Comparative analysis on working time allocation of the system of rice intensification (SRI) and non-SRI rice farming in West Sumatra

Y Usman¹, Y Yusmarni¹ and M Refdinal¹
¹Departemen of Agricultural Social Economics, Faculty of Agriculture, Universitas Andalas, Padang -Indonesia
E-mail: yusmarni@agr.unand.ac.id

Abstract. The System of Rice Intensification (SRI) is an effective and efficient rice farming technique to increase the rice yield. However, the preliminary finding indicates that most farmers are reluctant to apply the SRI farming system because it takes a lot of time and is more complicated than conventional rice farming systems. The aims of this research are to examine the working time allocation on both SRI and Non-SRI farming systems and investigate the difference between both farming systems. This research was conducted in two regions of West Sumatera to represent upland and lowland areas during the period of Mei – June 2018. The region that represents the upland area is Simarosok Village in the district of Agam, and the lowland area is Kasang Village in the district of Padang Pariaman. The research found that the average working time allocation on the SRI farming system was 145.41 man day/Ha, while on the non-SRI farming system was 91.40 man day/ Ha. Thus there was a significant difference between time allocation on SRI and Non-SRI farming systems in West Sumatera. Working time allocation on the SRI farming system was higher than the non-SRI farming system in the following activities: planting, weeding, making of organic fertilizer, and time to control the irrigation. Based on findings, it is suggested to the government and other related parties to provide appropriate weeding technology as well as organic fertilizer. Moreover, the farmers should be able to split time wisely between SRI farming and other business.

1. Introduction
1.1. Background
Rice has a vital role in Indonesia. In the economy, rice plays an essential role in national economic development in the form of 1) provides job opportunities and sources of income for households 2) is a staple food for 95% of Indonesia's population 3) around 30% of the total expenditure of low-income families in Indonesia is allocated to rice [1].

In Indonesia, efforts to increase rice production are continuously carried out through various introductions of technological innovations. But in reality, rice production has reached its climax. From observations of phenomena occurring in the field, the increase in rice production has been weak in recent decades. There is even a tendency to decrease production yields [2].
The System of Rice Intensification (SRI) in West Sumatera is known as Padi Tanam Sabatang. SRI is a method in implementing of rice farming effectively and efficiently through the root system by managing the soil, the plant, and water. West Sumatra Agriculture Service states that there is an increase in the application of SRI in West Sumatra during the period of 2013 – 2014 by 3, 15%. Ideally, the use of SRI would enable the farmer to increase the yield of rice production, although it might consume more working time of farmers [3]. Therefore, efforts are needed to improve production and product quality significantly. One of them is the organic System called System of Rice Intensification (SRI).

SRI technology has potentially higher productivity of rice to benefit both consumers and producers. Overall, SRI gives better yield in terms of productivity (higher plant, more seedlings, longer panicles, and heavier grain), invulnerability (immunity to pests and diseases), and profitability (lower cost production). However, the System of Rice Intensification has more activities that will require more working time in farming [4].

1.2. Problem statement
The preliminary research at Sakato farmers groups in Kasang Village finds that rice farming with the SRI method produced 6.7 ton/ha of grain, while the non-SRI method only produced 4 – 5 ton/ha. It can be seen that rice production with the SRI method is significantly higher than the non-SRI method. However, only 16 of 33 farmer group members applied SRI technology. The farmers stated that SRI technology is more complicated than non-SRI ones and also requires more working time. Most members of the farmer group thought that SRI technology disrupts their working hours because they also have jobs other than rice farming. For this reason, most farmers are not interested in implementing the SRI method.

1.3. Objectives
This research aims to describe and analyze the effective time allocation of SRI rice farming and non-SRI rice farming.

