

**SYSTEM OF RICE INTENSIFICATION
-SRI-**

**SUITABILITY FOR LOWLAND RICE
PRODUCTION IN THE LAO PDR**

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This report represents an evaluation of the potential of SRI for improved lowland rice production in the Lao PDR and is based on an FAO supported input provided in March 2004

EXECUTIVE SUMMARY

1. There are components of SRI production principles, which appear to have the capacity of improve yields relative to conventional rice cropping systems. One of the main potential benefits from the SRI production guidelines is the reported impact of the wetting and drying cycles on root development, during the first 50 days after transplanting. The improved root development then allows the rice plant to exploit to a greater degree (relative to conventional production practices), the soil environment in which it is growing
2. The control required over soil moisture early in crop growth makes the SRI system impractical for implementation for wet-season cropping under Lao conditions. Early wet-season rains can result in the submergence and death of seedlings transplanted at a young age, while drainage (and drying) of lowland rice areas is generally impractical in most lowland areas (including areas with the potential for wet-season irrigated cropping). Further, in an environment where periodic drought can be a regular occurrence in the rainfed lowland environment for wet-season rice, the release (drainage) of water from rice fields as prescribed under SRI early in the growing period of the crop, can potentially make the crop more drought prone; farmers in this situation would be generally reluctant to implement any practices that increase the potential for and damage by, drought.
3. The potential for the adoption/implementation of SRI principles of production in the dry-season in the irrigated environment under Lao conditions is restricted by the poor water reticulation systems (both delivery and drainage) that prevail in most irrigation scheme areas. Even with the poor reticulation systems, further difficulty in implementing the system in a 'scheme area' related to the necessity of synchronizing the cropping activities of all farmers within the area, to be able to achieve the desired patterns of water delivery and drainage.
4. Uniform water application in the early stages of crop growth can only be achieved with uniformly level paddy fields. Many paddy fields in both the rainfed and irrigated lowland rice growing environments in Laos, do not have the required uniformity to provide the required level of control of the watering regime. This can result in uniform growth and accentuate the problems of weed ingress, in early growth when the level of water in the paddy fields is low (reflecting the short stature of the seedlings when transplanted at an early age).
5. The SRI system is capable of achieving high yields, only under conditions of very high fertility and/or high levels of nutrient inputs. The level of soil fertility required or level of nutrient inputs required (in organic or inorganic forms) to achieve the SRI system yield potential, is very impractical under most Lao conditions. Most soils in the main lowland rice growing areas of Laos in the Mekong River Valley are of low fertility, with

many areas with severe (and often acute)¹ P deficiency, which must be alleviated before responses can be obtained to the other major nutrients such as N, and occasionally K.

6. Attempts to establish, under research conditions, a higher yield potential using SRI production principles when compared with ‘conventional’ technical recommendations for yield improvement, have generally not been successful. In the montane (higher elevation) lowland growing environment, an attempt at evaluating the potential of SRI cropping resulted in grain yields of only approximately one third of those from following ‘conventional’ cropping recommendations. In some situations where comparable yields from SRI practices have been achieved relative to conventional recommendations, most Lao researchers suggest that the ‘management aspects’ of SRI make it an unattractive option for smallholder producers (referring to the need for better seedbed preparation, difficulties in transplanting very young seedlings, increased weed ingress and the need for increased labor inputs for weed control, and difficulties in providing the water management required where farmers often do not have direct independent control over the cycles of water supply and drainage required for SRI).

7. Farmer plots visited in Fuang district in Vientiane province (an area of higher than average soil fertility relative to most other lowland rice growing areas in the Mekong River Valley) where SRI practices were reported as being followed for dry-season irrigated cropping, were assessed as being unlikely to achieve a yield potential in excess of about 4 t/ha (however, at one of the two sites visited it was apparent that apart from attempts to control the water regime, other aspects of SRI were not being strictly followed – plant spacing for example was, in some areas, less than 10 cm). A farmer in this area had reported achieving a yield of the equivalent of 10 t/ha in the 2003 wet-season (from an area of less than 0.2 ha), as a result of following SRI production principles. This farmer suggested that the potential for SRI was greatest under wet-season cropping conditions (contrary to the assessment of most Lao research and extension personnel, due to the inability to achieve the required control over soil moisture in the rainfed growing environment).

8. In all situations (on-farm and on-station) conditions where high yields were achieved from SRI in Laos, there were high inputs of organic fertilizer (particularly FYM), the levels of which would be difficult, if not impossible, to achieve with wider adoption of the production practices being followed in Laos.

9. Farmer representatives, researchers and extension representatives were generally in agreement in indicating that, if SRI production practices were adopted in the irrigated environment under Lao conditions, they would be only appropriate for small areas of production per household (it being suggested that an area of about 1 rai (<0.2 ha) would be what an average family could manage). Farmers testing the SRI system in Fuang district of Vientiane province indicated that they did not perceive the SRI system as appropriate for production in large areas.

¹ Refer to: Linquist, B. and P. Sengxua. 2001. Nutrient Management in Rainfed Lowland Rice in the Lao PDR. Los Banos (Philippines): International Rice Research Institute. 88 p.

