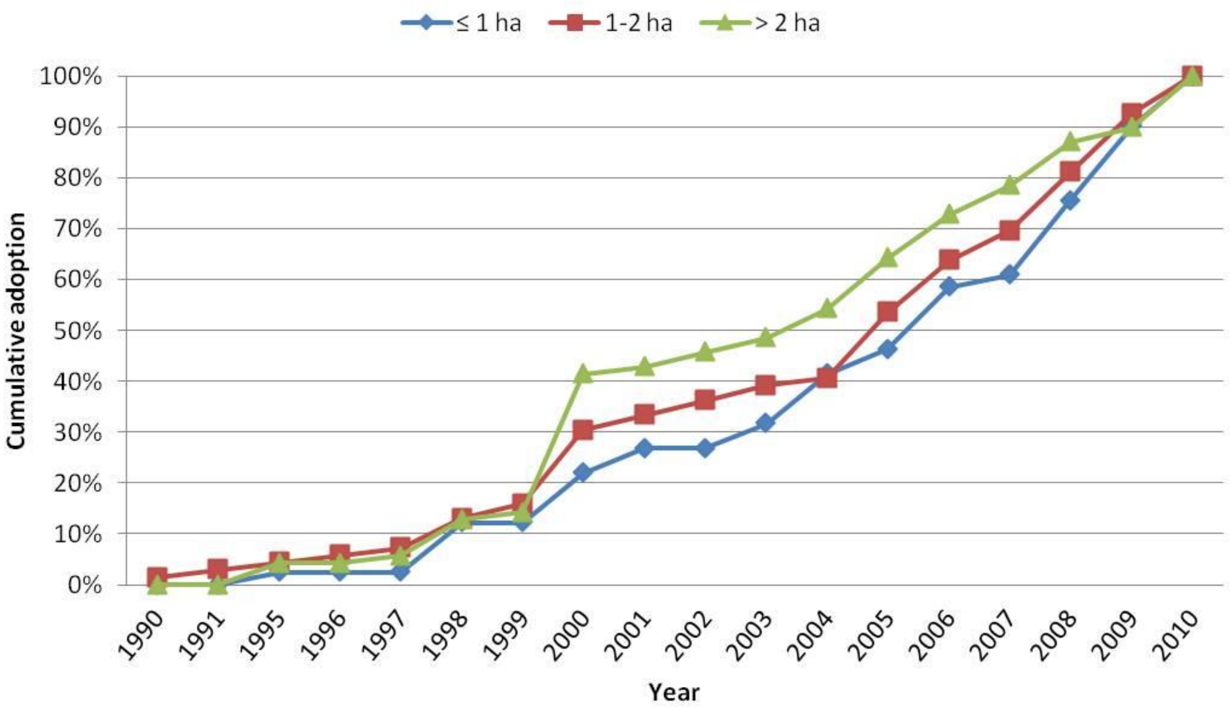


Figure 5.1 Cumulative adoption of MVs by survey households, by paddy area

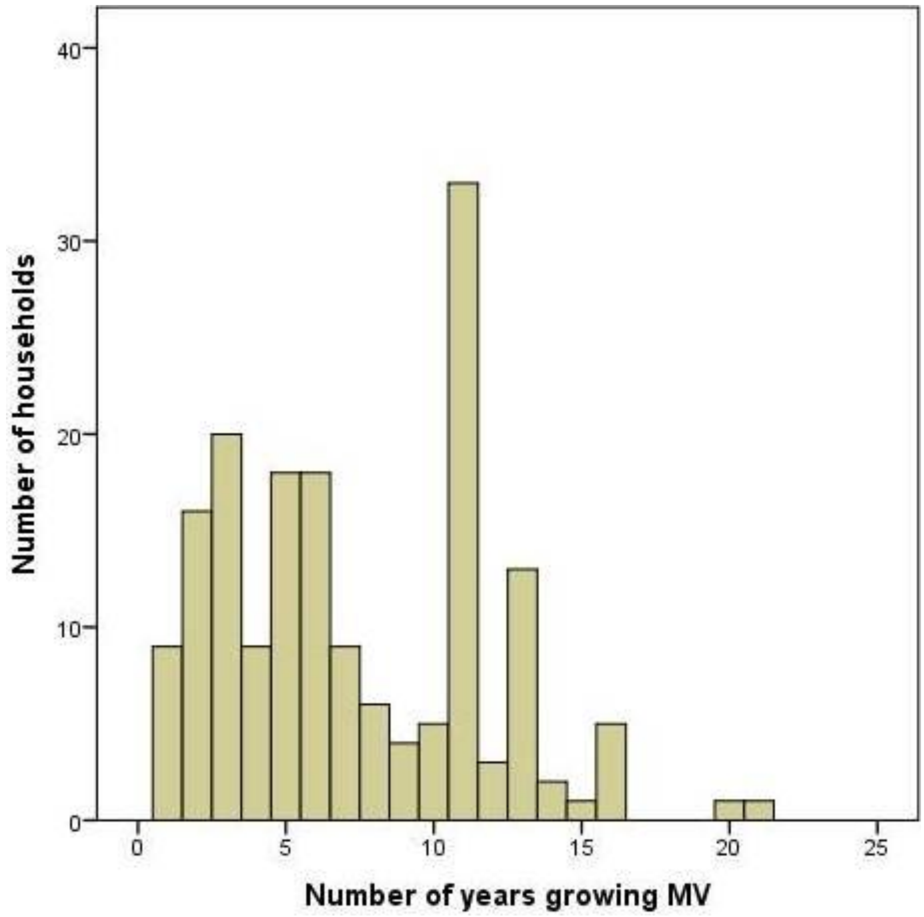


Figure 5.2 Distribution of households by number of years growing MVs

Farmers differed in whether they planted MVs only, TVs only, or a mixture of MVs and TVs. Over 90% of the households who grew rice in WS 2010 used only MVs. The rest planted only TVs or a combination of MVs and TVs. All the survey households in three of the six villages (V2-D1, V1-D2, and V2-D2) grew only MVs. However, around 21% of the farmers in None Phajao (V3-D1), the remote village with no irrigation, still grew only TVs. About 7% of the households who grew rice in WS 2010 in the two villages (V1-D1 and V3-D2) planted rice with both MVs and TVs (Table 5.2).

Farmers normally grew many rice varieties to reduce risk and spread the labour requirement for harvesting. Only a fifth (21%) of the farm households growing rice in WS 2010 planted only one variety, while almost half planted two varieties and 17% planted three varieties. Around 13% grew four or more varieties (Fig. 5.3).

Table 5.2 Percentage of households growing MVs and TVs in WS 2010

	D1			D2			Total (n=173)
	V1 (n=28)	V2 (n=29)	V3 (n=29)	V1 (n=29)	V2 (n=30)	V3 (n=28)	
MVs only	92.9	100.0	65.5	100.0	100.0	92.9	**91.9**
TVs only	0.0	0.0	20.7	0.0	0.0	0.0	**3.5**
Both MVs and TVs	7.1	0.0	13.8	0.0	0.0	7.1	**4.6**

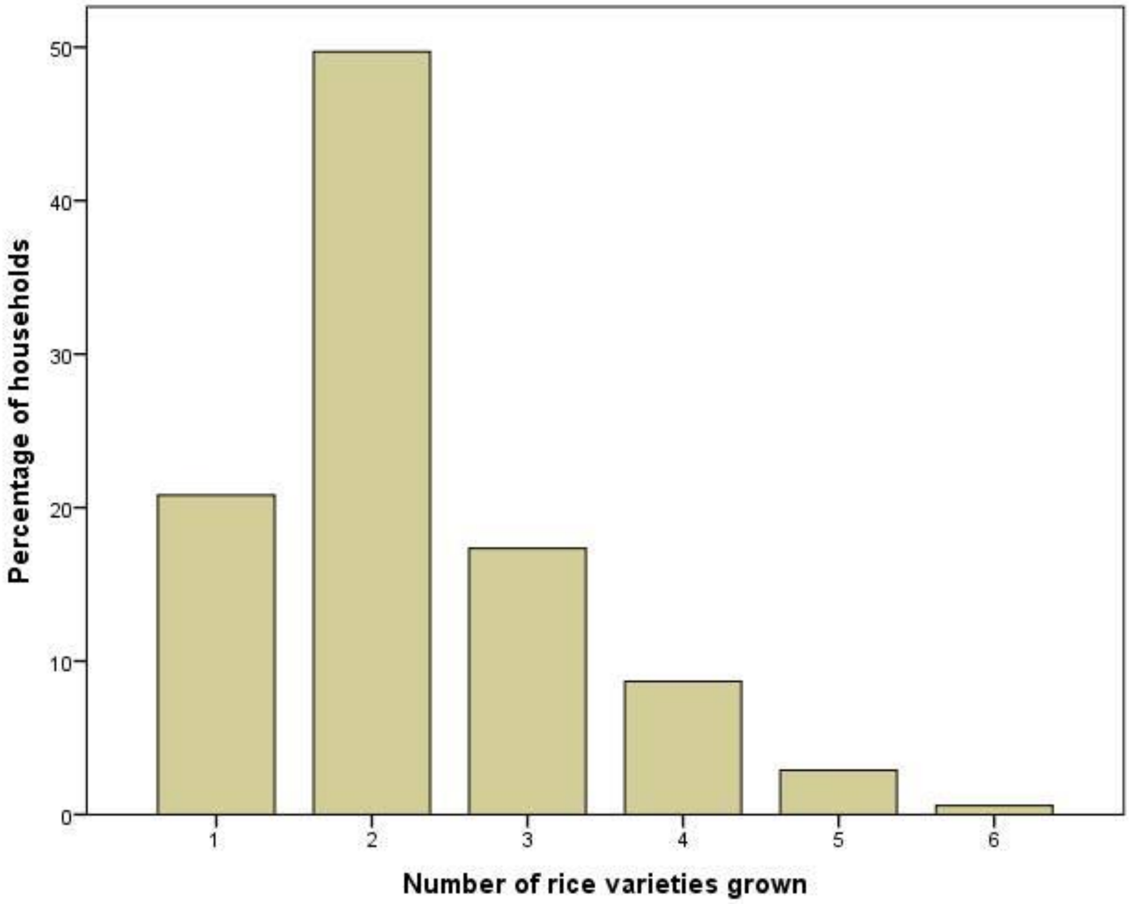


Figure 5.3 Distribution of households by number of rice varieties grown in WS 2010

The most widely grown rice varieties in the survey villages in WS 2010 were PNG1, PNG3, and PNG5, which were released from the local rice research and seed multiplication centre – Phong Ngam Station (Table 5.3). All of these varieties are glutinous, which is traditionally the preferred staple. However, more recently a range of non-glutinous varieties (*Khao Jao 15, Khao Jao Mali*, and *Khao Jao Homsavan*) have been grown by farmers for both consumption and for the market, where they typically receive a better price. In some cases, private-sector mills are providing extension and seed to encourage farmers to plant non-glutinous varieties specifically for export markets. A small proportion of farmers still planted older, glutinous Thai varieties (RD6, RD8, RD10) as well as TVs such as *Sunpatong* and *Eloub*. It should be noted that while many farmers knew exactly the names of MVs such as the PNG, TDK, and RD series, some farmers used local names instead of the MV name, or replaced the number of the MV series with the local terms representing the maturity period (short, medium, long). The names used by farmers were recorded but consultations were undertaken with other knowledgeable villagers and DAFO staff who worked as enumerators to get the most accurate names of the MVs. Table 5.3 also presents the proportion of area and the average area grown with each rice variety. Farmers planted almost half their total rice area with PNG1 or PNG3 or PNG5, each averaging around one hectare.

Table 5.3 Incidence of rice varieties grown in WS 2010

Variety names	**Type of variety**	**% of households growing each variety***	**% of area under each variety ***	**Average area under each variety* (ha)**
PNG1	Lao glutinous MV	57.8	49.0	1.01
PNG3	Lao glutinous MV	49.4	50.2	0.95
PNG5	Lao glutinous MV	27.8	49.6	1.15
TDK1	Lao glutinous MV	13.9	45.9	1.12
TDK7	Lao glutinous MV	3.3	45.8	1.11
TDK8	Lao glutinous MV	2.2	43.8	1.14
TDK11	Lao glutinous MV	1.7	31.9	0.92
RD6	Thai glutinous MV	2.8	31.7	0.94
RD8	Thai glutinous MV	1.7	26.0	0.82
RD10	Thai glutinous MV	5.0	41.4	1.98
Khao Jao 15	Thai non-glutinous MV	6.7	16.8	0.64
Khao Jao Mali	Thai non-glutinous MV	2.2	28.6	0.79
Khao Jao Homsavan	Lao non-glutinous MV	1.7	19.6	0.52
Sunpatong	Lao glutinous TV	2.2	21.1	0.73
Eloub	Lao glutinous TV	2.2	19.0	0.61

Note: * including multiple responses

In 2010 farmers grew mostly MVs while over a decade before farmers generally grew TVs combined with MVs. Fig. 5.4 compares the results of this survey with a survey in 1996 reported by Pandey and Sanamongkhoun (1998). The proportion of households in Phonethong District (D1) growing only MVs rose from only 1% in 1996 to 86% in 2010 while the proportion growing only TVs declined from 39% to 7%. The proportion of households growing both MVs and TVs dropped from 60% to 7%. Similar trends occurred in Soukhouma District (D2). Only 2% of households grew only MVs in 1996 compared to almost 98% in 2010, and 41% grew only TVs in 1996 but none did so in 2010. About 57% of households planted both MVs and TVs in 1996 whereas only 2% did so in 2010.

The proportion of area planted with MVs in the WS increased from 20% in 1996 to 91% in 2010 in Phonethong District. Similarly, the proportion of area rose from 17% in 1996 to 98% in 2010 in Soukhouma District. The average areas grown with MVs were not reported for 1996 but the average figures in 2010 were 2.5 hectares in Phonethong District and 1.8 hectares in Soukhouma District. This represents a rapid and large-scale adoption of MVs. This is comparable with other lowland areas of Laos, where before 1993 (the year in which several improved Lao glutinous varieties were released) almost all cultivation of lowland WS rice was based on the use of traditional varieties (Inthapanya et al., 2006).

The 1996 survey (which also included Khongxedon and Vapi Districts in Saravan Province) by Pandey and Sanamongkhoun (1998) revealed that the two most popular TVs grown at that time were *Eloub* and *Do Khao*. About 51% and 20% of farmers grew *Eloub* and *Do Khao* respectively and they accounted for around 20% and 5% of the total area planted with TVs. The two most widely grown MVs were RD6 and RD8, which were planted by 45% and 13% of farmers, respectively, and accounted for 65% and 17% of the total area under MVs. As Table 5.3 shows, these varieties are now of little importance as more local Lao MVs were released and adopted.

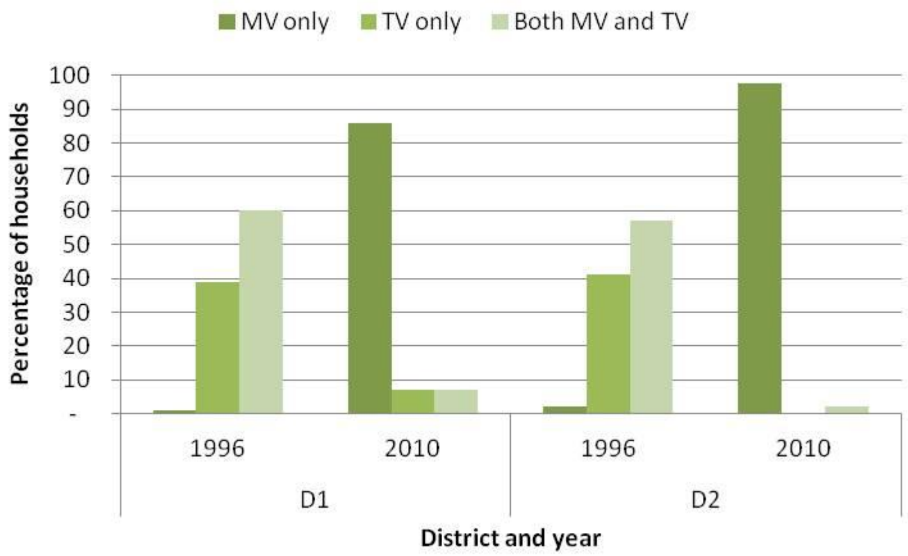


Figure 5.4 Percentage of households growing MVs and TVs in WS 1996 and 2010
Sources: 1996 from Pandey and Sanamongkhoun (1998), 2010 from author’s survey

Oupalath Village (V2-D1) has had a long history of research projects and interventions aimed at improving the productivity of rice farming systems, including the promotion of modern varieties and the use of inorganic fertilisers. Survey data reported by Schiller et al. (1999) on the use of MVs in 1994 and 1998 in this village are presented in Fig. 5.5, which also displays the survey data for 2010. Modern varieties were grown on only 29% of cultivated area in 1994, compared to 87% in 1998. In WS 2010, all farmers interviewed in Oupalath grew only MVs. The average area planted with MVs also increased from 0.6 hectare in 1994 to 1.7 hectares in 1998 and 2.4 hectares in 2010. The two most popular rice varieties grown in 1994 were *Eloub* and *Angdo* (both traditional varieties), PNG1 and PNG2 in 1998, and PNG3 and PNG1 in 2010. These varieties were among a number of MVs released from the local research station in Champasak Province and promoted by research projects in this village. About 93% and 76% of farmers grew PNG3 and PNG1 in their paddy fields in WS 2010 and over 40% of the area was planted with each of these varieties (Table 5.4).

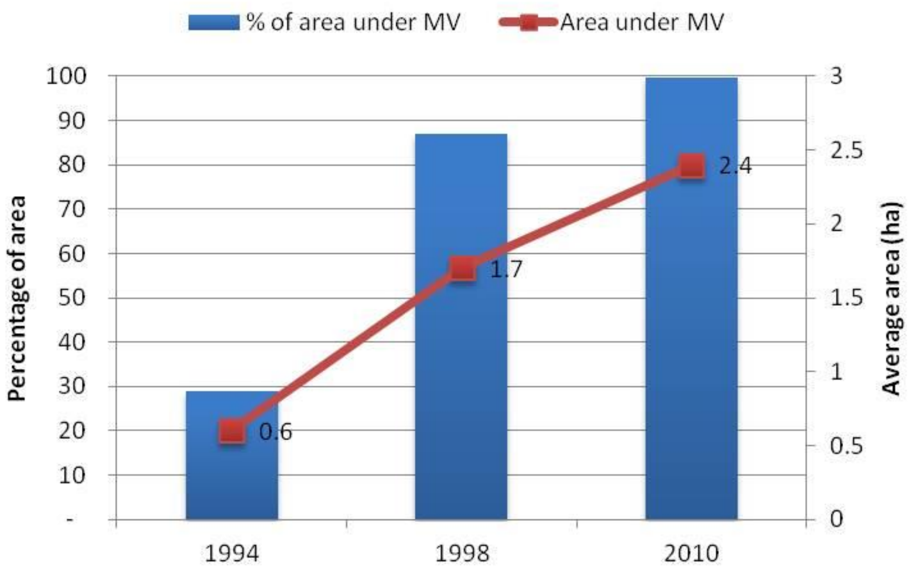


Figure 5.5 Percentage of area and area grown with MVs in WS 1994, 1998, and 2010 in Oupalath
Sources: 1994 and 1998 from Schiller et al. (1999), 2010 from author's survey

Table 5.4 Most commonly grown rice varieties in Oupalath in WS 1994, 1998, and 2010

	% of farmers growing					% of area planted with				
	Eloub	*Angdo*	PNG1	PNG2	PNG3	*Eloub*	*Angdo*	PNG1	PNG2	PNG3
1994	71	61	-	-	-	24	12	-	-	-
1998	7	-	96	51	-	2	-	45	16	-
2010	-	-	76	-	93	-	-	44	-	40

Sources: 1994 and 1998 from Schiller et al. (1999), 2010 from author's survey

5.2.3 Crop establishment

Before preparing the seed bed, farmers normally waited until there was enough water in the paddy fields, normally requiring 4-5 rain events, and also waited for each other (coordinated through a village meeting) so there would be no problem of livestock destroying the rice seedlings in the nursery. In addition to rain, farmers in None Phajao also waited until the ritual of feeding the village spirit had been completed.

When rice seedlings were from 20 to 25 days old, they were pulled out and transplanted. Farmers also waited for others before transplanting their rice seedlings, this time to avoid livestock destroying the rice crop in the field. In normal years there was enough water in the paddy fields at this stage. However, due to the late arrival of rain in WS 2010, about 72% of the households growing rice transplanted older rice seedlings (and 17% of these households planted more seedlings per hill), while around 36% re-established seed beds (Table 5.5). Significant differences at the $p<0.05$ level were found in the proportion of households that transplanted old rice seedlings between villages in D2 (the highest proportion was found in Hieng (V3-D2)) and in the proportion of households that re-established seedbeds between villages in D1 (the highest proportion was found in Oupalath (V2-D1)). The reasons for these differences were not immediately obvious.

Table 5.5 Incidence of changes in planting practice in response to late rain in WS 2010 (% of households)

	D1			**D2**			**Total (n=173)**
	V1 (n=28)	**V2 (n=29)**	**V3 (n=29)**	**V1 (n=29)**	**V2 (n=30)**	**V3 (n=28)**	
Transplant old seedlings	82.1	72.4	79.3	41.4	70.0	85.7	**71.7**
Plant more seedlings per hill	34.8	28.6	-	-	23.8	8.3	**16.9**
Re-establish seed bed	32.1	69.0	24.1	34.5	26.7	28.6	**35.8**

Some farmers implemented other strategies in response to late rain in WS 2010. Three households (two in None Phajao and one in Hieng) bought seedlings from others in the village. Four households (one in Phaling and three in None Phajao) asked for seedlings from others in the village. Two households in Khoke Nongbua planted young seedlings (18 days old) because they were afraid of drought and another household in the same village prepared the seed bed late to be able to transplant when the rain came. Farmers in the irrigated villages who were able to access the irrigation system (two households in Phaling and four households in Boungkeo) irrigated their paddy fields so they could plant the seedlings on time, that is, at the appropriate age.

In terms of planting techniques, almost all the survey households planted their rice by transplanting; only a few households had tried other planting techniques, including broadcasting, direct seeding, or the system of rice intensification (SRI).[2] In 2010, one household in Oupalath and another in Boungkeo planted rice following the SRI technique, as well as using conventional transplanting. The household in Oupalath experimented by using SRI in a small area as part of the Smallholder Development Project [3], and planned to continue trialling this technique in the subsequent WS. The household in Boungkeo also planted by SRI over 0.3 hectare in DS 2011-12, after producing a reasonable yield with this technique in the WS. One household in Phaling tried planting by broadcasting in addition to transplanting in WS 2009 because of limited family labour (the household head and spouse were vegetable traders and the children were attending school) but they returned to transplanting by hiring labour to help them in WS 2010. This household said that in WS 2011 they would plant rice by broadcasting in all 2 hectares as it was easier; they would also apply more inorganic fertilisers. Another household in Phaling tried planting by broadcasting in addition to transplanting in 2007 but stopped doing so because of low production. Another household in Boungkeo had tried planting by direct seeding in 2008 and 2009 but stopped in 2010 because of low production due to excessive weeds. Another household in this village planted rice by direct seeding and broadcasting, as well as transplanting, in 2008 but stopped doing so for the same reason. It is clear that there is not yet a strong momentum towards direct seeding, as has occurred across the border in northeast Thailand.

5.2.4 Inorganic fertilisers

Soil fertility has long been recognised as one of the major constraints to rice production in Laos. The soils throughout the main lowland rice-growing areas in the central and southern plains have been described as generally infertile, highly weathered, old alluvial deposits that comprise a series of low-level terraces with an elevation of about 200 m above sea level (Lathvilayvong et al., 1997). Previous studies have identified nitrogen as the most limiting nutrient in all regions of the country. In much of the central and southern regions, phosphorus deficiency is also critical. Potassium is the least limiting of the three tested nutrients in the central and southern regions, yet the need for

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[2] SRI is an agro-ecological technique for increasing the productivity of rice by modifying the management practices of plants, soil, water and nutrients (Uphoff et al., 2011).

[3] Funded by an Asian Development Bank loan and some contribution from the Government of Laos, the project aims to promote sustainable small-scale commercial agriculture and associated agribusiness in order to achieve sustained increases in rural incomes and long-term reductions in rural poverty in Laos. The project covers 16 districts of four provinces – Vientiane, Khammouane, Savannakhet, and Champasak (LAFE, 2013).

potassium inputs is expected to increase as production is increased through double cropping or as rice yields increase through changes in management (Schiller et al., 2001).

The use of both organic and inorganic fertilisers has been promoted in Laos for many years. Linquist and Sengxua (2001) developed broad fertiliser recommendations based on fertility management research throughout the country. Their recommendations recognised that the rainfed lowlands constitute a risky environment for crop production, hence obtaining maximum yields was not the objective of these recommendations. Rather, recommendations were formulated that required relatively low investment and used nutrients with maximum efficiency. Their recommendations were based on the three fertilisers that are more widely and readily available, namely, 16-20-00, 15-15-15, and 46-00-00 (referring to the percentages by weight of N-P_2O_5-K_2O). For the first year of application, the recommendation is to apply 60-[?]-30 kg/ha of N-P_2O_5-K_2O, with the recommended P_2O_5 rate varying according to soil texture. The rate of N recommended is lower than that required for maximum yields and reflects the risk facing farmers in the rainfed environment. Higher rates of 90-120 kg/ha of N usually result in higher yields but only under good growing conditions. The recommended rate of P_2O_5 is 20 kg/ha in sandy soils, 30 kg/ha in sandy loam soils, and 45 to 60 kg/ha in loams and clay loams. In the second and subsequent years, the recommendation is modified to account for P_2O_5 added in the first season that was not removed by the crop as less than 50% of the P_2O_5 applied in the first year is removed. This residual P_2O_5 is available to the plant in the following season. Therefore, only the amount of P_2O_5 that was removed by the previous crop needs to be applied. The amount of P_2O_5 removed by the crop is determined by the yield and is approximately 6 kg P_2O_5 per tonne of grain yield, depending on straw management. For example, if yields are 3 t/ha on a sandy loam soil, a further 18 kg P_2O_5 per hectare need to be applied in the second year. While most soils in Laos are not K_2O-deficient, the use of N and P_2O_5 fertilisers without K_2O will most likely lead to K_2O deficiencies over time. This is especially the case for sandy soils, which typically have low K_2O reserves. Therefore, applying K_2O and/or returning crop residues is recommended for sustainable systems.

The use of inorganic fertilisers has traditionally been limited in the rainfed lowlands of Laos. Surveys by Villano and Pandey (1998) for the 1996 WS crop in Champasak and Saravan Provinces found that 66% of households were using some chemical fertiliser and 48% of the area was fertilised. Of those applying fertiliser, about 54% did so both to the seedbed and the main field, 16% only to the main field, and 30% only to the seedbed. However, in recent years an increasing number of farmers are applying some inorganic fertilisers to their rice. Around 87% of the households growing rice in WS 2010 used inorganic fertilisers (Table 5.6). The proportion of households applying inorganic fertilisers in most villages was around the mean figure, rising to 100% in Oupalath (V2-D1) and falling to 69% in None Phajao (V3-D1). Significant differences at the $p<0.05$ level in the proportion of households applying inorganic fertilisers were found between villages in D1. As mentioned earlier in Section 5.2.2, a long history of involvement with research projects in Oupalath is probably the reason for it having the highest proportion of households applying inorganic fertilisers, whereas the poverty and remoteness of None Phajao is possibly the cause for the significantly lower proportion of households applying inorganic fertilisers there.

While the percentage of households using inorganic fertiliser has increased significantly, the level of use remains well below recommended rates. Table 5.6 presents the average N-P_2O_5-K_2O rates for each village. The average usage rates of nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O) across all the survey villages were around 17 kg/ha, 12 kg/ha, and 3 kg/ha, respectively. However, there were wide variations between villages. The application rates of N were about 26 kg/ha in Oupalath (V2-D1) but just over 4 kg/ha in None Phajao (V3-D1). The highest rate of P_2O_5 was found in Boungkeo (V1-D2) (almost 24 kg/ha) while the lowest rate was again nearly 4 kg/ha in None Phajao. The usage rate of K_2O ranged from 0.2 kg/ha in Hieng (V3-D2) to 5.7 kg/ha in Khoke Nongbua (V2-D2). Significant differences at the $p<0.05$ level in the mean phosphorus use were found between districts, but not so in the mean nitrogen and the mean potassium use. At the village level, there were significant differences between villages in each district at the $p<0.05$ level in the mean figures of those application rates.

Across all the surveyed villages, the lowest rate of adoption was in the relatively remote village of None Phajao. This village had some of the lowest rice yields in the survey. The overall average application rates of 17-12-3 kg/ha of N, P_2O_5, and K_2O in the survey villages were well below the conservative recommendation developed by Linquist and Sengxua (2001). The limited use of fertiliser reflects the high cost of purchasing inputs, the limited access to credit, the high level of production risk, and the market uncertainty should a surplus be produced in this village. Physical access, counterfeit products, and limited knowledge about appropriate rates and timing contributed to the problems faced by farmers in all the survey villages.

Table 5.6 Inorganic fertiliser application for rice production in WS 2010

	D1			D2			Total
	V1 (n=28)	**V2 (n=29)**	**V3 (n=29)**	**V1 (n=29)**	**V2 (n=30)**	**V3 (n=28)**	**(n=173)**
Percentage of households applying inorganic fertilisers (%)	92.9	100.0	69.0	93.1	80.0	89.3	**87.3**
Mean nitrogen (N) use (kg/ha)	18.8 (n=26)	26.2 (n=29)	4.4 (n=20)	24.1 (n=27)	19.1 (n=24)	7.3 (n=25)	**17.4 (n=151)**
Mean phosphorus (P_2O_5) use (kg/ha)	8.4 (n=26)	12.0 (n=29)	3.9 (n=20)	23.6 (n=27)	14.5 (n=24)	7.8 (n=25)	**12.1 (n=151)**
Mean potassium (K_2O) use (kg/ha)	4.4 (n=26)	2.6 (n=29)	0.8 (n=20)	3.6 (n=27)	5.7 (n=24)	0.2 (n=25)	**3.0 (n=151)**

The distribution of N rates varied with the size of the paddy (Fig. 5.6). While households with 1 hectare or less were less likely to be using inorganic fertiliser, if they did use it they were likely to apply more N per hectare than those with larger areas. It should be noted that these average amounts assume that farmers spread the fertiliser equally across their paddy fields. In practice, farmers tended to vary their application rates based on previous crop performance and perceived risk. Fig. 5.6 suggests that households with larger areas required less fertiliser to meet their self-sufficiency goals and lacked the economic incentive to lift production further, and/or that households had a limited budget for fertiliser purchases.

The most common type of inorganic fertilisers used by rice-growing households in WS 2010 was the product with an analysis of 16-20-00 (56%) followed by 15-15-15 (20%), 16-08-08 (12%), and 46-00-00 (10%). Other kinds of inorganic fertilisers were used by only 2% of the households (Fig. 5.7). All of the fertilisers were from Thailand. The fertiliser with analyses of 16-20-00 and 16-08-08 were *Hua Ngua Khun Thai* brand, while those with 15-15-15 and 46-00-00 were *Ka Tay* brand. Some farmers used only one type of inorganic fertiliser, e.g. 16-20-00, while others used more than one. About 54% of the households using inorganic fertiliser applied only one type, 41% applied two types, and only 5% applied three types.

A wide range of fertility management strategies was used, including only applying fertiliser to seedlings and various combinations of basal applications and topdressing (Fig. 5.8 and Table 5.7). About 9% of households using inorganic fertilisers applied fertilisers to the seedbed only, 15% to the rice field (basal dressing) only, and 4% to the transplanted rice crop only (topdressing). Nearly half used some combination of two of these application types, while around 27% used all three (Table 5.7). This means over 91% of households applied inorganic fertiliser to their paddy fields. Some who applied inorganic fertilisers to the seedbed only gave as their reasons that their paddy soil was sandy or turned hard from using inorganic fertilisers, hence they applied no fertilisers to their paddy land, whether basally or as a topdressing.

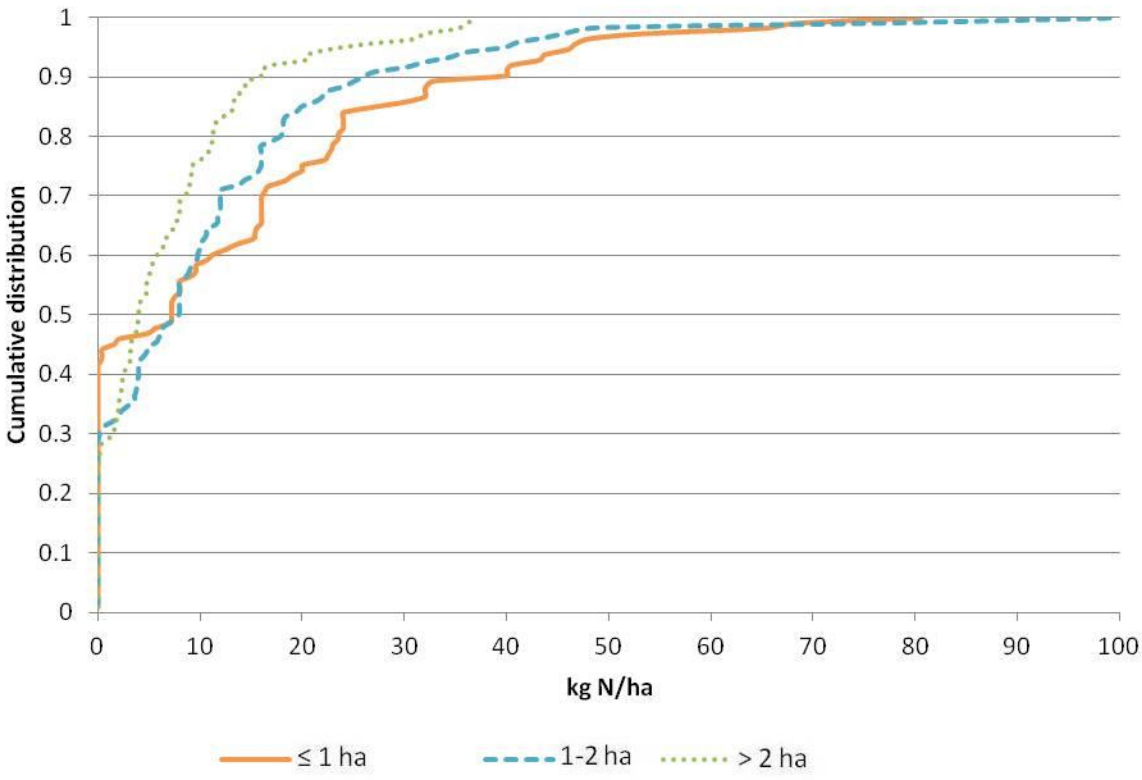

Figure 5.6 Cumulative distribution of N application rate by paddy area

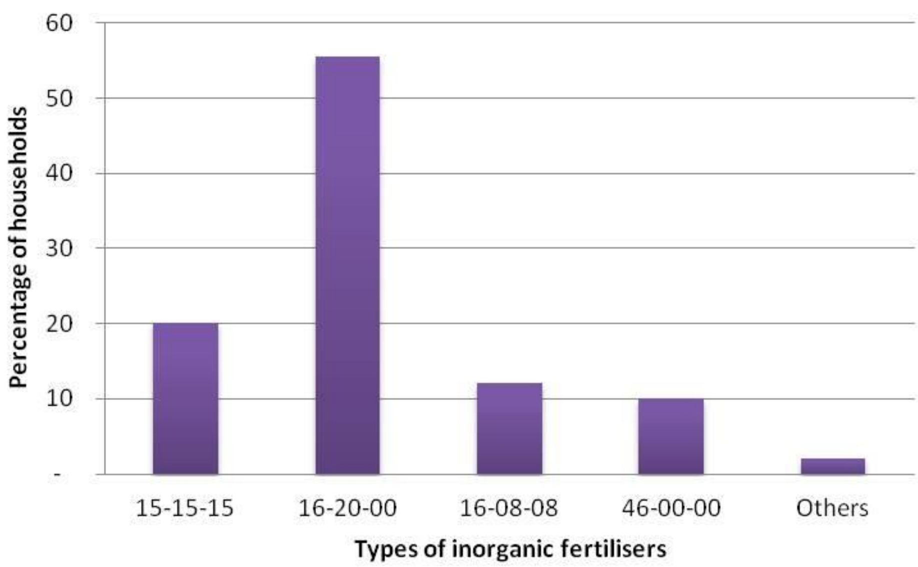

Figure 5.7 Incidence of different types of inorganic fertilisers used in WS 2010
(including multiple responses)

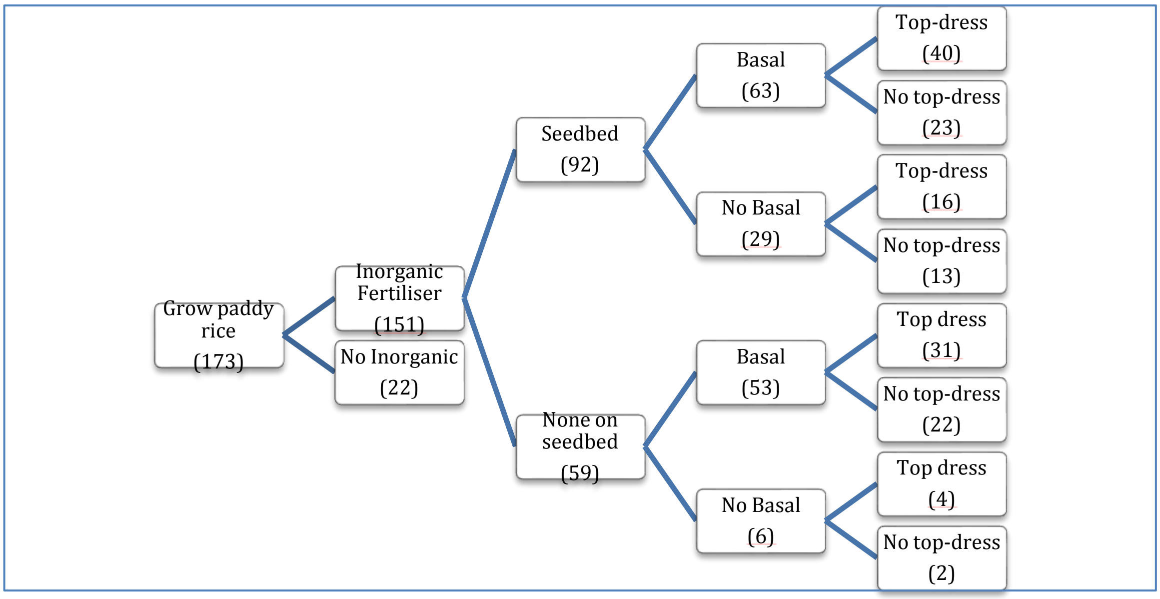

Figure 5.8 Use of inorganic fertilisers by households growing paddy rice in WS 2010 (no. of households)

Table 5.7 Incidence of inorganic fertiliser use for rice production in WS 2010 (% of households using fertiliser)

	D1			D2			Total (n=151)
	V1 (n=26)	V2 (n=29)	V3 (n=20)	V1 (n=27)	V2 (n=24)	V3 (n=25)	
Seedbed only	3.9	0.0	35.0	0.0	4.2	16.0	**8.6**
Basal only	3.9	6.9	20.0	18.5	16.7	24.0	**14.6**
Topdressing only	0.0	6.9	0.0	11.1	4.2	0.0	**4.0**
Seedbed and basal	11.5	0.0	10.0	22.3	20.8	28.0	**15.2**
Seedbed and topdressing	7.7	6.9	30.0	11.1	0.0	12.0	**10.6**
Basal and topdressing	11.5	37.9	0.0	18.5	37.4	12.0	**20.5**
All of the above	61.5	41.4	5.0	18.5	16.7	8.0	**26.5**

On average, almost two sacks (50 kg per sack) of inorganic fertilisers were applied per hectare for rice production. For different types of application, just over one sack of inorganic fertiliser was applied to paddy land as a basal application and the same amount was used on the transplanted rice crop (topdressing). Around 10 kg of inorganic fertilisers were used on the seedbed (Table 5.8). No significant differences at the $p<0.05$ level were found between districts; however, there were big differences between villages in the amount of inorganic fertilisers used. Farmers in the remote villages (V3) in both districts used about half a sack per hectare while those in other villages applied more, around two sacks per hectare, except Boungkeo where over two sacks were used.

Questions were asked about farmers' knowledge of fertiliser usage rates. Around 38% of the survey households reported they knew the recommended fertiliser application rate for their location, whereas 50% said they did not know and 12% were unsure about such recommended rates. Among those who knew the recommended rates, there was wide variations in the rates actually applied, ranging from only one sack per hectare to six sacks per hectare. This may indicate that information regarding fertiliser application should be made more widely available to farmers, in particular those with the ability to purchase fertilisers, so they know how much they should apply.

Table 5.8 Average rate of inorganic fertilisers used for rice production in WS 2010 (kg/ha)

	D1			**D2**			**Total (n=151)**
	V1 (n=26)	**V2 (n=29)**	**V3 (n=20)**	**V1 (n=27)**	**V2 (n=24)**	**V3 (n=25)**	
Seedbed	11.1 (n=22)	6.5 (n=14)	6.5 (n=16)	7.8 (n=14)	17.5 (n=10)	9.9 (n=16)	**9.6 (n=92)**
Basal application	43.4 (n=23)	53.1 (n=25)	24.8 (n=7)	101.2 (n=21)	71.9 (n=22)	36.8 (n=18)	**59.2 (n=116)**
Topdressing	41.0 (n=21)	59.0 (n=27)	33.2 (n=7)	87.0 (n=16)	42.2 (n=14)	30.2 (n=8)	**52.8 (n=93)**
All applications	80.9 (n=26)	103.8 (n=29)	25.5 (n=20)	134.3 (n=27)	97.8 (n=24)	42.5 (n=25)	**83.8 (n=151)**

Around a third of households growing rice in WS 2010 applied inorganic fertilisers fairly evenly across their rice fields, while two thirds applied the fertilisers selectively (or as spot applications). Of those who applied selectively, 30% used more on upper paddy land, 5% used more on lower paddy land, 97% used more on areas recognised as being of poorer soil fertility, and 90% used more on areas where the established crop was not growing well. Some farmers also changed the fertiliser usage depending on rainfall; about half of the households growing rice in WS 2010 used less fertiliser in dry years while the other half did not change their fertiliser usage from year to year. Some of the households with unchanged fertiliser usage were those who used a small quantity of fertilisers, hence they used the same amount even in dry years; if they did not use any, they were afraid they would have no production. Of the households who grew rice in both WS 2010 and DS

2010-11, 52% applied the same quantity of fertiliser in both wet and dry seasons while 48% applied more in the DS.

Over 72% of the households purchased their inorganic fertilisers from the retail shops in the village and the district market (Fig. 5.9). Some households received fertiliser credit from the Agricultural Promotion Bank, a project involving the DAFO, or the local agricultural research station. A few households also bought fertilisers from markets along the border with Thailand. In general, the price of inorganic fertilisers has been increasing gradually each year. For example, a 50 kg sack of the most common compound fertiliser (15-15-15) was sold for around LAK 191,000 and a 50 kg sack of urea (46-00-00) was sold for about LAK 197,000 in Champasak Province in 2007 (MIC, 2007).[4] Based on the survey, the average price of these two fertilisers in WS 2010 was around LAK 250,000 for the compound fertiliser and LAK 220,000 for urea (Table 5.9), a nominal increase of 10 to 30%.

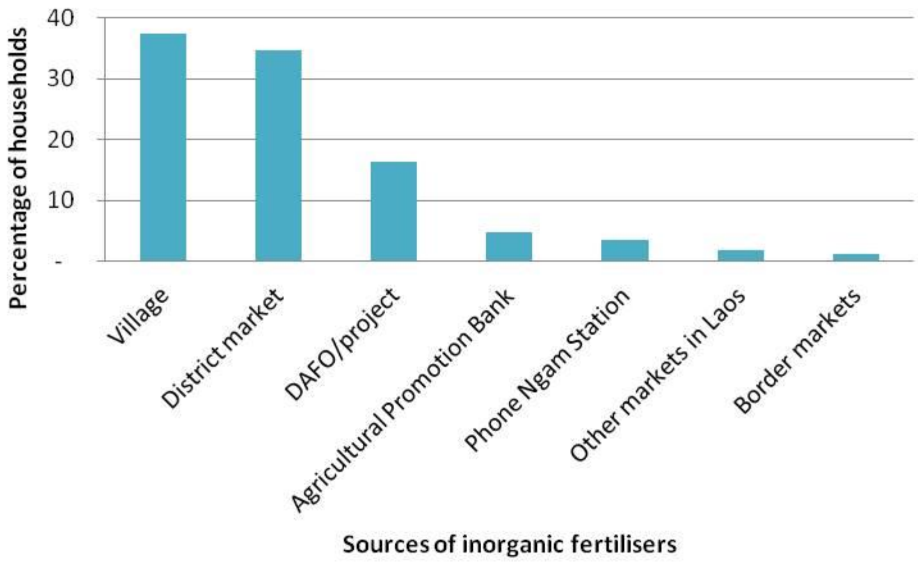

Figure 5.9 Incidence of alternative sources of inorganic fertiliser in WS 2010
(including multiple responses)

Table 5.9 Prices of inorganic fertilisers used by majority of farmers in WS 2010

Types of inorganic fertiliser	Average price (LAK/50 kg sack)
15-15-15	250,000
16-20-00	230,000
16-08-08	220,000
46-00-00	220,000

[4] USD 1 = LAK 8,027 (May 2011)

The proportion of farmers applying inorganic fertilisers to their rice production in Phonethong District increased from 79% in 1996 to 87% in 2010, while the figures for Soukhouma District changed from 57% to 87% in the same period (Table 5.10). Overall, the application rates for nitrogen, phosphorus, and potassium increased in both districts. In Phonethong District the average nitrogen usage increased from nearly 9 kg/ha in 1996 to 18 kg/ha in 2010 but the phosphorus application dropped slightly from around 11 kg/ha to 9 kg/ha over the same period. In Soukhouma District the usage rate for nitrogen increased from around 5 kg/ha to 17 kg/ha and the rate for phosphorus increased from around 6 kg/ha to almost 16 kg/ha. The potassium usage rates increased in both districts. Again, although there has been an increase in the application rates for N, P_2O_5, and K_2O in 2010, the average rates are still lower than the recommended rates.

Table 5.10 Inorganic fertiliser application for rice production in WS 1996 and 2010

	D1		D2	
	1996	**2010**	**1996**	**2010**
Farmers applying inorganic fertilisers (%)	79.0	87.2	57.0	87.4
Mean nitrogen (N) use (kg/ha)	8.6	17.8	4.6	17.0
Mean phosphorus (P_2O_5) use (kg/ha)	10.7	8.6	5.8	15.5
Mean potassium (K_2O) use (kg/ha)	1.5	2.8	0.0	3.2

Sources: 1996 - Pandey and Sanamongkhoun (1998), 2010 - author's survey.

In the case of Oupalath Village, in 2010 all the surveyed farmers reported that they used some inorganic fertilisers. The average nitrogen usage increased from 5 kg/ha in 1994 to 32 kg/ha in 1998 while the rate was nearly 26 kg/ha in 2010. Phosphorus application rose from around 7 kg/ha to 17 kg/ha for the same period (Table 5.11). It should be noted that the data in 1998 included the data for the farmers involved in field trials so the rates were quite high. Nevertheless, comparing the rates in 1994 and 2010 shows the marked increase in application rates of N, P_2O_5, and K_2O in this village.

The main reasons given by the 13% of households that did not use inorganic fertilisers were that they could not afford to purchase the fertilisers (36%) and their perception that their land was still fertile (28%) and as such inorganic fertiliser was not required. Other reasons included the incidence of drought or flood, making the application risky; a perception that fertilisers made the soil hard; and a preference for applying organic fertilisers (Fig. 5.10).

Table 5.11 Inorganic fertiliser application for rice in WS 1994, 1996, and 2010 in Oupalath village

	% of farmers applying inorganic fertilisers	Average application rate (kg/ha)		
		N	P_2O_5	K_2O
1994	na	5.4	6.8	0
1998	na	32.2	16.6	0.02
2010	100.0	26.2	12.0	2.6

Note: na = not available

Sources: 1994 and 1998 - Schiller et al. (1999), 2010 - author's survey

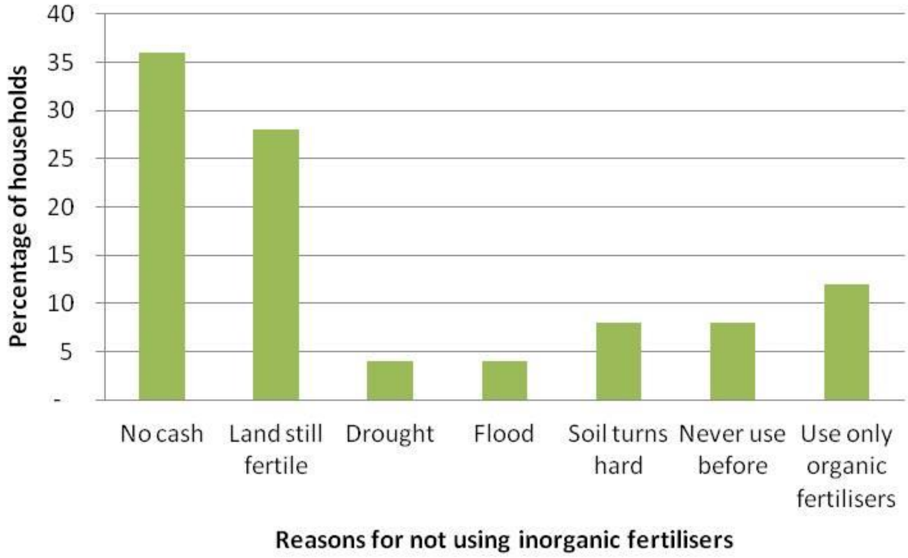

Figure 5.10 Incidence of reasons for not using inorganic fertilisers for rice in WS 2010 (including multiple responses)

5.2.5 Organic fertilisers

Lao lowland farmers customarily used organic fertilisers such as livestock manure or rice husks for rice production. About 65% of the households growing rice in WS 2010 used at least one type of organic fertiliser, whether livestock manure, rice husks, commercial organic fertilisers, or rice straw (Fig. 5.11). This did not differ significantly at the $p<0.05$ level between districts, but there was wide variation in the proportion of households using organic fertilisers between villages, from 93% in Oupalath (V2-D1) to 43% in Hieng (V3-D2). The higher proportion of households using organic fertilisers in V2 in both districts was associated with the higher number of households having cattle and buffaloes in these villages, and not with any less use of inorganic fertilisers. Farmers in Oupalath Village who grew straw mushrooms also brought rice straw to their paddy fields after they had finished producing the mushrooms. Recently some farmers had started to use commercial organic fertilisers since they were less expensive (LAK 120,000–150,000 per 50 kg sack) compared to inorganic fertilisers.