2. Material and Method
This research is analytical, explaining the relationship between two or more variables studied by testing hypotheses. This research was conducted to find an explanation of why an event or symptom occurred. The final result of this study is a description of the causal relationship [5]. This research was conducted during the period of Mei – June 2018 in two districts of West Sumatera province, each represents upland and lowland area. The topography of West Sumatera makes it possible to produce rice in both the uplands and lowlands. The advanced studies found that lowland rice production is higher then upland, therefore this study needs to include both upland and lowland to be able to describe rice farming in all of West Sumatera province. For upland area is Simarosok village in the district of Agam, and the Lowland area is Kasang village in the district of Padang Pariaman.

This study used a survey design. Our survey design is a mix of qualitative and quantitative methods. A qualitative method was carried out to find the relationships between variables that will be analyzed quantitatively. The quantitative method used in this research was the man working day (MWD). The research calculated and examine the allocation of working time of the farmers in the unit of man-day/ha. Later on, the study compares and analyzes the differences in time allocation among farm activities between SRI and Non-SRI rice farming qualitatively.

The respondents of this research consist of SRI farmers and Non-SRI farmers. Respondents that represent upland areas are Lurah Sepakat Farmers Group and Arraudah Women Farmers Group as many as 40 farmers. Meanwhile, representative of lowland area is Indah Sakato farmers group as many as 20 farmers. In total, there are 30 respondents of SRI farmers and 30 respondents of Non-SRI farmers.
3. Result and Discussion

3.1. Overview of Simarosok Village and Kasang Village

Simarosok Village (SV) located in Baso Sub-district, Agam district, West Sumatera, Indonesia. Geographically, this area is at an altitude of 800-1200 m above sea level, and its temperature is around 20\(^\circ\)C – 29\(^\circ\)C. The average rainfall per month in this area is 123.04 mm and the average distribution of rain throughout the year is 149 days/year. This condition is very suitable for rice farming in the upland area.

Kasang Village, on the other hand, has an altitude of 2 – 230 m above sea level with a temperature of 22\(^\circ\)C – 33\(^\circ\)C. The average distribution of rain throughout the years in this area is 135 days/year. This area has a good irrigation system because it has both surface and groundwater. This condition is suitable for rice farming in the lowland area.

3.2. Labor Allocation

The allocation of labor on SRI rice farming and Non-SRI rice farming is calculated based on activities on both systems. Analysis of working time allocation aims to determine the number of working hours of farmers used in various activities. The use of working hours here can be interpreted as the number of hours spent by farmers both in farming and outside farming, including non-agricultural activities [6]. The use of working times is influenced by cultivation technology carried out by farmers because in farming, the workforce requirements required to cover almost the entire production process takes place so that the cultivation techniques carried out will affect the use of workdays. This activity includes several types of work stages including (a) plant preparation, (b) procurement of agricultural production facilities (seeds, fertilizers, medicines), (c) planting/seeding, (d) maintenance consisting of weeding, fertilizing, treating, managing water and maintaining water structures, (e) harvesting and transporting produce, (f) selling [7].

3.2.1. Land Preparation

The activities in land preparation were as follows; 1) soil inundation for a week, 2) the first land preparation: reversing the ground, 3) the second land preparation: land refinement, 4) cleaning the dikes, 5) making tranches around and in the middle of the rice field, 6) removing weeds, 7) fertilizer application, and 8) land leveling. There is no difference in the activities of land preparation in SRI and Non-SRI rice farming. Thus the working time allocation would not significantly different in this activity. The research finds that the working time allocation in land preparation on SRI rice farming was 28.75 man day/ha, while on Non-SRI was 28.62 man day/ha. Working time allocation on SRI was slightly higher than Non-SRI because SRI rice farming requires more organic fertilizer. The need for organic fertilizer for SRI is 5 ton/ha or equivalent to 100 sacks. Meanwhile, the Non-SRI farmers only need 200 kg/ha of chemical fertilizer or equivalent to 4 sacks. Consequently, transporting organic fertilizer to SRI rice farming will take more working time than to Non-SRI rice farming.