10. A further potential constraint to the adoption of SRI production principles in the dry-season irrigated environment is the susceptibility of young seedlings to the ‘golden apple snail’. The snail has become a significant pest in most irrigated areas in the Mekong River Valley since its introduction in the late 1980s. Young rice seedlings (as used in SRI) are particularly susceptible to damage by the snail. However, it is also acknowledged that the more intensive land preparation required for weed control under SRI, also helps to control the snail. Further, it is also known that drainage of an area infested by the snail, can also reduce the damage caused by it. Further study would probably be required to determine if SRI production practices result in greater or less potential damage to seedlings by the snail.

Concluding Comments:

There appears to be only two aspects of the original SRI concept that are being followed in Laos by some NGO organizations; these are the transplanting of young (<15 days old) seedlings and the practice of intermittent irrigation (5 day wetting and drying cycles from the time of transplanting until the time of maximum tillering, about 50 days-after-transplanting (DAT)). The wide spacing of single plants recommended under the SRI ‘concept’ is not generally practiced in accordance with the original SRI concept, while it is clearly recognized in Laos that, to achieve yields, high levels of plant nutrition are required and this can only be achieved through high levels of nutrient inputs.

There is little evidence to suggest that the original SRI concepts currently being tested in Laos have the potential for widespread practical application by Lao farmers as a means of achieving high yields at reduced cost (of inputs). Although there is a lack of clear yield potential superiority from the adoption conventional technical recommendations as the basis for yield improvement, relative to the SRI practices being promoted, there are clear practical obstacles to the adoption of some of the SRI cropping guidelines, under Lao conditions. The constraints to the implementation of SRI related practices are greatest with wet-season cropping, but many of the constraints also apply to the dry-season irrigated environment.

1. PERCEPTIONS OF SRI FROM RICE RESEARCH ORGANISATIONS

1.1 Lao-IRRI Project: Lowland Rice Production in the Mekong River Valley

Interest in SRI and a research evaluation of its potential for Laos has been lead by the Lao-IRRI Project (through the Project Leader, Mr Karl Goeppert) in collaboration with the Lao National Rice Research Program (NRRP). The Lao-IRRI Project supported a research evaluation of the SRI principles of rice production during the 2001/2002 dry-season and the 2002 wet-season, the studies being focused on research station and on-farm conditions near the capital, Vientiane, and in Savannakhet province in the lower central agricultural region in the Mekong River Valley.

- The wetting and drying cycles are regarded as being critical to yield performance, with the intermittent drying promoting root development in a way that is not possible under a ‘wet’ regime.
- On account of the above, the system is not suited to wet-season cropping in Laos, when wet-season rains usually do not allow the control of the soil moisture regime advocated under the SRI system.
- During the evaluation under research conditions (at the National Agricultural Research Center (NARC) near Vientiane, dry-season yields were achieved in the range of 6-8 t/ha. It was noted that the studies undertaken in achieving this yield did not have comparative controls (using traditional farmer technologies or other more recently promoted technologies based on the results of research by the NRRP since the early 1990s.
- The yields which are being quoted from research plots are based on yields from very small plot sizes (usually 2 x 3 m) ; it is suggested that care needs to be taken in extrapolating such yields to whole farm situations.
- Increased weed ingress (during the drying component of the wetting and drying cycle) and the need for higher labor inputs for weed control (estimated up to 50% higher than under the ‘flooded’ water regimes) is acknowledged as a ‘downside’ of the SRI system.
- The SRI system is only working under conditions of high soil fertility, achieved with either high inputs of organic and inorganic fertilizers (or a combination of both). The levels of nutrient inputs required to achieve the high yield potential of the SRI system, are not regarded as being possible in Laos (either in terms of being able to access the high levels of organic nutrient sources – mainly FYM, or in being able to purchase inorganic nutrient sources in the event organic sources are unable to be accessed).
- Acknowledging the yield potential of the SRI system under ‘controlled’ conditions in the dry-season, it was also acknowledged that most irrigation systems in Laos do not facilitate the possible adoption of SRI for the following reasons:
 - * the delivery and drainage networks do not allow control over the moisture regime that is required to provide the wetting and drying cycles to maximize plant root development. In particular, it is noted in many irrigation scheme areas, water moves from plot-to-plot within the systems and often from ‘farmer-to-farmer’. The adoption of SRI would necessitate the synchronization of planting by all farmers within a given irrigation area. In reality this would be very difficult to achieve.
 - * Where water for irrigation use in the dry-season in the Mekong Valley is mainly based on pump schemes, pumping from the Mekong River or its tributaries, scheduling the pumping to allow the synchronized wetting and drying cycles would also not be readily achievable.
 - * The single plant per hill recommendation of the SRI system is regarded as being difficult to achieve under applied/farmer conditions. It is recommended that in any evaluation of the SRI approach, it be assessed under a situation where there is greater flexibility in the plant population (allowing 1 to 2 plants per hill). In relation to this, it was also noted that there is no one ‘recommended’ hill spacing that is regarded as being more successful, although it is generally acknowledged that 40 x 40 cm spacing is too wide.

