The comparison analysis of farming income between System of Rice Intensification (SRI) technology innovation and conventional agriculture system in rice production center in West Java

Y R Hidayat* and T Suciaty
Department Agriculture Faculty, Universitas Swadaya Gunung Jati Cirebon, Indonesia

*yayat.rahmat1982@gmail.com

Abstract. The purposes of this research are; to find out the shortcomings and strengths of applying the cultivation technology of the System of Rice Intensification in rice farming in the area of rice production centers in West Java. To know the comparison of rice farming results between conventional farming systems and the technological innovation of the System of Rice Intensification in the area of rice production center in West Java. The method used in this study is the quantitative approach survey method. Data analysis method using farming analysis is calculating the amount of production, revenue, income and level of farming feasibility in rice commodities in the production center. The results of the study prove that the cultivation technology innovation with SRI has strengths and weaknesses. The most visible strength is that this technology is able to increase rice production by 20% when it is compared to cultivation systems that use conventional methods. The method of cultivating rice plants using SRI technology is able to produce 6.20 tons/hectare of production, while those using conventional methods only produce 5.7 tons/hectare.

1. Introduction
Along with the increase of population, food need is also increase in quantity. One of the important staples of society is rice. Rice stands in the first rank of the demand. There are various efforts done by the government through policies, both on aspects of cultivation/production and other aspects such as technological innovation, processing of results and marketing policies. In the marketing aspect, the issue of rice trading is an important issue that aims to trade rice commodities so that there is a balance between stocks and prices that can solve the stability problem. In the current year, the government implements the policy of the Highest Retail Price (HET) to control stock stability and prices on rice commodities so that the society as the consumers can buy those commodities [1,2].

In the aspect of cultivation, the presence of innovation in technology is needed so that rice production increases. One of the innovations in rice cultivation technology is the System of Rice Intensification (SRI). This cultivation technology has actually been applied by farmers, but the distribution has not been maximized, meaning that there are still many farmers who have not implemented this water-saving cultivation technology. Economically SRI cultivation technology can increase income because it is able to produce more crops and better quality so that the harvest price is higher than the yields that use conventional cultivation methods [3,4].
Based on the results of the demonstration trials (experiment 3), we conclude that intermittent irrigation in rice cultivation may reduce irrigation water use considerably (27–37%) compared with flooded rice cultivation, while at the same time yields increase slightly (4–6%). Also in experiment 1, intermittent irrigation was associated with a similar yield increase of varieties Sanyou 10 and 923. Only Zhensan 97B produced better under flooded conditions, which indicates that varieties respond differently to water management. The dry-cultivation treatment showed the worst yield performance for all three tested varieties. Rice plants grown under intermittent irrigation management have higher root activity, produce more tillers per hill and biomass, and, in general, their leaves have a higher chlorophyll content. In experiments 1 and 3, yields of all four hybrid varieties increased under intermittent irrigation compared with flooded conditions, indicating that these hybrid rice varieties are well adapted to intermittent dry-wet conditions. In experiment 2, treatments with water tables 20 and 40 cm below the soil surface showed drought-stress symptoms and roots did not penetrate to deep soil layers as in the treatment with a water table 5 cm below the soil surface. Lafitte and Bennett (this volume) also reported that some rice varieties cease root development in response to drought stress. The treatment with a water table 5 cm below the soil surface showed a slightly higher root biomass production and relatively more roots in deep soil layers (40–45 cm) than in the flooded treatment. Higher yields in the intermittent irrigation treatments may be related to better root development, which facilitates nutrient uptake from deep soil layers [5].

SIR is not finished still evolving, changing, spreading, so it is premature to make final judgment or evaluation. SRI methods will not be suitable everywhere, but not a niche innovation; suitable in all 22 districts of Andhra Pradesh, and in north, south, east and west of China. SIR is not spectacular, not wishful thinking but a fact [6] There is no reason to think that SRI other agro ecological concepts and practices will replace all other kinds of agriculture; agricultural change does not proceed so discontinuously [7].

