Boosting Yields, Raising Incomes, and Offering Climate-Smart Options: The System of Rice Intensification Paves the Way for Farmers to Become More Successful “Agripreneurs”

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

Final Report

Prepared by Abha Mishra

Disclaimer

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of the ACISAI, AIT and can in no way be taken to reflect the views of the European Union.
Acknowledgment

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About the Project

SRI-LMB, an EU-financed regional project, aimed to contribute towards enhancing the resilience of rainfed farmers confronting climate change variability in the Lower Mekong River Basin (LMB) region. It brought various stakeholders together working at global, regional, national, and local levels. The purpose of the project was to increase crop yield, productivity and profitability on a sustainable basis from smallholder farmers’ rice fields in rainfed areas of the LMB.

The project through its actions addressed the food security and livelihood issues of small farming households by developing adaptive measures against climate change. The project was implemented in four LMB countries: Cambodia, Laos, Vietnam and Thailand. The total period for implementation was 72 months (2013 - 2018), and the total cost of action was approximately 3.4 million Euros, with 85% contribution from the European Union.

The project was led by the ACISAI Center of the Asian Institute of Technology (AIT) and implemented in partnership with FAO, Oxfam, the SRI-Rice Center at Cornell University, and the University of Queensland, together with many national partners coming from ministries, national universities, and NGOs. More can be seen at: http://www.sri-lmb.ait.asia/.

Contact

Dr. Abha Mishra
Project Manager, SRI-LMB
ACISAI Center,
Asian Institute of Technology, Thailand
Phone: +66-2-524-5826
FAX: +6685-323-5828
E-mail: abhamishra@ait.asia

Mr. Jerome Pons
Head of Cooperation
Delegation of the European Union to Thailand
E-mail: Jerome.PONS@eeas.europa.eu
Acronyms

ACISAI  Asian Center of Innovation for Sustainable Agriculture Intensification
AIT    Asian Institute of Technology
DAEC   Department of Agriculture Extension and Cooperative
DTEAP  Department of Technical Extension and Argo-Processing
EU     European Union
EP     Economic Productivity
FAO    Food and Agriculture Organization of the United Nations
FPARs  Farmer’s Participatory Action Research
GDA    General Directorate of Agriculture
GHG    Greenhouse Gases
GOV    Government of Vietnam
LMU    Local Management Unit
MAF    Ministry of Agriculture and Forestry
MAFF   Ministry of Agriculture, Forestry and Fisheries
MARD   Ministry of Agriculture and Rural Development
MoAC   Ministry of Agriculture and Cooperatives
MoE    Ministry of Education
NGO    Non-Government Organization
OA     Oxfam America
PCU    Project Coordination Unit
PMU    Project Management Unit
PPD    Plant Protection Department
PRA    Participatory Rural Appraisal
SRI    System of Rice Intensification
SRI-LMB Sustaining and Enhancing the Momentum for Innovation and Learning around the System of Rice Intensification (SRI) in the Lower Mekong River Basin
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<td>01 January 2013 – 31st December 2018</td>
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<td>3.4 million Euro (EU contributed 85%, AIT 8%, FAO 5%, Oxfam 2%)</td>
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<td><strong>Project partners</strong></td>
<td>AIT, FAO, Oxfam</td>
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<td><strong>Project associates</strong></td>
<td>SRI-Rice, Cornell University; University of Queensland, Australia</td>
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<td><strong>Beneficiaries</strong></td>
<td>Direct: 15,000 farmers (58% women)</td>
</tr>
<tr>
<td></td>
<td>Indirect: 30,000 farmers, 78 ministries staff, 17 researchers, 30 project staff</td>
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<td><strong>Ministries involved</strong></td>
<td>MOE and MoAC, Thailand</td>
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<td>MAF, Lao PDR</td>
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<td><strong>Universities involved</strong></td>
<td>Royal University of Agriculture, Cambodia; Nabong College of Agriculture, Lao PDR; Rajabhat University, Thailand; and Hanoi University of Agriculture, Vietnam</td>
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<td><strong>Number of action-research sites</strong></td>
<td>582</td>
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<td><strong>Number of farmer-led field trials</strong></td>
<td>2,634</td>
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**Impacts**

- > 15,000 farmers trained (> 50% women)
- > 15,000 farmer’s led training conducted
- 52% higher crop yield per hectare
- 70% higher on-farm economic returns
- 64% greater labour productivity
- 59% greater water productivity
- 34% less energy use per hectare
- 14% and 17% lower greenhouse gas (GHG) emissions from irrigated and rainfed cropping, respectively

Executive Summary

Given the challenges presented by climate-change, water shortage and land degradation, sustainable agriculture strategies that increase farming systems’ resilience are needed more than ever. This is especially true for sustaining rice production which is the staple food for hundreds of millions of people, and particularly in rainfed areas which are both flood-prone and drought-prone and thus pervasively food-insecure.

The learning reported here derived from a European Union (EU)-funded regional collaborative project titled “Sustaining and Enhancing the Momentum for Innovation and Learning around the System of Rice Intensification (SRI) in the Lower Mekong River Basin” (SRI-LMB). This involved smallholder farmers, researchers, extension personnel, and development professionals, together with staff of respective government ministries in the Lower Mekong River Basin (LMB) countries: Cambodia, Laos, Thailand and Vietnam (http://www.sri-lmb.ait.asia/).

SRI-LMB was a part of the EU’s 2009-2010 Global Programme on Agricultural Research for Development (ARD) and was funded under its Food Security Thematic Programme (FSTP) Component 1 – Research and Technology. The project was led by the Asian Center of Innovation for Sustainable Agriculture Intensification (ACISAI) at the Asian Institute of Technology (AIT) in Thailand, in partnership with the Food and Agriculture Organization of the United Nations (FAO), Oxfam America, SRI-Rice at Cornell University, USA, and the University of Queensland in Australia. The total cost of action was €3.4 million, and the total implementation period was from 2013-2018.

The main objective of the project was to engage farmers’ participation by educating themselves about System of Rice Intensification (SRI) practices and to facilitate building strong farmer networks at the community level. In contrast with traditional methods of rice cultivation, SRI techniques require less water, seed, manure, and labour and promise higher yield and economic returns. Major activities included exchanging ideas on new or alternative agro-ecological farming techniques, developing low-cost
location-specific technologies through farmer’s participatory action research with profitable harvesting and economic advancement through better market opportunities for rainfed farmers. Documenting the results and sharing them within farming communities and with communities at large through an inclusive participatory process, from local to national and regional levels, was the modus operandi of the project. Evidence-based policy options for more supportive policies were generated through a participatory consultation process working closely with all relevant stakeholders, including policy-makers in the countries.

With the support of ministries and governmental agencies in all four project countries, Cambodia, Laos, Thailand and Vietnam, the project functioned well in building capacity and confidence among farmers. More than 15,000 farmers (> 50% women) participated directly in the farmer-led field trials located in 33 districts of 11 provinces of the four countries, and another 30,000 were reached indirectly. The number of farmer-participatory experiments conducted was more than 1,500: 121 at 60 action-research sites in 2014; 465 at >173 sites in 2015; and then 1,134 at >582 sites in 2016-17.

The results showed that in comparison with the pre-project baseline, SRI practices helped to improve livelihoods and the environment across the LMB region in numerous ways:

- Average rice yield increased by 52%, and net economic returns by 70%,
- Labour productivity was increased by 64%, water productivity by 59%, and fertilizer use-efficiency by 75%.
- The total energy input required for farming operations was decreased by 34%, along with significant reductions in per-hectare net emission of greenhouse gases, respectively by 14% with irrigated rice production, and by 17% in rainfed cropping.

Monitoring of the adaptation response of farmers showed that across the region, a majority of farmers applied two major principles of SRI after receiving season-long training: (1) fewer seedlings or seeds per hill hole, and (2) wider spacing. The average yields reported from farmers’ fields after the FPAR training was in the range of 7-18% more, and average net economic return ranged from 15% to three times more. In comparison to male farmers, women farmers reported higher yields and higher economic returns.
The results of this farmer-participatory research characterized a set of climate-smart agricultural practices that can promote households’ food security and support market-oriented development at low cost, especially in rainfed areas that have not figured out prominently in national development plans.

The SRI-LMB has facilitated the development of informal farmers’ groups in 11 provinces across all four countries. These brought together the 15,000 farmers engaged in the trials and adaptation of new ideas, plus another 30,000 farmers were less directly involved but could be attracted as members based on the good results they witnessed over the past six years.

These groups, if strengthened further, can provide a basis for developing farmer organizations that can accelerate sustainable rice intensification and crop diversification along with market development for smallholders. The strategies to pave the ways for farmers to emerge as more successful ‘agripreneurs” has been discussed and put forwarded as a next phase of SRI-LMB.
1. The CHALLENGES

Understanding the Need

Although global food production over the past half century has managed to keep ahead of global demand, around 1 billion people today still do not have enough to eat, and a further billion lack adequate nutrition.

It was estimated that by 2030, global food demand will increase with 50%. With cultivated land area declining, we must achieve a 40% yield increase for major commodity crops or the food and nutrition situation will worsen (Godfrey et al., 2010). Also, there is concern that meeting the world’s food demand using current input-dependent technologies will further degrade the environment. This will, in turn, undermine the food production systems upon which food security is based.

Increasing food production remains a cornerstone strategy in efforts to alleviate global food insecurity. But since more than enough food is currently being produced in per capita terms to feed the world’s population, increasing food production alone is inadequate to achieve the Sustainable Development Goal of assuring food security for all.

Changing patterns of supply and demand (urbanization) have led to ever greater disparities between wealthy and poor. Globalization has increased the volatility in food prices as eccentric economic shocks can affect the whole food system, and these can be exacerbated by speculative forces able to influence trade at the regional level.

At the individual and household level, food price instability further undermines vulnerable livelihoods. While increasing food production alone is not enough to alleviate global food insecurity, it remains a cornerstone strategy. Why? Because
shortfalls in food supply ramify throughout the world, raising prices and causing shortages that have the most adverse effects on the poor, but hardly affect the wealthy.

A predominant feature of 21st century food systems is that they are inherently cross-level and cross-scale. They are dependent on the functioning of both biogeochemical and socio-economic processes. Further, there are global environment impacts whether through climate change or changing geo-political scenarios which interact with socio-economic dynamics such as poverty, gender inequality, and food prices increases. Their interaction gives rise to a potential ‘storm’ of food insecurity in vulnerable areas. Central to the achievement of sustainability is a recognition of the deeply interlocking nature of economic, social, political and environmental factors. This calls for integrated and multidisciplinary analyses, either in terms of finding root causes of crisis or for providing solutions to identified crises.

In particular, there needs to be attention given to agrarian economies where food insecurity is linked to poverty, and where most of the poor people are directly dependent on agriculture for their livelihoods. This is particularly relevant in Asia. According to World Bank analysis, welfare gains from economic growth that originates in the agricultural sector are substantially higher for the poorest households.

As a matter of fact, almost 75% of smallholder households, who operate 85 percent of the total number of agricultural farms, suffer from chronic hunger. A majority of these farmers operate under rainfed conditions, not having access to irrigation facilities, and confront an increasingly degraded natural resource base and climate-change variability. This puts additional pressure on them for maintaining livelihoods and household food security. Growth in the agricultural sector is thus essential for eradicating hunger and poverty.

Large increases in the amount of water and other physical inputs are needed to achieve this goal under a ‘business as usual’ scenario. No sector consumes as much fresh water as agriculture. Scenario analysis shows that approximately 7100 km$^3$ year$^{-1}$ are consumed globally to produce enough food for the world. Of this amount, 5500 km$^3$ year$^{-1}$ are used in rainfed systems and 1600 km$^3$ year$^{-1}$ in irrigated systems. Analysis also shows that much larger amounts of water will be required to produce enough food by 2050, projections ranging from 8500 km$^3$ year$^{-1}$ to 11000 km$^3$ year$^{-1}$, increases of between 20% and 55%, depending on assumptions made about what improvements in water productivity are achievable in rainfed and irrigated agricultural systems. This
increase much be achieved when many countries are already experiencing an insufficiency in their supply of water resources.

Current irrigation water withdrawals already cause great stress for people in many of the world’s major river basins (Moll et al., 2007). There is stiff competition between industries and agriculture for water, so there is little scope for expansion of large-scale irrigation schemes. Climate change may further impede attempts to supply increased water for agriculture due to expected declines in rainfall and amplification of extreme events (IPCC, 2007).

Limitations on fertile land are another major constraint, along with excessive use of agrochemicals that affect soil health and water quality are factors constraining desired growth in agricultural production to meet future demand. Other trends, such as increasing pesticide resistance among pests, spreading feminization of agriculture, and falling investment in agricultural research and development, further make the task of doubling food production in the decades ahead more challenging under a climate-change scenario, especially if our mentalities and actions assume ‘business as usual’.

Finding ways to produce ‘more output with less input’ while conserving our natural resources is an approach for agricultural R&D that aims for both accelerated agricultural growth and food security for the rural poor, as well as prosperity for national economies. There is broad agreement that there are significant ‘yield gaps’ at the field level, with actual production lagging behind what has been shown to be possible. This gap is more significant in rainfed areas, which are home for the majority of the poor farmers who are struggling to ensure food security at individual and household levels. Efforts to grow more with less and to conserving the quantity and quality of natural resources are evident in the public and private sectors in many countries, although to date mostly in irrigated areas. This disparity is evident in the Lower Mekong region.

**Food producers are food-insecure**

The Mekong River basin is one of the most dynamic, productive and diverse river basins in the world. It is home to approximately 65 million inhabitants, most of them are rural poor with livelihoods directly dependent on the availability of water for their production of food. The total area of the Basin is 795,000 km², draining parts of six countries: China, Myanmar, Laos, Thailand, Cambodia and Vietnam. The parts of the basin in China and Myanmar are known as the Upper Mekong Basin, and the lower
parts, including areas of the other four countries, are known as the Lower Mekong Basin (LMB), which occupies approximately 76% of total basin area. Sixty million of the 65 million persons living within the Mekong River Basin reside in the Lower basin, mostly in rainfed areas. One-third of them live on less than a dollar per day and directly rely on agriculture for their food and livelihoods.

Agriculture along with fishing and forestry employs 90% of the people living in the Lower Basin, mostly on a subsistence level or not much above. Rice is the most important crop in this region. Approximately 22 million hectares of land are devoted to rice cultivation in the LMB with about 90% of this rainfed. This area is characterized by seasonal flooding and drought, low cation exchange capacity and organic matter in the soil, with resulting low productivity. In addition to weather variability and the resulting water uncertainty, limited agricultural assets, low crop yields, low purchasing power, and fluctuating market prices put additional pressure on these households to maintain their food security. Farmers operate with limited cash flow so they must carefully weigh the risks of adopting more costly farming techniques given their level of uncertainty.

The nature and characteristics of food insecurity vary in the four LMB countries. A broadly-accepted definition of its converse, food security, is the definition offered by the World Food Program in 1996:

“...when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”.

By such criteria, complete food security is rarely achieved. It is an ideal to be striven for. It needs to be considered somewhat differently at different levels of society: globally, regionally, nationally, locally, as well as at the level of the household and the individual.

Food security also needs to be considered in relation to the types of risks that generate food insecurity and whether they are likely to be temporary, seasonal, or chronic. We used food security as an operational concept for summarily and specifically addressing the regional needs as well as an evolving concept that can guide recommendations for future intervention.
Recent trends of food security in the Lower Mekong Basin: Rice farmers still left behind

Recent data on food insecurity as measured by the Global Hunger Index indicate that over the last two decades there has been some strengthening of food security at national level (FAO, IFAD and WFP 2015). However, the food security situation is still very poor in Cambodia and in Lao PDR. While the situation is better in Thailand and Vietnam with relatively well-developed government capacity and infrastructure, transient food insecurity is still common at the household level in these countries also (Fullbrook, 2013).

Population by 2030 is projected to grow by 25% in Cambodia and Lao PDR and by 15% in Vietnam. In addition, urban population has increased throughout the Mekong region and is expected to increase significantly in years to come. Poverty which often exposes people to weakened food security and which by and large remains concentrated in the countryside will probably become a more urban phenomenon and will present different challenges for food security.

This has implications for agrarian societies since most of their farmers, especially smallholder rice farmers, are moving away from agriculture and are migrating to city areas for better livelihood. Additionally, the high cost of food relative to wages leaves many people vulnerable to rapid swings in their food-security status. What is unclear is whether trends in work and migration will leave too few people in the countryside to farm enough produce to ensure the food security of urban and rural poor.

There is also a great concern about the production methods employed. For example, Thailand’s food security from its agricultural sector is highly dependent on imported inputs such as seeds, fertilizers and fuel, and it is threatened by the prospect of a sharp contraction in the agricultural labour force as aging farmers are not being replaced by the next generation. Moreover, adverse climate changes will further compound these multiple pressures and can put all four countries in a state of food insecurity.
A further analysis of food-security status in the region indicates that food security is a serious concern for the people who are engaged in food production. Even as poverty is decreasing overall in the Mekong Basin, the poorest households remained poor, and this is most evident in the rainfed areas of the region. Livelihood in these areas is clearly linked to water availability with the majority of villagers engaging in crop farming, mainly rice, and fishing. Large-scale Mekong water diversion, which is intensifying, can add another dimension to overall food insecurity of the region.