Livestock manure was mainly from buffaloes or cattle, but some farmers mixed poultry or pig manure with buffalo or cattle manure. Of the households applying organic fertilisers, nearly 88% used livestock manure, 45% rice husks, and 7% commercial organic fertilisers (Table 5.12). Only small variations were found across the survey villages in the proportion of households using different types of organic fertilisers for rice production (Table 5.13). The normal practice for applying buffalo or cattle manure was that the buffaloes or cattle were tethered in the rice fields in the DS, being moved every few days. Some farmers with few livestock also collected the manure from their houseyard where livestock were penned at night (in both wet and dry seasons) and brought it to the paddy fields. In this case, the manure was normally used only on the seedbed due to the limited amount available.

Of the households that did not use any organic fertilisers in rice production in WS 2010, 21% reported that their paddy land was still fertile, 31% that the organic fertilisers were not available in the village, and 20% that they had no buffaloes or cattle so there was no livestock manure to apply. Other reasons reported by a small proportion of households included not having enough cash to buy organic fertilisers, that inorganic fertilisers were sufficient, that they had no tractor or time to transport rice husks, and that they did not use organic fertilisers in borrowed paddy land (Fig. 5.12).

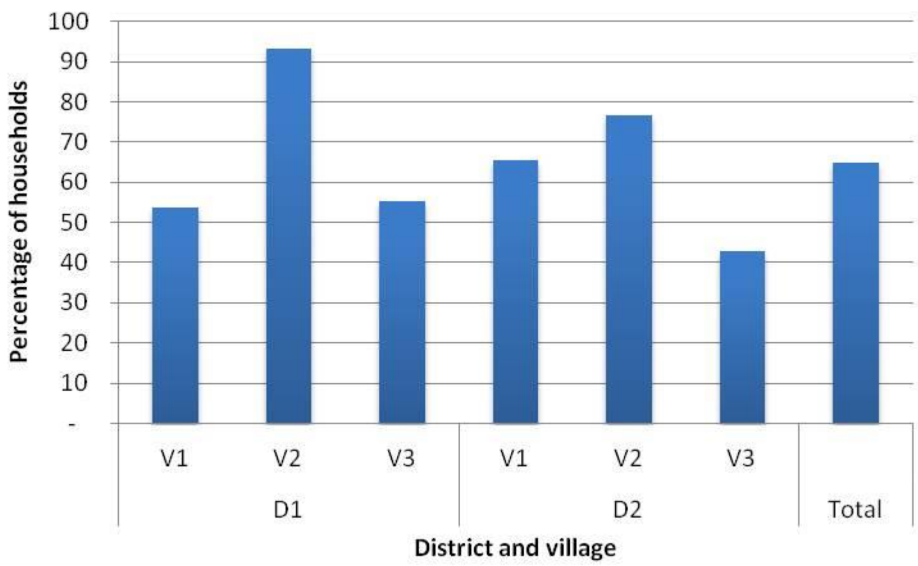

Figure 5.11 Percentage of households using organic fertilisers for rice production in WS 2010

Table 5.12 Incidence of different types of organic fertiliser used for rice production in WS 2010 (% of households)

	D1			D2			Total
	V1 (n=15)	V2 (n=27)	V3 (n=16)	V1 (n=19)	V2 (n=23)	V3 (n=12)	(n=112)
Livestock manure	86.7	96.3	81.3	94.7	91.3	66.7	**88.4**
Rice husk	33.3	40.7	12.5	68.4	47.8	66.7	**44.6**
Commercial organic fertilisers	13.3	3.7	18.8	-	8.7	-	**7.1**

Table 5.13 Usage of organic fertilisers for rice production in WS 2010 by type of application (% of households)

	D1			D2			Total
	V1	V2	V3	V1	V2	V3	
Livestock manure	***n=13***	***n=26***	***n=13***	***n=18***	***n=21***	***n=8***	***n=99***
Seedbed only	46.2	42.3	61.5	11.1	33.3	-	**34.3**
Paddy fields only	30.8	26.9	7.7	38.9	19.0	50.0	**27.3**
Both seedbed and paddy field	23.0	30.8	30.8	50.0	47.7	50.0	**38.4**
Rice husks	***n=5***	***n=11***	***n=2***	***n=13***	***n=11***	***n=8***	***n=50***
Seedbed only	40.0	18.2	-	23.1	18.2	12.5	**20.0**
Paddy fields only	40.0	63.6	50.0	46.2	54.5	37.5	**50.0**
Both seedbed and paddy field	20.0	18.2	50.0	30.8	27.3	50.0	**30.0**
Commercial organic fertilisers	***n=2***	***n=1***	***n=3***	***n=0***	***n=2***	***n=0***	***n=8***
Seedbed only	-	-	33.3	-	-	-	**12.5**
Paddy fields only	100.0	100.0	66.7	-	100.0	-	**87.5**

5.2.6 Weed and pest control

The use of herbicides to control weeds in rice was non-existent; none of the survey households had used herbicides for rice farming in the past five years. They normally cleared weeds by hand. Maintaining standing water was seen as the main means of controlling weeds in the paddy, with manual weeding performed as required. The limited exposure to herbicides may become a constraint to the adoption of alternative crop establishment methods (i.e., direct seeding) where weeds can become a problem, especially in the rainfed environment. However, it is likely that alternative establishment techniques will become increasingly common as wage rates limit the economic viability of hiring labour for transplanting, as seen in similar circumstances in Northeast Thailand (Rigg et al., 2012).

Though pests and diseases were identified as one of the key problems (Section 5.2.9 below), the use of pesticides was minimal in all the survey villages. About 14% of the survey households had used pesticides to control pests in the past five years (yet pests and diseases were one of the key problems mentioned. The highest rate of pesticide use (20% of households) was in None Phajao (V3-D1) and Khoke Nongbua (V2-D2). Of the households that did not use pesticides, almost 29% mentioned that they had no pest problems or experienced little damage from pests, while 13% said they could not afford to buy pesticides. About 25% did not use pesticides because they did not know what to use or how to apply them, and 31% simply did not like to use chemicals (Fig. 5.13).

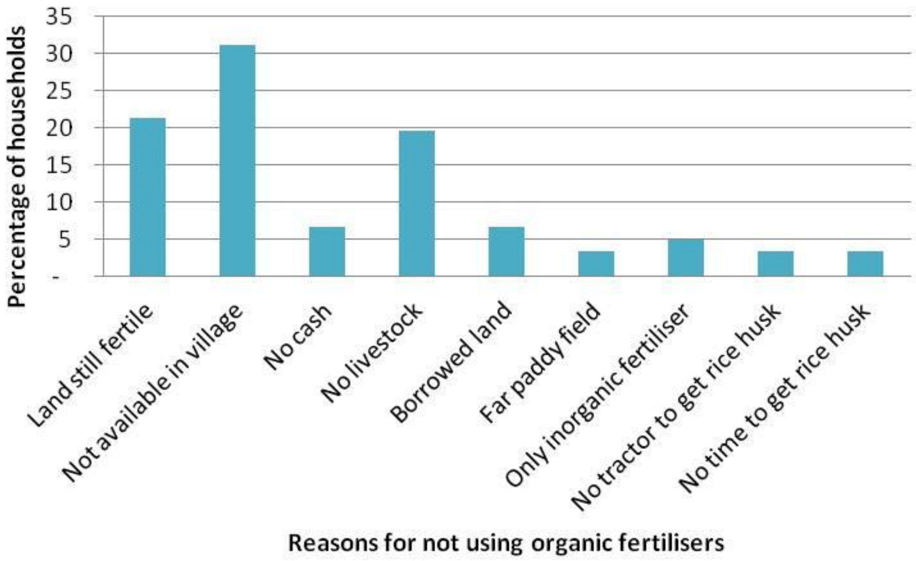

Figure 5.12 Frequency of reasons for not using organic fertilisers for rice production in WS 2010 (including multiple responses)

Around 22% of the survey households used traditional methods to control pests. The most common methods used were putting leaves of the *ka dao* tree or bark of the *dou* tree or *kheua khao hor* (convolvulus) in the water in the rice fields. Some farmers also added soap, detergent, tobacco, lemon grass, galingale, or ginger to the water. These methods were used for controlling rice bugs, thrips, or leaf-folders. Over 80% of those using these traditional methods said they could prevent some crop loss while the rest said they were ineffective.

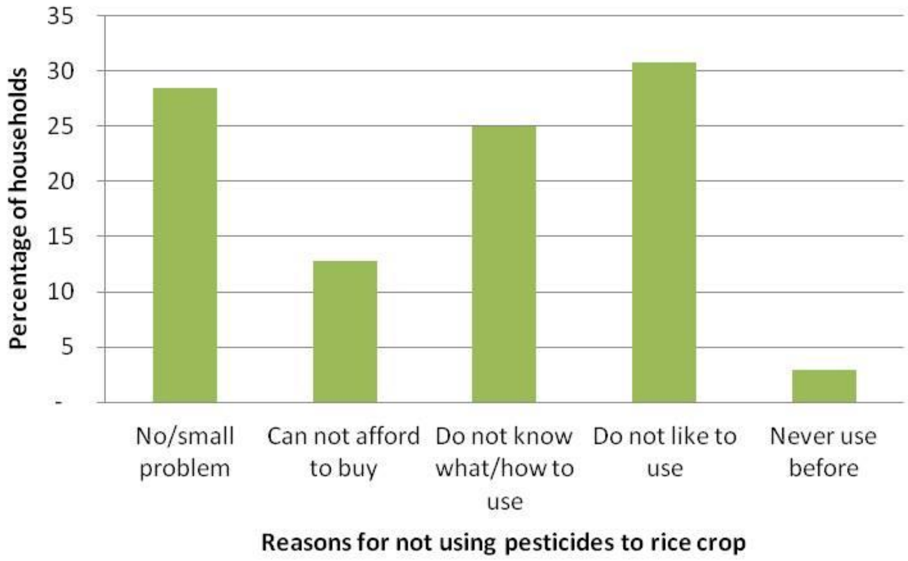

Figure 5.13 Frequency of reasons for not using pesticides for rice in the past 5 years
(including multiple responses)

5.2.7 Mechanisation and labour use

Mechanisation of rice production in Laos remains in its infancy, but with labour becoming increasingly scarce, changes are rapidly occurring as technology spills across the borders. Farmers in the lowlands of Laos have adopted mechanisation widely in recent years. With labour costs increasing substantially, the incentive to adopt labour-saving technologies has become very apparent. The form of mechanisation most widely adopted has been the hand-held, two-wheel tractor. While these machines are multi-functional, they reduce the amount of labour required for land preparation significantly.

Of the households surveyed, 55% now owned two-wheel tractors (Fig. 5.14); this differed significantly at the $p<0.05$ level between districts and between villages. In D1, the incidence declined with increasing remoteness, with only 23% owning two-wheel tractors in V3-D1. However, the greatest incidence of ownership (over 70% of households) was found in the remote village in the poor district (V3-D2). Despite being remote, V3-D2 was better off than V3-D1 because of its access to forest resources and its strategic location as a border market with Thailand. Adoption of tractors had thus extended into some more remote areas where rice productivity remained low and almost no surplus rice was produced. While the technology is not divisible like seed or fertiliser, the extent of adoption is not surprising given the versatility of the tractors and the extent of labour saved in both production and non-production activities, e.g., transport to regional centres.

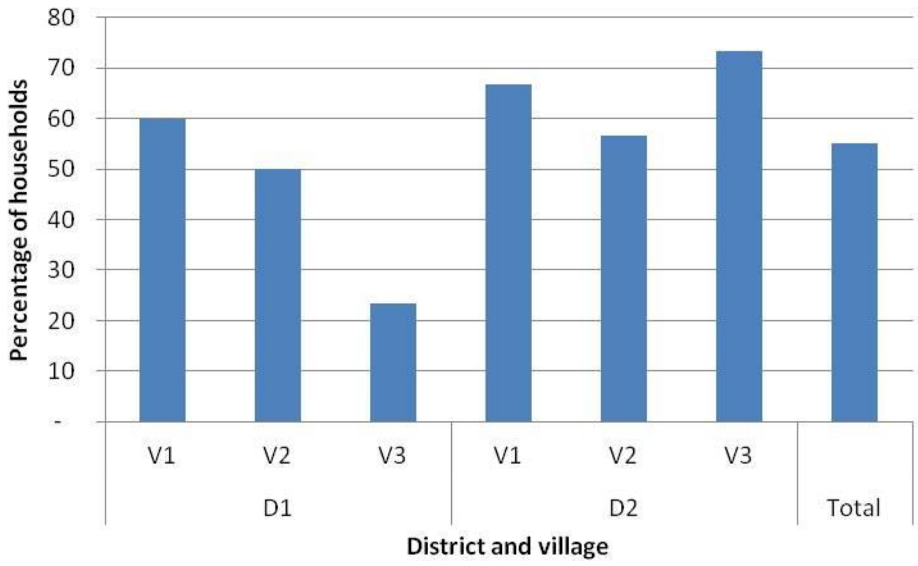

Figure 5.14 Percentage of households owning two-wheel tractors in 2010

Farmers who owned two-wheel tractors normally used their tractors for land preparation while some of those without tractors hired the services of a tractor for land preparation (including the labour of the tractor owner). Of the households growing rice in WS 2010, about 56% used their own tractors to prepare land and nearly 10% hired the service of a hand-held tractor for land preparation. Around 27% of the households growing rice in WS 2010 continued to rely on draught animal power (buffaloes) exclusively for land preparation, with the remainder using buffaloes in combination with either borrowing tractors from relatives or hiring land preparation services (Table 5.14). Significant differences at the $p<0.05$ level were found between districts in the proportion of households using different forms of land preparation (a higher incidence of tractor use in D2 resulted from the higher number of households owning two-wheel tractors in this district) and between villages in D1 (where the incidence of tractor use declined and of draught animal power increased from V1 to V3). The service fees were LAK 500,000–600,000 per hectare for hiring a tractor for two cultivations or LAK 300,000–400,000 per hectare for only one cultivation. As Table 5.15 shows, the area of paddy land cultivated by the household did not have a major impact on adoption. This was confirmed by the finding of no significant differences at the $p<0.05$ level in the proportion of households using different modes of land preparation between size classes.

Previous surveys in Ouplath (V2-D1) reported that no hand-held tractor was used for land preparation in both 1994 and 1998, with only draught animal power used for rice farming (Schiller et al., 1999). In 2010 almost half the survey farmers in Oupalath owned hand-held tractors and used them for land preparation (Fig. 5.15). However, about 45% still used only buffaloes and around

10% used a combination of buffaloes and hand-held tractors to save on the cost associated with using the tractor. The latter group of farmers normally hired the services of a hand-held tractor for the first cultivation then used their buffaloes for the second pass before transplanting. Apart from being used for land preparation, hand-held tractors were widely used for transportation.

Table 5.14 Incidence of land preparation methods for rice production in WS 2010 (% of households)

Land preparation by	D1			D2			Total (n=173)
	V1 (n=28)	V2 (n=29)	V3 (n=29)	V1 (n=29)	V2 (n=30)	V3 (n=28)	
Buffalo	21.4	44.8	75.9	6.9	6.7	3.6	**26.6**
Own handheld tractor	60.7	44.8	24.1	65.6	66.7	75.0	**56.1**
Hired handheld tractor	10.7	-	-	20.7	13.3	14.3	**9.8**
Buffalo and hired handheld tractor	7.2	6.9	-	3.4	13.3	7.1	**6.4**
Buffalo and own handheld tractor	-	3.5	-	3.4	-	-	**1.1**

Table 5.15 Incidence of land preparation methods by paddy area cultivated in WS 2010 (% of households)

Mode of land preparation	Size of paddy area cultivated			Total (n=173)
	≤ 1 ha (n=34)	1-2 ha (n=69)	> 2 ha (n=70)	
Buffalo	23.5	23.2	31.4	**26.6**
Own handheld tractor	44.1	59.4	58.6	**56.1**
Hired handheld tractor	17.7	8.7	7.1	**9.8**
Buffalo and hired handheld tractor	11.8	7.3	2.9	**6.4**
Buffalo and own handheld tractor	2.9	1.4	-	**1.1**

Another commonly used form of mechanisation was for threshing. Almost all farmers surveyed now threshed their rice by machine, either a self-operated, foot-powered machine or one powered by their tractor. Alternatively, they hired a tractor-powered threshing service. Around 81% of the households growing rice in WS 2010 hired the services of a rice-threshing tractor while nearly 7% threshed their rice with their own hand-held tractor connected to a threshing machine and 9% operated the thresher by foot-power. Only a handful of the households still threshed their rice manually (Table 5.16). Threshing service fees differed between providers, but the most common arrangement was crop-sharing in the ratio of 20:1 or 25:1. In other words, farmers paid 4-5% of their paddy rice production to the threshing service providers.

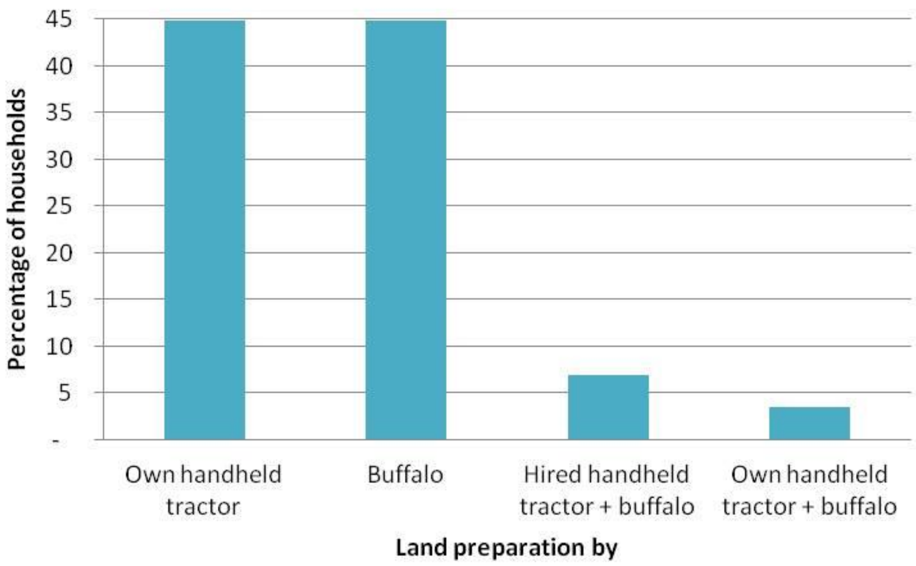

Figure 5.15 Incidence of methods of land preparation in Oupalath in WS 2010

Table 5.16 Incidence of different methods of threshing paddy rice in WS 2010 (% of households)

	D1			D2			Total (n=173)
	V1 (n=28)	V2 (n=29)	V3 (n=29)	V1 (n=29)	V2 (n=30)	V3 (n=28)	
Manual threshing	-	3.4	10.3	-	-	3.6	**2.9**
Foot-powered machine	14.3	17.2	24.1	-	-	-	**9.2**
Tractor-powered machine	10.7	13.8	17.2	-	-	-	**6.9**
Tractor-powered threshing service	75.0	65.5	48.3	100.0	100.0	96.4	**80.9**

While farmers in the study area have, over the past decade, adopted mechanisation for land preparation and threshing, transplanting and harvesting have largely remained labour-intensive manual operations (harvesting being undertaken with traditional sickles). Transplanters, drill-seeders, and combine harvesters were only beginning to be utilised in the past few years and only in small areas. In the survey villages, mechanical harvesting appeared for the first time in DS 2010-11 in V1-D1 (Fig. 5.16). Almost half the farmers in this village hired the mechanical harvesting service for their DS crop. Some farmers only hired the service in addition to manual harvesting because rain came early. They had to finish harvesting quickly, but manual harvesting with only household labour can stretch out over many days. The fee for the harvesting service was 20% of the total rice harvest. According to farmers who used the harvesting service, it was convenient, especially when there were many days of rain (but they needed an extra one or two days for sun-drying the paddy rice). Some of them noticed their paddy rice was drier than with manual harvesting (and then threshing) as manual harvesting took longer and so was sometimes affected by rain. They also believed that the cost was similar to hiring labour for harvesting combined with the threshing service fee.

(a) Paddy fields after rice was harvested by a combine harvester

(b) Combine harvester after completing the harvest at left

Figure 5.16 Mechanical rice harvesting in DS 2010-11 in Phaling Village (Author's photo, 2011)

Follow-up interviews in May 2013 with harvesting contractors in Phonethong and Soukhouma Districts revealed that the demand for contract services had remained high, even during periods of low rice price. However, the contractors had changed their charging structure away from a percentage of the crop to a flat fee per sack harvested (LAK 20,000 per sack of 35 kg) to avoid the price risk and the cost of transporting paddy to their storage. The contractors provided the harvesting service mainly in the WS but also in the DS in the irrigated villages in Phonethong District.

Thus both crop establishment and harvesting remain largely non-mechanised, labour-intensive activities. In addition to family labour, farmers in the survey villages used external labour for rice production by exchanging or hiring additional labour. For transplanting, over half the households growing rice in WS 2010 used family labour only, nearly 30% supplemented family labour with exchange labour (normally with relatives), and about 12% supplemented family labour with hired labour. Only around 4% used both exchange and hired labour in addition to family labour. Almost the same patterns were found in the case of harvesting (Table 5.17). No significant differences at the $p<0.05$ level were found in the proportion of households using different sources of labour for transplanting and harvesting rice.

This pattern was fairly consistent over time. In the past five years, around 53% of the survey households used only family labour for transplanting rice every year while almost 30% of the households utilised exchange labour from relatives in one or more years in addition to their family labour. About 13% hired additional labour in at least some years. Nearly 5% additionally used both exchange and hired labour. Again, almost the same patterns were found in the case of harvesting (Table 5.18).

Labour exchange was in the form of a small group of neighbours or relatives taking turns to help each other day by day. Some households had to hire additional labour because there was a shortage of family labour or there had been a decrease in family labour due to family members moving out after marriage, getting sick, or going to work in other areas or in Thailand. Furthermore, some households hired labour as they had to finish harvesting quickly to avoid damage by rain. Some households in the irrigated villages also hired additional labour in the DS.

Table 5.17 Incidence of different sources of labour for rice planting and harvesting in WS 2010 (% of households)

Sources of labour	D1			D2			Total (n=173)
	V1 (n=28)	V2 (n=29)	V3 (n=29)	V1 (n=29)	V2 (n=30)	V3 (n=28)	
Planting							
Family only	64.3	55.2	69.0	34.5	53.4	60.7	**56.1**
Family and exchange	32.1	31.1	20.7	27.6	33.3	28.6	**28.8**
Family and hired	3.6	10.3	3.4	27.6	13.3	10.7	**11.6**
All above	-	3.4	6.9	10.3	-	-	**3.5**
Harvesting							
Family only	53.6	51.7	62.1	44.8	56.7	50.0	**53.2**
Family and exchange	25.0	27.6	24.1	31.0	20.0	32.1	**26.6**
Family and hired	14.3	13.8	6.9	17.3	20.0	17.9	**15.0**
All above	7.1	6.9	6.9	6.9	3.3	-	**5.2**

Table 5.18 Incidence of different sources of labour for rice planting and harvesting in past five years (% of households)

Sources of labour	D1 V1 (n=30)	D1 V2 (n=30)	D1 V3 (n=30)	D2 V1 (n=30)	D2 V2 (n=30)	D2 V3 (n=30)	Total (n=180)
Planting							
Family labour every year	62.2	50.0	69.0	36.7	43.4	56.7	**52.8**
Exchange additional labour every year	24.2	26.6	20.7	23.2	26.7	23.3	**24.1**
Exchange additional labour some years	3.4	6.7	-	-	10.0	6.7	**4.5**
Hire additional labour every year	3.4	6.7	-	16.7	3.3	-	**5.1**
Hire additional labour some years	3.4	3.3	3.4	10.0	13.3	13.3	**7.9**
Exchange and hire additional labour every year	-	-	-	6.7	-	-	**1.1**
Exchange and hire additional labour some years	3.4	6.7	6.9	6.7	3.3	-	**4.5**
Harvesting							
Family labour every year	55.3	46.6	55.3	43.3	46.7	46.7	**48.9**
Exchange additional labour every year	20.7	20.0	20.7	30.0	20.0	20.0	**21.9**
Exchange additional labour some years	3.4	6.7	10.3	-	3.3	6.7	**5.1**
Hire additional labour every year	6.9	10.0	3.4	13.3	3.3	3.3	**6.7**
Hire additional labour some years	3.4	6.7	3.4	6.7	20.0	20.0	**10.1**
Exchange and hire additional labour every year	6.9	-	-	6.7	-	-	**2.2**
Exchange and hire additional labour some years	3.4	10.0	6.9	-	6.7	3.3	**5.1**

5.2.8 Harvest and post-harvest operations

As discussed in previous section, harvesting has largely remained a labour-intensive, manual operation. Rice was normally harvested with a sickle. After finishing the harvest for the day, the rice was left on the stem in the paddy field to dry out for a day (if the weather was sunny), and was then kept in a hut with a thatched roof. However, in seasons with less sunshine during the harvesting period, the harvested rice was dried on the ground for a few days and then put on long hangers made from bamboo (Fig. 5.17).

(a) Rice was left on the ground in the fields (b) Rice was dried out on bamboo hangers

Figure 5.17 Methods of drying rice after harvest, before threshing (Author's photo, 2011)

After threshing, the rice straw was spread out on the paddy fields (42% of households) or kept in piles in the field for livestock (37% of households) (Fig. 5.18). Some households (10%) also burnt the rice straw in the fields. Farmers in Oupalath (9% of the total survey households) used rice straw to grow mushrooms; after the mushrooms were harvested, the rice straw was brought back to the paddy fields for use as organic fertiliser.

Rice was normally milled by small village rice mills; however, it was sometimes taken to rice mills in nearby villages or in the district town. About 42% of the survey households milled their paddy rice at village rice mills, 44% used a mill in a nearby village, 7% used a mill in the district town, and 7% used two or more of these options (Table 5.19). The milling charges were LAK 200–250/kg. The rice milling recovery averaged about 60%, which is low, but with a very wide range from 35% to 85%, reflecting the low efficiency of local rice mills, resulting in lower quantity of milled rice.

Rice husks were mainly left at the rice mills (over half of the survey households), but over a third of households brought the husks back to the paddy fields, sometimes followed by burning. A small number of households brought rice husks to their vegetable garden (Fig. 5.19). Unlike rice bran, taking rice husks from the mills did not affect the milling charge. Rice bran was normally brought back to feed poultry, for those farmers with poultry; however, it was sometimes paid as part of the milling fee.

Figure 5.18 Incidence of different uses of rice straw
(including multiple responses)

Table 5.19 Use of rice mills in WS 2010 by location (% of households)

Location of rice mills	**D1**			**D2**			**Total**
	V1 (n=28)	**V2 (n=29)**	**V3 (n=29)**	**V1 (n=29)**	**V2 (n=30)**	**V3 (n=28)**	**(n=173)**
In village only	17.9	82.8	6.9	44.8	-	100.0	**41.6**
In other village only	71.4	6.9	93.1	17.2	73.3	-	**43.9**
In district only	-	-	-	13.8	26.7	-	**6.9**
In village and other village	7.1	10.3	-	3.5	-	-	**3.6**
In village and district	3.6	-	-	20.7	-	-	**4.0**

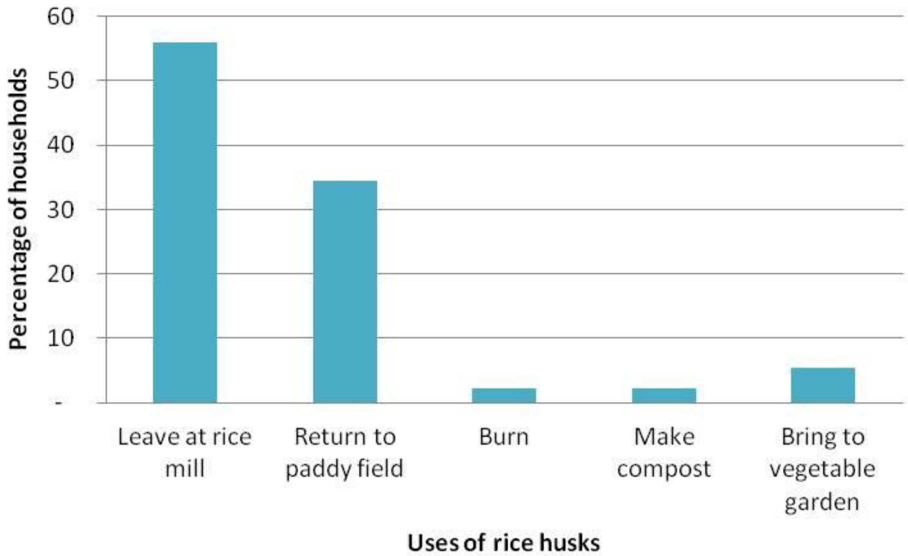

Figure 5.19 Incidence of different uses of rice husks
(including multiple responses)

5.2.9 Constraints to rice production

Rice production in the lowland environment of Laos is constrained by a number of abiotic and biotic factors (Schiller et al., 2001). Soil fertility, droughts, floods, pests, and diseases contribute to low yields and production uncertainty each year. It is likely that these factors create a level of risk that results in the adoption of low-input production systems, particularly given the limited mechanisms (other than emergency distribution of supplies in the case of a regional disaster) for households to manage production and income risk. This issue is analysed further in Chapter 7.

Several problems affecting rice production in the past five years were reported by survey farmers. The most common problem was drought (i.e., several weeks without rainfall that impacts on the crop (Fukai and Ouk, 2012)), which over 90% of households said had affected their rice production (Fig. 5.20). All the survey households in Boungkeo Village (V1-D2) reported having drought problems. Other problems were related to pests, of which the dominant ones were rice bugs, leaf folders, gall midge, and thrips. It should be noted that 2010 was a severe drought year. Nearly 51% of those households reporting drought ranked the extent of rice damage as severe and 28% as moderate (Fig. 5.21). Drought was still in the memory of many households during the household survey and was one of the reasons for the lower yields reported in 2010.

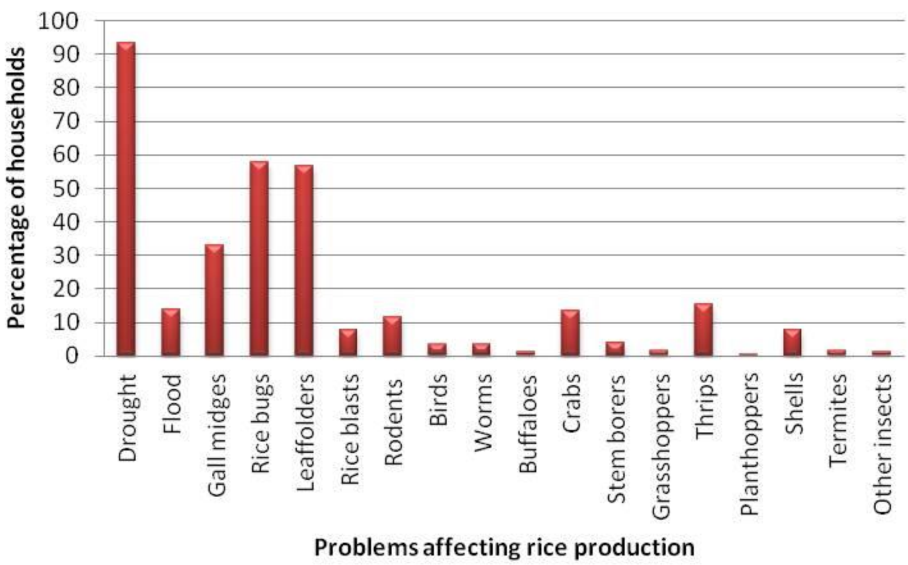

Figure 5.20 Incidence of problems affecting rice production in past five years
(including multiple responses)

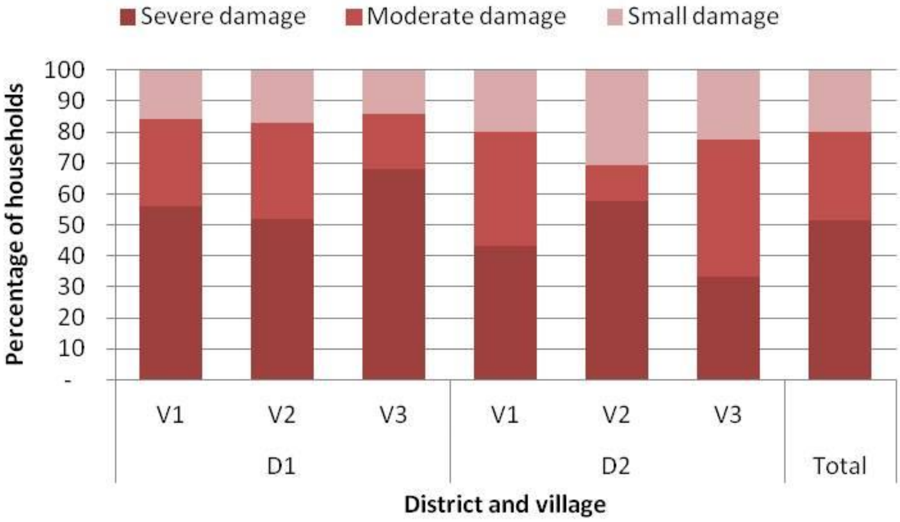

Figure 5.21 Incidence of damage to rice crop due to drought in WS 2010

5.3 Analysis of rice production and productivity in the wet season

5.3.1 Rice yields, shortages, and sales

Over 96% of the surveyed households cultivated paddy rice in WS 2010. The cultivated area averaged 2.3 hectares per household (fairly typical for Chamapasak Province), but ranged from only 0.2 hectare to 9.2 hectares. The proportion of households with 1 hectare or less was 20%, with 1-2 hectares was 40%, and with over 2 hectares was 40%. The WS 2010 rice yield averaged about 1.8 t/ha, little more than in the 1990s (Pandey and Sanamongkhoun, 1998), and ranged from less than half a tonne to 5.2 t/ha (Table 5.20).[5] The official target for WS rice is 4 t/ha. There were significant differences at the $p<0.05$ level in the mean paddy area cultivated and the mean paddy yield between villages within each district. The remote villages (V3) cultivated more paddy area but produced lower paddy yields than the other two villages. This may have been because they had sufficient land to achieve their subsistence target with lower yields, or because they chose to cultivate larger areas and therefore were less able to maintain their crops in a timely manner, given available labour.

Table 5.21 shows rice production and status for the two survey districts in 1996 and 2010. Rice yield was slightly higher in 2010 in D1 and substantially higher in D2. The proportion of households with rice shortage was around 42% in both D1 and D2 in 1996 but was around 26% for

[5] The yields for both WS 2010 and DS 2010-11 are the reported paddy (i.e., unmilled rice) yields, calculated from farmers' estimates of cultivated area and production. When cross-checked with case-study farms and field experiments, these estimates appear reasonably accurate to two significant figures (i.e., plus or minus 0.1 t/ha).

D1 and 28% for D2 in 2010. Though this may indicate a trend, the data for Oupalath (V2-D1) show the need for caution in interpreting these figures (Table 5.22). In this village, yields increased from 1994 to 1998 and rice shortage decreased, but the 2010 figures were little different from the 1994 figures, highlighting the year-to-year variability in the system.

Table 5.20 Rice production data for WS 2010

	D1			D2			Total (n=180)
	V1 (n=30)	V2 (n=30)	V3 (n=30)	V1 (n=30)	V2 (n=30)	V3 (n=30)	
Mean cultivated area (ha)	2.5 (n=28)	2.4 (n=29)	3.5 (n=29)	1.5 (n=29)	1.7 (n=30)	2.4 (n=28)	**2.3 (n=173)**
Mean yield (t/ha)	1.7 (n=28)	1.9 (n=29)	1.1 (n=29)	2.2 (n=29)	2.1 (n=30)	1.7 (n=28)	**1.8 (n=173)**

Table 5.21 Rice production and household rice shortage in 1996 and 2010

	D1		D2	
	1996	2010	1996	2010
Mean WS rice yield (t/ha)	1.3	1.6	1.1	2.0
Households with rice shortage (%)	42.0	25.6	42.0	27.8
Rice shortage (months)	na	4.3	na	4.1

Note: na = not available

Sources: 1996 - Pandey and Sanamongkhoun (1998), 2010 – author's survey.

Table 5.22 Rice production and househyold rice shortage in Oupalath in various years

	1994	1998	2010
Mean WS rice yield (t/ha)	1.8	2.6	1.9
Households with rice shortage (%)	na	na	13.3
Rice shortage (months)	2.3	1.0	1.5

Note: na = not available

Sources: 1994 and 1998 from Schiller et al. (1999), 2010 from author's survey

As already noted, WS 2010 was considered by farmers and researchers to be a drier than normal year, with reported yields somewhat lower than in previous years. Droughts and floods are a common occurrence in the region, affecting large areas. According to Schiller et al. (2006), over a period of 37 years (1966-2002) the central region of Laos was affected by extreme events in 32 years, while the southern region (which includes Champasak) was affected in 22 years. These events have a profound impact on household rice self-sufficiency, given that many operate close to a subsistence threshold. Nevertheless, this means that the 2010 yields, while low, were not greatly different from the normal run of seasons (e.g., the yield figure for WS 2009 was 2.2 t/ha). Another point to be mentioned is that the data for 1994 and 1998 for Oupalath in Table 5.22 included the data for farmer co-operators in the research project, who had full support for improved varieties and inorganic fertilisers as well as technical advice.

About 67% of the survey households sold some rice from the WS 2010 harvest. Of these, nearly 77% sold their paddy rice to the owners of rice mills, whether in the village or nearby villages or in the district town, while the remaining 23% sold their paddy rice to traders who came to buy in the village. The mean price of paddy rice sold by the survey farmers in WS 2010 was about LAK 2,600/kg. The price spiked in 2010 and farmers received up to LAK 3,500/kg.

5.3.2 Factors affecting rice yields

The factors affecting the WS 2010 rice yields were investigated through multiple regression analysis. Factors included in the model were household labour force per cultivated rice area, inorganic fertiliser use, organic fertiliser use, pesticide use, use of supplementary irrigation, rice variety types, the farm's location in the toposequence, the extent of drought damage, and the extent of pest damage (Table 5.23).

The variable "household labour force per cultivated rice area" was created by dividing the household labour force with the cultivated rice area in WS 2010. To more closely reflect the real situation, the household labour force used in this analysis was defined as the number of full-time equivalent household farm workers, estimated as the number of full-time workers plus the number of part-time workers, who were valued as one-third of full-time workers. Generally, a household comprises a primary and secondary labour force. The primary labour force is made up of adult, full-time workers. The secondary labour force comprises part-time workers – either older children (aged 10 to 15) who go to school and help the family farm during the weekend, or elderly members of the family who work a few hours a day or have the responsibility of taking care of their grandchildren. Larger households tend to have a larger effective labour force, while single-parent households with young children would, in general, have only one worker.

Inorganic fertiliser use was measured as the total amount of N applied per cultivated rice area in WS 2010. The use of organic fertiliser, pesticide, and supplementary irrigation water, defined as "yes or no", were likely to increase production and prevent crop loss. Although the WS crop was rainfed, access to irrigation water was likely to have reduced the impact of drought. The rice variety grown was designated as traditional variety or modern variety. The position in the farm toposequence was categorised as lower, middle, and upper field-types. A higher field position means greater susceptibility to drought. It should be noted that some households described their paddy land as including more than one field type. For these households, the category used was based on the dominant field-type in terms of area. Levels of damage by drought and by pests were based on farmers' assessments as small, moderate, or severe.

Table 5.23 Variables included in multiple regression analysis of rice yields in WS 2010 (n=173)

Symbol	Definition	Mean	SD
RiceYieldWS2010	WS rice yield in 2010 (kg/ha)	1,790	929
HHLabourPerArea	Full-time equivalent household labour force per cultivated rice area in WS 2010 (persons/ha)	2.0	1.3
InorganicFertiliserN	Amount of inorganic fertiliser N applied per cultivated rice area in WS 2010 (kg/ha)	15.2	15.4
OrganicFertiliser	Households who used organic fertiliser (yes/no)	0.7	0.5
Pesticide	Households who used pesticide (yes/no)	0.1	0.3
IrrigateWSRice	Households who supplemented water from irrigation to WS rice (yes/no)	0.2	0.4
RiceVariety	Rice variety grown (traditional variety/modern variety)	0.9	0.2
DMFarmTopo1	Farm topo-sequence (lower vs. middle)	0.5	0.5
DMFarmTopo2	Farm topo-sequence (lower vs. upper)	0.3	0.4
DMDrought1	Level of damage by drought (small damage vs. moderate damage)	0.3	0.4
DMDrought2	Level of damage by drought (small damage vs. severe damage)	0.5	0.5
DMPest1	Level of damage by pests (small damage vs. moderate damage)	0.2	0.4
DMPest2	Level of damage by pests (small damage vs. severe damage)	0.3	0.5

The results of the analysis are presented in Table 5.24. Before running the analysis, checks were made to ensure there were no violations of the assumptions regarding multicollinearity, outliers, normality, linearity, homoscedasticity, and independence of residuals (see Appendix 3). The model was statistically significant (p=0.000). The adjusted R Square of 0.38 showed that the model explained only 38% of the variance in the WS 2010 rice yields. No doubt much of the unexplained variation was due to measurement error (e.g., in actual labour input) and the limited number of site-specific variables in the equation. However, the model confirmed that the household labour force per cultivated rice area, the amount of inorganic fertiliser (N) applied, and both moderate and severe levels of drought damage were statistically significant, whereas the other variables were not significant factors.

Table 5.24 Results of multiple regression analysis of factors affecting rice yields in WS 2010

Independent variables	Estimated coefficients	t value
(constant)	1,237.31	2.61***
HHLabourPerArea	156.89	2.50**
InorganicFertiliserN	19.86	3.70***
OrganicFertiliser	112.19	0.72
Pesticide	14.81	0.06
IrrigateWSRice	-40.38	-0.18
RiceVariety	426.95	1.07
DMFarmTopo1	158.77	0.79
DMFarmTopo2	36.01	0.18
DMDrought1	-577.48	-2.62***
DMDrought2	-887.02	-4.16***
DMPest1	16.86	0.08
DMPest2	-31.51	-0.15

Adjusted R^2 = 0.38 F = 6.74, p = 0.000

*, **, *** significant at 10%, 5%, 1% level

The coefficient for household labour per hectare was positive and statistically significant (*p*=0.014), with a coefficient of 157, meaning an increase of 0.2 t/ha for each additional labour unit per hectare. Households with more labour may have achieved a higher yield because they had sufficient labour-time to maintain their rice fields (e.g., water control and weeding).

The amount of N-fertiliser use was statistically significant (*p*=0.000) with a coefficient of about 20 kg/ha, meaning that a one kilogram increase in the mount of N resulted in a yield improvement of 20 kg/ha. When an additional variable (N-squared) was included in the model to capture any non-linearity in the fertiliser response function, it was only weakly significant and the N variable became non-significant, hence the N-squared variable was omitted. This is consistent with experimental evidence of a linear yield response to low levels of N (Haefele et al., 2010). Based on the estimated coefficient, if the yield with no N fertiliser was 1.5 t/ha, the addition of 60 kg/ha (the recommended rate) would add a further 1.2 t/ha, giving a yield of 2.7 t/ha. The yield response at the recommended rate found experimentally averages around 3.3 t/ha (2.7 t/ha for middle-upper fields and 3.8 t/ha for lower fields) (Haefele et al., 2010). Given the general finding that yields from small experimental plots are larger than those from farmers' yields, the regression coefficient for N appears to be quite plausible.

The coefficient for moderate level of drought damage was statistically significant (p=0.01), with a value of -578. This means that rice yield decreased by 0.6 t/ha on plots with a moderate level of drought damage compared with plots with a small level of drought damage. Similarly, the severe level of drought damage was statistically significant (p=0.000) with a coefficient of -887, meaning that rice yield decreased by 0.9 t/ha on plots with severe drought damage compared with plots with a small level of drought damage. These figures underscore the potentially severe impact of drought in this environment.

As mentioned in Section 5.2.2, almost all farmers (96%) in the survey grew modern rice varieties. This explains why this variable was not significant. However, it was surprising that the variables for plot type and providing supplementary irrigation were not significant, given that it was a droughty season. However, access to irrigation may have merely indicated being positioned in a less drought-prone environment along the Mekong, rather than measuring the actual use of irrigation. Use of organic fertiliser and the reported severity of pest damage did not show up as significant factors, reflecting the greater reliance on inorganic fertiliser and the general prevalence of a minor level of pest damage.

5.3.3 Factors affecting inorganic fertiliser use

It has long been advocated that farmers should apply more fertiliser to their WS rice crop to get the benefit of the improved varieties they have adopted. As indicated above, fertiliser rates remain well below the already modest recommended rate. The determinants of technology adoption in agricultural production include a variety of field and farmer characteristics (Feder et al., 1985, Feder and Umali, 1993). Key field characteristics include soil type, land type, field hydrology, and field size. Important farmer characteristics include family size, farmers' education, access to market, access to credit, access to information and technology, tenancy, and the level of risk and risk aversion (Pandey and Sanamongkhoun, 1998). Some of these field and farmer characteristics collected during the household survey were used to analyse the adoption of inorganic fertilisers, measured in total quantity of fertiliser use. These characteristics were farm size, household labour force, household cash income, age of household head, education of household head, gender of household head, use of organic fertiliser, access to market, types of rice variety planted, farm's position in the toposequence, level of damage by drought, and level of damage by pests, as defined in Table 5.25.

Table 5.25 Variables included in multiple regression analysis of the quantity of inorganic fertiliser applied in WS 2010 rice production (n=173)

Symbol	Definition	Mean	SD
InorganicFertiliserUse	Amount of inorganic fertiliser use in WS 2010 (kg)	131	110
RiceCultivatedArea	Cultivated rice area in WS 2010 (ha)	2.3	1.4
HHLabour	Full-time equivalent household labour force (persons)	3.5	1.5
HHCashIncome	Household cash income (million LAK)	16.4	18.3
HHHeadAge	Age of household head (years)	47.9	11.2
HHHeadEducation	Education of household head (years)	4.8	3.4
HHHeadGender	Gender of household head (female/male)	0.9	0.3
OrganicFertiliser	Households who used organic fertiliser (yes/no)	0.6	0.5
MarketAccess	Access to market for inputs/sale (poor/good)	0.7	0.5
RiceVariety	Rice variety grown (traditional variety/modern variety)	0.9	0.2
DMFarmTopo1	Farm topo-sequence (lower vs. middle)	0.5	0.5
DMFarmTopo2	Farm topo-sequence (lower vs. upper)	0.3	0.4
DMDrought1	Level of damage by drought (small damage vs. moderate damage)	0.3	0.4
DMDrought2	Level of damage by drought (small damage vs. severe damage)	0.5	0.5
DMPest1	Level of damage by pests (small damage vs. moderate damage)	0.2	0.4
DMPest2	Level of damage by pests (small damage vs. severe damage)	0.3	0.5

The regression results are presented in Table 5.26. The assumptions regarding multicollinearity, outliers, normality, linearity, homoscedasticity, and independence of residuals were checked to ensure they were not violated (see Appendix 4). The model was statistically significant (p=0.000). The adjusted R Squared value of 0.34 showed that the model explained only 34% of the variance in the amount of inorganic fertiliser applied. The coefficients for cultivated rice area (p=0.002), household cash income (p=0.003), level of market access (p=0.000), and type of rice variety planted (p=0.093) were all positive, as expected, and statistically significant. So, not surprisingly, farmers with more land, more working capital (as frequently reported by farmers), and better access to both input and output markets used more inorganic fertiliser.[6] There was weak statistical support for the relationship between use of modern varieties and fertiliser use, as would be expected. As almost all

[6] However, the scatter plot of fertiliser rate per hectare versus cultivated rice area showed that the fertiliser rate decreased with cultivated area. This is not inconsistent with the finding that larger farmers applied more fertiliser in total.

the survey farmers grew modern varieties, this relationship was not clearly apparent in the regression results.

The effects of the other variables were not statistically significant at the 10% level. Farmer characteristics – education, age, and gender of household head – did not affect fertiliser use, nor did the availability of household labour (not surprising, as the application of fertiliser does not require much labour). Nor was the use of organic fertiliser correlated with the quantity of inorganic fertiliser applied, confirming the point made earlier that these forms of fertiliser are not generally seen as substitutes.

Table 5.26 Results of multiple regression analysis of factors affecting the quantity of inorganic fertilisers applied in WS 2010 rice production

Independent variables	Estimated coefficients	t value
(constant)	-185.92	-2.17**
RiceCultivatedArea	24.88	3.18***
HHLabour	0.48	0.08
HHCashIncome	1.70E-006	3.08***
HHHeadAge	0.49	0.54
HHHeadEducation	-2.18	-0.74
HHHeadGender	36.28	1.01
OrganicFertiliser	18.45	0.95
MarketAccess	98.98	4.15***
RiceVariety	85.74	1.70*
DMFarmTopo1	2.85	0.11
DMFarmTopo2	14.36	0.56
DMDrought1	11.28	0.42
DMDrought2	9.03	0.35
DMPest1	22.72	0.86
DMPest2	11.10	0.41

Adjusted $R^2 = 0.34$, $F = 4.85$, $p = 0.000$

*, **, *** Significant at 10%, 5%, 1% level

It was thought that risk would have a negative influence on the amount of inorganic fertilisers applied, so that low-lying farms, being less subject to drought, would have a higher usage of fertiliser than other land types. However, this analysis showed no significant effect of the farm's position in the toposequence on the amount of inorganic fertilisers used. There were also no significant effects of drought or pest damage, but the decision to apply fertiliser was likely taken before the severity of these risks became apparent.

5.4 Irrigated rice farming in the dry season

DS rice was also produced in the irrigated villages (V1) in each district but at a lower level of land utilisation than in the WS. About 43% of the survey households in the irrigated villages had land with access to the irrigation supply, with an average area of 1.2 hectares, ranging from 0.2 hectare to 3.0 hectares. There was no significant difference between the two districts in this respect. Of these households, 62% grew rice in all their irrigated land in the 2010-2011 dry season (DS 2010-11) while 27% grew rice in part of their irrigated land and rented out part. The remaining 11% rented out or left all their irrigated land unplanted (Table 5.27). Apart from those who owned irrigable land, around 33% of the households in the irrigated villages grew rice on rented land in DS 2010-11. Thus altogether 71% of households in the irrigated villages planted rice in DS 2010-11 on their own or on rented land. In addition, one household in a non-irrigated village (V2-D2) rented land in the irrigated village to grow DS rice.

Rice cultivation in the DS normally started a few weeks after the harvest of WS rice (early December) and finished around Lao New Year (mid-April). Overall, the practices used for DS rice were almost the same as for WS rice. The main differences were that only one round of land preparation was required, a higher amount of fertiliser was often used, and farmers had to pay an irrigation fee.

On average, for those with access to irrigated land, about 0.8 hectare of paddy land was planted with rice in DS 2010-11, but the range was 0.1 hectare to 2.0 hectares (Table 5.28). Thus farmers cultivated DS 2010-11 rice on about two-thirds of the total paddy area owned. One of the reasons was due to insufficient water to grow irrigated rice on the entire paddy area owned. Furthermore, there were higher costs associated with DS rice production (more fertiliser use, the water fee, and a higher labour requirement mainly associated with the management of irrigated water). The mean DS 2010-11 paddy yield was around 3.5 t/ha and ranged from 1.0 to 6.0 t/ha (Table 5.28). The official target for DS rice is 5 t/ha. There were no significant differences at the $p<0.05$ level in the mean paddy area cultivated and mean paddy yield in DS 2010-11 between districts.

