Sustaining and Enhancing the Momentum for Innovation and Learning around the System of Rice Intensification (SRI) in the Lower Mekong Basin River (SRI - LMB)

Participatory Rural Appraisal for System of Rice Intensification in Lao PDR

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Acronyms

ACISAI	Asian Centre of Innovation for Sustainable Agriculture Intensification
AIT	Asian Institute of Technology
APB	Agriculture Promotion Bank
CMI	Community Management Initiative
DAEC	Department of Agriculture Extension and Cooperative
DAFEO	District Agriculture and Forestry Extension Office
EM	Effective Microorganisms
FAO	Food and Agriculture Organization
FFS	Farmers' Field School
GoL	Government of Lao PDR
HH	Household
IRAD	Institut de Recherche Agricole pour le Développement
IRRI	International Rice Research Institute
Lao PDR / Laos	Lao People Democratic Republic
LPB	Luang Prabang
MAF	Ministry of Agriculture and Forestry
MT	Metric Tonne
MV	Modern Variety
NAFES	National Agriculture and Forestry Extension
NAFRI	National Agriculture and Forestry Research Institute
NRRP	National Rice Research Programme
NSEDP	National Socio-Economic Development Plan
PAFO	Provincial Agriculture and Forestry Office
PRA	Participatory Rural Appraisal
SRI	System of Rice Intensification
TV	Traditional Variety
WS	Wet Season
XKH	Xieng Khuang
XYBR	Xayabuly

1. Executive Summary

Existing farm management practices

The rainfed lowland ecosystem is the dominant rice ecosystem in Lao PDR. Rice cultivated in the rainfed lowlands accounts for 76% of total area cultivated and 79% of production. In 2012, 3.49 million metrics tonnes of rainfed lowland rice were produced or approximately 3.9 tonnes per hectare. By the year 2015, the Lao government aims to produce 4.2 million metric tonnes and increase average yield to 4.5 tonnes per hectare.

Current low productivity is due to a number of constraints, including limited and inappropriate use of inputs and production technologies, limited infrastructure, regional differences in soil and climatic characteristics, labor shortages, as well as insufficient market linkages.

In three selected provinces of Lao PDR, Luang Prabang, Xayabuly and Xieng Khuang, several modern and traditional rice varieties such as TDK5, TDK8, TDK11, CR6, CR8, Homsangthong, Hommari, Khao Kainoy, Obpop, Takiet and Buangam are currently in use. Improved crop management practices include use of machinery to plough land, plant spacing of 25x25 or 20x20 centimeters, and growing seedlings in nurseries for 25 to 30 days. In the identified provinces, System of Rice Intensification (SRI) has been promoted since late 2007 and 2008 after high yield was observed on demonstration plots. Strict systematic practices were introduced and promoted for the first few years; however, farmers found it difficult to adopt due to inadequate understanding of the technologies and technical constraints.

The costs of land preparation, transplanting and harvesting are considered to be the main input costs for rainfed lowland rice production in all three provinces. On average, rainfed lowland rice farmers receive 1.8-3.5 million kip per hectare (equivalent to US$ 225-438) per year profit on rice production. Some farmers reported rice insufficiency resulting from insufficient land for rice cultivation, labor shortages or flooding or drought. Rice shortages can occur from May to September, until the following harvest. Female-headed households are more vulnerable to rice insufficiency.

At the farm level, many rural rainfed lowland farmers have limited access to, and therefore low rate of adoption of, improved rice technologies. Even though rice productivity and quality have been improved in recent years, limited local enabling support has been provided to smallholder rice farmers.

Commercialization of rice production is limited. Once a farmer achieves rice sufficiency they are likely to maintain their conventional practices or be hesitant to adopt new rice production technologies because there is no clear comparative income advantage over other off-rice farming activities. At farm level, advancing rice production technologies are becoming more challenging especially because they require more inputs, higher costs and better farm management than conventional rice production technique; at the same time employment opportunities for planting sugarcane and rubber are becoming more available than in the past.

The future promotion of SRI could draw from the lessons learnt in the identified areas where SRI was introduced. Introduction of SRI in the areas with favorable soil and water condition with

a focus on demand-driven participation would be the keys for sustainability of the new technology adoption.

Existing government policies supporting smallholder farmers

Currently, as a top-down rice production policy, local governments have few different specific strategies on rice production. There have been initiatives to support the local agricultural sector:

- Effort to improve the infrastructure on maintenance and expansion of irrigated areas
- Improvement of productivity through introducing of high yielding varieties and technologies
- Fastening the land allocation for stable production areas and occupation
- Production of cash crop and livestock are the main current related policies

Despite these actions, government support has been neither clear nor specific in aiding rainfed lowland rice production. Besides, provision of rice production, training for seed selection and purification, constitution of rice producing groups and cooperatives, and capacity building of technical service center is limited. Households with female heads, the landless and ethnic minorities are not given special consideration for additional support. Groups of households could benefit by more focused and purposeful involvement in technical trainings, workshops and study tours. These would improve their crops and livestock productivity, as well as their access to market linkages and livelihoods.

Status of women and landless in the society

There is no clear labor division between men and women in rainfed lowland rice production. Women primarily undertake more time-consuming, 'light' work such as completing house chores, feeding animals, pulling seedlings and managing rice production income. Men are generally tasked with rice land preparation; soil and land inspection for cultivation of rice, hand or machine threshing and hauling harvested rice. Other tasks are shared between men and women.

Considerations of gender are generally more common in rice-related projects as opposed to government policy: in fact several development projects such as SRI Extension Project in Luang Prabang promoted women participation in SRI as well as rice breeding technologies dissemination.

Capacity of women to undertake advocacy and resource mobilization for their economic empowerment

If given the opportunity, women have shown their willingness to participate in technical trainings, workshops, cross visits, and study tours to enrich their capacity and mobilization of resources. Several rice producing groups and association committees in Xieng Khuang province are female-led. In addition, women tend to show a higher capability in terms of managing fund, linking to markets and liaising with stakeholders compared to their male counterparts.

While local governments have provided support such as encouraging use of good quality rice seeds, introducing better suitable rice production technologies, which are easy to adapt for farmers, additional efforts are needed to improve women capacity to undertake advocacy and resources for their economic empowerment. For example, technical and managerial on-the-job

trainings on rice related issues to women's roles such as managing livestock, managing rice marketing, sales and income could be provided to women in both the short and the long term to improve their productivity, as well as involving women in farmers to farmers technology transferring activities

Potential opportunities and 'quick wins' for advocacy activities

The implementation of SRI systems in some areas provides some good lessons to be learnt by both local government and farmers. This project will be implemented in rainfed condition where there are no sufficient water resources available: based on SRI requirements [1], water management is one of the key success drivers and this was confirmed by farmers interviewed during the PRA. Even though SRI needs less water than traditional technique, however it requires a minimum quantity of water and an efficient water management system. In the previous trails, SRI was demonstrated in areas with not sufficient water resources and it was therefore not possible to correctly follow the technology (e.g. water management). SRI should be implemented in lower paddy where water can be managed easier compared to the upper (higher) paddy where the water mainly depends on the rain and lack appropriate water management systems.

The technology should therefore be well demonstrated and introduced in areas where local conditions are sufficient (such as efficient water management system, good land preparation, appropriate tools and materials, suitable rice varieties, monitoring and supports, etc.), with a focus on local demand driven approaches for sustainability purposes. .

Working with farmer experts (e.g. Lao Extension for Agriculture Project , LEAP, trained farmers as trainers for other farmers) who gained expertise in rice production technologies previously involved in SRI Extension Projects is a feasible 'quick win' opportunity.

The key would be facilitating farmer to farmer participatory learning through demonstration plots, ToT and farmers' champions, farmers' field schools and field days in order to roll out agricultural farming best practices and their adoptions in areas with similar climates and ecosystems condition. By using gender scheme (gender mixed, women to women, man to man) it will be also possible to reach an extensive coverage and a balance between man and women.

By encouraging cross-regional or provincial relationships among farmers through exposure visits, it would also be possible to promote improved technical skills

Moreover, some PAFOs (e.g. Luang Prabang) have considerable capacities and experiences in introducing SRI technologies: they could be leveraged for further extension and introduction of the SRI in the future by organizing dedicated workshops and involving several PAFOs at the same time.

[1] As per the previous introduction of SRI technologies by SRI Extension Project, farmers need to keep water level at 2-3 cm for 1 month after transplanting. Afterwards, water should be drained out for 5 days, keep the paddy wet for 5 days for another month before keeping water level at 2-3 cm again until flowering stage reaches 70-85%. After that water should be drained out 2 weeks before harvesting

2. Project Background

Rice is the predominant crop produced in Lao PDR, where about 71% of all households (HHs) are involved in rice farming. The total area of rice planted in 2010/11 was 987,000 hectares (ha), of which 714,000 ha (72.3%) was wet season lowland rice (579,000 ha rainfed, and 135,000 ha irrigated), 215,000 ha (21.8%) was rainfed upland rice, and 57,000 (5.8%) was dry season irrigated rice[2].

Rice is grown in all regions throughout the country. According to the national rice production statistics by the Ministry of Agriculture and Forestry (MAF) of Lao PDR, in 2012 the central region accounted for over half of total rice area cultivated (53%) and total rice produced (54%). Savannakhet Province, located in the central region, has the largest area of land under rice cultivation of all provinces. It accounts for nearly 40% of the central region's production and 22% of national production. Vientiane municipality, Vientiane and Khammouane provinces also have large areas under rice cultivation. In 2012, the northern region accounted for 22% of total rice cultivation areas and 19% of total production, a reduction from 25% of rice areas and 22% of total production in 2004[3].

Rice production has increased considerably over the last two decades, from 1.5 million metric tonnes (mt) in 1990 to 2.5 million mt in 2004, 3.1 million mt in 2010 and 3.5 million mt in 2012. However, there is still room for further improvement. A number of factors contribute to low productivity, including regional differences in soil and climatic characteristics, inappropriate production technologies, limited infrastructure (including irrigation and drainage), use of traditional farming techniques and inappropriate input usage, labor shortages and insufficient market linkages.

The rainfed lowland ecosystem is the dominant rice ecosystem in Lao PDR. Rice cultivated in the rainfed lowlands accounts for 76% of total area cultivated and 79% of the production. The rainfed upland accounts for about 13% of rice harvested areas and 6% of production[2]. Rainfed rice is commonly referred to as wet-season rice. Rice is generally planted in May to July and harvested in November or December.

In 2012, national rainfed lowland rice productivity averaged 3.91 tonnes per hectare (t/ha). The northern region had the highest productivity of 4.39 t/ha. Phongsaly, Huaphan, and both Bokeo and Xayabuly produced 4.66 t/ha, 4.60 mt/ha and 4.45 t/ha, respectively. The lowest productivity was in Attapue (3.02 t/ha), Khammouane (3.39 t/ha) and Saravan (3.42 t/ha)[4].

One past effort to improve rice productivity was the introduction of System of Rice Intensification (SRI). SRI has reportedly been particularly beneficial in the northern provinces of Luang Prabang and Xayabuly. According to Cornell University's report on the 'Livelihood Improvement Project for the Rural Poor in Laos, with Increase of Rice Production', some farmers who planted rice with SRI methods achieved yields of nine tonnes per hectare, while the traditional method produced only 3 to 4 tonnes[5]. According to Xayabuly PAFO, SRI has been introduced since 2008 with the productivity of about 4.72-5.80 mt/ha for rainfed lowland rice while the average

[2] Source: MAF, 2012. Lao Census of Agriculture2010/11 Highlights, P35
[3] Source: MAF, 2013. Crop Statistics Year Book 2012
[4] Source: MAF, 2013. Crop Statistics Year Book 2012
[5] SRI-Rice, website: http://sri.ciifad.cornell.edu/

productivity for dry season 2013 was about 5.85 mt/ha with the average highest yield of 6.2 mt/ha. In 2012, in Luang Prabang province, SRI was planted in 672 ha with productivity of 5.88 t/ha (LPB PAFO, 2013). As shown in Table 1, the SRI cropped areas in Lao PDR increased from 2008/09 to 2009/2010, in both dry and wet season.