Total elemental analyses of representative rock and saprolite samples revealed extremely low levels of bases and phosphorus. Soil characterization data generally indicated pH values of 4.5, high to very high aluminum saturation levels, extremely low exchangeable base levels, and extremely low Olsen phosphorus values, regardless of landscape position. One area contained a geologic anomaly with extremely high phosphorus contents, but was limited in extent. With minor exceptions, the RNP area soils reflected not only very low available nutrients, but also very low total nutrient reserves. The combined geologic, total elemental, and soil characterization data revealed that soil nutrient levels in the RNP area are insufficient for sustained crop production without nutrient inputs. Those inputs must be obtained either from the rainforest biomass through burning, through nutrient harvesting of live biomass for compost, or through chemical fertilizers. Rainforest burning is incompatible with the RNP conservation objectives. Nutrient harvesting can concentrate nutrients in agricultural fields, but at the expense of other portions of the ecosystem. Inputs in the form of chemical fertilizers therefore represent the only long-term solution for sustainable agriculture if present population densities are maintained. To suggest that "alternative" agronomic practices (e.g., SRI, or system of rice intensification) can overcome these fundamental biological and chemical constraints only provides a false hope that will be ultimately proven unsustainable in the long-term. That will eventually spell calamity for both the Malagasy rainforest and the Malagasy farmers [8].

This study aims to determine the advantages and disadvantages that exist in the cultivation technology innovation System of Rice Intensification (SRI) and compare farming income between SRI technology cultivation systems and conventional cultivation systems.

2. Research method

2.1. Types of the research
This type of research was descriptive quantitative research with survey and literature review methods. Quantitative descriptive research describes the data which were generated from the sample locations in West Java Province and Indramayu and Cirebon Regency as the object of study. The most basic reason
of why making Indramayu and Kabupaten Regency were chosen for this research was that these two regions is a buffer zone of rice stocks in West Java. With these two regions, it will certainly be seen how the development of the method of System of Rice Intensification (SRI) for the cultivation of rice commodities. For literature studies, the qualitative data were collected from competent agencies such as the Agriculture Office and the Agricultural Extension Agency [9,10].

2.2. Research methods
The study was conducted in the center of rice production, namely Indramayu regency with a survey method through a quantitative descriptive approach. The research sample used was farmers who use SRI and who only use conventional farming systems. The type of data used was quantitative data by collecting questions in the form of questionnaires. The method of collecting was through Focus Group Discussion (FGD). The FGD was carried out by gathering the respondent farmers to produce data relating to the results of rice farming income through the application of SRI technology and then compared with farming income using only conventional cultivation technique [3,11].

3. Results and discussion

3.1. The analysis of the strengths and weaknesses of System of Rice Intensification (SRI)
Based on the research data, it can be explained that SRI has its advantages. However, there are some disadvantages so that it can actually be a barrier to the development of the application of rice cultivation technology in the central area in Indramayu Regency. The following is the outline of the advantages and disadvantages of the cultivation technology of the System of Rice Intensification (SRI).

| No | System of rice intensification method | Conventional method |
|----|--------------------------------------|---------------------|
| 1  | The use of SRI technology can increase rice production  
The use of SRI technology can reduce the use of chemical fertilizers and pesticides | The use of Young Seeds Requires high patience |
| 2  | The use of SRI technology can reduce the use of chemical fertilizers and pesticides | Planting 1 seedling/planting hole requires the farm labors who are competent |
| 3  | The use of the SRI method can improve the nutrient of rice fields | The arrangement of intermittent irrigation systems requires adequate irrigation channels |
| 4  | SRI technology is efficient in the use of seeds | The arrangement of intermittent irrigation systems requires adequate irrigation channels |
| 5  | The use of SRI technology can reduce business capital | Less of human resources development of farmers who apply SRI technology |
| 6  | The use of more labor, especially to transport organic fertilizer to rice fields | Requiring maximum planning |
| 7  | SRI technology can reduce labor | It takes time to select good seeds |
| 8  | SRI technology can increase operating profit | Requiring time to select good seeds |
| 9  | The SRI method produces healthy grain / rice | Triggering the growth of more weeds |
| 10 | SRI technology is a technology based on local wisdom | The rice is easy to get plant disturbance organizations (OPT) |
| 11 | Able to recycle waste |  |
| 12 | Saving on water and seed use |  |
| 13 | Improving soil fertility |  |
| 14 | An environmentally friendly farm |  |

3.2. The comparison of farming analysis result between SRI and conventional methods
In contrast to the farming practices of rice farming using the SRI method, the net benefits obtained by farmers with conventional methods are smaller. This is caused by the costs of purchasing chemical fertilizers including urea, NPK fertilizer and carbofuran, insecticides and fungicides. In short, there is a
difference in costs that must be incurred by farmers. The difference in production costs between rice farming SRI models is less than the conventional Rp. 1,088,000. SRI model uses fewer seeds and is not available for the purchase of urea fertilizer, NPK fertilizer, and carbofuran. The difference between SRI rice and non-SRI rice is also seen in the production results. SRI method produces wet rice products of 6.20 tons KG/GK/ha while non-SRI products are 5.70 tons KG/GK/ha.