Table 5.27 Use of paddy land in DS 2010-11 by households owning paddy land with access to irrigation supply (% of households)

Use of paddy land	D1 V1 (n=8)	D1 V2 (n=0)	D1 V3 (n=0)	D2 V1 (n=18)	D2 V2 (n=0)	D2 V3 (n=0)	Total (n=26)
1. Grew rice in all own irrigated land	50.0	-	-	61.1	-	-	**57.7**
2. Grew rice in all own irrigated land and rented paddy land to grow rice	12.5	-	-	-	-	-	**3.9**
3. Grew rice in part of own irrigated land and rented out part	25.0	-	-	27.8	-	-	**26.9**
4. Rented out all own irrigated land	-	-	-	11.1	-	-	**7.6**
5. Left all own irrigated land unplanted	12.5	-	-	-	-	-	**3.9**

Table 5.28 Rice production data for DS 2010-11

	D1 V1 (n=30)	D1 V2 (n=30)	D1 V3 (n=30)	D2 V1 (n=30)	D2 V2 (n=30)	D2 V3 (n=30)	Total (n=180)
Mean cultivated area (ha)	0.8 (n=17)	-	-	0.8 (n=26)	1.0 (n=1)	-	**0.8 (n=44)**
Mean yield (t/ha)	3.4 (n=17)	-	-	3.6 (n=26)	2.0 (n=1)	-	**3.5 (n=44)**

5.5 Household rice status and strategies

Household strategies in relation to rice production and disposal varied. Households in the survey could be distinguished into four categories – “sellers” were those who sold rice, “self-sufficient” households were those who were self-sufficient (producing rice exclusively for home consumption without selling or buying), “buyers” were those buying rice to cover a rice deficit, and “both” were those who sold rice immediately after harvest to pay off debts and then purchased rice later in the year to make up a shortfall (Fig. 5.22). These last households received low paddy prices when they sold their paddy after harvest and incurred higher rice prices when they re-entered the market to make purchases.

The majority of the survey households (50-77%) in all villages sold rice, regardless of access to water or distance to market (Fig. 5.22). The high price in 2010 (farmers received up to LAK 3,500/kg) was one of the key incentives for farmers to sell some rice from the WS 2010 harvest. Sellers included some households that had access to irrigation water for the subsequent DS, particularly in Boungkeo and Phaling (V1 in D1 and D2). WS rice remained largely rainfed in these villages unless subsidies were given for irrigation fees during drought years. About 21% of all households produced rice exclusively for home consumption in WS 2010 without selling or buying, another 12% purchased rice to fulfil a rice shortage, and 8% sold some rice and subsequently bought. The proportion of households in the "buyer" and "both" categories was higher in more remote villages (V3 in each district) (Fig. 5.22).

Figure 5.22 Disposal of WS 2010 rice crop

The average statistics relating to rice production for these four categories of households are presented in Table 5.29. Statistical tests indicated the mean paddy yield differed significantly at the $p<0.05$ level between the categories, but the mean paddy area cultivated did not. However, only the mean paddy yield for "seller" was significantly higher than "buyer" whereas other categories did not differ significantly from each other. That is, "seller" households were more likely to achieve higher yields than "buyer" households and this was the main source of their surplus, rather than larger cultivated area.

Table 5.29 Disposal of the WS 2010 rice crop

	Seller (n=107)	Self-sufficient (n=38)	Buyer (n=21)	Both (n=14)
Mean area cultivated (ha)	2.5	1.9	2.2	2.3
	(n =107)	(n =36)	(n =16)	(n =14)
Mean yield (t/ha)	2.0	1.9	1.2	1.5
	(n =107)	(n =36)	(n =16)	(n =14)

While farm households in the study area were engaging in multiple activities, achieving household rice self-sufficiency remained one of the primary objectives. Around 80% of the households were self-sufficient in rice from the 2010 WS crop (including those categorised as sellers and self-sufficient), with some variation based on the agro-economic zone in which the village was located (Fig. 5.22). While about 67% of households sold some rice after the 2010 WS crop, it was typically only a small proportion of the total production, especially in the rainfed villages (V3), and included a number of farmers who sold soon after harvest to pay off debts. On average, for those who sold, about one-third of the rice harvest from WS 2010 was sold (Table 5.30). The size of the surplus appeared to have increased from about 16% in the 1990s (Pandey and Sanamongkhoun, 1998), but still did not meet the World Bank's (2007) definition of "market-oriented farming" (greater than 50% of output sold); at most, we could say that those farmers selling surplus rice were "market-entrant" or (perhaps more appropriately) "semi-commercialised" rice farmers.

With at most relatively small surpluses, households can fall either side of the self-sufficiency benchmark each year, based on the prevailing weather conditions and pest problems. For the rice-deficit households, the average deficit was four months – ranging from one month to the whole year (for the few that did not plant rice in 2010). However, over half of the rice-insufficient households in 2010 actually sold some of their rice harvest. They sold rice to get money for urgent household needs such as paying for medical expenses, paying off their tractors, and buying fertilisers, and subsequently purchased rice for household consumption. As mentioned earlier in this chapter, the adoption of improved varieties, fertilisers, and new technologies such as power-tillers has helped many households improve their rice production to meet the rice self-sufficiency objective, and to do so in a more labour-efficient manner.

Table 5.30 Sale of the WS 2010 rice crop

	D1			D2			Total (n=180)
	V1 (n=30)	V2 (n=30)	V3 (n=30)	V1 (n=30)	V2 (n=30)	V3 (n=30)	
Percentage of households that sold rice (%)	53.3	66.7	73.3	80.0	70.0	60.0	**67.2**
Rice sales as percentage of rice harvest (%)	39.0 (n=16)	39.2 (n=20)	31.7 (n=22)	35.7 (n=24)	34.4 (n=21)	26.6 (n=18)	**34.4 (n=121)**

Given that yields fluctuate between years and many households are close to subsistence levels, the household's rice status is likely to change from year to year. Hence households formulate their livelihood strategy each year depending on the performance of the WS rice crop. For example, the migration patterns of young people in some case-study households were determined by the performance of the WS rice crop and whether cash income would be required to make up shortfalls (see case-study households in Appendixes 20 and 22). In villages located along the Mekong and its tributaries with access to irrigation infrastructure (V1 in each of D1 and D2), irrigation has also enabled double cropping and reduced some of the production risk associated with drought, in particular in the WS. The DS rice crop offers an opportunity to meet household subsistence needs for those remaining in deficit after the WS harvest, or to contribute to surplus stocks for the market. In some cases, land will be made available to households within the village who have not yet met their subsistence needs.

Leaving aside year-to-year variability, the household's rice status is a function of the number of household members (or, strictly, the number of people who share the harvest); the area of paddy land available for cultivation; and the yield of the rice crop. The average household size in the survey area was 6.6 members, but this is complicated by household dynamics throughout the year. Members of the household may migrate for periods of the year and not consume from the household's rice stock. On the other hand, sometimes the rice harvest is shared beyond the immediate household, including relatives who have moved away from the village. Similarly, there are other social obligations involving sharing rice with others, including offerings to monks. While noting these nuances, the national criterion for self-sufficiency of 350 kg of paddy (i.e., unmilled) rice per household member per year can be used as an approximate benchmark.

Fig. 5.23 shows the yield required for an average household to achieve self-sufficiency for a range of paddy areas. The "self-sufficiency curve" indicates the large difference in required yield as land size varies. For example, a household with 2 hectares of paddy land only requires a yield of around 1.2 t/ha to achieve household self-sufficiency, while a household with only 1 hectare would require a yield of close to 2.5 t/ha. The scatter plot presents the yield and area combinations for the 2010 WS. Self-sufficient households tend to track the "self-sufficiency curve", suggesting that households are trading off yield and paddy area, pursuing higher yields only when farm size is limited. As expected, most net purchasers of rice fall below the "self-sufficiency curve" and most net sellers are above the curve (remembering that actual family sizes vary between points). Some households remain net purchasers of rice, despite relatively large paddy area, due to low yields, while other households achieve relatively good yields but, due to area constraints, still fail to meet household requirements.

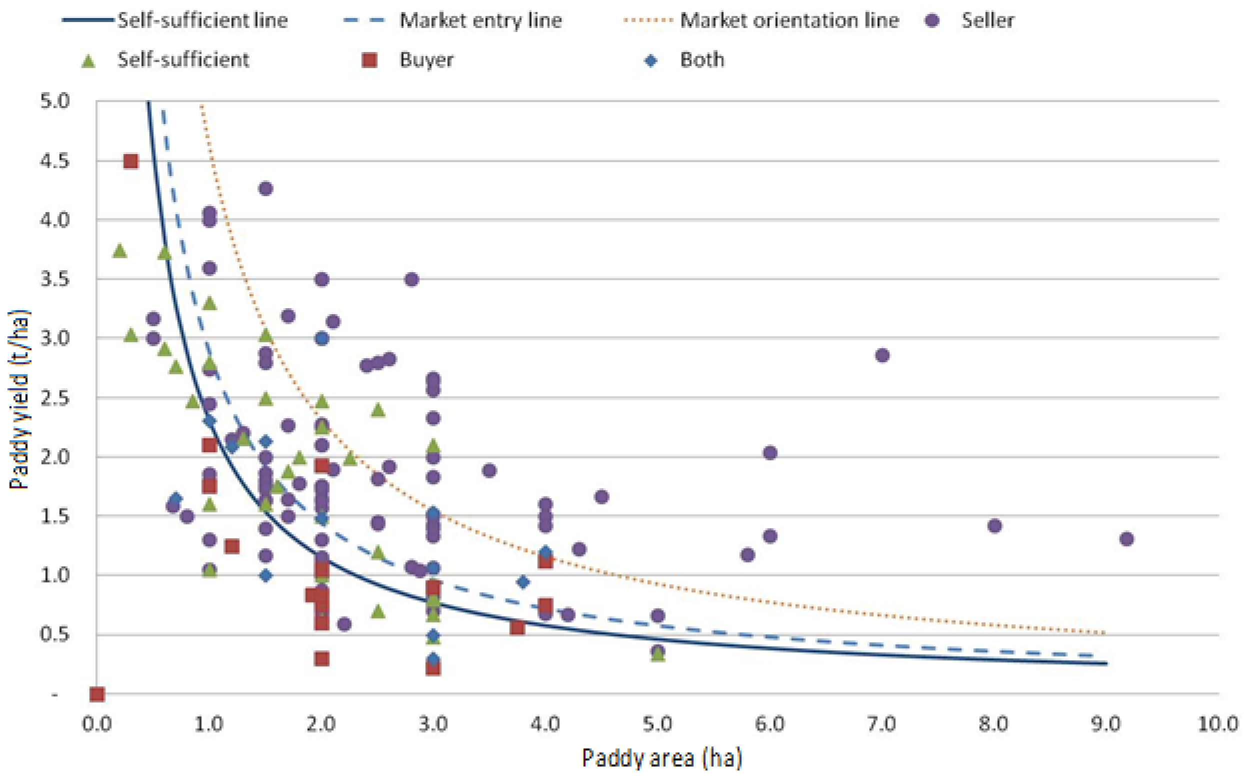

Figure 5.23 Yield-area combinations by household rice status

Regardless of the size of their paddy areas or the level of yields, for households that accessed irrigation to practise double cropping of rice, additional production from the DS crop helped them become net sellers. These households had less pressure to meet their self-sufficiency goal in the WS. When they produced enough WS rice for their consumption needs, they had more options in the DS, whether to grow rice or other non-rice crops for sale to maximise the returns to their resources.

The "market-oriented curve" in Fig. 5.23 shows the yield-area combinations enabling the average household to sell 50% of production, and the "market-entry curve" shows the combinations for sales amounting to 20% of production, reflecting an incipient market orientation (or "semi-commercial" status). Again, the scatter plot shows that the opportunity for a household to meet these market criteria varies considerably with paddy area. Households with 3 hectares or more could achieve a 50% surplus with 2 t/ha or less, while the few market-oriented households with less than 2 hectares were achieving yields of 3-4 t/ha.

In general, the data suggest that currently the majority of households remain largely subsistence-oriented and are willing to trade-off yields with paddy area to meet household requirements, limiting the incentive for intensification.

5.6 Conclusion

The household survey in the study area shows that lowland rice production systems in Southern Laos have been evolving over the past two to three decades. The majority of farmers in the survey had adopted new rice production technologies (improved varieties, inorganic fertilisers, and mechanised land preparation). However, rice yields and total production per household had increased only marginally. Modern rice varieties were widely planted, but most modern varieties had been used for many years and there had been little yield improvement since they were first disseminated in the 1990s. Similarly, while use of inorganic fertilisers had increased, the application rates were far lower than the modest recommended rates, further limiting yields. The adoption of two-wheeled tractors was the most dramatic change, but this had not helped boost yields or total production – rather it had decreased labour requirements in specific production phases and obviated the need for draught animals.

As such, rice production in all the study villages was primarily a low-yield, subsistence-oriented activity, or at most a semi-commercial activity. Almost all households grew rice, at least in the WS. Some grew insufficient for their needs and some produced a small surplus for sale, especially the minority with access to DS irrigation. However, the latter were not strictly "market-oriented" rice producers; rather, most farmers appeared to view rice production as a platform on which to construct a diversified livelihood strategy in which the use of family labour within and beyond the farm was the key element. With rice production providing a subsistence base, rural households in the study area were engaged in a range of other agricultural and resource-based activities. In the next chapter, these other livelihood activities are explored.

6 OTHER FARM AND FOREST ACTIVITIES

6.1 Introduction

Beyond paddy rice production, households in the study area were engaged in a range of other agricultural activities as well as forest and river utilisation. These other activities included small-scale production of vegetables and other non-rice crops and livestock enterprises. The utilisation of forest resources involved the collection of non-timber forest products and the hunting of animals. This chapter first discusses access to and management of water resources, an important factor in determining what types of farm activities to pursue. It then successively analyses the range of crop, livestock, and forest activities that farmers undertake in addition to rice production.

6.2 Water resources, access, and management

6.2.1 Introduction

As discussed in Chapter 5, rice production remained the central livelihood activity in the wet season (WS), whether as a subsistence or semi-commercial activity. However, improved access to and utilisation of water, largely driven by rural electrification, was having a significant impact on household livelihoods by creating opportunities for increased production and incomes, particularly during the dry season (DS). Households had access to a range of community and private water sources. In a limited number of villages along the Mekong River this included formal pump irrigation systems and in some cases individually-owned small pumps tapping smaller streams. Access to water at home through groundwater bores not only reduced the time required for collecting water for domestic purposes but also created the opportunity for maintaining home gardens throughout the DS. Similarly, small farm ponds also created DS cropping options. Understanding the management of water resources is critical to understanding issues surrounding the adoption of new technologies aimed for DS cropping. Data related to access and management of water resources were drawn from the household survey as well as focus group discussions with water-users' groups in the two irrigated villages.

6.2.2 Irrigation systems

The irrigation systems in the two irrigated villages, Phaling (V1-D1) and Boungkeo (V1-D2), were described in Chapter 4. About 43% of the survey households in these two villages had land with access to the irrigation supply. These households mainly devoted their land to grow rice in the DS. However, as mentioned in Chapter 5, some other households grew irrigated rice on borrowed land.

In drought years, in particular 2010, households with access to the irrigation supply used supplementary irrigation for their WS rice crop. Almost 54% of these households irrigated their WS rice nursery and nearly 58% irrigated their WS rice field. These farmers typically irrigated once before the second land preparation and again after transplanting. Farmers normally paid fees for the use of irrigated water but in a severe drought year like 2010 they did not because the Government provided support during the drought.

The use of irrigation fees based solely on cultivated area in these two irrigated villages reduced the incentive for households to adopt water-saving technologies, including alternative crops with lower water requirements. In an attempt to make a fairer arrangement for the planting of non-rice crops, the WUGs have developed a differential pricing system for rice and non-rice crops. For example, in Boungkeo the irrigation of non-rice crops was charged at only 15% of the water fee for growing rice. In Phaling the irrigation fee for non-rice crops was charged at 30% of the fee for DS rice, except for tobacco, which was charged 50% of the normal fee.

While the motivation to grow non-rice DS crops was to some extent influenced by water charges, the success of the WS rice crop was a major factor in a household's DS-crop selection. For example, if after the WS households still had a rice deficit they were more likely to grow a second rice crop to ensure self-sufficiency. However, if this subsistence goal was met, households became more interested in maximising the returns to their resources, which was more likely to be achieved by allocating labour, water, and cash to non-rice crops. In both Phaling and Boungkeo, severe drought damage in WS 2010 increased farmers' interest in growing a second rice crop to meet their subsistence targets.

Relative prices were also a major factor in determining the cultivation of non-rice crops on irrigated rice lands. In Phaling, the cultivation of sweet corn for sale in the Pakxe market had increased to around 10 hectares (of the 60 hectares that were irrigable) in DS 2008-09 but was lower in the next two dry seasons (DS 2009-10 and 2010-11) in response to the rice price spike at that time. However, the incentive to grow rice as a cash crop had again declined by DS 2012-13 as low prices meant the returns to labour from irrigated rice were often below the rural wage rate (see Section 7.5 in Chapter 7), hence only 3.5 hectares were cultivated with DS rice. The decrease in the cultivated area of DS rice was also found in Boungkeo (32 hectares in DS 2012-2013 compared to 107 hectares in DS 2011-2012).

The importance of returns to labour was emphasised by farmers during case-study interviews in Phaling. This included not only net returns but the time profile of labour requirements. Farmers mentioned that after establishing rice crops, young members of the household could leave the village to find employment, with the older members taking the responsibility for basic crop management such as water control. On the other hand, crops like corn and tobacco required ongoing attention.

6.2.3 Rivers and streams

Drawing water from the Mekong River and small streams was undertaken by 27% of the survey households to varying degrees (Fig. 6.1). The use of water from this source was found only in the villages close to the Mekong River (V1-D1 and V1-D2) or a tributary stream (V2-D2). The majority (80%) of the households drawing water from the river or streams used pumps, whereas the rest used buckets. The most common use of water was to irrigate small vegetable gardens, often located along the riverbank (see Section 6.3.1). However, in WS 2010 (regarded as a drought-affected year) five households used water from the river or streams to irrigate the WS rice nursery and two households irrigated the WS transplanted rice crop from this source.

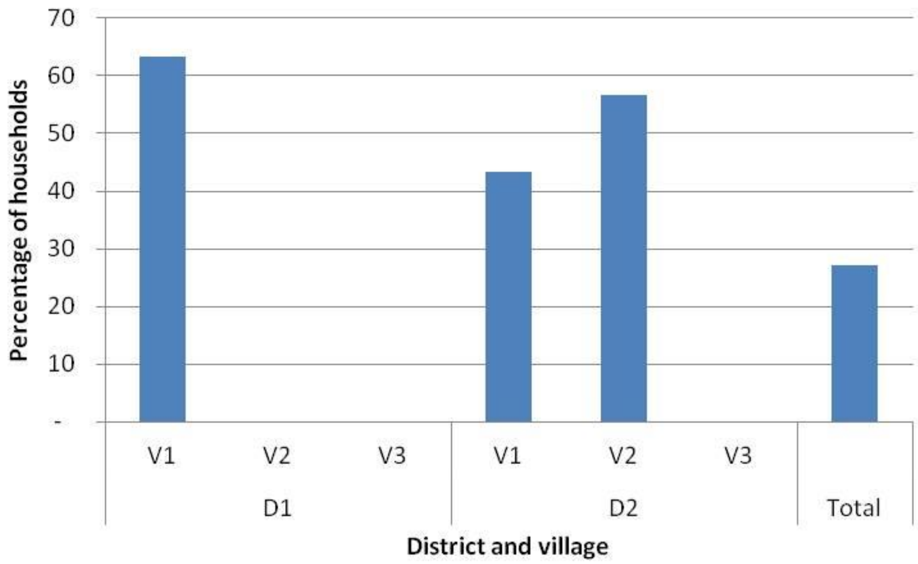

Figure 6.1 Percentage of households using water from rivers/streams in 2010

6.2.4 Fish ponds

Fish ponds were owned by about 19% of the survey households (Fig. 6.2); this did not differ significantly at the $p<0.05$ level between districts. However, significant differences were found between villages in each district (though numbers in each village were low). Across all villages the highest incidence (43%) was in Oupalath Village (V2-D1). Most of the ponds in this village were established during road construction when soil for road fill was given to the road-construction company in exchange for digging the ponds. In addition, some households established ponds with help from projects as this village has had a long history of involvement with research and development projects.

The ponds averaged 35 m long by 27 m wide by 2.3 m deep, giving a capacity of about 2,000 cubic metres. About 29% of these ponds did not have water available for part of the year, that is, late in the DS (Table 6.1). Apart from raising fish in the ponds in 2010, around 21% of those households with fish ponds used pond-water to irrigate WS rice nurseries and 29% to grow vegetables. About 32% of the ponds had electricity available nearby that could be used for electric pumps. Five households that did not have their own fish ponds shared the use of ponds with other households to grow vegetables.

Figure 6.2 Percentage of households owning fish ponds in 2010

Table 6.1 Attributes and uses of fish ponds (% of households)

	D1			D2			Total (n=34)
	V1 (n=3)	V2 (n=13)	V3 (n=5)	V1 (n=8)	V2 (n=4)	V3 (n=1)	
Pond without water for part of year	33.3	30.8	80.0	0	0	100.0	**29.4**
Pond-water used to irrigate WS 2010 rice nurseries	33.3	30.8	0	25.0	0	0	**20.5**
Pond-water used to grow vegetables in 2010	0	61.5	0	12.5	25.0	0	**29.4**
Pond with access to electricity	66.7	46.2	40.0	0	25.0	0	**32.4**

6.2.5 Groundwater bores

The Champasak plain is underlain by a series of shallow and deep aquifers that are still poorly understood; only the surface aquifer has been investigated and scientists have no knowledge of deep system(s) (Eberbach et al., 2014). This aquifer is composed of sandstone water-bearing material, probably with a weak confining layer. The groundwater is considered to be a finite resource – over-extraction will increase the depth to the water. However, the exploitation of this resource is still at an early stage.

Groundwater access was becoming common in the survey villages. Many households had invested in private bores, and often electric pumps. Overall, 70% of the survey households had individual access to groundwater, but this ranged from 33% to 93% depending on the village (the differences were significant at the $p<0.05$ level) (Fig. 6.3). The incidence of households owning groundwater bores was higher in the V2 villages, located further from the Mekong River (though some households in these villages had access to streams quite far from the village settlement). Coupled with access to electricity, the majority of households in these villages had invested in private groundwater bores to fulfil their water requirement for both domestic uses and cropping. In contrast, given access to the Mekong River and irrigation systems, there was less need for households in the V1 villages to establish groundwater bores. Households in the more remote and poorer V3 villages were also less likely to invest in groundwater bores, given that the cost of a bore was high and was generally associated with the installation of electricity supply. Electrification came to these two villages only recently – in 2005 for Hieng (V3-D2) and 2010 for None Phajao (V3-D1) – whereas the other survey villages have been electrified since 2000.[7]

The average depth of bores was around 30 metres, but ranged from shallow bores (less than 10 m) to deeper bores (up to 45 m). Some bores had been sunk over two decades ago, but most (84%) had been established since 2005 (Fig. 6.4). Of those households with groundwater bores, nearly 97% were using electric pumps with the remainder using hand-pumps (Table 6.2). Over 90% reported that their bore had water all year. The households experiencing water shortage reported that April and May (at the end of the DS) was the period when water was not available. About 9% of the households with groundwater bores reported having problems with water quality such as bad taste, bad smell, and sediment. Bore water was used for a range of purposes including domestic (e.g. washing, drinking), livestock, and crop production. Use for agriculture was typically limited to small home vegetable plots, but closer to markets (in particular in Phaling Village) these gardens were increasingly at a commercial scale.

The electrification of villages has meant that households could extract the groundwater resource using small electric pumps and hoses. This has the potential to greatly reduce the labour required to water vegetable gardens that have typically been used for household subsistence. As access to markets improves, there is also potential for the expansion of cropped areas for a commercially-oriented production system. Given the clustering of bores in the village and the range in depths, there could be potential for increased use to lead to externalities and raise equity issues in communities if production expands. This was the case during the driest period of the year when there was greatest demand for water; as the water level in the bores dropped, households with shallow bores could not access water every day and needed to wait for a several days for water levels to be restored.

While there are apparent measures in the Law on Water and Water Resources (NA, 1996) to manage groundwater extraction beyond household domestic needs,[8] in practice it is likely that the resource will be developed by individual households with little consideration of the overall rate of extraction or potential externalities. At the moment there are not even informal rules at the village

[7] In early 2010 about one-third of all households in None Phajao Village did not have electricity supplied to their houses whereas almost all households in the other survey villages already had access to the electricity supply.
[8] The current Law on Water and Water Resources specifies that underground water sources must principally be reserved for drinking and for small-scale use. Small-scale use is not of a business nature, including use in agricultural and forestry production and for raising livestock at the basic family level. Medium-scale use includes installing small mechanical water pumps to undertake production or services, which are not for family use. Large-scale use covers constructing medium and large-scale reservoirs for irrigation, water supply, and hydropower generation. Use of underground water in medium- and large-scale activities must be approved by a relevant agency.

level regarding groundwater management. Given that groundwater resources in lowland Laos are still poorly understood, utilisation for commercial crop production should proceed cautiously until there is a better understanding of the requirements for sustainable management of the resource.

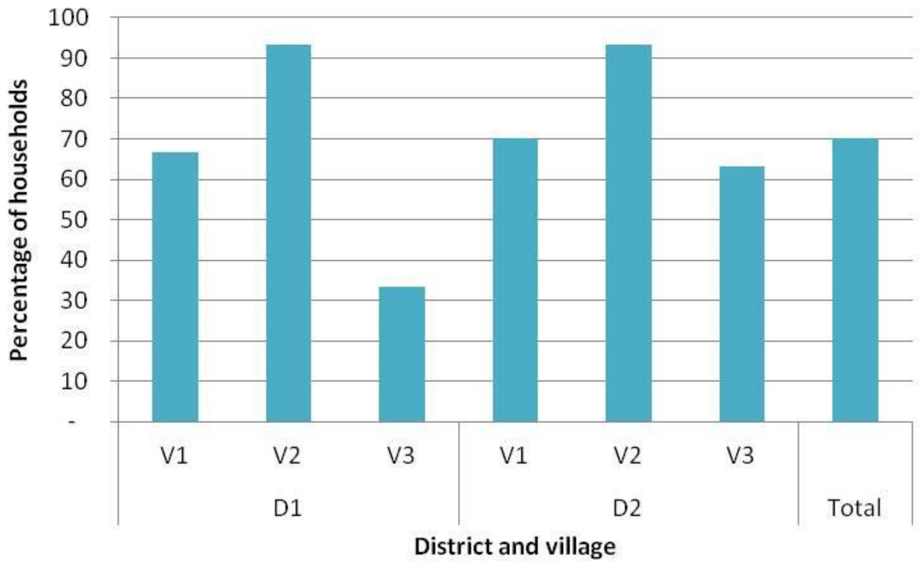

Figure 6.3 Percentage of households owning groundwater bores in 2010

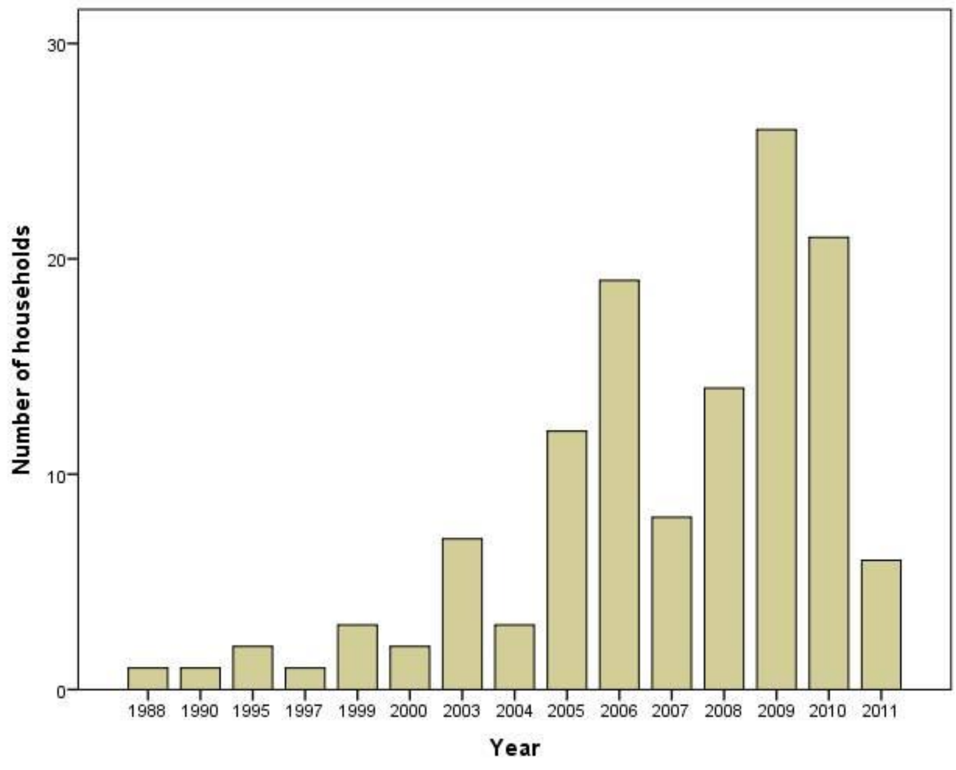

Figure 6.4 Distribution of households by year groundwater bore was sunk

Table 6.2 Attributes of groundwater bores (% of households)

	D1			D2			Total (n=126)
	V1 (n=20)	V2 (n=28)	V3 (n=10)	V1 (n=21)	V2 (n=28)	V3 (n=19)	
Electric pump	100.0	100.0	90.0	100.0	96.4	89.5	**96.8**
Hand-pump	0	0	10.0	0	3.6	10.5	**3.2**
Water all year	95.0	96.4	100.0	100.0	92.9	78.9	**93.7**
Water quality problem	0	10.7	60.0	0	3.6	5.3	**8.7**

6.3 Other cropping activities

6.3.1 Vegetables and other non-rice crops

Small-scale gardens for the production of vegetables (and in some cases other non-rice crops such as watermelon, tobacco, or mushrooms) were common in the survey villages, whether in house gardens, river gardens, paddy fields, or other non-paddy land. Nearly 71% of the survey households grew some vegetables in 2010 (Fig. 6.5); this did not differ significantly at the p<0.05 level between districts. The lowest incidence of vegetable-growing was in the more remote villages, in particular None Phajao (V3-D1), resulting in significant differences at the p<0.05 level between villages in each district.

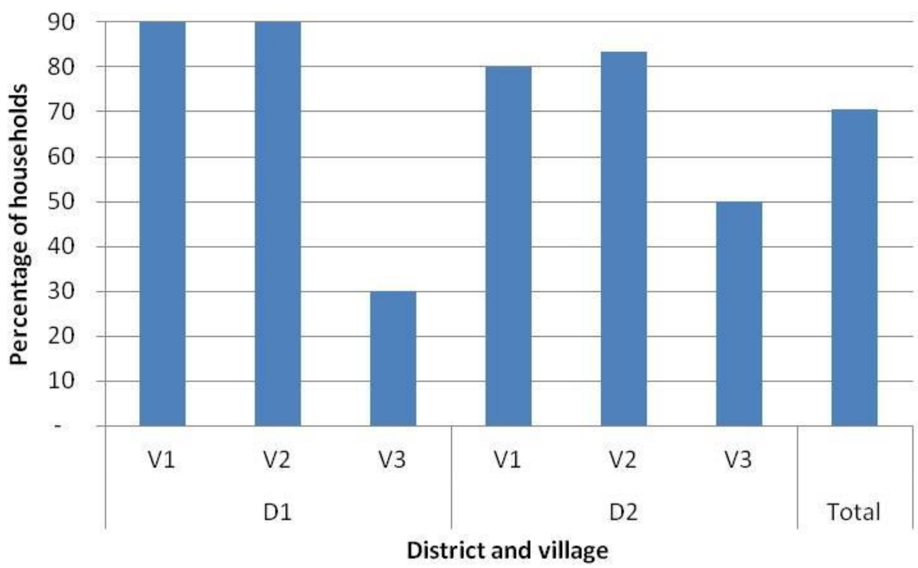

Figure 6.5 Percentage of households growing vegetables and other non-rice crops in 2010

Around 39% of the survey households grew vegetables in **house gardens** in 2010 (Fig. 6.6). Across all villages the highest incidence was in Oupalath Village (V2-D1), resulting in a significant difference at the $p<0.05$ level between villages in D1. It was possible to grow crops all year round (both wet and dry seasons), though less irrigation was required in the WS. The average cultivated area of house gardens was 0.06 hectare. Here a range of vegetables was grown, but the main crops planted (in descending order of frequency of households with house gardens planting the crop) were green onion, Chinese cabbage, mixed coriander, lettuce, chilli, Chinese coriander, and eggplant (Fig. 6.7). Nearly 86% of those growing vegetables in their house garden watered their vegetables from a groundwater bore and about 8% from a river or stream. Only a small number used water from the irrigation system or a fishpond (Table 6.3).

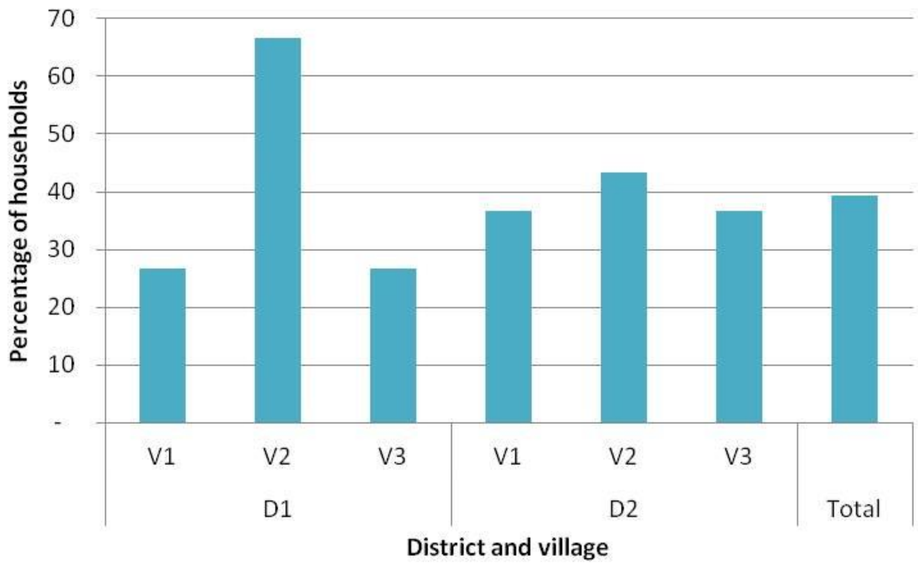

Figure 6.6 Percentage of households growing vegetables in house gardens in 2010

Table 6.3 Households growing vegetables in house gardens in 2010

	D1			**D2**			**Total (n=71)**
	V1 (n=8)	**V2 (n=20)**	**V3 (n=8)**	**V1 (n=11)**	**V2 (n=13)**	**V3 (n=11)**	
Mean cultivated area (ha)	0.29	0.08	0.004	0.008	0.20	0.21	**0.06**
% using groundwater	25.0	100.0	100.0	72.7	92.3	90.9	**85.9**
% using water from river or stream	50.0	0	0	18.2	0	0	**8.4**
% using irrigation system	25.0	0	0	9.1	0	0	**4.3**
% using water from fishpond	0	0	0	0	7.7	0	**1.4**

(a) Phaling Village – using irrigation systems (V1-D1) (b) Oupalath Village – using groundwater (V2-D1)

Figure 6.7 Vegetables grown in house gardens (Author's photo, 2011)

About 24% of households grew vegetables in **river gardens** in 2010 (Fig. 6.8). Normally crops were grown only in the DS as the water level was high during the WS (Fig. 6.9). These gardens were found in the villages along the Mekong River (V1 in each district) and streams (V2 in each district), but they were not possible in the V3 sites away from the river. The average cultivated area was 0.3 hectare, ranging up to 2.3 hectares (larger areas were found in Phaling Village (V1-D1) and Boungkeo Village (V1-D2)). A diversity of vegetables and non-rice crops were grown along the river bank, but long bean, Chinese cabbage, green onion, chilli, sweet corn, eggplant, lettuce, and cucumber were the key crops planted (in descending order of frequency of households with river gardens). All households with river gardens irrigated their vegetables from a river or stream.

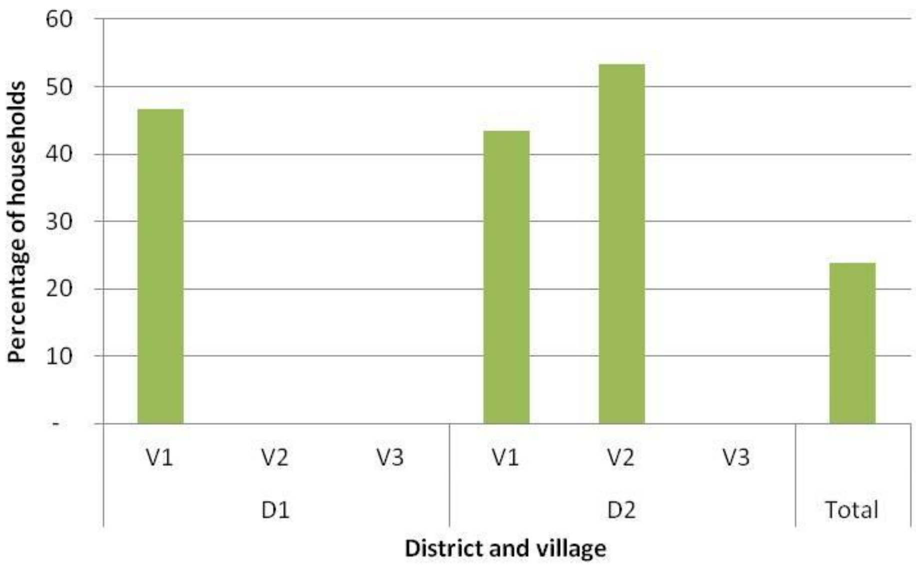

Figure 6.8 Percentage of households growing vegetables in river gardens in 2010

(a) Phaling Village (V1-D1)

(b) Khoke Nongbua Village (V2-D2)

Figure 6.9 Vegetables grown in river gardens (Author's photo, 2011)

About 15% of the survey households grew vegetables in **paddy land** in 2010, with major variations among the villages depending on the means of access to water – whether from an irrigation system, river/stream, groundwater, or fishponds. Crops were only planted in the DS as the area was all planted to rice in the WS. The majority of the households growing vegetables in paddy land were in Phaling (V1-D1), Boungkeo (V1-D2), and Oupalath (V2-D1), whereas only one household in each of other survey villages grew the crops. The average cultivated area was 0.2 hectare, ranging from only 0.01 hectare to 1.0 hectare. Nearly 41% of these households watered their vegetables from the irrigation system (that is, in the two irrigated villages). About 11% used water from the river to water their vegetables (again, in the two irrigated villages located along the Mekong River), 22% used groundwater (other villages, apart from the irrigated villages), and 22% used fishponds (only in Oupalath (V2-D1)).

As noted above, most of those who grew DS non-rice crops in their paddy land were in the irrigated villages. Around 33% and 13% of the survey households in Phaling and Boungkeo grew one or more irrigated non-rice crops in their paddy fields in DS 2010-11, respectively. The main crops grown in these villages were tobacco (obviously not a vegetable crop), watermelon, sweet corn, long bean, cucumber, and bitter gourd. Tobacco and watermelon were grown as single crops in larger areas of 1.0 hectare (Fig. 6.10 and 6.11) while the other crops were typically mixed together. In Phaling there was an expansion of tobacco production over a period of two years, reaching 5 hectares in DS 2010-11. Here the tobacco production was under a contract agreement with the Lao Tobacco Company in Vientiane. However, this has now ceased due to poor performance, with some farmers ending up in debt. A case-study of a household growing tobacco in DS 2010-11, including an enterprise budget, is presented in Appendix 7.

Figure 6.10 Tobacco planted in paddy land in Phaling Village (Author's photo, 2011)

Figure 6.11 Watermelon planted in Boungkeo Village (Author's photo, 2011)

Watermelon production was another crop that had seen large expansion in Boungkeo, with the number of farmers increasing from only three in DS 2010-11 to 22 in DS 2012-13. A total area of 35 hectares was grown within the irrigation area in DS 2012-13 compared to 3 hectares in DS 2010-11. A man who used to work in a large watermelon farm in Thailand had come to hire land in this village to grow watermelons in DS 2010-11. Later farmers learned how to grow watermelons. Seedlings, pesticides, and equipment were all bought from Thailand. Up to the time of fieldwork there was no problem with the market for watermelons as traders even came from other areas (including Savannakhet) to buy in the village. An enterprise budget for watermelons planted in DS 2012-13 is presented in Section 7.5.1 in chapter 7 and a case-study of a household growing watermelons in DS2010-11 is presented in Appendix 8.

Another interesting non-rice crop was straw mushrooms, which were only found in Oupalath (V2-D1), a non-irrigated village. Mushrooms were grown only in the DS, normally close to the house either on a small section of paddy land or in the house garden, as water used for mushroom production came from groundwater bores (Fig. 6.12). Farmers in this village had been growing rice straw mushrooms since 2000. Originally, they learned about growing mushrooms from people in nearby Kae Village who used to work in mushroom farms in Thailand. The production of rice straw mushrooms occurred in the DS from December (after the completion of harvesting WS rice, from where the rice straw was obtained) to March or April, as production of mushrooms was lower during the hotter months (April and May). Most of the inputs used for mushroom production were available locally; only the original mushroom stock and plastic cover were from Thailand but could be purchased at the village shops or the district market. Further details on the production of rice straw mushrooms, including an enterprise budget, are presented in the case studies in Appendix 9 and 10.

(a) Rice-straw mushrooms grown in paddy land (b) Rice-straw mushrooms grown in house garden

Figure 6.12 Rice-straw mushrooms grown in Oupalath Village (Author's photo, 2011)

Around 60% of the survey households in Oupalath grew straw mushrooms in DS 2010-11. The average area was about 0.08 hectare but the range was from only 0.01 hectare to 0.25 hectare. All the households growing straw mushrooms grew the crop for sale. The gross income in DS 2010-11 averaged LAK 3.5 million, ranging from LAK 1 million to 10 million. About two-thirds of the mushroom growers sold their product to village traders who then sold to traders in the provincial market, while the others brought their mushrooms to sell directly to traders in the provincial market.

Only 11% of the households growing straw mushrooms reported that they ever had trouble selling their mushrooms. The main production problems were low quality planting material leading to low production, mushrooms not growing well in hot weather, and mushrooms being eaten by termites.

Eight households (4%) grew vegetables on **non-paddy land** (neither home gardens nor river gardens) in 2010. The average cultivated area was around 0.05 hectare. Similar to house and river gardens, a variety of vegetables were grown mixed together, but the main crops were green onion, Chinese cabbage, chilli, cucumber, eggplant, lemon grass, and morning glory. Four of these households were in Hieng Village (V3-D2). Here vegetables were mostly grown under rainfed conditions in the WS on uncleared land close to the paddy fields. The other four households – two each in Oupalath village (V2-D1) and Boungeko Village (V1-D2) – used water from ponds or groundwater.

6.3.2 Input use and sale of vegetables and other non-rice crops

About 83% of the households growing vegetables and other non-rice crops in 2010 applied organic fertilisers to their crop, most commonly buffalo or cattle manure (54%) or poultry manure (55%) (Table 6.4); this did not differ significantly at the $p<0.05$ level between districts or between villages in each district. Almost all the manure applied was obtained from their own animals. Around 43% applied rice husks, mostly retrieved from the rice mill where their paddy rice was milled, while a few households had to buy rice husks. Nearly 53% of the households growing vegetables applied inorganic fertilisers and 34% used agrochemicals (mostly pesticides); this differed significantly at the $p<0.05$ level between districts, and, within D1, between villages, with the incidence of inorganic fertiliser and pesticide use declining with increasing remoteness of the village, probably due to limited market access to these inputs.

Vegetable growing was mainly for home consumption but also for sale. About 76% of vegetable-growing households sold at least one type of vegetable in 2010; this did not differ significantly at the $p<0.05$ level between districts but did so between villages in each district, with the remote villages (V3) showing a significantly lower incidence of sales. These households earned on average LAK 4.7 million in gross income, but this ranged widely from only LAK 50,000 up to LAK 48 million (Table 6.5 and Fig. 6.13). There was also large variation in the earnings from vegetable crops among villages; with a few big earners in Phaling Village (V1-D1).

Table 6.4 Use of inputs in vegetable gardens in 2010 (% of households)

	D1			D2			Total (n=127)
	V1 (n=27)	V2 (n=27)	V3 (n=9)	V1 (n=24)	V2 (n=25)	V3 (n=15)	
Organic fertilisers	**63.0**	**85.2**	**88.9**	**91.7**	**92.0**	**80.0**	**82.7**
- buffalo or cattle manure	40.7	81.5	77.8	41.7	48.0	46.7	**54.3**
- pig manure	7.4	7.4	0	45.8	68.0	6.7	**26.0**
- poultry manure	22.2	63.0	88.9	62.5	60.0	60.0	**55.1**
- rice husks	59.3	74.1	22.2	33.3	24.0	20.0	**43.3**
Inorganic fertilisers	**92.6**	**77.8**	**22.2**	**45.8**	**24.0**	**13.3**	**52.8**
Agrochemicals	**70.4**	**33.3**	**0**	**25.0**	**32.0**	**6.7**	**33.9**
- pesticides	70.4	33.3	0	25.0	32.0	6.7	**33.9**
- fungicides	7.4	0	0	0	0	0	**1.6**
- herbicides	0	0	0	0	0	0	**0**

The households with the largest income from vegetables were found in Phaling Village (V1-D1). This village is located near the Mekong River and a tributary stream and has a long history of vegetable growing for sale to the Pakxe market. The main income-generating crops in this village were sweet corn, cucumber, Chinese cabbage, long bean, bitter gourd, eggplant, and tobacco (only recently). These crops were typically grown in river gardens along the main stream passing through the village, except that tobacco was planted only in paddy land using irrigation. In contrast, vegetable-growing households in None Phajao Village (V3-D1) produced crops in 2010 exclusively for their own consumption. Other villages producing mainly for home consumption grew numerous herbs and condiments and also sold cucumber, sweet corn, long bean, rice straw mushroom, watermelon, eggplant, chilli, tomatoes, and other leafy greens.

6.4 Livestock activities

6.4.1 Overview

Livestock was an essential element of household livelihoods in all the survey villages. Over 90% of the survey households raised one or more types of livestock in 2010. The most common livestock raised were cattle, buffaloes, pigs, goats, and poultry. Livestock were raised for household consumption, cash income, and saving/investment. Some households also raised fish in their ponds.

Table 6.5 Data on sale of vegetables and other non-rice crops in 2010

	D1			D2			Total (n=127)
	V1 (n=27)	V2 (n=27)	V3 (n=9)	V1 (n=24)	V2 (n=25)	V3 (n=15)	
% of households selling at least one type of non-rice crop	96.3	96.3	0	62.5	100.0	33.3	**76.4**
Mean gross income from non-rice crops (million LAK)	12.32	2.89	0	2.16	1.32	0.36	**4.71**

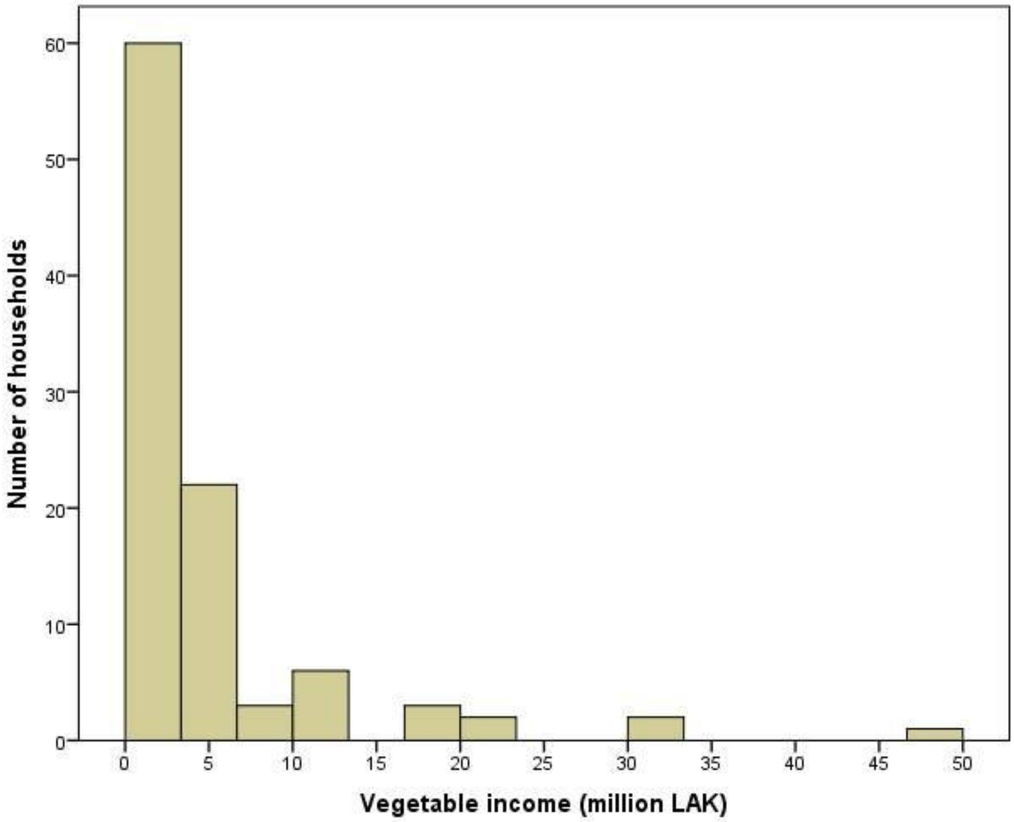

Figure 6.13 Distribution of gross income from vegetable and other non-rice crops in 2010

6.4.2 Cattle and buffaloes

Cattle were raised as a form of household savings as well as for periodic cash income. Nearly 27% of the survey households raised cattle in 2010. This was significantly higher at the *p*<0.05 level in Soukama District (40%) than Phonetong District (13%). The former district has a historical record of raising large ruminants, in particular cattle, perhaps due to its greater access to forestlands. On average, a household owned 10 cattle but the numbers ranged up to 56 head. Nearly one-third of the households with cattle reported selling cattle during 2010, earning on average about LAK 3.3 million (Table 6.6). Animals were sold for LAK one to three million. No significant differences at the $p<0.05$ level were found between districts or between villages within districts in the mean number of cattle raised or sold, or in mean cattle income.

