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Transforming the economy of small scale rice farmers in Malaysia via system of rice intensification (SRI)

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ABSTRACT

Malaysia is facing food security issues as it struggles to supply adequately the population's staple food, namely rice. The conventional rice planting method is observed to be ineffective in increasing the nation's rice production, compounded further by the frequent occurrence of various diseases, pest infestations and weather uncertainties. The long term practice of using high chemical inputs has adversely affected the country's natural resources such as water, soil and air. Rice farmers, who once were self-sustaining by having their own rice stock supplies, now need to purchase rice to fulfill their family's needs. Farming transformation is much needed in order to address the nation's food security. This transformation can be done via the involvement of small-scale farmers. System of Rice Intensification (SRI) is a method that has the potential to give a big positive impact on the rice sector and food security. Research based on field trials by farmers show that SRI gives satisfactory results and high economic productivity. This method can be used by small farmers in fulfilling their family's rice needs and contribute to the nation's food security.

Key words : *SRI, Rice, Economics transformation, Agroecology, Small scale farmers.*

Introduction

Rice is the staple food for the Malaysian population of approximately 29 million. In 2005, the per capita rice consumption for Malaysian population is about 82.5 kilogram per year (Malaysia, 2006). Rice consumption is expected to increase in line with the population growth of about 2.3% per annum. Based on the said population growth, rice consumption will increase from 1.8 million tons in 1995 to 2.3 million tons in 2010. Having said that, rice production has been hovering at 2.13 million tons since 1995 and only slightly increased to 2.46 tons in 2006. This development disrupted the domestic rice supply and in the long term poses a threat to the security of the nation's food supply.

Malaysia's rice needs are fulfilled through two main mechanisms, primarily from domestic production and secondarily from import activities. About 65-70% of the need is fulfilled from domestic production while the remaining 30-35% is imported from neighboring countries. About 70% of domestic productions are produced within eight main rice schemes while the balance of 30% are produced out-

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side the main schemes (Malaysia, 2006). Compared to the main rice schemes, the plantation areas outside of the main rice schemes face many problems such as poor irrigation system, lack of service for growth, poor soil fertility, pest infestations and many more. This situation results in low rates of productivity among the farmers. For example, rice production outside the Muda irrigation scheme is between 2.3 to 3 tons per hectare compared to 4.5 tons per hectare in Muda irrigation schemes (Rospidah, 2012). These low production rates put pressure on the farmers' livelihoods. Most of them are small-scale farmers working on leased land (Chamhuri, 1995). Meanwhile, more than 65% of these farmers cultivate rice on land of less than 3 hectares.

Since the 1970s, the plantation system practiced has been intensive monoculture where rice is planted twice in a season with the support of modern infrastructure like modern irrigation systems, farm mechanization, using advanced rice processing facilities, field roads, and other modern facilities (Fadzim, 1992). Farmers have been encouraged to use chemical inputs such as fertilizers and pesticides to control diseases. Meanwhile, mechanization has taken over the role of field laborers. The practice of continuous use of chemicals have led to serious implication on the paddy sector and negatively affecting the environment causing soil degradation, water pollution, reducedmicrobiota and decreased the numbers and biodiversity of wildlife.

At the international level, FAO (2011a) recommended a farming model named Sustainable Crop Production Intensification (SCPI). This model is said to have the potential to intensify crop and food production in an environmentally sustainable manner. SCPI empowers the role of small farmers in food production and conserves natural resources. There is, therefore, a need for a true agricultural transformation in order to guarantee the nation's food security. This transformation can be done through the involvement of small farmers (Altieri and Toledo, 2011). According to FAO (2011b), UN Special Rapporteur on the Right to Food (2011), and UN-DESA (2011), System of Rice Intensification (SRI) is a method that can play a significant role in sustainable agriculture that supports a green economy. In comparison, the conventional farming model that emphasize on the role of large-scale farming is unsustainable, in the long run.

UN Special Rapporteur on the Right to Food (2011) emphasized that it is better for investments to be concentrated on small farmers as multiple positive impacts are more apparent in terms of growth when these farmers' income increases, which in turn stimulates the demand of goods and services from local suppliers. Conversely, a large portion of a big estate's income is spent on input purchases and imported tools. This does not give a positive effect to the local suppliers' economy.