Conclusions:

1. Components of the SRI system appear to have the potential to maximize the yield potential of improved varieties, with the wetting and drying cycle being critical in promoting much greater root development than is normal, thereby maximizing the exploitation of soil nutrients.
2. Very high soil fertility (or levels of nutrient inputs) are required to achieve the yield potential of the SRI system and such levels of inputs are impractical under Lao conditions (it being noted also that in most rice growing areas of the country, natural soil fertility is low).
3. The SRI system is not potentially applicable to cropping during the wet-season due to the lack of control over the soil water conditions as a result of natural rainfall and the inability to drain water or control water depth; the latter is particularly important in the period immediately after transplanting.
4. Under dry-season irrigated conditions, the water reticulation systems that prevail, and the nature of the pump based irrigation schemes that predominate, make it difficult to provide the water control (either supply or drainage) on which the SRI production system is based.
5. In most situations in Laos, if water control can be achieved, the maximum area that most households would be able to manage under the SRI system would be about 1 rai (1 ha = 6.25 rai).

1.2 Lao-IRRI Project: The Montane Lowland Environment

The Upland Agronomist of the Lao-IRRI Project, Dr Bruce Linqvist, reported that in the 2002 wet-season a study was undertaken of SRI potential in the montane lowland environment (lowlands at higher elevations), the study being made under lowland conditions at the NAFRI Research Center (Houay Khot) in Luang Prabang province. Within the study a comparison was made of varying plant populations (1 to 3 plants per hill and using a hill spacing of 30 x 30 cm). The varieties used were the two improved varieties RD10 and TDK1 (the same varieties used in SRI studies in areas of central Laos). The recommendation of an application of approximately 1 t/ha of farmyard manure was followed. The average yield achieved in the study was only about one third of that achieved following conventional planting techniques. No specific reason could be given for the poor performance of the SRI methodology; the study of the SRI production methodology was not further pursued on account of the poor performance in the 2002 wet-season

1.3 National Rice Research Program - NRRP (Mr Phoumi Inthapany)

SRI Studies were undertaken by the NRRP at the National Agricultural Research Center (NARC) in the 2001/2002 dry-season and 2002 wet-season. Yields in the order of 6.3 t/ha were achieved with two varieties – TDK1 in the 2001/2002 dry-season, and TDK6 in the 2002 wet-season. However, it was also noted that maximum yields of up to 7 t/ha have been able to be achieved with conventional planting techniques.

Constraints to the SRI System were noted as:

- **Water control (wet-season):** The water control with alternate wetting and drying cycles to promote root development, were very difficult to achieve under wet-season conditions. Further, many paddy (rice) fields were not level enough to allow appropriate water management, particularly in the early period of growth when seedlings were still very short.
- **Water control (dry-season):** Although not faced with problem of flooding associated with wet-season rains, dry-season water management (irrigation and drainage) was very difficult to achieve under the irrigated conditions available in Laos. Further, even with improved reticulation and drainage systems, on a 'scheme' basis it would be very difficult to synchronize the plantings of all farmers within an area (to use SRI) and thereby try and synchronize the delivery of water and drainage, according the desired wetting and drying cycles recommended for SRI.
- **Use of young (15 day old) seedlings:** Wet season rains, when occurring immediately after planting, sometimes resulted in the submersion and death of these seedlings.
- **Weed management:** The alternate wetting and drying cycles resulted in significantly greater weed problems that was associated with conventional planting and watering systems. The weed problem was further aggravated when side spacing was used. With closer spacing, the rice canopy quickly gave the ground coverage required to suppress weed ingress. With the wider spacing combined with alternate wetting and drying in the first 50 days after transplanting, the weed ingress was significantly greater. Further, the weed problem with high levels of organic fertilizer input under SRI is recognized as being significantly greater than with inorganic fertilizer inputs (although it is also acknowledged that nutrient inputs from any source increase the problems associated with weed ingress, relative to the unfertilized situation).
- **Land preparation:** It is acknowledged that the magnitude of the weed problem (after transplanting) under SRI, closely reflects the type of land preparation undertaken prior to transplanting. Good weed control requires very good land preparation. Land preparation using buffaloes often does not give the weed control desired. It is acknowledged that, particularly in the main rice growing areas of the Mekong Valley, there has been a marked increase in the mechanization of land preparation in the past 6-8 years, and that the move to increased dependence on hand

tractors (and to a lesser degree, contract tractor operators) will continue. However, even with greater mechanization of land preparation, the level of weed ingress closely mirrors the level of land preparation.

The NRRP for Laos is not recommending the adoption of SRI production principles as a basis for improved rice productivity under Lao conditions.

Annex 1 contains a summary of the results of the research evaluation of SRI under Lao conditions, the studies being undertaken by the Lao National Rice Research Program.

2. PERCEPTION OF SRI FROM THE NATIONAL EXTENSION AGENCY

Interest in SRI was reported by the Senior Technical Advisor (Dr Karl Gerner) to the National Agriculture and Forestry Extension Service (NAFES), from Vietnam in 2000/01 and Thailand in 2002. Contact was then established with the US-based promoter of the system, Norman Uphoff. Subsequently NAFES has followed with interest, NGO organization (CAA and Oxfam) testing of the system under Lao conditions. SRI is not being promoted by NAFES as a means of achieving improvements in grain yield for rice, for the following reasons:

- SRI production principles require very good control of the water (irrigation) regime, which is very difficult to achieve under Lao conditions.
- The required seedbed preparation, seedling preparation and the transplanting of seedlings at a young age are regarded as complicated and too difficult for Lao farmers to implement.
- Good yields in Laos have only been achieved under very high fertility conditions (usually associated with high inputs or organic and/or inorganic fertilizers); this is contrary to the original concept and rationale for supporting the SRI approach to production, for which it was claimed that high yields are achievable with low inputs.
- Considerable skepticism is held regarding the reported grain yields of 10 and 11 t/ha being achieved under farming conditions when SRI production principles are followed. There has been no conclusive evidence produced from research trails or farmer participatory demonstrations of an ability to achieve higher yields from following SRI production principles, relative to the adoption of more conventional technology packages, which are much easier to implement.