Table 1: SRI Cropped Areas (Hectares), by Season by Year

	2008 – 2009	2009 - 2010
Dry Season	1,437	3,625
Wet Season	2,550	5,000

Source: Cornell University, SRI Report on Laos

As part of its sustainable agriculture initiative, the Asian Centre of Innovation for Sustainable Agriculture Intensification (ACISAI) at the Asian Institute of Technology (AIT) has initiated a European Union-financed project entitled: "Sustaining and Enhancing the Momentum for Innovation and Learning around the SRI in the Lower Mekong River Basin".

The project's overall objective is to contribute to enhancing the resilience of rainfed farmers of the Lower Mekong River Basin countries confronting climate change. The project seeks to stimulate local innovation using SRI and Farmers' Field School (FFS) approaches amongst smallholder farmers in rainfed areas of Cambodia, Laos, Vietnam and Thailand in order to sustainably improve agricultural productivity and food security in the context of climate change adaptation, and to enhance research capacities to continue to support this development.

The project also aims to support the intensification of small-scale agriculture as a performing model that could ultimately provide job opportunities to landless farmers and enhance food security. The project is designed to make progress towards the Millennium Development Goal (MDG) No. 1 to Eradicate Extreme Poverty and Hunger by 2015.

3. Project Objectives

AIT proposes to subcontract a portion of its project activities to support its participatory rural appraisal (PRA) work.

The objective of this particular participatory rural appraisal work is to identify and analyze key the constraints of rainfed rice production system in identified provinces of Laos in particular, and of the Lower Mekong River Basin's rainfed rice production system in general.

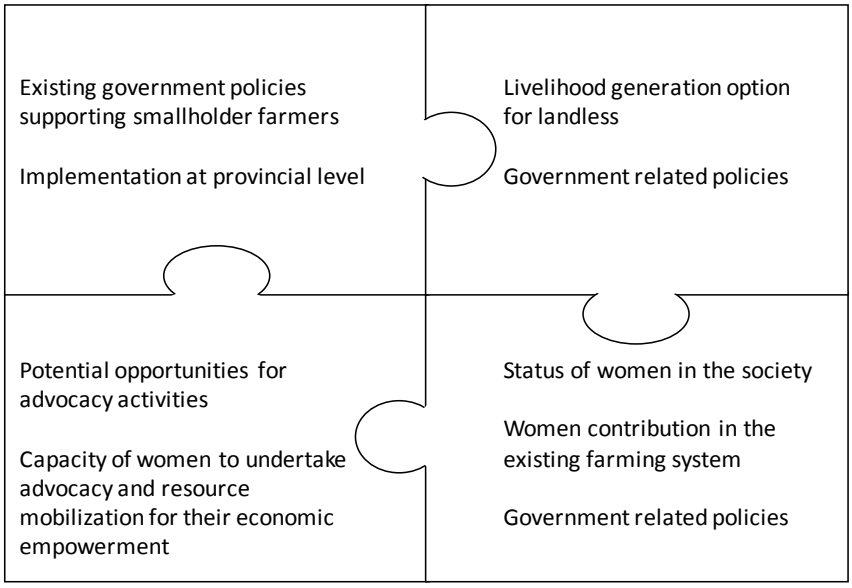
This study examines the physical and socio-ecosystems of three identified provinces: Luang Prabang, Xayabuly and Xieng Khuang. It is intended that PRA will provide:

1. information on the cause-effect relationships associated with current farm management practices in relation to their productivity in rainfed ecosystems and their impact on the socio-economic statuses of smallholders farmers
2. information to understand baseline scenario/baseline data (pre-project scenario) in all identified provinces
3. information that will assist in refining the project's monitoring and evaluation plan

4. information that will assist in refining training modules and capacity building interventions
5. information that will assist in identifying relevant policies and guidelines and frameworks for supporting project advocacy work

In addition to traditional PRA, other aspects are also included in the study. These aspects are summarized in the figure below.

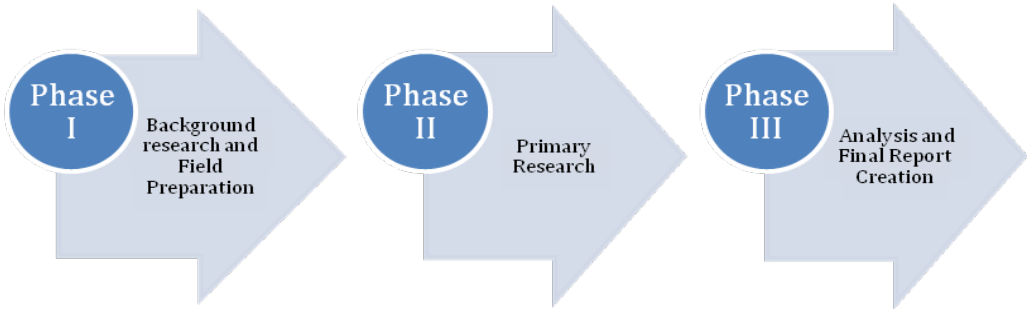
Figure 1: Other aspects included in PRA



4. Project Methodology

Emerging Markets Consulting (EMC) applies a classic business consulting methodology, based on initial qualification research, primary focused investigation, and qualitative and quantitative data analysis. This particular project was implemented in three phases: 1) background research and field preparation; 2) primary research; and 3) analysis and final report creation.

Figure 2: Phased Approach



As per the Terms of Reference, the project implementation period covered a total of four weeks, including twelve days of data collection fieldwork in three different provinces of Lao PDR.

Primary data was collected from farmers using structured interviews and focus group discussions. Farm surveys were conducted to collect basic farm-level information on lowland rice farming systems.

As shown in the table below (Table 2), a total of seven districts covering the three provinces of Luang Prabang, Xayabuly and Xieng Khuang were included in the analysis.

A multi-stage purposive sampling method was used to draw a representative sample. The criteria for village selection were determined in consultation with the DAFO staff and include: main and general rainfed lowland rice production villages, ethnic diversity (if accessible), proneness to flood/drought, access to markets, and distance from roads and research centers.

The team held meetings with each village chief to investigate the general socio-economic characteristics of the location, and to obtain information about the most experienced households in terms of SRI production. Women-headed households were selected on purpose if not enough were included through the sample randomization process. Similarly, farmers belonging to different ethnic groups were also included in the sample to represent ethnic diversity. Focus group discussions were conducted in each village and included three to five households to discuss broader issues. Additionally, one to two households were interviewed in depth to collect specific socio-economic and low-land rice production data.

The household heads of the identified households were interviewed with structured questionnaires to collect quantitative and qualitative data. Information was collected on a number of topics including:

- Rainfed lowland rice farming systems;
- Production, farming practices
- Cultivation of traditional and modern rice varieties
- Adoption (or lack of adoption) of new technologies
- Changes in cropping patterns
- Access to new technology
- Farmers' perceptions of changes in general living standards
- Role of women in society and in the farming process.

A total of 30 households from 12 villages were selected in the sample. The sample included farmers from seven districts. Depending on village size (with the average number of households of about 150, and 6% of rice deficiency households), 3 to 5 households were included in the focus group discussions, then 1-2 households were interviewed. The number of samples included from each selected district ranged from 3 to 6 with 10% of rice deficiency households.

The names of the districts by province and the corresponding names of the villages and household sample size are included in the table below. The survey was conducted from late

November to early December 2013 for a total of 12 days in the field. Data was collected for wet season rice production in the year 2013 (June-November in 2013).

Table 2: Identified provinces, districts and villages included in the PRA

Districts	Villages	Village category				# of lowland rice HHs	# of HHs in FGD	# of in-depth interviews	# of female in-depth interviews
		Rice production	Main ethnicity	SRI experience	Distance from DAFEO				
Luang Prabang	Pavieng	Main	Khmu and Hmong	Yes	64 km	56	5	2	1
	Sienmouk	General	Lao Lum	No	12 km	36	3	1	1
	Thin Som	Main	Lao Lum	Yes	16 km	93	4	2	1
Pak Ou	Hatkam	Main	Lao Lum and Khmu	Yes	2.5 km	56	5	1	-
	Phonsavan	General	Khmu and Hmong	No	30 km	13	5	2	-
Nan	Dontoum	Main	Khmu and Hmong	Yes	7 km	120	3	1	-
	Nakhery	Main	Lao Lum and Khmu	Yes	3 km	150	5	2	-
	Sirimoungkhoun	General	Lao Lum	Yes	2 km	Na	5	1	1
Xayabuly	Nala	Main	Lao Lum and Khmu	Yes	6 km	130	4	2	1
	Nayao	Main	Lao Lum and Khmu	Yes	6 km	Na	5	2	2
	Nonsavan	General	Lao Lum and Khmu	Yes	3 km	25	3	2	1
Thongmixay	Dan	Main	Lao Lum and Khmu	No	3.5	203		2	2
	Yai	Main	Lao Lum	Yes	1 km	188	5	2	1
Khoun	Sunnoy	Main	Hmong and Lao Lum	Yes	27 km	165	5	2	-
	Toum	Main	Lao Lum, Hmong and Khmu	No	5 km	94	5	2	1
Thathom	Vunghai	Main	Lao Lum and Khmu	Yes	28 km	124	5	2	1
	Yarmjalernxay	Main	Lao Lum	Yes	30 km	152	5	2	-
Total								**30**	**13**

Source: PRA field survey, 2013

5. Rice Policy in Lao PDR

The second Lao agricultural census of 2010 demonstrated that the proportion of households growing rice decreased from 77% in 1998/99 to 71% in 2010/11[6]. Rice is becoming increasingly concentrated in regions with a natural comparative advantage, such as the seven rice-producing plains (Vientiane province, Vientiane capital, Bolikhamxay, Khammouane, Savannakhet, Saravane and Champassack). However, despite the fact that rice production is increasingly concentrated in the seven lowland plains along the Mekong River, rice biodiversity is highest in the northern highlands, where rice production is in relative decline compared with national production. In the North, rice production accounted for 19% of national production in 2012, down from 22% in 2004. Lao PDR possesses the largest rice biodiversity in the world after India, with approximately 14,000 rice accessions collected by the International Rice Research Institute (IRRI) throughout the country.

Rice Sector Targets by 2015

- Total paddy rice production increased to 4.2 million mt from 3.5 million mt in 2012
- Average yield of paddy increased from 3.7 t/ha in 2010 to around 4.5 t/ha in the lowland rainfed regimes, and from 4.7 t/ha in 2010 to around 5.5 t/ha in the dry season regimes
- 170,000 ha in the plains areas opened up and/or provided with facilities for intensification of rice production
- 600,000 mt of high-quality, non-glutinous rice exported, mostly to countries in the ASEAN region but also to the international market
- Food insecurity (inability to meet minimum calorie requirements) and malnutrition (incidence of stunting and low birth weight) reduced by one-half through increased availability, access to and utilization of rice and other foods

To meet the Millennium Development Goals, the goals of the Political Report to the 9th Party Central Committee, as well as the 7th National Socio-Economic Development Plan (NSEDP), the Ministry of Agriculture and Forestry (MAF) has developed a number of quantitative targets for the rice sector in 2015 (see box).