Table 6.6 Data on cattle-raising in 2010

	D1			D2			Total (n=180)
	V1 (n=30)	V2 (n=30)	V3 (n=30)	V1 (n=30)	V2 (n=30)	V3 (n=30)	
Households raising cattle	***(n=2)***	***(n=4)***	***(n=6)***	***(n=13)***	***(n=9)***	***(n=14)***	***(n=48)***
Percentage of households (%)	6.7	13.3	20.0	43.3	30.0	46.7	**26.7**
Mean number owned (head)	6.0	5.5	11.2	8.2	13.5	12.2	**10.4**
Minimum number owned (head)	3	1	3	1	1	2	**1.0**
Maximum number owned (head)	9	12	24	25	48	56	**56**
Households selling cattle	***(n=0)***	***(n=1)***	***(n=2)***	***(n=5)***	***(n=4)***	***(n=4)***	***(n=16)***
Percentage of cattle households (%)	-	25.0	33.3	38.5	44.4	28.6	**33.3**
Mean number sold (head)	-	2.0	2.0	2.6	1.8	2.5	**2.3**
Mean income (million LAK)	-	2.0	2.1	4.4	2.7	3.5	**3.3**

Buffaloes were also raised as household savings and cash income. Buffaloes were used in the past as draught power for land preparation, but have been rapidly replaced by two-wheel tractors. Around 66% of the survey households raised buffaloes in 2010; this did not differ significantly at the $p<0.05$ level between districts and between villages in each district. The similar numbers of buffaloes in the two districts were because buffaloes were traditionally raised by the majority of households to provide draught power for land preparation, but the increased use of two-wheel tractors had resulted in a declining number of animals across both districts (see Section 5.2.7 in Chapter 5). On average, a household owned five buffaloes but the largest herd was 18 animals. Almost 24% of the households having buffaloes reported selling their buffaloes in 2010, with one buffalo selling for between LAK two and five million, earning about LAK 5.5 million (Table 6.7). Again, no significant differences at the $p<0.05$ level were found between districts or between villages in the mean number of buffaloes raised or sold, or in the income earned from buffalo sales.

Table 6.7 Data on buffalo-raising in 2010

	D1			D2			Total
	V1 (n=30)	V2 (n=30)	V3 (n=30)	V1 (n=30)	V2 (n=30)	V3 (n=30)	(n=180)
Households raising buffaloes	*(n=17)*	*(n=26)*	*(n=22)*	*(n=17)*	*(n=22)*	*(n=14)*	*(n=118)*
Percentage of households (%)	56.7	86.7	73.3	56.7	73.3	46.7	**65.6**
Mean number owned (head)	3.7	5.2	4.5	4.4	4.6	5.6	**4.7**
Min number owned (head)	1	1	2	2	1	1	**1**
Max number owned (head)	7	18	10	9	12	14	**18**
Households selling buffaloes	*(n=8)*	*(n=6)*	*(n=2)*	*(n=5)*	*(n=4)*	*(n=3)*	*(n=28)*
Percentage of buffalo households (%)	47.1	23.1	9.1	29.4	18.2	21.4	**23.7**
Mean number sold (head)	2.1	2.2	2.5	1.8	1.0	1.7	**1.9**
Mean income (million LAK)	6.4	5.7	6.3	5.6	3.2	5.0	**5.5**

Most cattle and buffaloes were tethered during the day in the WS to keep them out of the paddy fields, and either penned or tethered at night. During the DS, the management of livestock was different between the irrigated and non-irrigated villages. In the irrigated villages, cattle and buffaloes were managed much the same as in the WS to prevent damage to the irrigated rice crop or other DS crops. In the non-irrigated villages, cattle and buffaloes were allowed to graze freely on paddy lands and elsewhere during the day and penned at night, or, in the case of villages close to forested uplands, remained free until the end of the DS.

Looking after animals during both seasons was most commonly the joint task of working-age men and women (63%), followed by men only (30%). On average, four hours of family labour were allocated to looking after cattle and buffaloes each day during the WS. Less labour (only one hour of family labour) was devoted to managing cattle and buffaloes during the DS; those animals that were not penned were checked on every few days.

Natural grasses were a ready source of feed during the WS. Farmers often stated that they did not have a problem with feed during this period, although the collection of natural grasses could be time consuming. However, farmers were aware that their cattle and/or buffaloes lost condition during the DS when diets consisted of grazing on rice stubble, supplemented by rice straw. Over 90% of households with cattle and/or buffaloes reported that their animals lost weight during the DS, whereas only 5% reported weight losses during the WS. Around 61% of cattle/buffalo households believed they had access to enough feed to increase their herd size. Hence only 13% expressed interest in establishing forage crops for their cattle and buffaloes (Table 6.8). None of the households with cattle or buffaloes had ever planted forages for their animals.

Table 6.8 Cattle and buffalo management in 2010 (% of households)

	D1			D2			Total (n=134)
	V1 (n=17)	V2 (n=27)	V3 (n=23)	V1 (n=22)	V2 (n=24)	V3 (n=21)	
Livestock lose weight during DS	70.6	100.0	91.3	86.4	100.0	100.0	**92.5**
Livestock lose weight during WS	11.8	11.1	4.3	4.5	0	0	**5.2**
Have enough feed all year round	70.6	51.9	52.2	63.6	66.7	66.7	**61.2**
Interested in growing forages	5.9	14.8	30.4	13.6	8.3	4.8	**13.4**

During the last five years, households with cattle or buffaloes had faced problems, especially with regard to diseases, even though over 90% of these households had their livestock vaccinated (Table 6.9). The main problem was foot-and-mouth disease (FMD), which was common in the survey area. Around 67% of the households with cattle or buffaloes stated that their animals had been affected by FMD. The disease was more serious and widespread in 2010 and 2011. In those years the provincial authorities had to control the movement of cattle and buffaloes from the affected areas, of which Soukhouma District (D2) was one. On average, households with cattle or buffaloes had five animals affected by FMD in 2010 and nine animals in 2011. On average, one animal per household died because of the disease in both years. Apart from FMD, about 6% reported livestock theft or loss, 4% had livestock affected with haemorrhagic septicaemia, and 4% had animals with scours (*thong khai* or *thong yeuang*), though the animals did not die.

Table 6.9 Health problems of cattle and buffaloes (% of households)

	D1			D2			Total (n=134)
	V1 (n=17)	V2 (n=27)	V3 (n=23)	V1 (n=22)	V2 (n=24)	V3 (n=21)	
Vaccinated livestock	100.0	85.2	82.6	100.0	95.8	85.7	**91.0**
Problem of theft or loss	0	0	0	4.5	20.8	9.5	**6.0**
Problem of haemorrhagic septicaemia	0	3.7	0	4.5	8.3	4.8	**3.7**
Problem of scours	0	14.8	4.3	0	0	0	**3.7**
Problem of foot and mouth disease	23.5	66.7	52.2	86.4	75.0	90.5	**67.2**

Compared to five years ago, around 27% of the households with cattle mentioned they had much the same number of cattle, around 42% claimed they had fewer cattle, and nearly 31% said they raised more cattle (Table 6.10). Similar trends were found in the case of buffaloes. Statistical tests showed no significant differences between and within districts in these trends. The main reasons given by those reporting constant or reduced numbers were that they had sold cattle/buffaloes due to a need for cash, that the cattle/buffaloes had died due to diseases, especially FMD, and that they had limited feed supplies and labour so they could not raise cattle/buffaloes any more. Those households who reported increased numbers attribued this simply to natural increase. It was noticeable that the proportion of households stating that the numbers of cattle and buffaloes had increased tended to be higher in the more remote villages (V3) with access to forest resources.

Table 6.10 Cattle and buffalo numbers in 2010 compared with 5 years before (% of households)

	D1			D2			Total
	V1	V2	V3	V1	V2	V3	
Cattle numbers	*(n=2)*	*(n=4)*	*(n=6)*	*(n=13)*	*(n=9)*	*(n=14)*	*(n=48)*
More now	0	25.0	83.3	15.4	33.3	28.6	**31.2**
Less now	0	75.0	0	69.2	22.2	42.8	**41.7**
Same number	100.0	0	16.7	15.4	44.5	28.6	**27.1**
Buffalo numbers	*(n=17)*	*(n=26)*	*(n=22)*	*(n=17)*	*(n=22)*	*(n=14)*	*(n=118)*
More now	35.3	23.1	40.9	17.6	22.7	35.7	**28.8**
Less now	52.9	61.5	31.8	58.8	40.9	21.4	**45.8**
Same number	11.8	15.4	27.3	23.6	36.4	42.9	**25.4**

Cattle and buffaloes were regarded by farmers as a means of producing cash income and accumulating savings and capital for future household needs. As such, many households raised the animals without taking into consideration the market demand. The traditional production methods, with poor feed and high mortality, resulted in low output, making it very difficult for farmers to fit in with peaks in market demand.

The two case-study households in Appendixes 10 and 11 represent households that had large numbers of cattle and buffaloes (30 and 50, respectively) but did not adopt a production-oriented system; rather, animals were kept as a store of wealth that could be liquidated as required (cattle and buffalo sales were their main income sources in 2010). The two households had never grown forages specifically to give to their cattle and buffaloes. However, the household in Appendix 11 expressed interest in testing forages for their livestock, whereas the household in Appendix 10 was not interested. Similarly, the case-study households in Appendixes 8 and 13 represent the households having the highest income in 2010 from cattle, but they raised just enough cattle (13 and 17 head, respectively, which was slightly above the average herd in the household survey) to generate income each year. Again, both the latter two case-study farmers were not interested in growing forages for their cattle.

6.4.3 Pigs

Pigs were raised by 38% of households in small numbers, on average three. Pigs were raised for cash income; they were rarely consumed except on special occasions or ceremonies but were periodically sold to cover shortages of food or cash. Over 75% of the households with pigs reported sales during 2010, earning about LAK 1.6 million on average (Table 6.11). Pigs were sold for LAK 0.3 million up to two million depending on the weight. There were significant differences (at the $p<0.05$ level) between districts and between villages in the proportion of households raising pigs, but not so in the mean number of pigs raised or sold, or the income from pigs. The historical emphasis on animal-raising in D2 was reflected in the higher proportion of households raising pigs in that district. In contrast to the pattern with large ruminants, however, the incidence of pig-raising declined with increased remoteness (V1-D2 to V3-D2), possibly reflecting declining availability of crops and crop residues for feed.

Table 6.11 Data on pig raising in 2010

	D1			**D2**			**Total (n=180)**
	V1 (n=30)	**V2 (n=30)**	**V3 (n=30)**	**V1 (n=30)**	**V2 (n=30)**	**V3 (n=30)**	
Households raising pigs	***(n=5)***	***(n=10)***	***(n=4)***	***(n=23)***	***(n=18)***	***(n=9)***	***(n=69)***
Percentage of households raising (%)	16.7	33.3	13.3	76.7	60.0	30.0	**38.3**
Mean number raised (head)	3.6	2.9	2.0	2.8	2.8	3.5	**2.9**
Minimum number raised (head)	1	1	1	1	1	1	**1**
Maximum number raised (head)	8	6	4	6	8	9	**9**
Households selling pigs	***(n=3)***	***(n=6)***	***(n=2)***	***(n=19)***	***(n=15)***	***(n=7)***	***(n=52)***
Percentage of households selling (%)	60.0	60.0	50.0	82.6	83.3	77.8	**75.4**
Mean number sold (head)	4.3	2.2	1.5	1.7	1.6	3.1	**2.1**
Mean income (million LAK)	2.5	2.4	1.0	1.3	1.4	1.8	**1.6**

All the households who raised pigs reported that they purchased piglets to fatten as the normal practice. Most households with pigs kept them penned during the day and at night; only a few allowed their pigs to roam freely and scavenge for food around the house. Looking after pigs was typically the work of female members of the household. Pigs were commonly fed with rice bran (this applied to all the households with pigs in 2010). Over 80% of households used their own rice bran and nearly half of these households bought additional rice bran (Table 6.12). The relationship between total rice harvest and the number of pigs raised in 2010 was investigated using the Pearson product-moment correlation coefficient. There was a weak, positive correlation between the two variables [r=0.18, p<0.05] indicating that those with higher rice production tended to have more pigs. About 46% of the households with pigs in 2010 also fed their pigs with food scraps, and nearly 25% with crop leaves or roots such as cassava roots, banana trunks, *bon* or *kabook* leaves and roots (wild plants). The low number of pigs was the main reason for there being little interest in establishing forages for pigs – only 15% of households with pigs expressed interest. The small number of pigs raised also affected the amount of feed needed; over two-thirds of the households with pigs in 2010 indicated they had sufficient feed. Those households who recognised a feed constraint to increasing the number of pigs they raised identified the high cost of purchasing rice bran as a limitation to increasing production.

Table 6.12 Data on pig feeding in 2010 (% of households)

	D1			**D2**			**Total (n=69)**
	V1 (n=5)	**V2 (n=10)**	**V3 (n=4)**	**V1 (n=23)**	**V2 (n=18)**	**V3 (n=9)**	
Fed with own rice bran	80.0	40.0	50.0	30.5	27.8	33.3	**36.2**
Fed with purchased rice bran	0	0	25.0	21.7	27.8	11.1	**17.4**
Fed with own and purchased rice bran	20.0	60.0	25.0	47.8	44.4	55.6	**46.4**
Fed with food scraps	40.0	50.0	50.0	47.8	50.0	33.3	**46.4**
Fed with crop leaves or roots	20.0	10.0	0	21.7	38.9	33.3	**24.6**
Have enough feed	80.0	70.0	50.0	69.6	66.7	44.4	**65.2**
Interested in growing forages	0	0	25.0	17.4	27.8	0	**14.5**

During the last five years, only a few had problems related to pig-raising, all in Soukuma. One household in Hieng Village (V3-D2) reported the theft of a pig and another in Boungkeo Village (V1-D2) mentioned that one of their pigs had foot and mouth disease in 2010 but did not die. Four households (two in V1-D2 and two in V2-D2) had pigs with swine cholera but with only one reported death from this cause. Another problem mentioned by a few households was that pigs died after castration. Pig numbers appeared to be stable or declining. Around 45% of households with pigs said they had much the same number as five years before and nearly half claimed they had fewer pigs. Only a handful said they now raised more pigs. The main reason given by those with constant or smaller pig numbers was that they had sold pigs to meet the need for cash.

6.4.4 Goats

Only three households (one in each village in Phonethong District) raised goats in 2010 and none of these sold any goats in that year. Farmers said that raising goats was difficult because they tended to damage crops, for which the owner was held responsible. All three households with goats allowed their goats to roam freely in the day to search for food (natural grasses or leaves) and kept them penned at night. Looking after goats was typically the work of the husband and wife. The household in Oupalath Village (V2-D1), with six goats, reported that three of their goats had died of foot and mouth disease in 2010. The household in None Phajao Village(V3-D1) reported that five of their goats had died in 2010 after being attacked by dogs; they currently had only two. With regard to trends in goat numbers, the household in Phaling Village (V1-D1) stated that they had less goats then five years before due to the difficulty of raising them, the household in Oupalath Village (V2-D1) reported that they had the same number of goats due to the impact of foot and mouth disease, and the household in None Phajao Village (V3-D1) said they had more goats (17 in 2010) as they were building up their herd to sell in the future. None of the households with goats was interested in establishing forages for their goats as they had never done so and were not familiar with them.

6.4.5 Poultry

Poultry were raised for household consumption and cash income. Poultry raised by the survey households included chickens and ducks. About 75% of the households had some chickens in 2010, spread across the six villages. On average, a household owned 28 chickens but the number ranged up to 280 birds. Almost 39% of the households with chickens reported selling chickens in 2010, with one chicken selling for between LAK 10,000 and 50,000, earning an average gross income of about LAK 0.7 million. Around 53% of the survey households had some ducks in 2010, averaging 21 ducks per household but again ranging up to 200 birds. Nearly 40% of the households having ducks sold some in 2010, with one duck selling for between LAK 15,000 and 60,000, generating a gross income of about LAK 0.7 million. The proportion of households raising or selling chickens or ducks did not differ significantly at the $p<0.05$ level between districts or between villages within each district. Likewise, the mean number of chickens and ducks raised or sold, or the income from poultry, did not differ significantly between districts or between villages, reflecting the status of poultry as a common and low-input form of village livestock.

Poultry scavenged for food around the house during the day and were penned during the night. Those households with a large number of poultry fenced an area near their house or paddy farm. Poultry were sometimes fed with broken rice, paddy rice, or in some cases milled rice. Large numbers of deaths in a single event were reported by around 72% of the households with poultry. The main cause of death identified by the farmers was fowl cholera. Farmers said that poultry raised in the village were more likely to suffer a large number of deaths at one time, whereas the incidence of death was less for poultry raised near the paddy farms.

6.4.6 Fish

As mentioned in Section 6.2.4, about 19% of the survey households owned fishponds in 2010, with one pond each. Nearly 56% of these households raised some fish in their ponds in 2010; however, only three households sold fish, generating an average income of nearly LAK one million. The most common fish raised were tilapia, catfish, and common carp.

6.5 Forest utilisation

6.5.1 Non-timber forest products

Farmers in the study area also utilised the forest as part of their livelihoods. Over half of the forest area in the study districts was classified as dry dipterocarp forest and about one-third was mixed deciduous forest (ALRC, 2007a, ALRC, 2007b). These types of forest were more evident in the more remote survey villages – None Phajao (V3-D1) and Hieng (V3-D2). Both types of forest were semi-open with relatively little undergrowth. Cattle and buffaloes were often grazed in the forest. In addition, new paddy lands were periodically created through clearing this forest. With the permission from village authorities villagers were allowed to cut down trees for timber from the forest, but for the purpose of house construction only.

Various types of non-timber forest products (NTFPs) were collected in the forest by farmers in the survey villages, including bamboo shoots, bamboo, rattans, mushrooms, and forest vegetables. Wood from lopped tree branches or cut-down trees, or fallen branches gathered from the ground, was also used to produce charcoal. NTFPs were mainly consumed or used by farm households; a proportion of them was also sold for cash income.

Bamboo shoots appeared more in the WS, which is when most households collected them (Fig. 6.14). About 24% of the households collecting bamboo shoots sold some, earning on average about LAK 0.2 million in 2010 (Table 6.13). Bamboo was mainly collected for household use (e.g. fencing, making sticks for bundling rice seedlings or harvested rice, producing fish cages) in both wet and dry seasons (Fig. 6.14), but was also sold by a few households in the remote village (V3-D1) located near mountainous terrain (Table 6.13). No significant differences at the $p<0.05$ level were found in any aspects related to the collection and sale of bamboo shoots and bamboo between districts and between villages in each district, except that the incidence of selling bamboo shoots differed significantly between villages in D2, with V2-D2 having the highest incidence.

Rattans, whether cooked for human consumption or used in handicraft production, were collected in wet and dry seasons by only a few households in the remote villages located close to the forest areas in the mountains (V3-D1 and V3-D2). One in three of the households collecting rattans sold some, earning around LAK 0.2 million in 2010.

Mushrooms and forest vegetables were collected more in the WS than in the DS. Nearly 80% of the survey households collected mushrooms in 2010 and about 34% of them sold some of their mushrooms, earning around LAK 0.3 million (Table 6.14). The main mushrooms collected were *hed phor*, *hed puak*, and *hed la ngo*. Almost 59% of the survey households collected forest vegetables in 2010, mainly for household consumption; only 15% sold some and earned about LAK 0.14 million (Table 6.14). *Phuk teu*, *phuk kadone,* and *phuk kadao* (leafy vegetables) were foremost among the wild vegetables collected. Only the proportion of households selling mushrooms differed significantly at the $p<0.05$ level between districts and between villages, with the more remote villages in the more remote district having the highest incidence. The mean income from mushrooms was significantly higher in the more remote district.

Resins were collected in both wet and dry seasons, exclusively for sale; however, only a few households in the remote villages undertook this activity as many trees had disappeared and it was now hard to get the resins (Table 6.15). Charcoal was produced mainly in the DS as the production process involved the burning of wood in earth ovens for a few days. Some households produced charcoal during the WS as well, but this was more difficult as they needed to stop producing when it rained. Charcoal was produced mainly for household usage, but some of the surplus was sold for cash income. Around 23% of the survey households produced charcoal in 2010 across the six villages and only 14% sold charcoal. The average income earned from charcoal in 2010 was LAK 0.8 million (Table 6.15). Significant differences at the $p<0.05$ level were found in the proportion of households producing charcoal between villages in each district, but with no obvious pattern.

(a) Bamboo shoots in Hieng Village (V3-D2)

(b) Sticks made from bamboo
in None Phajao Village (V3-D1)

(c) Fish cages made from bamboo
in Khoke Nongbua Village (V2-D2)

Figure 6.14 Bamboo shoots and bamboo products in the study area (Author's photo, 2011)

Case-studies of households relying on the collection of NTFPs (for consumption and sale) are presented in Appendixes 8, 11, 15, 16, 17, 18, and 21. For these households, the NTFPs contributed considerably not only to their food consumption and household use, but also to their cash income (from about LAK 0.2 million to 1.6 million). Almost all of these households were in the remote villages (V3 in both districts), where they had access to forestlands with plentiful wild products. The household described in Appendix 21 was in V2-D2.

Table 6.13 Bamboo and bamboo shoots collection in 2010

	D1			D2			Total
	V1 (n=30)	**V2 (n=30)**	**V3 (n=30)**	**V1 (n=30)**	**V2 (n=30)**	**V3 (n=30)**	**(n=180)**
Bamboo shoots	***(n=26)***	***(n=27)***	***(n=28)***	***(n=23)***	***(n=24)***	***(n=28)***	***(n=156)***
Households collecting (%)	86.7	90.0	93.3	76.7	80.0	93.3	**86.7**
Households selling (%)	15.4	37.0	17.9	4.3	58.3	14.3	**24.4**
	(n=4)	(n=10)	(n=5)	(n=1)	(n=14)	(n=4)	**(n=38)**
Mean income (million LAK)	0.33	0.28	0.11	0.5	0.23	0.13	**0.23**
Bamboo	***(n=13)***	***(n=11)***	***(n=16)***	***(n=9)***	***(n=15)***	***(n=11)***	***(n=75)***
Households collecting (%)	43.3	36.7	53.3	30.0	50.0	36.7	**41.7**
Households selling (%)	0	0	18.7	0	0	0	**4.0**
	(n=0)	(n=0)	(n=3)	(n=0)	(n=0)	(n=0)	**(n=3)**
Mean income (million LAK)	-	-	0.15	-	-	-	**0.15**

Table 6.14 Mushrooms and forest vegetable collection in 2010

	D1			D2			Total
	V1 (n=30)	**V2 (n=30)**	**V3 (n=30)**	**V1 (n=30)**	**V2 (n=30)**	**V3 (n=30)**	**(n=180)**
Mushrooms	***(n=17)***	***(n=25)***	***(n=24)***	***(n=22)***	***(n=26)***	***(n=27)***	***(n=141)***
Households collecting (%)	56.7	83.3	80.0	73.3	86.7	90.0	**78.3**
Households selling (%)	0	4.0	58.3	4.5	38.5	81.5	**34.0**
	(n=0)	(n=1)	(n=14)	(n=1)	(n=10)	(n=22)	**(n=48)**
Mean income (million LAK)	-	0.08	0.14	0.05	0.3	0.5	**0.34**
Forest vegetables	***(n=19)***	***(n=14)***	***(n=14)***	***(n=19)***	***(n=21)***	***(n=18)***	***(n=105)***
Households collecting (%)	63.3	46.7	46.7	63.3	70.0	60.0	**57.8**
Households selling (%)	0	0	7.1	0	42.9	33.3	**15.2**
	(n=0)	(n=0)	(n=1)	(n=0)	(n=9)	(n=6)	**(n=16)**
Mean income (million LAK)	-	-	0.05	-	0.16	0.13	**0.14**

Table 6.15 Resin collection and charcoal production in 2010

	D1			D2			Total (n=180)
	V1 (n=30)	**V2 (n=30)**	**V3 (n=30)**	**V1 (n=30)**	**V2 (n=30)**	**V3 (n=30)**	
Resins	***(n=0)***	***(n=0)***	***(n=3)***	***(n=0)***	***(n=0)***	***(n=1)***	***(n=4)***
Households collecting (%)	0	0	10.0	0	0	3.3	**2.2**
Households selling (%)	-	-	100.0	-	-	100.0	**100.0**
	(n=0)	(n=0)	(n=3)	(n=0)	(n=0)	(n=1)	**(n=4)**
Mean income (million LAK)	-	-	0.43	-	-	0.15	**0.36**
Charcoal	***(n=3)***	***(n=11)***	***(n=5)***	***(n=9)***	***(n=2)***	***(n=12)***	***(n=42)***
Households producing (%)	10.0	36.7	16.7	30.0	6.7	40.0	**23.3**
Households selling (%)	33.3	0	40.0	11.1	0	16.7	**14.3**
	(n=1)	(n=0)	(n=2)	(n=1)	(n=0)	(n=2)	**(n=6)**
Mean income (million LAK)	0.3	-	0.45	0.1	-	1.75	**0.8**

6.5.2 Aquatic animals and trade

Apart from NTFP collection, most farmers in all the survey villages searched for fish and frogs in their paddy fields (Fig. 6.15). Fish were also captured by trapping, casting, or setting nets in rivers or streams (Fig. 6.15), in particular in the villages close to the Mekong River (V1-D1 and V1-D2) or streams (V2-D2). Fish and frogs were captured in both wet and dry seasons, but more in the WS. Over 70% of households captured fish and frogs in 2010 and over a third of them sold some. The average earnings were LAK 2.3 million from fish and LAK 0.3 million from frogs (Table 6.16). Only the mean income from frogs differed at the $p<0.05$ level between villages in D1, with the irrigated village (V1-D1) having the highest income. The case-study households in Appendixes 12, 14, and 15 represent households that captured frogs in paddy fields and fish in the Mekong River. The latter two households captured frogs and fish for their own consumption only, whereas the former household also sold fish and earned up to LAK 4 million in 2010.

(a) Fish from river in Phaling Village (V1-D1)

(b) Frogs from paddy fields in Hieng Village (V3-D2)

Figure 6.15 Fish and frogs in the study area (Author's photo, 2011)

Table 6.16 Fish and frog capture in 2010

	D1			**D2**			**Total (n=180)**
	V1 (n=30)	**V2 (n=30)**	**V3 (n=30)**	**V1 (n=30)**	**V2 (n=30)**	**V3 (n=30)**	
Fish	***(n=22)***	***(n=21)***	***(n=21)***	***(n=23)***	***(n=25)***	***(n=15)***	***(n=127)***
Households capturing (%)	73.3	70.0	70.0	76.7	83.3	50.0	**70.6**
Households selling (%)	36.4 (n=8)	47.6 (n=10)	14.3 (n=3)	65.2 (n=15)	32.0 (n=8)	0 (n=0)	**34.6 (n=44)**
Mean income (million LAK)	2.93	0.82	0.12	3.7	1.35	-	**2.27**
Frogs	***(n=20)***	***(n=23)***	***(n=24)***	***(n=22)***	***(n=19)***	***(n=24)***	***(n=132)***
Households capturing (%)	66.7	76.7	80.0	73.3	63.3	80.0	**73.3**
Households selling (%)	15.0 (n=3)	34.8 (n=8)	37.5 (n=9)	27.3 (n=6)	31.6 (n=6)	54.2 (n=13)	**34.1 (n=45)**
Mean income (million LAK)	0.73	0.32	0.13	0.25	0.4	0.27	**0.29**

Some households in Hieng Village (V3-D2) engaged in trade of NTFPs. They bought NTFPs in the village as well as in other villages in the district, even in areas near the Cambodian border to the south. They sold NTFPs to Thai traders in Song Ta Ou traditional border market (Fig. 6.16; cf. Fig. 4.2 in Chapter 4), open three days a week (Monday, Wednesday, and Friday). The main NTFPs traded were *hed phor* (a kind of mushroom) and *eung* (a kind of frog). In 2010 a kilogram of *hed phor* was sold from THB 120 up to THB 150 while a kilogram of e*ung* was priced for THB 80.[9]

Case-studies of households engaged in NTFP trade at the Song Ta Ou border market are presented in Appendixes 11 and 17. For the household in Appendix 11, the husband went with motorbike to buy NTFPs and wild animals in the village as well as in other nearby villages, normally on the day before the market day. Then the wife went to sell those products to Thai traders in the market. This household earned about LAK 12 million in profit in 2010 from this trading business (which was their highest income source). In case of the household described in Appendix 17, the wife gathered wild products (mainly mushrooms and frogs) from other people in the village before the market day. The following day she brought those products to sell in the market. In 2010 this household earned about LAK 7.2 million profit from this business (i.e., after paying the collectors), which was their highest income source.

Figure 6.16 Song Ta Ou border market between Soukhouma District, Laos, and Bouthalik District, Thailand (Author's photo, 2011)

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[9] THB 1 = LAK 266 (May 2011)

6.6 Conclusion

Though WS rice production was the main livelihood activity of farmers in the study area, they undertook a wide range of other resource-based activities, including cultivation of non-rice crops, livestock-raising, and forest and river utilisation. Water resources were extracted from streams, ponds, and groundwater, as well as irrigation systems. Several households had already begun to utilise available water sources to flood-irrigate a post-rice crop on paddy land as well as to water riverbank or home garden vegetables. The use of electric pumps had lowered the costs of irrigation compared to fuel pumps and allowed the cultivated area to be expanded by relaxing the labour constraint imposed by hand watering. However, the use of electric pumps remained limited to a few households that were closer to both the village and the water source. The diversification of cropping systems through cultivation of non-rice crops was one alternative for improving the productivity and profitability of farming systems and the productivity of water use in the irrigation area. Chapter 5 and this chapter have thus demonstrated that, while the rainfed production system has remained largely subsistence-oriented, farmers have selectively adopted a range of new technologies and continue to respond to changing incentives. The next chapter aims to explain farmers' decisions regarding the intensification of lowland rice systems as well as other non-rice crops in the context of current resource endowments, product demand, and production and market risk.

7 ECONOMIC ANALYSIS OF CROP ACTIVITIES

7.1 Introduction

Rice cultivation remains an essential livelihood activity for the majority of households in the study area. Once the household's objective of rice self-sufficiency has been met, further intensification of rice production is typically compared to other commercial options for utilising household resources. This includes alternative uses of paddy land, household labour, and capital. That is, it becomes a more commercial decision as to how the household can maximise the returns to its resources. While economic return is not the only factor influencing this decision, it is a strong motivator of household decisions.

In recent years the area of rice production in the study area has decreased as land resources are allocated to higher value activities or left fallow. Similarly labour is seeking a higher return in both the agricultural and non-agricultural sectors, including wage employment in industrial plantations. These trends will continue to put pressure on rural wages. With the wage rate and the opportunity cost of using household labour increasing, the returns to labour have become the key consideration when deciding whether to intensify rice production systems, either through increased use of inputs, especially fertiliser, or by double cropping where irrigation is available.

This chapter presents an economic analysis of lowland rice production in the conditions faced by a typical farmer in the study area. This is then used as a basis for examining the returns to intensified rice production in the wet season (WS) to achieve the government's yield targets. The analysis is then extended to evaluate the relative returns to irrigated rice and non-rice crops in the dry season (DS) for those farmers with access to irrigation infrastructure or small-scale sources of irrigation such as riverside gardens, farm ponds, and groundwater bores. Finally, the chapter elaborates options for rice intensification.

7.2 Methods

There are many economic appraisal tools for assessing the profitability of agricultural production. The technique of enterprise budgeting was used for this analysis. Enterprise budgeting is a relatively simple technique but can nevertheless provide a powerful and well-grounded analysis that corresponds to farmers' decision-making about household resource allocation. Enterprise budgets require detailed and accurate data on input requirements, crop yields, and input and output prices, whether these data are obtained from surveys, record-keeping, expert opinion, or experiments (Dillon, 2003). They can then be used to examine plausible alternative scenarios by varying key parameters in the budget.

The enterprise budget for WS rice was based on a representative farm, representing the most commonly observed situation of rice farmers in the study area. As shown in Chapter 5, there was little variation between households or villages in the scale and technology of WS rice production. An enterprise budget for one hectare of WS rice production was constructed, incorporating the material and labour inputs and the physical and economic returns. Estimates of costs and yields were obtained from the household survey and from case studies of selected households conducted in 2011. This concept was also applied to the enterprise budget for DS rice, with slight adjustment to reflect the inputs and labour used in DS rice cultivation. Enterprise budgeting was also undertaken for the two most important DS crops, sweet corn and watermelon. The estimates for these budgets were derived from case-study interviews conducted in May 2013.

To help understand the adoption patterns for fertiliser use, enterprise budgeting scenarios were developed based on the household survey and case study data, supplemented with field experimental results. These include data from fertiliser response trials conducted by IRRI and NAFRI over more than a decade (Haefele et al., 2010, Linquist and Sengxua, 2003, Linquist and Sengxua, 2001). These representative budgets were first developed using estimated values for prices and yields, then sensitivity and threshold analysis and risk analysis were applied to explore the impact of key variables on farmer returns. A range of indicators was used in an attempt to capture the criteria for farm-household decision-making with regard to input use.

The gross margin (GM) was defined as the gross value of rice production at market prices, or gross income (GI), less variable input costs (VIC), that is, the cost of all current inputs, whether in cash or kind, but not including household labour. This measured the income earned by the household's resources of land, labour, and capital. When divided by the number of days of household labour (GM/day), it gave the best indicator of the relative advantage of the practice to the farmer as it could be readily compared with the prevailing wage rate (W) – which is an upper-bound estimate of the opportunity cost of household labour. Hence GM/day can be considered a useful proxy measure of the "returns to labour". The net income (NI) or, strictly, the "margin after labour costs", was defined as the GM less the imputed cost of household labour (LC), valued at the rural wage rate. When expressed on a per hectare basis it can be considered a proxy measure of the "returns to land". Total variable costs (TVC) were defined as variable input costs plus household labour cost

(VIC + LC). In summary, GM = (GI – VIC) while NI = (GM – LC) = (GI – TVC).

Marginal analysis of the returns to incremental changes in fertiliser use was also undertaken. The marginal net return (MNR) was defined as the increment in NI attributable to moving from a lower to a higher level of input use. The marginal rate of return (MRR) was defined as the MNR divided by the associated increment in TVC, expressed as a percentage. The MRR was evaluated against different benchmarks to reflect the minimum returns farmers generally expect from an additional investment of scarce capital and labour in a risky environment. Previous studies have suggested a MRR of at least 100% is required before adoption of major new investment is likely, although 50% may be sufficient for relatively small system changes (CIMMYT, 1988).

Among the indicators, GM/day was one of the most important criteria as a household's labour resource is a key limiting factor in pursuing alternative rural livelihoods. Households can direct their labour into the production of crops to meet their subsistence needs, the cultivation of cash crops for the market, or off-farm work such as daily wages for transplanting or harvesting rice. Non-farm employment opportunities in both Laos and neighbouring Thailand have also become an attractive option, pulling labour out of traditional semi-subsistence agricultural production (as analysed in Chapter 8).

In May 2013 a small-group discussion was held with farmers in Boungkeo Village in Soukhouma District and Phaling Village in Phonethong District. Farmers were presented with both the representative budget and the intensification scenarios for comments, validation, and modification. In general, the estimated level of material inputs was close to what farmers thought was the case, but input prices had increased since 2010. Labour requirements had been slightly overestimated, although there was considerable variation in the labour used for transplanting and harvesting. The three main indicators (NI/ha, GM/ha, and GM/day) were also discussed in terms of their usefulness for farmers for evaluating activities. Farmers preferred the NI/ha measure to the GM/ha as it explicitly placed a value on their own labour, but they found the GM/day an easy way to compare the returns to different activities with the opportunity cost of labour at different times of the year and for different household members.

7.3 Economic appraisal of WS rice production: current representative production system

The enterprise budget presented in this section is for a representative WS rice farm of one hectare, using 2010 prices. The costs associated with rice production comprise material costs and labour costs. The material inputs are rice seed, inorganic fertilisers, and fuel for the two-wheeled tractor used to prepare the land. The labour costs are the imputed value of household labour.

It was assumed that there was no cost involved with the use of organic fertilizer, the use of a two-wheeled tractor for land preparation, or the use of the land. As mentioned in Section 5.2.5, about two thirds of the households growing rice in WS 2010 used organic fertiliser, with almost 90% of them using buffaloes and/or cattle manure. In most cases the livestock were tethered in the paddy fields in the DS. The tethering work was normally part of undertaking other activities such as the collection of NTFPs. For those with few or no livestock who collected manure and brought it to their paddy fields, the manure was normally used only on the seedbed due to the limited amount available. In the latter case, the labour used for collecting manure was included in the labour requirement for seedbed preparation and sowing (Table 7.1). The depreciation cost of two-wheeled tractors used for land preparation was considered to be negligible due to the multiple uses of a tractor, making it difficult to allocate the share of depreciation due to rice farming. The tractor was only used for only a few days a year for ploughing paddy fields and then used for other purposes such as transportation for the rest of the year. Including the small depreciation cost of the tractor in the analysis would not make much difference to the outcomes. The value of land has not been included as there was plenty of empty land and even when people used other people's land there was often no payment.

Table 7.1 shows the estimated quantities of the materials used and their prices as reported for WS 2010. It was estimated that three sacks of rice seed (30 kg/sack) were broadcast on the seed bed to produce the rice seedlings needed for a one hectare paddy field. The rice seed was typically the farmer's own seed, kept from the previous year. About 10 kg of urea (46-00-00) was applied during seedbed preparation. The most popular inorganic fertilisers used on the rice field were 16-20-00 for basal application and 46-00-00 for top-dressing. It was assumed that one sack (50 kg/sack) each of 16-20-00 and 46-00-00 was applied. About 30 litres of fuel were used for two rounds of land preparation. In addition, there was a threshing fee as most farmers used a tractor-powered threshing service. The most common arrangement for hiring the threshing service was on a crop-share basis in the ratio 20:1, that is, the farmer paid 5% of his rice production to the threshing service providers.

Labour requirements in each production phase for WS rice production (land preparation, planting, maintenance, and harvesting), expressed in person-days, are also shown in Table 7.1 and Fig. 7.1. The first round of land preparation was undertaken in May with a two-wheeled tractor, normally operated by male family members (household head and/or son). Later, in early June, the seedbed was also established, with the land preparation done by men and the seed broadcast by women. Inorganic fertiliser was applied as a basal application to the seedbed and as a top-dressing to the rice seedlings. The labour requirement was four person-days for the first round of land preparation and two person-days for preparing and sowing the seedbed.

Table 7.1 Enterprise budget for typical WS rice production on one hectare (2010 prices)

Items	Unit	Amount	Price*	Value
Material				
Rice seed	kg	90	2,000	180,000
Fertiliser (46-00-00) for seedbed	kg	10	5,000	50,000
Fertiliser (16-20-00) for basal dressing	sack	1	230,000	230,000
Fertiliser (46-00-00) for topdressing	sack	1	220,000	220,000
Fuel for 2-wheel tractor to prepare land	litre	30	9,000	270,000
Threshing fee (5% of total harvest)	kg	100	2,000	200,000
Variable input cost (VIC)	LAK			**1,150,000**
Labour				
First land preparation	person-days	4		
Seedbed preparation and sowing	person-days	2		
Second land preparation (incl. transplanting)	person-days	30		
Water and weed management	person-days	12		
Harvesting, threshing, hauling	person-days	45		
Total labour	person-days	**93**		
Wage rate	LAK/person-day		30,000	
Imputed labour cost (LC)	LAK			**2,790,000**
Total variable cost (TVC)	LAK			**3,940,000**
Returns				
Paddy rice yield	kg	2,000		
Paddy rice price (Pr)	LAK/kg		2,000	
Gross income (GI)	LAK			**4,000,000**
Gross margin (GM)	LAK			**2,850,000**
Net income (NI)	LAK			**60,000**
GM per person-day	LAK/person-day			**30,645**

* USD 1 = LAK 8,027 (May 2011).

Sources: household survey (May 2011), case-study interviews (September 2011), and focus-group interviews (May 2013).

The second round of land preparation was done in late June, along with applying basal fertiliser and pulling up the seedlings and bundling them to transport to the field for transplanting. Again, the second round of land preparation was usually undertaken by male family members. Other family members transplanted the rice seedlings, with some exchange labour or hired labour if needed to complete the task. Totally, about 30 person-days were needed to finish the second round of land preparation and transplanting the rice seedlings.

After planting rice from July to September, normally one or two family members managed water in the field, removed weeds by hand, and applied fertiliser, working for half a day on alternate days. About 12 person-days were required for these operations. Fences were not normally established, especially for the inner paddy fields; the outer paddy fields were sometimes fenced to protect the rice crop from livestock. However, livestock owners had to look after their livestock to avoid damage to the crop and were responsible for any damage that occurred. Hence no fencing cost was included in the budget.

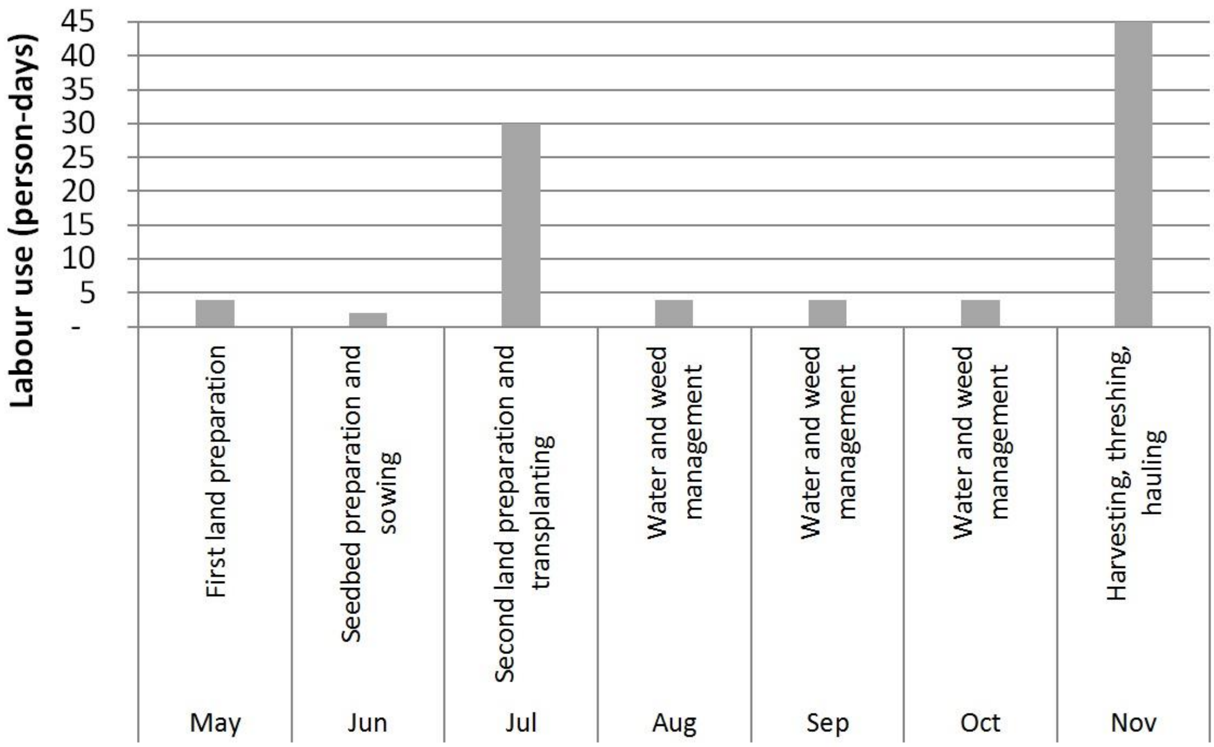

Figure 7.1 Monthly labour requirements for one hectare of WS rice production

Rice was harvested from early November and the harvesting operation required 45 person-days. Rice was then threshed by tractor-powered thresher. Although farmers paid for the threshing service, they normally supplied some labour as well as transporting the rice to the thresher and hauling the bags of threshed grain to the barns, normally close to their houses.

Overall, about 93 person-days were required for one hectare of rice production in the WS. The 2010 farm wage rate of LAK 30,000/person-day was used to impute a value to the unpaid family labour used.

The return from WS rice production was valued based on the yield of paddy rice achieved in the 2010 WS and the expected price of paddy rice in 2010 (Table 7.1). The WS 2010 rice yield in the household survey averaged about 1.8 t/ha. However, as mentioned in Chapter 5, the 2010 WS was considered by farmers and researchers to be a drier than normal year, with reported yields (calculated from farmers' estimates of cultivated area and production) somewhat lower than in previous years. Hence, for this analysis a yield of 2 t/ha was assumed as this was reported to be a typical yield over several seasons. The analysis revealed the gross margin per day of family labour (GM/day) for WS rice production was nearly LAK 31,000/day, roughly equal to the 2010 farm wage rate. Hence, when imputed labour costs were deducted from the GM, the NI was just positive (LAK 60,000/ha or about USD 7.5).

7.4 Economic appraisal of WS rice production: intensified production systems

The following analysis aims to explain farmers' decisions regarding intensification of WS rice production in the context of current resource endowments, product demand, and production and market risk. As highlighted in Chapter 5, while the WS production system remains largely subsistence-oriented, farmers have selectively adopted a range of new technologies and continue to respond to changing incentives. However, to date this has largely involved the adoption of low-input, more labour-efficient, and more stable production systems rather than commercially-oriented, high-input, high-yield systems that would be needed to achieve Government yield and production targets.

7.4.1 The input (fertiliser-yield) scenarios

The household survey and case study data were supplemented with agronomic trial results in order to construct enterprise budgets for various input scenarios, ranging from farmers' practice to the input levels required to achieve Government policy targets. As noted above, these included data from fertiliser response trials conducted by IRRI and NAFRI over more than a decade (Haefele et al., 2010, Linquist and Sengxua, 2001, Linquist and Sengxua, 2003). Official yield data were not used as these tend to overestimate actual farm yields (Pandey and Sanamongkhoun, 1998), presumably a reflection of the pressure to show progress in achieving policy targets. The four scenarios are outlined below.

Scenario 1 (No-Input) – In this scenario, yield estimates are based largely on experimental results for trials in which no inorganic fertiliser was added to the transplant crop. The household survey suggests that this represents around 30% of households. Both survey and experimental results show wide variation in the yields obtained where no inorganic fertiliser is used due to factors such as the indigenous soil fertility, soil-water balance properties, and other management practices. An average yield of 1.5 t/ha has been assumed here.

Scenario 2 (Low-Input) – This scenario is based on the current low-input system that many households adopt. It assumes again that households use inorganic fertiliser to establish seedlings but then apply 1 bag (50 kg) of 16-20-00 as a basal application, followed by a top-dressing of 1 bag of urea. This results in a rate of 31-10-0 kg/ha of N-P_2O_5-K_2O. An average paddy yield of 2 t/ha has been estimated (as in the representative budget in Table 7.1 above).

Scenario 3 (**Medium-Input**) – This scenario was developed using the current broad recommendation of 60-30-30 kg/ha of N-P_2O_5-K_2O. This is applied through a basal application of 15-15-15 (200 kg/ha) with the remaining N coming via top-dressing with urea. The yield assumption is based on adjusted experimental results (allowing for the well-known yield loss when moving from small to large plots). Again, experimental results have shown a range of responses to applied nutrients according to location. An average yield of 3 t/ha has been assumed.

Scenario 4 (High-Input) – This was based on ongoing experimental work in Champasak Province (Benjamin Samson and Pheng Sengxua, pers. comm., 15 March 2013) where a high rate is used in an attempt to achieve the Government target yield of 4 t/ha. The current trials have site-specific application rates with no replications and therefore it has been necessary to estimate an average treatment with a rate of 120-60-60 kg/ha of N-P_2O_5-K_2O, resulting in a yield of 3.75 t/ha, based on experimental results from the WS 2011 and 2012.

Other key assumptions are presented in Table 7.2, including the values used for sensitivity analysis. Sensitivity analysis was conducted on the main input costs (fertiliser prices and fuel prices) and wage rates. In 2010 the price of fertiliser varied between locations, particularly for fertilisers such as 16-20-00, 46-00-00, and 15-15-15 in more remote areas, and by 2012 the price of these fertilisers had increased across Champasak Province (Fig. 7.2). Furthermore, fuel prices had increased and wage rates continued to rise, adding to the cash outlay of farmers.

Sensitivity analysis was also applied to take into account the variable farm-gate prices of paddy, based on the high 2010 price and the 2012 price in Champasak, which was extremely low. The farmer groups consulted in 2013 also considered this to be the lowest price that traders would offer before not coming to purchase rice at all. Threshold analysis was conducted on the farm-gate price of paddy to achieve various criteria.

The labour required for each scenario was only varied for harvesting, threshing, and hauling, which are related to crop yield. As recorded in Table 7.1, the labour needed for harvesting-related activities of 2,000 kg of paddy rice is 45 person-days. It was assumed that labour would increase by a further 11 person-days for each additional 1,000 kg of rice to be harvested, thus the labour requirement for harvesting 3,000 kg of paddy rice was assumed to be 56 person-days (Table 7.3). The variation in labour for fertiliser application was minor, occurring during other operations.

Table 7.2 Assumptions for scenario budgets

Parameter	Base assumption	Sensitivity analysis
Farm gate price of paddy rice	LAK 2,000/kg	LAK 1,200 and 3,500/kg
Fertiliser price		
- 16-20-00	LAK 230,000/sack	LAK 250,000/sack
- 46-00-00	LAK 220,000/sack	LAK 250,000/sack
- 15-15-15	LAK 250,000/sack	LAK 300,000/sack
Fuel price	LAK 9,000/litre	LAK 10,000/litre
Wage rate	LAK 30,000/day	LAK 50,000/day

Note: USD 1 = LAK 8,027 (May 2011)

Table 7.3 labour requirement for harvesting, threshing, and hauling for various yields

Yields (kg/ha)	Labour for harvesting-related activities (person-days)
1,000	34
2,000	45
3,000	56
4,000	67
5,000	78
6,000	89

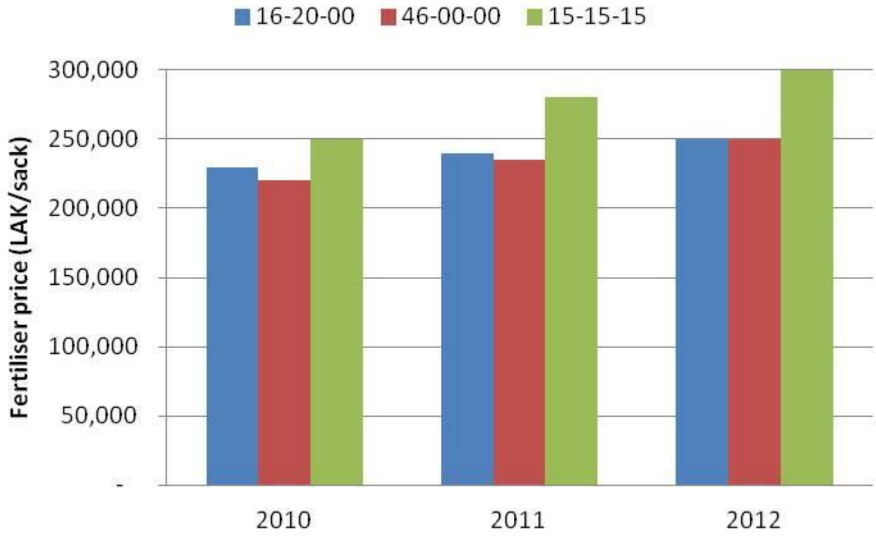

Figure 7.2 Prices of main inorganic fertilisers sold in Champasak Province
Source: MIC (2013a)

7.4.2 Enterprise budgets and sensitivity analysis

The scenario analysis confirms the marginal nature of rice farming in the rainfed lowlands of Laos, and the challenge facing farmers and Government alike (Table 7.4).