The National Agriculture and Forestry Extension Service for Laos is not recommending the promotion of SRI principles in rice growing areas, as the basis for improved rice productivity.

3. PERCEPTIONS OF SRI FARMER PARTICIPANTS IN SRI-BASED PRODUCTION

The following information is a summary of a discussion held with an official of the Muang Fuang Agriculture and Forestry Office, followed by 'site visits' to two dry-season farmer-collaborative SRI sites. One of the farmer collaborators was reported to have achieved a yield of 10 t/ha of grain in the 2003 wet-season.

3.1 District Agriculture and Forestry Office

Promotion and testing of SRI is being carried out within the district in collaboration with the NGO organization Oxfam CAA (CAA = Community Aid Abroad). The initiative is being supported by AusAID funding. The on-farm promotion of SRI is in its third year (three dry-season and two wet-season crops), commencing with 3 families in the 2001-02 dry-season, and involving 15 households in the 2003 wet-season.

Rationale for interest in SRI: This was cited as a combination of the following:

- high cost of seed associated with conventional practices (wide spacing of single plants under SRI is reported to require a maximum of 15 kg of seed per ha, compared with about 60 kg of seed for conventional planting techniques;
- transplanting often takes place with seedlings greater than 30 days old (beyond the optimum age for transplanting)
- high water requirement in both the irrigated and rainfed growing environments (implying a high and unnecessary cost in providing the water).

Varieties: The varieties used in SRI are mostly improved varieties, with those being grown including the Lao improved variety TDK1, the Thai varieties RD10 and Jasmine, and a local variety known as '28' (this variety was apparently originally grown under upland conditions but is also suited to lowland cultivation – it is liked on account of its relative resistance to lodging under high fertility conditions). It was also indicated that there had been some studies undertaken in collaboration with research staff from the the Pak Chaeng Research Station (in Vientiane province), to evaluate a number (8) of improved Lao varieties under wet-season conditions, however, these studies had only been done in one season.

Fertilizer: Farmers do occasionally purchase and use inorganic fertilizer, there being three types of fertilizer available – 46:00:00, 15:15:15, and 16:20:00. The fertilizer most commonly used is 46:00:00 (urea). It is generally recognized that the soils in the lowland rice growing area of Muang Fueng are fertile clay-loams (considerably more fertile than most of the lowland rice growing areas elsewhere in the Mekong River Valley). In the SRI plots, no chemical fertilizers are used. However, high inputs of FYM based organic fertilizer are applied to the cropping areas, immediately before transplanting.

Participating Villages: 7 villages in the district were reported to be participating in the on-farm evaluation of SRI. Individual plots were usually about 1 rai in area (1 ha = 6.25 rai). Perceived difficulties with the implementation of SRI:

- The transplanting of small and very young seedlings is difficult and labor-intensive (each rai of SRI crops requires a labor input of 2 days x 4 people (= 8 man-days per rai));
- Weed ingress as a result of the drying cycle during early crop growth, can be significantly greater than if the plots are kept permanently flooded; subsequent weed control can be difficult, particularly when the rice plants are still small. In this situation, early land preparation prior to transplanting becomes increasingly important in helping control the subsequent ingress of weeds.
- Water management to achieve the recommended wetting and drying cycles, can be difficult to achieve in many areas, even in the dry-season. In the wet-season, due to the normal frequency of wet-season rains, control over the soil moisture regime is more difficult to achieve.
- Proper water management under SRI can only be achieved in fields that are uniformly flat. In practice, many farmer's fields do not have the required uniformity to allow the desired water management.

Reported Achievements

In the 2003 wet-season, one farmer was reported to have achieved a yield of 10 t/ha from the variety RD10 when grown on a 1 rai plot. A yield of 8 t/ha was reported from the Lao improved variety TDK1 (which was reported by the farmers to have been affected by 'gall midge' but which is now known to have likely to have been 'bakanae' disease (which was introduced to the area through the import of infected seed). The comparative yields in the district from conventional cultivation practices are usually in the range 4 to 4.7 t/ha in both the wet and dry-season seasons. The yield measurements from the SRI 'plots' have been based on grain yield after three days of sun-drying, and have been based on the total harvested plot yield, rather than sub-sampling from within the larger plots.

The general perception reported of farmers in the area is that SRI might be appropriate for small areas of rice cultivation, but not for large areas (due to the more intensive management required for SRI relative to conventional cultivation practices).

3.2 Farmer Experience in Feuang District of Vientiane Province

3.2.1. Village Ban Nam Haay (Mr Thong Mee)

Mr Thong Mee reported that he had used SRI production principles in two years (2003 wet-season and the current (2003-4) dry season, using the improved varieties TDK1 and RD10. The Lao improved variety TDK1 had been introduced to his village about 5 years ago. Prior to this, he and other farmers in the village usually grew several local varieties (Pong and Na Leuang being two of those mentioned). In his conventional plantings he usually applies a small amount chemical fertilizer (about 100 kg) of 16:20:00 to his 1.5 ha of land. This is applied as a basal application and he usually does not make any

further fertiliser application (as he generally feels that the crop grows well without such additional inputs).