3.2.2. Seed Selection

Technically seed selection process on SRI is similar to non-SRI, so the allocation of working time on both systems was not much different. The effective time allocation in seed selection on SRI rice farming was 0.98 working day/ha, and on Non-SRI rice, farming was 0.96 working day/ha. The activities consist of 1) preparation of the seeds, 2) soaking the seeds on the water, 3) removing the floating seeds which are the bad seeds, 4) cleaning the selected seeds, 5) packing the selected seed on the sacks and leave in the water for a night.

3.2.3. Nursery

The process of the nursery on the SRI method is different from Non-SRI. The activities of the nursery on SRI are as follows: 1) preparation of seeds (3-5 kg/ha), 2) preparing the container as a place for seed nursery, 3) mixing fertilizer and soil on the container, 4) sowing the seed evenly, 5) cover the box
with the earth. The seeding process took 7 – 12 days and usually is held in the farmers' backyard. This activity is done at the same time of land preparation.

Meanwhile, the activities of sowing on Non-SRI are as follows: 1) preparing the land for seed sowing in the rice field, 2) cleaning and fertilizing the land, 3) preparation of seeds (20 – 25 kg/ha), 4) sowing the seed evenly, 5) cover the nursery area with soil and then with leaves. The nursery process on Non-SRI is held before the land preparation and took 18-25 days.

The research finds that working time allocation for nursery on Non-SRI rice farming was higher than SRI. As can be seen from the activities above, there are more activities on Non-SRI rice farming than SRI, such as the preparation area of seed seeding in the rice field and covering the seeding area with broad leaves.

### 3.2.4. Trans Planting

The process of transplanting on SRI and Non-SRI is quite different. The activities of rice planting on SRI consist of 1) preparation of the field by reducing water level, 2) making spacing (25 cm x 25 cm and 30 cm x 30 cm), 3) Transplanting the seedling one seedling per hole, and planting should not be too deep so the roots can move freely. Moreover, the processes of transplanting on Non-SRI are as follows: 1) seedlings that have been pulled out and then tied and cut off the ends, 2) spread the seedlings in the rice field, 3) set the water level as high as 2 cm, 4) transplanting.

The research finds that working time allocation for transplanting on SRI was much higher than Non-SRI. The distribution of working time in planting activities on SRI was 10.81 working day/ha, while on Non-SRI was seven working day/ha. This is because the SRI farmers took more time to pull out the seedling from the container. The farmers have to pull out the seedlings carefully because the seedlings are relatively young (7 – 12 days), so the roots are still weak and can be broken easily.

### 3.2.5. Seedlings Replacement

Seedlings replacement is the process of replacing seeds that are dead or not growing properly with the better seedlings. This activity is the same on SRI and Non-SRI. Working time allocation in seedlings replacement on SRI was 2.27 working day/ha and on Non-SRI was 2.13 working day/ha.

### 3.2.6. Weeding

Research finds that working time allocation of weeding on SRI was much higher than Non-SRI. The distribution of working time on SRI was 28.67 working day/ha, while on Non-SRI was only 10.87 working day/ha. SRI farmers spent a lot of time in weeding because weeds overgrow on SRI rice farming when land is not flooded. On the contrary, weeds are not easy to grow on the Non-SRI rice on the flooded plot.

### 3.2.7. Producing Organic Fertilizer

SRI strictly requires organic fertilizer. This fertilizer is not always available, so the farmers have to produce it themselves. The allocation of working time on the activity was 8.27 man day/ha. This activity is only on SRI farming. Non-SRI does not require organic fertilizer, and farmers only use chemical fertilizer.

### 3.2.8. Applying Fertilizer

SRI farming applied fertilizer three times, namely during; land preparation, first weeding, and second weeding. Meanwhile, on Non-SRI farming, the fertilizers applied two times: during land preparation and fertilization with chemical fertilizer. Due to there is more fertilizer application on SRI, the working time allocation on SRI was also higher than Non-SRI, 7.64 working day/ha, and 6.65 man day/ha, respectively.
3.2.9. Irrigation

The research finds that SRI farmers spent much more time in irrigation than Non-SRI farmers. The allocation of working time for irrigation on SRI farming was 12.58 man day/ha, while on Non-SRI farming was only 2.57 working day/ha. SRI farmers have to keep the water right above the land surface. Therefore the farmers spent more time controlling irrigation for their rice field. The average time spent by SRI farmers to control the irrigation was 18 days/ha, while non-SRI farmers were only 8.2/ha days.