For the No-Input scenario, the GM is positive, but when calculated as a ratio to household labour, the GM/day is below the 2010 wage rate of LAK 30,000/day. That is, while there are positive returns to household-owned resources (land, labour, durable capital), these are not sufficient to provide a return greater than the upper-bound estimate of the opportunity cost of household labour. Hence the NI, which is net of imputed labour costs, is negative.

The Low-Input scenario produces a small, positive NI and as such the GM/day is slightly above the market wage. There is thus a positive marginal net return (MNR) to moving from the No-Input to the Low-Input scenario, with a marginal rate of return (MRR) of 50% on incremental investment (including the imputed cost of household labour).

The Medium-Input scenario provides a further increase in NI per hectare and a GM/day above the opportunity cost of labour by an additional LAK 9,000/day (over USD 1/day). Moving from the Low- to the Medium-Input scenario provides a MRR of 84%.

However, a further movement to the High-Input scenario sees the NI/ha and GM/day both fall, although the GM/day remains just above LAK 30,000/day. As such, this is considered to be a dominated scenario (D).

Threshold analysis was conducted on the farm-gate price of paddy (Pr) to determine at what price (a) the NI would become positive, (b) the GM/day would be LAK 50,000/day, (c) there would be a positive MRR from moving to the next scenario, and (d) the MRR would be greater than 50% and 100%. The results, shown in the last lines of Table 7.4, indicate that, unless the paddy price increases to nearly LAK 2,000/kg, the NI for a Low-Input system will be negative, but as long as the price is above about LAK 1,300/kg there is still some gain relative to applying no fertiliser at all. The threshold prices for realising positive returns to the Medium- and High-Input scenarios were in the achievable range, but the price would have to be very high indeed (> LAK 4,500/kg) for the move from Medium-Input to High-Input to offer an acceptable rate of return.

The impact of higher assumed costs on the economic indicators can be seen in Table 7.5. The increase in input prices reduces the NI such that all scenarios produce a negative result. Increased fertiliser and fuel costs reduce the GM/day such that the Medium- and High-Input scenarios are barely above the previous wage rate (LAK 30,000/day), but are now below the new, higher wage of LAK 50,000/day. A move from No-Input to Low-Input still marginally improves the GM but only achieves a MRR of 21%. Similarly, a further increase to the Medium-Input Scenario improves the GM and GM/day, but also falls short of an acceptable MRR. The High-Input Scenario is again dominated.

The preceding analysis further highlights the marginal nature of rainfed lowland rice production and the difficulties in maintaining a viable intensification and commercialisation pathway for households, given the economic environment. The situation was made worse in 2011 and 2012 when the farm-gate price of paddy fell to as low as LAK 1,200/kg. At this price the GM/day for each scenario is far less than the current wage rate of LAK 50,000/day (Table 7.6). On the other hand, during the price spike that was part of global food price instability in 2010, when farm-gate prices reached LAK 3,500/kg in some regions, the GM/day from intensification strategies looked promising. However, farmers in discussion groups in 2013 did not expect that prices would again be at that level in the coming season, but expected a return to prices around LAK 2,000/kg.

Table 7.4 Economic analysis of fertiliser-input scenarios

	No Input	Low Input	Medium Input	High Input
Fertiliser applied (kg/ha of N-P_2O_5-K_2O)	0-0-0	31-10-0	60-30-30	120-60-60
Yield (t/ha)	1.5	2	3	3.75
GI (LAK/ha)	3,000,000	4,000,000	6,000,000	7,500,000
TVC (LAK/ha)	3,275,000	3,940,000	5,026,000	6,635,000
NI (LAK/ha)	-275,000	60,000	974,000	865,000
GM (LAK/ha)	2,350,000	2,850,000	4,094,000	4,233,000
GM/day (LAK/day)	26,857	30,645	39,365	37,710
MNR (LAK/ha)		335,000	914,000	-109,000
MRR (%)		50%	84%	D
Threshold Pr for positive NI (LAK/kg)	2,206	1,967	1,658	1,757
Threshold Pr for GM/day of LAK 50,000 (LAK/kg)	3,517	2,994	2,388	2,387
Threshold Pr for positive MNR (LAK/kg)		1,295	1,121	2,152
Threshold Pr for MRR > 50% (LAK/kg)		1,995	1,755	3,316
Threshold Pr for MRR > 100% (LAK/kg)		2,733	2,328	4,543

Note: Labour cost LAK 30,000/day; paddy price (Pr) of LAK 2,000/kg; USD 1 = LAK 8,027 (May 2011); D = Dominated scenario

Table 7.5 Sensitivity analysis of variation in fertiliser costs and wage rates

	No Input	Low Input	Medium Input	High Input
Fertiliser applied (kg/ha of N-P_2O_5-K_2O)	0-0-0	31-10-0	60-30-30	120-60-60
Average yield (t/ha)	1.5	2	3	3.75
GI (LAK/ha)	3,000,000	4,000,000	6,000,000	7,500,000
TVC (LAK/ha)	5,055,000	5,880,000	7,375,000	9,388,000
NI (LAK/ha)	-2,055,000	-1,880,000	-1,375,000	-1,888,000
GM (LAK/ha)	2,320,000	2,770,000	3,825,000	3,725,000
GM/day (LAK/day)	26,514	29,785	36,779	33,185
MNR (LAK/ha)		175,000	505,000	-513,000
MRR (%)		21%	34%	D
Threshold Pr for positive NI	3,539	3,039	2,482	2,530
Threshold Pr for positive MNR (LAK/kg)		1,632	1,514	2,719
Threshold Pr for MRR > 50% (LAK/kg)		2,513	2,229	4,189
Threshold Pr for MRR > 100% (LAK/kg)		3,444	2,917	5,741

Note: Labour cost LAK 50,000/day; paddy price (Pr) of LAK 2,000/kg; USD 1 = LAK 8,027 (May 2011); D = Dominated scenario

Table 7.6 Sensitivity analysis of variation in farm-gate paddy prices

	No Input	Low Input	Medium Input	High Input
Farm-gate price of paddy of 1,200 LAK/kg				
NI (LAK/ha)	-3,123,000	-3,328,000	-3,655,000	-4,737,000
GM (LAK/ha)	1,252,000	1,322,000	1,545,000	875,000
GM/day (LAK/day)	14,309	14,215	14,856	7,795
Farm-gate price of paddy of 3,500 LAK/kg				
NI (LAK/ha)	-53,000	835,000	2,900,000	3,456,000
GM (LAK/ha)	4,322,000	5,485,000	8,100,000	9,069,000
GM/day (LAK/day)	49,400	58,978	77,885	80,791

Note: Labour cost LAK 50,000/day; input prices based on Table 7.5; USD 1 = LAK 8,027 (May 2011)

Given these results, what strategy should a farm-household adopt? A move from the No-Input to Low-Input scenario improves the NI/ha and the GM/day, but the NI would remain negative under 2012 conditions. Furthermore, the MRR of the change is only 50% under the 2010 price conditions and 21% if the higher costs are assumed. However, assuming household self-sufficiency is the overriding objective, some households with smaller areas of paddy may be induced to apply the additional fertiliser needed to reach their subsistence requirement, even though marginal returns to labour and capital are low. This is illustrated in Fig. 7.3, which maps the total paddy production from different sized farms for each of the four scenarios. As can be seen, a No-Input household with 1.2 hectares could move from being 75% self-sufficient, with an output of 1,800 kg, to 100% self-sufficient, with an output of 2,400 kg, by adopting the Low-Input package.

Under the 2010 price conditions, a move from the Low-Input scenario to the Medium-Input scenario provides a positive NI/ha and a GM/day above the wage rate. This move provides a MRR of 84% (or a 71% return if the Low-Input strategy is considered dominated and removed). The threshold analysis on paddy price suggests that this scenario is likely to provide positive NI and MNR for most price scenarios, and a small increase in the price would deliver a MRR greater than the CIMMYT rule-of-thumb of 100%. Even allowing for an increased price of fertiliser, this outcome holds. However, the increase in the cost of labour to LAK 50,000/day pushes this scenario to a negative NI unless the paddy price is above about LAK 2,500/kg.

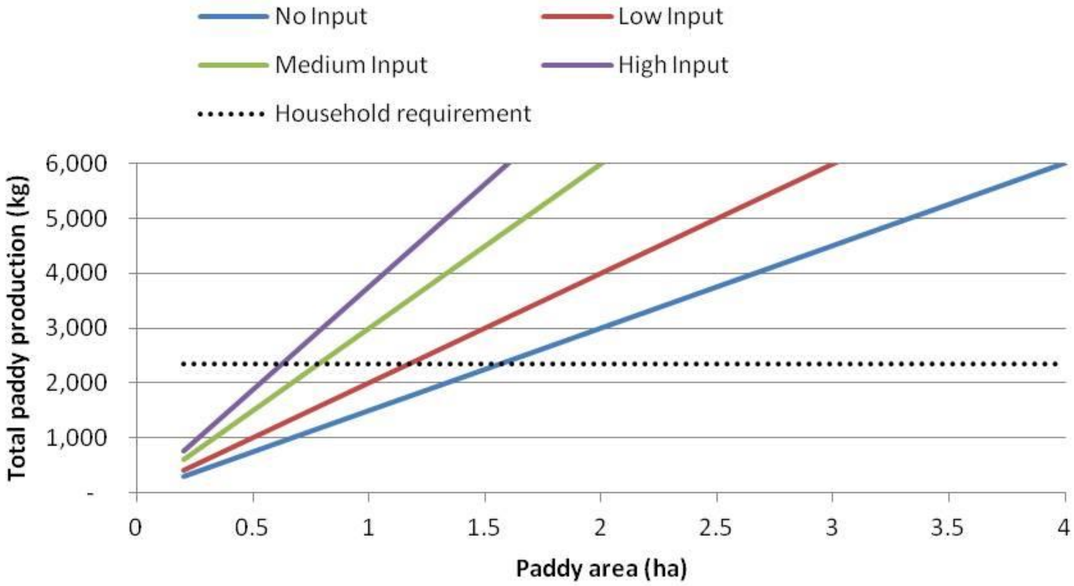

Figure 7.3 Total paddy production for each input scenario by paddy area

It is very unlikely that a household would adopt the High-Input scenario, given that returns to both land and labour decline compared to the Medium-Input case. Nevertheless, a land-scarce household may be forced to adopt this strategy if achieving household self-sufficiency remains the dominant objective, given that the GM/day remains above the wage rate. However, households with acute land constraints are also less likely to have the capital to make the necessary investment.

Given that labour use does not greatly increase with increased fertiliser application, rising wage rates are not predicted to impact greatly on the WS intensification decision, though they will impact on the overall economic performance of all scenarios. On the other hand, for households with access to irrigation water that enables cultivation of a DS crop, the question becomes of greater importance, given that self-sufficiency may be achieved in the WS, allowing labour to move off-farm and earn relatively higher returns in the DS. As shown in Table 5.27 in Chapter 5, some surveyed farmers in the irrigated villages were making this decision and not growing a second rice crop in DS 2010-11; rather, they made their irrigable land available to households with smaller paddy areas who had not yet achieved self-sufficiency in the WS.

7.4.3 Risk analysis of fertiliser-yield scenarios

The results of the enterprise budgeting suggest that households would be willing to adopt the Medium-Input scenario, provided they are satisfied with a return on additional investment of labour and working capital of between 50 and 100%. However, this analysis is based on representative budgets that ignore both production and market risk, both of which are vital considerations in the rainfed lowlands. The sensitivity analysis showed the influence of recent price fluctuations on the outcome. In addition, another factor profoundly affecting the economic outcome is the effect of weather, pests, and other stochastic variables on grain yields. Risk analysis was conducted to assess the stability of the results to fluctuating paddy prices and uncertain grain yields.

The paddy price in recent years has fluctuated widely in response to supply shocks brought about by floods and droughts, and by demand shocks, transmitted from elsewhere in the Mekong region (Clarete, 2012, Eliste and Santos, 2012). Both these shocks have been exacerbated by policies aimed at securing national or regional food supplies through various ad hoc trade restrictions. The monthly price of paddy in Champasak Province for the past five years, averaged across mills, is presented in Fig. 7.4. The figure includes the nominal prices recorded and real prices computed in December 2012 values, averaged over the five-year period. Both the peak in 2010 and the low points in 2011-12 can be attributed to local and regional production failures and various government responses. This led to increases in stocks from the 2011 season, with the price falling further in late 2012 after the WS harvest.

For the risk analysis, due to the nature of the continuous variables, triangular distributions were created for both the grain yields from each scenario and the paddy price, requiring estimates of minimum, most likely, and maximum values (Table 7.7) (Hardaker et al., 2004). Three values of rice yields for each scenario were drawn from fertiliser response trials conducted by IRRI and NAFRI (mentioned earlier in this chapter), following a consultation with locally-based IRRI and NAFRI agronomists (Benjamin Samson Benjamin and Pheng Sengxua, pers. comm., 15 March 2013). The maximum and minimum paddy prices were based on the high 2010 price and the low 2012 price in Champasak, while the most likely paddy price was the "normal" farm-gate price farmers in the study area had received in recent years and which they also expected to receive in the future. It should be noted that the prices used in Table 7.7 have been adjusted from the mill prices in Fig. 7.4 to reflect the farm-gate price. With regard to input prices, low-price and high-price assumptions were tested, giving rise to two versions of the risk analysis. The model budgets including the stochastic variables for price and yield were run using the @RISK software package (Version 6) to determine the probability of important criteria being satisfied (Palisade Corporation, 2012).

The results of Version 1 of the risk analysis, assuming the lower input prices for fertiliser, fuel and labour (the base case assumptions in Table 7.2), are presented in Fig. 7.5 and Table 7.8. The cumulative distributions (CD) of the returns to household labour (GM/day) for each scenario in Fig. 7.5 show that the Low-Input scenario displays first-degree stochastic dominance (FSD) over the Medium-Input scenario (that is, the CD of the former lies everywhere to the right of the CD of the latter) which in turn shows FSD over the High-Input scenario, while the No-Input scenario displays second-degree stochastic dominance (SSD) over the High-Input scenario (that is, the cumulative difference in area between the two CD curves is always positive in favour of the former, moving from left to right). FSD requires no assumptions about risk attitudes, only that the farmer prefers more income to less. SSD requires the plausible assumption that the farmer is risk averse, that is, given two options with the same income, the less risky option will be preferred (Anderson et al., 1977). In other words, the High-Input scenario does not stand up in the risky environment of the rainfed lowlands, while the Low-Input scenario is to be preferred, with the Medium-Input scenario not far behind. For a risk-averse farmer, even the No-Input scenario is preferable to the High-Input scenario.

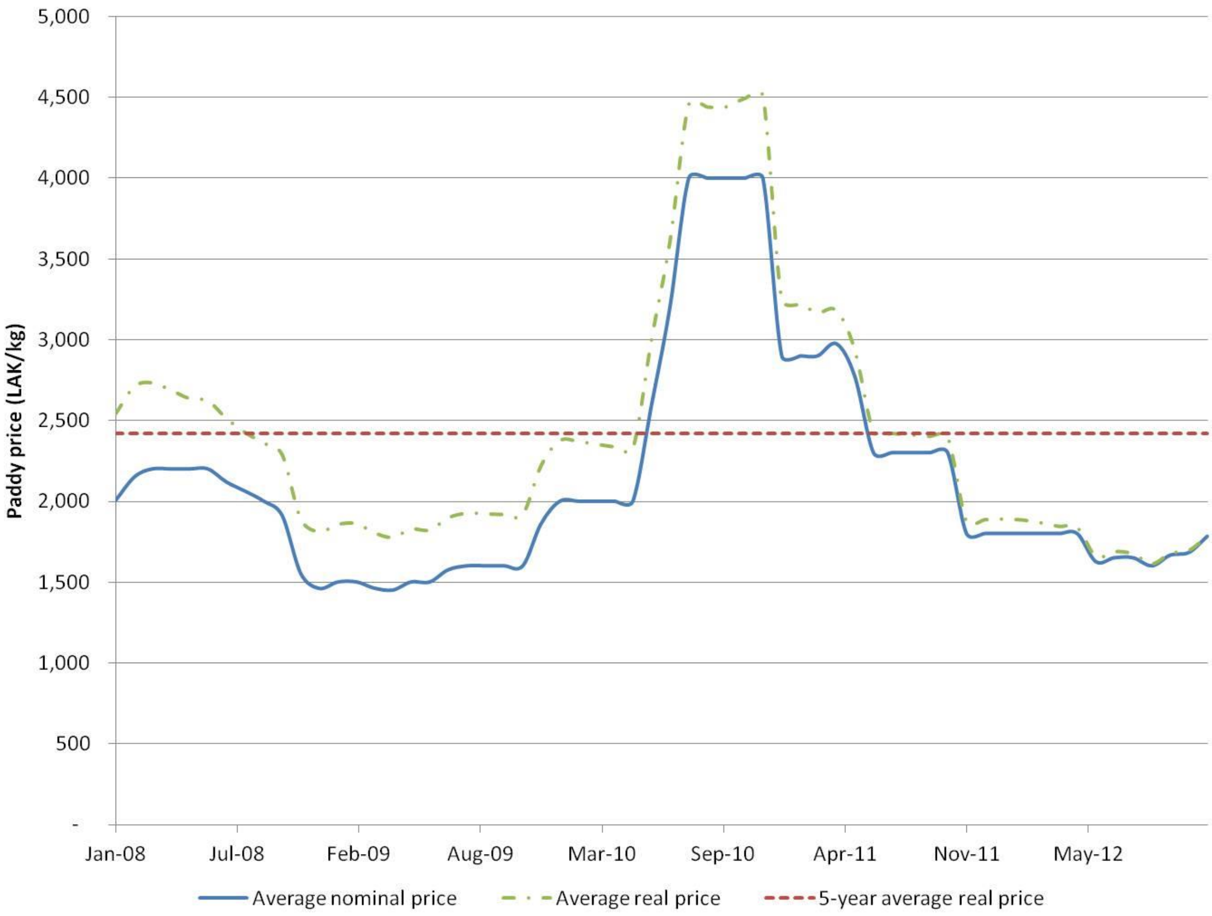

Figure 7.4 Monthly average nominal and real paddy prices (at mills) in Champasak, 2008-2012
Source: MIC (2013b)

Table 7.7 Values for triangular distributions

	Rice yield (kg/ha)				Paddy price
	No Input (0-0-0)	Low Input (31-10-0)	Medium Input (60-30-30)*	High Input (120-60-60)	(LAK/kg)
Minimum value	200	200	200	200	1,200
Most likely value	1,400	2,000	2,500	3,500	2,000
Maximum value	3,000	4,000	4,500	5,000	3,500

* Current recommendation

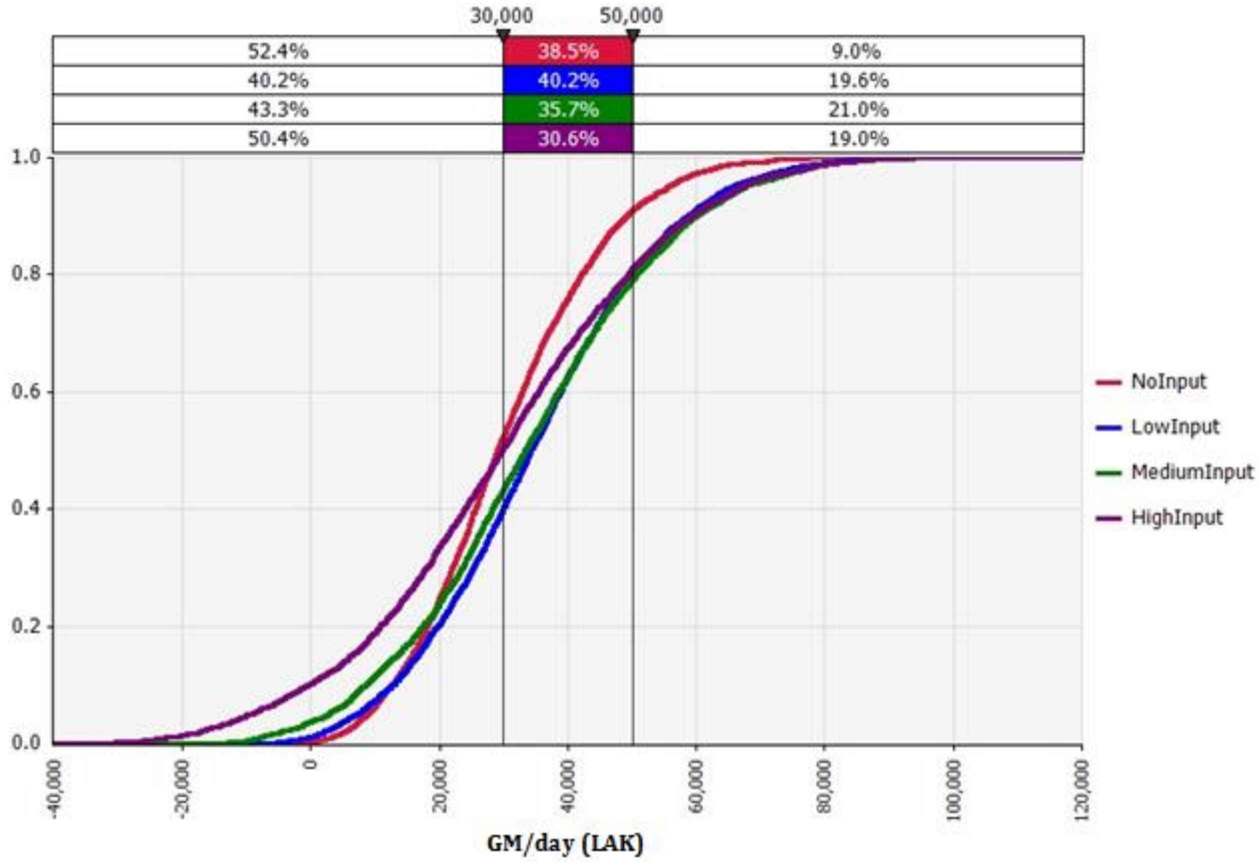

Figure 7.5 Cumulative distribution of GM/day (LAK) for fertiliser-yield scenarios (Version 1)

Fig. 7.5 also shows the challenge under all scenarios as wage rates continue to increase, with benchmarks of LAK 30,000 and 50,000 per day shown by the vertical lines in the diagram. There is only a 9-21% chance of a GM/day above LAK 50,000. Though some farmers may get this level of return, it is slightly lower than the wage rate for non-farm work in Laos and much lower than the minimum daily wage rate in Thailand (i.e., THB 300 or about LAK 80,000).

Table 7.8 shows the probability of important criteria being met. Across the scenarios, the probability that the GM/ha was positive was between 90 and 100%, with yields high enough to at least pay for cash costs (fertiliser, fuel, and seed). However, the probability that the GM/day was above LAK 30,000 (equivalent to a positive NI, given that labour is valued at the same rate) ranged between 48 and 60%. That is, discounting self-sufficiency objectives, growing rice in all scenarios was only better than wage-earning in around 54% of the iterations. If the higher wage rate (LAK 50,000/day) is considered, this falls to less than 22%. In only 60% of the iterations was there a positive marginal net return (MNR>0) in moving from the No-Input to the Low-Input scenario. Similarly, it was beneficial to move further to the Medium-Input scenario less than half the time.

This suggests that, if households have enough land to achieve self-sufficiency, they would prefer to accept low yields and low average returns, given the low marginal rates of return to further intensification and the high risk they will receive zero benefit. However, as remarked above, some households with small paddy areas may have little choice but to apply fertiliser up to the point at which they can achieve self-sufficiency, provided the returns to labour do not fall too far below the wage rate.

Table 7.8 Risk assessment of fertiliser-yield scenarios

	No Input	Low Input	Medium Input	High Input
Version 1				
Mean NI (LAK/ha)	102,000	607,000	558,000	181,000
Mean GM (LAK/ha)	2,738,000	3,419,000	3,480,000	3,268,000
		Probability of occurrence (%)		
GM > 0	~100	99	96	90
NI > 0 or GM/day > LAK 30,000	48	60	57	50
GM/day > LAK 50,000	9	20	21	19
MNR > 0		60	49	44
MRR > 50%		36	25	12
MRR > 100%		29	19	6
Version 2				
Mean NI (LAK/ha)	-1,692,000	-1,353,000	-1,649,000	-2,395,000
Mean GM (LAK/ha)	2,702,000	3,334,000	3,221,000	2,750,000
		Probability of occurrence (%)		
GM > 0	~100	98	94	86
NI > 0 or GM/day > LAK 50,000	9	19	17	13
MNR > 0		57	43	35
MRR > 50%		24	14	4
MRR >100%		17	9	1

The risk analysis was repeated (Version 2) using the higher price assumptions for fertiliser, fuel and labour (Fig. 7.6 and Table 7.8). Fig. 7.6 again shows that the Low- and Medium-Input scenarios display clear first-degree stochastic dominance over the High-Input scenario, and the No-Input scenario displays second-degree stochastic dominance over the High-Input scenario. The Low-Input Scenario, corresponding closely to the current practice of most farmers, emerges even more strongly as the preferred alternative. The results in Table 7.8 also confirm that higher input prices limit the incentive to go beyond a Low-Input system. In all cases the High-Input system provides no attraction to farmers, giving a negative average net income and a lower probability of achieving the key criteria. Furthermore, the possibility of a GM/day above LAK 50,000 was less than 20%.

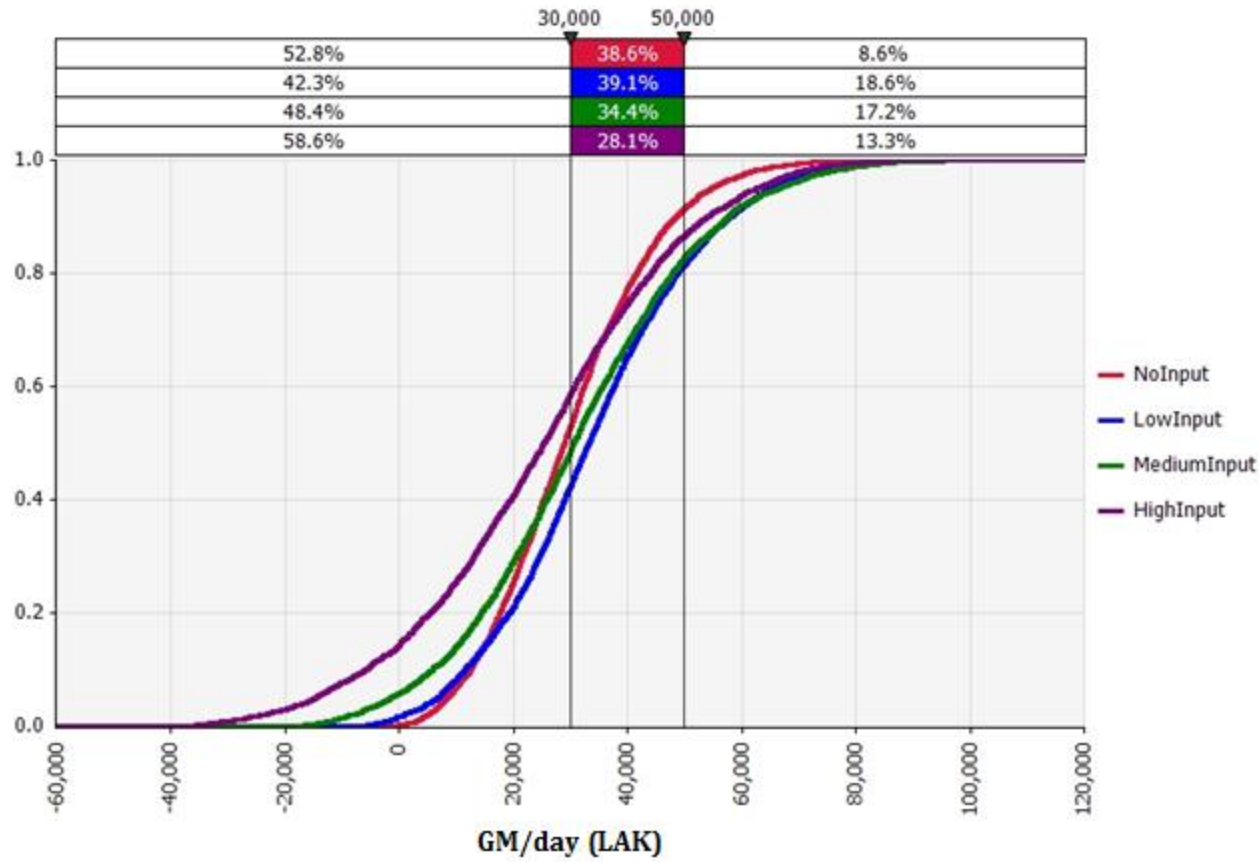

Figure 7.6 Cumulative distribution of GM/day (LAK) for fertiliser-yield scenarios (Version 2)

7.5 Economic appraisal of DS rice production

7.5.1 Base-case analysis

While the main issue facing farmers in the WS is the intensity of production needed to achieve self-sufficiency in rice, the issue in the DS, for those farmers with access to irrigation, is whether to grow rice or an alternative cash crop, or whether to grow no crop at all and use household labour in other pursuits. This section addresses the question of DS cropping by first developing an enterprise budget for one hectare of DS rice production as currently practised, referred to as the base case.

The costs associated with rice production in the DS were almost the same as in the WS, including material costs and labour costs. The material inputs included rice seed, inorganic fertilisers, and fuel for the two-wheeled tractor to prepare the land. As with the budget for WS rice production (Section 7.3), it was assumed that there was no cost involved with the use of organic fertilizer, no capital cost for the use of the two-wheeled tractor for land preparation, and no opportunity cost of land. Table 7.9 presents the estimated quantities of the materials used and their prices as reported for 2010-11. As in the WS case, the farmer was assumed to use his own seed and to hire the threshing service. However, inorganic fertiliser use was assumed to be greater. Two sacks (50 kg/sack) each of 16-20-00 and 46-00-00 were used for basal application and the same again as top-dressing. As in the WS, 10 kg of 46-00-00 was used during the seedbed preparation. About 30 litres of fuel were used for land preparation. In addition, in the DS there was an irrigation fee.

Labour requirements for DS rice production are also shown in Table 7.9. This was based on the current farmers' practices for rice cultivation – the use of a two-wheeled tractor for land preparation, manual transplanting and harvesting, and threshing by tractor-powered thresher. The seedbed was established in early January, with the land prepared by male family members using a two-wheeled tractor. The next day, the rice seed was broadcast and inorganic fertilisers applied by female family members. The labour requirements for preparing the seedbed were two person-days. In contrast to WS rice, land preparation for the main field was undertaken in only one round, normally in late January. At this time, basal inorganic fertiliser was applied. The land preparation and planting work required 30 person-days. Between February and March, irrigation water was supplied to the paddy fields, normally three times a week, typically by the male household head, who spent a whole day for each irrigation. On those days, hand-weeding was also undertaken. About 20 person-days were required for water control and weeding. Fences were not normally established, for the same reasons as in the WS. Rice was harvested in April and the harvesting operation required 61 person-days. In total, about 113 person-days were required for one hectare of DS rice production. The 2010-11 farm wage rate of LAK 30,000 per person-day was used to value household labour costs.

The return from DS rice production was estimated based on the mean yield of paddy rice in the DS and the expected price of paddy rice in 2011. The analysis showed the return to household labour (GM/day) for DS rice production was about LAK 40,000 (Table 7.9), above the 2010-11 wage rate.

Table 7.9 Enterprise budget for representative DS rice production on one hectare (2010-11 prices)

Items	Unit	Amount	Price*	Value
Material				
Rice seed	kg	90	2,000	180,000
Fertiliser (46-00-00) for seedbed	kg	10	5,000	50,000
Fertiliser (16-20-00) for basal application	sack	2	230,000	460,000
Fertiliser (46-00-00) for topdressing	sack	2	220,000	440,000
Fuel for 2-wheel tractor to prepare land	litre	30	9,000	270,000
Irrigation fee	LAK			700,000.0
Threshing fee (5% of total harvest)	kg	175	2,000	350,000
Variable input cost (VIC)	LAK			**2,450,000**
Labour				
Seedbed preparation	person-days	2		
Land preparation (incl. transplanting)	person-days	30		
Water and weed management	person-days	20		
Harvesting, threshing, hauling	person-days	61		
Total labour	person-days	**113**		
Wage rate	LAK/person-day		30,000	
Imputed labour cost (LC)	LAK			**3,390,000**
Total variable cost (TVC)	LAK			**5,840,000**
Returns				
Paddy rice yield	kg	3,500		
Paddy rice price (Pr)	LAK		2,000	
Gross income (GI)	LAK			**7,000,000**
Net income (NI)	LAK			**1,160,000**
Gross margin (GM)	LAK			**4,550,000**
GM per person-day	LAK/person-day			**40,265**

* USD 1 = LAK 8,027 (May 2011).

Sources: household survey (May 2011), case-study interviews (September 2011), and focus-group interviews (May 2013).

7.5.2 Sensitivity and risk analysis

As discussed in the case of WS rice, apart from paddy yield, the economic outcomes of rice production are affected by the paddy price, key input prices, and the rural wage rate. The farm-gate price in May 2011 was LAK 2,000/kg but it had fallen as low as LAK 1,200/kg in June 2012 before recovering to LAK 2,000/kg in May 2013. Sensitivity analysis was conducted using the low farm-gate price in 2012 and the extremely high farm-gate price in 2010 (LAK 3,500/kg; see Fig. 7.4). There was an expectation that the paddy price would be higher after the harvest of the WS rice crop (December 2013), with farmers estimating a price of around LAK 2,000/kg. This was taken to be the "most likely" price. The main input costs (fertiliser prices and fuel prices) and wage rates have continued to rise in recent years, hence these variables were also included in the sensitivity analysis. The values used for the base case and the sensitivity analysis are presented in Table 7.10.

Table 7.10 Values for base case and sensitivity analysis

Parameter	Base case	Sensitivity analysis
Farm gate price of paddy rice	LAK 2,000/kg	LAK 1,200 and 3,500/kg
Fertiliser price		
- 16-20-00	LAK 230,000/sack	LAK 250,000/sack
- 46-00-00	LAK 220,000/sack	LAK 250,000/sack
Fuel price	LAK 9,000/litre	LAK 10,000/litre
Irrigation fee	LAK 700,000/ha	LAK 800,000/litre
Wage rate	LAK 30,000/day	LAK 50,000/day

Note: USD 1 = LAK 8,027 (May 2011)

The results of the base case and sensitivity analysis are presented in Table 7.11. As shown above in Table 7.9, the base case with low input prices gave an adequate return (NI of LAK 1.12 million/ha and GM/day of LAK 40,000/day), but when higher input prices were factored in the NI became negative and the GM/day fell below LAK 40,000, assuming the most likely output price. With these higher input prices and the low paddy price (LAK 1,200/kg), the NI became even more negative and the GM/day fell to only LAK 15,000. It is unsurprising, therefore, that farmers ceased planting at this low price. To achieve the current benchmark GM/day of LAK 50,000, the paddy price would need to be at least LAK 2,340/kg for the low input price scenario and LAK 2,411/kg for the high input price scenario. Hence, with the upper-range paddy price of LAK 3,500/kg, the NI and GM/day became attractive, even with the higher input prices.

Table 7.11 Results of sensitivity analysis

	Base analysis (low input prices)	Sensitivity analysis (high input prices)		
		Lower farm-gate paddy price	Most-likely farm-gate paddy price	Upper farm-gate paddy price
GI (LAK/ha)	7,000,000	4,420,000	7,000,000	12,250,000
TVC (LAK/ha)	5,840,000	8,118,000	8,330,000	8,728,000
NI (LAK/ha)	1,160,000	-3,918,000	-1,330,000	3,522,000
GM (LAK/ha)	4,550,000	1,732,000	4,320,000	9,172,000
GM/day (LAK/day)	40,265	15,327	38,230	81,173
Pr for positive NI (LAK/kg)	1,641	2,411	2,411	2,411
Pr for GM/day of LAK 50,000 (LAK/kg)	2,340	2,411	2,411	2,411

Note: USD 1 = LAK 8,027 (May 2011); Pr = threshold farm-gate paddy price

Farmers face considerable uncertainty about the yield and price of paddy rice. Again, risk analysis (using @RISK) was undertaken. Values for triangular distributions (minimum, most likely, and maximum values) of grain yield and paddy price are presented in Table 7.12. The yield figures for DS rice were drawn from the yields reported by the survey households for DS 2010-11. The mean paddy yield in DS 2010-11 was around 3,500 kg/ha, ranging from 1,000 kg up to 6,000 kg per hectare (the standard deviation was 1,431 kg/ha) (Fig. 7.7). The parameters of the paddy price distribution were based on the values used when analysing WS rice production.

Table 7.12 Values for triangular distributions of rice yield and price used in risk analysis

	Rice yield (kg/ha)	Paddy price (LAK/kg)
Minimum value	1,000	1,200
Most likely value	3,500	2,000
Maximum value	6,000	3,500

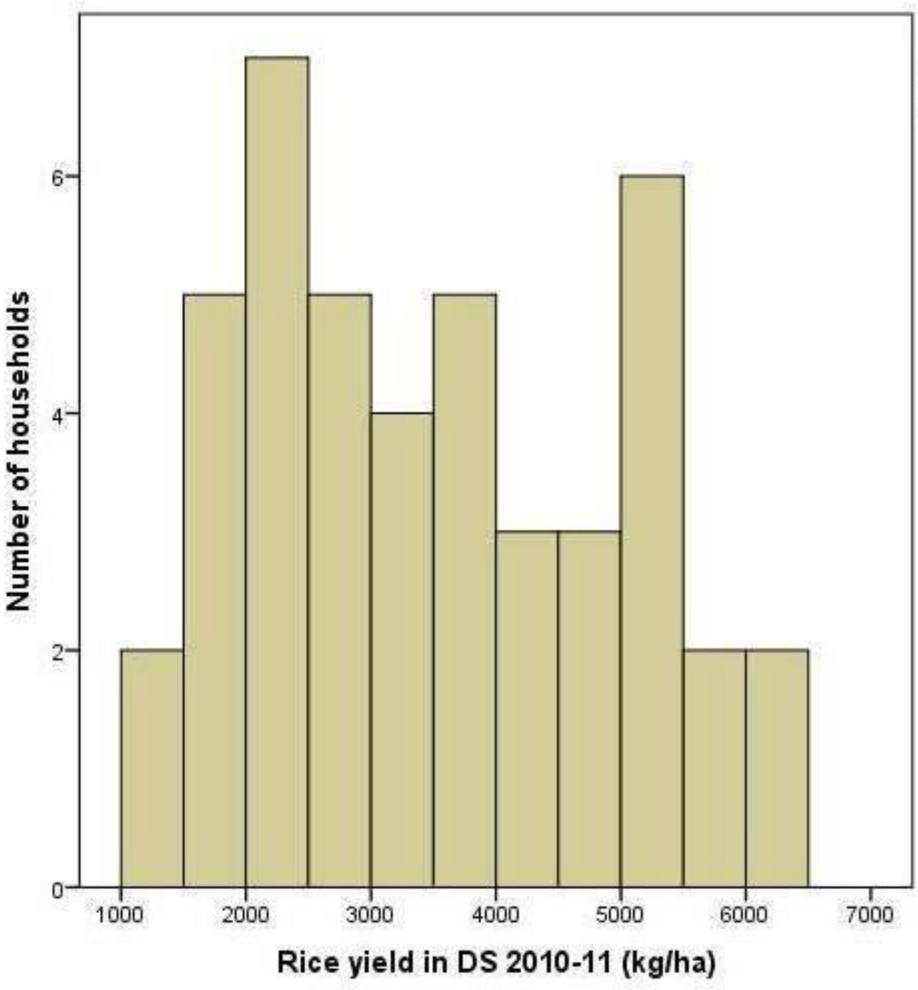

Figure 7.7 Distribution of rice yields obtained by survey households in DS 2010-11

Table 7.13 shows the results of the risk analysis. The first case assumes the lower input prices for fertiliser, fuel, and labour (the base assumptions in Table 7.10) and the second case assumes the higher prices shown in Table 7.10. The mean NI/ha for the first case was about LAK 1.9 million, but it became negative for the second case. In both cases, the mean GM/day was around LAK 40,000 and the probability that GM/ha was positive was close to 100%. The probability of a positive NI dropped from 74 to 39% when high input prices were used. However, the probability that the GM/day was greater than LAK 50,000 was around 40% in both cases. This can be seen in the cumulative distributions of the returns to household labour (GM/day) for each case (Fig. 7.8). Though there was a one-in-three chance of gaining a return of LAK 50,000/day (USD 6.20/day), this was slightly lower than the wage rate for non-farm work in Laos and much lower than the minimum daily wage rate in Thailand (USD 10/day). Hence the risk analysis confirms the marginal nature of DS rice production.

Table 7.13 Results of risk analysis

	Risk analysis	
	Low input prices	High input prices
Mean NI (LAK/ha)	1,916,000	-566,000
Mean GM (LAK/ha)	5,306,000	5,084,000
GM/day (LAK/day)	40,265	38,230
	Probability of occurrence (%)	
GM > 0	~100	99
NI > 0	74	39
GM/day > LAK 50,000	41	39

Note: USD 1 = LAK 8,027 (May 2011)

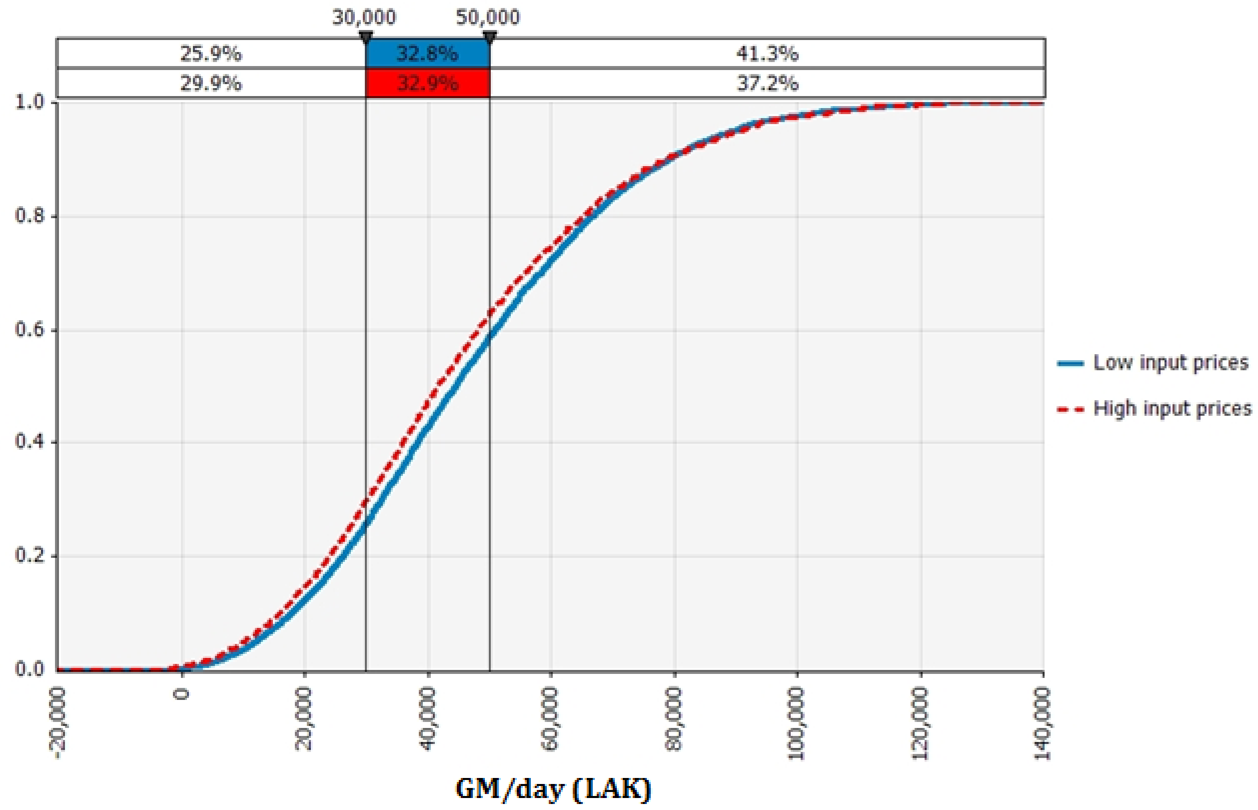

Figure 7.8 Cumulative distribution of GM/day (LAK) for DS rice production

Of the two uncertain variables, yield and price, variation in yield had the largest effect on the mean GM/day for DS rice production, in both low-cost and high-cost cases (Fig. 7.9 and 7.10). Varying paddy yield while other variables remained static, the mean GM/day varied widely from only about LAK 12,000/day to around LAK 79,000/day. Varying paddy price also had a significant contribution but over a narrower range, from LAK 23,000/day to LAK 71,000/day. This highlights the risks faced by farmers, who have experienced flood or drought problems causing wide variation in yields as well as a wide range of paddy prices in the past few years.

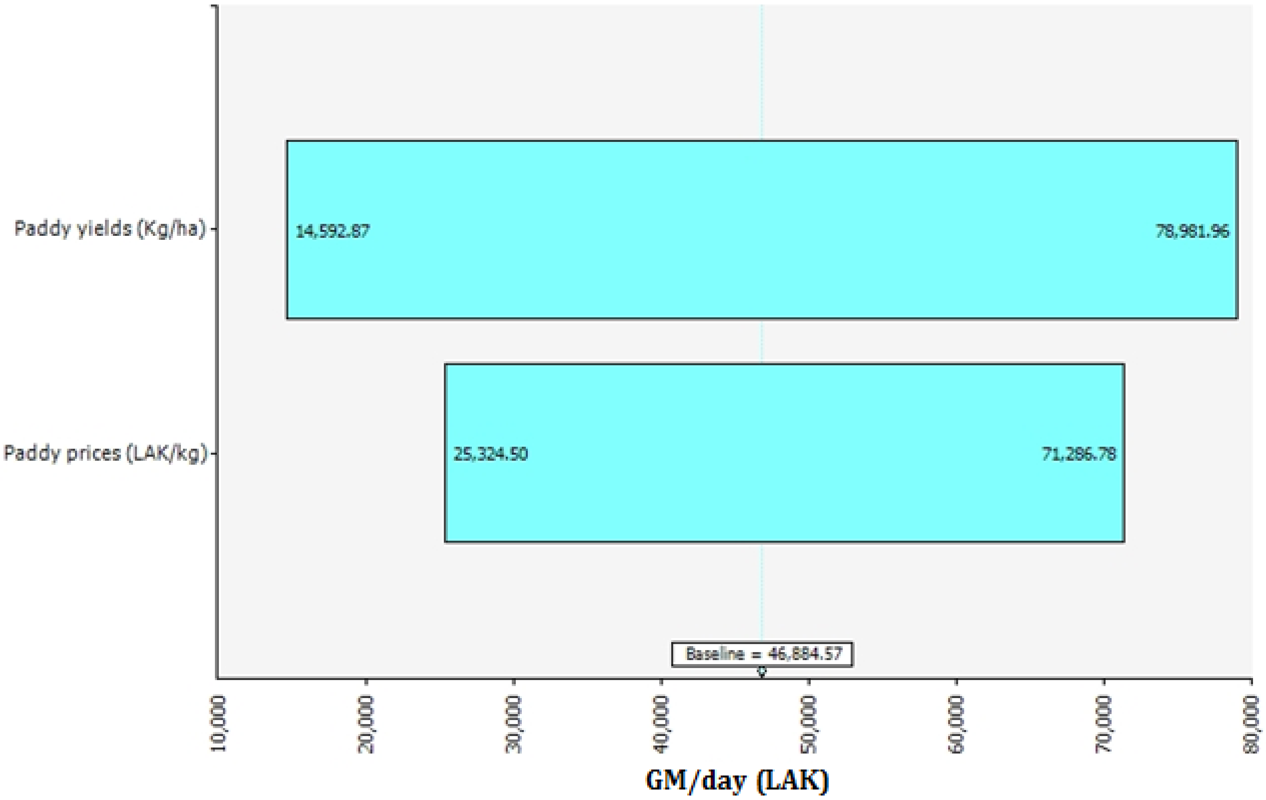

Figure 7.9 Stochastic variables ranked by effect on the mean GM/day for DS rice production (low input prices)

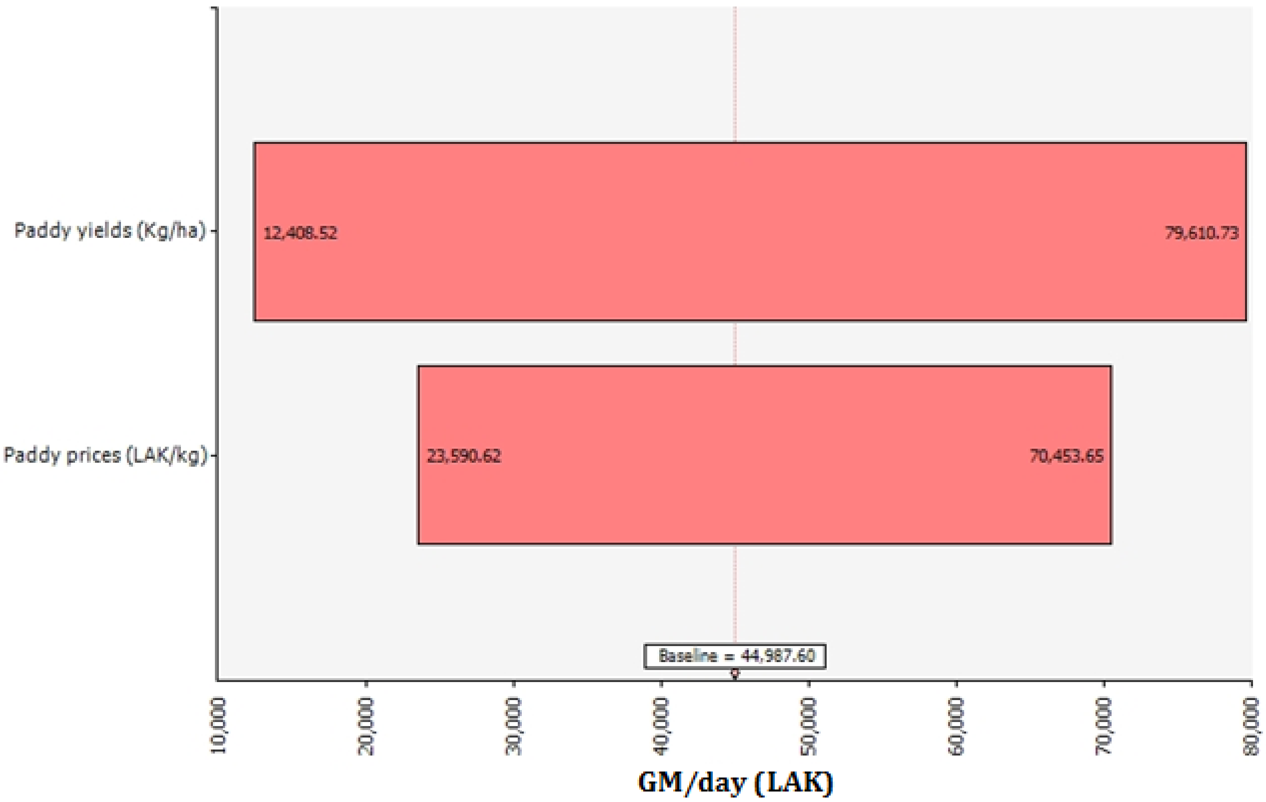

Figure 7.10 Stochastic variables ranked by effect on the mean GM/day for DS rice production (high input prices)

7.5.3 Farmers' response to the results of enterprise budgeting

During the May 2013 fieldwork, the enterprise budget for DS rice was presented to farmers in the two irrigated villages. The budgets were adjusted to reflect the current prices of inputs and paddy, and village-specific yields. In Boungkeo Village (V1-D2) the GM/day was around LAK 38,000/day with an assumed yield of 3,500 kg/ha. In Phaling Village (V1-D1), on the other hand, the GM/day was only LAK 21,000/day. The result for Phaling was based on an assumed yield of 2,500 kg/ha as farmers believed this was the most likely yield they could obtain.