Knowing that location-specific, low-cost technological options are available and can increase productivity and resource-use efficiency, contributing towards food security without further increasing pressure on land and other resources, SRI-LMB was launched in 2013.
2. **Tackling Household Food Insecurity**

Addressing smallholder farmers’ needs by launching SRI-LMB

This regional collaborative project was formulated in 2012 and implemented from 2013-2018 in rainfed areas of the four Lower Mekong River Basin countries: Cambodia, Laos, Vietnam and Thailand. The project was led by the Asian Center of Innovation for Sustainable Agriculture Intensification (ACISAI, www.acisai.ait.ac.th), Asian Institute of Technology (AIT, www://www.ait.asia), Thailand.

The project was implemented in partnership with the Food and Agriculture Organization (FAO), Oxfam America (OA), SRI-Rice at Cornell University in USA, and the University of Queensland in Australia together with key ministries in Cambodia, Laos, Thailand and Vietnam. The action engaged smallholder rice farmers (including especially women and landless), researchers, extension personnel, and development professionals along with staff of government ministries in these countries (http://www.sri-lmb.ait.asia/).

**SRI-LMB was funded under the EU’s 2009-2010 Global Programme on Agricultural Research for Development (ARD), Food Security Thematic Programme (FSTP), Component 1 - Research and Technology**

*Budget line: 21.02.01 for food security*
3. IMPLEMENTING: MAKING KNOWLEDGE MORE EFFECTIVE

Objectives, Purpose, Activities, and Outputs for action

Project action aimed to enhance the resilience of rainfed smallholder farmers and farming communities confronted with climate change and other challenges by stimulating and supporting local innovation through farmers’ participatory action research (FPAR) and by strengthening and expanding collaboration among farming communities, agricultural professionals, researchers, NGOs, governments, and national and international organizations. The project partners stimulated and supported local innovation using the System of Rice Intensification (SRI) ideas. In contrast with traditional methods of rice cultivation, SRI techniques require less water, less seed, less manure, less labour, and give higher yields and returns.

Figure 1: SRI-LMB program’s Objective, Purpose, and Outputs
Major activities, elaborated later in this report, included exchanging ideas on SRI and on new or alternative agro-ecological farming techniques, developing low-cost, location-specific technologies with profitable harvesting and increasing economic opportunities with better market needs for rainfed farmers. (*For specific project activities, see Figure 2*). Documenting the results and sharing them with the immediate farming community and communities at large through an inclusive participatory process from local levels to national and regional levels represented the modus operandi of the project. Evidence-based policy options for better policies was generated through a participatory consultation process working closely with all relevant stakeholders, including policy-makers in the respective countries.

**Figure 2: SRI-LMB activities**
4. Harnessing the Potential of Rainfed Agriculture

SRI-LMB implementation in rainfed areas of the four LMB countries: Cambodia, Lao PDR, Thailand and Vietnam

Eleven food-insecure provinces in peninsular Southeast Asia – 3 each in Cambodia, Laos, and Thailand, and 2 in Vietnam -- were selected for this study by the relevant government ministries which implemented the field training-cum-adaptive research programme in all four countries. Names of the implementing ministries are given in the SRI-LMB Partnership section of this report.

In each province, 3 districts were selected, making a total of 33 districts throughout the region. Of these, 27 districts were entirely rainfed, whereas farmers in six districts (3 in Thailand and 3 in Vietnam) have some access to irrigation facilities at some FPAR sites (See Figure 3). This made for more instructive comparative evaluation.
Figure 3: SRI-LMB across all four LMB countries showing action-research sites, 11 provinces and 33 districts in the Lower Mekong Basin region.
**Table 1:** Names of the districts and provinces where SRI-LMB was implemented from 2014-2018

<table>
<thead>
<tr>
<th>Country</th>
<th>Province</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAMBODIA</strong></td>
<td>Kampong Speu province</td>
<td>Samrong Tong, Korng Pisei, and Borseth</td>
</tr>
<tr>
<td></td>
<td>Kampot province</td>
<td>Chhouk, Chum Kiri, and Angkor Chey</td>
</tr>
<tr>
<td></td>
<td>Takeo province</td>
<td>Bati, Tramkok, and Prey Kabas</td>
</tr>
<tr>
<td><strong>LAO PDR</strong></td>
<td>Vientiane province</td>
<td>Vangvieng, Fuang, and Meun</td>
</tr>
<tr>
<td></td>
<td>Khammouane province</td>
<td>Gnommalat, Mahasay, and Nakai</td>
</tr>
<tr>
<td></td>
<td>Savannakhet</td>
<td>Champone, Songkhone, and Xonnabouly</td>
</tr>
<tr>
<td><strong>THAILAND</strong></td>
<td>Uttaradit</td>
<td>Bankok, Faktha, Nampad, Tron, and Pichai, Suirum</td>
</tr>
<tr>
<td></td>
<td>Sisaket</td>
<td>Uthumpornpisai, Kantalalak, Posisuwan, and Kukan</td>
</tr>
<tr>
<td><strong>VITENAM</strong></td>
<td>Bac Giang</td>
<td>Yen The, Luc Nam, and Lang Giang</td>
</tr>
<tr>
<td></td>
<td>Ha Tinh</td>
<td>Loc Ha, Thach Ha, and Can Loc</td>
</tr>
</tbody>
</table>
5. COLLABORATING FOR INNOVATION AND KNOWLEDGE CO-GENERATION

SRI-LMB partnership

The project was led by the Asian Center of Innovation for Sustainable Agriculture Intensification (ACISAI), Asian Institute of Technology (AIT), Thailand, in partnership with the Food and Agriculture Organization of the United Nations (FAO), Oxfam America, SRI-Rice at Cornell University in USA, the University of Queensland in Australia, together with key ministries. These were, respectively, the Ministry of Agriculture, Forestry and Fisheries (MAFF) in Cambodia, the Ministry of Education (MoE) and the Ministry of Agriculture and Cooperatives (MoAC) in Thailand, the Ministry of Agriculture and Rural Development (MARD) in Vietnam, and the Ministry of Agriculture and Forestry (MAF) in Lao PDR. In addition, the project also involved four national universities: Royal University of Cambodia, National University of Laos, Hanoi University of Agriculture and Rajabhat University, Thailand.

Figure 4: Key SRI-LMB partners and associates
Table 2: Roles and participation in the action of the various actors and stakeholders (local partners, target groups, local authorities, regional and international actors, etc.)

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Expertise/occupation</th>
<th>Role and responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallholder farmers, farmers’ trainers, women, and landless labourers</td>
<td>Farming for self and society, household tasks and providing labour for farming activities; organizing farmers’ meetings and community resource persons</td>
<td>Active participants in CFPAR and leading partners of FPARs, implementers of FPARs</td>
</tr>
<tr>
<td>Trainers (From agricultural ministries/local NGOs/academic institutes)</td>
<td>Training and extension</td>
<td>Active participants in CFPAR and FPAR; leading local extension personnel facilitated CFPAR &amp; FPAR</td>
</tr>
<tr>
<td>Academics (local)</td>
<td>Teaching and research</td>
<td>Carried out MEL research and monitored CFPAR and FPAR and brought local crop management knowledge and social issues to academic institutions</td>
</tr>
<tr>
<td>Local NGOs</td>
<td>Directly linked to farmers/grass roots, working for development work</td>
<td>Support for implementation (PRA survey work, women and landless training programs)</td>
</tr>
<tr>
<td>GOs (NIPM, MAFF, MAF, MARD, MOAC, MoE and DTEAP)</td>
<td>Expertise and experience in implementing FFS action research; national extension systems</td>
<td>Lead national implementing agencies participated in project activities from beginning, coordinated NIP platform, work with local authorities</td>
</tr>
<tr>
<td>Policy makers</td>
<td>Persons from Agriculture and other relevant ministries</td>
<td>Participated in national workshops and regional workshop deliberations and policy formulation</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Oxfam America</strong></td>
<td>30 years in the region focusing on poverty alleviation, policy dialogue, and advocacy on women’s and landless issues</td>
<td>Research for the involvement of women and landless in FPAR; support to program’s overall policy advocacy work at regional and country level</td>
</tr>
<tr>
<td><strong>FAO IPM Programme, FAO</strong></td>
<td>Long expertise in farmers’ education, action research, and FFS programmes in Asia</td>
<td>Support to farmer participatory action research in implementation through its National IPM networks in Cambodia, Lao PDR and Vietnam</td>
</tr>
<tr>
<td><strong>ACISAI, AIT</strong></td>
<td>50 years of experience in education research and outreach activities in the context of sustainable development in Asia</td>
<td>Research management, implementation, supervision, documentation, project management and coordination and reporting at regional level</td>
</tr>
<tr>
<td><strong>UQ</strong></td>
<td>FFS/IPM experience in Asia</td>
<td>Advisory role: brought long experience on FFS/ action research</td>
</tr>
<tr>
<td><strong>SRI-Rice (Cornell University, USA)</strong></td>
<td>SRI International Network and Resource Centre</td>
<td>Brought extensive SRI experiences from all over the world, closely supervised project work</td>
</tr>
</tbody>
</table>

Note: ACISAI, AIT: Asian Center of Innovation for Sustainable Agriculture Intensification (ACISAI), Asian Institute of Technology (AIT); CFPAR: Central Farmers Participatory Action Research; DTEAP: Department of Technical Extension and Agro-processing; FFS: Farmer’s Field School; FPAR: Farmers Participatory Action Research (FPAR); GO: Government organizations; FAO: Food and Agriculture Organization of the United Nations; IPM: Integrated Pest Management; MAF: Ministry of Agriculture and Forestry, Lao PDR; MAFF: Ministry of Agriculture, Forestry and Fisheries, Cambodia; MARD: Ministry of Agriculture and Rural Development, Vietnam; MOAC: Ministry of Agriculture and Cooperatives, Thailand; MoE: Ministry of Education, Thailand; NIPM: National IPM Programme; NIIP: National Innovation Platform; SRI: System of Rice Intensification; UQ: University of Queensland, Australia.
6. **STRENGTHENING NORTH-SOUTH AND SOUTH-SOUTH PARTNERSHIPS**

**Programme Structure**

To achieve the programme objective through better collaboration at all levels, the SRI-LMB established local, national and regional project management unit (LMU, PMU and PCU, respectively) that led to the development of innovation platforms for implementation, knowledge-sharing and dissemination. These processes of network building and strengthening that were initiated by the project were expected to continue as a common meeting-point at all levels, serving as platforms for facilitating policy dialogue on food security, research for development, marketing improvements, and extension capacity for the rainfed LMB region.

During the tenure of the project, the individuals and organizations that worked with these LMUs, PMUs and PCU got first-hand opportunity to engage in knowledge management and dissemination. Particularly at local levels, farmers, farmer-trainers, and district trainers, along with NGOs and GO staff, were facilitated to articulate local needs and aspirations of farmers into the conduct of the FPAR via their respective local management units (LMUs).

Similarly, LMUs supported the development of ways and means to educate more farmers in their respective communities on the results and outcomes of their participatory action research. They also facilitated wider diffusion of knowledge through various means. In addition, these local groups through their experiences of working with the project acquired greater skills of management, bookkeeping, and various tools and techniques of extension, as well as the art of analysis and interpretation of their own experimentation process and results.

The programme structure at regional, national and local level can be visualized as in Figure 5.
Programme Implementing Consortia

Figure 5: Programme Implementing consortia

ACISAI – Asian Center of Innovation for Sustainable Agriculture Intensification
AIT – Asian Institute of Technology
CFPAR – Central Farmers’ Participatory Action Research
FAO-IPM – Food and Agriculture Organization – Integrated Pest Management
FPAR – Farmers’ Participatory Action Research
GOs – Government Organizations
LIP – Local Innovation platform (possible outcome of the proposed processes)
LMU* – Local Project Management Unit
NGOs – Non-Government Organizations
NIP – National Innovation Platform (possible outcome of the proposed processes)
P1, P2, P3 – Province 1, Province 2, Province 3
PCU – Project Coordination Unit (coordinated by AIT)
PMU – Project Management Unit (coordinated by country offices of FAO-IPM in Cambodia, Laos, and Vietnam, and in Thailand by AIT)
RIP – Regional Innovation Platform (possible outcome of the proposed processes)
SRI-Rice – SRI International Network and Resources Center, Cornell University, USA
UQ – University of Queensland, Australia
7. EXPERIENCES FROM THE FIELD: SRI-LMB ACTIVITIES

7.1 Inception and planning workshops at regional and country level in all four countries and establishment of the programme structure at regional, national and local level

The inception workshop organized in the year 1 of the project achieved the following:

- Launched the project, informed large audience and the media;
- Kick-started project activities;
- Revisited the project documents, goals, and overall work plan;
- Developed country background papers (with information on provinces selected for project activity) and basic information aligning with project activities/work plan discussed;
- Structure of Project Management Units at country level and at local level discussed and developed;
- Country-specific log-frames and budgeting formulated; and
- Regional steering committees formed

Workshop reports and country background papers are available at the following links:


### 7.2 Regional Training of Trainers

A Regional Training of Trainers (ToT) was organized during the inception phase of the project, attended by Project Management Unit (PMU) Coordinators, District Coordinators, Training Experts, Local Management Units (LMUs), and Provincial Coordinators from all four countries: Cambodia, Vietnam, Laos and Thailand, and by regional partners, FAO and Oxfam. The training highlighted the project’s goals and work along with country-specific implementation issues. Also, it developed common understanding among participants about the concept and principles of SRI and its relevance for rice farmers in rainfed production.
In addition, the ToT aimed to familiarize and strengthen the scientific capacity for experimental design, implementation and analysis, including a clear-cut understanding among participants about the concept of participatory action research. Other objectives were to agree upon the country-specific criteria for selection of districts, villages, CFPAR sites and farmers, for field-level intervention and to develop the design of the field-school diaries suitable for chosen provinces. The CFPAR process and its concept were developed and the definition of SRI was established based on key issues identified for the field intervention for development of location-specific solutions.

For more, visit http://sri-lmb.ait.asia/resources/past.php

**7.3 Visualization of pre-project scenarios, conducting of training programs, and formulation of location-specific activities for capacity-building intervention**

### 7.1.1 Participatory Rural Appraisal (PRA)

Prior to commencement of the Central Farmers’ Participatory Action Research (CFPAR) and Farmers’ Participatory Action Research (FPAR) field experimentation, participatory rural appraisal (PRA), and baseline surveys were done in each identified FPAR district with the objective of visualizing the pre-project scenario and for establishing criteria for selecting village and farmer, landless and women participants. The PRA survey captured country-level data in the following key areas:

- Existing farm management practices in identified provinces, and farm productivity in rainfed ecosystem;
- Socio-economic status of the smallholder farmers; Existing government policies supporting smallholder farmers (or lack of same) and their implementation at provincial level;
- Livelihood-generation options for landless (or lack of same) and government policies;
- Status of women in the society and their contribution in the existing farming systems, associated benefits (or lack of same) and current government policy;
- Capacity of women to undertake advocacy and resource mobilization for their economic empowerment; Potential opportunities and ‘quick wins’ for advocacy activities.
PRA Highlights:

**Existing farm management practices**
Low crop productivity is due to 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. The costs of land preparation, transplanting and harvesting (Labour costs) and of chemicals (Thailand and Vietnam) are considered to be the main input costs for rainfed lowland rice production. Some farmers reported rice insufficiency (Cambodia and Lao PDR) 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.

**Existing government policies supporting smallholder farmers**
Existing government policies are: 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; and 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 except Thailand. 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.

**Status of women in the society and their capacity to undertake advocacy and resource mobilization for their economic empowerment**
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. 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. Technical and managerial on-the-job trainings on rice related
PRA reports, one from each country, are available at the following links:


7.1.2 Baseline survey

A series of activities were undertaken in the 11 selected provinces after June 2013. These included the scoping visits of provinces to meet the local ministry officials, trainers and farmers; visits to farmers’ fields and discussions with farmers on their challenges and opportunities. These provided inputs for the development of baseline survey questionnaires. Subsequently, the survey was carried out in 33 selected districts of these 11 provinces, involving 33 district trainers and 20-30 farmers per district.

