

# RICE PRODUCTIVITY MEASUREMENT: STUDY ON SYSTEM OF RICE INTENSIFICATION INNOVATION

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## ABSTRACT

*Innovation and creativity are the two essential elements of a country in moving towards developed country and high-income people by 2020 especially in Malaysia. High-income people are the people who innovate. Malaysia has implemented a transformation in all fields so that it is aligned with the execution of the country's economic transformation to produce innovation-based economy, including the agricultural sector. Agriculture is critical field to ensure national food security. Thus, System of Rice Intensification (SRI) is an innovative methodology found can enhance the production and productivity of agricultural at optimal level. Many studies show this method has been successful in increasing productivity of rice in various countries such as Vietnam, Indonesia, and India. In Malaysia, SRI began practice in 2009. However, there are various methods of yield productivity measurement of SRI rice has been used in the area. Therefore, this exploratory case study will identify and discuss methods of SRI paddy yield productivity measurement that has been used in Agro Belantik Corporation in Sik, Kedah. In addition, methods Muda Agricultural Development Authority (MADA) will also be discussed. The methodology used is an interview with SRI practitioners and observation. The scope of this study is rice farmers use SRI methods in Sik, Kedah. Results showed that there are some differences and similarities in the calculation method used in productivity measurement of rice yields produced using the SRI method.*

**Keywords:** *Productivity Measurement, Rice, SRI*

## INTRODUCTION

System of Rice Intensification (SRI) is a methodological innovation in the management of rice cultivation. The method is a revolution in rice

farming and was introduced in 1983 in Madagascar by Fr Henri de Laulanie. SRI is a sustainable method for increasing the productivity of irrigated rice cultivation that reduce water, fertilizer and chemicals (Ishak, 2011). Since its introduction, many studies have been done to see the true potential of SRI in increasing yield, reducing resources and environmental friendly.

SRI is based on the philosophy and natural farming methods . Cultivation of rice by this method is made organically. According to Ishak (2011), SRI is to reduce the use of water, fertilizers and chemicals. This method is done by changing the management of plants, soil, water, and nutrients in soil.

The body responsible for disseminating information about SRI is Cornell International Institute For Food, Agriculture and Development (CIIFAD) which is based in Ithaca, New York, USA. This institute is headed by Professor Dr. Norman Uphoff.

According to Norman Uphoff (2011) apparently SRI is not a technology but rather a methodology based on a set of ideas and understanding which developed into specific practices and aims to create a conditions that are more suitable for paddy to maximize it real potential.

Uphoff (2011) stated that SRI is a revolution and innovation in rice farming and have successfully adapted in 48 countries. He added that the world's major rice-producing countries such as China, Indonesia, Vietnam and India have tried and adopted this method since 1999. These rice producers have also expressed their confidence in SRI methods and are committed to expanding the use of this method in the future.

In 2002, Vietnemamese rural farmer had manage to produce 12 tan of rice yeild by using SRI method. This amazing achivement had open many eyes. Later a SRI farmer in rural area of Tamil Naidu, India, had broke the record by producing 16 tan of rice yeild.

## **Problem**

Nowadays, the agricultural sector has been a priority to our country because we cannot rely on food imports from abroad solely forever. Financial crisis had an impact on developing countries including Malaysia. Decline and change in the value of dollars has resulted in increased prices of imported agricultural inputs and food from year to year thus increasing the cost of production in the agricultural sector.

Agriculture will continue to evolve over time. Various implementations have been done to address the problem of low productivity in the rice sector, yet the farmers are not able to improve their productivity as targeted.

Othman (2012) stated that among the factors contributing to the decline of rice productivity is the result of global warming, environmental crisis, paddy plant diseases and insect attack. In addition, agricultural areas are shrinking every day due to the impact of development activities that have contributed to the decline in rice productivity.

The use of agricultural inputs such as chemical fertilizers and pesticides in paddy farming has caused pollution to the environment and disrupt the balance of the ecosystem. Use of pesticides that are not in accordance with the regulations is dangerous to the farmers and others in the field. Report of the International Assessment of Agricultural Science and Technology for Development (IAASTD) (2008) states the effect of uncontrolled chemical inputs has led to 1.9 billion hectares of land has become infertile, groundwater contamination and nearly 70 % of the world's water supply has been used for agriculture.

Many studies have been conducted by researchers and government agencies involved to increase rice yield, but it has not been able to solve the problems faced by the Malaysia's agricultural sector. But this problem has potential to be solved as the emergence SRI method can increase rice yield and contribute to environmental sustainability (Kabir and Uphoff 2007; Sato and Uphoff 2007; Namara et al . 2008).