This paper discusses the potential of SRI to increase rice production and to improve the economic situation of small farmers. For this purpose, we use experiences gathered from Malaysian small-scale farmers who have applied the SRI method in their farming practices.

Materials and Methods

This research uses primary and secondary data. Primary data was obtained from the farmers' pilot trial in using SRI completely organic in land area of 1,000 square meters in Sik, Kedah and in Tunjung, Kelantan. Both these areas are outside the irrigation schemes. They both adhere to all of SRI principles and practice. The result is measured for 5 to 7 seasons.

The method for the yield calculation in Tunjung Kelantan is based on yield component calculations such as the amount of panicle per meter, weight of 1,000 rice grains at the humidity of 14% and the amount of grain per panicle. Casanova *et al.,* (2002) observed that calculations based on produce component are closely related to the amount of panicle, rice grain, existence of weeds and planting uniformity. In these farmers' trials, the plantation was very well taken care of (meticulous weeding and exact planting with 20-30 centimeters distance). Therefore, this yield component calculation showed the best possible result. To ensure the farmers' family food stock security, data based on yield and yearly consumption per family was used. Malaysia's annual rice consumption per capita is estimated at 86.5kg for 2014 (OECD/FAO, 2013). This calculation is done by assuming that average family size is 4.2 people (Department of Statistics Malaysia, 2010). Therefore, the rice consumption for each household is supposed to be at 363 kg annually.

Results and Discussion

System of Rice Intensification and its Practice Sharing

System of Rice Intensification (SRI), a climate-smart, yield-increasing methodology practiced by more than 10 million small farmers in over 55 countries. SRI method includes several changes in the current conventional rice planting system. It emphasizes on the health of plant roots. The method consists of five core principles: (1) to select healthy seedlings only and to transplant them to the rice field at the age of 5-7 days. (2) The seedlings are planted at a distance of 25-30 cm to encourage healthy root growth by reducing competition for nutrients. (3) Soil aeration through mechanical weeding to eliminate weed, as well as to aerate the soil, (4) Instead of permanent flooding, SRI rice is flooded only occasionally. This enables better aeration and growth of microorganisms, (5) Using organic fertilizers instead of chemical fertilizers. Besides supplying nutrients to plants, organic fertilizers bring about the right conditions such as soil structure, organic matter, oxygen, temperature, humidity and fertility to encourage microbial activity and faunal diversity (Uphoff *et al.,* 2005).

The SRI method does not only increase the production of the rice harvest but also increases biodiversity (Norela *et al.,* 2013), giving resistance to plants against pest infestation and reduces the presence of toxic metalssuch as arsenic (Lauren and Duxbury, 2005). The increase in biodiversity means that the farmers are now more inclined to try planting local rice varieties that has been facing extinction. Furthermore, the quality of soil and air is improved by the reduction of agrochemical materials (Uphoff, 2013). According to UN-DESA (2011) the practice of SRI method is an example of creative innovation and presents a major impact on farming preservation.

Several researches have pointed out to the successes of SRI practices. Rice plantings using SRI method have increased the rice yield in Cambodia (Channthla, 2009; Koma, 2011), Indonesia (Sato *et al.,* 2011), China (Chen *et al.,* 2013; Zhao *et al.,* 2009), India (Thiyagarajah and Gujja (2013), Phillipines (PNA, 2013) and Sri Lanka. Thiyagarajan and Gujja (2013) mentioned that the increase in productivity of SRI practitioners in areas with no irrigation in India has encouraged the farmer families to start planting rice for their own consumption. This research also shows the increase of food security to 41.8% or 217 days of sustenance for farming families who practice the SRI method on land areas of 0-1 acres, and an increase of 126.4%, equivalent to 738 days for areas of more than 2 acres (NABARD 2011). In the district of Damoh, Uttar Pradesh, India, farmers increased their rice yield from 2 tons per hectare to 8.5 tons per hectare. Bihar (India) is the most advanced SRI practice area. The size of SRI plantation has increased from 30 hectares in 2007 to 135,000 in 2012 (Editor in Corps, 2013) In Indonesia, SRI had reached a total area of 178,055 hectares in 2013 (Rahman, 2013). The SRI farmers were able to gain yields of up to 22 tons per hectare (Diwakar *et al.*, 2012). Tech and Rattana (2005) reported that 120 farmers in Cambodia who have been using the SRI method for 3 years are able to obtain twice the original yield. In total, some 200,000 farming families practicing SRI with a yield increase between 50 percent to 100 percentwere reported.

