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Assessing the Adoption Problems of System of Rice Intensification (SRI) by Analytic Hierarchy Process (AHP)

~Case study in Pagelaran, Malang, Indonesia~

階層分析法による SRI (System of Rice Intensification)各要素の重要性比較

～インドネシア国マラン地域パゲラランにおけるケーススタディ～

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修　士　論　文

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～インドネシア国マラン地域パゲラランにおけるケーススタディ～

東京大学大学院新領域創成科学研究科
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本論文は，修士（国際協力学）取得要件の一部として、2018 年 1 月 23 日に提出され、
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2018 年 2 月 2 日

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国際協力学専攻

主査＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

ABSTRACT

Rice is Indonesian staple food. Indonesian population has grown over two hundred million people, rank number four in the world. The country has to supply more food to the growing population. To increase rice productivity, farmers need to be introduced a new crop cultivation method which is called SRI (System of Rice Intensification). Research objectives of this study are to identify the affecting factors of farmers who discontinue SRI method and to suggest strategies for overcoming SRI adoption problems. Field survey with a semi-structured questionnaire, key informant interview, and focus group discussion was conducted. This study used Analytic Hierarchy Process (AHP) to analyze experts' judgment regarding SRI practices. The survey was conducted in two villages in Pagelaran, Malang. It was found that SRI farmers were doing 10-12 days nursery, planting 1-2 seedlings per hill, using 25-28 cm plant spacing, but water management was still following conventional method. They were encouraged to use an organic fertilizer with the ratio of organic and chemical fertilizer is 3:2. Farmers were aware of the advantage of SRI method but unwilling to adopt SRI method. Inconvenient practices, low cost-benefit, and unavailability of resources are identified as factors hindered SRI adoption. AHP is considered to give better suggestions to farmers. Experts are asked to score SRI practices according to its priorities. Results will be used to give farmers suggestion about which SRI practices should be adopted it first. AHP is a theory of measurement through pairwise comparisons and relies on the judgment of experts to derive priority scales (Saaty, T.L, 2008). As a result, experts score soil organic enhancement as the most important factor in successfully adopting SRI method. Intermittent irrigation and planting of young seedling is in second and third place but the difference is just about 0.1 %. Plant single seedling per hill is in fourth priorities. Sufficient spacing and weeds control are in fifth and last place with each weights less than 10%. Soil organic, intermittent irrigation, and frequent weeding are the most affecting factors in downgrade adoption. Based on AHP results, farmers should improve their knowledge in soil as well as intermittent irrigation performance and less concerned about weeds. Also, in order to increase the adoption rate of SRI method, farmers should be given a proper training to raise their understanding of sustainable paddy planting and researcher should guide appropriate SRI method on site.

Keywords: adoption, AHP, rice, SRI, sustainable paddy planting

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Lastly, I thank all of you who help and support me throughout the entire process.

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LIST OF ACRONYMS

AHP: Analytical Hierarchy Process

BPS: Badan Pusat Statistik (Indonesian Central Statistical Bureau)

CSR: Corporate Social Responsibility

ICM: Integrated Crop Management

NGO: Non-Government Organization

SRI: System of Rice Intensification

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CHAPTER 1

INTRODUCTION

1.1 Rice in Indonesia

Rice is Indonesian staple food. As for today, Indonesian population has grown over two hundred million people, rank number four in the world. To meet Indonesian needs, rice productivity has to be increased. According to the Indonesian Central Statistical Bureau, Indonesian population will grow at the rate of 0.82% between 2025-2030. Harvested paddy field in Indonesia is about 13,445,524 Ha in 2012 with 69,056,126 ton paddy production. It shows increasing trend every year (fig 1.1). Indonesian population in 2010 is about 237,600,000 people (BPS, Indonesia, 2011). With the growing population, the country has to supply over than 100 million ton in 2025 to fulfill Indonesian needs. Indonesian government makes some effort to meet that needs. Until now, Indonesia still imports rice from other countries to satisfy country needs.