On 28 September 2009, 32 acres of land owned by private owners from several nearby villages including Kampung Lintang, Kampung Kubang , Kampung Surau, Kampung Pinang and Kampung Bukit Batu were redeveloped by Kedah Regional Development Authority (KEDA) a government agency, under Project Agropolitan and fully funded by the government. The project aims to increase the incomes of local people through the redevelopment of vacant land in rural areas through SRI method.

Over 30 years ago , this area was the center of rice cultivation as a source of primary income for the residents in the area. However, these activities have been hampered by numerous problems including lack of good infrastructures, support and capital.

KEDA had established Agro Belantik Corporation to help rural farmers in this area. This purpose of this corporation is to organizing , planning and carrying out activities in the area of rice cultivation. Meanwhile,

members of the corporation made up of landowners and residents of a nearby village. To launch the project, the corporation has leased all the land for 15 years to carry out activities of organic rice cultivation.

KEDA had sent a total of 24 people consisting of 19 villagers and five officers to undergo training of SRI cultivation method in Nagrak Organic SRI Center ( NOSC), Indonesia on 27 January, 2011. After completed the training, these farmers had apply the SRI method on their rice farm.

The purpose of this exploratory case study is to identify and discuss the methods of SRI productivity measurement that has been used in Agro Belantik Corporation, Sik, Kedah.

## LITERATURE REVIEW

This literature review will discuss the SRI, the second part will discuss the situation in Malaysia SRI, the third part will discuss the use of innovative methodologies in improving rice yields and the fourth part discusses how components of the result .

SRI is a new method of rice farming (Glover, 2011). It is a set of rules that have changed the way the practice of changes to the management of land, water and nutrients. The changes are intended to provide a better condition for the growth of paddy rice yield is higher. There are several principles that should be adhered to recognize a rice crop as “ SRI “

- According to Stoop, Uphoff and Kassam (2002), the implementation of rice cultivation using SRI method is based on six key principles of cultivation as follow : Use young seedlings to preserve mature plants growth potential Avoid trauma to the roots -- transplant quickly, shallow (1-2 cm), with no inversion of seedlings root tips that will delay the plants resumption of growth after transplanting Give plants optimally wider spacing – *one plant per hill* and in *square pattern*.
- Keep paddy soil sufficiently moist but not continuously flooded, mostly aerobic and not saturated.
- Actively aerate the soil as much as possible, using a rotary hoe or conoweeder to control weeds.
- Enhance soil organic matter as much as possible applying compost, mulch, manure, etc.

By applying these principles, it is believed to increase the productivity of rice. This is because the higher yield is very important to ensure food security for the country to offset the increase in population. This method is also seen to overcome some of the constraints faced by rice farmers such as limited of land area, the problem of soil fertility and limited water resources. Limited water resources are due to the area does not have an irrigation system and just rely on rainfall or irrigation systems are not perfect.

SRI was first known in Malaysia through NGOs and researchers from local universities. In 2008, Prof. Dr. Norman Uphoff have come to Malaysia to discuss SRI together with the Ministry of Agriculture, Universiti Kebangsaan Malaysia (UKM) and interested parties to bring SRI to the country's rice industry.

SRI is a system formed by some combination of the methods set paddy rice farmers as a result of innovation. Uphoff, Stoop & Kassam (2002), also agreed that SRI is innovation out of the box that this methodology can improve the productivity of land, labor, water and capital simultaneously. SRI is a union of intensive management practices that have been refined to give an advantage to increase rice production and cost containment. Most researchers agree SRI is a methodology and not a technology.

In this method, the main focus is on the development of roots. Most SRI procedure is intended to growth and healthy root formation because of the healthy root will produce healthy rice plants thus giving high yields. In addition, the root of healthy and strong support from the rice plants uprooted wind blow (Uphoff, 2007). Most farmers plots fill with water to control the growth of weeds without considering the opportunity cost is higher due to the roots and beneficial microbes that can not breathe well (Ramasamy, et al., 1997). Similarly, the vast distances between the tiller with other tillers also to the development of a healthy root.

Based on previous studies, the cultivation of rice using this system is seen to increase rice yields , through a comparative study between SRI system of paddy by rice farmers and rice yield trials using this system in the field is done consistently showed remarkable results in some countries (Uphoff, et. al., 2002; Berkhout & Glover, 2011). SRI method has been successful in increasing rice yields in some countries, on average rice yield increased by 20 per cent - 50 per cent or more was achieved ( WWF- ICRISAT, 2010).