In the 2003 wet-season the farmer tested SRI on about 1 rai of land, using the Lao improved variety TDK1. Local varieties are not used for SRI as they badly lodge in the SRI regime. However, the resulting yield was reported to be only the equivalent of about 3.8 t/ha, due to a high incidence of the seed borne disease ‘bakanae’ disease.

The 2003-04 dry-season SRI crop represented the farmer’s first attempt at dry-season SRI cropping. The principles which he was trying to use in his SRI approach to production included – the transplanting of seedlings < 15 days old; 20 x 20 cm spacing of single plants; 5 day wetting and drying cycles for the first 60 days after transplanting. He also used a tractor for paddy preparation prior to transplanting. He had applied some chemical fertilizer to the seedbed prior to seeding, but no fertilizer (organic or inorganic) was applied to the field prior to or after transplanting (although the farmer indicated that an application of 16:30:00 was required when growing the improved varieties).

At the time of making observations of the crop, it was about the time of heading. It was apparent that the crop was not showing any indications of exceptional growth and would only provide a moderate yield. Further, it was clear that the recommended 20x20 spacing of single plants had not been applied, for the hill spacing in parts of the field was less than 10 cm, while it was also apparent that many hills contained more than one plant. The farmer indicated that he had employed four people over four days (at a cost of kip 12,000 per person per day) to undertake the transplanting of his plot. He also acknowledged that, when relying on hired labor, it is difficult to control both the plant spacing and the number of plants transplanted in each hill.

It was generally acknowledged by the farmer and those visiting the plots, that moderate yields at best could be expected from the SRI plot observed. Further, the farmer indicated that he did not see great potential from the SRI concept, for dry-season cropping. Apart from difficulties in transplanting and weed control, the required water management was also difficult to achieve. He did not see the system as having potential for wider application beyond small plots. Overall it was felt that the conventional planting technique using improved varieties and moderate levels of chemical fertilizer input were regarded as being more practical.

3.2.2 Village Ban Na Waan (Mr Siang Theng)

Mr Theng was in his third season of SRI assessment. The first two crops were wet-season assessments – the wet-season season of 2002 and the wet-season of 2003. The assessments were made on a 1 rai (<0.2 ha) plot of land. Using the Thai improved variety RD10, yield performance differed greatly between the two seasons, 4.5 t/ha being recorded in 2002 and 10 t/ha being reported for 2003. The 4.5 t/a recorded in 2002 was comparable to the yield achieved for conventional planting of the improved varieties by other farmers. The main factor regarded as responsible for the higher yield achieved in 2003 relative to 2002, was a high input of organic fertilizer in 2003. Mr Theng applied

an organic fertilizer mix at a rate of in excess of 3 t/ha. The organic fertilizer applied was made from a mixture of buffalo manure, wood ash and vegetative matter from the local weed, *Chromalena adorata*. A 'compost' was made up comprising the mixture, which was also treated with the 'bio-agent' known as 'B.E.' (= Bio-Extract). This compost mix was prepared a couple of months in advance of the transplanting of the crop. Mr Theng indicated that it would be difficult to prepare the same compost mix in sufficient quantities to apply to an area in excess of 1 rai. It was also acknowledged that it would also be difficult for many farmers in the village to be able to find the raw materials required to produce the compost mix in sufficient quantities for them to apply it at the same rate as he applied it, to achieve the 2003 wet-season yield of 10 t/ha.

An inspection of the 2003/04 dry-season SRI plots (shortly before heading of the crop) revealed a crop that, at best, was uneven in growth and unlikely to achieve the 4.5 t/ha that was achieved from the 2002 wet-season SRI crop, and also unlikely to achieve the yield of crops observed in the larger irrigation areas of Vientiane province. Mr Theng, in acknowledging the likely poor performance of the dry-season crop, suggested that SRI had its greatest potential with wet-season cropping rather than dry-season cropping (this suggestion was contrary to that of most other 'participants' in the PSI studies, many of whom indicated that a lack of water control in the wet-season makes the PSI approach to production impractical).

3.3.3. Conclusions of Farmer Participatory SRI Studies

It was apparent from the reports and observations of SRI practices in Fuang district of Vientiane province, that the main factor responsible for the single significant high yield response recorded in the 2003 wet-season, was a response to high inputs of nutrients in the form of organic fertilizer, rather than a response to some of the other practices related to SRI. There was little evidence or consensus of a high grain yield response to the adoption of other parameters that are recommended as part of the SRI 'package of technologies'. Further, the single high yield response was reported for wet-season cropping when, it is regarded as most difficult to exercise the control over one of the most important parameters regarded as essential in SRI, the control over the water regime under which the crop is grown. The general consensus of farmer participants in the SRI farmer participatory studies was that SRI was generally impractical as a general recommendation for improving rice grain yields under Lao conditions. Rather, if SRI guidelines (or some of them) are to be adopted as a basis for improved crop yields, they would only be appropriate for small areas of production.

4. REFERENCES

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Sengxua, Pheng, and Duangsila, Kuang. Effectiveness of system of rice intensification in lowland rice productivity of the Lao PDR. 8 p. (see Annex 1).