The results from both villages were below the opportunity cost of labour, which ranged from LAK 40,000 to 50,000/day in DS 2012-13. As such it is little surprise that a total of only 3.5 hectares of DS rice was planted in Phaling in DS 2012-13, a reduction from 38 hectares in DS 2011-12, and this was the only area planted in the whole of Phonethong District (KPL, 2013). A sharp decrease in the cultivated area of DS rice was also found in Boungkeo (32 hectares in DS 2012-13 compared to 107 hectares in DS 2011-12).

Due to the small number of farmers willing to grow rice in DS 2012-13, the water-users' group in Boungkeo (together with DAFO staff) encouraged farmers to grow DS rice in designated zones (requiring temporary reallocation of plots) and to prepare seedlings in a single nursery area in order to supply water efficiently. Relatedly, the group encouraged farmers with upper paddy land to grow watermelon while those with lower paddy land (with good access to irrigation) to grow rice. However, farmers did not follow the recommendations as they perceived there was a carry-over of nutrients between seasons, which they would lose out on if they shuffled their plots between the DS and WS. This shows the institutional constraints to the optimal timing and management of different crops within the irrigated landscape.

7.6 Economic appraisal of DS non-rice crop production

7.6.1 Background

In both the irrigation villages surveyed, households were diversifying their DS cropping to include crops such as sweet corn, watermelon, and tobacco rather than rice. This was occurring in the paddy fields as well as in riverbank gardens. Both these activities can be compared with DS rice production in terms of the returns to household resources, especially labour. In addition, some farmers in the rainfed villages were using on-farm irrigation sources (ponds and/or groundwater) to grow DS crops. These sets of activities are appraised in this section.

7.6.2 Alternative DS crops grown in paddy fields

A range of non-rice crops have been trialled by farmers in the irrigation villages during the DS, with mixed results. Corn, tobacco, and watermelons are some of the more common crops, due to the perceived prospects of high returns. These crops often require new equipment and knowledge. In general, input costs tend to be high, which can have a large impact on the household should there be production problems or lower than expected prices.

In Phaling, there was an expansion of tobacco production over a period of two years, reaching a total of 5 hectares in DS 2010-11. However, tobacco cultivation has now ceased due to poor performance, with some farmers ending up in debt. In DS 2011-12, a mixture of various crops such as cucumber, longbean, and gourds was grown in Phaling’s paddy fields, totalling about 7 hectares, dropping to only 1 hectare in DS 2012-13. Farmers used to grow sweet corn in the paddy land in the DS, but the area was very small as farmers mainly grew rice. Vegetables and other non-rice crops (including sweet corn) were mainly grown in riverbank gardens along Phaling stream, a tributary of the Mekong River.

In Boungkeo, watermelon production has seen large expansion, with the number of farmers increasing from only three in DS 2010-11, cultivating 3 hectares, to 22 in DS 2012-13, cultivating a total of 35 hectares within the irrigation area. Three years ago a man who used to work on a watermelon farm in Thailand had come to this village to hire land in the DS to grow watermelons. Local farmers learned how to grow watermelons from this farmer. Seeds, pesticides, and equipment were all bought at Song Ta Ou market, a border market with Thailand (see Section 6.5.2).

Enterprise budgeting for one hectare of DS watermelons grown in paddy land was undertaken with three watermelon growers in Boungkeo. Results are presented in Table 7.14. The detailed description of production and the budgeting analysis is presented in Appendix 26. These farmers grew watermelons in three rounds, averaging one hectare per round. The table shows the potential for high returns to land and labour, as well as the risk of low or negative returns, especially in the third round. According to the farmers, the low production in the third round was attributed to pest problems that were in turn ascribed to the hot weather; this highlights the potential risk of growing a crop with high cash costs. Even with this low performance in the third round, farmers received high returns for the season, with the return to family labour (GM/day) ranging from LAK 80,000 to 160,000. This was two to four times both the GM/day for DS rice and the current rural wage rate.

This case shows that at least some farmers were willing to outlay a large amount of capital and incur significant risk by hiring land and borrowing money from the bank to invest in watermelon production in the DS. The primary reason was that it was substantially more profitable than DS rice production. So far there was no problem in the marketing of watermelons as traders came even from other areas (including as far as Savannakhet) to buy watermelons in the village. According to the Deputy Director of DAFO, Soukhouma, growing watermelons was a better prospect than rice but might have an impact on the environment due to the high use of chemical inputs.

Table 7.14 Enterprise budgets for watermelon production in Boungkeo Village

	Farmer A	**Farmer B**	**Farmer C**
		1st round (1 ha)	
NI/ha (LAK)	17,711,851	11,711,851	21,997,565
GM/ha (LAK)	20,246,851	14,246,851	24,532,565
GM/day (LAK)	319,477	224,802	387,102
		2nd round (1 ha)	
NI/ha (LAK)	17,711,851	-288,149	-2,288,149
GM/ha (LAK)	20,246,851	2,246,851	246,851
GM/day (LAK)	319,477	35,453	3,895
		3rd round (1 ha)	
NI/ha (LAK)	-11,788,149	-1,288,149	-11,431,006
GM/ha (LAK)	-9,253,149	1,246,851	-8,896,006
GM/day (LAK)	-146,006	19,674	-140,371
		Season	
NI/ha (LAK)	23,635,553	10,135,553	8,278,410
GM/ha (LAK)	31,240,553	17,740,553	15,883,410
GM/day (LAK)	164,316	93,310	83,542

Note: USD 1 = LAK 8,027 (May 2011)

Source: Group interview with watermelon farmers, May 2013

7.6.3 DS crops grown in riverbank gardens

Given that the irrigation villages were located in close proximity to the Mekong or major tributaries, river gardens were an important economic activity during the DS. While they did not compete with irrigated rice for land, they utilised household labour resources and capital and so could be considered another alternative to DS rice production. The returns to vegetables and other crops grown along the river tended to be higher than irrigated rice production.

The example of sweet corn grown in Phaling, Phonethong District, is presented in Table 7.15 (with details in Appendix 27). The return to labour (GM/day) of around LAK 65,000 (USD 8.10) indicates the attractiveness of this crop, despite high cash outlays, including much higher levels of expenditure on fertiliser than for either WS or DS rice production.

Table 7.15 Enterprise budget for 0.2 hectare of sweet corn production in riverbank garden, Phaling Village

Items	Value
Variable input costs (LAK)	2,265,000
Imputed labour costs (LAK)	4,160,000
TVC (LAK)	6,425,000
GI (LAK)	9,000,000
NI (LAK)	2,575,000
GM (LAK)	6,735,000
Labour days	104
GM/day (LAK)	64,760

Note: USD 1 = LAK 8,027 (May 2011)

Source: Interview with farmer growing sweet corn in riverbank garden, May 2013

7.6.4 DS crops in the rainfed region

In areas outside formal irrigation areas there was still water available for DS cropping activities. Farm ponds were common in both districts, excavated during road construction often at no cost to the farmer. Although many farm ponds were poorly designed, there was potential to improve rural incomes through utilisation of this water during the DS. There had also been a rapid expansion of groundwater bores, primarily for domestic use. Around 70% of surveyed households now had their own groundwater bore, with the rapid expansion induced by the electrification of villages, which made pumping cheaper. While the use of bores was mostly limited to domestic purposes and small home gardens, some households had expanded this to a semi-commercial scale. The potential to increase incomes in the rainfed area was significant, but the groundwater resource remains poorly understood and there is potential for mismanagement of the resource with negative impacts on the supply of domestic water for the majority of households.

Budgeting was conducted with two farmers (Farmers D and E) in Nasomvang, Phonethong District, who grew sweet corn as part of the ACIAR Project "Developing Improved Farming and Marketing Systems in Rainfed Regions of Southern Laos" (Table 7.16 and Appendix 28). The GM/day for Farmer D was well above the assumed opportunity cost of labour (LAK 40,000/day) and also above that for irrigated rice, while the GM/day for Farmer E was a little below the assumed opportunity cost. However, several inputs (seeds, inorganic fertilisers, fencing materials, and electricity pumps) as well as the establishment of ponds were provided by the project such that the farmers' actual cash-flow and net income were better than would be the case for a farmer adopting autonomously.

Budgeting was also conducted with a household in Donjod (Farmer F) who had recently established a groundwater bore with the specific purpose of irrigating crops and forages for livestock as part of the ACIAR Project. However, the activity proved highly unprofitable, generating only LAK 7,000/day or less than a dollar. This was due to the low yield of sweet corn, reflecting that the farmer was experimenting with this crop for the first time, whereas Farmers D and E had been involved in trials for three consecutive years with the ACIAR Project.

Table 7.16 Results of enterprise budgeting analysis for sweet corn production in Phonethong District

	Farmer D	**Farmer E**	**Farmer F**
Village	Nasomvang	Nasomvang	Donjod
Water source	2 ponds	1 pond	Groundwater
Estimated area of pond	1,590 m^2	560 m^2	NA
Area (ha)	0.33	0.17	0.15
Variable input costs (LAK)	1,972,000	909,000	901,000
Imputed labour costs (LAK)	3,170,000	2,310,000	2,145,000
TVC (LAK)	5,142,000	3,219,000	3,046,000
GI (LAK)	7,600,000	2,500,000	1,250,000
NI (LAK)	2,458,000	-719,000	-1,796,000
NI/ha (LAK)	7,448,485	-4,229,412	-11,973,333
GM (LAK)	5,628,000	1,591,000	349,000
GM/ha (LAK)	17,054,545	9,358,824	2,326,667
Labour days	79	58	54
GM/day (LAK)	71,016	27,550	6,508
GM/day* (LAK)	76,341	32,935	12,308

* These values for GM/day were derived by excluding the cost of inputs provided by the ACIAR Project

Source: Interviews with sweet corn farmers, May 2013. Note: USD 1 = LAK 8,027 (May 2011)

7.7 Options for rice intensification

7.7.1 Background

As demonstrated in Chapter 5 and in this chapter, there have been some successes related to the adoption of improved rice production technology in lowland rice farming in Laos, including improved Lao varieties, fertility management, and two-wheel tractors. As a result, farmers have obtained higher yields with less labour use and many households have achieved self-sufficiency in rice. However, there are challenges facing rice farming in coming years. Input costs (fertiliser, fuel, irrigation water, hired labour) are rising and there is less family labour available due to movement to off- and non-farm employment in Laos and migration to work in Thailand (Chapter 8). Farmers also face production risks due to pests, climate variability (floods, droughts), and climate change. Morever, there are large market fluctuations and uncertainty. The paddy price flutuates widely (a range of LAK 1,200 to 3,500/kg in recent years) and the policy responses in some cases add to uncertainty. As discussed, the farm-gate paddy price fell to as low as LAK 1,200/kg in 2012, at which price the return to labour for WS rice was only around LAK 14,000/day, providing no incentive for households to produce surplus rice. Furthermore, there is significant variation in the yields that households achieve based on the biophysical environment (including the position of the paddy field, soil fertility, micro-climate) and crop management. At this low price of paddy, to achieve a benchmark GM/day of LAK 40,000, the yield would need to be 4 t/ha for the WS and 6 t/ha for the DS (Fig. 7.11). In light of these trade-offs, this section evaluates some policy options to improve the economics of lowland rice-based farming systems.

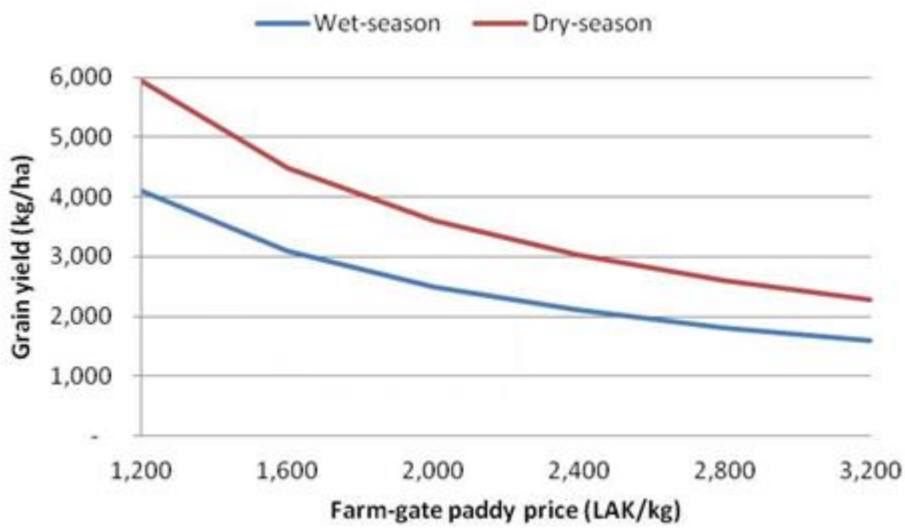

Figure 7.11 Yield and price combinations required to achieve a GM/day of LAK 40,000

7.7.2 *Option 1: Increase in rice price*

Many governments have intervened in domestic markets to protect and stabilise the prices of agricultural produce (Pingali and Rosegrant, 1995). The price of rice in Laos normally depends on the domestic and global markets; however, policy makers sometimes talk about implementing measures to increase the price to farmers. Based on the economic analysis of one hectare of WS rice production, to increase the GM/day from LAK 30,000 to 40,000, the paddy price would need to be increased to LAK 2,500/kg from the current price of LAK 2,000/kg. Therefore, the Government would have to outlay a subsidy of around LAK 1 million (USD 125) per hectare of rice cultivation, assuming current yields of around 2 t/ha. To achieve a GM/day of LAK 50,000 (from LAK 30,000), the paddy price would need to be increased to LAK 3,000/kg from the current price of LAK 2,000/kg and hence the Government would have to outlay about LAK 2 million per hectare, again assuming current yields (Fig. 7.12).[10] An outlay of this magnitude is unlikely to be financially sustainable in the long run, given the precarious state of the Government's budget. Moreover, to implement price support of this nature would require additional government investment in storage and other infrastructure, as well as the creation of a bureaucracy. Thailand's recent experience with such a scheme reflects the generally bad performance of such price-support mechanisms around the world. All this is quite apart from the effect of distorting farmers' incentives to move into higher-value crop or livestock activities or invest in non-farm sources of income.

Though merely supporting the price is likely to be financially and economically unviable, there are other opportunities for improving the returns to rice cultivation, such as by (1) improving the quality of rice varieties demanded by the local market through improved post-harvest operations and milling; (2) accessing export markets and meeting international standards for milling and packaging; (3) engaging with the private sector through contract farming; (4) adopting trade and food security policies that provide long-term incentives for production, not short-term measures (such as trade bans) that have long-term negative impacts. For example, in the last few years a large Thai-owned mill in Phonethong District has been promoting farmers to grow non-glutinous rice by providing seeds, fertiliser, credit, and technical advice in collaboration with the DAFO, and buying non-glutinous paddy rice at a higher price than the standard glutinous rice (LAK 3,000-3,500/kg in 2013). This mill has exported their rice to Europe under the brand name "Golden Mekong". Likewise, three Vietnamese investors are promoting farmers in Soukhouma District to grow rice and buying the paddy rice from the farmers. One company is also building a large mill and planning

[10] Of course, if the higher price was able to be sustained, farmers would be expected to intensify production and output per hectare would increase, altering the trade-off curves in Fig. 7.12.

to build a rice-flour processing factory. These examples suggest that rice production could be made more profitable in specific locations, without adopting costly across-the-board price support.

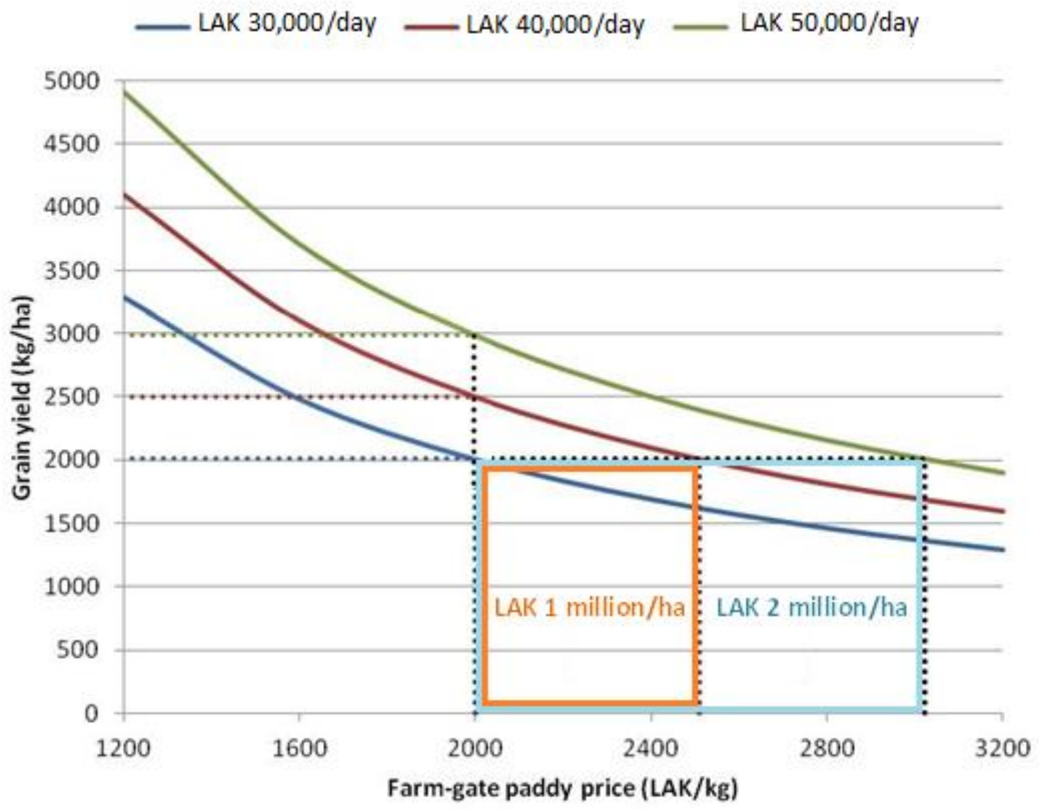

Figure 7.12 Threshold analysis of yield and price combinations to achieve a specific GM/day

7.7.3 Option 2: Increase in rice yield

At the current paddy price of LAK 2,000/kg, if farmers can increase their paddy yields from 2 t/ha to 2.5 t/ha the GM/day would rise from LAK 30,000 to 40,000, and with an even higher yield of 3.0 t/ha the GM/day would reach LAK 50,000 (Fig.7.12). However, as shown in Section 7.4, to increase yields in this way requires additional cost, whereas risk analysis showed that farmers were rational to adopt a low-input, low-yield strategy. Hence the increase in yields resulting from applying more inputs (inorganic fertiliser) may not help increase the GM/day. To encourage farmers to increase yields by applying more fertiliser, without reducing the return to labour, policymakers have sometimes considered the use of a fertiliser subsidy. However, as with price support, this would be excessively costly and difficult to administer.

Nonetheless, even without subsidising the price, there are opportunities for improving the efficiency of fertiliser use by improved extension on appropriate timing and rates of fertiliser application, and further research to develop site-specific and season-specific recommendations. There is also scope to reduce the farm-gate price of fertilisers by reducing taxes and transport costs and enabling group purchase by farmer organisations. There is also the possibility of developing and promoting varieties for specific agro-economic zones to reduce the risk of low yields, such as drought-tolerant or flood-tolerant varieties. However, care needs to be taken that varieties bred for greater resilience retain preferred attributes such as eating quality. For example, a farmer in Khoke Nongbua Village (a case-study household in Appendix 20) who had tried the submergence-tolerant variety TDK1sub1 remarked that it had inferior eating quality compared to the usual variety, PNG1.

7.7.4 Option 3: Decrease labour required

A further option to improve the profitability of rice farming is to reduce labour requirements. This has already occurred to some degree with the mechanisation of land preparation. New techniques such as direct seeding can save about 30 person-days for planting rice. Taking this innovation as an example, Fig. 7.13 shows that, at the current paddy price of LAK 2,000/kg, in order to maintain a GM/day of LAK 40,000, the yield needs to be only around 1.9 t/ha with this labour-saving innovation, compared to 2.5 t/ha without it. If, however, yields can be maintained at 2.5 t/ha, the adoption of labour-saving innovations can increase the return to labour above LAK 40,000/day. The scope for further adoption of labour-saving innovations includes land consolidation to facilitate more efficient mechanisation, mechanised options for direct seeding (though weed management then becomes an issue), and mechanised harvesting. Mechanised rice farming not only saves labour but has the potential to alter the cropping calendar, enabling farmers to grow more crops within the year.

7.7.5 Option 4: Farm and livelihood diversification

Crop diversification and improved livestock management are activities that can potentially generate good returns to family-owned resources. Growing a range of food crops can provide a buffer against yield and price risks and also contribute to food security at the household level. Many farmers in the study area, in particular in the existing irrigation areas, shared this view and were trialling various non-rice crops. As demonstrated earlier in this chapter, higher value crops such as watermelons and corn grown in the DS offered high potential returns. However, there was higher cash cost in growing these crops compared to rice and they could lead to large losses if yields were low or prices fell. Research is on-going to find out the best management for non-rice crops in different agro-economic zones and to improve marketing. Assessing the returns to directing land, water, and labour into irrigated forage plots rather than vegetable plots is also underway. Several farmers who participated with the ACIAR project (mentioned in Section 7.6.4) are just beginning this transition into more intensive livestock systems. These two activities (non-rice crops and intensive livestock) offer different characteristics in terms of flexibility of product disposal, time-dispersion of costs and returns, and complementarity with the existing farming system.

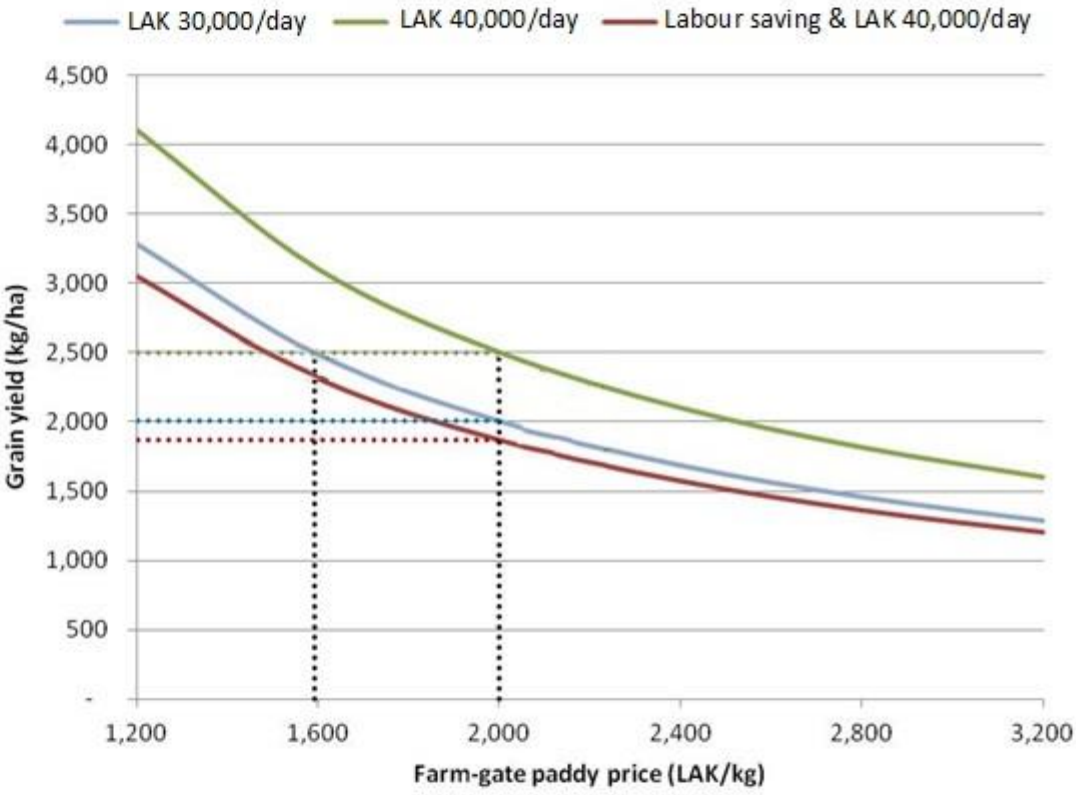

Figure 7.13 Threshold analysis of yield and price combinations to achieve a specific GM/day, with and without the adoption of direct seeding

Rice self-sufficiency remains an important household objective in the study area. Achieving this goal efficiently allows resources to move to higher returning activities. As noted, these may include agricultural activities (non-rice crops and livestock) but also off-farm or non-farm employment. This livelihood diversification can potentially help farmers to improve their cash incomes and increase their resilience to production and market shocks. The option of livelihood diversification is explored in the next chapter.

7.8 Conclusion

The budget models and risk analyses presented in this chapter show that, given their resource endowments and the high degree of production and market risk they encounter, households in the study area have been rational in adopting a low-input system of rice production rather than intensifying production to achieve government yield and output targets. In general, WS rice production enables households to achieve their subsistence goals with an adequate return to labour. As the opportunity cost of labour continues to increase, technologies that improve labour productivity and enable labour to move off-farm are likely to be adopted more readily than technologies that seek to intensify production. Likewise, the development and adoption of improved varieties that are well adapted to abiotic and biotic stresses and reduce risk in specific environments can potentially improve the profitability and stability of the lowland rice production system. Moreover, it has long been argued that improving the efficiency of fertiliser application through site-specific recommendations is more important than increasing absolute fertiliser rates. While the improvements in profitability that these technologies bring may induce some intensification, the strategy of diversifying livelihoods while maintaining a largely subsistence-oriented rice production system is likely to persist, given the current economic trends. While this may not help lift rice production to reach national targets, it is likely to improve the livelihood outcomes of the numerous households living in this marginal environment.

With subsistence goals attained through a low-input WS rice crop, most farmers view DS cropping options in more commercial terms. As a commercial option, irrigated rice has an advantage over rainfed production given the greater control over water and the higher yields obtainable from roughly the same labour input. However, yield and price risks remain a problem for farmers, especially given the larger outlays for fertiliser and irrigation costs. Other crops such as maize and watermelons, though requiring high input levels and cash outlays, can provide considerably better returns to household resources than irrigated DS rice. This has meant that DS rice production has substantially declined and that much irrigable land remains idle in the DS as the non-rice crops are cultivated on much smaller areas.

In addition to the option of non-rice crops, employment opportunities away from the farm have increased due to economic growth in Laos and neighbouring Thailand. As a consequence, rural households in the survey area have become increasingly diversified, with one or more members pursuing off-farm or non-farm work or even migrating to work in Thailand for extended periods.

This reduces the labour available for rice intensification as well as driving up the rural wage rate still further. The next chapter elaborates on these issues.

8 BEYOND THE FARM

8.1 Introduction

Rural livelihoods in Champasak have become increasingly diversified as economic growth in Laos and especially Thailand has created considerable employment opportunities away from the farm. Labour migration to work in neighbouring Thailand is now a well-established livelihood strategy for young lowland Lao. This chapter analyses the role of off-farm and non-farm economic activities in the livelihoods of the rural households in the study villages. The chapter first analyses household demographic data to provide the context for these activities. Then the analysis turns to the activities undertaken by household members beyond their farms, including off-farm work, local non-farm employment, and labour migration. It then presents case studies of households pursuing activities beyond the farm. Finally, the chapter discusses the consequences of this major trend to working away from the family farm.

8.2 Household demography

Traditionally, a Lao farming household comprises a nuclear family (a couple and their unmarried children) or a stem family (a couple, one married child and spouse, and grandchildren). On average, a household in the study area had 6.6 members, almost the same figure (6.5 members) found in the mid-1990s survey by Pandey and Sanamongkhoun (1998) (Table 8.1). Though the size ranged from 2 to 13, nearly 65% of the households had 5 to 8 members. Smaller households consisted of young parents (or a single parent) and small children, whereas larger households comprised up to three generations living together. The variation in these measures reflects the traditional domestic cycle in Lao rural families, beginning with a young married couple with small children and continuing through predictable phases as the children grow, marry, and mostly hive off to form new households, while the parental household becomes a three-generational stem family with a married child (normally the youngest daughter or son) and grandchildren.

The household has at its disposal a primary and secondary labour force. The primary labour force is made up of adult, full-time workers. The secondary labour force comprises part-time workers – either older children (aged 10 to 15) who go to school and help the family farm during the weekend, or elderly members of the family who work a few hours a day on lighter tasks or have the responsibility of taking care of their grandchildren. Larger households typically have a larger and more diverse labour force, while single-parent households with young children in general have only one worker. To reflect the household's situation, the full-time equivalent (FTE) number of workers was used in this analysis and is referred to as the "household labour force". This was estimated as the number of full-time workers (regardless of gender) plus the number of part-time workers, valued at one-third of a full-time worker. On average, a household in the study area had 4.5 FTE workers, but the size of the household labour force varied considerably from 1.0 to 10.3 FTE workers, with a pronounced mode at 2.0 FTE workers (Table 8.1 and Fig. 8.1). These statistics did not vary significantly between districts or villages. The high number of workers relative to household size is indicative of the "demographic dividend" being experienced by rural households in mainland Southeast Asia as fertility rates and hence dependency ratios fall (Rigg, 2012). In particular, the more workers in the household, the greater is the household's capacity to engage in work beyond the farm, as seen below.

Usually the senior economically active male is regarded as the head of household, but in the case of a sole female parent, she is regarded as the head of household; this applied to 7% of the survey households. The mean age of household heads in the survey was 48 years; compared to 45 years found in the survey over a decade ago (Pandey and Sanamongkhoun, 1998), reflecting a slowly ageing farm workforce, but the range was from 24 to 84 years. The education level of household heads averaged 5 years of schooling, but ranged from no schooling to 15 years.

Table 8.1 Demographic characteristics of survey households

	D1			**D2**			**Total (n=180)**
	V1 (n=30)	**V2 (n=30)**	**V3 (n=30)**	**V1 (n=30)**	**V2 (n=30)**	**V3 (n=30)**	
Mean number of household members	7.2	7.0	6.6	6.7	6.5	5.8	**6.6**
Mean number of FTE workers	3.8	3.8	3.3	3.6	3.0	3.4	**3.5**
Mean age of household head (years)	53.1	51.9	45.6	47.5	45.3	45.7	**48.2**
Mean education of household head (years)	4.9	5.5	2.9	5.8	5.9	4.1	**4.9**

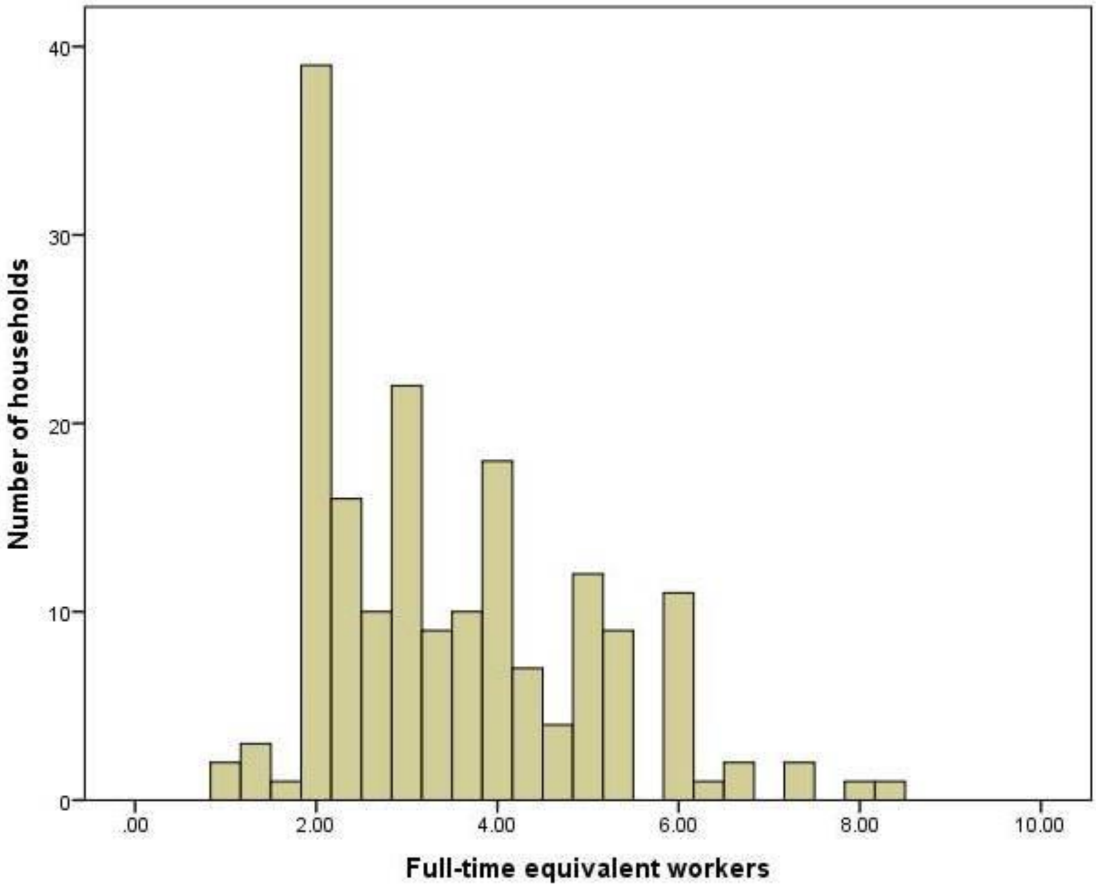

Figure 8.1 Distribution of survey households by number of full-time equivalent workers in 2010

8.3 Activities beyond the farm

Rural livelihoods in the survey villages have become increasingly diversified in recent years. Some farm households have engaged in off-farm or non-farm employment locally or elsewhere within Laos, while many households also have members working long-term in Thailand.[11] Only 15% of the survey households utilised their household labour exclusively for their own agricultural production, mainly rice farming. The remaining 85% used some of their labour to earn additional income from either off-farm employment, non-farm employment in Laos, work in Thailand, or some combination of these options (Table 8.2). Surprisingly, this did not differ significantly (at the $p<0.05$ level) between districts or between villages within each district, suggesting that pull factors are the predominant influence.

[11] "Off-farm work" in this thesis means working off their own farm but on neighbouring farms or private farms such as rubber plantations, usually within the same village or general location. "Non-farm employment" refers to non-agricultural work such as construction work that may be local or elsewhere in Laos (such as in the capital, Vientiane). In the latter case, workers would return to the village only occasionally. "Working in Thailand" means working either in agricultural or non-agricultural employment in Thailand, hence it involves migration away from the village with only intermittent return.

Off-farm work, non-farm work, and work in Thailand were not mutually exclusive. Some households had members engaged exclusively in only one of these activities, but other households pursued a combination. The greatest proportion of households (36%) had members working only in non-farm activities in Laos, followed by working only in Thailand (27%). Around 12% of households had members working in non-farm employment in Laos and in Thailand and only three households had members employed in all three categories of work (Table 8.2).

Table 8.2 No. of households with members employed in off-farm and non-farm work

	D1			D2			Total (n=180)	%
	V1 (n=30)	V2 (n=30)	V3 (n=30)	V1 (n=30)	V2 (n=30)	V3 (n=30)		
Only off-farm in Laos	0	0	1	2	1	1	**5**	**2.8**
Only non-farm in Laos	4	10	6	14	11	19	**64**	**35.6**
Only work in Thailand	9	11	12	5	9	3	**49**	**27.2**
Off-farm and non-farm in Laos	0	1	2	1	0	3	**7**	**3.9**
Off-farm in Laos and work in Thailand	2	0	1	1	0	0	**4**	**2.2**
Non-farm in Laos and work in Thailand	4	5	3	3	6	0	**21**	**11.7**
All of the above	2	0	0	1	0	0	**3**	**1.7**
None of the above	9	3	5	3	3	4	**27**	**15.0**
Total	**30**	**30**	**30**	**30**	**30**	**30**	**180**	**100.0**

8.4 Off-farm employment in Laos

Most households in the survey villages used household labour for their own rice production; however, off-farm employment was an immediate source of cash income for a few poor households with limited paddy land – around 11 % of households had members working off-farm for cash wages for periods of the year (Fig. 8.2). The incidence of off-farm employment within each district was significantly higher in V1 and V3 than in V2. Some farms in V1 (with irrigation) employed workers during the DS, and a number of poor households in the more remote villages (V3) resorted to off-farm work to earn cash income. One of the reasons for the low incidence of off-farm employment in V2 was that the majority of the survey households in these villages also utilised their family labour to grow vegetables and other non-rice crops in home and river gardens as they had access to additional water sources through pumping from streams, fishponds, or groundwater bores.

The most common type of off-farm employment was rice planting and harvesting (as noted in Chapter 7, the peak activities in the crop season). Off-farm work was mainly undertaken in the wet season; only 10% undertook off-farm work in the dry season and 10% in both the wet and dry seasons. Off-farm work was normally carried out in the village in which the household resided. Hence off-farm work in the dry season was only found in the irrigated villages. In the wet season, rice planting occurred in June and harvesting in November. In addition, in the irrigated villages, dry-season rice planting occurred in January and harvesting in April.

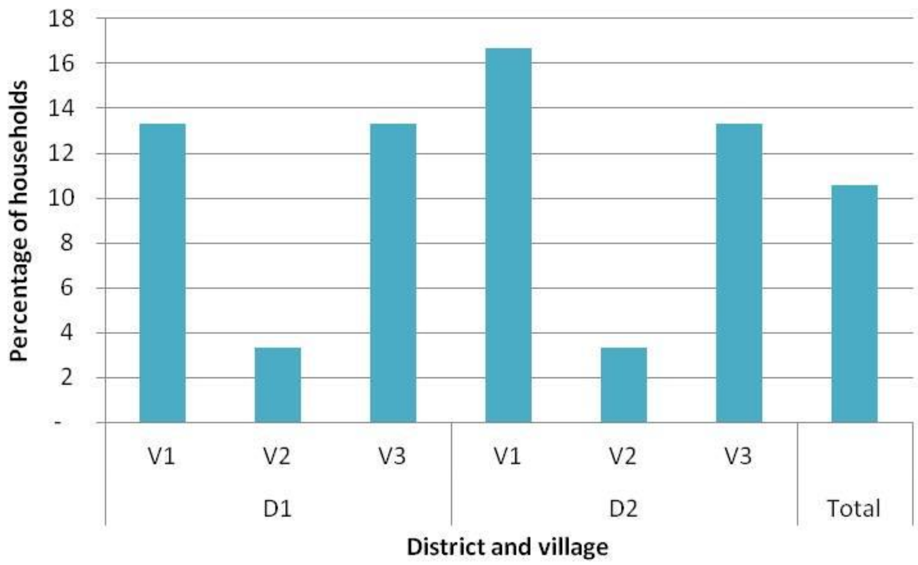

Figure 8.2 Incidence of households with members working off-farm in Laos in 2010

For households pursuing off-farm work, the average number of household members engaging in off-farm work was 1.7, ranging from 1 to 4. Just over half of these households had only one member working off-farm while about a third had two members (Table 8.3). The wage rate for rice planting and harvesting in 2010 was LAK 30,000 per day (USD 3.70) per day. Average annual off-farm income for households engaging in off-farm employment was about LAK 600,000 (USD 75), but the range was from LAK 90,000 to LAK 2.8 million (USD 11-349). For these households, the contribution of the off-farm income to total income[12] averaged 7%, with a higher proportion in the remote villages of up to 19% (Table 8.4).

[12] Total (gross) income includes the income from rice even if not sold, sale of vegetables and other non-rice crops, sale of livestock, sale of NTFPs, off-farm earnings, non-farm earnings, and remittances. Remittances here were the net transfers (deducting costs such as transfer fees).

Table 8.3 Incidence of households with members undertaking off-farm work in Laos in 2010, by location and season of off-farm employment (% of households)

	D1			D2			Total (n=19)
	V1 (n=4)	V2 (n=1)	V3 (n=4)	V1 (n=5)	V2 (n=1)	V3 (n=4)	
Village of residence	100.0	100.0	100.0	100.0	100.0	100.0	**100.0**
Wet season only	75.0	100.0	100.0	40.0	100.0	100.0	**79.0**
Dry season only	0	0	0	40.0	0	0	**10.5**
Both wet and dry seasons	25.0	0	0	20.0	0	0	**10.5**

Table 8.4 Features of off-farm employment within Laos in 2010

	D1			D2			Total (n=19)
	V1 (n=4)	V2 (n=1)	V3 (n=4)	V1 (n=5)	V2 (n=1)	V3 (n=4)	
Mean number of off-farm workers	1.5	2.0	1.5	1.2	1.0	3.0	**1.7**
Mean income from off-farm work (million LAK)	0.4	0.8	0.6	0.4	0.1	1.2	**0.6**
Off-farm income as % of total income	1.3	1.7	8.6	2.6	1.1	19.2	**7.0**

8.5 Non-farm employment in Laos

While a small number of households were involved in off-farm employment, non-farm employment within Laos was one of the main livelihood activities for many of the households surveyed. Around 53% of the households had one or more members working in non-farm activities in Laos for periods of the year (Fig. 8.3). This was significantly higher in D2 (64%) than D1 (41%); however, no significant differences were found between villages within each district. Though V1-D1 and V1-D2 had similar demographic features and locations with respect to market and district centres, for a range of historical reasons the latter (V1-D2) had over three times as many people working as government officials, traders, or technicians, as well as a higher number of retail shops, two-wheel tractors, threshing tractors, motorbikes, and boats with engines. Similarly, V3-D2 had a higher incidence of non-farm employment than V3-D1, in this case because the former had a market in the village and a border trade with Thailand (37 retail shops were registered there, compared with only five shops in V3-D1).

Figure 8.3 Incidence of households with members undertaking non-farm work in Laos in 2010

Non-farm work included construction work (30%); government services (29%) such as teachers, district agricultural staff, nurses, soldiers, and policemen; rural services (15%) such as land preparation by tractor, sawing wood, rice threshing by tractor, rice mills, and motorbike repair; retail shops and services (8%) including food shops and salons; small trading and enterprises (13%) such as buying and selling vegetables, NTFPs, and scrap metal, and making furniture or whisky; and factory and private company work (6%) such as garment or noodle factories and construction companies (Table 8.5).

Table 8.5 Types of non-farm employment in Laos in 2010 (% of households)

	D1			**D2**			**Total (n=95)**
	V1 (n=10)	**V2 (n=16)**	**V3 (n=11)**	**V1 (n=19)**	**V2 (n=17)**	**V3 (n=22)**	
Construction work	0	37.5	36.4	31.6	47.1	18.2	**29.5**
Government services	40.0	31.3	36.4	36.7	29.3	9.1	**28.5**
Rural services	30.0	12.5	18.2	5.3	5.9	22.7	**14.7**
Retail shops and services	10.0	6.2	0	0	5.9	22.7	**8.4**
Small trading and enterprises	10.0	0	0	21.1	5.9	27.3	**12.6**
Factory and private company work	10.0	12.5	9.1	5.3	5.9	0	**6.3**

Non-farm work was primarily undertaken close to the place of residence; nearly 50% of the survey households undertaking non-farm work did so exclusively in the village of residence, 12% solely in a nearby village, and 7% solely in the district town, hence these workers could also contribute part of their time to rice production and other farm activities. Some households had members who went to work further away in other districts in Champasak Province and even in other provinces. Around 53% of the households engaged in non-farm employment worked for the whole year while about 45% worked only in the dry season (Table 8.6).

Table 8.6 Incidence of households with members undertaking non-farm work in Laos in 2010, by location and season of non-farm employment (% of households)

	D1			D2			Total (n=95)
	V1 (n=10)	V2 (n=16)	V3 (n=11)	V1 (n=19)	V2 (n=17)	V3 (n=22)	
Village of residence	50.0	37.6	72.7	47.3	23.5	68.3	**49.5**
Nearby village	0	6.2	9.1	15.8	17.6	13.6	**11.6**
District town	0	6.2	0	10.5	23.5	0	**7.4**
Other districts in the province	30.0	18.8	0	0	11.8	0	**8.4**
Other provinces	10.0	0	18.2	10.5	5.9	0	**6.3**
Village of residence and nearby villages	0	25.0	0	5.3	11.8	13.6	**10.5**
Village of residence and district town	10.0	6.2	0	0	0	0	**2.1**
Nearby villages and other districts	0	0	0	5.3	5.9	4.5	**3.1**
Other districts and other provinces	0	0	0	5.3	0	0	**1.1**
Wet season only	10.0	0	0	0	0	4.5	**2.1**
Dry season only	10.0	50.0	54.5	36.8	47.1	59.1	**45.3**
Whole year	80.0	50.0	45.5	63.2	52.9	36.4	**52.6**

For households with non-farm work, the average number of household members so engaged was 1.4, but the number ranged from 1 to 6. Around 70% of these households had only one member working in non-farm employment and 23% had two members. The average annual income from non-farm work within Laos was LAK 8.3 million (USD 1,034), ranging up to LAK 96 million (USD 11,960). The contribution of this non-farm income to total income averaged around 30%; this did not differ significantly between districts, nor between villages in each district (Table 8.7).

Table 8.7 Features of non-farm employment within Laos in 2010

	D1			D2			Total
	V1 (n=10)	V2 (n=16)	V3 (n=11)	V1 (n=19)	V2 (n=17)	V3 (n=22)	(n=95)
Mean number of non-farm workers	1.1	1.4	1.1	1.5	1.4	1.7	**1.4**
Mean income from non-farm work (million LAK)	4.6	7.8	3.5	7.5	13.7	9.4	**8.3**
Non-farm income as % of total income	19.5	29.0	33.2	24.5	33.2	33.3	**29.6**

8.6 Labour migration to Thailand

As indicated above, a major new livelihood strategy in the survey villages was to seek work in Thailand (both the study districts have border checkpoints with Thailand, cf. Section 4.4 and Fig. 4.2 in Chapter 4). Around 43% of the survey households had one or more members working in Thailand (Fig. 8.4). Labour migration was found in all the survey villages, even in more accessible and irrigated villages with more potential to employ family labour (and hired labour) on-farm. In fact, against initial expectations, the incidence of migrants from the poor and remote villages was lower than for the better-situated villages, in particular, significantly lower (p=0.10) for the remote village in D2 (V3-D2), which had the lowest proportion of households with members working in Thailand. This was because (as noted above) people in this village had other sources of income from the forest – collecting NTFPs and hunting aquatic or wild animals – as well as operating trading businesses in the border market.

Work in Thailand involved both agricultural and non-agricultural work. Farm work, including work in livestock farms and in rubber and sugarcane plantations, was reported by 21% of households with migrant workers; construction work by 38%; retail work by 20%; factory work by 13%; domestic work by 7% (including taking care of children or elderly persons); and other types of work by 3%, including car repair and fishery (Table 8.8). Monthly wage rates differed between types of work, but averaged THB 5,000-6,000 (USD 167-200)[13] for farm labour, domestic work, construction work, working in shops, or factory work. Working in rubber plantations (tapping) could earn up to THB 10,000 (USD 333) per month.

[13] USD 1 = THB 30, May 2011

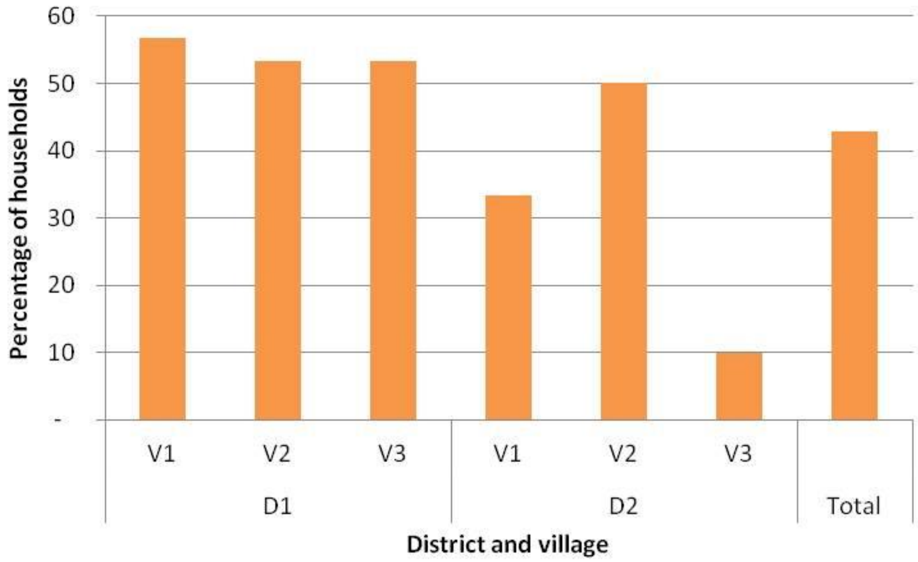

Figure 8.4 Incidence of households with members working in Thailand in 2010

Table 8.8 Types of work in Thailand in 2010 (% of households)

	D1			**D2**			**Total (n=77)**
	V1 (n=17)	**V2 (n=16)**	**V3 (n=16)**	**V1 (n=10)**	**V2 (n=15)**	**V3 (n=3)**	
Farm work	29.4	25.0	18.8	0	26.7	0	**20.8**
Construction work	11.8	25.0	50.0	50.0	53.3	66.7	**37.7**
Factory work	5.9	18.8	0	30.0	13.3	33.3	**13.0**
Retail work	41.1	18.8	12.4	20.0	6.7	0	**19.5**
Housework	5.9	6.2	18.8	0	0	0	**6.5**
Others	5.9	6.2	0	0	0	0	**2.5**

On average, households had just over two people working in Thailand, but the range was from 1 to 6. Around 39% of these households had only one member working in Thailand while 31% had two members and 16% had three members. The number of migrant workers averaged 38% of the household's FTE labour force; this was not significantly different between villages, varying only from 32% to 43%. The average age of household members working in Thailand was 24, ranging from 15 to 41. Of those households with members working in Thailand, about 27% had only men absent, the same proportion had only women absent, and 46% had both men and women absent. Most migrant workers (84%) remained in Thailand for the whole year, returning for only a short period, particularly during the Lao New Year festival, while around 16% went only in the dry season (Table 8.9).