Laos is vulnerable to climatic events such as flood and drought. Nevertheless, with the expansion of rice production and the localized nature of most climactic events, Laos should still be able to produce enough rice for its domestic needs and export even in the event of floods or drought.

Furthermore, as incomes increase nation-wide, and particularly in urban areas, dietary patterns may gradually shift away from rice to other food products. This gradual shift of dietary patterns also confirms that the Lao PDR could produce sufficient rice for its local consumption and export.

A recent Lao rice sector policy study conducted in 2012[7] concluded that the rice deficits commonly experienced in the Northern provinces and upland areas will likely continue to increase, in light of stagnating production levels and increasing population numbers, even if national rice surpluses continue to grow. As more and more households switch to other more

[6] Source: MAF, 2012. Lao Census of Agriculture2010/11 Highlights
[7] MAF, IRRI, World Bank and Food and Agriculture Organization (FAO) conducted a Lao People's Democratic Republic Rice Policy Study in 2012

profitable or diversified economic activities, these provinces are expected to continue experiencing rice deficits.

Furthermore, the government's liberalization of the rice industry in 2010 had unexpected negative consequences in the rice farming sector in Northern provinces. In 2010, Luang Namtha was officially authorized to export rice outside of Laos. Although not officially opened to international markets and due to the porous nature of the border, farmers and traders in Luang Prabang Province sold their rice to travelling Chinese buyers who offered higher prices thus rapidly depleting local stocks. This deficit in the province required the importation from neighbouring countries (especially Thailand) with milled rice price hikes reaching 9000 kip (1.15) per kg, a substantial increase from the starting price of 5,000-6,000 kip (US$ 0.63-0.75) per kg. In early 2012, a strict total ban on exports was put in place for the Luang Prabang Province. As the District of Nambak was worst affected it was not authorised to export outside of its border until later of the year[8].

Its policy of low domestic prices and weaknesses in enforcement of appropriate rules and informed business behaviors resulted in outflows of rice from the country, local shortages and high prices that necessitated rice imports at market prices. To prevent a reoccurrence of these events in 2011 rice exports were banned from districts of Luang Prabang province. This resulted in a drop in paddy prices that severely impacted the most vulnerable producers.

As Lao PDR continues to open up its economy and foreign investments grow, a wide range of choices for cash crop cultivation apart from rice have opened up. In many Northern provinces the majority of farmers are choosing commercial crop cultivation as an alternative to production of food crops for self-consumption. As the government continues its policy of keeping rice prices low without sharing the risks with producers via subsidies, farmers are choosing to move into higher-value agricultural products.

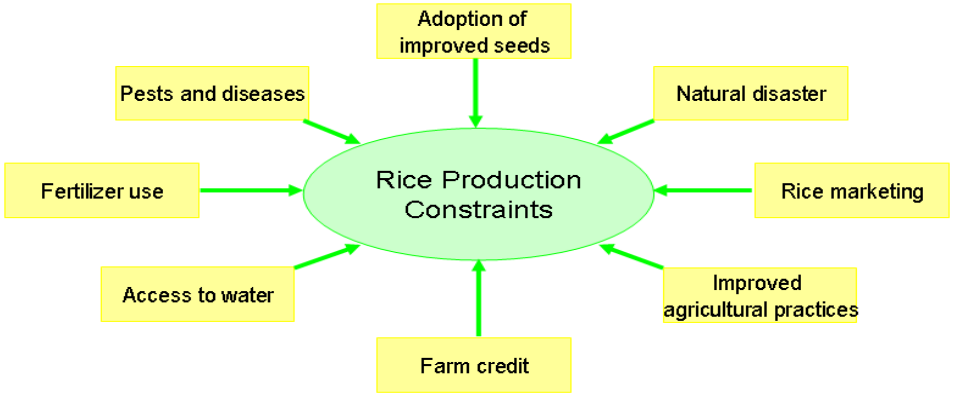
In some neighboring countries like Thailand, the government offers a minimum price for paddy (15 Bath or US$ 0.49 per kg) with clear market price information system, while the government of Laos has instead set ceiling prices for paddy. Additionally, China has launched subsidies to help offset between 15 to 20 % of the cost of inorganic fertilizer.

[8] NURiFaR, 2012. Rice marker assessment in NURiFaR target provinces

6. Rice Production Constraints

There are a number of physical and ecological factors influencing the low productivity of rice production in Lao PDR. Some of the main factors are illustrated in the chart below.

Figure 3: Rice Production Constraints



Source: Summarised from the rice policy in Lao PDR, 2012

Fertilizer Use - A key input constraint to increased productivity is the low and inappropriate use of both inorganic and organic fertilizers in rice cultivation due to limited cash for and/or access to fertilizer. Despite many demonstrated positive responses to fertilizer use on wet season and dry season rice production gross margins, it appears that the input cost of fertilizer is a major deterrent to many smallholder farmers. The technical recommendations would suggest farmers to utilize about 150 to 200 kg/ha of fertilizer during basal fertilization (NPK 15-15-15), about 50 kg/ha during active tilling and another 50 kg/ha during panicle initiation stage (flowering stage) (NPK 46-00-00). These are added to 3 to 5 tons/ha of manure. However, farmers find it extremely difficult to adopt these quantity recommendations. Specific recommendations are based on specific variety, soil type, soil fertility, and locality. Further information is available through NAFRI's publications on rice varieties recommendations for northern Laos (NAFRI, 2013), as well as recommendations on other rice production techniques.

Access to Water- Access to water has also been identified as a major constraint to improvements to rice-based farming systems. This includes farms within large-scale irrigation schemes as well as those drawing on smaller scale, intra-village surface water and groundwater resources. In both settings, there are issues surrounding the institutional arrangements for infrastructure maintenance, water distribution, pumping costs, water charging and associated incentives, and the equitable sharing of costs and benefits given scarce and variable water supply.

Despites of the governments' effort to expand and maintain the irrigated areas, only 135,000 ha (14% of total rice areas) are rainfed irrigated while about 579,000 ha (59% of total rice areas) of rice cultivated areas are rainfed lowland without irrigation. Rice production in this system is more vulnerable to rain, draught and climate change.

Farm Credit - Accessing farm credit is a significant constraint to the use of more productive inputs e.g. seeds, planting materials, fertilizers, pumps, tractors, threshers and dryers.

Government-supported agricultural promotion banks endeavor to meet some of the shortfall in credit. However, many farmers do not want to take the risk on farm investment in case of crop failure due to natural disaster such as flood, drought or outbreak of pest and diseases. In many cases, farmers take informal loans, which require lower interest than market price. In order to access to short term loan (mostly 1 year with 8%- 13% interest rate) from the state banks (e.g. Agricultural Promotion Bank and Nayobai Bank), farmers have to form rice producing groups. Some rice farmers also access revolving funds where development projects have set up the group with funds and capacity of the group to manage the fund; however, only groups with enough sources of income have been functioning well. Rice producer groups hardly implement the revolving fund as mostly there is no collective action on income.

Improved Agricultural Practices - A further constraint to the adoption of improved practices in Lao PDR is the general under-resourcing of extension services and, in many cases, heavy dependence on donor funding, which is tied to project cycles. In the Lao PDR, a preferred extension model – the Lao Extension for Agriculture Project (LEAP) – has been developed with Swiss Cooperation assistance and adopted by the former National Agriculture and Forestry Extension Service (NAFES)[9]. LEAP is an agricultural capacity building initiative, working as an extension of LEA. The latter is responsible for a set of policies, principles, structures and processes that should be applied in all provinces and districts, and by all projects that support extension activities in Laos. The system has been consolidating since it was introduced in 2005. The structure of LEA consists of two parts: the Government Extension Service and the Village Extension System.

However, resources for this system are limited and subsequent projects implemented by government and non-governmental agencies have not always followed this approach. Moreover, even though technical and training modalities have been defined, it is difficult to ensure sufficient incentives for extension staff to efficiently carry out their work at current funding levels.

Rice Marketing - The marketing of surplus rice in the irrigated and rainfed lowlands of southern Lao PDR for example is a potential source of improved livelihoods for farmers and therefore an incentive for the adoption of more intensive production practices (such as increased fertilizer use and mechanization). However, there are practical constraints that are affecting rice marketing such as poor post-harvesting management, in terms of storing and milling, which in turn affect the rice quality and its market value.

Natural Disaster - Annual droughts and floods are still problems for rice cultivation throughout the central and southern regions, and the situation in the north is only slightly better. Regular flooding of the Mekong River affects 10 to 30% of the rice area in the southern and central regions. In the South specifically, it is estimated that late season drought alone results in a 30% loss in yield.

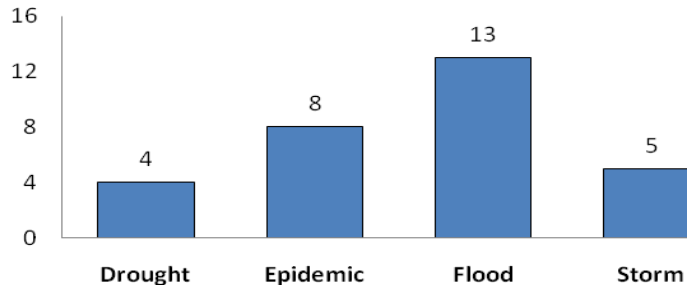
In 2012 Luang Prabang's rice production was affected by natural disaster: 138 ha of rainfed lowland rice was damaged by flooding and another 68 ha of rainfed upland was damaged by land slide and drought. In 2013, the flooding area increased to 288 ha and the area damaged by land slide ramped up to 89 ha[10].

[9] NAFES now is Department of Agricultural Extension and Cooperative
[10] MAF, 2013. Crop Statistics Year Book 2012

More generally, Lao PDR has always been subject to rain bearing depressions, floods and drought so in some ways farmers have always been adapting and managing the impacts of large storms and times of water deficiency. A study on the impact of climate change on the frequency of floods and droughts in Lao PDR indicated that disasters used to occur every 10 years or so, while more recently they occur every 2 to 3 years[11]. Within the same study, it was observed that donor organizations are switching their efforts from aid initiatives to farmers in times of crisis towards capacity building to teach them how to predict, prepare and react to them.

The figure and table below analyze the climactic events that occurred in Lao PDR between 1980 and 2010. It is apparent that floods were by far the most recurrent natural disaster in the country, and were second only to storms in terms of number of affected people and economic damage. Epidemics were the second most recurrent disaster in the country, but they affected much fewer people (and no data was reported on their economic impact). Droughts and storms are similar in terms of frequency of occurrence and number of people affected, but storms have a much larger economic impact on the country.

Figure 4: Disaster Occurrence between 1980 and 2010, (Number of Incidentes)



Source: http://www.preventionweb.net/english/countries/statistics/?cid=94

Table 3: Disaster Impacts in Lao PDR between 1980 and 2010 (Number of people and USD 000s)

Type of Disasters	Affected People	Economic Damages
Drought	187,500	250
Epidemic	2,491	...
Flood	214,826	1,756
Storm	287,239	81,190

Source: http://www.preventionweb.net/english/countries/statistics/?cid=94

Adoption of Improved Seeds - Adoption of improved rice varieties has been the single most important factor in achieving significant productivity increases since the 1990s. The National Agriculture and Forestry Research Institute (NAFRI), through its Rice Research Centre, the National Rice Research Programme (NRRP), and a regional network of seed multiplication centers and stations, has developed improved Lao rice varieties and promoted their use among smallholder farmers. The adoption rates of these varieties over the past decade have been quite

[11] Hogan C., Training Needs Analysis and Training Report, United Nations Development Programme, 2012

high, particularly in the central and southern lowland production systems, 65–80% of farmers in the wet season and 100% in the dry season. In the North, farmers face more challenges with rice varieties, qualities and characteristics such as high yield with resistance to low temperature and draught, ability to cope with poor soils, sensitivity to pests and diseases, long grains and big panicles corresponding to consumers' preferences. Currently, a limited number of improved varieties and seeds are available (see section 8).