## **Current Issues in Rice Industry**

Global warming, environmental crises, infectious diseases in plants and insects, has been a factor that interferes with the production of food in many countries around the world. At this time when the world's population is rapidly increasing and the demand for food is high, these problems have threatened food security and the health of people worldwide. 24,000 people die due to causes related to hunger every day, including one child every five seconds (FAO, 2008)

Rice is the staple food for more than three billion people around the world. At least 114 countries grow rice and more than 50 have an annual production of 100,000 tons or more. Rice is also a staple food for many countries in Asia, about 90 percent of global rice area, production and consumption are focused on Asia. At this time, when the world's population already reeling from higher food prices, many countries have banned or restricted their rice exports, which pushes up the price of rice is higher. Rice yield has increased since the 1960s, but since 1990, the increase in rice production has been slower than population growth. Therefore, rice production is expected to increase by 30 percent by 2025 to meet the needs of a growing world population (FAO, 2008).

Food and Agriculture Organization (FOA) reported that more than 860 million people worldwide suffer from hunger and suffering from a chronic lack of nutrients due to the country they do not have food security (FOA, 2008). Increased productivity of rice is a major concern because the government knows rice productivity will allow other goals such as food security, increase farmers' income and thus the standard of living will be achieved (Devendra & Aziz, 1994).

Development and application of methodology or technology is seen as a major determinant of increased output, and allows the use of agricultural inputs such as labor, fertilizers, pesticides and machinery can be made better (Fatima et al., 2011). This statement agreed by Berkhout and Glover (2011), the SRI methodology as the appropriate method of the poor because they do not need to spend a high external inputs of seed, water and fertilizer.

To achieve these goals, strategies such as research and development, extension, training, credit facilities and the implementation of the cluster has been implemented by various government agencies (Ma'rof & Fariborz, 2009).

## **SRI in Malaysia**

In 2008, Prof. Norman Uphoff was invited by a group of researchers in Malaysia to introduce SRI thus giving momentum to the rice industry in the discussion Malaysia. Turut the Minister of Agriculture and stakeholders such as the Institution of Agriculture and Rural Development Malaysia ( MARDI), representatives of civil society, and representatives of researchers from Universiti Kebangsaan Malaysia (UKM). Prof. Dr. Anizan Isahak from UKM has taken advantage of the discussion by forming a research group SRI UKM known as “ SRI- PADI “.

After representing UKM National SRI Symposium, held in Coimbatore, Tamil Nadu, India in 2008, Assoc. Prof. Dr. Anizan Isahak also attended a training session at the National Organic organic SRI SRI Center (NOSC) in Nagrak, Indonesia . SRI research results were presented at the International Conference for the Development of Promising Practices Sustainable Paddy Fields in Bogor, Indonesia, in October 2009, and all research findings have been displayed and updated from time to time on the blog SRI - PADI.

## **The Method of Yeild Components**

Rice crop productivity measurement method is named The Method of Yeild Components. This method takes into account the components of the rice harvest , the number of stems , number of seeds on the stalk, the percentage of empty seeds and cloves weight of 1000 grains (Matsushima, 1995). The components of the rice yield is influenced by genetic and environmental factors such as weather, nutrient, soil, and water (Matsushima, 1995).

Environmental factors affecting rice yield components as described by Ismail et al. (2003), the weight of 1000 seeds is in a positive relation with the rain down fall and the contents of soil moist. Number of grains per panicle and panicle number is affected by pressure and water level on the soil so that it can produce the optimum amount of grains.

However, in contrast to the percentage of empty seeds were determined by the air temperature during the critical growth stages in meiosis (9-12 days before flowering ) and during flowering (Shihua, et al., 1991). To increase the yield components, the use of nitrogen fertilizer at a rate of 0-195 kg / ha can increase grains at a rate of 70.8 to 93.1 grains, and the weight of 1000 seeds from 23.5 to 25.9 kg.

If proven this programs has the potential to be developed as a good economic returns, then the programs promoting SRI method of paddy cultivation is worthy.

## **METHODOLOGY**

This study used interview and observation to obtain information . The primary data obtained were from interviews with practitioners of SRI at Agro Belantik Corporation at Sik, Kedah and at Muda Agriculture Development Agency (MADA). Observations and interviews with the first respondent, the SRI farmers at Agro Belantik Corporation was carried out on 22 August 2013. In addition, information obtained from the interview with second farmers was done on 24 August 2013.