A representative sample of farms was selected from each identified FPAR district in terms of farm resources, area, and crop type. The respective farmers were surveyed using a semi-structured questionnaire designed for the purpose. The questionnaire was developed and adapted according to country-specific needs prior to pre-testing at village level. Questions were asked about general household information, farm characteristics, and socio-economic conditions, access to productive capital, agricultural practices, production and income, migration patterns, and familiarity with SRI. Baseline report can be accessed at: http://www.sri-lmb.ait.asia/downloads/SRI-LMB_Regional_baseline_report.pdf
Baseline Highlights

- The higher percentage of female farmers participating in Thailand than Cambodia, Laos and Vietnam. At regional level, 37% of the total households surveyed were female farmers. Average age of household head at regional level was 51 years, and 83% of the total farmers were above 41 years old.
- A majority of the household head had either primary or secondary school education across the countries.
- Surveyed farmers had experience in rice cultivations for 22-28 years except in Laos where surveyed farmers had only 7 years of experience on average.
- Rice area per household was higher in Thailand (3.2 ha) followed by Laos (2.0), Cambodia (1.2 ha) and Vietnam (0.62 ha). Average rice yield reported from surveyed farmers were 4.8, 3.3, 2.7, and 2.4 ton/ha in Vietnam, Thailand, Laos, and Cambodia, respectively.
- At regional level, around 50% of the households had some kind of off-farm income. The percentage of households having off-farm income was higher in Cambodia (59%), followed by Thailand (51%), Vietnam (47%) and Laos (34%). Ninety percent of households from Cambodia and Vietnam, and 80% of households in Laos, and all the households in Thailand had sufficient rice from own cultivation for the whole year. Households in Cambodia and Laos have more large livestock (81%) than other two countries.
- In the region, 80-88% of the households have chickens/ducks, mainly for home consumption.
- In LMB region, 95% of the surveyed households have access to agricultural land.
- In a majority of the households, both men and women were jointly taking decision on what to grow in agricultural land in the LMB region. Similarly, on adopting new agricultural practices, 50% decided jointly, and 38% by men. Men mostly taking decisions on pesticide use while women mostly taking decisions on selling the crops in the region.
- More number of farmers were aware of SRI in Cambodia than other three countries. The top most three common factors across the countries for preference to SRI were less seed and water requirements and higher yield.
- Limited market linkages except Thailand
Table 3: Biophysical and socio-economic characteristics of SRI-LMB provinces of Cambodia, Lao PDR, Thailand, and Vietnam (Baseline information)

<table>
<thead>
<tr>
<th></th>
<th>Cambodia</th>
<th>Lao PDR</th>
<th>Thailand</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topography</strong></td>
<td>Lowland</td>
<td>Lowland</td>
<td>Lowland</td>
<td>Upland</td>
</tr>
<tr>
<td><strong>Soil types</strong></td>
<td>Gleytic and ferric Acrisols, mostly sandy loam</td>
<td>Ortho Acrisols, clay-enriched</td>
<td>Gleytic Acrisols; sandy loam and clay</td>
<td>Gleytic Arisols and Dystric, Gleysols; alluvial soil</td>
</tr>
<tr>
<td><strong>Soil PH</strong></td>
<td>5.1</td>
<td>5.03</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td><strong>Average rainfall (June-Dec) in mm</strong></td>
<td>1074</td>
<td>1849</td>
<td>1072</td>
<td>1414</td>
</tr>
<tr>
<td><strong>General Cropping pattern</strong></td>
<td>Rice-fallow</td>
<td>Rice-fallow</td>
<td>Rice-fallow</td>
<td>Rice-Rice</td>
</tr>
<tr>
<td><strong>Gender distribution (% of female)</strong></td>
<td>60 ± 2.12</td>
<td>41 ± 1.95</td>
<td>65 ± 2.35</td>
<td>76 ± 3.01</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>55 ± 2.16</td>
<td>46 ± 1.19</td>
<td>55 ± 2.08</td>
<td>47 ± 1.07</td>
</tr>
<tr>
<td><strong>Rice growing-season (per year)</strong></td>
<td>1.41 ± 0.16</td>
<td>1.23 ± 0.05</td>
<td>1.44 ± 0.07</td>
<td>1.83 ± 0.08</td>
</tr>
<tr>
<td><strong>Average rice area per households (ha)</strong></td>
<td>0.88 ± 0.03</td>
<td>2.0 ± 0.09</td>
<td>3.2 ± 0.13</td>
<td>0.62 ± 0.02</td>
</tr>
<tr>
<td><strong>Average rice productivity (t/ha)</strong></td>
<td>2.6 ± 0.12</td>
<td>2.7 ± 0.13</td>
<td>3.3 ± 0.15</td>
<td>4.8 ± 0.21</td>
</tr>
<tr>
<td><strong>% of households having off farm income</strong></td>
<td>59 ± 2.13</td>
<td>34 ± 1.5</td>
<td>51 ± 1.9</td>
<td>47 ± 2.1</td>
</tr>
<tr>
<td><strong>% of off-farm income with respect to total income</strong></td>
<td>40 ± 1.71</td>
<td>35 ± 1.65</td>
<td>48 ± 2.19</td>
<td>52 ± 2.3</td>
</tr>
<tr>
<td><strong>Household rice sufficiency for 12 months (%)</strong></td>
<td>88 ± 3.41</td>
<td>78 ± 2.99</td>
<td>100 ± 4.13</td>
<td>92 ± 3.71</td>
</tr>
<tr>
<td><strong>%Household dependence on credit to buy food</strong></td>
<td>50 ± 2.05</td>
<td>7 ± 0.25</td>
<td>50 ± 1.25</td>
<td>7 ± 0.25</td>
</tr>
</tbody>
</table>
This does not include household's own subsistence production and consumption. Apart from rice, the source of income for household is rearing livestock, working in factories, growing vegetable crops/cash crops.

<table>
<thead>
<tr>
<th></th>
<th>5.6 ± .25</th>
<th>6.1 ± 0.28</th>
<th>4.6 ± 0.21</th>
<th>4.2 ± 0.19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average household members</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average household labour</td>
<td>4.7 ± 0.09</td>
<td>4.2 ± 0.05</td>
<td>2.3 ± 0.07</td>
<td>4.6 ± 0.08</td>
</tr>
<tr>
<td>(labour units/household)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total household income</td>
<td>2106.25 ± 113.5</td>
<td>2013.23 ± 110.5</td>
<td>2494.84 ± 116.5</td>
<td>1972.23 ± 105.5</td>
</tr>
<tr>
<td>(US$/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* This does not include household's own subsistence production and consumption. Apart from rice, the source of income for household is rearing livestock, working in factories, growing vegetable crops/cash crops.

7.1.2 Desktop review research and training guide formulation for strengthening the role of women and landless labourers

In the Lower Mekong Basin region, our project location, the women represent more than 48% of the agricultural labour force. Therefore, they constitute central audience whose involvement had to ensure throughout the activities of the project. Another group of attention is the agricultural labourers, especially landless who are considered among the most marginalized groups; they are poor with few productive assets, are mostly under-employed and under-paid with little education and skill. As a part of initial project activities, this desktop review focused on the role of women and landless in agriculture. Country-specific review was conducted with the intention of strengthening the ability of Farmer Field Schools (FFSs) to foster women’s leadership, and the ability of the project to engage with landless groups, where appropriate and feasible. The study covered three major topics:

1. Understanding the situation of women and agricultural labourers
2. Discussing the circumstances of women and agricultural workers
3. Adopting a Participatory Activity Plan

Country specific reports covering these three topics can be seen at:


Some of the recommendations resulting from this exercise were considered for the development of a training guide to support the FPAR trainings in all four countries.

7.1.3 Action Research Group and Farm selection, and Conduction of CFPARs trainings

The information collected from the initially identified group was utilized to develop the crop calendars to initiate the focused group discussions. A number of constraints related to crop management were identified in this process. These locally identified challenges were utilized to develop learning curricula in the CFPAR process so as to develop capacity of the farmers trainers to work with the communities to develop location specific technology beginning June 2014. Using standard selection criteria (Mishra et al. 2013), in each province three districts were selected, and in each district, four FPAR sites were identified for farmer-led field experimentation.

At province level, a representative catchment area – centrally-located for a farmers’ participatory action research site, also known as the CFPAR site -- was selected for common meetings and for conducting season-long training and field experiments, one in each province. The season-long CFPAR trainings involved 24 farmers, 8 farmers from each selected district, 3 landless, one from each district and 3 district trainers, one from each district, provincial coordinator, national coordinator, national training expert and regional coordinator. The training session was designed at four growth stages: 1) Sowing/transplanting, 2) tillering stage, 3) flowering stage, and 4) harvesting stage. This activity was capacity building intervention for farmers trainers and districts trainers who were supposed to lead the FPAR activities in their respective districts. The CFPARs:

- Developed understanding among participants about the project, its goals, objectives, work plans and project implementation;
- developed common understanding among participants about the concept and principles of System of Rice Intensification (SRI) and relevance for rice farmers in mainly in rainfed but also irrigated production systems based on the need of the community;
• Familiarized and strengthened the scientific capacity for experimental design, implementation and analysis, including development of a clear understanding among participants about the concept of participatory action research;

• Developed practical understanding of setting up field experiments, identification of key indicators (data), developing data formats and data analysis from field observations;

• Developed understanding of using Farmer’s diary for systematic collection of field data and data on cost benefit analysis.

• Developed understanding on ‘growing healthy root systems’ and soil ecology for growing a health rice crop;

• Discussed and integrated gender aspects into learning curricula and in practice of CFPAR and FPAR process;

• learnt on organization of the Field-Day evaluations for sharing of results with other members in community and evaluation of experiments (both agronomical and economical).

CFPAR reports can be seen at:


Although below structure was originally planned but at some places, the structure was adapted based on the existing local government extension departments’ programme implementation structure and also according to the farmer’s needs and requirements.

Key constraints identified by farmers in relation to crop management during baseline and CFPAR process

• Dry spell / water shortage early season for transplanting

• High production cost (high seed rate, higher cost of fertilizers, rice prices slump [Thailand], labor shortage)

• Weeds, pests and diseases

• Soil deterioration

• Flooding
The CFPAR and FPAR implementation structure can be seen in the Figure 6 below:

**Figure 6:** Structural diagram of CFPAR and FPAR in one province

CFPAR = Central Farmers’ Participatory Action Research (at provincial level)
DT = District Trainer
FT = Farmers’ Trainer
FPAR = Farmers’ Participatory Action Research (at village level, 4 sites/district)
One FFS site = run by two FT, set up two experiments involving 60 farmers (30 farmers in each experiment).
7.2 Farmer-led evaluation and adaption of SRI practices at FPAR and post FPAR sites

The common issues and interests expressed by farmers in all four countries were to achieve higher yield with reduced costs of production by reducing input use for cost saving and for making rice cultivation more efficient and profitable. Using various group-dynamic tools such as sub-group discussion, visual tools, and brainstorming sessions, a range of options were selected for each of the target areas that revolved around the integration of a few SRI principles with existing conventional practices to be applied on a learning plot for location-specific adaptation, but also to have application of the full set of SRI principles on a demonstration plot which served as a ‘test site’ to test and show the full potential of SRI methods at smallholder farmers’ field level. For comparison purposes, the practices that were applied were categorized into: 1). Baseline; 2). Farmer’s practices (FP), 3). SRI-demonstration (SRI-D), and 3). SRI-transition (SRI-T).

1. **Baseline** - the existing conventional management practices (CP) generally followed in the target area as identified through the baseline survey prior to action research set up.

2. **Farmer’s practices (FP)** - the existing management practices generally followed in the target areas and set up by farmers as FP plots for comparisons purpose during the action research field experiment set up.

3. **SRI-demonstration (SRI-D or SRI)** where the full set of SRI practices was applied.

4. **SRI-transition (SRI-T)** - where a few principles of SRI were applied in combination with modified or existing conventional practices. The word “transition” was used because the practices are generally transitioning towards SRI with different degrees of

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**SRI: Capturing farmers’ imagination by enabling them to get higher yield with reduced external inputs, and fueling their capacity for innovation**

- Offers low cost solution
- Doesn’t require external inputs
- Practices are amenable to farmers experimentation
- Follows agro-ecological principles
- Strengthens livelihoods
SRI adoption and types. These practices do not fall in either category of SRI or FP, but that are modified, improved and better than FP. Details of the SRI-D or SRI, SRI-T, and CP alternatives are given in below Table:

**Table 4:** Crop management practices followed in SRI-demonstration (SRI-D), SRI-transition (SRI-T) and conventional management practices (CM)

<table>
<thead>
<tr>
<th>Crop management practices</th>
<th>Conventional practices (Baseline)*</th>
<th>SRI-transition (SRI-T) **</th>
<th>SRI-D or SRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seedbed</td>
<td>Wet seedbed with high seeding rate (more than 150 kg/ha)</td>
<td>Wet seedbed with less seeding rate (110-105 kg/ha 20-30% less than CM)</td>
<td>Dry raised seedbed with less seed rate (5-10 kg/ha)</td>
</tr>
<tr>
<td>Seedling age</td>
<td>More than 30-day old</td>
<td>16-30-day-old</td>
<td>8-15-day-old</td>
</tr>
<tr>
<td>Seed rate/if doing direct seeding/broadcasting</td>
<td>More than 200 kg/ha</td>
<td>20-30% less than CM (160-140 kg/ha)</td>
<td>5-20 kg/ha or less than 5 kg</td>
</tr>
<tr>
<td>Transplanting spacing</td>
<td>Random/less than 10 x 10 cm</td>
<td>10 x 15 cm – 19 x 19 cm</td>
<td>20 x 20 cm – 30 x 30 cm</td>
</tr>
<tr>
<td>Planting/hill</td>
<td>&gt;5-6 seedlings/hill</td>
<td>4-5 seedlings/hill</td>
<td>1-3 seedlings/hill</td>
</tr>
<tr>
<td>Soil condition</td>
<td>Flooded (or no effort in maintaining aerobic soil condition)</td>
<td>Relatively aerobic soil condition with respect to CM either through shallow water level or through intermittent drying</td>
<td>Maintaining aerobic soil condition at least for a week during tillering stage</td>
</tr>
<tr>
<td>Compost application</td>
<td>Less than 5 t/ha</td>
<td>6-9 t/ha</td>
<td>More than 9 t/ha</td>
</tr>
<tr>
<td>Weed management</td>
<td>Chemical and manual</td>
<td>With rotary hoe 1-2 times</td>
<td>With rotary hoe more than 2 times</td>
</tr>
<tr>
<td>Pest management</td>
<td>Chemical</td>
<td>Apply IPM</td>
<td>Apply IPM with emphasis on plant environment management</td>
</tr>
</tbody>
</table>
With these set up, altogether 1720 field experiments were conducted involving more than 15,000 farmers directly across all 33 districts of 11 provinces of four countries and reached out to another 30,000 indirectly through Field Days, provincial workshops, farmer’s congress, etc. (Fig 7).

**Figure 7:** Number of action research sites, field experiments and number of farmers directly involved in the FPAR training programs of the SRI-LMB from 2014 to 2017.

These FPAR sites were the sites where field experiments and trainings were designed and conducted by farmer trainers who were trained at CFPAR at the beginning of the project. The training guides were developed and translated into local languages. Session guide can be seen at: [http://sri-lmb.aot.asia/downloads/Session%20Guide%20on%20participatory%20action%20research%20.pdf](http://sri-lmb.aot.asia/downloads/Session%20Guide%20on%20participatory%20action%20research%20.pdf)

Data were recorded at three stages: tillering, flowering, and harvesting, and were recorded at two levels: 1) at farmer trainer level, which was recorded using farmers’ diaries (input use, yield and cost-benefit, number of sessions conducted, number of FPAR participants, number of women participants, number of landless) and was cross-checked during backstopping visits by researchers, implementing ministries, and 2) at researcher level, by both national and regional researchers, with an objective to study the effects of applied management practices on yield and income and their contribution to household income.

Final results of the field experiments were reported by implementing ministries, cross-verified by national and regional researchers and discussed and deliberated on at the provincial, national and regional workshops organized at the end of each FPAR cycle.
The workshops involved farmers, researchers, ministries, national universities, and development professionals from government, international organizations/institutions and civil society organizations.

Final data were entered in the project database created for each FPAR site (Fig. 8). User’s Guide for online project database can be seen at: http://sri-lmb.aist.asia/downloads/User’s%20guide%20on%20online%20database%20for%20SRI-LMB.pdf

**Figure 8:** Field data handling at country and regional level through intra and internet database

Data were compiled for further analysis and for presentation and deliberations at provincial, national and regional workshops.

Country specific results can be seen in the FPAR reports available at the following links:


For analysis and reporting at the regional level, the results were clustered under three performance indicators which had been selected based on performance indicators for sustainable rice cultivation developed by the Sustainable Rice Platform (SRP) affiliated with the International Rice Research Institute and UN Environmental Programme.

These categories are:

1. Improved farmer livelihoods: productivity (yield per hectare), profitability, and labour productivity;
2. Resource use efficiency: water productivity, inorganic fertilizer use efficiency, and total energy input; and
3. Reduction in greenhouse gas (GHG) emissions, where possible.

These SRP Performance indicators are a work in progress with revised standards and indicators anticipated for adoption by the general assembly later in 2019.

For GHG emissions, these were estimated based on the input use and following the protocol developed by Yan et al. (2005), IPCC (2006) and Mossier et al. (1998) (Figure 2). Methane emissions were estimated for both flooded and rainfed conditions of rice production. N$_2$O emissions were accounted from both direct and indirect sources: direct N$_2$O-N emissions from N inputs to managed soil (N$_2$O-N inputs), and the N$_2$O emissions through two indirect pathways, by decomposition and leaching. For CO$_2$, emissions from urea fertilization, chemical substances (pesticides and insecticides) and fuel were estimated.

All emissions were expressed as CO$_2$ equivalent per ha per year. Total GHG emissions were calculated by:

\[
Total\ GHG\ (tCO_2\ eq./ha/year) = CH_4(flooded) + N_2O(direct) + N_2O(indirect) + CO_2(urea) + CO_2\ (chemical\ substances) + CO_2(fuel)
\]
A random-effects analysis\(^{1}\) was used to assess the regional pattern of results for how SRI-D and SRI-T practices responded in terms of yield and economic return in comparison to the baseline (CP). Data were presented as means ± standard error (s.e.). In most cases, the analysis was performed for each country and across the region; and in some cases, such as for GHG, it was performed by production system, comparing rainfed systems with irrigated systems. The results are discussed in the next section of the report.

7.3 Bring the equity: Special training for women and landless vulnerable groups for better livelihoods and better environment

After the FPAR trainings, in Vietnam, the local CSO Center of Initiatives on Community Empowerment and Rural Development (ICERD) implemented activities

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\(^{1}\) The random effects model assumes that the studies were drawn from populations that differ from each other in ways that could have an impact on the treatment effect. It follows that the effect size will vary from one study to the next for two reasons: the first is random error within studies, and the second is true variation in the effect size from one study to the next.
to support FPAR women’s groups and landless laborers to i) develop techniques to achieve more efficient SRI application and improve production of other crops in rice-based systems; ii) develop non-chemical measures to manage pests in “home gardens”; and iii) enhance the cooperation and the role of women in improving livelihoods and the environment. Similarly, in Cambodia, the training on chicken raising was implemented by the women and landless groups with the aim to address the issues of landlessness and land poverty that contribute towards food insecurity and vulnerability. The training on chicken was foreseen to i) improve the income of small scale, vulnerable landless, land-poor and women farmers through providing improved agricultural techniques (e.g., chicken raising), and ii) enhance and encourage farmers (many who are women) to apply the techniques through building synergy with the Saving for Change Project implemented by a local CSO (RACHA) in the SRI-LMB target areas. As per the findings reported by implementing ministries, these initiatives yielded good results and contributed towards the better livelihoods for vulnerable groups.