Many farmers have adopted these new varieties in response to market demand, while continuing to cultivate traditional indigenous varieties in parallel in order to meet personal and family taste preferences. At the same time, the price of the new varieties improved seed is more than twice of the traditional varieties (6,000 kip/kg which is equivalent to US$ 0.75/kg for improved seeds compared with 2,000 – 2,500 kip/kg (US$ 0.25-0.31/kg) for normal seeds). This is another reason why some farmers are reluctant to adopt the improved seeds.

Pests and Diseases – Some modern rice varieties are moderately or non-resistant to pests and diseases. This in turn requires farmers to use more inputs in the form of pesticides and insecticides. Without proper utilization of ecosystem services conservation-based pest and disease management, there is no certainty that farmers can increase their productivity. NAFRI has recommended some popular rice varieties; their levels of resistance to pests and diseases are listed in the table below:

Table 4: Description of widely grown varieties- (a) Improved; (b) traditional

a) Improved variety	Growth duration /Flowering date	BPH	BI	BLB	NB	BD	GLH	GM	Fe tox
VTE450-2	135-140	S	MR	MR	MS	R	S	S	MT
VTE450-1*	Early Oct	S	MR	MR	MS	R	S	S	MT
TDK8	135-140	MS	MR	MR	MS	R	S	S	MS
TDK1 *sub1*	140-145	S	MR	MR	S	R	S	S	S
TSN5	135-140	MS	R	R	R	R	S	S	MS
TDK12	Early Oct	S	MS	MS	MS	R	S	MS	MT
TDK11	135-140	MS	R	MR	MR	S	S	S	T
TDK9	Late Sept	S	R	MR	MS	R	S	S	T
TDK10	Mid Oct	S	R	R	MS	R	S	S	T
PNG3	130-135	R	MR	S	MS	R	S	S	MT
PNG5	125-130	S	S	MR	S	R	S	S	MT
PNG6	130-135	S	R	MR	MS	R	S	S	MT
TSN2	130-135	S	MR	MR	MS	R	S	S	MS
Homsavanh	Mid Oct	S	MR	MR	MS	R	S	MS	MT
TSN4	125-130	S	S	S	MS	R	S	S	MS
TDK6	135-140	MS	MS	MR	MS	R	MS	MS	MT
TDK5	125-130	MS	MS	MR	MS	R	MS	S	MT
TDK4	Mid Oct	MR	MR	R	MR	R	S	S	S
TSN1	140-145	MS	MR	MR	MS	R	MS	MS	T
NTN1	130-135	MS	MS	MS	S	R	MS	S	MS

PNG2	Mid Oct	S	S	S	S	R	S	S	T
TDK1	135-140	MR	MR	MR	S	S	S	MS	S
PNG1	125-130	S	R	MR	S	R	R	MS	T
RD10	Mid Oct	S	S	S	S	R	S	S	T
KDML105	Mid Oct	S	S	S	S	R	S	S	T
RD6	Late Oct	MS	MR	MS	MS	R	S	S	MT
RD8	Late Oct	S	MR	MS	MS	R	S	S	MT
TSN3	135-140	MS	R	R	MR	MR	R	S	MT
RD15	Early Oct	S	MR	MS	MS	R	S	S	MT
(b) Traditional	**Flowering time**	**BPH**	**Bl**	**BLB**	**NB**	**BD**	**GLH**	**GM**	**Fe tox**
Nang-nuan	5-10 Oct	S	S	S	S	R	S	S	MT
Hom-nang- nuan	15-20 Oct	S	MS	MS	S	R	S	S	MT
Muang-nga	10-15 Oct	S	R	S	R	R	S	R	T
Ta-khiat	5-10 Oct	S	R	S	R	R	S	R	T
Mak-hing	10-15 Oct	S	S	S	S	R	S	S	T
Dok-mai	10-15 Oct	S	S	S	S	R	S	MS	MT
Lay-keaw	15-20 Oct	S	S	S	MS	R	S	MS	MT
Dok-tiou	Late Sept Early Oct	S	S	S	R	R	S	S	T
Kai-noi	Late Sept	S	S	S	MS	R	S	R	T
Dodeng	Late Sept	S	R	R	MR	R	S	S	T
Chao Dok Dou	Mid Oct	S	MR	MR	MS	R	S	MS	MT

Source: NAFRI, 2013, Recommended Rice Varieties in Laos. NAFRI, MAF

*non-glutinous; # Number of trials tested in brackets

Fl=flowering; BPH=Brown plant hopper; Bl=Blast [12]; BLB=Bacterial Leaf Blight; NB=Neck Blast [13]; BD=Bakanae Disease; GLH=Green Leaf Hopper; GM=Gall Midge; Fe Tox=Iron (Fe) toxicity. Ratings: R=Resistant; MR=Mildly resistant; MS=Mildly susceptible; S=Susceptible; VS=very susceptible; T=tolerant; MT=Moderately tolerant.

In addition to technological challenges, labor-related challenges were also identified in Laos, particularly in the northern rainfed lowland rice areas where Chinese investment and concessions for rubber, sugarcane and other cash crops plantation has been booming in the past decade. One of the key issues is labor shortages in the rice farming sector. Comparatively higher income in other sectors have resulted in an ongoing shift from farm labor to off-farming and non-farming sectors, and at the same time, the farm labors also started to demand higher salary of between 30,000-50,000 kip/day (US$ 3.75-6.25/day) while the government's set rate is

[12] Rice blast (Pyricularia grisea) is a fungus that feeds on the rice plant, causing severe damage usually during the seedling stage. It attacks different parts of the plant: the collar, which can ultimately kill the entire leaf blade; the stem, which turns blackish and breaks easily (node blast); the neck of the panicle, where the infected part is girdled by a grayish brown lesion, or when severe, causes the panicles to fall over; or on the branches of the panicles which exhibit brown lesions when infected.
Source: www.irri.org, http://irri.org/our-work/research/better-rice-varieties/disease-and-pest-resistant-rice

[13] Neck blast occurs when the pathogen infects the neck of the panicle.
Source: www.irri.org, http://www.knowledgebank.irri.org/ipm/rice-blast/symptoms.html

690,000 kip/month (US$ 86.25). This has implications for the competitiveness of traditional as well as modern rice production systems. The currently prevalent low input, and consequently low output, rice farming systems may no longer be competitive vis-à-vis against alternative

crops cultivation and other employment opportunities. Therefore, there is a need to ensure higher economic returns and income from rice farming if the government of Lao PDR expects farmers to respond to its rice production goals previously outlined.

In this way, reduced input costs and better management practices aimed at greater efficiencies in rice production systems are worthwhile exploring as part of this SRI project.

7. Rainfed Lowland Rice Ecosystems in Identified Provinces

As illustrated in the following table, glutinous traditional varieties account for the majority of rice production in the identified provinces. In Luang Prabang for instance, 82.2% of the rice farming households grow glutinous rice (44,700 ha under cultivation), compared to 12.3% of rice farmers who grow non-glutinous rice (5,500 ha).

The 2010 Agricultural Census indicated that rainfed lowland rice production in Luang Prabang (LPB), Xayabuly (XYBR) and Xieng Khuang (XKH) is around 12,700 ha, 30,700 ha and 22,400 ha respectively.

Table 5: Rainfed lowland rice ecosystems in identified provinces

	Land holdings	Wet Season lowland rice		Traditional variety		Modern variety		Glutinous rice		Non-glutinous rice	
	000 HHs	000 HHs	Area[14] ha	000 HHs	000 ha	000 HHs	000 ha	000 HHs	000 ha	000 HHs	000 ha
LPB	59.3	15.8	12,700	49.4	46.1	5	4.2	48.8	44.7	7.3	5.5
XYBR	62.5	40.7	30,700	46.3	38.7	17.6	14.1	56.1	50.2	3.2	2.5
XKH	36.2	26.3	22,400	34.5	32.2	0.9	0.6	30.3	27.3	7.4	5.6
Lao PDR	776.7	535		508.4	538	295.3	448.5	672.5	903.7	99.6	82.9

Source: Lao Census of Agriculture 2010/2011

According to annual reports from the Provincial Agriculture and Forestry Offices (PAFO), in 2013 rainfed lowland rice production in Luang Prabang, Xayabuly and Xieng Khuang was 13,576 ha, 31,440 ha and 21,370 ha respectively, accounting for 66%, 77% and 84% of total provincial production respectively. Average productivity was 4.62 mt/ha in Xayabuly, 4.55 mt/ha in Luang Prabang and 4.62 mt/ha in Xieng Khuang. Some characteristics and challenges associated with rainfed lowland rice production are highlighted in the table below.

Table 6: Characteristics of rainfed lowland rice ecosystems and challenges in identified provinces in 2013

	Characteristics	Challenges

[14]Rainfed lowland rice area is referred to planted area in 2013

	Characteristics	Challenges
Luang Prabang	• During 2013 wet season, Luang Prabang province planted 13,895 ha of rice with an average yield of 4.55 mt/ha. • To have better market links, the province promotes single modern varieties (MV) such as TDK8, Naxang, etc. in each district • The Northern Community Managed Irrigation sector project (CMI), and ADB loan government project implemented by Department of Irrigation during 2007-2010. Together with improvement of the irrigation system, the project has promoted SRI in farming areas of 672 ha in 2012 and about 600 ha in 2013. With SRI technology, farmers are supposed to apply lots of fertilizer, but they only applied limited fertilizer which does not meet the requirement of the technology. Farmers were advised to apply at least 3 mt of manure or compost and 136 kg of inorganic fertilizer per ha; however, on average, only about 50 kg of inorganic fertilizer is applied. • In 2013,319 ha of Wet Season (WS) rice was damaged by flood, landslide, drought, pests and other natural disasters. • The province experiences rice insufficiency for 3-4 months of the year. In order to fulfill demand, the province aims to produce 120,000 mt/year through the introduction of high yielding varieties, and improvement of productivity and irrigation system. • With current population (421,292) and rice production, the average paddy rice consumption is about 220 kg/person/year	• There is limited agricultural land for rice. Some urban land has been used to construct properties (106 ha, 2013) instead of farming and rice farms have been converted into farms for alternative cash crops. • Most rice farmers are smallholders with subsistent practices and limited (or no) fertilizer use. • Rice cultivation is vulnerable to natural disaster and climate change. • Insufficient rice technology extension with a weak monitoring and reporting system.
Xayabuly	• In 2013, Xayabuly province grew 31,440 ha of rainfed lowland rice with 70 ha of new paddy rice planted during the wet season. • Approximately 651 ha of SRI[15] and 2.36 ha of Parachute techniques, a new transplanting technology introduced by the Chinese, have been demonstrated. • Rice production is focused in three main plain areas in the province: Xayabuly, Phiang and Xienghone districts. • To improve productivity, rice producing group	• Limited access to credit and inputs to support group and individual production • Limited good quality rice seeds with resistant to pests and disease protection, resulting in low quality and quantity • Technical service centers and researchers have limited capacity, experience and budget • Weak group producers' competence

[15] SRI was first introduced to Xayabuly province in 2008 following the technology pattern; however, currently farmers adopt only young seedling (about 2 weeks) with around 3 seedlings and littler inorganic fertilizer.