SRI planting was started on a pilot scale by a Malaysian farmer in 2004 in BalikPulau and resulted in a production of 6 tons per hectare. Then in 2008, Sabah farmers (Alab Lanas and Penampang) started using this method. It was then followed by the farmers in Kelantan (Tunjung) in 2009 and in Kedah (Sik) since 2010. The spread of planting by way of SRI is still in its infancy; nevertheless it has started to attract the interest of some farmers in Rompin, Pahang and Mersing in Johor (Anizan *et al.,* 2012).

Increase of Rice Yield through System of Rice Intensification

Rice productivity research was conducted in Tunjung, Kelantan and Sik, Kedah in 2012. Table 1 shows the result after harvesting for the amount of panicle in the range of 30.14 – 77.57, amount of rice grain per panicle (105.88-131.64) and weight of 1.000 rice grains (28.80 -34.22 gr). Based on these estimations, the potential rice yield is between 7.5 and 19.4 tons per hectare. The high values achieved correspond to other research done on SRI. This research was supported by Anizan *et al.,* (2012), where the farmers in Sawah Sempadan in Tanjung Karang Selangor obtained rice yields of 12.4 tons per hectare. The implication from this research alluded that with well-managed SRI, farmers are able to obtain outstanding yields.

The positive performance of SRI can be understood from the level of plant interactions with the soil's microbes as well as its association with the plants' parts themselves. Anas *et al.,* (2011) had shown that SRI management can positively influence soil microbial population, increase enzyme activities in the roots (rhizosphere).

Table 1. Rice Yield with different rice varieties, locations, planting pattern, soil type, panicle numbers, filled grain number and 1000-grain weight

Rice variety	Location	Planting pattern	Plants density m²	Soil type	Panicle number	Filled grains number	1000-grain weight (g)	Yield potency (ton/ha)	Source
MR219	Tunjung *Kelantan– Season 7, April 2012	30 cm × 30 cm Legowo 5**	9.26	Silty Clay, pH 6	53.06	131.64	29.93	19.4	This research n = 35
MR253	Tunjung*, Kelantan– Season 7, April 2012	30 cm × 30 cm Legowo 5**	9.26	Silty Clay	38.14	105.88	34.22	12.8	This research n = 35
MR219	Tumpat, Kelantan	30 cm x 30 cm Square pattern	11.11	Silty Clay, pH 7.4	41	133	27.2	16.8	This research n = 35
MR263	Kg. Lintang, Belantik, Sik, Kedah Season 6	35 cm × 35 cm Squere pattern	8.16	Sandy loam, pH 5.33	34	98.9	27	7.5	Jabatan Pertanian Titi Serong, Perak
MR219	Sawah Sempadan, Selangor	30 cm × 30 cm Square pattern	11.11	Silty Clay, pH 5	25.1	153.8	28.8	12.4	Anizan *et al.* (2012)
MRQ 74	Ledang, Johor	30 cm × 30 cm Square Pattern	Sandy loam, pH	6.5	27	110.37	22.8	7.58	Doni *et al.*, (2015)

Notes: *Sunnah Tani Sdn Bhd
** Legowo 5-Planted in rows of five then skipping one row before the next set of five
n= refers to total sample

Food Security for the Small Farmers

The high yield potential of SRI means a farmer can support the daily rice consumption for the whole family based on the yield produced from a small plot of land. Farming productivity can be calculated as output per input (cost/benefit ratio). Table 2 shows that, based on an estimation of rice yield of 10 tons per hectare, equivalent to 6.8 tons rice per hectare per season. If a family farmer is able to plant rice using SRI organically on a plot of 1.000 square meters (0.25 acres) for two seasons, they would be able to yield 1,360 kg. This is a surplus of 997 kg of rice when an annual consumption of 363 kg is assumed. This surplus can be sold at RM2.60 per kg. The said family is also able to sell the surplus byproducts such as rice brans and broken rice that is normally rejected at mill stage to be sold at the value of RM2,718.00 annually. Input cost is very low at RM1.25 only. If the management cost were to include overall wage, then the production cost is only RM778.50. It is clear, therefore, that the productivity of SRI based farming activity is high as demonstrated by the high cost/benefit ratio of 4.71. According to Ghee-Thean and Ismail (2013); Malaysia's rice production efficiency is low (ratio of 51.7% to 63%). Research by Khai and Yabe (2011)shows that technical efficiency depends on intensive labor use in rice plantation, irrigation and education. Bagchi and Shunbo (2013) found that small sized rice field is more efficient technically compared to the large schemes/large-scale. In terms of value distribution efficiency, as SRI depends on the use of a small quantity of seeds, less water, self-made fertilizers from local natural waste, the component distribution efficiency of SRI can turn out to be very high. All these research supports the assumption that the small-scale adoption of SRI can potentially raise economic efficiency.