The reports of these activities can be seen at:


7.4 Understanding the pattern of change among different groups of farmers due to SRI capacity building intervention through Monitoring, Evaluation and Learning (MEL) study

In order to learn the evolution of farmers’ practices at FPAR sites and non-FPAR sites, a Monitoring Evaluation and Learning (MEL) study was conducted to analyze and understand the cause and effect relationships that contribute to or hinder the evolution of farmers practices in a given biophysical and socio-economic conditions for SRI adaptation in local condition and what benefits they are deriving in terms of economics and other associated benefits. The methodology adopted for the study included pre-

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2 Saving for Change (SfC) is a project implemented by the local CSO, RACHA that helps the poor gain access to capital to achieve improved health and wellbeing through holistic approaches. Through the project, women become members of a collective saving group to create shared capital and engage in income generating activities that augment their household income.
and post-intervention surveys from 30 districts in 10 provinces from the 4 LMB countries. The purpose of the assessment was to learn from the evolution of farmers’ practices at FPAR and non-FPAR sites with respect to the pre-project baseline scenario, and with the respect to the control group.

The baseline surveys in the four countries were undertaken in all four countries prior to MEL study. The MEL surveys were undertaken by ACISAI (AIT) involving four country-level organizations as partners: The Royal University of Agriculture (RUA) Cambodia; the NCA in Laos PDR; the Hanoi University of Agriculture in Vietnam; and Ubon Ratchathani Rajabhat University (UBRU) in Thailand (see Figure 10). The respondents for the MEL surveys were selected randomly using stratified sampling methods.

Before field implementation, MEL study protocol was developed and agreed by all project colleagues. The MEL study protocol can be assessed from: [http://www.sri-lmb.aii.asia/downloads/MEL%20Protocol-SRI-LMB-AIT.pdf](http://www.sri-lmb.aii.asia/downloads/MEL%20Protocol-SRI-LMB-AIT.pdf) The survey was conducted after the completion of each cycle of FPAR. Organizational structure for the implementation of the MEL study has been given in Figure 10.

![Organizational structure for the implementation of the MEL study](http://www.sri-lmb.aii.asia/downloads/MEL%20Protocol-SRI-LMB-AIT.pdf)

**Figure 10:** Organizational structure for the implementation of the MEL study

Where, AIT - Asian Institute of Technology in Thailand; RUA - Royal University of Agriculture in Cambodia; NCA - Nabong College of Agriculture in Laos – HUA - Hanoi University of Agriculture in Vietnam; UBRU - Ubonratchathani Rajabhat University in Thailand; RR - Regional Researcher; NR - National Researcher; P1 - Province 1; P2 - Province 2; P3 - Province 3; D1 - District 1; D2 - District 2; D3 - District 3; LM - Local Monitor
The lists of FPAR participants were collected from country offices, i.e., from Project Management Unit (PMU) in each country. Farmers were randomly selected for interviewing with a set of questionnaires for gathering information on demographic, socio-economic and farmer’s practices on rice cultivation. Simultaneously, the data were also collected from non-FPAR groups and control groups in each province. The local monitors, one from each district, were selected for data collection by the national universities/institutions. The national researcher, based at national universities/institutions along with regional researcher, based at AIT, trained local monitors by using training manual to ensure a common understanding of the objectives of the MEL survey and procedural detailing about conducting the survey for gathering complete and robust data. Training manual can be seen at: [http://www.srilmb.aia/downloads/Guide%20for%20training%20LMs_for%20MEL%20study.pdf](http://www.srilmb.aia/downloads/Guide%20for%20training%20LMs_for%20MEL%20study.pdf)

A full set of questionnaires can be seen in the MEL study protocol.

Three groups of farmers were monitored over the three years period. These groups have been categorized and defined as:

1. **FPAR group**: Farmer participants in the direct interventions of the project which included attendees from both CFPAR and FPAR,
2. **Non-FPAR group**: Farmers from the same village/neighborhood where the FPAR has been conducted, but who have not attended and followed the project’s direct interventions, but could be indirectly influenced by their neighbor who attended FPAR, and
3. **Control group**: Farmers with similar agro-ecological and socio-economical profiles as that of FPAR group, but that have not been directly or indirectly influenced by the project’s interventions.

*The data were collected in four broad areas:*

- Crop management practices applied w.r.t. SRI principles
- Cost and benefit to the households
- Women farmer’s socio-economic status and overall well-being
- Responses of farmers to extreme events (drought/flood/pests/disease outbreak), if any.

*Indicators selected for the MEL study were:*

1. For crops/cropping system – (change in yield, change in maturity period, change in farming systems (diversification of crops/livestock)}
2. For socio-economic aspects – change in net on-farm return, relative change in food security, change in labour requirement
3. For exposure and sensitivity to extreme events

**Figure 11:** FPAR structure and FPAR MEL survey group in each province

Microsoft excel 2016 was used to perform various exploratory and descriptive statistical analysis and tests. Statistical tests were performed by using analysis of variance (ANOVA) in Sigma Plot 12.5. Details can be seen at: [http://www.sri-lmb.aii.asia/downloads/SRI-LMB%20MEL%20REPORT%20Final.pdf](http://www.sri-lmb.aii.asia/downloads/SRI-LMB%20MEL%20REPORT%20Final.pdf)

**7.5 Scanning the policy environment: Policy baseline research and formulation of pro-poor options for policy advocacy and dialogue**

The policy analysis was done of all four countries with an aim to provide critical insights and contextual analysis on the current policies and practices of public and private sector actors where they affect smallholder farmers. Firstly, overall policy environment was studied and further specific research were conducted around four major specific areas:
1. Access to productive agricultural land by the landless, land poor and smallholder farmers
2. Implication of small-scale farmers’ investment in the four LMB countries: Cambodia, Lao PDR, Thailand and Vietnam
3. Public and private policy environment and practices towards smallholder farmers and small-scale agriculture in the context of food security and climate change in the Lower Mekong River Basin countries

Key findings and recommendations were formulated for each country to inform the future work for policy and advocacy.

7.5.1 Overall policy environment within the context of smallholder agriculture development

CAMBODIA

Although there is no official definition of a smallholder, in Cambodia smallholders are usually defined as household with 3 ha or less of arable land. Further categorizations of smallholders have appeared in the literature and grey literature, such as subsistence smallholders, usually those with less than 1 ha of land, and commercial smallholders, those households with between 1 and 3 ha of arable land and who get them most of their income from farming.

The country is undergoing a dramatic social and economic transition that is having enormous impacts in the agricultural sector. The existing policy framework only partially addresses the needs and opportunities of the sector. Opportunities - presented by the current fuzziness of the policy environment and the rapid changes affecting agriculture – ought to be seized rapidly, especially while it is still possible to influence the policy framework impacting smallholder agriculture in Cambodia. The policy analysis showed a complex and contradictory array of public sector policies with inadequate evidence-based policy analysis and implementation, Moreover, Coordination between line ministries and lack of policy enforcement and evaluation have also been identified as a
major concern in policy implementation. Given this policy environment, there is a need for advocacy for an increase in policy analysis particularly before designing further policies. Gender is reasonably well represented in this policy environment however investment and implementation are weak. This warrants focused attention. Cambodia has a vibrant civil society (as demonstrated during the recent political events) with numerous NGOs and INGOs. It also benefits from an exceptional support by multilateral and bilateral agencies that collaborate with government and civil society. This multiplicity of stakeholders is an advantage as it can pursue its advocacy strategy through various channels and create synergies which hold the key to the efficiency of policy advocacy work.

LAO PDR

Smallholder rice farmers can be broadly categorized in 2 groups in Lao PDR: (1) Lowland (and upland valleys) wet season rice farmers (irrigated or not) who have partially adopted new rice varieties (around 50%) and are increasingly using mechanized means of production (2-wheels tractors) and chemical inputs. The majority farm rice on less than 1 hectare of land in the North, and less than 1.5 hectare in the central and South.

LAO PDR

MAFF Strategies (2011-2020)

✓ Increase of agriculture productivity applying of newer scientific and technological methods
✓ Ensure food security and encourage agriculture for local consumption as well as export.
✓ The country is adopting key policy reforms to make its strong economic growth benefit more people, especially the poor and disadvantaged, while protecting the environment. “Green Growth “

The Government of Lao PDR has recently made radical shift in its approach toward agriculture sector support with the recognition of the need to (1) to harness and influence of private sector and; (2) to involve and develop civil society actors, be they existing NGO/Association or soon to be created Farmer Cooperatives. This is considered in relation to the development of the next National Socio-Economic Development Plan. Key considerations; (1) that it includes provision for smallholder rice farmers in the upland to continue farming; and (2) that the overall industrialization strategy is reshaped from resource extraction towards cottage industry and the production of goods to be
consumed locally with sufficient quality and at competitive prices. Apart from fostering an evidence-based dialogue on these issues advocacy is also needed in encouraging the corresponding reshaping of public extension from the provider of service role to a facilitator/coordination role.

**VIETNAM**

The proportion of rice growing smallholders with less than 0.5 hectare is 84%. A generic profile of smallholders includes (1) having less arable land than the average; (2) being located in disadvantaged areas (e.g. remote, mountainous, and vulnerable to natural disaster), and (3) limited access to income-generating activities.

Although Vietnam has been considered very successful in transforming its agriculture sector over the past two decades of Doi Moi policy, agriculture is now facing a new set of challenges. Various extension services are offered, including technical trainings, field demonstration workshops, on-site consultation, and provision of market information. However, extension services mostly respond to government objectives (not really focused on demand-side), with insufficient budget especially when reaching to the poor. Beside this, the major gap is seed quality with about 40-45% of seeds not registered or of poor quality.

To address those challenges there is a need to advocate for making quality certified rice seeds (produced by public institutions or farmers’ groups) a priority. Incentives for private or farmer-led extension services (including transparent input registration…) and facilitation of contract farming arrangements with development of regulations and mechanisms to protect the poorest. Beyond the issues on skill and quality inputs, Farmer s’ opportunities to diversify into other areas and increase incomes are limited by fact that government designated rice land policy and restriction in land-use transformation
(Decree No. 42/2012/NĐ-CP dated 11 May 2012 requires the Prime Minister's approval for any change of land-use purpose from designated rice land to non-farm usage). According to those challenges there is a need of review the new agriculture restructuring to identify potential benefit to smallholder farmers in Viet Nam new agriculture restructuring program. However, the space for advocacy in Vietnam remains tight. Policy advocacy work should be skillfully conducted with a mix of lobbying, relationships nurturing and collaboration with Mass Organizations, the Government and development partners at central level. At local level, it mostly ought to build evidences that can convince central decision makers.

THAILAND

In Thailand, rice is produced by smallholder farmers with average farm size of around 3.5 hectares per household. In Thailand, about 65% (3.7 million) of farm households engage in rice farming. Farmers in Thailand can be broadly categorized by farm size: (1) Small farmers with at most 3.2 hectares (56 % of Thai farmers). Regions can also classify farmers across Thailand that vary in topography, access to coast, and spread of rainfall over the year and soil quality that could lead to the capacity of productivity.

This county is a more mature agricultural producer than the 3 other countries. The Thai Government has much experience in modifying implementation arrangements to affect various objectives, especially in the area of fertilizer use and contract farming. The Philosophy of Self-Sufficient Economy and The New Theory – guiding principles behind the ‘Thai development way’ - provide ideal methods around which to arrange new interventions, with their focus on self-sufficiency and resilience. The rice-pledging scheme has been one of the most prominent governmental policies in Thailand in the recent years. Immediately after the 2011 election, the Thai Government announced a paddy-pledging program that guaranteed prices for farmers 30-50% higher than market prices. It aimed to guarantee farmers’ income in a market dominated by middlemen. The rice-pledging scheme was terminated in February 2014 because of its shortcomings as it has been demonstrated
that policy didn’t benefit to poor farmers and it was highly unprofitable for the government. Thailand’s Government promoted the implementation of contract farming based on the aspect this will provide a system to arrange production by many farmers with different size of farms and as it results in efficient extension of services to farmers via the contracting entities, who are also profiting. Nevertheless, contract farming presents a few shortcomings, especially for poor farmers who have a low bargaining power. Given those issues there is a need to call for research on the impact of global markets and how small farmers may benefit (position in the value chain). Space available for advocacy is now a vacuum. Gov’t will be especially sensitive to better focus of subsidies towards the poorest, through strengthen implementation of legal framework to protect smallest farmers and lobbying agri-business for long-term mutually beneficial approach.

7.5.2 Policy baseline research

After scanning the overall policy environment, specific research was conducted around the four major specific areas, as listed below. Key findings of the specific research conducted on policy research around four major specific areas are given below:

1. Access to productive agricultural land by the landless, land poor and smallholder farmers

- Land rights need to be maintained legally and politically in the interest of smallholder farmers, the landless, and access to natural resources, markets, and knowledge is important
- Land redistribution programs, which is underway in LMB region, show mixed results and require further assessment.
- Access to the justice system for land disputes, including the courts, is limited, and therefore the role played by the civil society is important.
- Unjustifiable institutional policies, such as promoting large plantations at the expense of local livelihoods, and the use or threat of violence are not uncommon. Intensification of land use, land degradation, and increased use of agrochemicals threatens environment.
2. Implication of small-scale farmers’ investment in the four LMB countries: Cambodia, Lao PDR, Thailand and Vietnam

Since small farmers’ access to production inputs, knowledge, and supply chain including markets is limited, this study recommends

- Better coordination among the ministries/agencies associated with agriculture development.
- Support to small farmers in terms of knowledge, climate-resilience mechanisms, paddy processing and markets, financial services, and providing irrigation services. The necessity of integrating small-scale farmers into the wider economy and enabling them to benefit from global trade is emphasized. The authors identified contract farming as a mechanism to avoid or reduce risk and increase profits.
- Assist in post-harvest management, including access to market information and marketing.


3. Public and private policy environment and practices towards smallholder farmers and small-scale agriculture in the context of food security and climate change in the Lower Mekong River Basin countries

Most affecting policies are:

- Cambodia: Agricultural extension; Land titling; Water management and irrigation; and Climate change
- Lao PDR: Agricultural strategy; Irrigation; Access to natural assets/land; New extension paradigm and farmer cooperatives
- Thailand: Agricultural strategy; Fertilizer policies; Rice pledging scheme; Contract farming; Organic initiatives
- Vietnam: Food security; Land use policy; Labor market policies; Access to credit; Agriculture extension

7.6 Reflecting on our work and adjusting our action: Project review and reflection at local, national and regional level

The results and processes of FPARs, field studies, supporting research and policy studies, also programme implementation status, its pros-and-cons were reviewed every year and learning emanating from this process were taken into consideration for the next cycle of activity. One such workshop in each province (provincial or LMU workshop) and further in each country (national workshop) was organized with the involvement of national steering committee of the project, provincial coordinators, district trainers, farmers’ trainers, local NGO’s person, national university representative (researcher and supervisors), policy makers, all project partners (regional) and local EU delegates.

The information, results and feedback collected from all countries were reviewed at the regional workshop, one workshop/year, in light of the project objectives and broader objectives (climate change adaptation and AR4D). Based on the feedback and emerging trend in all four countries, a regional trend was imagined and strategic directions were setup for the next year activity. This was an iterative process to plan and review and adjust the project work involving national and regional project stakeholders.

The report of such annual planning and review workshops can be seen at the link given below:

**Country workshop reports**

Cambodia
- National Review and Planning Workshop, Cambodia
- Brief Report - Provincial Reflection Workshops 2016 in Cambodia
- Brief Report - Provincial Workshop, Cambodia (23 Feb - 07 Mar 2015)

Lao PDR
- Final National Workshop of FPAR in Laos 2018 - Final Report
- FPAR in Laos Final Report (Jun- Dec 2017)
- Lao PDR Progress Report 2017
- NRPW Report Lao PDR (April 2017)
• Provincial Review and Planning Workshop/Refresher - Training on FPAR and Soil improvement (Apr 2017)

Vietnam
• National Review and Planning Meeting, Ha Tinh, Vietnam, Aug 2017
• National Review & Planning Meeting - Bac Giang, Vietnam (Nov 2016)

Thailand
• National Workshop and Farmer Congress, Uttaradit, Thailand (29-30 March 2018)
• Brief Report - Farmers Congress and National Review & Planning Workshop, Thailand, 23-24 June 2016 (In Thai)
• Brief Report - Farmers Congress and National Review & Planning Workshop, Thailand, 23-24 June 2016 (In English)
• Brief Report - National Review & Planning Workshop, Thailand (28-29 Apr 2015)
• Brief Report - Provincial Workshops in Surin & Uttaradit, March 2015 (in Thai)
• Brief Report - Provincial Workshops in Surin & Uttaradit, March 2015 (in English)

Regional workshop reports
• Regional Workshop (1-2 November, 2018)
• Regional Review and Planning Workshop (23-25 April, 2017)
• Regional Review & Planning Workshop (02-03 June 2015)

7.7 Documentation and sharing with wider audience

The SRI-LMB programme through its multi-stakeholder and multidisciplinary approaches contributed to the evolution of knowledge on sustainable agroecological system by maintaining a strong partnership between participating farmers, researchers and development professionals and by adopting multiple mechanisms to share and utilize the knowledge generated from different sources, including System of Rice Intensification (SRI) field testing and refinement, Farmers’ Field Schools (FFSs) structure, soil ecology, climate smart agriculture and Integrated Pest Management (IPM). Local, national and regional networks, established through the project actions, provided platforms for the learning process and collaboration among participating farmers, researchers, other national and international development professionals, and government partners including ministries.