	Characteristics	Challenges
	production (cooperative farming) is promoted in all districts. • Average paddy rice consumption is 514kg/per person/year.	and experience resulting from limited local capacity and supports on both budget and group management
Xieng Khuang	• In 2013, Xieng Khuang province grew 21,370 ha of rainfed lowland rice and productivity averaged 4.50 t/ha. • Improved varieties including TDK11 and Homsangthong[16], and traditional varieties such as Khao Kainoy, have been widely adopted in the province. • Improved rice seeds are promoted, as well as organic inputs such as Effective Microorganisms (EM), compost, etc. through LEAP • SRI was promoted by CMI within the past five years, but adoption was limited. • Average paddy rice consumption is around 421 kg/per person/year. • In Xieng Khuang province, SRI is being implemented by a limited number of farmers and in a limited cultivation area. However, the PAFO plans to demonstrate SRI in 400 ha in 8 districts across the province where there is enough water; some farmers surveyed were trained on these techniques before.	• Limited competent technical extension • Weak agricultural information distribution • Limited farmer experts to scale out technologies • Insufficient inputs such as fertilizer, seeds, pesticides, and machinery • Insufficient proper irrigation systems for good water management • Limited market linkages for rice and other cash crops • The main constraints are insufficient low-temperature suitable rice varieties, however, farmers felt that more time and labor consuming for weeding and farm management is needed.

7.1 Rainfed Rice Production in Luang Prabang Province

In 2013, rainfed lowland rice production varied across the identified provinces. In Luang Prabang province, Nambak, Luang Prabang and Nan districts are the main wet season lowland rice areas. These three districts account for approximately 55% of land under rice cultivation in the province. SRI has been adopted in Nan and Xieng Ngean districts, covering a total area of 651 ha.

During the wet season 2013, three hundred and nineteen ha of lowland rice was damaged by flood (228 ha), drought (2 ha), landslides (57 ha), and pests such as rodents and stem borer in 2013. Luang Prabang district was the most affected district (111 ha). Some villages e.g. Ban Phavieng in Kum Kokwan were affected by flooding resulting from the broken cannel/irrigation during the heavy rain. In this damaged area only about 50% of rice was harvested.

Table 7: Rainfed Lowland Rice Production in Luang Prabang Province in 2013, by District

District	WS 2012	Plan for WS Rice 2013	Actual Implementation Area

[16] Non-glutinous rice originated from Sangthong district in VTE Capital, similar to Hommari

					Conven-tional	SRI	Trans-planted	Damaged	Har-vested
	ha	ha	t/ha	t	ha	ha	ha	ha	ha
Luang Prabang	2,295	2,295	4.80	11,014	2,172	71	2,242	111	2,131
Xieng Ngean	440	495	4.70	2,328	323	117	440	9	431
Nan	1,996	2,006	4.80	9,628	1,767	256	2,023	-	2,023
Pak-Ou	1,466	1,496	4.40	6,581	1,432	48	1,480	85	1,396
Nambak	3,260	3,287	4.60	15,118	3,304	12	3,316	-	3,316
Ngoy	875	875	4.70	4,110	803	74	875	5	869
Pakxieng	173	174	4.20	728	145	21	166	3	163
Phonxay	358	358	4.00	1,433	385	3	388	73	314
Chomphet	1,542	1,577	4.02	6,340	1,610	50	1,659	32	1,628
Viengkham	187	187	4.00	747	176		176	-	176
Phoukhoun	474	474	4.70	2,230	470		470	-	470
Phonthong	660	660	4.50	2,968	660		660	1	659
Total	13,725	13,882	4.55	63,225	13,246	651	13,895	319	13,576

Source: Luang Prabang PAFO annual report, 2013

7.2 Rainfed Rice Production in Xayabuly Province

Paklai and Phiang districts are the largest rice producers in Xayabuly province, accounting for about 37% of rice cultivated in rainfed lowland ecosystems in the province. In 2013, the province focused on promotion of rice production in three main plain areas: Xayabuly, Phiang and Xienghone districts. About 651 ha were planted as SRI, mainly in Xienghone and Xayabuly districts.

Table 8: Rainfed Lowland Rice Production in Xayabuly Province in 2013, by District

District	Plan	Transplanting			
	Plan area (ha)	area (ha)	SRI (ha)	Total area (ha)	Seeds (kg)
Xayabuly	3,796	3,855	224	4,079	305,873
Khop	1,480	1,572		1,572	139,912
Hongsa	1,460	1,461		1,462	116,810
Ngean	800	685		685	70,080
Xienghone	3,150	3,147	300	3,447	261,943
Phiang	5,480	5,448	85	5,333	439,249
Paklai	6,060	5,985	31	6,015	485,044
Keanthao	4,874	4,888	11	4,899	382,520
Botean	2,965	2,380		2,380	224,000
Thongmixay	1,271	1,273	0	1,273	101,446
Xaysathan	74	96		96	7,680
Total	31,410	30,790	651	31,441	2,534,557

Source: Xayabuly PAFO annual report, 2013

Adoption of SRI has been variable between 2008 and 2013. According to Xayabuly PAFO (2013), 73 ha of rice were planted with SRI in 2008. The number increased to 494 ha in 2009 and decreased to 189 ha in 2012. The yield with SRI has ranged from 4.72 mt/ha to 5.80 mt/ha.

8. Farm-Level Rainfed Ecosystems

Agricultural Land Holding and Labor

In Luang Prabang, Xayabuly and Xieng Khuang provinces, the rainfed lowland rice farmers interviewed held an average 1.3 parcels of land, with an area of 1.07 ha, 1.36 ha and 1.86 ha, respectively. The land holding ranges from 0.13 ha to 3.2 ha per household According to the survey, less than 20% of farmers have two or more parcels of rice land.

The demographic information in the identified provinces shows that household size averages between five and six persons per households. Compared to other provinces where female participation in rice farming is higher than or equal to that of males, in Xieng Khuang province the average number of males participating in rice production is higher (2.50 people/HH) than the number of females (1.75 people/HH) mainly because of households selected have more male than female.

Table 9: Average Household Size and Number of Laborers in Indentified Provinces, 2013

	Number of Males (>15 yrs old)	Number of Females (>15 years old)	Number of Children (<15 years old)	Household Size
Luang Prabang	1.67	2.25	1.63	5.00
Xaybouly	2.20	2.20	1.38	5.50
Xieng Khuang	2.50	1.75	1.75	6.00

Source: PRA field survey, 2013

Adoption of Rice Varieties

Both modern varieties (MV) and traditional varieties (TV) are planted in Luang Prabang, Xayabuly, and Xieng Khuang. In Luang Prabang province for instance, 85% of correspondents have adopted MV while 79% of farmers in Xayabuly have adopted MV. In Xieng Khuang province, most farmers in the surveyed area are using traditional varieties (Khao Kainoy). According to the survey, the average yield is about 3.81 t/ha (Luang Prabang province), 3.17 t/ha (Xayabuly province), and 3.34 t/ha (Xieng Khuang province).

In 2013, farmers in the identified provinces planted several MV and TV in the rainfed lowland ecosystems. The MV includes TDK5, TDK8, TDK11, CR6, CR8, CR10, Homsangthong, and Hommari. The primary TVs are Obpop, Kao Lueang, Takiet and Buangam. Some of these varieties are in line with the varieties recommended for wet seasons at different terrace positions in regions in Lao PDR (Table 9)[17]. Some main reasons for adoption or non-adoption of varieties are shown in the table below.

Table 10: Benefits and Problems with Currently Adopted Varieties

	Benefits	Problems
Modern Variety	• Early or medium maturity varieties • Strong plants, good tilling, big panicles and high yield • Resistant to some pests and diseases • Suitable to the specific soil condition,	• Not resistant to some pests, insects and diseases • More water management and weed control required, as compared with TV • Seeds have to be refreshed every few

[17] Recommended rice varieties in Lao PDR. NAFRI, 2013

	no lodging • Good eating quality	years, otherwise yield will be very low • Fertilizer input is required
Traditional Variety	• Suitable to local weather and soil condition with more resistant to pests and diseases, such as gall midge • Strong plant, big grain and heavier • Good eating quality	• Attacked by plant hoppers • Plants too high and easy to fall (lodge) • Lower yield than MV

Source: PRA field survey, 2013

Table 11: Recommended Varieties for Wet Season at Different Terrace Positions in Regions of Lao PDR

Regions	Terrace position		
	Lower	Middle	Top
Northern	TDK1, TDK5,TDK6, TDK11, TDK8, RD10, Kai Noi		
Central-upper	RD6*, RD8,TDK10	TDK1, TDK1*sub*1, TDK8, TDK6, TSN1, VTE450-1*, TDK4, VTE450-2, KDML105, RD15, Hom Nang Nouane, Chao Dok Dou	TDK9*, TDK11, TDK12, RD10 , NTN1
Central-lower	RD6*, TDK10,	TDK1, TDK1*sub*1, TDK8, TDK6, PNG1, TSN3, TSN1, TSN5	TDK9*, RD15, TDK11, PNG1, PNG3, TDK12, RD10, NTN1
Southern	RD6*, TDK10	TDK1, TDK1*sub*1, TDK8, TDK6, PNG1, TSN3, PNG5, Chao Dok Dou, PNG6, KDML105*	TDK9*, TDK11, PNG1, PNG3, TDK12, RD10, NTN1, KDML105*

*photoperiod sensitive

Pests and Diseases

In Luang Prabang province, crabs seriously damage some areas of wet season lowland rice every year. Other frequently encountered pests and diseases include gall midge, Bacterial Leaf Blight (BLB), stem borers and plant hoppers. In Xayabuly province, crabs, plant hoppers and golden apple snails are the main pests that cause damage to rice during the wet season. In Xieng Khuang province, fewer pests and diseases were reported. Many of the interviewed farmers reported that they do nothing to control pests and diseases, while a smaller group does spray pesticide (Sevin-active ingredient-cabaryl) about 2 or 3 times per season to control plant hoppers, if they perceive that crops are suffering substantial damages. Other farmers use traditional herbs such as Khue Khaohor (*Tinospora crispa* (L.) Hook. f. & Thomson MENISPERMACEAE); additionally, some farmers manually collect crabs for home consumption.

Table 12: Pests and Diseases in Rainfed Lowland Rice Production (Average), 2013

	Luang Prabang			Xayabuly			Xieng Khuang		
	Level	Frequency	Incidence	Level	Frequency	Incidence	Level	Frequency	Incidence

Gall midge	1.6	1.0	41%	2.5	1.5	40%	2.4	1.3	100%
Golden apple snail	1.5	2.0	16%	2.0	2.0	40%	3.0	2.0	13%
Blast	3.0	1.5	16%	3.0	1.0	10%	-	-	-
Bacterial Leaf Blight	3.0	1.0	8%	3.0	1.3	30%	2.7	1.3	75%
Brown plant hopper	1.5	2.5	33%	3.0	1.0	10%	2.9	2.1	100%
Stem borer	1.7	1.0	25%	3.0	2.0	10%	-	-	-
Leaf borer	2.0	2.0	8%	-	-	-	-	-	-
Crab	1.0	1.0	16%	1.0	1.0	10%	2.0	2.0	13%
Plant hopper	2.0	1.2	50%	2.0	1.0	20%	-	-	-
Green leaf hopper	1.0	1.0	8%	-	-	-	-	-	-

Level: 1=Serious, 2=Medium, 3= Low
Frequency: 1= Every year, 2= 1-3 Years, 3=4-6 years
Incidence: Respondents that suffered from the pestilence / total respondents in the province

Source: PRA field survey, 2013

Adoption of crop management practices

In the 2013 wet season in Luang Prabang and Xayabuly provinces, the most widely adopted improved crop management practices were: (1) use of machinery to plough land;(2) plant spacing of 25x25 cm or 20x20; and (3) growing seedlings in nurseries for 25 to 30 days. In Xieng Khuang province, the use of machinery to plough land, application of manure to nursery beds and growing seedlings in nurseries were the most widely adopted practices.