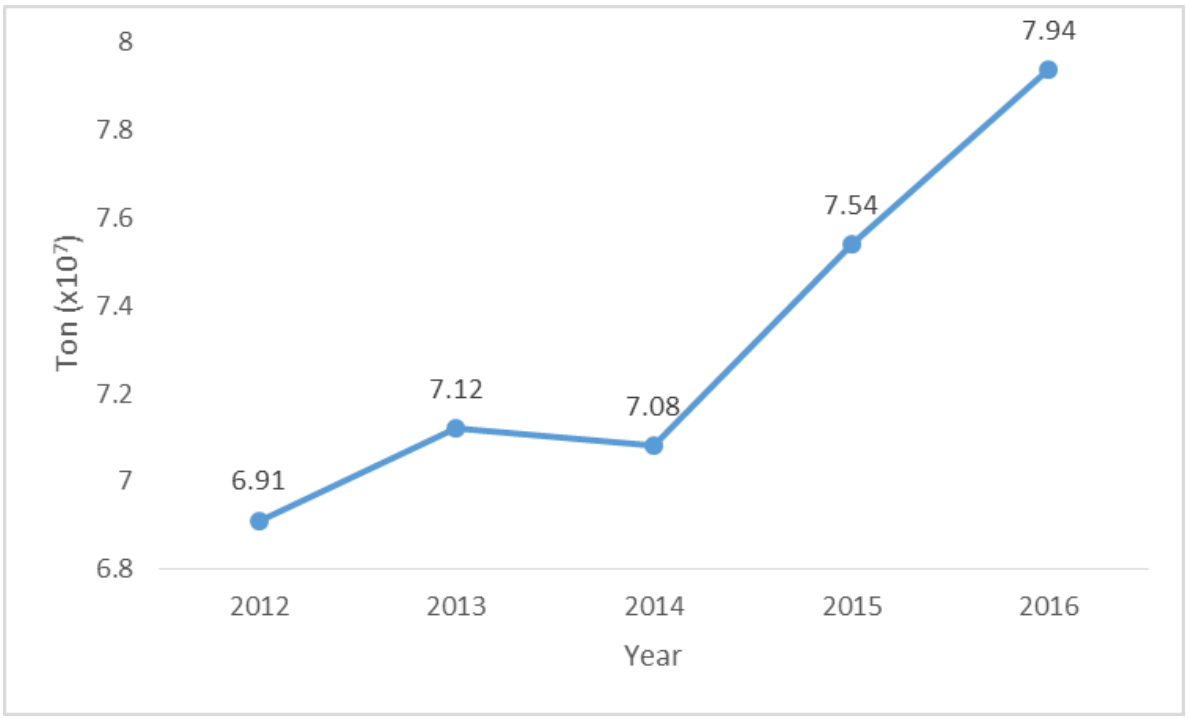

Fig 1.1 Indonesia paddy production

Source: https://aplikasi2.pertanian.go.id/bdsp2/id/lokasi (Accessed 2017-12-5)

Presently, soil becomes less fertile to grow agricultural products which can be indicated by the low organic substances (less than 1%). Low organic substances cause soil hardened, difficult to be treated, insufficient irrigation water usage and decreasing productivity. Decreasing of soil fertility can be caused by the wrong method which using chemical fertilizer continuously due to the continuous usage of chemical fertilizer. Farmers in Indonesia are mostly using chemical fertilizer because they think that chemical fertilizer can increase rice productivity than using organic fertilizer. But actually, using chemical fertilizer continuously can decrease soil quality and affect rice production quantitatively. Farmers in Indonesia are getting used to the conventional method which has been taught from across generations. Generally, conventional method paddy cultivation has been characterized by using an old seed which is more than 20 days the age of the seed; planting more than one seed in the same hole that is too deep; flooding paddy field with water; using too much inorganic fertilizer; and planting space is too close.