Table 8.9 Features of labour migration to Thailand in 2010

	D1			D2			Total (n=77)
	V1 (n=17)	V2 (n=16)	V3 (n=16)	V1 (n=10)	V2 (n=15)	V3 (n=3)	
Mean number of workers in Thailand	2.4	2.3	2.0	1.8	2.0	2.3	**2.1**
Migrant workers in Thailand as % of FTE labour force	38.6	37.7	37.0	31.5	40.2	42.7	**37.6**
Mean age of workers in Thailand (years)	22.5	25.6	22.7	25.8	26.0	23.4	**24.3**
Households with male migrants (%)	35.3	31.2	31.2	20.0	13.3	33.3	**27.3**
Households with female migrants (%)	23.5	18.8	31.2	50.0	26.7	0	**27.3**
Households with both male and female migrants (%)	41.2	50.0	37.6	30.0	60.0	66.7	**45.4**
Households with members working in Thailand for the whole year (%)	82.4	81.2	87.5	100.0	73.3	100.0	**84.4**
Households with members working in Thailand in dry season only (%)	17.6	18.8	12.5	0	26.7	0	**15.6**

Around 92% of the households with members working in Thailand received remittances from their family members in 2010 (Fig. 8.5), on average about LAK 8.6 million (USD 1,071) per year, but the remittances ranged from LAK 134,000 up to LAK 55.6 million (USD 17-6,927). Remittances contributed about 30% of the total income of these households (Table 8.10); this did not differ significantly between districts and between villages in each district. Considering all the survey households, about 39% received remittances from Thailand and the contribution of remittances to total income averaged around 12%.

Though Lao labour migrants in Thailand engaged in various types of work, there was little evidence of transfer of skills back to Laos; only 10% of the households with members working in Thailand reported that they used the knowledge and skills gained. Of those households, 50% used their acquired skills for building houses, while the rest used them for cooking food, making dresses, welding iron, and floral decoration. However, the main reason given by the households that did not use knowledge and skills gained in Thailand was that the migrant family members had not yet returned (90%). In other cases it was reported that they did not acquire sufficient skills (4%) or that they did not have funds to use them (6%).

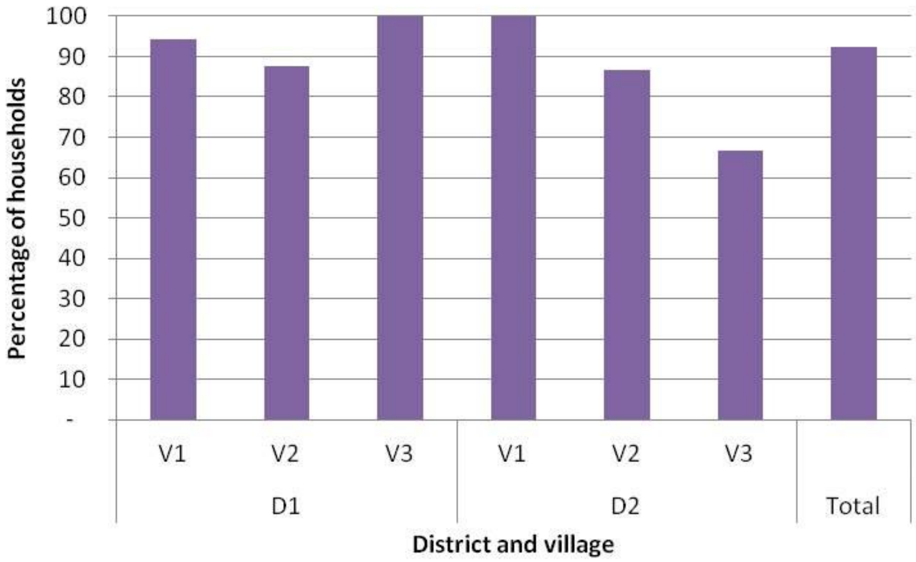

Figure 8.5 Incidence of households with migrant workers that received remittances in 2010

Table 8.10 Remittances from Thailand in 2010

	D1			**D2**			**Total**
	V1 (n=16)	**V2 (n=14)**	**V3 (n=16)**	**V1 (n=10)**	**V2 (n=13)**	**V3 (n=2)**	**(n=71)**
Mean income as remittances (million LAK)	9.5	15.1	3.6	10.1	5.8	8.0	**8.6**
Remittances as % of total income	22.0	36.8	26.4	39.0	28.5	41.4	**30.0**

8.7 Analysis of factors affecting labour migration

Though migration to work in Thailand was a major phenomenon in all the study villages and had become an important source of livelihood for the majority of households, the degree of involvement in this livelihood activity varied considerably between households. An analysis of the survey data was undertaken to examine the factors contributing to labour migration. As seen from the case studies in Section 8.8 below, decisions to migrate to work in Thailand are complex, involving many reasons, only some of which could be captured by the survey data. It was expected that migration would be more common for households living in more remote villages with fewer agricultural resources, having small farm size, possessing more economically active members, and facing a higher degree of rice shortage in the last 5 years. In contrast, it was expected that the attractiveness of labour migration would be reduced in households with access to irrigation in the DS, allowing cropping with rice or non-rice crops; in households owning more large ruminants; and in households having a higher income from vegetables, livestock, NTFPs, off-farm work, and non-farm employment in Laos.

A logistic regression model was specified to examine the factors predicting the likelihood that a household would have one or more members working in Thailand. That is, the dependent variable took the value 1 if the household was a "migrant household" and 0 if it was not. The variables included in the model (predictors) are defined in Table 8.11 and their means and standard deviations presented. Logistic regression does not make assumptions concerning the distribution of scores for the predictor variables; however, it is sensitive to high correlations among the predictor variables (multicollinearity). Outliers can also influence the results of logistic regression. Hence, before running the analysis, checks were made to ensure there were no problems regarding multicollinearity and outliers (see Appendix 5).

Table 8.11 Variables included in logistic and multiple regressions of labour migration to Thailand (n=180)

Symbol	Definition	Mean	SD
LabourMigration	Labour migration to Thailand (number of migrants)	0.9	1.3
LabourMigration	Labour migration to Thailand (no = 0, yes = 1)	0.4	0.5
VillageLocation	Village location (0 = remote, 1 = close to town)	0.7	0.5
AccessWaterDS	Access to irrigated water in DS (0 = no, 1 = yes)	0.3	0.4
PaddyArea	Paddy area owned (ha)	1.9	1.8
ActiveHHMember	Economically active household members (persons)	4.1	1.8
LargeRuminants	Number of large ruminants	5.8	8.2
VegetableIncome	Income from vegetables and non-rice crops (million LAK)	2.6	6.1
LivestockIncome	Income from livestock (million LAK)	2.0	3.1
NTFPIncome	Income from NTFPs (million LAK)	0.8	1.8
Off-farmIncome	Income from off-farm work in Laos (million LAK)	0.1	0.3
Non-farmIncome	Income from non-farm employment in Laos (million LAK)	4.4	11.1
RiceShortage	Degree of rice shortage in the last 5 years (number of rice-shortage years, defined as years with at least one month of rice shortage)	1.0	1.8

The results of the logistic regression model are presented in Table 8.12. The model was highly significant (p = 0.000). The -2 Log Likelihood test, Hosmer and Lemeshow test, and other R^2 tests supported this finding. Overall, the model correctly predicted about 81% of the variation in the labour migration behaviour of the survey households. The number of economically active members in the household had a strong positive influence on the attractiveness of labour migration. This indicated that households with more economically active members had a greater tendency towards migrating to work in Thailand. The odds of a household having a migrant member increased by 2.5 for each additional economically-active member. The result also indicated the significant negative influence on migration behaviour of the number of large ruminants possessed (providing an alternative livelihood activity at home) and the income earned from non-farm employment within Laos. However, none of the other hypothesized predictors was statistically significant, indicating that the pull of migration was overwhelming other considerations such as farm size, access to irrigation, and access to markets.

Table 8.12 Results of logistic regression of labour migration to Thailand

Independent variables	Estimated coefficients	Wald stats	Odds ratios
(constant)	-3.40	18.78***	0.03
VillageLocation	0.45	0.73	1.57
AccessWaterDS	-0.25	0.21	0.78
PaddyArea	0.06	0.24	1.06
ActiveHHMember	0.92	36.10***	2.51
LargeRuminants	-0.07	3.38*	0.93
VegetableIncome	-0.01	0.02	0.99
LivestockIncome	-0.04	0.25	0.96
NTFPIncome	0.04	0.10	1.04
Off-farmIncome	-1.14	1.25	0.32
Non-farmIncome	-0.13	6.42**	0.88
RiceShortage	-0.14	1.29	0.87
Model Chi-Square = 87.67***			
-2 Log Likelihood = 158.10			
H-L Chi-Square = 15.03			
Cox & Snell R-Square = 0.39			
Nagelkerke R-Square = 0.52			
% correctly predicted = 81.1			

*, **, *** significant at 10%, 5%, 1% level

A second model was estimated with the dependent variable specified as the number of migrant workers in the household. As this could be construed as a continuous variable, multiple regression was used. The same independent variables were used as in the previous analysis (Table 8.11). Checks were made to ensure there were no violations of the assumptions regarding multicollinearity, outliers, normality, linearity, homoscedasticity, and independence of residuals (see Appendix 6).

The results of this analysis are presented in Table 8.13. The model was statistically significant (p=0.000). The adjusted R Square of 0.44 showed that the model explained 44% of the variance in the extent of labour migration to Thailand, as defined. No doubt much of the unexplained variation was due to other factors that were not included in the model such as personal characteristics and access to pre-existing migration networks. The coefficient for the number of economically active household members was positive and statistically significant at the 1% level, with a coefficient of 0.46. In other words, the size of the household labour force was a major predictor of the number of migrants, as seen in the logistic regression model. The coefficient implies that for every additional two workers in the household, one would likely be absent in Thailand. A further implication is that households were first ensuring that there was enough labour to meet their subsistence requirements for rice and then releasing *additional* labour to earn higher returns away from the village. Despite reaching statistical significance and having the expected signs, the coefficients for the number of large ruminants owned and the number of rice-shortage years were quite small.

The insignificant contribution of the village location did not support the expectation that migration would be more common in those remote villages with fewer agricultural resources. Households in the study area seek employment in Thailand regardless of whether they live close to town or in a remote area. In fact, as presented in Section 8.6, the most remote rainfed village had the lowest incidence of migration because of profitable, forest-based sources of livelihood. The negative sign of the coefficient for the income from NTFPs provided weak support for this.

The paddy area did not turn out to be a significant factor, but the negative sign of the coefficient for accessibility to water in the dry season gave weak support to the hypothesis that households with the ability to irrigate dry-season rice or non-rice crops were likely to have fewer migrant members. Likewise, the coefficients for both off-farm and non-farm income (earned within the village or within Laos) were negative and weakly significant.

Two additional multiple regressions were performed using as the dependent variable (a) total remittances and (b) the share of remittances in total income. All the factors listed in Table 8.11 were included as independent variables. The first model was statistically significant (p=0.000) but with an adjusted R Square of only 0.22, so the degree of variation explained was less than the model in Table 8.13. The coefficient for the number of economically active members in the household was positive and statistically significant at the 1% level and the coefficients for the number of large ruminants owned and the income from livestock were negative and statistically significant at the 5%

level. In this model, the coefficient for access to irrigation in the dry season was negative and statistically significant at the 10% level. The second model was also statistically significant (*p*=0.000) with an adjusted R Square of 0.24. Again, this model confirmed that the number of economically active members in the household was a statistically significant factor at the 1% level, while the coefficients for the number of large ruminants owned and the income earned from vegetables and non-rice crops were negative and statistically significant at the 5% level. Furthermore, the coefficient for the income earned from non-farm employment in Laos was negative and significant at the 10% level.

Table 8.13 Results of multiple regression of labour migration to Thailand, measured as number of migrant household members

Independent variables	Estimated coefficients	t value
(constant)	-0.64	-2.41**
VillageLocation	0.08	0.38
AccessWaterDS	-0.26	-1.31
PaddyArea	0.03	0.69
ActiveHHMember	0.46	10.43***
LargeRuminants	-0.03	-2.85***
VegetableIncome	-0.002	-0.13
LivestockIncome	0.02	0.58
NTFPIncome	-0.05	-1.10
Off-farmIncome	-0.45	-1.55
Non-farmIncome	-0.01	-1.53
RiceShortage	-0.11	-2.26**

Adjusted $R^2 = 0.44$ $F = 13.96$, $p = 0.000$

*, **, *** significant at 10%, 5%, 1% level

In sum, the regression analyses strongly suggest that migration to Thailand is part of a conscious livelihood strategy in which households consider the available labour to maintain rice production and the use of labour in alternative livelihood activities (on-farm, off-farm, and non-farm) at home. Thus it is the deployment of labour in the best portfolio of activities that is the key household livelihood decision, rather than deriving the maximum output from their land.

8.8 Case studies of households pursuing activities beyond the farm

8.8.1 Case-study household 1 – off-farm work in a remote village

This young household lives in None Phajao, a remote rainfed village in Phonethong District.[14] The household has two main workers, the husband, aged 24 and the wife, aged 22, and a one-year-old son.[15] The couple moved out to build their own household in 2009, next to the house of the wife's parents. The husband had finished only Grade 1 and the wife, Grade 2, hence they could not read or write in Lao.

Apart from growing rice on their farm, the husband and wife worked for wages planting rice in the village in the wet season. They did not go to work in other villages because they had to cultivate their own rice as well. In 2010 the husband worked for 10 days while the wife worked for 22 days. They earned about LAK 0.8 million (USD 100) from wage labour in 2010.[16] Sometimes other people also worked as wage labour together with them. In WS 2011 they did not transplant rice for others because they had no time (they did not know whether they would undertake harvesting work because it was not the harvest period at the time of interview - September). In addition, the household head provided a wood-sawing service for others in the village in the dry season, earning about LAK 0.25 million (USD 31) in 2010. They have never worked in Thailand as there were only three members in the household and they could earn some income from local work and forest resources.

This household shared half of the wife's parents' land, which totalled four hectares. The parents had not yet divided the land. In WS 2010 the case-study household produced only 900 kg from the two hectares it cultivated due to severe drought (restricting yield to only 0.3 t/ha). They could produce up to 4,500 kg from the same area in a normal year (a yield of 2.3 t/ha). In WS 2011 they again grew rice in the shared paddy land. Unfortunately, there was too much rain this year so that many rice plants had lodged and were partly submerged, hence the rice grain was likely to be spoiled and difficult to harvest. Normally the household did not sell any rice.

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[14] Details of this case-study household are presented in Appendix 15.
[15] This was their third child. The previous son and daughter had passed away.
[16] The wage rates for rice planting and harvesting were LAK 25,000 (USD 3.10) per person-day (lunch provided by paddy owners) and LAK 30,000 (USD 3.70) per person-day (own lunch).

The household did not have a fish pond or a groundwater bore. They used water from a relative's groundwater bore for domestic use without any cost. They had a small home garden, growing only a few types of vegetables for household consumption. They had no livestock but collected some wild products such as bamboo shoots, mushrooms, rattan, forest vegetables, and fish and frogs. The wild products were mainly for their own consumption; only some were sold. They earned about LAK 0.25 million (USD 31) from the sale of mushrooms, fish, and frogs in 2010. They also collected scrap metal for sale and earned LAK 30,000 (USD 4) in 2010.

During the last five years this household had incurred a rice shortage every year. They faced a rice shortage of about 3 months during 2006-2009, but this extended to 6 months in 2010, when production was low due to severe drought. They borrowed rice from other people in the village with interest (repaying two sacks of paddy rice after six months for each sack borrowed). They sometimes purchased milled rice to consume but never borrowed money to buy rice.

8.8.2 Case-study household 2 – off- and non-farm employment in a remote village

This household lives in Hieng, a remote rainfed village in Soukhouma District.[17] The husband is 52 and the wife is 50 years of age. The husband used to be a soldier but stopped due to illness. Both the husband and wife finished non-formal education.[18] There are 13 people in the household – the husband and wife, five daughters, two sons, a son-in-law, and three nephews. However, only 6 members are full-time workers while the rest are still young or in school.

This household owns two hectares of paddy land, inherited from the wife's parents. Between 2008 and 2010 they did not cultivate rice because the husband was sick and during this period the eldest daughter and her husband lived and cultivated rice with her parents-in-law in another village in the district. In WS 2011 the household cultivated rice again because their daughter and son-in-law came to stay with them. They mentioned they would continue growing their own rice if their eldest daughter and her husband continued to live with them. However, the daughter said that she and her husband would like to build their own house next year.

Since the household did not grow their own rice in 2010, three daughters helped working in other rice farms in the village and received 38 sacks of paddy rice in return. In addition, those three daughters and the wife worked for wages, planting and harvesting rice in the village. They earned

[17] Details of this case-study household are presented in Appendix 16.
[18] Non-formal education is for adults who have not completed primary school and are illiterate, enabling them to study again to improve their literacy.

LAK 2.8 million (USD 349) from this off-farm work in 2010. In 2011, besides growing their own rice, the wife and three daughters again engaged in rice planting for wages. They planned to harvest rice for wages in November or December.[19] Other people also worked as wage labour together with these household members. The process of getting work was that people in the village who needed labour to work on their farms (planting or harvesting) would contact this household. They would then ask others to join them so the work could be finished on time. Sometimes other wage workers also asked members of the case-study household to join them. According to the household members, there was still high demand for labour to plant and harvest rice in this village. No member of the household worked in Thailand.

The household did not own a hand-held tractor. They did not have either a fish pond or a groundwater bore, but accessed water from a village tap for domestic use. They had no vegetable garden, only growing a few chilli bushes near the house. They also had no large ruminants (only a few chickens). During the last three years (2008-2010) they raised others' buffaloes (15-20 head) in the wet season (June-December). The livestock were returned to the owners in the dry season, when they were left free-grazing. The household received 100 kg of milled rice per month in return. The husband, wife, and two daughters took turns to tether the livestock in the village bushland during the day and bring them back to be penned at night. The household had to take responsibility for the loss or death of the buffaloes in the case of accidents or disease, but so far this had not occurred. The animals had to be maintained fat; however, when they became thin the owners only complained but did not reduce the care-taking fee. In 2011 the household raised buffaloes only from June to August because they were busy with their rice farming.

This household collected some wild products such as bamboo shoots, forest vegetables, mushrooms, and frogs for their own consumption and sale. They also traded wild products at the Song Ta Ou border market close to the village, which was open three days a week (Monday, Wednesday, and Friday). Before market day, the wife gathered wild products (mainly mushrooms and frogs) from other people in the village. The following day she brought those products to sell in the market. In 2010 they earned about LAK 7.2 million (USD 897) after paying the collectors, their highest income source.

Since they stopped cultivating rice between 2008 and 2010 they had to purchase rice to consume, averaging about 500 kg of milled rice each year. They sometimes borrowed milled rice from other people in the village. Sometimes in September and October, the critical period of rice shortage with

[19] During the time of interview (September 2011) rice was not yet being harvested.

no off-farm work and limited wild products to trade, they consumed other food instead of rice (such as *koy*, a root crop similar to taro, but growing naturally in the forest area).

8.8.3 Case-study household 3 – labour migration to Thailand by "choice"

This young household lives in Khoke Nongbua, a partially-irrigated village in Soukhouma District, the poorer of the two districts in the study.[20] The household has two workers, the husband, aged 37, and the wife, aged 27, and three young children, a nine-year-old daughter, a seven-year-old son, and a five-year-old son. From 2006 to 2009 both husband and wife went to work in Thailand, leaving their children with the husband's parents in a nearby village. They went because they were poor and wanted to earn a higher income. They worked in a car accessory factory in Bangkok. They heard about the work from other villagers employed there so they decided to go. They went together, crossing the border at the Chongmek border checkpoint using passports. They had first taken the bus to Vientiane Capital to get the passports. Now passports can be requested in Champasak, with no need to go to Vientiane. They did not extend their 3-month tourist visa but remained illegally working in Thailand and when they returned home they hired a van to bring them to Chongmek to cross back into Champasak Province.

While in Thailand they received daily wages of THB 200 (USD 6.70) paid every fortnight. After one year, the husband received THB 220 (USD 7.30) per day but the wife continued to receive the same rate because her work was said to be easier and not requiring high skill. They worked six days a week and stayed in the factory accommodation, but paid for electricity, on average about THB 300-350 (USD 10-12) per room per month. They faced no problems in Thailand because most of the time they stayed inside the factory compound and their employer paid some money to the police. During four years working in Thailand they came home to visit their children only once, in March 2008, and then returned home in 2010. They decided to return because it had been a long time away and they had saved about THB 150,000 (USD 5,000). They had originally thought to stay longer but they missed their children. While away, they sent money to the husband's parents to support their children and keep the money for them. They sent about THB 20,000 (USD 667) every few months by transferring money to the bank account of a person in Soukhouma District who passed on the money to the husband's parents. The bank transfer fee was THB 50 (USD 1.70) and the person in the district charged THB 300 (USD 10) for every THB 10,000 (USD 333). At the end

[20] Details of this case-study household are presented in Appendix 21.

of each year the husband's parents paid a fee of LAK 300,000 (USD 37) per person to Khoke Nongbua Village.[21]

Before working in Thailand, they grew rice on their own paddy land of 1.5 hectares, inherited from the wife's parents. They had two buffaloes but sold them because of family illness. While working in Thailand, their relatives grew rice on their paddy land in return for giving some quantity of rice to the husband's parents and their children. After returning to the village in 2010, they bought a two-wheeled tractor and built a new house. They did not engage in either off-farm or non-farm work but only worked on their own rice production, without hiring any labour. They grew rice in the 2010 wet season, obtaining a yield of 1.8 t/ha. They had sufficient rice for their needs and about 1,200 kg of unhusked rice were sold, earning LAK 3.6 million (USD 448). They grew some vegetables in a small home garden, earning about LAK 500,000 (USD 62) in 2010. They also reared pigs and earned around LAK 800,000 (USD 100) from selling pigs in 2010. In addition, they collected some wild products such as bamboo shoots, mushrooms, forest vegetables, fish, and frogs, but mainly for their own consumption. Their main sources of income in 2010 were from rice, pigs, and vegetables. They had no plan to go back to work in Thailand again. They had a comfortable new house and would continue growing rice.

8.8.4 Case-study household 4 – labour migration to Thailand from "necessity"

This household is also based in Khoke Nongbua Village in Soukhouma District.[22] The husband is 61 and the wife is 58. They are the only full-time farm workers as the other household members have migrated to take up other opportunities. One son aged 22 had moved to Pakxe, the provincial capital, to work in the construction sector and did not return home to help with wet-season rice production nor send any money. The elder son (aged 26) and his wife (aged 28) had migrated to Thailand over two years before, leaving their children – two girls (aged 9 and 5) and one boy (aged 6) – with the grandparents. According to the household head, his son and daughter-in-law migrated to earn more money as they had limited opportunities in the village. They were employed in the construction sector in Chonbouri Province and had not come back since they left the village.

[21] Based on discussion with the deputy head of Khoke Nongbua, the village authority collected a fee of LAK 300,000 (USD 37) per person per annum on behalf of the Soukhouma District from parents whose children were working in Thailand. In 2009 the village handed over nearly LAK 6 million (USD 747) to the District Labour and Social Welfare Office (after deduction of administration costs). However, in 2010 the Governor of Soukhouma District issued an order to stop collecting this kind of fee. The deputy head of Khoke Nongbua said that the decision was due to the difficulty in collecting the fee. Some parents of migrants did not pay the fees while some did. Those who did not pay claimed that their children did not earn enough money. Other districts in Champasak Province (including Phonethong District) have also stopped collecting this kind of fee.

[22] Details of this case-study household are presented in Appendix 22.

The household owns around 1.5 hectares of paddy land located near a stream. In the 2010 wet season they obtained a yield of only 1 t/ha (1,500 kg in total). Of this, 300 kg of unhusked rice (10 sacks) were sold to pay back the District Agriculture and Forestry Office (DAFO) for fertilisers purchased on credit. In 2009 the yield was 1.3 t/ha – still very low. During the case-study interview in 2011, all 1.5 hectares was subject to flooding. The rice plants had turned black but had not yet died. According to the household head, the rice grains were likely to be poorly filled so production would be very low and of poor quality. He thought this was the worst flood to occur to their paddy rice in 20 years.

While migration presented an opportunity, it was hard on the family. The household head wanted his son and daughter-in-law to return from Thailand because he and his wife were getting too old to grow rice alone and to look after the grandchildren. His son and daughter-in-law also wanted to return because they missed their children and their home. They had planned to return in 2011 but their parents asked them to stay until March 2012 because of the flood, which meant they would need money to buy rice. In 2010 the migrant couple remitted THB 20,000 (USD 667). Money was sent to a person in the district with a bank account who took a THB 600 (USD 20) commission. So far total remittances were estimated to be around THB 100,000 (USD 3,333), which was the household's main source of income. While the young couple was away, money was loaned at interest to their relatives who operated a business. This household also grew vegetables in their riverbank garden, earning about LAK 800,000 (USD 100) in 2010. They had 6 cattle, 1 pig, and 7 poultry, but none were sold. Collection of bamboo shoots, forest vegetables, fish and frogs was mostly undertaken for household consumption but contributed a very small amount to the household's cash income (LAK 100,000 or USD 12).

A revisit to this household was undertaken in May 2013. The son and daughter-in-law had returned to the village the previous year (2012) and resumed rice cultivation. Production was quite high (4,800 kg in total, with a yield of 3.2 t/ha) as a result of good weather, unlike the flooding in 2011. At the time of interview they had already sold 1,000 kg of unhusked rice and planned to sell a little more to buy fertilisers. They estimated that they would have enough rice to consume until the WS 2013 harvest. In total, the migrant couple had saved about THB 200,000 (USD 6,667) from working in Thailand. At first they thought of buying a Hyundai truck to operate a passenger service, but later decided to use most of their remittances to buy a coffee plantation in the uplands of Pakxong District, Champasak Province (Fig. 4.1). People in this village had bought coffee plantations before. They bought 1.5 hectares and their uncle, living in the same village, bought another 2.5 hectares. In their coffee plantation there were 1,000 mature trees and they had planted another 7,000 trees at a cost of LAK 5 million (USD 623) that they expected to harvest in the next three years. They harvested the mature trees in late 2012 and earned nearly LAK 1 million (USD 125). They said they would not go back to work in Thailand again as their parents were old and they had responsibility for rice cultivation, the coffee plantation, and looking after their children.

8.9 Motivations for and implications of working beyond the farm

Households in different circumstances pursued migration for dissimilar reasons. In terms of Ellis's (2000: 55-57) dichotomy, most households migrated by "choice", taking up opportunities for higher and more diversified income, while some migrated from "necessity", being obligated to work as labourers to help the household survive. Nevertheless, as the case studies above show, this distinction is difficult to make in practice, as "choosing" to pursue higher incomes can be viewed as a matter of "necessity", given the poverty of the household in Laos. Moreover, the higher incomes are traded off against the risks and vulnerabilities associated with migrating "informally" or illegally, and the hardships involved in living cheaply to accumulate savings, not to mention the separation from children, family, and home. Moreover, as seen from the revisit to the case-study household 4, for which migration was initially deemed to be from necessity, on the return of the migrants there may be new opportunities to get ahead rather than just survive.

In general, there is no doubt that remittances from Thailand contributed substantially to household income by providing scarce cash resources. For households with rice deficits, off-farm earnings and remittances helped to meet daily food requirements and other household necessities. For households producing sufficient or surplus rice, remittances could contribute to working capital and investment in farm assets such as the purchase of inorganic fertilisers, two-wheeled tractors, and water pumps, or even farm land (case studies 3 and 4). Investment in house construction was also common; this was found in the case-study households in Appendixes 10, 21, and 24.

As elaborated in Chapter 7, rice was a marginal economic activity in the study villages and labour had moved away seeking higher returns, which was the main motivation for the migration phenomenon. That is, "pull factors" predominated. The resultant limited availability of labour for agricultural activities was reflected in the increased farm wage rate in the study villages. Even where water and capital were available, labour often remained a binding constraint – especially in the dry season when many workers typically moved into non-farm employment in Laos or migrated to work in Thailand. The critical issue is how farmers can overcome their labour shortage in the face of this strong off-farm demand. In the short run, they may be able to attract labour from nearby villages by offering a higher wage rate, financed by remittances, but in the long run other villages will face a shortage of labour too as a consequence of expanding out-migration.

Technological innovations may help to overcome some labour constraints, but they often require additional capital. The issue is whether the investment in agricultural technology is likely to occur when rice production remains marginal and subsistence-oriented. There appears to be more incentive for the adoption of low-cost, labour-saving technologies in rice farming (e.g., direct seeding) rather than more intensive technologies (e.g., increased fertiliser use). However, only a small number (2%) of households had used the direct-seeding technique, suggesting there may be a barrier to its diffusion. The marked increase in ownership and use of two-wheeled tractors provides evidence of labour-saving investment by many households (a technology with many uses apart from land preparation, including transportation). However, larger investment (e.g., rice planting and harvesting machinery) is less likely because it is too costly for most individuals and the machines are idle for much of the year. It is more likely that contract services will emerge, enabling market-oriented farming households to hire machinery services on an hourly basis rather than make a large capital investment. This has already occurred in neighbouring countries such as Thailand, Vietnam, and Cambodia (Hirsch, 2012, Rigg and Salamanca, 2012, Saruth, 2011, Viet, 2011).

The small number of households involved in local farm labouring suggests that the adoption of labour-saving technologies will not harm many households. However, if these poorer households cannot make a transition to other activities they may experience a loss of income. Other than transplanting and harvesting, there are few other off-farm opportunities in surrounding areas in Champasak Province. However, as some households become more diversified and prosperous, more off-farm employment may become available for labour-dependent households, not necessarily only in rice production.

8.10 Conclusion

While some poorer households (11%) were dependent on working for wages at peak times on their neighbours' farms, a much larger number of households from across the land-ownership and agro-economic spectrums (82%) combined subsistence-oriented (or at most, semi-commercial) rice farming with non-farm employment in Laos or Thailand, including 43% with one or more members who were migrant workers in Thailand. The impact of this external employment on the household labour force available for rice farming and the contribution of wages and remittances to household income were substantial. The findings in this chapter confirm that rural households in the lowlands of Southern Laos are engaged in a variety of livelihood activities, including farm-based activities, off-farm and non-farm employment locally, and labour migration. However, rice production is still the basic subsistence activity on which most of them rely. The interesting and important questions that follow are: What types of households will emerge from these changes? What trajectories are they pursuing? These issues are explored in the next chapter.

9 HOUSEHOLD TYPES AND LIVELIHOOD TRAJECTORIES

9.1 Introduction

The process of agrarian transition in the study area and in the wider Mekong region has led to the emergence of a diversity of household types from the predominant subsistence-oriented paddy farming household that prevailed until about two decades ago. The livelihood strategies of survey households were analysed according to the degree to which mobile household resources (labour and capital) were directed into agricultural production for the market, off- and non-farm activities, or migration. This chapter first identifies the evolving household types, based on the dominant livelihood activities. It then outlines the features of these types, drawing on detailed case studies that were selected to be representative of each type. This is followed by a discussion of the various strategies and trajectories of these different types of rural household.

9.2 Household types

The purpose of the development of household types is to group farm decision-makers with broadly similar goals and circumstances in order to diagnose constraints and identify potential solutions. Agro-economic zoning, combining agro-ecological and socio-economic parameters derived from secondary data, is the starting point. However, these zones are useful only to the extent that they help to characterise the circumstances of the decision-making entities within them, that is, farm households. Farm households can be distinguished further, based on their existing assets and activities, which can vary widely within a given zone. Household activities may include non-agricultural activities, both those based on natural resources (such as collection of forest products) and those not directly based on natural resources (such as rural transportation or trade).

As well as these structural features of the existing situation, the development of household types needs to incorporate dynamic elements to indicate in which direction a household is heading. That is, different livelihood strategies and trajectories need to be identified. This necessarily makes the classification more fluid, with the boundaries between types somewhat blurred and the classification of a given household changing over time, as for example when a decision is made by a key household member to migrate, shifting the household from a market-oriented agricultural strategy to a migration-oriented strategy. A forward-looking focus on pathways is likely to be more relevant to both technical research and policy development. The household types can also serve as a guide to differentiating both technical and policy recommendations to make them more relevant to specific subsets of the rural population.

Based on the data collected from the study area (reconnaissance and household surveys) within each agro-economic zone (irrigated, supplementary-irrigated, purely rainfed), households were first classified according to their access to assets (paddy land, water, labour, machinery). Household livelihood strategies were subsequently analysed according to their foremost livelihood strategy, e.g., whether household resources (mainly labour and capital) were directed into agriculture, non-farm activities, or migration. Adapting the World Bank's typology outlined in Chapter 2 (World Bank, 2007, pp. 75-76), five broad types of household orientation were identified – subsistence-oriented farming households, semi-commercial farming households, labour-oriented households, migration-oriented households, and households with diversified livelihoods (Table 9.1).

Subsistence-oriented farming households were those producing paddy rice exclusively for household consumption or selling less than 20% of total rice production. These households produced rice close to their subsistence needs, and cash income was derived mainly from agricultural activities such as surplus rice, vegetable production, and livestock-raising, with some contribution from NTFP collection and hunting. Wages and salaries contributed less than 50% of total cash income, as did remittances. Only 17% of households remained in this category, concentrated in the more remote, purely rainfed villages (V3) in each district (Table 9.1).

Semi-commercial farming households included those that were making regular production decisions with a view to supplying the market, whether for rice, livestock, or other products such as corn and watermelon. Using rice production as the main indicator, households were classified as semi-commercial if they sold more than 20% of their total rice production. This is considerably less than the World Bank's criterion of 50% for "market-oriented farming", hence the use of the term "semi-commercial" to reflect a somewhat lower degree of market orientation. In any case, only 16% of households, half of them in the irrigated, accessible village in the more prosperous district (V1-D1), fell into this category (Table 9.1).

Labour-oriented households engaged in local agricultural labour markets, self-employment, or wage employment in the non-farm economy. These households earned a large amount of their cash income from off-farm and non-farm activities (less than 20% was derived from own-farm activities or, in other words, 80% was derived from wages, salaries, and business income combined). These households had no surplus rice to sell, but may have achieved their subsistence requirements.

Fourteen per cent of households fell into this category, 40% of them from V3-D2, the remote village with a high degree of involvement in cross-border trade in NTFPs (Table 9.1).

Migration-oriented households (or remittance-dependent households) were those households whose main income was from remittances sent by migrant household members. These households tended to have no surplus rice to sell, but may have attained rice self-sufficiency in good years. This was the smallest group, accounting for only 11% of survey households, scattered across the six villages (Table 9.1).

Diversified households (combining two or more livelihood strategies) included those households where agriculture, labour income, and remittances all contributed to the household's cash income. Agriculture accounted for at least 20% of cash income, with the remainder derived from wages and other labour income of resident members and/or from remittances sent by migrant workers. These diversified households had the resources (land, labour, water, and capital) to maintain reasonably productive cropping and livestock systems. While some household members were involved in non-farm activities or regularly migrated to Thailand, farming activities remained important, both for subsistence and cash income. Remittances could therefore be used largely for productive investments (whether in farming or business) rather than to underpin the subsistence needs of those remaining on the land. Diversified households were by far the most common type, accounting for 43% of the survey households. They were the dominant group in all villages, except for V1-D1, where they were just outnumbered by semi-commercial farmers, and V3-D2, where subsistence-oriented households and labour-oriented households (mainly engaged in NTFP trade) were slightly more common (Table 9.1).

Table 9.1 Emerging household types based on dominant livelihood activities (no. of households)

Household types	**D1**			**D2**			**Total (n=180)**	**%**
	V1 (n=30)	**V2 (n=30)**	**V3 (n=30)**	**V1 (n=30)**	**V2 (n=30)**	**V3 (n=30)**		
Subsistence-oriented farming	1	5	8	3	4	10	**31**	**17.2**
Semi-commercial farming	14	4	3	4	3	0	**28**	**15.6**
Labour-oriented	1	4	3	3	4	10	**25**	**13.9**
Migration-oriented	1	5	4	4	4	1	**19**	**10.6**
Diversified	13	12	12	16	15	9	**77**	**42.8**
Total	**30**	**30**	**30**	**30**	**30**	**30**	**180**	**100.0**

Table 9.2 shows the main characteristics of each household type based on the data from the household survey. There were no significant differences in the measured human capital endowments of the household types (age, education, household size, and household workforce), though there would have been differences in the personal attributes of farmers that were not measurable in a simple survey. The labour-oriented households had the smallest area of paddy land, indicating that their farms were too small to fully absorb the household workforce; however, there was no statistically significant difference in the mean paddy land holdings between household types (Table 9.2 and Fig. 9.1). Hence, measured asset endowments are not always good indicators of the different types of household. This shows that market orientation can also be influenced by other factors such as soil fertility, access to water sources, or access to markets, affecting crop choice and productivity. In terms of total income earned, the diversified households generated significantly more income than the other types of households, except semi-commercial farming households (Table 9.2 and Fig. 9.2).[23] Key features of the case-study households representing each household type are summarised in Tables A.13 to A.17 in Appendix 7.

9.3 Features of household types based on representative case studies

9.3.1 Subsistence-oriented farming households

This household type is located in partially irrigated or purely rainfed villages. Household members normally work on their own farms, but some household members may work for wages in the village during rice planting and harvesting, or in some cases undertake non-farm work in Laos or Thailand. With access to water through a groundwater bore or village groundwater tap, these households can grow some vegetables in a small home garden for consumption only. They also collect some types of NTFPs, but mainly for household consumption. This household type also owns a few large ruminants.

The subsistence-oriented households can be differentiated by their asset base into small-scale and medium-scale rainfed rice farmers. Small-scale producers mainly produce rice for household consumption. The area of paddy land is less than 2 hectares. When household rice is in deficit, purchases of rice are largely funded through the sale of livestock (including large ruminants, pigs, and poultry) and some off-farm and non-farm employment. Wages and remittances can be used to

[23] Total (gross) income includes the income from rice even if not sold, sale of vegetables and other non-rice crops, sale of livestock, sale of NTFPs, off-farm earnings, non-farm earnings, and remittances. Remittances here were the net transfers (deducting costs such as transfer fees).

purchase inputs or invest in livelihood development. Medium-scale rice producers are similar to the small-scale rice producers, but the area of paddy land is greater than 2 hectares. Due to the larger area, this group tends to achieve rice self-sufficiency despite low yields.

Table 9.2 Main characteristics of household types

Characteristic	Mean values from household survey					
	Subsistence oriented farming (n=31)	**Semi-commercial farming (n=28)**	**Labour-oriented (n=25)**	**Migration-oriented (n=19)**	**Diversified (n=77)**	**All (n=180)**
Age of head (years)	47.5	49.1	47.9	52.4	47.1	48.2
Education of head (years)	3.9	4.9	5.2	4.0	5.3	4.9
Household size (persons)	6.3	6.3	5.6	7.8	7.0	6.6
Household workers (FTE)	3.5	3.9	3.1	3.8	3.4	3.5
Paddy area owned (ha)	2.0	2.2	1.3	1.8	2.1	1.9
Total income (million LAK)	14.0	26.0	19.8	18.5	30.8	24.4
Income per capita (million LAK)	2.3	4.7	4.2	2.6	4.5	3.9
Vegetable income (million LAK)	0.8	7.3	0.4	0.5	2.9	2.6
Livestock income (million LAK)	1.0	2.4	2.0	1.6	2.3	2.0
NTFP income (million LAK)	0.6	1.2	0.2	0.8	1.0	0.8
Off-farm income (million LAK)	0.08	0.02	0.2	0.05	0.03	0.06
Non-farm income (million LAK)	0.3	0.3	10.7	0.6	6.4	4.4
Remittances (million LAK)	0.16	0.13	0.16	9.1	5.5	3.4

Note: 1 USD = 8,027 LAK, May 2011

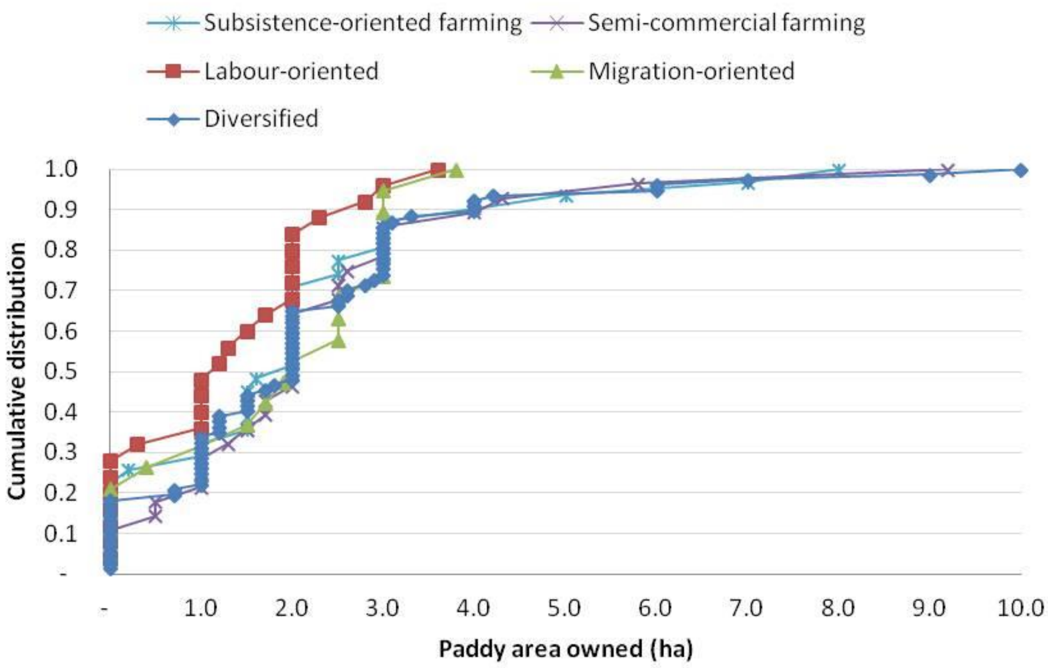

Figure 9.1 Cumulative distribution of paddy area owned, by household types

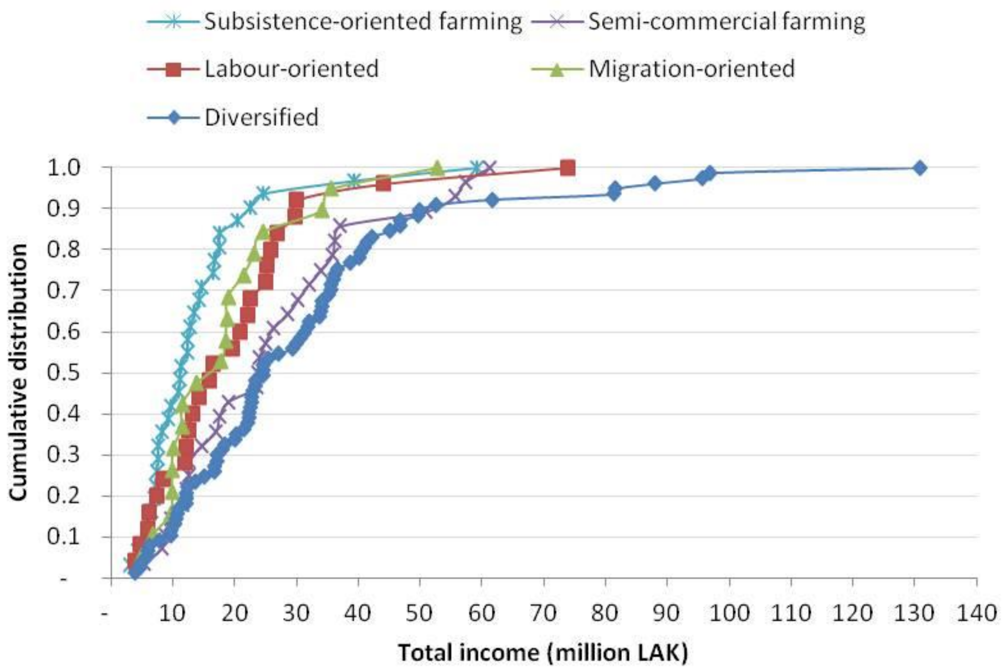

Figure 9.2 Cumulative distribution of total income, by household types

The ability to utilise water in the dry season allows some subsistence-oriented farming households to cultivate non-rice crops. While many households grow some vegetables during the dry season, this sub-set of subsistence-oriented households grows vegetables on a scale beyond household consumption. Water is sourced from streams, ponds, or groundwater bores.

Being located in the remote villages close to the forested mountains offers some subsistence-oriented farming households the option of collecting NTFPs for household consumption and cash income. In this respect their labour is used away from the farm to meet subsistence needs. They are not self-sufficient in rice and use income from NTFP sales as the primary source of cash to make up the shortfall in rice.

In particular circumstances, some of these subsistence-oriented farming households have considerable capital stored in large ruminants (over 10 head). They could be called "livestock keepers" as they do not adopt a production-oriented system (i.e., they still use a free-grazing, low-input system), with animals kept as a store of wealth to be liquidated as required. Case-study households in Appendixes 10 and 11 represent this type of subsistence-oriented farming household.

The case study in Appendix 10 can be used as an example of the labour utilisation and income sources of the subsistence-oriented farming households. The monthly availability and utilisation of labour for this household in 2010 are presented in Fig. 9.3. The household had four main workers (the 39-year-old female household head, a daughter and her husband, and a 15-year-old son) and three part-time workers (students) who helped during weekends and school break (June-August). They only used their family labour (i.e., no exchange or hired labour). The peak labour requirements were in June, July, and November, corresponding to the periods of land preparation, rice transplanting, and rice harvesting, respectively. This household also allocated time for collecting wild products and taking care of cattle and buffaloes, in particular in the wet season. Nevertheless, there was considerable underutilisation of labour for much of the year. On an annual basis, they utilised 42% of their family labour for wet-season rice cultivation, 34% for NTFP collection, 24% for managing cattle and buffaloes, and a very small proportion for home-garden vegetable production (Fig. 9.4). In the dry season their 22 cattle and 8 buffaloes grazed freely in the nearby mountain forest in the day and were penned at night at their paddy fields, whereas in the wet season they were tethered in the mountain forest in the day and penned at night at their paddy fields. The household earned income from farm production and remittances. In 2010 farm income produced 73% of the total household income while remittances contributed 28%. Around 64% of farm income in 2010 was from wet-season rice whereas cattle contributed about 36% to farm income (Table 9.3).

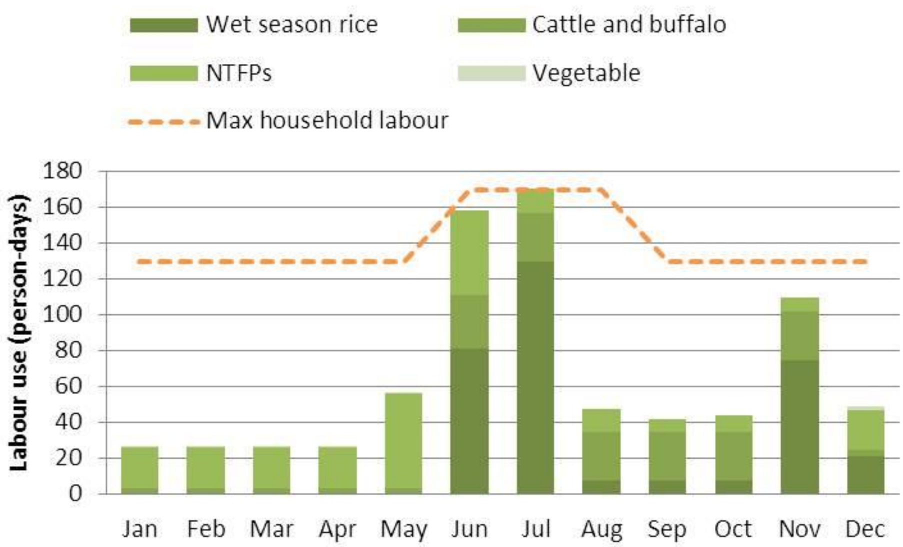

Figure 9.3 Monthly family labour availability and utilisation for farm production in 2010 (derived from case-study household in Appendix 10)

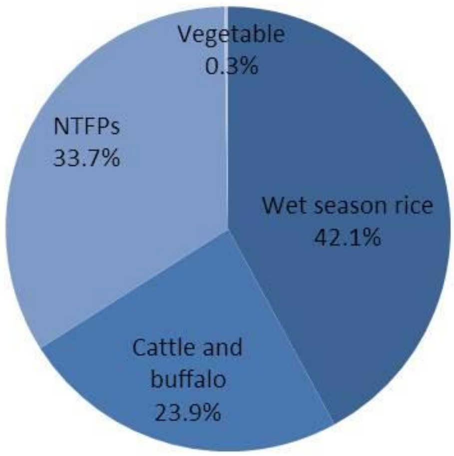

Figure 9.4 Proportion of family labour utilisation for farm production in 2010 (derived from case-study household in Appendix 10)

Table 9.3 Household income sources in 2010 (derived from case-study household in Appendix 10)

Sources of income	Gross income (million LAK)	Variable expenses (million LAK)	Gross margin* (million LAK)	% of sub-total income	% of total family income
Farm					
Wet-season rice (5 ha)	5.3	1.1	4.2	63.6	46.1
Home-garden vegetables (16 m^2)	0	0	0	0.0	0.0
Cattle and buffaloes	2.4	0	2.4	36.4	26.4
NTFPs	0	0	0	0.0	0.0
Sub-total 1	**7.7**	**1.1**	**6.6**	**100.0**	**72.5**
Others					
Off-farm	0	0	0	0.0	0.0
Non-farm	0	0	0	0.0	0.0
Remittances	2.5	0	2.5	100.0	27.5
Sub-total 2	**2.5**	**0**	**2.5**	**100.0**	**27.5**
TOTAL FAMILY INCOME	**10.2**	**1.1**	**9.1**		**100.0**

* Remittances can be treated as the gross margin income as the transfers are already the net earnings, taking account of the expenses of the migrant workers.

9.3.2 Semi-commercial farming households

This household type is typically located in irrigated or partially-irrigated villages. Access to water in the dry season offers this type the option to cultivate rice or non-rice crops for the market. Household members normally work on their own farms and not off-farm, but they may engage in non-farm work or a young member might work in Thailand. This type of household typically owns a handheld tractor, has a groundwater bore, and operates the bore with an electric pump. The bore water is used for domestic purposes and gardening. Vegetables grown in the home garden are for household consumption and sale. They may collect some types of NTFPs but mainly for household consumption. They also own some large ruminants.

Some semi-commercial farming households can be "rice specialists"; they produce paddy rice beyond the household's consumption needs. At least 20% of the total rice production is sold. They can achieve this surplus by cultivating a large area, achieving high yields, and/or accessing irrigation for a dry-season rice crop. Such farmers are also likely to be interested in improving rice quality and marketing.