The survey also found that higher levels of inputs (inorganic fertilizer) are used in MV (Modern Variety) cultivation compared with TV (Traditional Variety), particularly during the seedbed and basal (few days after transplanting) stages. Compared with other identified provinces, farmers in Xieng Khuang apply less inorganic fertilizers because they thought the local variety (Khao Kainoy) does not react well with the inorganic fertilizer, and they also believe that the inorganic fertilizer will affect the quality of the rice, for instance, making the rice less aromatic.

Table 13: Crop Management Practices in Identified Provinces (% of farmers interviewed), 2013

	Luang Prabang	Xaybouly	Xieng Khuang
Seedling nursery			
Apply manure to nursery bed	25	33	71
Apply inorganic fertilizer after 10-15 days of seeding	42	63	25
Seedlings grown in nursery for 25 to 30 days	43	75	50
Use of machinery to plough land	100	100	100
Use of direct seeding method for sowing seed	8	10	-
Use of intensified rice systems	67	70	37
Plant spacing: 25x25 cm per hill	83	30	10
Plant spacing: 20x20 cm per hill	58	50	25
Inorganic fertilizer			
Basal	42	40	-
Active Tilling	17	40	-
Panicle Initiation	17	20	-

Organic fertilizer			
Farm Yard	17	20	25
Animal Manure	42	30	12
Insecticide / Pesticide	42	10	-
Herbicide*[18]	-	-	-

Source: PRA field survey, 2013

System Rice Intensification

Adoption of SRI during the CMI and JICA (SRI Extension Project in Luang Prabang) projects, promotion was generally limited and one the projects were completed, farmers' interest in SRI faded quickly. In the identified provinces, SRI has been being promoted since late 2007/08 after high yield were exhibited on demonstration plots. Strict systematic practices were introduced and promoted for the first few years. However, farmers found it difficult to adopt and adapt the technology and they were not able to follow it. Even though they have adopted the SRI technology, these farmers are applying more seedlings, less frequent water management, and use less inorganic fertilizer compared with what is required by the SRI system.

Table 14: Pros and Cons of SRI According to Adopted and Non-Adopted Farmers

	Pros	Cons
Adopted Farmers	• Requires at least five times fewer seeds • New rice production technologies which result interesting to farmers • Good tilling and high yield • Systematic rows and easy for weeding and management • Less time consuming and less labor required for weeding	• More fertilizer inputs required, otherwise yield would be decreased possibly as high as 50% • Requires sufficient water source and management • No tools and equipment to use for the SRI • In order to have good water management system, good land preparation (such as even and level the land) is necessary, but is difficult for some paddy fields to do so.
Non adopted Farmers	• Fewer seeds required • New technology and interested to try • High yield if farmers can follow the technology • Project-driven with some supports e.g. fertilizer, equipment, but while project phased out farmers lost interest	• Young seedlings difficult to pull and transplant • Requires more labor and fertilizer for cultivation and farm management • Rice field is far away from water sources, do not have access to sufficient water • Difficult to manage the farm • Prefer cultivation of traditional varieties • Damaged by pests such as crabs and snails after transplanting • Time consuming for re-transplanting • When hiring laborers for transplanting, laborers do not follow the spacing as they want to finish transplanting faster

[18] According to the survey, the use of herbicide is more popular in upland or garden farming; little or no herbicide is normally used in the paddy field

Source: PRA field Survey, 2013

Rainfed lowland rice production inputs and income

With daily hired labor cost approximately 30,000-50,000 kip, equivalent to US$ 3.75-6.25 per day per labour, the costs of land preparation, transplanting and harvesting are considered to be the main input costs for rainfed lowland rice production in all three provinces. On average, farmers require 845,000 kip (US$ 106) in Xayabuly province, 659,000 kip (US$ 82) in Luang Prabang province and 606,000 kip (US$ 76) in Xieng Khuang province for land preparation and labor cost per hectare each season. The total cost to produce a hectare of rainfed lowland rice is approximately 1,506,731 kip (US$ 188) in Luang Prabang province, 1,576,308 kip (US$ 197) in Xayabuly province and 1,136,538 kip (US$ 142) in Xieng Khuang province.

Food security, income sources and general welfare

In Luang Prabang, Xayabuly and Xieng Khuang provinces, some farmers reported insufficient rice for household consumption. The main reasons given are:

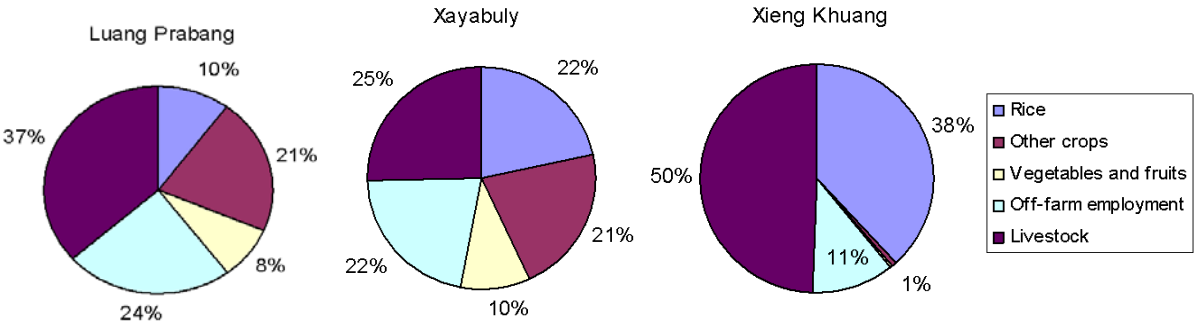
1. not enough land for rice cultivation resulting from new settlement of the households;
2. not enough labor for rice production or;
3. flooding or drought resulting in low yields.

The rice shortage period is usually from May until September the next harvesting season. The results also show that female household heads (divorced or widowed), in some context are more vulnerable to rice insufficiency. Less male labor to produce rice is the key constraint for such HHs.

Some farmers solved their rice insufficiency through other income generation activities such as construction. Borrowing money from relatives and neighbors to purchase milled glutinous rice (from market) of about 5,000-6,500 kip/kg (US$ 0.63-0.81/kg) was also mentioned.

In the surveyed villages, the average number of local households was around 150, and they were characterized by an average 6% deficiency of rice. The majority of rainfed lowland rice farmers interviewed (90%) have enough rice for consumption and surplus for sale. Average annual rice income in the surveyed areas is about 5,210,000 kip (US$ 651) in Luang Prabang province, 4,488,000 kip (US$ 561) in Xayabuly province, and 6,750,000 kip (US$ 843) in Xieng Khuang province. Income from other cash crops such as job'stears, beans, maize, etc., and vegetables and fruits are also high, particularly in Luang Prabang (8%) and Xayabuly provinces (10%). Income from livestock accounts for about 37% in Luang Prabang, 25% in Xayabuly province and 50% in Xieng Khuang provinces.

Figure 5: Sources of Income Generation Activities in Identified Provinces, 2013



Source: PRA survey, 2013

The Table below shows the simple cost-benefit of rice production in three identified province. On average, Luang Prabang rice farmers earn about 3,527,000 kip (US$ 441) per ha compared to 1,808,000 kip (US$ 226) in Xayabuly, and 2,986,000 kip (US$ 373) in Xieng Khuang.

Table 15: Cost-Benefit Analysis for Rainfed Rice Production in Identified Provinces (kip/ha)

	Income	Cost	Return
Luang Prabang	5,033,000	1,506,000	3,527,000
Xayabuly	3,384,000	1,576,000	1,808,000
Xieng Khuang	4,122,000	1,136,000	2,986,000

Source: PRA survey, 2013

As rice sufficiency was achieved some years ago, most of the farmers in surveyed areas have been able to earn more income from higher yields and other revenue streams. Except for Xieng Khuang province where the traditional variety (Khao Kainoy) is still highly adopted, MV was widely cultivated in Luang Prabang and Xayabuly. Adoption of MV is really one of the key factors improving of productivities. Experience of NURIFAR (2013)[19] showed that local varieties usually yield around 4t/ha compared to around 4.5-5 t/ha of the local introduced varieties, and around 5-5.5 t/ha for MV.

Many farmers reported that their paddy soil condition is still good because they have applied limited of inorganic fertilizer in their field, and hence the soil was not degraded.

Nearly all rice sufficient farmers interviewed realized that the health of their children has improved and are able to access to better and more meat, eggs, and vegetables resulting from rice sufficiency, more income from rice and other cash crop, better accessible to markets, and more livestock raising. Some farmers sold their livestock to buy better agricultural equipment, and to pay for children's schooling. Another reason for livestock reduction is disease outbreak. Most farmers interviewed have their own two-wheel tractor and livelihood comfort items such as motorbikes, radio, TV, etc.

The majority of farmers also access to farming information from District Agriculture and Forestry Extension Office (DAFEO) staff, development projects, TV and radio; however, many farmers

[19] NAFRI, 2013. End term review of NURIFAR project. NAFRI, MAF

hesitate to adopt new technologies as they have been embedded in conventional practices and risk of change can be high.

Role of women

The PRA ToR specifically required to investigate gender-related issues, more specifically the "status of women in the society and their contribution in the existing farming system" [20]: gendered market mapping and other tools are used to better understand the role that women play and to identify strategies to increase their skills, economic and social leadership as well as strengthen their position in a value chain.

The research carried out in the end of November – beginning of December 2013 used different tools to assess gender roles within the rice farming practices. These provided some insights on workload as well as information on productive/reproductive roles and access/control of key resources.

Access to natural and productive resources is mostly shared between men and women, although motorized power is dominated by men for land and the role of women is concentrated on livestock raising. Control of resources such as land, irrigation, motorized power, and management of labor force is heavily dominated by men. Women's role, on the other hand, is raising, feeding and taking care of the livestock.