The following were among the knowledge-sharing mechanisms initiated and completed since 2013 by SRI-LMB project:
• Inception and design and review workshops at different levels
• Training of Trainers courses
• Central and Farmer’s Participatory Action Research (CFPAR and FPAR) and trainings (series of season-long activities where large numbers of participants and visiting people learned and shared knowledge, with “seeing is believing” practice)
• Trainings of Local monitors and national researchers for Monitoring, Evaluation and Learning study
• Development of training curricula and session guide for FPAR and farmer’s led SRI adaptive research
• Regional farmers’ exchange visits
• Farmers’ Congress
• Research on SRI adaptation responses by farmers
• Policy dialogue and studies
• Collaborative action and linking with national extension systems
• Presentations and sharing experience at national and international workshops
• Video documentaries, case studies, information leaflets, photo compilations, journal publications, opinion articles, etc.
• “Information Resources” and “Media Center” sections of the project website (http://www.sri-lmb.ait.asia/) include newsletters, leaflets, brochures, documents on project events, technical notes, and research publications, videos, photos, etc.

Care was taken to make sure that the ready-to-use information is available for all the audience either local, regional or international.
7. **LEARNING FROM THE FIELD**: Action speaks

8.1 Increased crop yield, productivity and profitability on sustainable basis at smallholders farmers’ field in rainfed areas of LMB region

As indicated earlier, the three major indicators of the project performance were the effects in terms of:

(a) Improved Livelihoods;
(b) Resource Use Efficiency; and
(c) Climate Change Mitigation.

Improved livelihood effects were measured by using indicators, such as: productivity or yield (tons/ha); profitability or net return (US$/ha); labour productivity (kg of rice yield/man-day of labour). Resource use efficiency was assessed in terms of water productivity (kg of rice yield/m3 of water input); inorganic fertilizer use efficiency (kg of rice yield/kg of inorganic fertilizer); and total energy (chemical, mechanical and biological) input (GJ/ha). The effects of Climate Change Mitigation were examined by measuring the greenhouse gas (GHG) emissions – CH4, N2O, CO2 (tCO2 eq./ha) and the GHG emissions (rainfed and irrigated scenarios).

8.1.1 Improved farmers livelihood (productivity, profitability and labour productivity)

Meta-trends on SRI-Demonstration (SRI-D, where all practices were applied) (or SRI) and SRI-Transition (SRI-T, where few SRI practices were applied) indicated significantly higher yield benefits compared to conventional practices, reflected in baseline yield before SRI was introduced in these areas. As the results showed (see Figure 12), the FP plots, which were set up adjacent to SRI-D or SRI-T plots, had significantly lower yield compared to the SRI-D and SRI-T in Cambodia, Thailand and Vietnam. When compared with the baseline yield, all four countries showed higher
yield with SRI method. The three-year results from across the region showed that in the SRI demonstration plots (SRI-D), the average yield increment was 52% higher than farmers production with their usual practices, while in the SRI-T plots, the yield was 21% greater in Cambodia and 33% in Vietnam compared to baseline.

Similarly, based on data on the cost of production, labour use and farm-gate paddy price that were reported by all four countries, the trends of SRI-D and SRI-T for on-farm net return were calculated. It showed that across the region, significant increase in net return were achieved with SRI. More particularly, SRI-D in Cambodia, Thailand and Vietnam showed significant increases in net return with respect to the baseline. With SRI-D, where all SRI practices were applied, the average net return across the region was 70% more than the baseline figure. The net returns that we have presented here had also accounted the family labour costs while calculating the total costs of production even though they were not paid for. This means the actual net return to households would have been more than the estimated return that we present here.

At country level, the percentage change in net returns was higher in Thailand and Vietnam compared to Laos and Cambodia. The percentage net returns in Thailand was higher due to less cost of production (less fertilizers, labours and seed costs) and higher yield, but also due to higher paddy price that they received for the paddy grown with the SRI method, (two-three times more price than the prince of conventionally grown paddy). Whereas in Vietnam, this was due to less costs of production (less labour, less fertilizers and less seed costs) and higher yield. It has to be noted that in Vietnam, with labour cost, the cost of cultivation was exceptionally high. This was due to conversion of labour costs from “sao” (a local unit for land size, 1 sao = 360 m²) to hectare. The average landholding in Vietnam is 0.3 ha in project provinces. Owing to small land size, all labours come from the family. However, for cost-benefit analysis, family labour has been accounted in the cost of cultivation using the market rate. The unit used for labour use was “man/day/sao” and converted into hectare and therefore it doesn’t reflect the actual labour costs. Since FPAR training sites reported less labour use and so there was huge reduction in cost of cultivation. This is one of the reasons for exceptionally higher net return in Vietnam.
Figure 12: Standardized mean differences and average paddy yield in SRI-D, SRI-T and FP plots with respect to CP (baseline) values in the four countries: Cambodia (CAM); Thailand (TH); Vietnam (VN) and Laos (LAO). X axis shows the effect size. The overall effect size is positive and significant.

The higher yield in SRI practices also increased labour productivity (Kg rice/day of labour) across the region and in all four countries (see Figure 13). Across the region and with respect to the baseline, the labour productivity for SRI-D was 64% higher and in SRI-T it was 14%. The results showed that farmers with the conventional practices produced 46.2 kg rice/day of labour whereas with SRI-T they got 68.4 kg rice/day and with SRI-D, they were able to harvest 76 kg rice/day of labour.

Although, with respect to the baseline data, the labour requirements (days/ha) in SRI-D were higher in Cambodia (8 man-days more), Vietnam (7 man-days more) and in Laos (19 man-day more) but due to the significantly higher yields from SRI-D plots, the labour productivity increased in all three countries. Thailand reported relatively less labour use in SRI-D compared to the conventional practices. In the SRI-D plots, it was 39.2 man-days whereas in conventional it was 86.3 man-days. This was basically due to adoption of SRI principles with adapted practices in which farmers used direct seeding machines for sowing, i.e., they sowed fewer seeds/hill while maintaining wider spacing (25 x 25cm). Overall, the labour requirement in SRI-D was 65 man day/ha in Laos and
Cambodia against 52 and 56 in conventional practice respectively. In Vietnam it was 77 man-days/ha in SRI-D and 70 man-day/ha in conventional.

**Figure 13:** Mean +/- s.e for Labour productivity in SRI-D and SRI-T and in conventional management practices (Baseline). Number above the bars show % increase in labour productivity with reference to baseline.

8.1.2 Resource Use Efficiency: Water productivity, inorganic fertilizer use efficiency, and total energy input

With reference to the baseline, water productivity (kg paddy/m³water) was higher in the SRI-D treatments across the region and in all four countries (Figure 14). At the regional level, water productivity was 59% higher in SRI-D plots compared to the baseline figures. Similarly, inorganic fertilizer use efficiency (Kg paddy produced/kg of mineral fertilizers) also increased due to the significant increase in yield from SRI-D plots (Figure 15). Thailand, Vietnam and Laos, showed significant increase in the efficiency of inorganic fertilizer use with SRI; however, in Cambodia, the FPAR trials that were led by the farmer trainers and supported by the project resources showed
lower efficiency. This was due to their increased applications of mineral fertilizer in all plots, both SRI-D and SRI-T, compared to the amounts used by farmers with their conventional practices (baseline). The average dose of mineral fertilizers in baseline was 130 kg/ha where as at the FPAR training sites, as per government recommendation, it was 240 kg/ha.

This was not according to SRI protocols, it should be noted, but Cambodian farmers when having free access to mineral fertilizers used more of it. We reported the results, as occurred, but in a case like this, they are easily explained. The government recommendation can be seen and understood with respect to average fertilizer use in the region. Compare to Thailand and Vietnam, Cambodia applies less fertilizer. The baseline data says that the average dose of mineral fertilizers in Vietnam is 400 kg/ha whereas in Thailand it is 395 kg/ha. Cambodian farmers still use very less fertilizers (130-150 kg/ha). Since we have compared the results with county baseline that’s why it showed less fertilizer use efficiency, higher energy, higher GHG emission in SRI-D plots in Cambodia.

Farmers in all four countries could see that yields and efficiency could be increased with less reliance on fertilizer.

**Figure 14:** Water productivity (Kg of paddy yield/m3 of rainfall water) in SRI, SRI-T and FP. Figure in % shows percentage increase in water productivity with respect to baseline
Figure 15: Inorganic fertilizer use efficiency (kg paddy/kg of inorganic fertilizer) in SRI, SRI-T and FP. Figure in % shows percentage increase in water productivity with respect to baseline.

With regard to energy use, overall and across the region, there was a 52% increase in paddy yield reported with a 34% reduction in energy inputs. The country-by-country results were a 52% reduction in Thailand, a 36% reduction in Vietnam and a 51% reduction in Laos, with a 26% energy input increase in Cambodia, respectively (Figure 16).

Figure 16: Total energy input (GJ/ha) and percent change in total energy input with respect to baseline in SRI, SRI-T and FP.
The reductions were mainly due to reduced amount of fertilizer and seed used. At the regional level, 74% seed saving was reported with country average 69% in Cambodia, 79% in Thailand, 57% in Vietnam and 90% in Laos. This resulted in very high seed productivity. At the regional level, farmers were able to produce 190.5 kg paddy with 1 kg of seed. In Thailand, in addition to reducing fertilizers and seeds, the reduced use of labour also contributed to a big reduction in total energy input in the SRI demonstration (SRI) plots.

8.1.3 Reduction in greenhouse gas (GHG) emission)

Less material inputs and also less energy use also reduced the GHG emissions from SRI (or SRI-D) and SRI-T plots compared to the conventional practice (Table 5). In irrigated production systems across the region, a 14% reduction compared to conventional practice was reported whereas in rainfed fields, the reduction was 17% compared to conventional practice (Figure 17). Thailand, Vietnam and Laos reported significant reductions in GHG emission due to the lower amount of fertilizer use and less seed use in SRI-D, whereas in Cambodia, GHG emissions increased significantly in SRI-D due to farmers’ increase in the amount of mineral fertilizer used (almost double), as explained above (see page 69).

**Table 5:** Greenhouse gas (GHG) emission (t CO2 eq./ha) from SRI and conventional fields

<table>
<thead>
<tr>
<th>COUNTRIES</th>
<th>IRRIGATED</th>
<th>RAINFED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SRI</td>
<td>Baseline</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.86</td>
<td>2.52</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2.35</td>
<td>2.92</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>1.17</td>
<td>1.74</td>
</tr>
<tr>
<td>Cambodia*</td>
<td>2.20</td>
<td>1.54</td>
</tr>
<tr>
<td>Regional (av. of four countries)</td>
<td>1.89</td>
<td>2.18</td>
</tr>
<tr>
<td>Regional (av.of three countries : Thailand, Vietnam and Lao PDR)</td>
<td>1.79</td>
<td>2.39</td>
</tr>
</tbody>
</table>

* Application of N fertilizer was promoted and increased in Cambodia, not according to SRI recommendation.
Figure 17: Percent change in greenhouse gas (GHG) emission reduction with respect to baseline in SRI, SRI-T and FP in irrigated and rainfed production systems.

Nevertheless, if we see the average reduction in GHG emission from SRI fields in three countries (Thailand, Vietnam and Lao PDR), it was 25% from irrigated and 30% from rainfed systems. The case of Cambodia has already been explained (see page 69).

These findings are based on the general bio-physical properties of the production environment where trials were conducted and on the cropping pattern followed in those areas, as detailed in the Materials and Methods section. Since the rainfed rice production of the LMB region doesn’t emit much methane (CH$_4$), which is the main GHG produced by (irrigated) rice production with its hypoxic soil conditions, we were assessing primarily the effects of input use for estimating GHG reduction. If we look across the four countries, 64% area is rainfed (74.1% in Thailand, 83.7% in Cambodia, 41.1% in Vietnam and 81% in Lao PDR), and only 36% is irrigated in the region. Using the data that we have from our research findings to calculate the GHG emission from current conventional practice for the LMB region as a whole, there will be 6.41 million t CO$_2$ eq from rainfed and 5.18 million t CO$_2$ eq from the irrigated regions of the four countries. With adoption of SRI-D methods, the GHG emission will be 5.13 million t CO$_2$ eq from rainfed and 4.11 million t CO$_2$ eq from irrigated rice areas, a 20% reduction overall. These figures show that the absolute gain for GHG reduction could be more in the rainfed parts of the region compared to the irrigated ones.
Figure 18: GHG emission estimation in SRI, SRI-T and FP at country and regional level in irrigated and rainfed systems of the LMB region

Reduction in GHG emission from the rainfed areas cannot be the main objective for agriculture research and development in the region, but this can be seen as a complementary benefit along with the cost reduction from less input use and greater resource use efficiency for smallholder farmers as a result of their applying SRI principles in crop production.

Table 6: Area under rice cultivation (Million Ha)

<table>
<thead>
<tr>
<th>Country</th>
<th>irrigated</th>
<th>Rainfed</th>
<th>% Irrigated</th>
<th>% Rainfed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>2.33</td>
<td>6.67</td>
<td>25.9</td>
<td>74.1</td>
</tr>
<tr>
<td>Cambodia</td>
<td>0.48</td>
<td>2.62</td>
<td>15.5</td>
<td>84.5</td>
</tr>
<tr>
<td>Vietnam</td>
<td>4.59</td>
<td>3.2</td>
<td>58.9</td>
<td>41.1</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>0.19</td>
<td>0.79</td>
<td>19.5</td>
<td>80.5</td>
</tr>
<tr>
<td>Regional</td>
<td>7.62</td>
<td>13.26</td>
<td>36.5</td>
<td>63.5</td>
</tr>
</tbody>
</table>
We also calculated correlation between energy use and paddy yield using the yield and input data (and corresponding energy use) reported from our project sites. It was clear that yield was increasing with increasing input/energy use until 10 GJ/ha but after that it was showing negative trend (Fig. 19). Therefore, a well-established notion that high input use will always translate into higher yields is not correct. Optimization of input use need to be taken into consideration. SRI provides space for optimization through adjustment in crop management practices and input usage.

![Figure 19: Correlation between total energy input vs. paddy yield](image)

8.2 Rainfed and organic production systems are more efficient than irrigated

It was surprising that with SRI crop management, the economic benefits from rice production were higher in rainfed areas compared to irrigated areas (Table 6, Mishra et al., 2016). Further, we learned from experience in Thailand in 2016, where different groups of farmers reported varying farm-gate prices for their produce, depending on perceived difference in quality. Those farmers who were involved in quality rice production, either organic or inorganic SRI rice, they reported higher economic return, if not always higher yields.

This was seen even when the paddy price declined, as in 2016, because quality rice did not experience as much decline in its market price as did standard rice. Although this learning was from Thailand only, it provides support for the idea that agronomic improvements, if complemented by favorable market opportunities for smallholder farmers of rainfed areas, there can bring benefits for farmers, consumers, and the environment.
Table 7 (a): Production efficiency of different practices in irrigated and rainfed project sites of SRI-LMB provinces

<table>
<thead>
<tr>
<th>Variables</th>
<th>Irrigated SRI-D (2014-15)</th>
<th>Irrigated baseline</th>
<th>Rainfed SRI-D</th>
<th>Rainfed baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (t/ha)</td>
<td>6.26±0.12</td>
<td>4.5±0.06</td>
<td>5.82±0.11</td>
<td>3.06±0.09</td>
</tr>
<tr>
<td>Economic productivity (US$ earned/ha) @ farm-gate price – US$ spent/ha</td>
<td>2.06±0.04</td>
<td>0.05±0.001</td>
<td>2.9±0.08</td>
<td>0.54±0.01</td>
</tr>
</tbody>
</table>

Table 7 (b): Comparison between Organic SRI, inorganic SRI and Farmer’s practice for their economic productivity

<table>
<thead>
<tr>
<th>Variables</th>
<th>Organic SRI rice (yield data from Sisaket province only)</th>
<th>Inorganic SRI rice (yield data from Uttradit province only)</th>
<th>Farmer’s practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy yield (t/ha)</td>
<td>3.92±0.07</td>
<td>4.62±0.13</td>
<td>3.4±0.06</td>
</tr>
<tr>
<td>Cost of production (US$/ha)</td>
<td>560±17.8 US$/ha</td>
<td>744±22.32 US$/ha</td>
<td>828±24.84 US$/ha</td>
</tr>
<tr>
<td></td>
<td>0.14±0.004 US$/kg</td>
<td>0.16±0.004 US$/kg</td>
<td>0.24±0.007 US$/kg</td>
</tr>
<tr>
<td>Net return (US$/ha) with farm-gate price reported in 2016</td>
<td>636±25.44</td>
<td>470±18.8</td>
<td>217±8.68</td>
</tr>
<tr>
<td>Economic productivity</td>
<td>1.13±0.04</td>
<td>0.63±0.01</td>
<td>0.26±0.009</td>
</tr>
</tbody>
</table>

Therefore, there was evidence that agronomically-sound practices such as SRI, which encourage less use of external inputs (seed, water and fertilizer) and, at the same time, produce more, can redirect rainfed agriculture in ways that enhance food production and address the LMB region’s need for food security.