In order to increase rice productivity, farmers need to be introduced a new paddy planting method which is called by SRI (System of Rice Intensification) that is environmentally friendly because it does not use chemical fertilizer thus can benefit the soil in the long term. Also, SRI can increase rice productivity due to the change in management practices in terms of soil water and nutrient management. According to Stoop et al (2002), SRI is not a technology but more like a management strategy for crop improvement. SRI is based on certain principles such as transplanting young seedlings; avoiding trauma to the roots; giving plants wider spacing; keeping paddy soil moist but unflooded; actively aerating the soil; enhancing soil organic matter. The first three practices stimulate plant growth, while the latter three practices enhance the growth. SRI was developed first in Madagascar by Father Henri de Laulanie, S.J who wants to improve farmers' productivity and their livelihoods without having to rely on purchased inputs. Farmers are encouraged to use as many of the practices as possible. Being farmer-centered, SRI is always being modified, improved, and extended. It was empirically developed and continually improving the scientific understanding of SRI concepts. So, SRI is not yet finished.

1.2 SRI as a new strategy for crop improvement

SRI was spread around the world by Professor Norman T. Uphoff from the Cornell International Institute for Food, Agriculture, and Development (CIIFAD). Then, it was introduced first to Indonesia in October 1997 by Professor Norman Uphoff presentation. At that time, Indonesian Agency for Agricultural Research and Development (IAARD) started to evaluate the system and concluded that there was something to be learned from SRI methods. In 1999, SRI method had been tested in Research Institute for rice (RIR) in Sukamandi, West Java province. The method indeed increased rice productivity. According to Gani et al (2002), on average, the rice yield obtained from plots practicing Integrated Crop and Resource Management (modified SRI) principles in the dry season of 1999 was 6.2 ton/ha, or 51% higher than on plots with farmers' standard management practices (4.1 ton/ha).

1.3 Target area

East Java (*Jawa Timur*) has the most paddy production in the country (fig 1.2). It is related to paddy field area in East Java which has the largest area of paddy field nationwide (fig 1.3). Also, it shows that paddy production in East Java increases slowly every year (fig 1.4). As SRI method succeeds in West Java, the application became wider. SRI was introduced first in Malang district, East Java in 2008 as a part of Corporate Social Responsibility (CSR) program of a company. Farmers said that they knew about SRI from training that company gave. As 2011, SRI training was provided to 403 farmers from 9 villages. The methods learned were being applied to 182.75 hectares. The typical yields with SRI methods in the area were 7 tons per hectare. Also, SRI Rice plants often have 70-80 tillers which make farmers happy. Farmers said that since they used the SRI water scarcity, pests, and disease are no longer becoming serious problems.