Table 16: Access to and Control of Natural Productive Resources

RESOURCES	Access to		Control of	
	Men	Women	Men	Women
Land (Tenure)	√√	√	√√	√
Irrigation	√	√	√√	
Production fields	√	√	√	√
Livestock for motive power	√√	√	√√	√
Livestock for raising purposes	√	√√	√	√√
Fodder, grazing land	√	√	√	√
Seeds	√	√	√	√
Supplies (fertilizers, pesticides)	√	√	√	√
Production Tools	√	√	√	√
Labour force	√	√	√√	√
Decision on management practices	√√	√	√√	√

Source: PRA survey, 2013

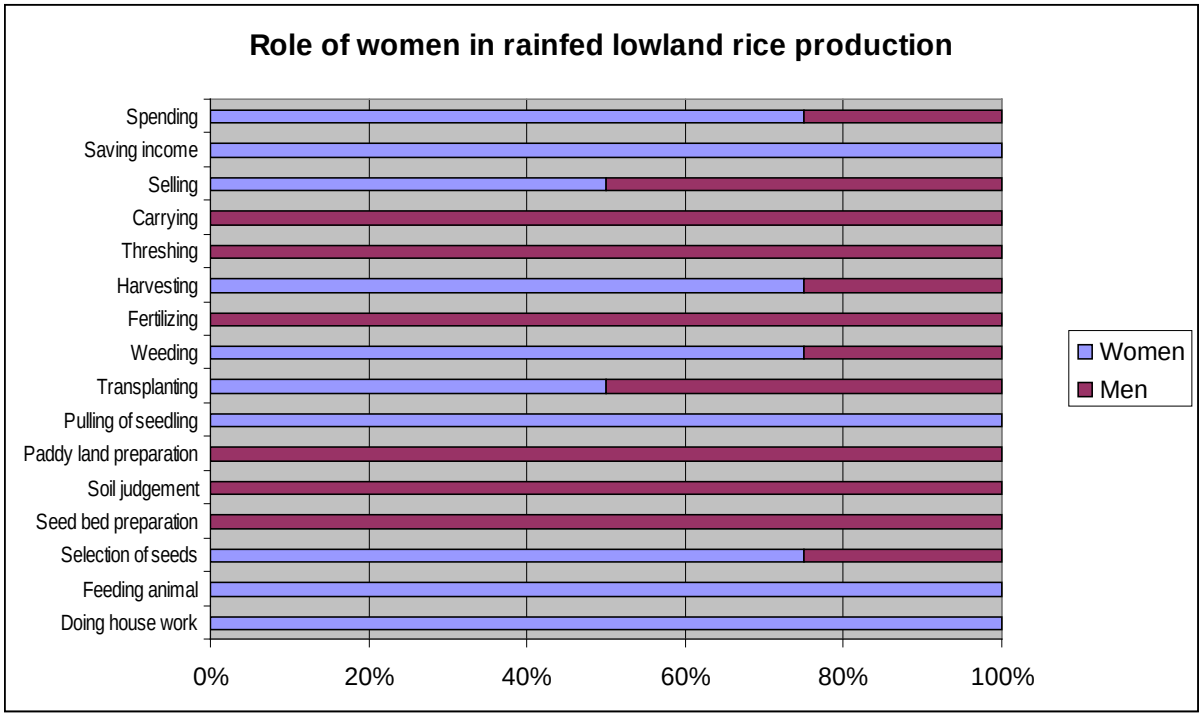
One of the concerns in development literature is that rice technology interventions may have intrinsic biases that favor male-headed households relative to female-headed households. The

[20] PRA ToR

PRA illustrated that the adoption of rice technologies has a broadly gender-neutral effect. There is no apparent built-in bias in the nature of technologies that disadvantages the female-headed households. The results of the PRA confirm that there is no clear labor division between men and women besides hard labor for men and time-consuming, light labor for women.

Mostly, women do house work, feeding animals, pulling of seedlings and managing income from the sale of rice while men prepare and inspect land for rice cultivation. Men also handle hand tools and machinery for threshing and the transportation of rice. Other tasks, for example transplanting, weeding and harvesting are shared between men and women.

Figure 6: Role of Women in Rainfed Lowland Rice Production



Source: PRA field survey, 2013

9. Provincial Enabling Environment

Since 2000, with increased rice sufficiency at the national level, food security strictly measured as availability or rice access to rice is no longer a problem in an aggregate sense, but rather a localized problem mainly in Northern provinces where lowland areas are limited. While the Lao PDR is vulnerable to extreme climatic events, according to an analysis by NAFRI in 2013, in the 'Evolving Rice Markets in the Northern Upland' report, due to the expansion of rice production, despite the nature of the local climatic events, Lao PDR is still able to produce enough rice for its domestic demand at the national level, and produce a surplus that can be exported. This result shows that food security support programmes related to rice availability only need to target specific groups and locations and need to include integral safety net and disaster preparedness elements.

Currently, as a top-down rice production policy, local governments in identified provinces have very little difference in specific strategies on rice production. Improvement of infrastructure on maintenance and expansion of irrigated areas, improvement of productivity through introducing of high yielding varieties and technologies, fastening the land allocation for stable production areas and occupation, and production of cash crop and livestock are the main current related policies For smallholder farmers, particularly in rainfed lowlands, several enabling environment challenges have been addressed. The sections below are mainly based on field observations and EMC key findings inferred from the PRA that has been conducted in the three provinces.

For smallholder farmers

- With the government Samsang approach[21], local governments focus on smallholder rice farmers so they can have more access to rice technology and credit. Nayobai bank, Agriculture Promotion Bank (APB), and other state banks provide small amounts of loan to smallholder farmers with a maximum of 5 million kip per household with 13% of interest over 1 year. However, the responses to the loans are not very satisfying. The loan was taken by some producer groups, but many groups are weak and the farmers in the groups are not interested to take the loans due to their risk aversion attitude. Besides, the farmers think that the repaid period of the loan is too short and the interest is too high.

- To have better link to rice markets, identified provinces are promoting one MV rice variety for one district to meet private company demand through contract farming and improvement of productivity; however, improvement of the awareness and adoption of rice production technologies, rice seeds needs further efforts from local governments. Even though relying on just one variety it's a risky strategy, however this approach, promoted by local PAFO (e.g. Luang Prabang PAFO), is market-oriented and meets the requirements of private companies.

- Fresh quality seeds, in the form of rice seeds bank, soybean, and vegetable seeds were also provided, in combination with rice technologies, through the supports of development projects to some smallholder farmers, especially to the ones with limited land for rice farming. In this way, it could be possible to improve productivity through better quality seeds and in the meantime farmers could grow other crops and vegetable during the dry season to support their income.

- Some ethnic minority smallholders were encouraged to raise livestock e.g. poultry and pigs through revolving fund of about 5-8 million kip per village as well as replacing rice with cash crop production. In many rainfed lowland rice areas, many landless farmers have changed to other income generation occupations.

- Recognizing some competitive advantage of local conditions and rice varieties, some organic rice production is promoted in Xieng Khuang province. For example, the promotion by the Xieng Khuang PAFO mainly focuses on the organic Khao Kainoy. Another "push" effect is from the regional integration to meet demand from export markets in the ASEAN Economic Community (AEC). However, the technologies have

[21]Samsang (three formulations), a political driven development approach has been piloted in considered poor districts started in late 2012. Formulation of Provinces as Strategic Units, Districts as Planning-Finance Units, Villages as Implementing Units

not been widely disseminated and adopted by farmers mostly due to slow return on change, inadequate labor, and limited markets.

- Some rice variety and technical improvement trials are implemented to better suit with the local situation particularly, for better seeds. The PAFO officers in the targeted provinces highlighted that they are supporting the selection of seeds that suit the local temperature, for instance to choose the seeds that are tolerant to the cold weather in the northern region.

Options for livelihood generation

- Rice insufficiency occurs more in rural areas resulting from resettlement of villages because they do not have enough land for paddy plantation, hence the local governments have allocated land for these new and relocated households. The allocation is implemented and supervised by district authorities.

- Promote smallholder or landless to explore the new land for paddy rice, cultivate cash crops for markets e.g. maize, job's tear, coffee, etc. For low labor HHs, certain areas promote livestock (poultry and cattle) raising.

- Some forage techniques for cattle and buffalo raising were promoted by local governments (Luang Prabang and Xieng Khuang) as livelihood generation options

- Few farmers without land are encouraged to rent from others particularly from their relatives who do not want to grow rice in that season. Local governments also promote expansion of paddy rice area where water is available.

Gender considerations

- There is no specific gender consideration in local policy related to rice production.

- Women participation is mostly supported through project-driven activities, for instance via CMI and JICA projects. Some projects indicate that at least 30% of participants to the trainings, workshops, activities must be women. Gender balance and equal participation in rice breeding and SRI trainings is also promoted within some projects.

- As mentioned, there is no clear labor division between men and women on rainfed lowland rice production; however, similarly to men, if provided, women are able to participate in technical training, workshops, cross visits, study tours, etc. to enrich their capacity and mobilization of resources. Several rice producing groups in Xieng Khuang province have female head and association committee to operate and manage the group. In addition, women are more capable in terms of managing fund, linking to markets and liaising with stakeholders, etc.

- While local governments have provided support such as encouraging use of good quality rice seeds, introducing better suitable rice production technologies, which are easily to adapt and adopt by farmers, additional efforts are needed to improve women capacity to undertake advocacy and resources for their economic empowerment. For example,

technical and managerial training on rice related to women's roles such as managing livestock, managing rice marketing, sales and income could be provided to women in both short and long term on the job trainings to improve their productivity, as well as involving women in farmers to farmers' technology transferring activities.

Advocacy Activities opportunities

- In terms of potential opportunities and 'quick wins' for advocacy activities for using of SRI, since the SRI system has been introduced in some areas, there are some good lessons learnt by both local government and farmers. However, the technology should

  be well demonstrated and introduced in areas where there is sufficient local condition (such as areas with sufficient water resources, suitable rice varieties, monitoring and supports, etc.) with a focus on local demand driven for sustainability purposes.

- Working with farmer experts (e.g. LEAP trained farmers for trainers) expert in rice production technologies, and involved in previous SRI Extension Projects is a 'quick win' opportunities. The key intervention should be educating farmers about ways to change their practices to improve quality. By facilitating farmer to farmer participatory learning through demonstration plots, ToT and farmers' champions, it will be possible to roll out agricultural farming best practices. By using gender scheme (gender mixed, women to women, man to man) it will be also possible to reach an extensive coverage and a balance man/women pool.

- By encouraging cross-regional or provincial relationships among farmers it would also be possible to promote improved market access and technical skills.

  Hosting a trip of farmers to a different area to meet with other farmers using best farming techniques is a useful way to increase knowledge. Attendees could witness new and improved production techniques, different ways to manage their farm, and meet with successful famers to see how they plan and have invested in their operation. Participants might also learn more about market linkages and may obtain ideas on solving technical and other issues. All of these would be would be instrumental in promoting adaptations.

- Some PAFOs (e.g. Luang Prabang PAFO) has considerable capacities and experiences in introducing SRI technologies and could be leveraged for a further extension and introduction of the SRI in the future.

  In order to strengthen and supplement the above training, it would be possible to facilitate the creation of linkages between different PAFOs and famers (expert vs not expert) via facilitated workshops. Workshops and seminars that include farmers, local authorities and others across the chain (e.g. local input suppliers, traders etc) would provide a virtual platform for linking the value chain participants with high-quality technical advice and support.

Farmer cooperatives

- Decree on Association, No. 115/PM provides very top-down forum for local government to direct the farmers groups, association and cooperatives with the purpose of collective

action under supervision of local authorities. In reality, however, many groups are not active as limited support has been provided.

- With the government Samsang approaches, formation and strengthening of farmers group has been focused in some target villages; however, most of these groups are politically based and in reality not very active.

- Some farmers groups are formed in order to access credit from banks and inputs, such as seed and fertilizer, from traders. Some producer groups on rice seeds production have been formed and are supervised by District Agriculture and Forestry Extension Office (DAFEO). Many groups are formed by the development projects such as LEAP. However there is a sustainability struggle, meaning that many of the groups do not gain sufficient income and the incentive to encourage members to maintain membership is

  not high. Group formation is a cost-effective way to disseminate the production technologies, but the group committees' ability to manage the group, to create market links, and to implement collective actions have been rarely seen to be successful.

- With the strategy of the new department, Department of Agriculture Extension and Cooperative (DAEC), provinces are promoting farmer groups, cooperatives, association, collective action; however, as this is still new to Laos, limited progress has been achieved.

- There are no clear strategies on how women can improve their role through the current existing farmers cooperatives.

- Farmer to farmers is a cost-efficient approach to transfer rice technologies. New extension approach requires strong collaborating framework for technologies, group production and marketing.