**Effectiveness of SRI (System of Rice Intensification) for Lowland Rice
Production in the Lao PDR**

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Abstract

Lowland rice cultivation in the Lao PDR is cultivated by the indigenous knowledge of Lao farmers, usually planted old seedling and water flooded during the season up to 15 days before harvest. Therefore, the young seedling with wider spacing and organic fertilizer application would be needed to test in the Lao's conditions, it would increase lowland rice yields in some instance. The objectives of this experiment are: to evaluate the yield potential of the Lao improved rice varieties in the difference spacing with young seedling and low water supplying condition, and to investigate the SRI technology in the Lao's condition. This study was conducted in the five rice research stations (Agriculture Research Center, Nongheo Station, Pakcheang Station, Seed Multiplication Center Tasano and Research Center Phonengam), as split plot design. The main plots were three spacing (20x20; 25x25 and 30x30 cm) and sub-plot were three Lao improved rice varieties (TDK 1, TDK 3 and TDK 5). Transplanting with 15 days seedling age and water limited during the vegetative phase. In transplanting with wider spacing (30x30cm), rice yields of all varieties were increased significantly only in two sites (NARC and Pakcheang station). Transplanting rice with young seedling, could be increased yields. The low yield of this experiment due to low of organic fertilizer rate and low in soil fertility and on the other hand might be the young seedling could easily damage by snail.

Key words: Spacing, rice variety, young seedling

Introduction

Rice is a single most important food for Lao people because, rice is the base for every meal in the term eating food “kin khao” as eats rice. The lowland, rice cultivation in the Lao PDR is cultivated by the indigenous knowledge of Lao farmers. These indigenous methods usually plant local varieties with the older seedling age and planted spacing, it depend on soil fertility (wider in fertile soil and closely in poorer soil). Previous recommendation of seeding age and spacing for transplanting is about 25 to 30 day after seed sowing and transplanting at the hill and row of 15x15 to 20x20 cm and paddy should be flood during the growing season. The system of rice intensification is to provide all suitable condition for rice such as young seedling, water flooding deficits.

The results of system of rice intensification (SRI) that implemented in many countries in the Southeast Asia indicated that rice yields increased by more than 200% (Gamini & Batuwitage). In order to increase lowland rice production in Lao, National Rice Research Program would like to introduce the SRI technique to Lao farmers. However, it needs to test in the Lao condition first. The objectives of this experiment are: to evaluate the yield potential of the Lao improved rice varieties in the difference spacing with young seedling and low water supplying condition, and to investigate the SRI technology in the Lao's condition.

Materials and Methods

The experiment was conducted in the 2002 wet season (WS) in five rice research stations, which to evaluate the yield potential of different transplanted spacing of the Lao improved rice varieties with young seedling, low water input condition and organic fertilizer application. The experiment was set up as a split-plot design (Table 1) with three replications. The main plots were three different spacing for transplanting (20x20; 25x25 and 30x30 cm, respectively) and the sub-plots were three different Lao improved rice varieties (TDK 1; TDK 3 and TDK 5). Sub-plot size was 3 x 5 m. The sub-plots harvest areas were 9.24; 8 and 7.02 m² in each main plot respectively.

In order to have a healthy seeding for transplanting, to the seed bad manure was applied at the rate of 0.5 kg/m², before sowing seed and seed rate was 50g/m². All varieties were transplanted after 15 day after sowing, with 1 seedling per hill. Water standing in the plot during five days after transplanting and after that let the field only wet.

Fertilizer application to this experiment were 5 t/ha of chicken manure and 60; 30; 30 kg/ha of N; P₂O₅; K₂O. The N application was split equally into three applications [15, 30 and 50 days after transplanting (DAT)]. The P and K were applied as a basal along with chicken manure. All basally applied fertilizers were incorporated into the soil before transplanting. Weeding was done before each N application. Tiller and panicle counts were taken at 50 DAT and at maturity, respectively. At maturity, 12 hills were sampled at ground level for harvest index and the remaining hills within the harvest area were harvested for plot grain yield. Grain yields were adjusted to 14% moisture.

Table 1. Treatment that applied to this experiment

#	Treatment	Main plot (spacing cm)	Sub-plot (Rice varieties)
1	Recommendation spacing	20x20	TDK 1
2	Recommendation spacing	20x20	TDK 3
3	Recommendation spacing	20x20	TDK 5
4	Farmer practice	25x25	TDK 1
5	Farmer practice	25x25	TDK 3
6	Farmer practice	25x25	TDK 5
7	SRI	30x30	TDK 1
8	SRI	30x30	TDK 3
9	SRI	30x30	TDK 5

Results

National Agricultural Research Centre (NARC): The grain yields with recommendation spacing of TDK 1, TDK 3 and TDK 5 were 7.5, 6.1 and 5.8 t/ha respectively (Figure 1), and the highest yield was TDK 1. In increasing the spacing of transplanting to 25x25 cm as farmer's practice, yields significantly increased by 16% only for TDK 5, compared to recommendation spacing. With the application of the lowest spacing of the SRI (30x30cm), yield increased by 7, 20 and 24% (to 0.5, 1.2 and 1.4 t/ha) for TDK1, TDK 3 and TDK 5, respectively, compared to recommendation spacing. However, only the yield of TDK 3 and TDK 5 were significantly different ($P=0.0009$). The interaction of spacing and variety was not found.