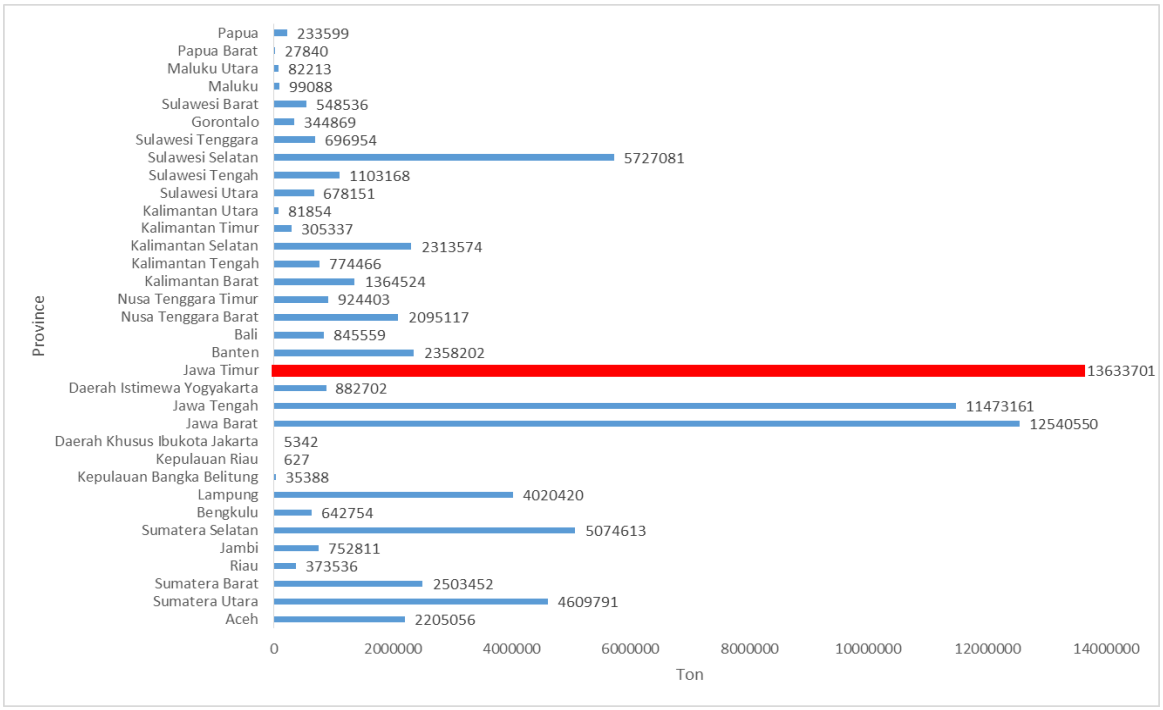

Fig 1.2 Paddy production in Indonesia (2016) by province

Source: https://aplikasi2.pertanian.go.id/bdsp2/id/lokasi (Accessed 2017-12-5)

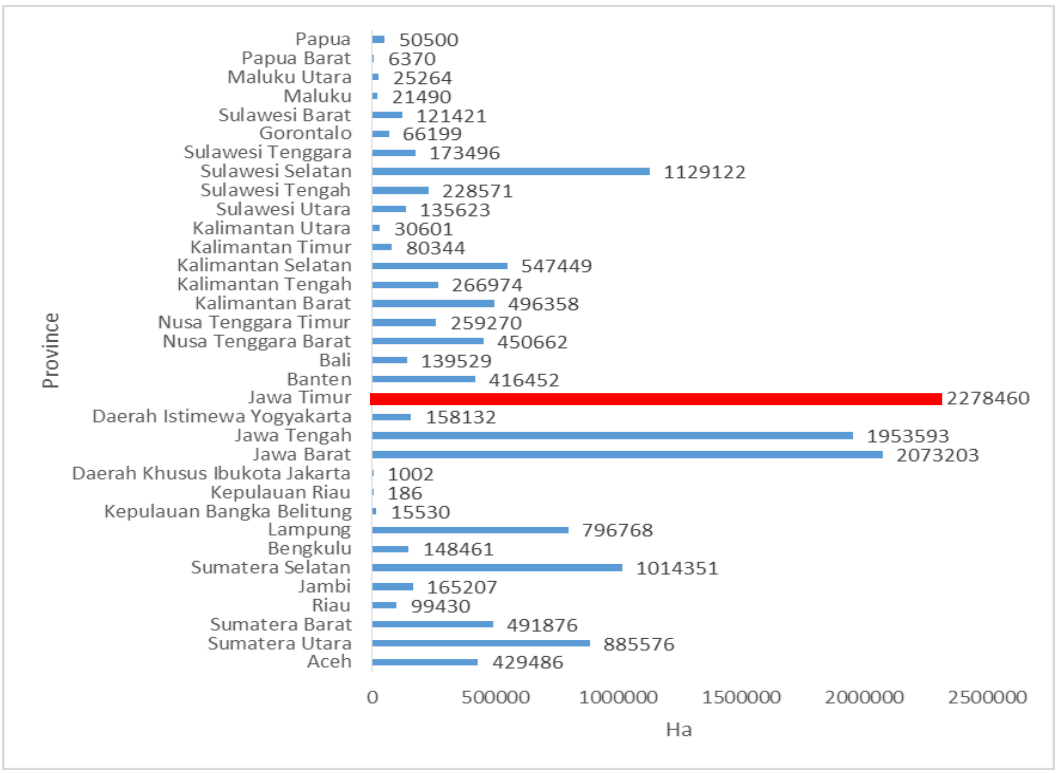

Fig 1.3 Paddy field area (2016) by province

Source: https://aplikasi2.pertanian.go.id/bdsp2/id/lokasi (Accessed 2017-12-5)