3.2.10. Pests and diseases Control

The types of pests that attacked SRI and Non-SRI farming in the research sites were the same, which were snails. The working time allocation on SRI farming was higher than Non-SRI farming, 10.26 man day/ha, and 4.66 man day/ha, respectively. The research finds that the pest (snails) grow rapidly on the SRI rice field, due to the unflooded field. Meanwhile, snails cannot live and grow easily on flooded Non-SRI field.

3.2.11. Harvesting

Harvesting activities on SRI and Non-SRI are the same. Working time allocation on SRI for harvesting was 25.06 man day/ha, and on Non-SRI was 24.18 man day/ha. The distribution of working time on SRI was slightly higher than Non-SRI, due to the higher production of SRI farming. The research finds that the average output of SRI farming was 5.003.95 kg/ha, while Non-SRI farming was 3.994.70 kg/ha.

Table 1. The average working time allocation of SRI and Non-SRI

| No | Activities                       | Working Time Allocation (man-day/ha) | SRI   | Non-SRI |
|----|----------------------------------|-------------------------------------|-------|---------|
| 1  | Soil Preparation                 |                                     | 28.75 | 28.62   |
| 2  | Seed Selection                   |                                     | 0.98  | 0.96    |
| 3  | Seed Seeding                     |                                     | 2.00  | 2.50    |
| 4  | Trans Planting                   |                                     | 10.81 | 7.93    |
| 5  | Seedlinga Replacement            |                                     | 2.27  | 2.30    |
| 6  | Weeding                          |                                     | 28.67 | 10.87   |
| 7  | Producing Organic Fertilizer     |                                     | 8.27  |         |
| 8  | Fertilization                    |                                     | 7.64  | 6.65    |
| 9  | Irrigation                       |                                     | 12.58 | 2.57    |
| 10 | Pests and Diseases Control       |                                     | 10.26 | 4.66    |
| 11 | Harvesting                       |                                     | 25.06 | 24.18   |
|    | **Total**                        |                                     | **145.41** | **91.40** |

Table 1 shows that the average working time allocation on SRI farming is much higher than Non-SRI farming. The allocation of working time on SRI farming was 145.41 man day/ha, while on Non-SRI agriculture was 91.40 man day/ha. The statistical test shows that there are significant difference between working time allocation on SRI farming and Non-SRI farming. Specifically, the differences in working time allocation between SRI and Non-SRI are in the following activities:

a. Trans Planting

The reason working time allocation was higher on SRI farming are: a) the farmers have to pull out seedlings carefully because the seedling are relatively young and still soft, 2) the farmers have to arrange plant spacing

b. Weeding
SRI farmers spent a lot of time in weeding because weeds grow quickly of SRI rice farming, which is not flooded. On the contrary, weeds are not easy to grow on Non-SRI rice farming that is flooded.

c. Producing Organic Fertilizer

Organic fertilizer is not always available, so SRI farmers have to produce it themselves. This activity is only on SRI farming, because SRI strictly requires organic fertilizer, while Non-SRI is not.

d. Irrigation

SRI farmers have to keep the water right above the land surface. Therefore the farmers spent more time controlling irrigation for their rice field.

4. Conclusion

The average working time allocation on SRI farming is much higher than Non-SRI farming. The allocation of working time on SRI farming was 145.41 working day/ha, while on Non-SRI farming was 91.40 man day/ha. The statistical test shows that there is a significant difference between working time allocation on SRI farming and Non-SRI farming. Specifically, the differences in working time allocation between SRI and Non-SRI are in the following activities: planting, weeding, making organic fertilizer, irrigation and pests, and disease control.

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