Vientiane Municipality, Hatxaifong District: The grain yields with recommendation spacing were 5.1, 4.9 and 4.1 t/ha for TDK 1, TDK 3 and TDK 5 respectively (Figure1), and TDK 1 was the highest yield. In increasing the spacing of transplanting to 25x25 cm as farmer's practice, and with the application of the lowest spacing of the SRI (30x30cm), yields were not significantly decreased in all varieties. The interaction of spacing and variety was not found.

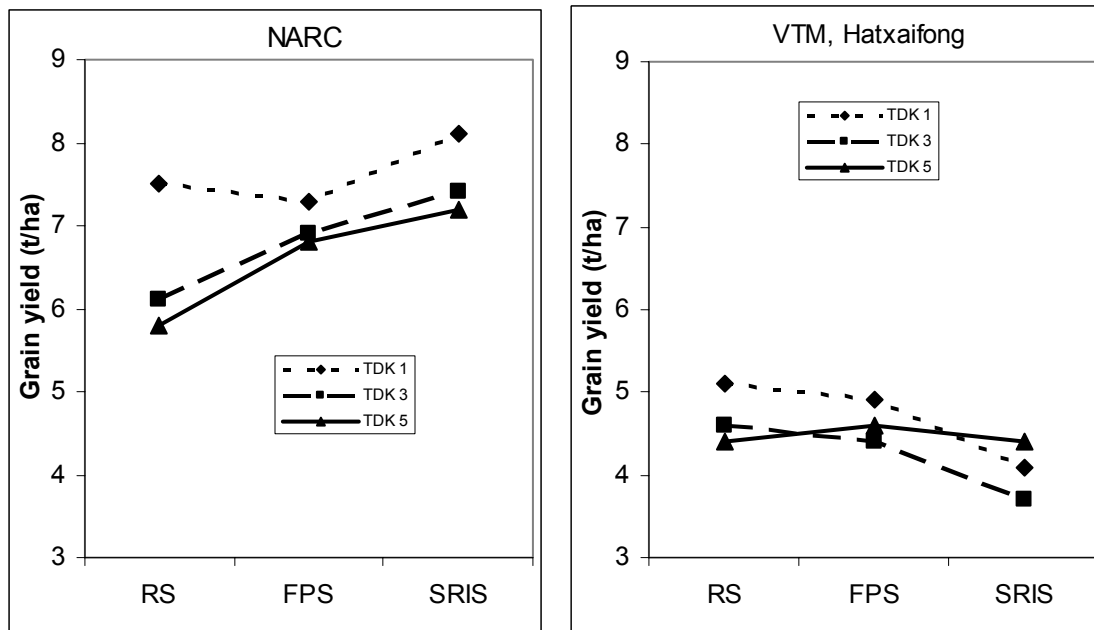


Figure 1. Rice yields of different planted spacing with young seedling and low water input in Vientiane Municipality National Agricultural Research Center (NARC) and Hatxaifong District) in 2002 WS. Values are means of three replications. RS-recommendation spacing, FPS-Farmer practice spacing, SRIS-System of rice intensification spacing.

Vientiane Province, Pakcheng station: The grain yields with recommendation spacing were 4.7, 4.5 and 4.7 t/ha for TDK 1, TDK 3 and TDK 5 respectively (Figure 2). In increasing the spacing of transplanting to 25x25 cm as farmer's practice, yields were significantly increased by 9, 11 and 6% for TDK 1, TDK 3 and TDK 5 respectively, compared to recommendation spacing. With the application of the lowest spacing of the SRI (30x30cm), yields also significantly increased by 26, 22 and 17% for TDK 1, TDK 3 and TDK 5 respectively, compared to recommendation spacing, and by 16, 10 and 10, respectively compared to farmer practice spacing. There were no interaction between spacing and variety.

Chapasack Province, Phonengam station: The grain yields with recommendation spacing were 3.4, 3.5 and 3.3 t/ha for TDK 1, TDK 3 and TDK 5 respectively (Figure2). In increasing the spacing of transplanting to 25x25 cm as farmer's practice and lowest

spacing of the SRI (30x30cm), yields were increased not significantly different in all varieties, compared to recommendation spacing. There were no interaction between spacing and variety.