Components of production costs incurred on non-SRI farming methods are the same as SRI farming, namely the fixed costs incurred by farmers at Rp. 3,225,000, - which consists of land rent per planting season of Rp. 3,000,000, -, Land tax of Rp. 35,000, -, Irrigation fee of Rp. 90,000, - and the depreciation of Alsintan which is calculated per year, the amount of which is the value of the tool multiplied by 20% per season.

While the variable costs consist of; first, the cost of production facilities involving seeds, artificial organic fertilizers, liquid supplementary fertilizers, insecticides and fungicides occurring at a cost difference with a total cost of Rp. 1,028,000. Because of the SRI method there are costs that are not released compared to conventional methods, namely the variables of urea fertilizer, NPK fertilizer, and carbofuran. With the existence of these three variables, the farmer generates a production cost, which amounts to Rp. 1,420,000.

Second labor costs. Labor costs incurred by farmers concern; Nursery for Rp. 150,000, -, Processing of land with a tractor of Rp. 750,000, -, Repairs small dike Rp. 500,000, -, Basic fertilization of Rp. 150,000, -, the cost of planting is Rp. 700,000 rupees, Rp. 175,000, -. The first supplementary fertilization is Rp. 150,000, -, the first and second weeding are Rp. 700,000 rupees and 1,000,000, -, the cost of family labor is Rp. 200,000, - and other costs of Rp. 700,000. The amount of costs incurred for labor on the SRI method is Rp. 5,425,000, - whereas in the conventional method Rp. 5,475,000. So that the total production costs that must be incurred in the conventional method amount to Rp. 10,925,000, - while the total cost of production in the SRI method is Rp. 9,837,000.

Production in conventional methods is 5.70 tons of KG/GK/ha with the price of rice of Rp. 450,000, - /ku then the revenue is Rp. 25,650,000, - then reduced by post-harvest costs by 10% (Rp. 2,565,000, - ) and production costs of Rp. 10,925,000, - and the income obtained by conventional farmers is Rp. 12,175,000. While the SRI method of rice production amounted to 6.20 tons of KG/GK/ha with the same price of Rp. 450,000, - /ku then the revenue is Rp. 27,900,000, - after deducting 10% postharvest costs (Rp. 2,790,000) - and production costs of Rp. 9,837,000, so that a profit or net income of Rp. 15,373,000. The income of farmers in the SRI method is bigger than the conventional method which is Rp. 3,198,000. The difference in profits obtained from these two methods is influenced by the amount of production produced so that it affects the net profit.

Some things that are considered by farmers using conventional or non-SRI methods are the perception that farmers consider conventional methods easier and have more income by increasing production inputs, namely chemical fertilizers can increase production. In the SRI method farming, the total cost incurred by farmers in Susukan Lebak Village, Susukan Lebak Subdistrict, Cirebon Regency is Rp. 10,095,000, - with a total production of 6.20 tons of Milled Dry Rice (KG/GK), as for total revenue after deducting post-harvest costs of Rp. 22,320,000. so the profits obtained by farmers amount to Rp. 12,225,000, - whereas in the non-SRI method of rice farming, the production costs incurred amounted to Rp. 10,635,000, - with a total rice production of 4.56 tons of paddy. The profit obtained by farmers in this non SRI method farming is Rp. 9,595,000.

 Although SRI technology is only limited to cultivation methods, but in substance this method seeks to practice the cultivation of organic-based crops, namely optimizing the use of natural fertilizers and pesticides made by farmers. With the development of SRI technology, the average farmer has used pure organic fertilizer or known as organic farming and at least semi-organic. Empirical data proves the production of rice cultivation with SRI technology produces healthy rice, namely rice without chemical fertilizers and pesticides. Organic rice produced by farmers is responded positively by society. This positive response is supported by the awareness and participation of the community to consume organic rice, moreover coupled with the issue of public health, the size of which is affected by the cultivation system (organic farming system). This organic farming system is a step towards sustainable agriculture,
namely promoting natural materials as production inputs. In relation to the progress of organic farming systems, this technology optimizes the use of local wealth which is available around farmers' land. Agriculture based on local wisdom is not only limited to making production inputs, but various methods exist to be used as alternative technologies. One of the technologies that prioritizes local wisdom is SRI Technology because of the principles contained therein, which utilize local potential that surrounds farmers.