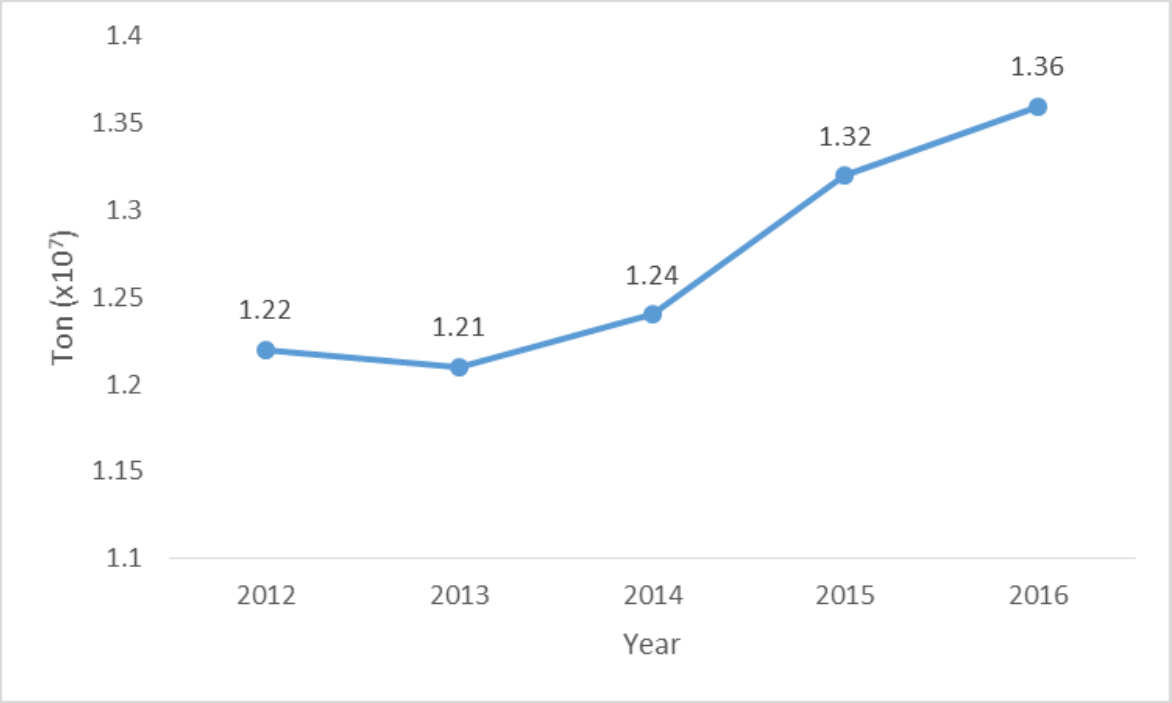

Fig 1.4 Paddy production in East Java

Source: https://aplikasi2.pertanian.go.id/bdsp2/id/lokasi (Accessed 2017-12-5)

Malang district (Kab. Malang) has a total of 71,000 hectares paddy field (fig 1.5) with 446,513-ton paddy production (fig 1.6) in 2016.