SRI is seen to produce more output with less input use, and with less energy and less carbon footprint. This is an unexpected departure from the current Green Revolution-based model for agriculture which is based on increased use of external inputs. Except for Cambodia, where farmers chose to follow in part the greater-input track with respect to their baseline, the other countries, Thailand, Vietnam and Laos, all showed...
that more production could be achieved with less input use, with less energy use, and with a reduced carbon footprint. Cambodia reported higher yields and greater net return, but factor productivity there was decreased. This was due to farmers’ increased use of fertilizer and labour at their FPAR sites compared to their baseline figures.

With regard to higher inorganic fertilizer use in Cambodia, which was contrary to SRI practices and recommendations, a close look at baseline statistics of average fertilizer use in all four countries reveals that the average dose of mineral fertilizers used in Cambodia was 150 kg/ha, whereas elsewhere it was much higher: 400 kg/ha in Vietnam, 395 kg/ha in Thailand, and 217 kg/ha in Laos. Actually, the participating Cambodian farmers used less fertilizer compared to other three countries, so in a way, they were trying to ‘catch up’ with their neighbors. They did raise yields but in doing so they reduced their fertilizer productivity. The average amount of fertilizer used at the FPAR sites in Cambodia was 233 kg/ha, which was relatively lower than the baseline figures of Thailand and Vietnam. As the results have been presented at the country level, and have been discussed with reference to the country’s baseline fertilizer use, the analysis shows lower fertilizer productivity in Cambodia.

On the other hand, in Laos, many of the FPAR sites did not use any mineral fertilizer at all, especially at those sites located near to mountains, because the soils in those areas are reasonably rich, having nutrients washed down the mountainsides to their fields. They also relied on manure rather applying mineral fertilizers. At sites in Laos where fertilizers were used, the average dose was 175 kg/ha. Therefore, significant yield increases coupled with lower fertilizer use was one of the reasons for the higher factor productivity observed in Laos. Similarly, Thailand and Vietnam used 60% and 35% less mineral fertilizers, respectively, compared to their respective baseline figures, getting more rather than less yield.

Therefore, it was confirmed from these farmer-based evaluations that rice yield can be sustainably intensified in rainfed areas with lower input use. But further questions arise: are these changes making farming more profitable? Are poor farmers’ livelihoods being improved? Are the changes introduced giving them additional income from rice farming? Are their food security needs being addressed?

8.3 Did SRI contribute to food security and household income?

When we look at the figures for household rice sufficiency, it is evident that households in all the four countries are nearly self-sufficient, in Thailand and Vietnam almost 100% already produce enough rice for their family needs, whereas in Cambodia and Laos
these percentage are 88 and 72%, respectively (Table 3). Therefore, getting higher yields only may be an immediate concern for Lao and Cambodian farmers, whereas this is not in issue for Thai and Vietnamese farmers.

Table 8 provides data on the average contribution of paddy production makes to households’ incomes in the four countries. We discussed results for two years, i.e. for 2015 and 2016, since these two years the project witnessed significant fluctuation in weather as well as paddy price. Except for Thailand, where paddy contributes 62% of households’ income, households in the other three countries do not get major economic benefits from their rice farming. These are aggregate statistics, not data for FPAR project participants only. At the province level in Cambodia, the contribution of paddy to household income is only 21%; in Laos it is 24%; and in Vietnam it is 22%. It means that rice is being grown mainly for household consumption in these countries, functioning differently than in Thailand.

If we analyze the situation of farmers involved in our project, however, we see that in Cambodia, Thailand, and in Vietnam where relatively poor farmers were selected, rice contributes only a small fraction to their household income, 16% in Cambodia, 22% in Thailand, and 3% in Vietnam. In Laos, on the other hand, more progressive farmers were apparently selected. There, rice contributed 32% to the household income of participating farmers, remembering that the percentages are for household income and not for household consumption.

With SRI intervention, either as SRI-Demonstration or as SRI-Transition, it can be said that due to the higher yield and higher net income, paddy’s contribution to household income was significantly improved relative to the baseline. The economic benefits from rice production were more than doubled in Laos and Vietnam, more than 100% in Thailand, and 11% greater in Cambodia. However, except for Thailand, participating farmers in the other three countries are not much linked to markets; therefore, they are not getting as much significant economic benefits from rice farming, as seen in Thailand. But rice sufficiency was strengthened with some surplus production, and as costs of production were reduced, the new method reduced overall household expenditure and need for money.

Further if land productivity is increased following SRI practices, farmers can diversify their farming practices, reducing their area under rice cultivation and increasing areas under other crops such as vegetables, legumes, etc. This diversification can enhance
nutritional security of the poor households and can make farming and farmers more resilient to climate, market and other stresses.

Table 8: Percentage contribution ($mean + se$) to household income due to change in practices

<table>
<thead>
<tr>
<th>Practices</th>
<th>Year 2015 income (US$) based on average paddy area /HH)</th>
<th>Year 2016 income (US$) based on average paddy area /HH)</th>
<th>% contribution to household income due to change in practices (2015)</th>
<th>% contribution to household income due to change in practices (2016)</th>
<th>% contribution of paddy to household income (Baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAMBODIA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRI-D</td>
<td>434.37 ±20.15</td>
<td>305.21 ±14.61</td>
<td>20.62 ±1.01</td>
<td>14.49 ±0.62</td>
<td></td>
</tr>
<tr>
<td>SRI-T</td>
<td>326.31 ±15.21</td>
<td>218.14 ±9.53</td>
<td>10.50 ±0.42</td>
<td>10.35 ±0.45</td>
<td></td>
</tr>
<tr>
<td>FP</td>
<td>175.17 ±14.50</td>
<td>160.75 ±6.81</td>
<td>8.31 ±0.39</td>
<td>7.63 ±0.25</td>
<td></td>
</tr>
<tr>
<td>Baseline (province)</td>
<td>442.31 ±21.10</td>
<td></td>
<td></td>
<td>21 ±1.01</td>
<td></td>
</tr>
<tr>
<td>Baseline reported by FPAR farmers</td>
<td>331.19 ±15.24</td>
<td></td>
<td></td>
<td>15.72 ±0.6</td>
<td></td>
</tr>
<tr>
<td>LAO PDR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRI-D</td>
<td>1676.12 ±73.41</td>
<td>1517.68 ±70.12</td>
<td>83.25 ±3.41</td>
<td>75.38 ±3.43</td>
<td></td>
</tr>
<tr>
<td>Baseline (province)</td>
<td>483.12 ±21.51</td>
<td></td>
<td></td>
<td>24 ±1.06</td>
<td></td>
</tr>
<tr>
<td>Baseline (reported by FPAR farmers)</td>
<td>642.3 ±28.23</td>
<td></td>
<td></td>
<td>31.89 ±1.3</td>
<td></td>
</tr>
<tr>
<td>THAILAND</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRI-D</td>
<td>3201.37 ±151.13</td>
<td>1644.11 ±80.34</td>
<td>65.90 ±3.19</td>
<td>28.31 ±5.84</td>
<td></td>
</tr>
<tr>
<td>FP</td>
<td>1676.43 ±76.87</td>
<td>289.82 ±13.32</td>
<td>67.19 ±2.63</td>
<td>11.61 ±0.34</td>
<td></td>
</tr>
</tbody>
</table>
8.4 What if farmers are connected to market?

When we analyzed the situation of those farmers who are linked to markets, particularly in Thailand, it can be seen that their income from paddy production decreased in 2016 compared to the previous two years. This is
because paddy price was higher in 2014 (see Mishra et al. 2016: http://www.aimspress.com/article/10.3934/agrfood.2016.2.102), went down in 2015, and then further declined in 2016, making rice farming less profitable (See page 10, Progress Report of Thailand at http://www.srilmb.ait.asia/downloads/Thailand%20Progress%20Report%202017.pdf). The decline in income from rice thus had nothing to do with SRI productivity. For example, in 2016 the farmgate price for paddy was only 0.32 US$/kg (32 THB = 1 US$), half the price received two years before, when it was 0.65 US$ (21 THB). Therefore, in addition to fluctuation in water availability and climate which rainfed farmers are continually exposed to, the project witnessed at household level how rice price instability works to the disadvantage of vulnerable households who are dependent on market transactions.

If we compared SRI yields and net returns compared to those achieved through conventional practices, however, it was consistent that SRI yields and net returns were always higher compared to the baseline levels and use of current farmer practices. This differential was similar in all three years. Therefore, the rice crops and SRI farmers were more resilient compared to conventional farmers.

In addition, as discussed in the above section, with SRI crop management, the economic benefits from rice production were higher in rainfed areas compared to irrigated areas. This was seen even when the paddy price declined, as in 2016, because quality rice did not experience as much decline in its market price as did standard rice. Although this learning was from Thailand only, it provides support for the idea that agronomic improvements, if complemented by favorable market opportunities for smallholder farmers of rainfed areas, there can bring benefits for farmers, consumers, and the environment.

In Vietnam, farmers reported relatively lower costs of production in 2016 and therefore more benefits, but not much difference was seen in Cambodia and Laos. Slight variations in price were reported due to fluctuations in currency exchange rates (local currency to US$), but the farmgate price of paddy remained relatively stable.
8. **LEARNING FROM FARMERS:** What do they prefer and why do they prefer?

Farmer’s adaptation response resulting from the SRI capacity-building interventions

The results that were discussed in the earlier section was from the FPAR training sites led by the farmers trainers or SMART farmers where farmers and their neighbors were engaged in the season-long training-cum-SRI evaluation, adaptation and capacity building interventions. These FPAR sites were supported by the project. Once the farmers finish the training, they go back to their village and apply all or few or not apply SRI practices. The Monitoring Evaluation and Learning study captured the farmer’s adaptation response that resulted from the SRI capacity building intervention.

9.1 General background of the respondents and land holding who participated in MEL survey

One of the important trends that has emerged in agriculture in the LMB region with respect to age distribution and gender is what is referred to as ‘the feminization of agriculture’, with women farmers accounting for a larger share of farm households in Cambodia, Thailand and Vietnam. The percentage of women farmers in these countries ranged from 65-70% in Thailand and Cambodia to 80-85% in Vietnam (Figure 21). However, Laos PDR was an exception, where the proportion of women farmers was close to 40%. Quite interestingly, the average age of rice farmers was the lowest at 40-45 years in Laos PDR, while the average age was 50-55 years in Thailand and Vietnam, and 48-50 years in Cambodia.
The average size of farm holdings was found to be the lowest in Vietnam (0.25 to 0.5 ha) as compared to 3-4 ha in Thailand, 2-3.5 ha in Lao PDR, and 0.75 ha to 1 ha in Cambodia (Figure 22).

**Figure 21:** Gender and age group of the MEL survey respondent

**Figure 22:** Average land holding and area under SRI cultivation of MEL respondent
9.2 Adaptation response with respect to SRI crop management practices

Following the introduction of SRI, the adoption of specific SRI practices has increased in Thailand, Vietnam, and Cambodia. The rate of adoption of various SRI practices, such as fewer seedlings/hill or fewer seeds/hole, wider spacing, application of organic manure, etc., had increased in Thailand, Vietnam and Cambodia over the past 2-3 years. It was seen that in Cambodia initially transplanting was the main sowing method for crop establishment (90% followed transplanting in 2014), but the recent trend, i.e., in 2016, the findings indicated that the farmers are switching to direct-seeding method from transplanting method. In Thailand, broadcasting is the common sowing method for crop establishment, as established during the baseline survey.

Figure 23 (a, b & c): Change in SRI practice over the years in Cambodia, Thailand and Vietnam

Transplanting is followed by 25-28% farmers only. With respect to pattern of response in the last three years, there were no major changes observed in Thailand. But it was seen in some districts that farmers are switching to direct-seeding method from broadcasting (from 8% in 2014 to 18% in 2016).

In Vietnam, The MEL survey in two project provinces indicated that farmers are not
inclined to any single method. It was seen that manual transplanting was common in Ha Tinh province, whereas in Bac Giang, both manual as well as parachute transplanting were common. In Laos, transplanting is the main sowing method and there were no significant changes observed at the FPAR farmer’s fields over the years. Farmers and government counterparts were mainly interested in evaluating the SRI practices rather adapting and adopting it,

The practices of fewer seedling per hill and wider spacing, along with younger seedlings, have enabled the SRI rate of adoption to rise over the past 3-4 years following SRI training activities in these countries. Not surprisingly, the adoption of various SRI practices mentioned above was highest among FPAR farmers as compared to non-FPAR farmers (see MEL presentation file at https://drive.google.com/drive/folders/19LQa3cZ9or60boEIfpYoEc9Sl6nbAK, full report can be assessed from http://www.sri-lmb.ait.asia/downloads/SRI-LMB%20MEL%20REPORT%20Final.pdf

Overall, on farmers’ response to learning SRI practise, which was characterized as SRI in transition (SRI-T), it was observed that seedlings/hill (1-3 seedlings/hill) and SRI spacing (20x20 cm – 30 x 30 cm) was the most widely adopted practices in all four countries and were applied by 78% of the FPAR farmers (see Figure 24 & 25).

**Cluster profile plots for SRI management practices**

<table>
<thead>
<tr>
<th>SRI practices</th>
<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seedling/hill</td>
<td>7307.98</td>
</tr>
<tr>
<td>Spacing</td>
<td>412.39</td>
</tr>
<tr>
<td>Seedling raising method</td>
<td>398.12</td>
</tr>
<tr>
<td>Seedling age</td>
<td>80.23</td>
</tr>
<tr>
<td>Aerobic soil condition</td>
<td>0.358</td>
</tr>
<tr>
<td>at least for a week at vegetative stage</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 24:** Adaptation response on SRI practices by FPAR farmers in 30 districts of 10 provinces of the LMB countries.
Figure 25: Adoption rate of the SRI practices by FPAR farmers after the FPAR trainings in 30 districts of 10 provinces of the LMB countries.

SRI seedbed (dry seedbed) and younger seedlings (10-15 day-old) were applied by relatively few farmers. Keeping paddy soil aerobic for a week or so during the vegetative stage were least followed. However, most of the farmers responded that aerobic soil management were not followed as a part of their crop and soil management because this occurred naturally, given that they are working in rainfed environment. Almost all FPAR districts experienced early drought during the project implementation years. Early drought is common in Southeast Asian countries.

9.3 Economics of SRI crop management practices at farmer’s fields

9.3.1 Why farmers widely adopted fewer seedlings/hill and wider spacing SRI practices
To understand the response better, cost of production and net return in SRI and conventional practices were analysed and it was seen that unit cost of production of SRI paddy (as a package) was relatively lower compared to the conventionally grown paddy (Figure 26).

![Graph: Average unit cost of production of rice under SRI and conventional practices](image)

**Figure 26:** Average unit cost of production of rice under SRI and conventional practices

The applied practices were further analysed to understand the effects of plant spacing and seedlings/hill (the most preferred and adopted SRI practices) and the associated cost of production, yields and net returns. The incremental yield benefits as well as the increase in net returns realised from these two SRI practices as shown in the Figure 27. This was the reason for wider adoption of these two practices. The increased net return was due to cost reduction and also due to higher yields and so higher benefits.
Similarly, fewer seedlings/hill (1-3 seedlings/hill) were agronomically and economically efficient choice for the farmers compared to planting 5-6 seedlings/hill (Figure 28). The data has been presented for two countries only. In Vietnam, 1-3 seedlings/hill transplanting is already a part of conventional practice, therefore no adoption or rejection were seen. Whereas, in Lao PDR, farmers applied all the SRI practices and evaluated SRI as a 'package'. No learning plots were set up to compare the effects of one or two practices of SRI. In addition, the application of manures increased in Thailand, with a slight increase in Vietnam. The other important findings were that
women farmers have reported higher yield and higher net returns from their farms compared to their male counterparts. (See https://drive.google.com/drive/folders/19LQa3cZ9ov60boEJjSapYOEnkSl6nbAK & page 41-47, MEL report, available at: http://www.sri-lmb.ait.asia/downloads/SRI-LMB%20MEL%20REPORT%20Final.pdf

9.3.2 Why Mechanization in SRI?

In Thailand and later in Cambodia, farmers switched from manual transplanting to mechanized transplanting and direct seeding and they evaluated the effects of both practices on yields and net returns. The finding suggested that average paddy yields under manual and mechanical transplanted rice were not very different but average net returns were always higher with mechanically transplanted rice even with the higher farmgate price for paddy reported for the manually transplanted rice (Fig. 29). This was due to significant higher labour costs associated with the manual transplanting compared to mechanical transplanting in Thailand.

Figure 29: Economics of mechanical vs. hand transplanting in Thailand

Overall and in all four countries, labour and fertilizer costs contributed substantial portion of cost of cultivation followed by seed and pesticide costs in all four countries (Fig. 30). The ‘other costs’ (cost of intercultural operation, field supervision, etc.) also substantially added to the total costs of cultivation. It has to be noted that the labour wage in Thailand is much higher than the other three countries. Also, only 40-50% labour is supplied from family, rest they hire from outside.
If we see the recent trend of agricultural labour wage in Thailand, it is increasing continuously, also the farmgate price of paddy is decreasing except for the quality rice hence farmers are inching towards mechanization for cost reduction. Therefore, labour availability and labour costs are the main costs along with fertilizer costs that influence the adoption decisions coupled with the market paddy price. In other three countries, labour cost is not the actual costs and therefore emphasis is more on saving seeds and chemicals to reduce the cost of cultivation, making rice farming more profitable, if these inputs are purchased by farmers. Otherwise decisions on adoption of innovative practices are mainly influenced by the productivity gain that are achieved through improved agronomic management practices such as SRI.