Eco-friendly farming is defined as farming practices that avoid as far as possible the use of chemical-based production inputs which are usually available on the market. With this principle, environmentally friendly farming is related to the process of recycling farmers' production inputs by utilizing the existing local wealth. Through SRI technology, eco-friendly farming maximizes the existing local potential with the experience and technology already owned by farmers. The comparison of Farming Analysis Result between SRI and Conventional Methods seen at Table 2.

### Table 2. Comparison of farming analysis result between SRI and conventional methods.

|                                | System of Rice Intensification Method | Conventional Method |
|--------------------------------|--------------------------------------|---------------------|
| Fix costs                      | 3,225,000.00                         | 3,225,000.00        |
| Variable costs                 | 1,197,000.00                         | 2,225,000.00        |
| Labor costs                    | 5,425,000.00                         | 5,475,000.00        |
| Total costs                    | 9,847,000.00                         | 9,897,000.00        |
| Production                     | 6,20 tons                            | 5,70 tons           |
| Revenue                        | 27,900,000.00                        | 25,650,000.00       |
| Post-harves costs              | 2,790,000.00                         | 2,565,000.00        |
| Total Revenue                  | 15,373,000.00                        | 12,175,000.00       |
| R/C Ratio                      | 2,55                                 | 2,11                |

The analyzed data revealed that B:C ratio (BCR) was significantly influenced by age of seedlings and crop geometry. The average benefit cost ratio ranged from 0.95 to 1.28. The highest BCR was observed in 8 days old seedlings (1.54), which was at par with 15 days old seedlings but different from 20 and 29- days- old seedlings respectively. The latter two were not significantly different from each other. Significantly higher B:C in 8-days-old seedlings was due to high yield which ultimately caused both the high gross and net return per hectare [12].

4. Conclusion

4.1. Conclusion

Based on the results of the research and discussion, it can be concluded; SRI technology actually has strengths and weaknesses. The most visible strengths are that the production of SRI is higher than conventional cultivation systems. The most dominant weaknesses are the lack of human resources from farmers who master the SRI system cultivation technique so that it can hinder the development of the application of this water-saving cultivation technology. The income of SRI rice farming systems is bigger when it is compared with conventional cultivation systems. In addition, SRI technology innovation results in greater business feasibility.

4.2. Suggestion

The suggestion given in this research is to accelerate the success of the application of SRI cultivation technology. it requires maximum effort to increase the capacity of farmer resources through various training conducted by the government and other stakeholders.

References

[1] Perdana T 2014 Pemetaan Penentu Harga Komoditas Beras (Bandung)
[2] Ban V D and Hawkins H 1998 Penyuluhan Pertanian (Yogyakarta: Kanisius)
[3] Anugrah I S and Wardana I P 2008 Gagasan dan Impelmentasi System of Rice Intensification (SRI) dalam Kegiatan Budidaya Padi Ekologis (BEP) Analisis Kebijakan Pertanian 6(1), 75-99

[4] Ukrita I and Musharyadi F 2011 Analisa Prilaku Petani Dalam Penerapan Penanaman Padi Metode Sri (The System Rice Of Intensification)(Kasus: Kelompok Tani sawah Bandang di Kanagarian Koto Tuo Kecamatan Harau Kabupaten Limapuluh Kota) LUMBUNG 10(2) 119-127

[5] Bouman B, Hengsdijk H and Hardy B 2002 Water-Wise Rice Production (Metro Manila, Philippines: International Rice Research Institute)

[6] Uphoff N 2004 The System of Rice Intensification: An Opportunity for Raising Productivity the 21 Century Paper for The International Years of Rice Conference, FAO

[7] Uphoff N 2012 Supporting food security in the 21st century through resource-conserving increases in agricultural production

[8] Johnson B K 2012 Soil characterization and reconnaissance survey of the Ranomafana National Park area, southeastern Madagascar (NCSU Libraries, Raleigh, NC, Soil characterization and reconnaissance survey of the Ranomafana National Park area, southeastern Madagascar)

[9] Efendi S 2012 Metode Penelitian Survei (Jakarta: LP3ES)

[10] Fujisaka S 2001 Will Farmer Participatory Research Survive in the International Agricultural Research (London: IIED)

[11] Sugiyono 2013 Metode Penelitian Kuantitatif, Kualitatif dan RD (Bandung: Alfabeta)

[12] Khem R and Ram K B 2012 Performance of Rice with Varied Age of Seedlings and Planting Geometry under System of Rice Intensification (SRI) in Farmer’s Field in Western Terai, Nepal Nepal Journal of Science and Technology 13(2), 1-6