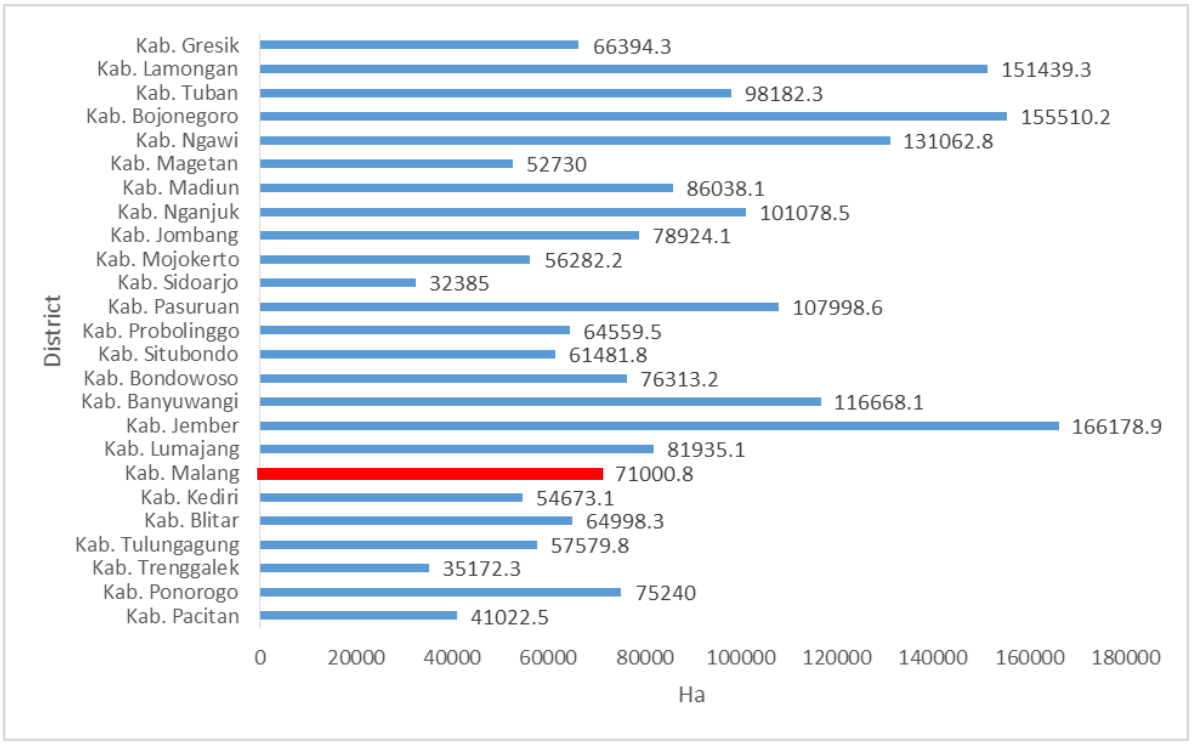

Fig 1.5 Paddy field area in East Java (2016) by district

Source: https://aplikasi2.pertanian.go.id/bdsp2/id/lokasi (Accessed 2017-12-5)