9.4 Is SRI efficient? Let’s evaluate the productivity gains at FPAR training sites, FPAR farmers’ fields with respect to baseline (pre-project scenario)

9.4.1 Paddy yield and on-farm net return

The Figure 31 (A&B) shows the yield and Net Return at FPAR training sites, FPAR farmer’s fields and baseline figures. With respect to baseline, the average yield gains across the region was 52% at FPAR training sites, whereas it was 19% at FPAR farmer’s
fields. At country level, Laos reported 98% yield gains at training sites whereas Vietnam and Cambodia reported 46%. In Thailand, it was 18%. At FPAR farmer’s fields (farmers who applied some of the SRI practices after receiving FPAR trainings), with respect to baseline, Laos reported 45% yield increase, Vietnam 32% and Thailand 10%. In Cambodia, the average (average of three years) yield gains with respect to baseline was -9%. It was interesting to note that farmers of Vietnam and Laos opted to go with transplanting whereas in Thailand and Cambodia, SRI practices were applied with direct seeding by majority of the farmers.

The average net return across the region at FPAR training sites (with respect to baseline) was 196%, whereas at FPAR farmer’s fields it was 112%. At country level, Vietnam and Thailand reported higher economic return. The higher net return at training sites in Vietnam (>4 times higher than the baseline) was due to less costs of production and higher yields. In Thailand, the higher net return (> 3 times higher) was due to less cost of production (due to less fertilizers, labors and seed costs. In Cambodia and Laos, it was 15 and 19% higher respectively. At FPAR farmer’s fields the net return was 292% in Thailand, 129% in Vietnam, 49% in Laos and -19% in Cambodia. It has to be noted that net return in Laos at FPAR farmer’s fields was higher than the net return reported from the FPAR training sites. This was due to minimal use of fertilizers at farmer’s fields. The farmers in Laos use very little amount of fertilizers. More than 45% farmers did not report fertilizer use. Whereas as a part of training, mineral fertilizers were used at all training sites, resulting into higher cost of production and so less economic return.

9.4.2 Economic productivity (Net return/cost of production/ha)

The Economic Productivity (EP, dollar gained/dollars spent/ha) of SRI practices applied at the training sites and FPAR farmer’s fields and compared with the control
and baseline. The results clearly showed that in Thailand and Vietnam, with respect to baseline and control, the EP was higher at FPAR training sites and at FPAR farmer’s fields. In Cambodia, the EP at FPAR training sites was lowest and even at FPAR farmer’s fields, it was less than the baseline and control. Although, yields were higher at both the sites, training sites and FPAR farmer’s fields, but due to higher costs of production (mainly fertilizers), the EP was less. Similarly, in Laos, majority of the farmers do not apply mineral fertilizers but at the FPAR training sites, the fertilizers were applied resulting into higher costs of production compared to the baseline and control and therefore lower EP. As a trend, it is evident that Laos and Cambodian farmers apply less fertilizers compared to Thailand and Vietnam. Both countries are in the process of modernizing their agriculture with an objective to increase the productivity (yield/ha), often encouraging higher input use, but also looking for the market, as they grow sufficient rice to meet the domestic demand. Currently, in both countries, farmers do not have access to market and also, they are not doing chemical intensive agriculture. If the market is created and opportunities are given to smallholders, both countries can enter into sustainable rice production without much transition.

**Figure 32:** Economic productivity of SRI practices applied at FPAR training sites (FPAR-TS), FPAR farmer's fields (FPAR-MEL) with respect to control and baseline scenarios
9.5 How many farmers practicing SRI? Adoption rate and performance index related to SRI practice adoption by FPAR trained farmers

Adoption rate is the number of FPAR farmers adopting the new SRI practices divided by total number of farmers who have received FPAR trainings and multiplied with 100. In Thailand, the adoption rate was 34% in 2014, increased to 60% in 2015 and to 65% in 2016. This indicated the number of farmers adopting SRI practices in 2016 compared to 2014 increased by 31 percentage points (Fig. 33A). In Cambodia, there is slight increase in adoption rate from 35.2% to 38% from year 2014 to 2016. Average adoption rate was 51% and the total number of farmers who were directly involved in the FPAR trainings was 10,366 (5131 in Cambodia and 5235 in Thailand). It means more than 5000 farmers adopted SRI practices, few or more, after receiving the training. In Vietnam, The FPAR structure was different than the other three countries. Following the existing extension programme, applied by the National IPM Programme of the FAO, the FPAR cycle were not repeated at the same location, instead every season, the FPAR were conducted at new location in the same village involving 50% new and 50% old farmers. The MEL survey interviewed both groups of farmers. And it was found that more than 70% of farmers are applying some of the SRI practices (date not shown here). It has also to be noted that many practices categorized as SRI is already a part of conventional farmer’s practices, such as transplanting relatively younger seedlings, transplanting fewer seedlings and maintaining wider spacing. This was due to policy support given to the SRI in Vietnam and associated capacity building intervention including through FFS. The SRI has been endorsed as “Technical Advance” and recommended for the resource poor farmers. The SRI has also been included in the climate change strategic plan and action and the emphasis has been given to the water management practices. No clear trend was observed in Laos.

![Performance Index and Adoption rate in Cambodia and Thailand](image)

**Performance Index:** The performance index is the yield from the adopting new practices (SRI yield at FPAR farmers field) divided by average yield from both adopting new practices and conventional practices (control and SRI).

**Adoption rate:** Adoption rate is the number of farmers adopting the new practices divided by total number of farmers and multiplied with 100.
We also calculated the performance index which is the yield from the adopting new practices (SRI) divided by the yield from both adopting new practices and conventional practices (control and SRI) in the same year and at the same location. The performance index in Thailand was 1.25 in 2014 which decreased to 1.09 in 2015 and further to 1.07 in 2016, which means 11% yield increased in 2014 while 10% increase were noticed in 2015 and the trend continued in 2016 as well in the SRI practices. Similarly, in Cambodia, performance index was 1.1 in 2014, decreased to 1.06 in 2015 and 1.04 in 2016 (Fig. 33B). The decrease was insignificant. It means the relative average yield gain at FPAR farmer's field was 11% when they used new practices with respect to the conventional practices in the same year and at the same location.

9.6 Farmers transitioning towards SRI: Major conclusions emerging from the MEL study

The earlier sections discussed the key results of the MEL study. Following points summarized the key learning resulted from the study. Full report of the study can be assessed from http://www.sri-lmb.ait.asia/downloads/SRI-LMB%20MEL%20REPORT%20Final.pdf

1. The analysis of SRI adoption and practices being followed in the four LMB countries showed that ‘SRI farmers’ are not practicing 100% SRI as per the SRI definition. They seem to have modified the practices according to their needs and adapted and applied them to suit the local conditions.

2. The common principles, which were the guiding force for SRI adaptation, were increase in yields, increase in benefits, and reduction in cost of cultivation. Even though farmers have not applied the full principles of SRI, the SRI intervention offered increased yields and net return in all four countries. The average increase in yield reported was 7-18% whereas average net return reported ranged from 15% to three times more.

3. Fewer seedlings/hill and wider spacing were the most preferred practices, if they applied transplanting method for crop establishment, and wider spacing and fewer seeds/hole if they used the direct-seeding method. The reason for wider adoption was higher yields and higher net returns from these two practices compared to others.
Thailand, motivating factors were reduction in inputs (seeds and labour costs), increased yields, and better paddy price.

4. The adoption response was based on the agronomic and economic performance of the practices in the SRI fields and was linked with the input (labour, seeds, fertilizers) and output (paddy price, incentive, where applicable) price policies of the countries. This was visible in Thailand and Vietnam, which focused on the reduction of input use (seeds, chemicals and labour) through training intervention, whereas in Cambodia and Laos, interventions appear to be mixed, encouraging good practices such as SRI and also encouraging application of increased doses of fertilizer, both organic and inorganic. Although Laos’ average fertilizer dose at FPAR sites was less compared to the baseline survey, this was due to the fact that many FPAR farmers did not apply any fertilizer at their SRI/FPAR sites, especially in the sites located near mountain areas.

5. Adoption of SRI practices seems to be more prominent at women farmers’ fields. They have not only reported better adoption of practices but also higher yields and higher net returns. They have also reported less labour use. They stay at home, so they are in a better position to take care of their fields with regular supervision and so with less field maintenance costs (other costs).

6. Labour and fertilizer were the two main inputs where costs saving was significant, if they tend to reduce the costs of cultivation such as in Thailand and Vietnam. In Thailand, introduction of direct seeder was one of the approaches that reduced labour and seed use. A similar trend was followed in Cambodia in 2016, where more than 50% farmers undertook SRI with direct seeding.

7. Training and capacity building on SRI practices appeared to be one of the hallmarks of the SRI-LMB project in the four countries. It was found that training on the production methods that conserve natural resources seems to improve soil health and to enhance ecosystem services and would strengthen sustainability of the production system and resilience capacity of the smallholder farmers.

8. Whatever the location-specific adaption and adoption processes used and results achieved, it was clear from the results that this project has demonstrated that even under rainfed condition, the farmers have achieved yields more than the national average, and this even with just partial adoption of SRI. This is a remarkable achievement. The next phase should target yields of 4.5 to 5 t/ha under rainfed conditions.
9. The study brings out that improved farmer’s connectivity to markets along with farmer compliance with market standards would be required to maximize the benefits arising from the adoption of SRI. Laos and Cambodian farmers apply fewer chemical fertilizers and more organic manures. Both countries have a good environment for organic rice/crop production. However, at present there is no remuneration for quality rice. This could be changed through the development of farmers’ cooperatives and by changing price policy to compensate for their higher quality produce.

10. Mobilization and collectivism among the farmers are another important strong aspect of the SRI interventions as evident from the surveys. SRI-LMB has already created informal farmers’ groups in 11 provinces across all four countries through the involvement of 30,000 farmers directly in project activities over the last five years. These groups can be further strengthened to develop farmer’s cooperatives at district and province levels, and also at the country level, to accelerate the sustainable rice intensification along with market development for smallholders.
9. **ACCELERATION**: Let’s put the ‘pieces’ together and walk the talk

10.1 Policy environment and SRI adaptation response, and key recommendations for achieving the food security goal

Issues of food and income insecurity have been on the rise in Asia, in particular, due to increased pressures and competition for land, water and inputs. Also, it is widely known that women play a major role in rice farming in all countries in Asia: transplanting, weeding and harvesting – their work being mostly unrecognized. Women also lack ownership of land have very limited access to finance, extension services and other technical support. These constraints and challenges facing the Asian smallholder agriculture need proper attention and one of the important priorities would be to invest in agriculture for reasons of food (also nutritional) and employment security in Asia.

In particular, this is very relevant for rice production in LMB countries since 60% of the annual cropped area in Thailand and Vietnam, and close to 90% in Cambodia and Lao PDR, are devoted to growing rice and mostly by smallholder farmers. This region is also the largest rice-exporting region with annual export volume that constitutes approximately 55% of the global rice trade. It thereby makes a large contribution to the world food security, although it should be noted that most of the exported rice comes from the region’s irrigated rice area. The ability of these countries to export rice from their national pools of production is of course greatly dependent on how well smallholders are able to maintain their food security and contribute to those pools.

The high Panel of Experts on Food Security and nutrition (HLPE) of the Committee on World Food Security (CFS) recommends investing in smallholder agriculture focusing on the following components: 1) conservation and enhancement of soil health; 2) sustainable management of all water resources and launching a “more crop and income per drop of water” movement; 3) extending appropriate technologies and inputs; and 4) providing the needed credit and insurance. All five components should ideally be addressed. But how to address these components with the smallholding food insecure population fully involved and benefitted is yet to be worked out as smallholders operate under very diverse environmental conditions which are often difficult to understand and satisfy through technological intervention alone. The human learning philosophy says that if appropriately ‘fuzzy’ boundaries are created and if structural design are loosely defined and if some degree of uncertainty is built into the system, it can impel human being to unfold his power for creativity and productivity.
Appreciating that within the farming community there is more potential for problem solving, innovation, and resource mobilization than usually evident under current organizational structures and stratification. The SRI-LMB used this learning philosophy and worked with the principles of SRI which are amenable to farmer’s experimentation and adaptation.

The SRI practices were introduced and adapted with and for smallholders who have few economic inputs but have greater control over their own household resources. The technical and economic performance of the location specific SRI practices that were developed and applied in all four LMB countries clearly showed the relevance of SRI in this context. Some of the interesting observation emerging from the analysis of country-level performance of farms adopting SRI and regional trends are:

(a) Economic productivity of SRI farms was higher in rainfed compared to irrigated system;
(b) Organic SRI was more profitable than inorganic SRI;
(c) Majority of the farmers have preferred the SRI practices of wider spacing while planting as well as use of fewer seedlings per unit area; and
(d) Higher average yield and net returns from the SRI spacing method in comparison to the spacing adopted in conventional rice farming
(e) Women farmers are getting higher benefits from SRI compared to their male counterparts
(f) GHG reduction was possible with SRI without any reduction in yields
(g) Factor productivity (land, labour, water, energy) was always higher with the SRI compared to the conventional systems

Figure 34: World Food Security, FAO and ASEAN policies for smallholder farmers

CFS, FAO, and ASEAN policies for smallholder farmers
In addition, the SRI-LMB was quite successful in terms of facilitating the development of informal farmer’s group through farmer participatory action and research (FPAR) approach involving 15000 farmers directly in trials and adaptation of new ideas plus (less directly) 30,000 over the past six years in the LMB region, majority (56%) of them being women farmers. More importantly, the reported beneficial outcomes (economic, social and environmental benefits) of SRI project, along with the participatory approach involved in the wider adoption of SRI like practices should eventually promote the sustainable development goals (SDGs) underlying the principle of green growth (cleaner, more efficient and more resilient farming system) as presented in Figure 35 below.

**Figure 35:** Green growth in agriculture with System of Rice Intensification practices using the farmers participatory action research approach.
Even so, the policy environment and the institutional responses to the adaptation and adoption of SRI like practices in the LMB region needs to be further strengthened realizing that policy environment across the LMB countries is at different stages of development and yet evolving. Nevertheless, the promotion and scaling up of SRI can be the next step in the order of progression starting from Laos PDR, followed by Cambodia, Vietnam and Thailand (Fig. 36). Thailand and Vietnam are relatively ‘mature’ countries and can initiate integration of SRI and Conservation Agriculture along with market development. In this regard, a conceptual framework has been developed in the form of a ladder, the small-scale farmer development transition ladder (See Figure 36). The ladder is built around two dimensions looking at productivity and transition stages in respect to rice farming. At the start of the ladder, the bottom left, the level of productivity is relatively low. At this stage intensification strategies can be applied to help small-scale farmers become more self-sufficient. At some point scaling up and expansion strategies may become relevant and can help the farmers to expand and increase productivity further. Farmer groups and coops are commonly applied to help in this regard. As farming develops and the macroeconomic situation improves, some farmers may diversify into other industries, provided infrastructure and other support mechanisms are in place.

**Figure 36:** Macroeconomic situation of all four LMB countries and possible next steps towards economically efficient Green Growth and sustainable intensification in agriculture
To this end, and to support the broader development goal, following key policies and recommendations have been suggested.

10.2 Country specific policy options and recommendations

Lao PDR

✓ **Promote SRI for green growth in agriculture** - The country is adopting key policy reforms to make its strong economic growth benefit more people, especially the poor and disadvantaged, while protecting the environment. The First Programmatic Green Growth Development Policy aims to establish the foundations for ‘green growth’. Green growth is cleaner, more resource-efficient and more resilient to risks such as climate change. SRI provides opportunities for this inclusive growth and should be promoted within the context of SSG (See Figure 36).

✓ **For positive impact on macro-economic growth, agriculture should be made**, or continue to be, a national priority and smallholder, landless and women farmers should be viewed as essential participants when it comes to sustenance and economic growth in Laos.

✓ **Smallholder farmers, landless and especially women farmers should be included** in the process of policy development to ensure smallholders can benefit from them in their growth path and to avoid negative outcomes.

✓ **Reinforcement/adjustment of capacity of extension staff at district level, targeting both GoL and ODA.** Importantly, efforts should be made to influence donor’s agenda so field extension staff can benefit from higher benefit. Key areas for capacity building include: dealing with private sectors and contractual laws (understanding of contract farming), basic economic and marketing training, management and group facilitation, PRA, land use planning, legislation on the use of chemical agricultural input Explore and promote interim measures for tenure security on village land, e.g., village use forests and old fallow lands.
✓ Establishment of national-level farmer network which will advocate for better policies for farmers is essential and will be useful. In this regard, linking FPAR /project farmers to Farmer National Group would be a next step.

✓ Support will be needed to reduce market vulnerabilities of small-scale producers as Laos enters the ASEAN Economic Community (AEC), and other measures to help ward against unsustainable debt and the risk of distress sales of land.


Cambodia

✓ Scale up SRI for sustainable rice production: Evidence from Cambodia shows that SRI is environment friendly, can increase the yields at lower costs and improve farmer livelihoods. It can be a vital component of operationalizing the RGS. There is a need to promote it to ensure wider adoption by farmers. Utilizing the SRP indicators, farmers can proceed towards quality rice production and better access to markets.

✓ Invest more in agriculture sector: This should be a priority for a more sustainable and equitable development of the country. Macro-economic policies for improving infrastructure, reducing the costs of doing business in Cambodia and attracting more external investment in farming should be encouraged.