Other semi-commercial farming households are "cropping specialists", growing non-rice crops (e.g., corn, watermelons) for the market. This may include contract-farming arrangements for commodities such as tobacco. Access to water is essential for this type of household, which is generally found in the proximity of a large-scale irrigation scheme. Household rice self-sufficiency is often met through wet-season production, allowing the household to explore other options that provide good economic returns to household resources. Case-study household in Appendix 14 (a tobacco grower) represents this type of semi-commercial farming household.

None of the survey or case-study households can yet be designated as "livestock specialists". Such households would direct labour and capital into commercial livestock production, with livestock sales accounting for over 50% of cash income. In the future, some of the current "livestock keepers" may become "livestock specialists" by learning the appropriate management practices and investing in forage resources.

The information on labour utilisation and income sources derived from the case-study household in Appendix 13 can be used as an example of a semi-commercial farming household. The monthly availability and utilisation of labour for this household in 2010 are presented in Fig. 9.5. The household head (41 years of age) was the full-time farm worker while his wife (40 years of age, a primary school teacher) and three children (a 16-year-old daughter, a 14-year-old son, and a 12-year-old son, all students) helped during weekends and the mid-year school break (June-August). The peak labour requirements were in July and November (the periods for transplanting and harvesting wet-season rice) and January and April (the same operations for dry-season rice). In addition to drawing on family labour, this household used exchange labour during these peak periods. For the whole year, the household utilised over half of their labour for rice cultivation and the remainder for growing vegetables in riverbank-gardens and managing cattle (Fig. 9.6). In the dry season the household's 17 cattle were allowed to free-graze in the village non-irrigated area in the day and penned at night, while in the wet season they were tethered around their paddy fields in the day and penned at night. This household earned income from farm production and non-farm work. In 2010 farm income accounted for nearly 79% of total household income while non-farm income (the primary school teacher's salary) contributed about 21%. Of farm income, rice contributed 46% whereas cattle contributed almost 25% (Table 9.4).

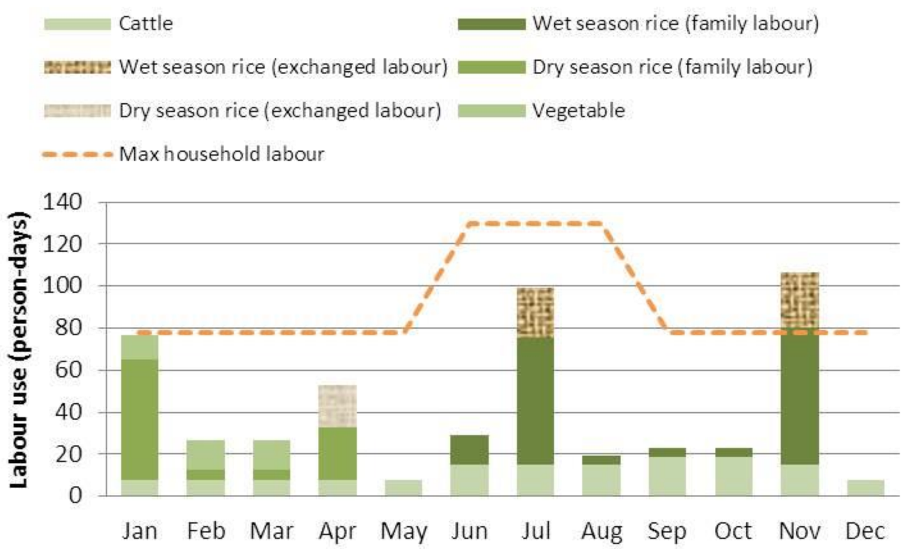

Figure 9.5 Monthly labour availability and utilisation for farm production in 2010 (derived from case-study household in Appendix 13)

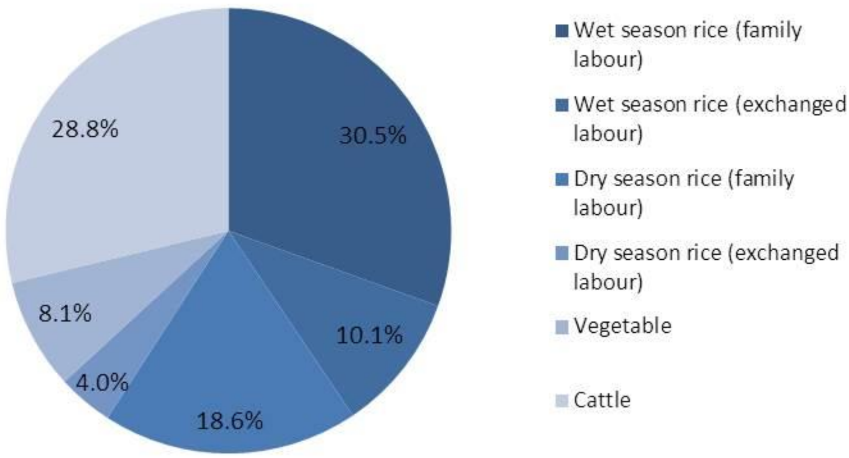

Figure 9.6 Proportion of labour utilisation for farm production in 2010 (derived from case-study household in Appendix 13)

Table 9.4 Household income sources in 2010 (derived from case-study household in Appendix 13)

Sources of income	Gross income (million LAK)	Variable expenses (million LAK)	Gross margin* (million LAK)	% of sub-total income	% of total family income
Farm					
Wet-season rice (2 ha)	12.3	1.6	10.7	31.8	25.1
Dry-season rice (1 ha)	10.9	2.0	8.9	26.5	20.9
Riverbank-garden vegetable (1200 m^2)	2.8	0.5	2.3	6.7	5.3
Cattle	10.5	0	10.5	31.4	24.7
Poultry	1.2	0	1.2	3.6	2.8
Sub-total 1	**37.7**	**4.1**	**33.6**	**100.0**	**78.8**
Others					
Off-farm	0	0	0	0.0	0.0
Non-farm	9.0	0	9.0	100.0	21.2
Remittances	0	0	0	0.0	0.0
Sub-total 2	**9.0**	**0**	**9.0**	**100.0**	**21.2**
TOTAL FAMILY INCOME	**46.7**	**4.1**	**42.6**		**100.0**

* Income from other sources is considered as the equivalent to the gross margin income because the variable expenses were insignificant.

9.3.3 Labour-oriented households

This type of household tends to be located in remote villages and to derive most of its cash income from off-farm and non-farm activities. Household members are typically available for peak-season rice activities (planting, harvesting) but take up off-farm or non-farm employment within Laos to generate income, often to purchase household needs, including rice. The household typically does not have a groundwater bore, but can access water through a village groundwater tap or a relative’s groundwater bore. They have only a small home garden (if any), growing a few vegetables for household consumption, and tend not to have livestock. Being in the remote villages close to forested mountain areas allows this type of household to collect NTFPs for household consumption and cash income.

In some cases, labour-oriented households are of a quite different sub-type, that is, those with members who are salary earners (usually government employees) or engaged in local business (traders or agricultural service providers such as threshing or milling). In these cases, income diversification is largely due to skills, opportunities, and assets rather than necessity, as it is with those dependent on off- or non-farm wage employment. This sub-category maintains paddy rice production for household consumption but is more likely to hire labour for transplanting and harvesting, given their alternative employment. They are also more likely to adopt labour-saving technologies that provide a better return than hired labour. These households have no surplus rice to sell but may achieve desired subsistence levels.

Fig. 9.7 shows the monthly availability and utilisation of labour in 2010 for the case-study household in Appendix 15, which is an example of the first category of labour-oriented household. This household had two main workers (a 24-year-old husband and a 22-year-old wife) and a 3-year-old son. The peak labour requirements were in June-July and November, the periods of wet-season rice transplanting and harvesting. During this period, household members also worked as wage labourers, transplanting rice for others in the village. On a whole-year basis this household utilised the majority of their labour for NTFP collection (44%) and rice cultivation (27%). They also used about 30% of their labour for wood sawing (concentrated in the dry season) and wage labour (in June-July) (Fig. 9.8). This household earned income from farm production and off-farm and non-farm work. Of the total household income in 2010, off-farm and non-farm work contributed over half whereas wet-season rice produced 32% and NTFPs nearly 15% (Table 9.5).

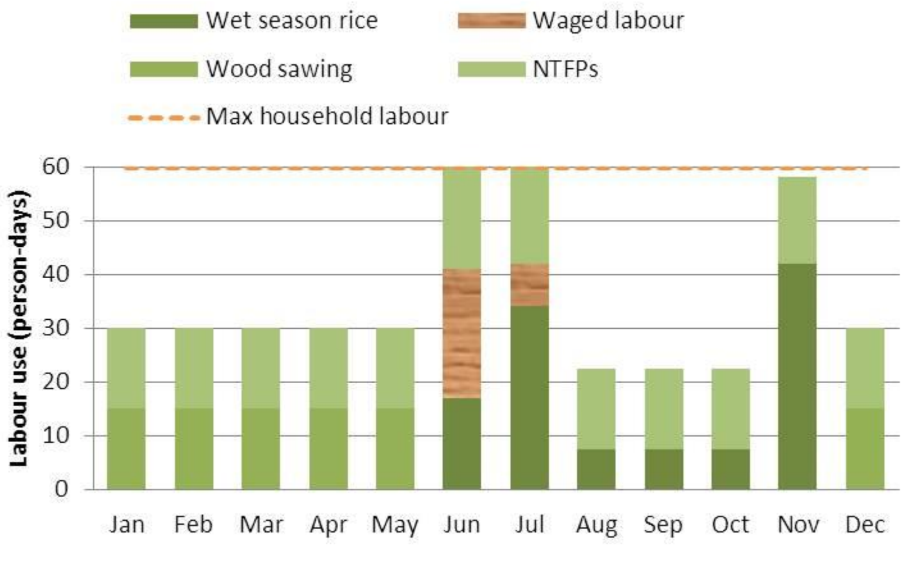

Figure 9.7 Monthly labour availability and utilisation for farm production in 2010 (derived from case-study household in Appendix 15)

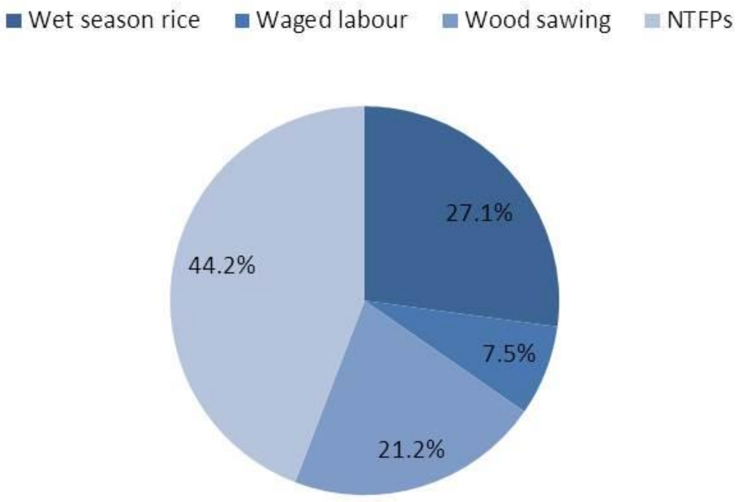

Figure 9.8 Proportion of labour utilisation for farm production in 2010 (derived from case-study household in Appendix 15)

Table 9.5 Household income sources in 2010 (derived from case-study household in Appendix 15)

Sources of income	**Gross income (million LAK)**	**Variable expenses (million LAK)**	**Gross margin* (million LAK)**	**% of sub-total income**	**% of total family income**
Farm					
Wet-season rice (2 ha)	1.2	0.7	0.5	68.4	32.1
NTFPs	0.3	0	0.3	31.6	14.9
Sub-total 1	**1.5**	**0.7**	**0.8**	**100.0**	**47.0**
Others					
Off-farm	0.6	0	0.6	71.9	38.1
Non-farm	0.3	0	0.3	28.1	14.9
Remittances	0	0	0	0.0	0.0
Sub-total 2	**0.9**	**0**	**0.9**	**100.0**	**53.0**
TOTAL FAMILY INCOME	**2.4**	**0.7**	**1.7**		**100.0**

* Income from other sources is considered as the equivalent to the gross margin income because the variable expenses were insignificant.

9.3.4 Migration-oriented households

This type of household can be found in any village type. They normally grow some vegetables in their small home garden, mainly for household consumption. They may collect some types of NTFPs, again mainly for household consumption. They normally own a number of large ruminants. At least one household member works in Thailand, but none in off-farm or non-farm employment within Laos. As a consequence, the availability of family labour for farming has decreased. Their main cash income is derived from remittances, on which they depend greatly. These households are more likely to use remittances for consumption and house construction; however, in some cases remittances are used to invest in farming, not necessarily in rice production. The accumulation of capital can see some households move out of this category over time (e.g., becoming diversified households).

Fig. 9.9 shows the monthly availability and utilisation of labour in 2010 for the case-study household described in Appendix 20, which is a good example of a migration-oriented household. This household had five members (a 61-year-old household head, a 58-year-old wife, 9- and 5-year-old granddaughters, and a 6-year-old grandson). This did not include two migrant workers (a son and his wife) in Thailand and a son doing construction work in Pakxe (he did not come to help in wet-season rice production or send money back home, and only visited for short periods). Hence this household had two main workers while young grandchildren were attending school. The peak labour requirements (not counting the labour time of the migrant household members) were in the period of wet-season rice transplanting (August) and harvesting (November-December). The household had to use exchange labour and hired labour to finish transplanting rice. On a whole-year basis this household utilised the majority of its labour for rice cultivation and the remainder for growing vegetables in a riverbank garden and managing cattle (Fig. 9.10). Their six cattle grazed freely in their paddy fields in the dry season whereas they were tethered in a nearby village in the day and penned at night in the wet season. Income was received from farm production and remittances. In 2010 the farm income (mainly from rice) and remittances from Thailand contributed almost the same proportion (50%) to the total household income (Table 9.6).

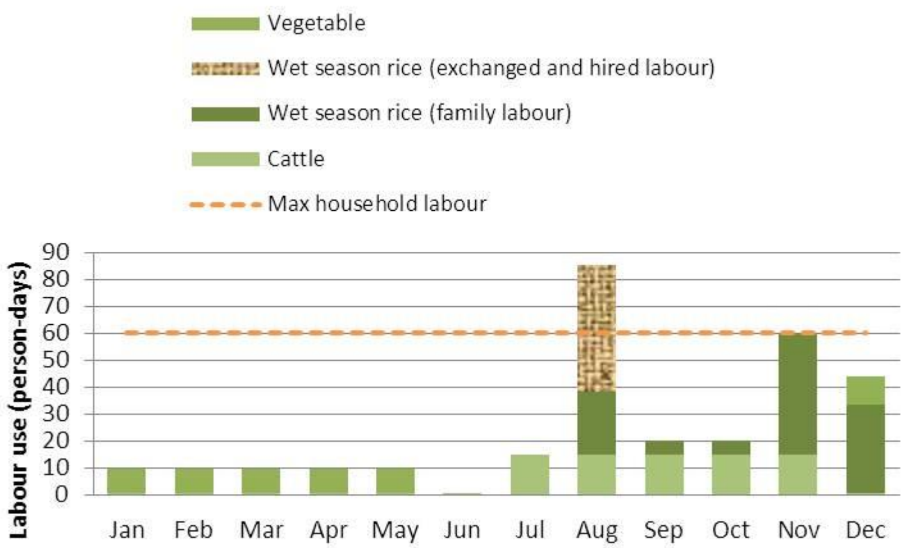

Figure 9.9 Monthly labour availability and utilisation for farm production in 2010 (derived from case-study household in Appendix 20)

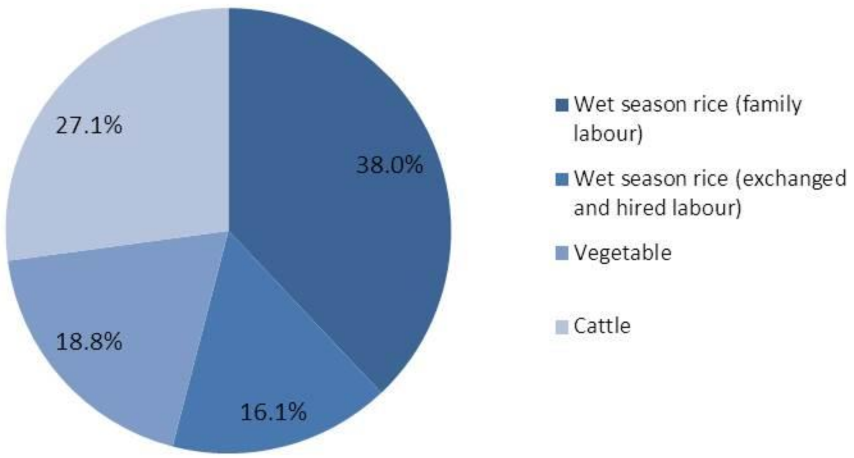

Figure 9.10 Proportion of labour utilisation for farm production in 2010 (derived from case-study household in Appendix 20)

Table 9.6 Household income sources in 2010 (derived from case-study household in Appendix 20)

Sources of income	**Gross income (million LAK)**	**Variable expenses (million LAK)**	**Gross margin* (million LAK)**	**% of sub-total income**	**% of total family income**
Farm					
Wet-season rice (1.5 ha)	11.7	1.7	10.0	94.4	47.3
Riverbank-garden vegetable (30m x 40m)	0.8	0.2	0.6	5.6	2.8
Sub-total 1	**12.5**	**1.9**	**10.6**	**100.0**	**50.1**
Others					
Off-farm	0	0	0	0.0	0.0
Non-farm	0	0	0	0.0	0.0
Remittances	10.6	0	10.6	100.0	49.9
Sub-total 2	**10.6**	**0**	**10.6**	**100.0**	**49.9**
TOTAL FAMILY INCOME	**23.1**	**1.9**	**21.2**		**100.0**

* Remittances can be treated as the gross margin income as the transfers are already the net earnings, taking account of the migrant family member's expenses.

9.3.5 Diversified households

This household type is typically located in irrigated or partially-irrigated villages. Household members engage in a variety of livelihood activities (agricultural, non-farm, and wage migration). This means they have cash income from agricultural activities (cropping and livestock), salaries and wages, and remittances. Access to water in the dry season, whether through irrigation or groundwater bores, allows this household type to produce rice or non-rice crops for sale. They possess a few large ruminants but do not collect NTFPs, being far from the main source of these commodities and having better uses of their labour.

Rice production is typically sufficient for household consumption needs, allowing remittances to be used for investment in farm and non-farm enterprises. Migration is by choice rather than necessity. Though migration reduces the labour available for agricultural activities, remittances allow for some investment in labour-saving technologies, such as two-wheel tractors and pumps, which may be out of reach for labour-oriented households.

Fig. 9.11 shows the monthly availability and utilisation of labour in 2010 for the case-study household described in Appendix 22, which is an example of a diversified household. This household had two full-time workers (the 40 year-old household head and his 38 year-old wife) and a secondary worker (a 14 year-old daughter). This did not include two migrant workers (18 and 16 year-old daughters) in Thailand and a 20 year-old son studying at the Southern Agricultural College in Pakxe District, Champasak Province. The peak labour requirements were in June and November (the periods of wet-season rice transplanting and harvesting) and January and April (the same operations for dry-season rice). In addition to family labour, this household had to use some hired labour for harvesting watermelons in the dry season. On a whole-year basis, the household utilised the majority of their labour for rice cultivation in both seasons (66%) and the remainder for growing watermelons, vegetables in a riverbank garden, and managing livestock (Fig. 9.12). In the dry season the household's two cattle were allowed to free-graze in the village non-irrigated area in the day and penned at night, while in the wet season they were tethered around their paddy fields in the day and penned at night. Two pigs were penned both day and night. The household's income came from farm production and non-farm activity. In 2010 farming accounted for around 57% of total household income while income from non-farm work (making wooden furniture) and remittances from Thailand contributed nearly 43%. Of the farm income, rice contributed over half whereas watermelon and vegetable production accounted for about 15% and livestock for 20% (Table 9.7).

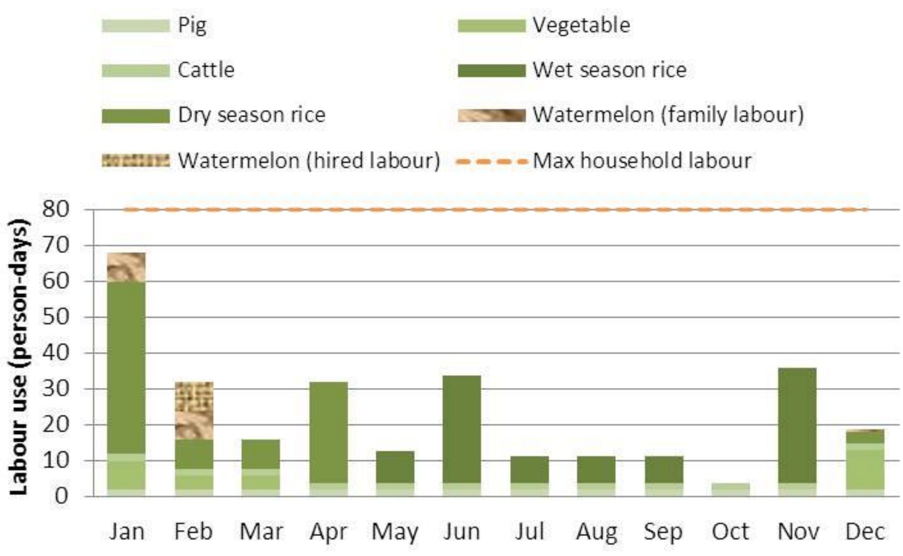

Figure 9.11 Monthly labour availability and utilisation for farm production in 2010 (derived from case-study household in Appendix 22)

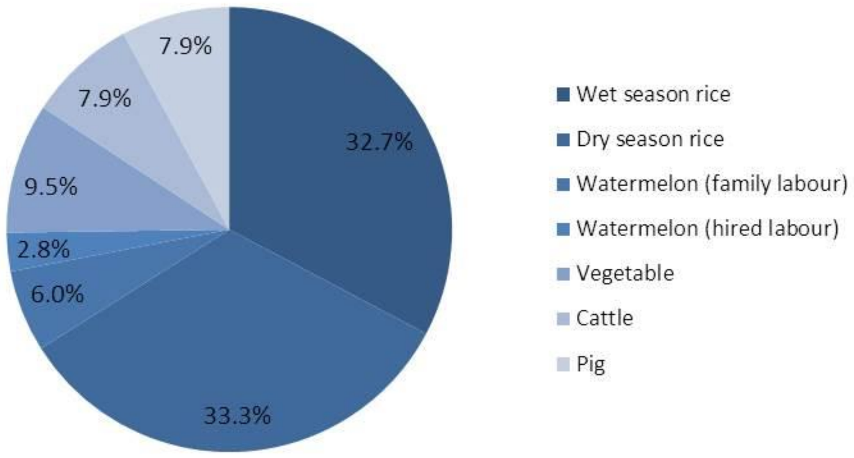

Figure 9.12 Proportion of labour utilisation for farm production in 2010 (derived from case-study household in Appendix 22)

Table 9.7 Household income sources in 2010 (derived from case-study household in Appendix 22)

Sources of income	**Gross income (million LAK)**	**Variable expenses (million LAK)**	**Gross margin* (million LAK)**	**% of sub-total income**	**% of total family income**
Farm					
Wet-season rice (1 ha)	3.8	1.6	2.2	17.2	9.8
Dry-season rice (1 ha)	9.8	3.7	6.1	47.5	27.1
Watermelon	2.0	0.7	1.3	9.8	5.6
Riverbank-garden vegetable	1.5	0.8	0.7	5.4	3.1
Pig	1.6	0	1.6	12.4	7.1
Poultry	1.0	0	1.0	7.6	4.3
Sub-total 1	**19.7**	**6.8**	**12.9**	**100.0**	**57.1**
Others					
Off-farm	0	0	0	0.0	0.0
Non-farm	5.0	0	5.0	51.7	22.2
Remittances	4.7	0	4.7	48.3	20.8
Sub-total 2	**9.7**	**0**	**9.7**	**100.0**	**42.9**
TOTAL FAMILY INCOME	**29.4**	**6.8**	**22.6**		**100.0**

* Income from other sources is considered as the equivalent to the gross margin income because the variable expenses are insignificant.

9.3.6 Household types and livelihood outcomes

This section attempts to compare livelihood outcomes of the different household types. According to the Government's poverty criterion for 2010-2015, a rural household is considered as "poor" when it has an average monthly total income per capita (regardless of gender and age) of less than LAK 180,000 (or an average annual total income per capita of less than LAK 2.16 million) (GoL, 2009). Base on this criterion and an average household size in the survey villages of about 7 persons, a non-poor household would have an average annual total income of more than LAK 15 million.

The case-study households presented in Sections 9.3.1 to 9.3.5 above showed that the subsistence-oriented farming households and labour-oriented households had lower annual income than the poverty line, whereas semi-commercial farming and diversified households had incomes above the poverty line, as well as more diversified income streams and greater food security. This can also be seen in Table 9.2 and Fig. 9.2, derived from the survey data, which showed that the mean total income of diversified households was around LAK 31 million (twice the poverty line), of semi-commercial farming households, around LAK 26 million, of labour-oriented and migration-oriented households around LAK 19-20 million, and of subsistence-oriented households around LAK 14 million.

In terms of the level of risk associated with dependence on WS rice and farm wages, subsistence-oriented farming households were subject to greater production and market risk as this type of household was largely dependent on their own WS rice cultivation for both household consumption and income generation. Labour-oriented households also face a higher degree of risk and uncertainty as more farmers use machinery for rice planting and harvesting, since they rely heavily on farm wages for these activities. The semi-commercial farming households (having a high degree of on-farm diversification) and the diversified households face the lowest degree of risk due to their portfolio of activities. Hence the attraction of moving from the traditional subsistence-oriented farming to greater farm and livelihood diversification can be readily appreciated.

9.4 Household livelihood strategies and trajectories

The household types identified in Section 9.2 and explored in more detail in Section 9.3 were based on both resource endowments and resource utilisation. It should be emphasised that these household types were not intended to "lock" households into categories with clear-cut boundaries. The typology can be used to highlight potential pathways or trajectories that each household can take and to identify potential interventions that each might be interested in and capable of responding to. For example, a household may initially be a small-scale rice producer facing land constraints. Then some family members may migrate to Thailand, making the household remittance-dependent and labour-constrained. When the family members return, the household may have the capital needed to invest in a hand-tractor and a pump, allowing for dry-season cultivation. This investment, along with the return of family labour, may enable it to respond to opportunities for agricultural diversification and commercialisation. Thus the classification of household types provides only a snapshot for the present, with households moving between types in the medium term (that is, within a decade or less). Of course, the movement is not necessarily in one direction; a semi-commercial farming household may revert to a subsistence-oriented or labour-oriented household with the loss of a household worker or farm assets.

While the initial structural characteristics of the household (resource endowments) are important in determining livelihood strategies and outcomes, the emergence of non-farm opportunities both in Laos and Thailand has meant that, in general, households have become increasingly diversified, with livelihoods less determined by the original endowment of natural resources. With increasing non-farm opportunities, initially subsistence-oriented households can go through a process of transition by incorporating non-farm and migration activities in their livelihood portfolios. The role of off-farm, non-farm, and migration activities in facilitating capital accumulation and development of the initial resource base is of key concern. In some cases, households may remain labour-dependent, with wages and remittances largely going to meet immediate consumption needs. The absence of family labour also limits the opportunities for such households to pursue agricultural intensification. Such households can be viewed as in a "poverty trap" rather than on a "pathway out of poverty". However, many households have been able to use the emerging economic opportunities in the wider Mekong region to pursue a strategy of agricultural and livelihood diversification.

As elaborated in Chapter 8, migration to work in Thailand was a major phenomenon in all the study villages and has become an important additional source of livelihood for the majority of households, particularly those following a diversified strategy. What are the implications for the government's focus on promoting rice intensification for national food security (as discussed in Chapter 5)? It has been shown that most households fully utilise their available paddy land in the wet season with the aim of producing their subsistence needs and perhaps having a small surplus to sell. Some have to rent additional land to achieve this target, while some have sufficient land that they can make a portion available to others. Some with access to irrigation also have the option of planting a small area of dry-season rice to make up any deficit. The evidence presented in Section 9.3 of this chapter indicates that households retain enough household labour on the farm, typically the senior married couple, to ensure they meet their subsistence target. However, if there is additional labour, such as a younger married couple or unmarried sons and daughters, this labour is preferentially allocated to non-farm employment, mainly in Thailand, rather than to intensification of rice production, whether through yield-increasing activities in the wet season or by expanding cultivation of dry-season rice.

In principle, labour could be used in many ways to increase rice yields, from land-levelling, bund maintenance, improved water control, more attention to pest and weed control, and completing operations from transplanting to harvesting in a more timely fashion, through to giving more time to post-harvest operations, especially drying. In addition, increased yields in themselves require more labour for harvesting. Thus the trend to out-migration of labour not only affects the household's capacity to intensify rice production but increases the overall scarcity of farm labour in the village, as reflected in the sharply increasing agricultural wage rates in the study area. Hence labour-scarce households are also constrained from intensifying rice production because of the increased cost of hired labour.

While the widespread adoption of mechanised land preparation has reduced the labour requirement for this activity, the factor limiting rice production was still the labour available for the intensive activities of transplanting and harvesting, as seen in the annual labour profiles presented in Section 9.3. Though some farmers used labour exchange or hired labour to finish these tasks quickly, these labour peaks remained the main constraint to expanding rice production, despite the almost universal mechanisation of land preparation. Conversely, the loss of family labour due to migration meant a scaling back of production in almost direct proportion to the number of labour units – for example, a household with four adult workers could transplant and harvest around two hectares, but if two of these workers were absent in Thailand, the remaining two could manage only one hectare (without hiring labour). Only a few survey households had briefly tried direct seeding to reduce the labour requirement for transplanting, and one or two mechanical harvesters had only just appeared in the survey districts. It is possible that direct seeding will eventually be adopted, as in neighbouring rice-producing regions such as Northeast Thailand. While this will lift the labour constraint on cultivated area, it will do nothing to increase yields. In fact, direct seeding in Northeast Thailand has resulted in increased weed problems, thereby reducing yields and/or adding to labour requirements for weeding (Pandey et al., 2002). With regard to mechanical harvesting, this has become widespread in equivalent lowland areas of Cambodia such as Takeo Province, but only in the dry season where a commercial crop is now being produced for export to Vietnam (Chea Sareth, pers. comm., 2 April 2014). There remain problems with getting combine harvesters onto muddy land at the end of the wet season, not to mention the constraint on outlaying cash to hire machinery services for what is essentially a subsistence crop.

The increased monetary and opportunity cost of labour means that, after meeting subsistence requirements, farmers look for activities with a high cash return to their labour, even if this means leaving some land unutilised. Thus, in the irrigated and partially irrigated villages, farmers allocated scarce labour (and capital) to crops such as corn, watermelons, and vegetables, rather than produce extra rice for sale. The higher returns to non-rice and non-farm activities meant that increased use of yield-increasing inputs on rice, especially fertiliser, was not considered a worthwhile use of scarce capital, as demonstrated in Chapter 7.

Overall, the evidence from the study villages indicates a sharp contradiction between the government's policy of rice intensification and the trajectories being pursued by rice-growing households, even in villages with access to irrigation. The positive inducement of higher incomes from non-farm employment, especially through international migration, is transforming rural livelihoods, despite the risks and personal hardships involved. The diversification of livelihoods has not been associated with agrarian differentiation as such but, as in other countries where international migration has come to play a significant role, has provided an alternative to landed wealth or "natural capital" as the basis for household prosperity. Nevertheless, it would not be true to say that the study villages have become "de-agrarianised" – a mere "shell" to accommodate non-farm labour – as argued by Rigg (2005a). Even less is it a case of the peasantry being transformed into a landless, rootless proletariat (Hayami, 1998). Rice farming still remains an essential foundation for the diversified livelihoods that rural households are pursuing. Hence innovations and interventions that can enable households to achieve their essentially subsistence goals in more labour- and cost-efficient ways will strengthen this foundation and thus give more scope to improve household livelihoods. However, such interventions will need to go beyond the government's somewhat narrow focus on rice intensification and include greater support for commercial production and marketing of non-rice crops and livestock.

Labour migration to Thailand is likely to continue to be a common livelihood strategy for farming households in Champasak, whether they are diversified households or (less commonly) migration-oriented households. Whether by choice or necessity, migration is allowing some household members (younger men and women) to support themselves independently of farm resources, while the flow of remittances is augmenting household consumption and, for many households, their capacity for investment (though not necessarily in rice production). The increase in employment opportunities in Thailand has resulted in lower availability of family labour for rice-farming and higher rural wage rates. Hence, farming systems will need to adapt to these labour constraints. Attempts to intensify rice production (and other components of the farming system), by increasing per-hectare yields and cropping intensity, need to take account of the implications for labour use and the returns to labour. The opportunity cost of using family labour for agricultural activities is increasing and labour has become the binding constraint. Hence returns to labour (rather than land) should be central to the assessment of new agricultural technologies and practices, as well the evaluation of agricultural policies.

9.5 Conclusion

The process of agrarian transition in the study area and the wider Mekong region has led to the emergence of a diversity of household types from the predominant subsistence-oriented paddy farming household that prevailed until about two decades ago. Adapting the World Bank’s typology, five broad types of household orientation were identified – subsistence-oriented farming households, semi-commercial farming households, labour-oriented households, migration-oriented households, and households with diversified livelihoods. These categories are dynamic; households change their livelihood orientation over time, often in more than one direction. Nevertheless, the emergence of non-farm opportunities both in Laos and neighbouring countries has meant that households have become increasingly diversified. Labour migration to work in neighbouring Thailand has become an important additional source of livelihood, helping to support migration-oriented and especially diversified strategies. This additional economic opportunity has major implications for the trajectory of farming in the lowlands. While wet-season rice will likely retain its role as the subsistence base for some time, the main agricultural trajectory is towards activities that provide higher returns to the household’s labour and capital resources. Hence the clear trend is towards diversification away from both sole dependence on rice and sole dependence on farming – that is, a trajectory of farm and livelihood diversification.

10 CONCLUSION

10.1 The research problem

The agricultural growth and development underway in Laos needs to be seen as part of a general agricultural transition occurring throughout Southeast Asia in recent decades. The rapid change from a subsistence-based economy to a more market-oriented economy is happening in both uplands and lowlands, but especially the latter. The main factors contributing to the agricultural transition in lowland Laos are the improved domestic economy, the increased integration with regional and international markets, and government policy supporting agricultural commercialisation. As a consequence, rural households have been experiencing rapid change in their farming and livelihood systems. The lowlands of Champasak Province in Southern Laos have been experiencing all the dimensions of the agricultural transition. Rural livelihoods in the province have become increasingly diversified – a variety of crops apart from rice are produced for consumption and market, non-farm activities are growing in significance, and labour migration to work in neighbouring Thailand is increasing and has become a well-established livelihood strategy.

This study has explored livelihood strategies of rural households in lowland rice-based farming systems in Laos, particularly Champasak Province, in relation to government policies for agricultural development and the agrarian transition occurring in Laos and the region. The specific objectives were to examine the effects of the agricultural transition on farming systems and rural livelihoods; to investigate rural household strategies during the period of agricultural transition; to identify factors affecting the adoption of different innovations in rice-based farming systems and appraise their economic returns; to explore the effects of government policies for lowland agriculture, particularly the tension between the government policy of rice intensification and the rapidly emerging trend towards livelihood diversification; and to identify trajectories of rural households in lowland Southern Laos, in particular, those which constitute pathways out of poverty.

10.2 Theoretical framework and methodology

Agrarian systems analysis (ASA) was reviewed as a basis for understanding the change in agriculture underway in lowland Southern Laos. ASA focuses on the interactions among system components at different levels and moves from the general to specific, using a holistic method, which respects a hierarchy of processes and determinants. ASA is normally undertaken at three levels. The first phase of analysis, at the regional level, is to identify a limited number of homogenous agro-ecological zones or sub-regions through (a) observations in the field to observe the agricultural landscape along transects and (b) discussions with experienced farmers to understand the agricultural situation and changes over time such as landscape transformation, technical adaptations, and socio-economic trends. The next phase of analysis, at the zone level, is to understand the organisation and function of the different types of agro-ecosystem (or farming system) in each zone, again through observations and discussions with farmers who undertake similar activities with similar means of production and following similar evolutionary paths. Finally, at the farm level, the analysis aims to understand the main characteristics of each farming system and scrutinize their potentials and problems through semi-structured interviews with sampled farm households from each category of farmers.

In addition, some elements of the rural livelihoods framework, in particular, the concept of household livelihood strategies, were incorporated into the analysis in order to understand the diversity and complexity of the evolving production systems and rural livelihoods of lowland farmers in Southern Laos. Rural people in different agro-ecological circumstances engage in a variety of livelihood strategies, which have been grouped into three main strategies – agricultural intensification, livelihood diversification, and migration – to achieve sustainable livelihoods. These three main livelihood strategies are normally interrelated and affect each other. Agricultural intensification and migration are often strategies complementing overall livelihood diversification. Households may pursue these strategies alternately or they may combine different strategies simultaneously.

As farmers are transitioning towards commercial agricultural production and livelihoods are diversifying, the economic returns to various production systems and livelihood activities become progressively more important to them. Hence particular attention was given to the methods of farm management (or farming systems) economics, including the tools of enterprise budgeting, partial budgeting, input-output budgeting, and whole-farm analysis. To allow for the production and market risks facing farmers, the techniques of sensitivity analysis, threshold analysis, and risk analysis were also used in the budgeting analysis. The farm management framework made sense of farmers' decisions and resource allocation, within the broader and more dynamic frameworks provided by agrarian systems and livelihoods analysis.

A total of six villages in two contrasting lowland districts of Champasak Province were chosen for detailed study. Within each district, villages were selected to represent three distinct agro-ecological zones. Both primary and secondary, and qualitative and quantitative data were collected during fieldwork, which was conducted throughout 2011 and for the first half of 2013. Primary data were collected through key informant interviews, group interviews, direct observation, household surveys, and case-study interviews. Secondary data were reviewed and collected from different sources. Relevant reports, both published and unpublished, were collected from government agencies, non-government organisations, and projects at the national, provincial, district, and village levels. Information about the study villages was obtained from the village authorities during reconnaissance surveys. Data from farm household interviews were analysed using conventional statistical techniques.

The combination of structured questionnaire surveys, semi-structured group interviews, and household case studies proved to be useful, complementary tools for data collection and provided a rich source of quantitative and qualitative data. The pre-test of household survey questionnaires helped reduce irrelevant questions and check whether the respondents could understand the questions and provide meaningful answers. Case-study interviews provided more detailed and nuanced information than could be obtained from the household surveys. Moreover, group interviews could provide additional information, in particular providing feedback on the income and productivity measures used and validation or correction of the estimates of costs and returns used in budgeting enterprises. Though much of the information relied on farmers' estimates and recall rather than direct measurement, the triangulation of complementary data sets from several sources provided a reasonable degree of confidence in the accuracy of the data and the analysis.

10.3 Key findings

Rural households in the study area were engaged in a variety of livelihood activities, including farm-based activities, off-farm and non-farm employment locally, and labour migration. However, wet-season rice production was still the basic subsistence activity on which almost all of them relied.

Lowland rice production systems in the survey area have been changing over the past two to three decades as farmers have taken up new practices, particularly improved rice varieties, inorganic fertilisers, and mechanised land preparation. However, yields, total household production, and marketed surpluses have not greatly increased. Modern rice varieties were widely planted, but most modern varieties had been used for many years and there had been little yield improvement since they were first disseminated in the 1990s. Similarly, while use of inorganic fertilisers had increased, the application rates were far lower than the modest recommended rates, further limiting yields. The adoption of two-wheeled tractors was the most dramatic change, but this had not helped boost yields or total production. Rather, it had decreased labour requirements for land preparation and obviated the need for draught animals. However, there had been no impact of mechanisation on the two peak activities of transplanting and harvesting. Yet the growth in non-farm employment, especially wage migration to Thailand, was drawing labour away from rice cultivation, impacting on the availability of household labour for farm work, and increasing the cost of hiring labour, especially during these peak seasons.

Hence rice production in all the study villages was still primarily a low-yield, subsistence-oriented activity, or at most a semi-commercial activity. Almost all households grew rice, at least in the wet season. Some grew insufficient for their needs and some produced a small surplus for sale, especially the minority with access to dry-season irrigation. However, the latter were not "market-oriented" rice producers; rather, most farmers appeared to view rice production as a platform on which to construct a diversified livelihood strategy in which the use of family labour within and beyond the farm was the key element. Thus, once the household's objective of rice self-sufficiency had been met, further intensification of rice production was typically compared to other commercial options for utilising household resources. This included alternative uses of paddy land, household labour, and capital. That is, it became a more commercial decision as to how the household could maximise the returns to its complement of resources. While economic return was not the only factor influencing these decisions, it was clearly a strong motivator.

With rice production providing a subsistence base, rural households in the study area were engaged in a range of other agricultural and resource-based activities, including cultivation of non-rice crops, livestock-raising, and forest- and river-utilisation. Water resources were extracted from streams, ponds, and groundwater, as well as irrigation systems. Several households had already begun to utilise available water sources to flood-irrigate a post-rice crop on paddy land as well as to water riverbank or home garden vegetables. The use of electric pumps had lowered the costs of irrigation compared to fuel pumps and allowed the cultivated area to be expanded by relaxing the labour constraint imposed by hand watering. However, the use of electric pumps remained limited to a few households that were closer to both the village and the water source. The diversification of cropping systems through cultivation of non-rice crops was one alternative for improving the productivity and profitability of farming systems and the productivity of water use in the irrigation areas.

With the wage rate and the opportunity cost of using household labour increasing, the returns to labour have become the key consideration when deciding whether to intensify rice production systems, either through increased use of inputs, especially fertiliser, or by double cropping where irrigation is available. The budget models and risk analyses of rainfed rice production showed that, given their resource endowments and the high degree of production and market risk they encountered, most households were likely to continue to adopt low-input, more labour-efficient, and relatively stable rice production systems, with small areas of high-input, commercially-oriented systems of rice in favourable conditions. With subsistence goals attained via a low-input, wet-season rice crop, most farmers viewed dry-season cropping options in more commercial terms. As a commercial option, irrigated rice had an advantage over rainfed production given the greater control over water and the higher yields obtainable from roughly the same labour input. However, yield and price risks remained a problem for farmers, especially given the larger outlays for fertiliser and irrigation costs. Other crops such as maize and watermelons, though requiring high input levels and cash outlays, could provide considerably better returns to household resources than irrigated dry-season rice. This has meant that dry-season rice production has substantially declined and that much irrigable land remains idle in the dry season, as the non-rice crops were cultivated on much smaller areas.

In addition to the option of non-rice crops, employment opportunities away from the farm have increased due to economic growth in Laos and neighbouring Thailand. As a consequence, rural households in the survey area had become increasingly diversified, with one or more members pursuing off-farm or non-farm work or migrating to work in Thailand for extended periods. Labour migration to Thailand had become a well-established livelihood activity for young lowland Lao, but mostly as an integral part of a household's long-term livelihood strategy. Households with more workers were more likely to deploy some of those workers in Thailand for an extended period, while others maintained the home farm for subsistence and some cash income. Migration provided a buffer to households with limited resources, while for others wages and remittances contributed capital for longer-term livelihood investments.

The process of agrarian transition in the study area and the wider Mekong region has thus led to the emergence of a diversity of household types from the predominant subsistence-oriented paddy farming household that prevailed until about two decades ago. Adapting the World Bank's typology, five broad types of household orientation were identified – subsistence-oriented farming households, semi-commercial farming households, labour-oriented households, migration-oriented households, and households with diversified livelihoods. These categories were dynamic; households changed their livelihood orientation over time, often in more than one direction. Nevertheless, the emergence of non-farm opportunities both in Laos and especially in Thailand has meant that household livelihoods have become increasingly diversified. Labour migration had become an important additional source of livelihood, helping to support migration-oriented and especially diversified strategies. This additional economic opportunity had major implications for the trajectory of farming in the lowlands. While wet-season rice will likely retain its role as the subsistence base for some time, the main agricultural trajectory is towards activities that provide higher returns to the household's labour and capital resources. Hence the clear trend is towards diversification away from both sole dependence on rice and sole dependence on farming – that is, a trajectory of farm and livelihood diversification.

The overwhelming impression from this research is that Lao farmers in areas such as the lowlands of Champasak are caught up in and contributing to a much larger regional process of agrarian transition, which government rice-intensification policies will be hard-pressed to counter. To the extent that their judgements about the relative short- and long-term returns of alternative strategies are correct, lowland rural households are spontaneously following trajectories that, if not exactly an assured "pathway out of poverty", are at least making them better off, in the sense of having substantially higher and more diversified income streams and greater food security. This is not, however, a case of "de-agrarianisation". Rice production for subsistence and perhaps a small surplus is still central to the strategies most households are following, as well as the production of non-rice crops and livestock for the marker. However, the changes underway are transforming rural Champasak from an isolated, subsistence-oriented, rice economy to becoming the diversified rural hinterland, not just of a rapidly developing Lao economy but of a wider regional economy.

10.4 Research and policy implications

The above findings show that households in the rainfed lowlands continue to manage rice production systems that are largely subsistence-oriented. The adoption of new technologies has been important in helping households meet self-sufficiency objectives and has enabled some to produce a small surplus. Despite this, rice production remains an economically marginal activity that is under increasing pressure from rising costs, particularly for labour. Rural livelihoods in the study area have become increasingly diversified, with households allocating labour to a range of alternative farm and non-farm activities. However, rainfed rice production continues to be the platform on which these other livelihood activities are based. The development and adoption of technologies that enable households to achieve self-sufficiency in a labour-efficient manner are important to improving household welfare in this context.

Technological innovations can improve the stability and resilience of this subsistence platform, allowing for diversification that leads to livelihood improvements rather than just contributing to food security. For example, a household that adopts improved varieties and appropriate management practices, enabling it to achieve rice self-sufficiency in a way that utilises labour and capital more efficiently, can use non-farm income and remittances to invest in alternative sources of livelihood. This may include investing in groundwater bores or fish ponds for vegetable and fish production, in small-scale livestock enterprises, or indeed in establishing a non-farm enterprise. While rice production may remain subsistence-oriented, productivity improvements (especially with regard to labour) can enable these other beneficial developments. For this reason, research into low-input, labour-efficient technologies for rice should continue to be a priority, along with research directed at the small number of primarily market-oriented rice-producing households.

As the costs of labour continue to increase, technologies that improve labour productivity and enable labour to move off-farm are likely to be adopted more readily than technologies that seek to intensify rice production. In the same way, the development and adoption of improved varieties that are well adapted to abiotic and biotic stresses and reduce risk in specific environments can potentially improve the profitability and stability of the lowland farming system as a whole. Moreover, it has long been argued that improving the efficiency of fertiliser application through site-specific recommendations is more important than increasing absolute fertiliser rates. While the improvements in profitability that these technologies bring may induce some intensification, the strategy of diversifying livelihoods while maintaining a largely subsistence-oriented rice production system is likely to persist, given the current economic trends. While this may not help lift rice production to reach national targets, it is likely to improve the livelihood outcomes of the numerous households living in this marginal environment. Research and extension efforts should recognise this diversity of production systems and household livelihood strategies.

Although the majority of survey households remained subsistence-oriented with regard to rice production, there was an emerging group of semi-commercial rice-farming households that could potentially increase yields and output, resulting in an increase in the marketable surplus. However, this group was also subject to rising labour costs and was prepared to invest additional capital to save labour and increase production, especially in the dry season, if the returns to this capital investment were considered adequate. Hence research on further mechanisation of the production system, including mechanised planting and harvesting, as well as measures to improve post-harvest operations and increase the quality of the rice produced, would seem to be sensible priorities. The emergence of contract farming for specific niche markets also warrants monitoring.

With regard to crop diversification, improved access to water could change the relative returns to farm and non-farm opportunities. This may enable subsistence- and labour-oriented households to make the transition to diversified cropping households. It is true that the returns to these non-rice crop activities would still need to compete with potential non-farm earnings. However, it needs to be remembered that the opportunity cost of labour differs between household members. For example, if older members of the household can manage crop gardens irrigated with groundwater, the opportunity costs are likely to be lower than for younger members of the household who could potentially work in non-farm activities such as construction or migrate to Thailand during the dry season. Hence research is needed into crop diversification and the implementation of agricultural programs to support a more balanced crop mix to meet domestic demand as well as export markets. Crop diversification is one important way to improve the livelihoods of lowland farmers as well as supporting the local economy.

Many farmers in the study area, in particular in the irrigated and partially-irrigated villages, were testing various non-rice crops, though with mixed results. Improvement of irrigation infrastructure and changes to the basis of charging water fees (i.e., based on the water requirements of each crop, not merely on an area basis) would provide an incentive for crop diversification. Access to groundwater is of even greater significance for crop diversification. The majority of the survey households had individual access to groundwater for crop production. However, the groundwater resource is poorly understood in Laos and there are not even any informal rules for groundwater management. Laos is in a rather unique position to formulate the policies needed to manage the groundwater resource sustainably before it is over-exploited or contaminated. There is an urgent need for research to develop this understanding to ensure economic benefits in the long run.

There is also potential for livestock development. There were few households in the study area that could yet be classified as livestock specialists, that is, who directed resources into improving the productivity of animals for sale. However, livestock were important to most households. Reducing the labour required for managing livestock has long been seen as a key entry point for encouraging adoption of more productive livestock systems. The majority of land was cropped with rice during the wet season, making livestock management critical. Livestock damage to wet-season crops was the responsibility of the owner, leading to tethering or herding of animals – both labour-intensive. Moreover, in some villages in Champasak not included in the survey, the increase in land concessions and contract farming for rubber meant that forested areas that were previously used for grazing during the wet season were no longer available. Introduced forages are the key element in moving from being merely livestock keepers to livestock specialists, saving labour and adding to livestock productivity, but the adoption of forages requires significant change in the cropping system, including the possibility of using groundwater to irrigate forages on paddy land in the dry season.

Overall, what does this mean for research and policy for rice-based farming systems in the lowlands? It is suggested that crop research could focus on risk-reducing options for wet-season rice, recognising its primary function as the subsistence base of livelihoods; this could include research to select and breed varieties for specific agronomic risk zones (such as flood, drought, or pests) and on site-specific and financially-safe fertiliser recommendations. Further, research on rice and non-rice options (including forages) for the irrigated dry season (including use of groundwater) could proceed in recognition that farmers treat the choice between these options as a commercial decision. Research for both wet-season and dry-season cropping needs to give priority to labour-efficient options, for example, research on methods of direct seeding, weed management, mechanical harvesting, and the interactions between agronomy and mechanisation. With regard to rice policy, if the policy of rice intensification to achieve yield and production targets remains unchanged, it is necessary to recognise that this would require expensive, inefficient, and hence unsustainable measures to support and stabilize the farm-gate price of rice and subsidise the farm-gate price of fertiliser. Some improvement in the incentives for rice intensification could be made merely by removing trade restrictions and reducing the costs of input distribution. However, the results of this research support the contention that is more sensible to accept the subsistence-orientation of most lowland rice farmers and their trajectory towards farm and livelihood diversification, and focus on a few commercially-oriented irrigated zones for increased rice production and exports.

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