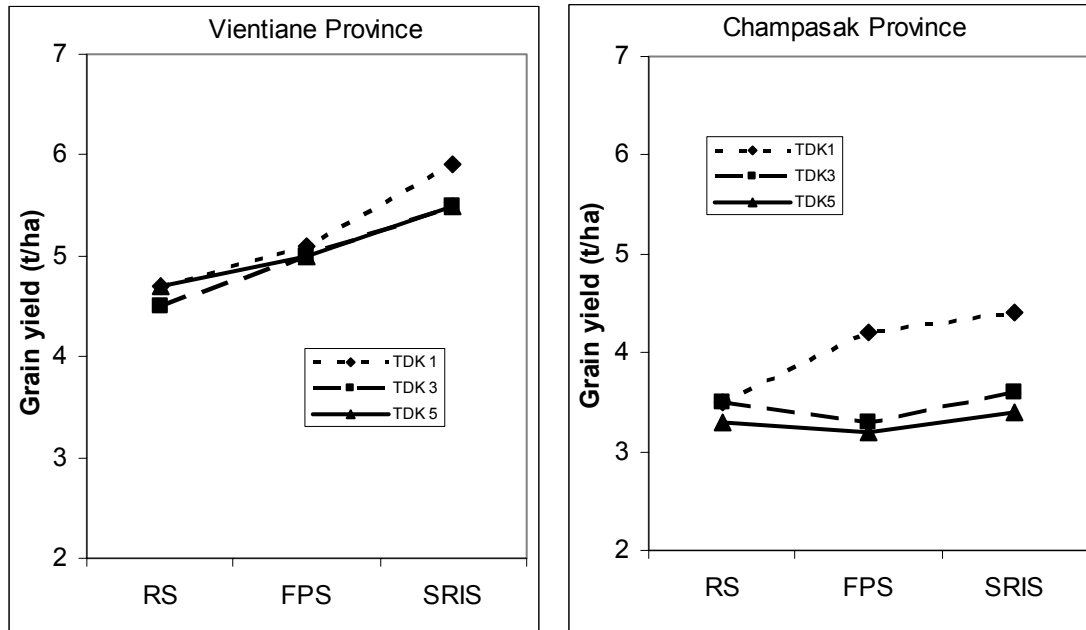


Figure 2. Rice yields of different planted spacing with young seedling and low water input in Vientiane and Champasack province in 2002 WS. Values are means of three replications. RS-recommendation spacing, FPS-Farmer practice spacing, SRIS-System of rice intensification spacing.

Savannakhet Province, (Seed Multiplication Center Thasano): The grain yields with recommendation spacing were 5.9, 5.1 and 6.3 t/ha for TDK 1, TSN 1 and TDK 5 respectively (Figure 3 a). In increasing the spacing of transplanting to 25x25 cm as farmer's practice, yields were decreased not significantly different for all varieties, compared to recommendation spacing. With the application of the lowest spacing of the SRI (30x30cm), yields were significantly decreased by 30, 25 and 37% for TDK 1, TSN 1 and TDK 5 respectively, compared to recommendation spacing, and by 23, 24 and 38, respectively compared to farmer practice spacing. There were no interaction between spacing and variety. In the comparison of the seedling age which only conducted in this station indicated that planted 10 days seedling, yields were higher than 15 and 25 days for

TSN 1 and TDK 5. However, there were not significantly different to TDK 1 and between them.

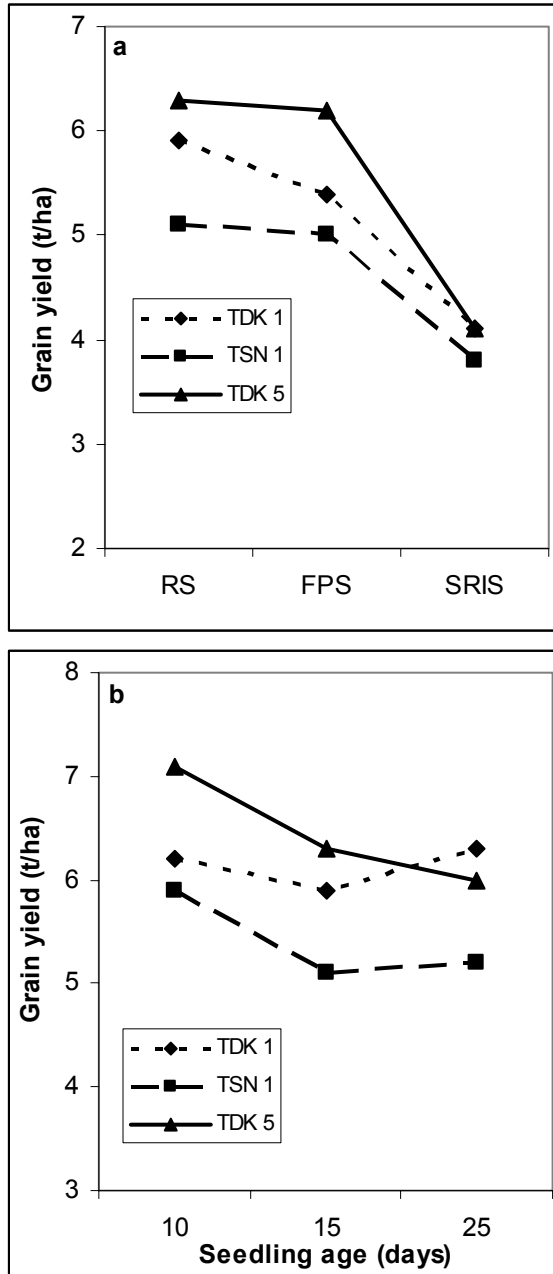


Figure 3. Rice yields of different planted spacing with 15 days seedling (a) and different seedling age with 20 cm spacing in low water input, in Savannakhet Seed multiplication Center, in the 2002 WS. Values are means of five replications. RS-recommendation spacing, FPS-Farmer practice spacing, SRIS-System of rice intensification spacing.

Discussion

The application of SRI technique in Lao lowland rice cultivation condition which were mentioned above reveals that only yields in two sites were significantly increased when the spacing was increased to 30x30 cm. The main problems in these experiments are water control and young seedling. Thus, water and golden snails damaged could not control in some site due to the rain and easily damaged of young seedling. The other factors are might be due to the soil fertility and manure quality. In almost all sites were a very low tiller and panicle numbers and tiller productivity. The SRI technique is aimed to provide the suitable condition for rice in order to get high tiller, bigger panicle and percentage of tiller productivity. However, in this condition it seem to be no any effect on tiller and panicle.

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