✓ Ensure land tenure security for smallholders, especially women farmers: Research shows that land tenure security is closely linked to better and sustainable land use. It is also positively linked to improved wellbeing of the farmers.

✓ Ensure better access to agricultural inputs for smallholders, especially women farmers: Improving access to reliable and low-cost agricultural inputs will help farmers invest in agricultural development, build assets and reduce their vulnerability to crises. The opportunity for providing well-
designed high-impact financial services though savings groups and agricultural cooperatives is immense.

✓ **Support women farmers as extension agents:** Experience from Cambodia shows that trained women farmers can be effective extension agents, especially in reaching out to the women farmers. They should be actively considered to be part of the efforts directed for improving the agricultural extension system.

✓ **Strengthen linkages between smallholders and the markets:** There is a need to facilitate partnerships between individual farmers and producer groups with the private sector to ensure that the former have more access to domestic and international markets, and other avenues for engagement for improving their livelihoods (e.g. agritourism).


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**Thailand**

✓ **Promote efforts for scaling up SRI:** Experience of Thai farmers with SRI shows that they appreciate the improved productivity and produce quality. These gains are obtained with a reduced cost of production while increasing efficiency of inputs used. There is a need to scale up these efforts to reach a greater number of farmers. Utilizing the SRP indicators, farmers can proceed towards quality rice production and better access to markets. Efforts in this direction is already initiated by Thai government, donors and researchers.

✓ **Support participatory policy and program development in agriculture:** Agriculture should continue to be a national priority. More recognition for the smallholders, especially the women farmers, for the vital role they play in the country’s economy, is needed. They should be actively involved in farming-related policy and program development and implementation.

✓ **Strengthen systems for ensuring better market access, prices and returns for the smallholders:** Identifying critical leverage points in the agri-produce supply chains which can be advantageous for the smallholders and training them to access such systems is essential. Niche areas such as organic rice production
can be considered for market development for the produce by working with other stakeholders in the value chain, and linked to interested farmers. Educating farmers and regulations are both needed for alleviating the debt burden of the farmers. Assisting them in diversifying their agriculture can aid risk reduction and enhance the potential of farming to be more profitable.

✓ **Prioritize providing land security to landless, forest land cultivators, ethnic minority and women farmers:** The population groups mentioned often consist the most marginalized community members. Gender-sensitive policies based on rigorous research findings are needed to ensure that they are provided with land security. Modifying the process of land title registration to also include the name of the women in the household would be a positive step.

✓ **Farmer’s education on financial management and control to mitigate debt burden:** In Thailand debt is an ongoing problem for smallholders and it is very likely that smallholders in other countries face the same problem. This may be one of the most important issues to address. Education in combination with regulation is potentially the most effective way to reduce the debt burden amongst SSFs.

✓ **Monitor and support the programme on gender and land access:** Post-title monitoring and support programs should have an explicit gender component from the beginning stages, recognizing that women have been excluded from programs and their names excluded from land titles. One way to remedy this at a superficial level is to require both spouses’ names on land titles and other property documents. This could also be a start to acknowledging and compensating both men and women as part of displacement related to development projects, which at present disproportionately affect women. Research is also needed to understand how female-headed households have been successful (or not) in obtaining credit and paying off household debts. This would directly inform policy making at the national level as well as Oxfam’s programming on rural poverty.

Vietnam

✓ **Scale up SRI for sustainable rice production:** Evidence from Vietnam shows that SRI is environment friendly, can increase the yields at lower costs and improve farmer livelihoods. The Ministry of Agriculture and Rural Development’s institute has included SRI as a part of plan to reduce greenhouse gas emission in rice production by 15-20% by 2020. It is encouraging that the Vietnamese policymakers support this. Further scaling up of SRI can help in increasing the quality, quality and safety of rice produce, and also aid in increasing the farmer incomes. Utilizing the SRP indicators, farmers can proceed towards quality rice production and better access to markets. Efforts in this direction is already initiated by government, donors and researchers.

✓ **Tap key importers for investments in rice sector:** There is a need for higher investments in Vietnamese rice value chains. The government should actively consider replacing produce sales contracts with key importing countries with investment options linked to rice procurement. These investors can be directly linked to the producers, which could also assist in enhancing grower incomes.

✓ **Facilitate better participation by the farming communities to ensure them more benefits:** The farmer groups and cooperatives being formed and strengthened should be better linked to other actors in the value chain. Creation of infrastructure which will directly benefit them (e.g. irrigation systems, storage facilities, transport systems) and assist trading is necessary.

✓ **Support other actors in the rice value chain:** There is a need for further investment to strengthen other actors working with the farmers. For instance, improvements in rice research and development, and agriculture extension capabilities, can yield rich dividends. At the other end of the value chain, even the prominent traders and exporters could be assisted in building brands for Vietnamese rice.

✓ **Ensure better land access especially to the landless, land poor and women farmers:** More clarity on all agencies responsible and their respective authority for acquiring lands for specific purposes will be helpful. The guidelines for and process of land repossession from farmers need to be streamlined, with a guarantee of proper compensation and efforts for creating alternative livelihood opportunities for the dispossessed. The farmers will benefit with land use certificates without time limits. The regulations and the processes
should especially be sensitive to the needs of the women farmers. Land use certificates should also include their names, in addition to the male household member, during registration.

- **Cooperatives should be enhanced** to link farmer’s linkage to facilitate agriculture extension including SRI scaling up.
- **The government should have a rice sub-sector master plan** with two different but mutually complementary policy targets, including commercial production and small-scale production for self-consumption or for sale in local communities, as we see in Thailand.


10.3 Regional policy environment and key recommendations for future intervention

The ASEAN Integrated Food Security Framework (AISF) and Strategic Plan of Action on Food Security (SPA-FS), has highlighted a strategy to attain long-term food security and improve the livelihoods of farmers in the region ([https://www.asean-agrifood.org/?wpfb_dl=58](https://www.asean-agrifood.org/?wpfb_dl=58)). In particular, in the context of climate change, the Strategic Plan of Action on Food Security for 2015-2020 included as one of its ‘strategic thrusts’ the introduction of climate-smart agriculture in the ASEAN member-states. For this, pilot testing of technologies and practices such as System of Rice Intensification and Conservation Agriculture, as integrated production systems, has been recommended. However, there has not yet been much visible action taken on the ground for such recommendations. SRI-LMB’s multi-year and multi-location results, which resulted from collaborative engagement with governments, experts and farmers in all for countries confirmed that SRI can contribute towards achieving the ASEAN’s food security goal, producing more food with fewer resources and benefitting the millions of smallholder rainfed farmers within the wider region. There is already a good empirical base for SRI expansion in other ASEAN countries such as Indonesia, Malaysia, Philippines and Timor Leste. Such work should be scaled up and scaled out to achieve the larger goal of the region within the climate change context. In addition
to this specific recommendation, we propose following key areas that need to be strengthen at the regional level. They are:

**Development of pro poor policy to ensure food security, sustainable livelihood and choice for attaining wellbeing of smallholder farmers**

- Though agriculture might not be supporting GDP growth as much as other sectors, support to agriculture would be needed to be continued, keeping in mind its two main contributions – food security and job security for the rural population dependent on farm labour. If prosperous, it can also help to minimize migratory trends and keeping labor within the country.
- There is need to improve education programs and job-relevant skills building to engage the smallholders during crop holiday time as alternative livelihood and also to tap into job markets to which smallholders may migrate to, in the future.
- Introducing modernized agricultural techniques and building knowledge of smallholders on how to participate and take advantage of supply chain systems to command a higher price for their produce.
- Striking a balance between crop diversion, expansion and crop intensification like SRI methodologies depending on the specific conditions and developmental stage of the smallholders. Look at alternative, high value crops or value-added systems that can help smallholders increase their income.
- Creation of exclusive agricultural market zones with facilities for smallholders. Providing efficient, real-time market information through a channel designed to reach a large proportion of SSFs (e.g. smart phone application or radio).
- Smallholders should be viewed as essential participants when it comes to sustenance and economic growth in the LMB countries. The respective LMB governments should develop policies and ensure appropriate implementation to enable smallholders play a significant part of the macro-economic scenario of each country.
- All LMB countries under the study have various policies for developing agriculture. But an integrated policy, which can address all the above issues as one, could be a key macro-economic policy. The onus is on the agricultural ministry of the respective governments to coordinate with other departments and develop a vision for a practical policy.
- Beyond policy and regulation development, there is a need for stricter implementation of policy decisions and regulations, with bottom-up
coordinating mechanism, which currently happens to varying degrees in each of the LMB countries

The opportunity costs associated with investing in small scale agriculture needs to be better understood in the LMB region

✓ Within the near future, all LMB countries should prioritize self-sufficiency to safeguard food security, an aspect that could be endangered if the agricultural sector, dominated by smallholders in all LMB countries, is not supported.
✓ Governments should clear the path for a more comprehensive supply chain system, complete with relevant infrastructure like quality agricultural inputs, land rights, mitigating land grabbing, access to credit & technology, access to domestic and export markets, quality maintenance, more reliable contract farming systems, and control mechanism for input supply.
✓ Governments should encourage and facilitate smallholders to access modern technologies, where needed, while striking a balance between expansive cultivation and intensive cultivation so that SSFs can produce optimum quantities with good quality to help improve domestic sales, exports and thus contribute to economic growth.

Extent to which challenges affect the decision and choices of smallholders attaining food security, sustainable livelihoods and well-being

✓ Agricultural agencies of the respective LMB governments such as Extension Offices should provide the necessary technical support to smallholders, and quality control for agricultural inputs. Additional capacity building may be needed for strengthening the Extension Officers.
✓ Improve knowledge and access for smallholders with respect to quality inputs, machinery and tools, affordable credit, and risk mitigating methodologies.
✓ Promote various methods of insurance (crop, cattle and weather) combined with more education and knowledge building for smallholders.
✓ LMB governments, development agencies, private sector and other stakeholders should collaborate to combine their efforts to educate smallholders.
To ensure inclusive economic growth that can bring more benefit to smallholders in terms of existing investment, policies and their implementation

✓ The challenges need to be handled and resolved considering the specific situation in each LMB country. Regional aspects to consider would include: available water resources, soil productivity, available support from government agencies and NGOs, traditional farming knowledge augmented with modern techniques.

✓ Group Farming and or Contract Farming, as part of Dynamic Supply Chain system, are possible solutions to consider. But to be effective, and to protect the interests of SSF, good supervision together with guidance from extension offices / NGOs needs to be in place. While LMB governments need to play an active and facilitating role, with regular monitoring, periodical reviews and timely interventions when necessary.

✓ Smallholders, especially women farmers should be included in the process of policy development to ensure SSFs can benefit from them in their growth path and to avoid negative outcomes by developing participatory guideline and process to ensure/promote active participation.

✓ To monitor and determine the appropriateness of policies and strategies and taking corrective recourse to ensure that they work for the well-being of smallholders.

✓ Evaluations should be undertaken to gain insight into the effectiveness of implemented policies.
10. **WAY FORWARD:** Let’s make farmers ‘Agripreneurs’ and build the momentum for economic and environmental improvements in the region

Multi-location farmer-managed SRI evaluations and adaptation across the rainfed areas of the Lower Mekong Basin region showed that SRI practices, when adapted to local conditions, to be high-yielding, climate-smart and low-cost with much-increased factor productivity of land, labor, capital, water, seeds and agrochemicals inputs. SRI can contribute to poverty reduction and can make smallholder farming more attractive, efficient and smart. The results also showed that how the adoption of low input based improved management practices such as SRI helped to achieve a significant yield with greater resource use efficiency and with higher economic productivity and at the same time reduced GHG emissions from the rice sector.

So far, most of the initiatives in agriculture are intrinsically driven by a mitigation motive with some trade off, but the adoption of SRI practices is an adaptation measure with important mitigation co-benefits. Further benefits can be realized when SRI practices are applied under no till system, sequestering more carbon into the soil and hence building resilience to drought and flooding making rainfed farming more resilient. Efforts are required to take the SRI forward to broaden its scope from a mere cropping practice to a system of agriculture that addresses the larger and much pressing concerns of sustainable agriculture development in the region in particular.

Within the context of Climate-Smart agriculture, SRI as a system should be taken to the next level of its expansion, by which the SRI should be made as an integral aspect of Conservation Agriculture in order to address the problems of land degradation, loss of soil fertility, GHG emissions, water scarcity, empowerment of women, increased youth participation through in the programme and mobilization of the communities for collective action leading to economic and social development and welfare.

Utilizing the momentum that SRI-LMB has created in the region, as a part of next strategy, there is need to work on the following areas:
• Development of farmer’s network (formalization of network) through SRI activities for smallholder market development (partnership with market stakeholders)

• Integration of SRI practices with Conservation Agriculture principles and pilot testing in LMB regions and beyond, leading to development of climate-smart production systems and practices.

• Scaling-up and scaling-out the SRI-LMB learning in the region and beyond (targeting numbers and areas


Enhancing small-farmer profits and living standards is possible through ‘SRI-centered climate-smart agriculture practices’ with forward and backward linkages managed by farmers’ organizations (FOs) and through mutually-beneficial collective action that includes partnerships with private sector actors.

The SRI-LMB has facilitated the development of informal farmer’s groups in 11 provinces across all four countries by involving 15,000 farmers directly and 30,000 farmers indirectly over the last five years. These groups if further strengthened can provide a basis for developing farmer organizations at the district and province levels and also at the country level to accelerate the sustainable rice intensification along with market development for smallholders.

To achieve these objectives, it is proposed to extend the SRI learning to non-rice crops (through the System of Crop Intensification, SCI), and the focus on climate-smart agriculture would be continued and intensified by following a watershed-based approach. Building on the existing SRI-LMB experience, development of farmers’ organizations would be facilitated. This can be proposed as the key strategy in Phase 2 of the SRI-LMB, with other activities promoted through collective action managed by farmers’ organizations.

1. Extending production improvements to other crops through the System of Crop Intensification (SCI)

This effort would include planned diversification, appropriate mechanization, post-harvest management including marketing, and local value-addition would be concrete focuses of such a strategy.
2. **Watershed-based approach**

Phase 2 of the SRI-LMB would facilitate the establishment of watershed-wide networks of farmers’ organizations (FOs). FOs at sub watershed/micro watershed level would be the base organizations for larger systems of cooperation, environmental protection, and collective action.

3. **Catalyzing Farmers’ Collective Action**

The focus on on-farm primary productivity in the first phase of the SRI-LMB Project would continue with provisions for forward and backward linkages of farm operations. Commercialized rural farming and associated trades, including input-output marketing and local value-addition by FOs, would create employment opportunities and make agriculture more economically and socially attractive to the youth. Strengthening the growth of agriculture and commercialization activities by the FOs would lead to healthy competition, inclusive growth, and more equitable distribution of benefits among stakeholders.

4. **Continued and intensified focus on climate-smart agriculture**

As partners in the global movement to mitigate the adverse effects of climate change on rice cultivation, and vice versa, the policy makers of LMB countries are agreed to enhance the efficiency of their agriculture, on one hand, and making efforts to strengthen agriculture, including supportive policy structure, on the other hand. Phase 2 of the Project should build on this experience and should design and implement broader mechanisms towards Conservation Agriculture / green growth. As environmental pollution by agriculture is caused mainly by non-point sources, farmers’ organizations can play a key role in promoting environment-friendly farming. Catalyzing small farmers’ collective action with watershed-based strong farmer organization (FO) networks would be a robust and sustainable mechanism for widening the scale and benefits of climate-smart green growth in agriculture. Phase 2 can intensify the integration of SRI and Conservation Agriculture. Further reduction in the use of agrochemicals would be a focus of the follow-up project through: a) lowering ‘over-use’, b) substituting inorganic with organic inputs that would yield added benefits, and c) gradually adopting other climate-smart practices and agroecological principles.
5. Capacity-building of stakeholders

In addition to capacity-building of farmers, specific mechanisms for building the capacities of other stakeholders like government agencies including ministries and departments, as well as universities would be perused in the phase 2.

Therefore, the informal group that has been established through the SRI-LMB project, if strengthened further, can provide a basis for developing farmer organizations that can accelerate sustainable rice intensification and diversification along with market development for smallholders. Hence it is important to explore the potential of farmers’ collective action evolved through the process of experiential capacity building activities to accelerate the scaling up of SRI and market development. What we might need is to make use of this collective action as a strategic instrument for evolving farmers’ companies/ co-operatives with a greater stake in the market.

These farmers cooperatives/companies would focus on: (1) Production planning, input-output services with an objective to accelerate adoption of ecologically-sound SRI and Conservation Agriculture; (2) Post-harvest management including marketing and value addition; and (3) Institutional arrangements for capturing economies of scale for commercialization of rainfed agriculture through mutually beneficial partnership with private sector. The ulterior goals of the farmers’ collective action could be to: use SRI activities to empower farmers for equitable development, reduce the cost of farming, gaining access to high quality inputs through FO managed input-output services, creation of local employment opportunities and poverty reduction in the region. Such development efforts can be framed within the context of climate-smart agriculture (CSA), which is defined as “agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHG (mitigation) if possible and enhances achievement of national food security and development” (FAO, 2013). To this end and to acknowledge farmers’ efforts, it is important to incentivize them in their climate-smart practices and to offer them opportunities to become ‘agripreneurs’. We continue our journey…

System of Rice Intensification paves the way for farmers to emerge as more successful “agripreneurs”
References


Useful weblinks:

For SRI-LMB Project info visit: http://www.sri-lmb.ait.asia/
For country specific information visit:
http://www.sri-lmb.ait.asia/country/Cambodia.php for Cambodia
http://www.sri-lmb.ait.asia/country/Laos.php for Lao PDR

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