Rice production also can be integrated with other farming activities such as fish farming or duck rearing in paddy fields, and vegetable farming (FAO, 2000) to increase farmers' income. SRI enables farmers to produce and sell further organic products such as fish or ducks. These also can be sold at a higher price compared to conventionally driven farms. For example, 1 kg of snakehead fish can fetch RM 34 per kg in the local market.

Opportunities and Challenges to Promote System of Rice Intensification in Malaysia

There are many lessons that Malaysia can learn from the experience of other countries that have been practicing SRI. SRI spread can be effectively carried out through the participation of three different stakeholders, namely (i) the farmers, (ii) the officers and (iii) the government. Farmers benefit from low seed input, low water usage, more productive panicles, reduction of pest and disease infestation, ability to generate own seeds, high grain weight and high seed quality. On the other hand, the factors that often hinder the farmers from practicing SRI is the long duration needed to aerate the soil while weeding, transplanting of young seedlings, water control for alternate wet and dry conditions, absence of or-

Table 2. Productivity of 1000 meter square SRI plot for two planting seasons

NoUnit	Amount per season	Price (RM*)	Total in two seasons (RM)	
Land preparation				
i) Plowing with small machine	hour	3	8.00	24
ii) Levelling and irrigation preparation	hour	2	8.00	32
Sowing				0
i) Seed	Kg	0.5	1.50	0.75
ii) Seedlings preparation	hour	0.5	8.00	4.00
iii) Maintaining the seedlings	hour	0.5	8.00	4.00
Marking	hour	0.5	8.00	4.00
Planting the rice seedlings	hour	7	8.00	56
Organic fertilizers				
i) Molasse	Kg	0.2	2.50	0.5
ii) Kitchen waste	Kg	1	0.00	0
Manual weeding and organic fertilizer application	hour	5	8.00	40
Water maintenance	hour	2	8.00	16
Herbicide and pesticide application	hour	0	8.00	0
Harvesting	hour	10	8.00	80
Rice processing	hour	8	8.00	64
Postharvest process	hour	8	8.00	64
Land rental	m^2	800	0.00	0
Total cost per season				389.25
Total cost in two seasons				778.50
Yield (per season)	Kg	1000		
Rice (per season)	Kg	680	2.60	1768.00
Rice (per two seasons)	Kg	1360	2.60	3536.00
**Profit and cost ration		4.71		
Surplus for selling	Kg	997	2.60	2592.20
Revenues (Hired workers)				1813.70
Revenue (own work)				2589.70
**Side product (two seasons)				128.00
Incomes (own work) rice and side product				2717.70

Note: Revenues is based on assumption of rice yield is 10 tons/ha
Source: Field observation.
*1 RM = 0.23 USD
**Profit-cost ratio according to side product (bran and broken rice)
**measurement of Profit-cost ratio according to side product is according to measurement done by PaddytechSdnBhd and Lian Tong SdnBhd, Kelantan.

ganic materials, requirement of experienced workers and lack of proper tools. Malaysia faces acute labor issue in comparison to other countries.

Thiyagarajan and Gujja (2013) also mentioned that low understanding of SRI principles and the requirement for detailed attention and monitoring are also among the main causes that contribute to farmer's low interest in SRI. Like the other new farming methods, the farmers may try on this method for a while and then possibly discontinue for some reasons. Therefore, technical support and continuous encouragement for several seasons are needed to change the farmers' ways of managing rice planting.

In 2014, the UN recognised the importance of family farming by declaring it the year of International Family Farming. This hopefully will lead to further encourage governments to support small-scale farming and to motivate farmers to take up SRI.

Conclusion

This research highlights the potential of the SRI method for small-scale farming in Malaysia. SRI offers many benefits for farmers in terms of economy and environment. Farmers are able to secure their food supply and to produce a surplus of high-quality organic rice and other products that can be sold at a high price.

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