Capacity building and extension of rice technologies

- With limited budget, rice production training is normally propagated/promoted twice a year in some limited target villages and similarly, for the demonstration of organic and bio-fertilizer

- The SRI technologies were first introduced in 2007 by JICA funded project, Pronet - SRI Extension Project in Luang Prabang (2007-2010). Project driven approach to transfer any rice production technologies has to be carefully delivered in order to sustain its adoption

- Limited number of projects are currently working on rainfed lowland rice production and extension e.g. Institut de Recherche Agricole pour le Développement (IRAD)[22] (2012-2017) while some government funded projects focus more on improvement of rice productivity under climate change challenges

[22]Improving the Resilience of the Agricultural Sector in Lao PDR to Climate Change Impacts

- District Agriculture and Forestry Extension Office (DAFEO) staffs are based in some target villages and clusters to monitor and provide technical services to farmers. However, limited technical expertise, capacity, and budget have limited their impact.

- Some organic fertilizer and pesticide techniques were given to farmers in some districts; for instance, in Xieng Khuang province, LEAP, and Sustainable Agriculture and Environment Development Association (SAEDA) who have been promoting the organic agriculture in the last 5 years; however, actual adoption is limited. Some sustainable agriculture farmer experts have been trained by a number of development projects; however, only a limited number of farmers adopt the technologies. Improvement of rice production technology dissemination through good demonstration, ensuring market access and price is very necessary

- With limited financial supports from government, trainings and technical extension from DAFEO has been lacking. Previous reliance on projects for financial support makes it difficult for PAFO/DAFEO to continue activities once the project has finished. .

- Promotion of mechanization on rice production has not been implemented. Extension materials on rice production, seeds, SRI, IPM, are seriously insufficient at PAFEO and local communities. Many farmers in main rice production areas have not had access to mechanization technologies.

10. Conclusions

The results presented in this report demonstrate the existing rainfed lowland rice ecosystem in Lao PDR. Even though at national level, there has been reported rice self-sufficiency since 2000, this report addresses the challenges in local areas, mainly in the Northern provinces where lowland areas are limited.

The Government of Lao PDR's ambitious goal is to increase rainfed lowland rice productivity from 3.7 mt/ha in 2012 to around 4.5 mt/ha in 2015. There are many factors which cause constraints to production, such as limited access to and inappropriate use of production technologies and inputs, insufficient infrastructure, and natural disasters (such as floods and drought) which may be exacerbated by climate change.

Luang Prabang, Xayabuly and Xieng Khuang provinces have experimented with SRI in the past five years. However, the adaptation is considered not successful in many ways due to the limited support and lack of thorough understanding of technologies. Government and project driven approaches do not ensure that the introduced technologies will be sustainably adopted by farmers.

Regarding the local enabling environment, besides the current policies relating to improvement of infrastructure on maintenance and expansion of irrigated areas, improvement of productivity through introduction of high yielding varieties and technologies, fastening the land allocation for stable production areas and occupation, and production of cash crop and livestock, there is no clear or specific local government support on rainfed lowland rice production.

At the farm level, many local rainfed lowland farmers have limited access to and adoption of improved rice technologies. Limited local enabling support has been provided to smallholder rice farmers. Currently, the government policy does not highlight any gender considerations; only development projects initiated by development partners pay attention to gender issues in rice production.

Commercialization of rice production is limited as smallholder farmers do not see rice farming as income generation activities and they usually plant rice for family consumption. Even though there is much potential for rice productivity improvement, there is no special consideration or support given to households with female heads, landless persons or ethnic minorities. While local governments have provided certain support such as encouraging use of good quality rice seeds and introducing better rice production technologies (which are easily to adapt and adopt by farmers), additional efforts are needed to improve women's capacity to undertake advocacy and resources for their economic empowerment. For example, technical and managerial training on rice related to women's roles such as managing livestock, managing rice marketing, sales and income could be provided to women in both short and long term on the job training to improve their productivity, as well as involving women in farmers to farmers' technology transferring activities.

11. Recommendations

Since the SRI system has been introduced in certain areas in Lao PDR, there are some good lessons learnt by both local government and farmers. Therefore it is recommended that in the future, the technology should be demonstrated through dedicated workshops in areas with compatible local conditions (such as areas with sufficient water resources, efficient water control and management) with a focus on local demand.

At the moment, SRI local capacity in Lao PDR is still far from being sufficient, very few PAFO's and DAFO's staff have properly learnt the technologies: it's therefore necessary to improve and expand SRI extension tools, materials, trainings and study tours. Additionally, mass media campaigns targeting farmers through radio and television should be financed by local authorities and developmental projects and accompanied by other marketing tools, such as leaflets, brochures and posters.

Together with the introduction of SRI technologies, rice production groups should be trained and strengthened. At the moment, the government is trying to use the rice production group to scale up the rice production technologies; however, the existing production groups have very limited resources and could not produce as expected. Wherever it's possible, it's recommended the creation of group fund (e.g. revolving fund), linking producing groups to markets for income generation from rice, cash crops, livestock, etc.

A clear cost-benefit analysis for adoption of SRI technologies should be presented. The key challenge would be being able to demonstrate the positive effects of properly applying SRI techniques through demonstration trials. Potential recommended demonstration trials would include (but are not limited to) seed germination, good seedbed management, good land preparation, land management (pruning and weeding) and water management. Another recommended technical demonstration trial is on the effects of different rate of fertilizer yielding

with SRI technologies. Suitable variety improvement for SRI technologies should be included. Variety demonstration trials involving MVs, local introduced varieties (local varieties with high yielding) and local varieties (farmers preferred varieties) are recommended specifically in each project target areas.

By involving in the demonstration plots farmer experts, previously involved in SRI Extension Projects, would facilitate "farmer to farmer" participatory learning in order to roll out agricultural farming best practices and their adoptions in areas with similar climates and ecosystems condition. Similar approaches such as farmers' champions, farmers' field schools and field days would contribute to disseminate SRI awareness.

Some PAFOs and DAFOs interviewed are interested in organic rice production. An appropriate solution to adopt SRI technologies (e.g. BE and IPM) with locally available compost organic fertilizer should be demonstrated and introduced.

Even though there has been some lessons learnt on adoption on SRI in Laos, little information has been published and disseminated. A learning alliance on SRI technologies in Laos and in the MRB countries will help promoting the SRI technologies. Establishing a regional network to study the variability and constraints which are limiting SRI dissemination[23] would be a great mean to increase regional and local awareness.

Moreover, it would be possible to set up multi-country evaluations of SRI on yield, water use efficiency, and socio-economic impacts to support and spread positive views on SRI. Through facilitating the collaboration among regional and national research institutes, as well as main development actors (including but not limited to FAO, World Bank) it will be possible to sustain the SRI momentum in order to facilitate mutual learning through regular regional exchanges.[24]

The challenge to adapt towards enhanced climate resilience requires a considerable technical, policy and institutional effort and has to be set as a priority in each national, regional and global agenda. It is necessary to initiate a more inclusive regional collaboration with all the stakeholders in the MRB countries in order to cope with these challenges.

[23] Mishra A., Kumar P, 2009, "Southeast Asia Regional Knowledge Exchange on SRI Southeast Asia Regional Knowledge Exchange on SRI - Producing More with Less Water Producing More with Less Water", AIT, Bangkok, Thailand
[24] Ibidem.

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Annexes

Annex 1. Summary of Rice Production Statistics in the Lao PDR 2012

	Irrigated 2011-2012				Rainfed Lowland 2012				Rainfed Upland 2012				Total			
Province	Planted area (ha)	Harvested area (ha)	Yield (t/ha)	Production (t)	Planted area (ha)	Harvested area (ha)	Yield (t/ha)	Production (t)	Planted area (ha)	Harvested area (ha)	Yield (t/ha)	Production (t)	Planted area (ha)	Harvested area (ha)	Yield (t/ha)	Production (t)
Northern	**9,933**	**9,932**	**4.17**	**41,460**	**104,560**	**104,422**	**4.39**	**458,740**	**87,858**	**87,790**	**1.82**	**159,544**	**202,351**	**202,144**	**3.26**	**659,744**
Pongsaly	203	203	4.41	895	7,209	7,209	4.66	33,600	11,170	11,170	1.59	17,736	18,582	18,582	**2.81**	52,231
Luang Namtha	519	519	4.49	2,330	11,592	11,592	4.39	50,845	4,644	4,644	1.90	8,820	16,755	16,755	**3.70**	61,995
Oudomxay	536	536	3.43	1,840	14,157	14,157	4.17	59,100	9,922	9,922	1.62	16,081	24,615	24,615	**3.13**	77,021
Bokeo	2,589	2,589	4.71	12,200	14,590	14,590	4.45	64,945	8,742	8,742	1.93	16,903	25,921	25,921	**3.63**	94,048
Luang Prabang	1,313	1,313	3.03	3980	13,731	13,593	4.10	55,790	21,693	21,625	1.48	32,055	36,737	36,531	**2.51**	91,825
Houaphan	1,876	1,876	4.07	7,630	11,840	11,840	4.60	54,435	16,415	16,415	2.24	36,825	30,131	30,131	**3.28**	98,890
Sayabouly	2,897	2,896	4.35	12,585	31,441	31,441	4.45	140,025	15,272	15,272	2.04	31,124	49,610	49,609	**3.70**	183,734
Central	**73,453**	**73,384**	**4.68**	**343,745**	**399,720**	**396,871**	**3.80**	**1,508,375**	**21,061**	**21,061**	**1.81**	**38,202**	**494,234**	**491,316**	**3.85**	**1,890,322**
Vientiane Capital	20,831	20,762	4.86	100,945	55,641	55,548	4.35	241,645	0	0	-	0	76,472	75,539	**4.54**	342,590
Xiengkhouang	100	100	3.65	365	21,055	21,045	4.21	88,595	8,502	8,502	2.00	17,030	29,657	29,647	**3.58**	105,990
Vientiane Province	6,612	6,612	4.36	28,850	53,017	52,031	4.43	230,430	7,073	7,073	1.64	11,570	66,702	65,716	**4.12**	270,850
Bolikhamxay	5,180	5,180	5.68	29,405	35,516	33,756	3.70	124,945	3,388	3,388	1.80	6,113	44,084	42,324	**3.79**	160,463
Khammouane	9,444	9,444	4.79	45,265	61,374	61,374	3.39	208,160	681	681	1.98	1,350	71,499	71,499	**3.56**	254,775
Savannakhet	31,286	31,286	4.44	138,915	173,117	173,117	3.55	614,600	1,417	1,417	1.51	2,139	205,820	205,820	**3.67**	755,654
Southern	**24,651**	**24,651**	**5.06**	**124,715**	**206,854**	**204,735**	**3.89**	**796,035**	**10,921**	**10,921**	**1.68**	**18,394**	**242,426**	**240,307**	**3.91**	**939,144**
Saravane	10,235	10,235	5.27	53,950	71,279	70,727	3.42	242,000	6,011	6,011	1.53	9,171	87,525	86,973	**3.51**	305,121
Xekong	767	767	4.09	3,135	7,528	7,528	3.90	29,370	2,784	2,784	1.96	5,463	11,079	11,079	**3.43**	37,968
Champasak	13,241	13,241	5.02	66,490	106,380	104,813	4.38	459,180	0	0	-	0	119,621	118,054	**4.45**	525,670
Attapue	408	408	2.79	1,140	21,667	21,667	3.02	65,485	2,126	2,126	1.77	3,760	24,201	24,201	**2.91**	70,385
Total	**108,037**	**107,967**	**4.72**	**509,920**	**711,134**	**706,028**	**3.91**	**2,763,150**	**119,840**	**119,772**	**1.80**	**216,140**	**939,011**	**933,767**	**3.74**	**3,489,210**