Information on methods of computation performed by MADA was obtained from interviewed with the third responden. The responden is the representatives from MADA that are responsible for the calculation of paddy yeild under MADA area. Interviews was conducted in MADA Headquarters in Alor Setar , Kedah on 28 August 2013. In addition, to strengthen the retrieval of data, interviews were also conducted by telephone with the fourth respondent from MADA.

## **PRODUCTIVITY MEASUREMENT METHODS OF RICE**

This section will discuss the method of SRI productivity measurement in Agro Belantik Corporation at Sik. Kedah and MADA agency.

### **Case of Agro Belantik Corporation, Sik, Kedah**

Rice crop productivity measurement method used by Agro Belantik Corporation is known as calculation of yield components. Interviews with regard to this calculation method of paddy was conducted with respondents 1. Samples taken at the age of 110 days after planting. Samples from fields were taken using Quadrat 1 x 1 m. Sampling is done by throwing Quadrat 1 x 1 m into the field at random.

Quadrat were thrown for five times in five different places in the same plots for a sample representative of the entire plots. Moreover, quadrat thrown in different places to avoid overlapping of the same sample and for a sample with a density varying stalk . Then the rice plants are cut at the base and we recorded the number of stalks



Before the calculations, it is noted that the calculation is made based on paddy moisture content of 10 percent set in 1000 seeds. Once samples are collected, the number of stalks was recorded. Then, a sample of 1000 seeds were taken and weighed, the moisture measurement is carried out next.

Once all the parameters for the method of calculation is obtained, the calculation will be done by multiplying the results of all parameters, the parameters are the number of stems, the average number of seed stalk and weight of 1000 seeds. Once the data of these three parameters is obtained, the unit of measurement of grams per square meter converted to tons per hectare, such as the following formula:

$$\text{Result} = \frac{(\text{Number stalk}) \times (\text{number of seeds bunch}) \times (\text{weight of 1000 seeds})}{1000 \times 1000 \times 1000} \times 10000$$

The calculation of rice productivity at Agro Belantik Corporation as follows, panicle number is derived from a sample of 300, the number of seeds were obtained an average of one stem is 120 pips and weight of 1000 seeds is 25g and the percentage moisture obtained was 22 per cent. Once all the parameters obtained, we enter the data into the formula yields as follows:

$$\text{Result} = \frac{(\text{Number stalk}) \times (\text{number of seeds bunch}) \times (\text{weight of 1000 seed})}{1000 \times 1000 \times 1000} \times 10000$$

$$\text{Yeild} = \frac{(300) \times (120) \times (25) \times 10000}{1000 \times 1000 \times 1000}$$

Yield = 9.0 tan / hectare at 22 percent humidity, so count results on the humidity of 10 percent is:

$$9.0 \text{ tons / hectare} \times \frac{(100-22)}{(100-10)} = 7.80 \text{ tons / hectare}$$

### **MADA Method of Yeild Measurement**

The method of calculation carried out by MADA is based on the actual sales receipt of rice harvested. MADA will refer to harvest sales receipt to obtain the actual weight information stated on the receipt. After that, for the purpose of measuring the moisture content of paddy grain, MADA

will take a kilogram of rice grain samples from each lot of land rice has been harvested and drying tests will be conducted in the laboratory to obtain the net weight.

## FINDINGS AND DISCUSSION

The method of rice productivity used at these two sites were analyzed and noted that there are some differences that have been identified. The first difference is the unit used. Agro Belantik Corporation used unit gram per square meter and the unit was later converted to tan per hectare by estimation whereas MADA used actual output produce by the farmer. The second difference identified was age appropriate for rice as samples for the calculation of the results. Agro Belantik Corporation used rice samples at the age of 110 days after planting. MADA method used harvested rice sample as base and the age of the sample was more than 110 days.

The third difference is the method of taking the sample. In the case of Agro Belantik Corporation, quadrat was thrown for five times and the throws were made to ensure that there is no overlap in the same place. MADA do not used quadrat for sample collecting.

The fourth difference is in the parameters of rice per wedge. Agro Belantik Corporation taking into account the parameters percentage grains while MADA does not take into account the parameters.

As a result, MADA rice yield was accurate measurements and did not use estimates as measurements used by Agro Belantik Corporation.

## CONCLUSION

Based on the findings of this study concluded that there are differences in the calculation of the productivity of rice, made by the two agency. The study, which covers the two areas of SRI methods and non SRI methods. However, MADA information such as information productivity of paddy rice acreage and yield of rice for one season of the sales receipt rice paddy farmers. MADA staff will find paddy farmers to obtain a copy of the sales receipt paddy after paddy harvesting is done for each season and the rice is sold. Further research is needed to find out the actual yeild of rice produce by using SRI method.

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