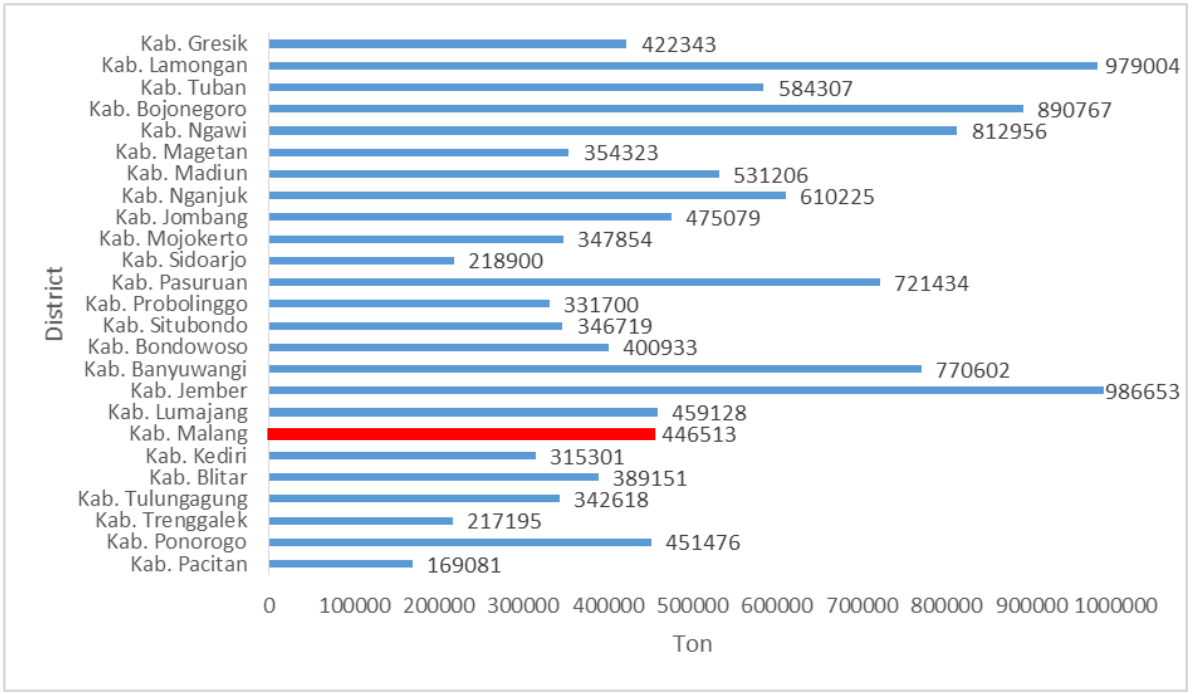

Fig 1.6 Paddy production in East Java (2016) by district

Source: https://aplikasi2.pertanian.go.id/bdsp2/id/lokasi (Accessed 2017-12-5)

After SRI has been introduced by company CSR in Kepanjen area, which is capital sub-district, the government encouraged farmers in other sub-district to adopt SRI. Figure 1.7 is a local article about SRI pilot project that has been successfully harvested. But when it was confirmed to local government in 2017 by interview, the pilot project held just once and had no follow up after that.

PADI SRI HASIL UJI COBA BERHASIL DIPANEN

Selasa , 2 Des 2008

PADI SRI HASIL UJI COBA BERHASIL DIPANEN

Metode padi jenis *System of Rice Intensification* (SRI) merupakan sistem pengembangan produksi pertanian hemat air dengan mengoptimalkan kesehatan dan produktivitas agro-ekosistem secara alami. Dengan pengembangan ini, hasil produksi padi yang didapat merupakan jenis padi yang mempunyai serat yang cukup berkualitas. Sehingga padi jenis ini adalah salah satu pilihan bagi para petani untuk terus dikembangkan.

Demikian disampaikan Wakil Bupati Malang, Jawa Timur, H. Rendra Kresna, saat acara "Pemanenan dan Desiminasi Hasil Pelatihan dan Uji Coba Padi SRI" di Daerah Irigasi (DI) Molek, Desa Kedungpedaringan, Kecamatan Kepanjen, Malang pekan lalu.

Fig 1.7 Article about SRI pilot project in Malang district

Source: http://www.pu.go.id/berita/2488/PADI-SRI-HASIL-UJI-COBA-BERHASIL-DIPANEN (Accessed 2017-01-24)

One of sub-district which introduced SRI after pilot project is Pagelaran. It is the youngest sub-district in Malang district which is located 500-1000 meters above sea level and 22^0 – 28^0 C on average temperature. This area has 2,649 ha agricultural area with less than 8% soil slope. It has average 151 mm rainfall in 10 years (2005-2014).

SRI was first introduced in Pagelaran in 2009. 20 Farmers joined training from Ministry of Agriculture, but now all farmers modified SRI method. Farmers try SRI method for two years then in 2011 they decide to adopt just some of its practices. It is interesting to see why farmers modifiy SRI or even discontinue adopting the method. After conducting preliminary study, farmers who discontinue SRI method adoption despite benefits offered to them, was found as a problem for this research.

1.5 Research objectives

Purpose of this study is to assess SRI adoption problems in Pagelaran, Malang using Analytic Hierarchy Process (AHP). To make clear what kind of adoption problem in that area, the following objectives are given as follow:

1) To identify the affecting factors of farmers who discontinue SRI method
2) To suggest strategies for overcoming SRI adoption problems

The goal of this study is to give farmers information about which practices should be adopted first to adopt SRI method successfully. In the future, government is expected to make easier policy in crop improvement regarding food safety along the country.

1.6 Research questions

For this study, two main research questions have been developed as follow:

1) Why do farmers not adopt SRI method despite knowing it?
2) Why do farmers not use SRI method despite having tried it on their farmland?

1.7 Hypotheses

To respond research questions above, two hypotheses is given as follow:

1) Farmers have the necessary knowledge on SRI and its benefits but hampered by capital and labor constraints to make the intended investment and less intense social network to push them to use the practices.
2) Farmers understand the perceived benefits, have large network and access to credit, but they cannot take the risk due to conservative mind, or have the SRI return smaller than expected due to only partially adopt the technology or insufficient knowledge.

1.8 Theoretical framework

In order to gain further understanding about this study, a theoretical framework is developed which is shown as figure 1.8.

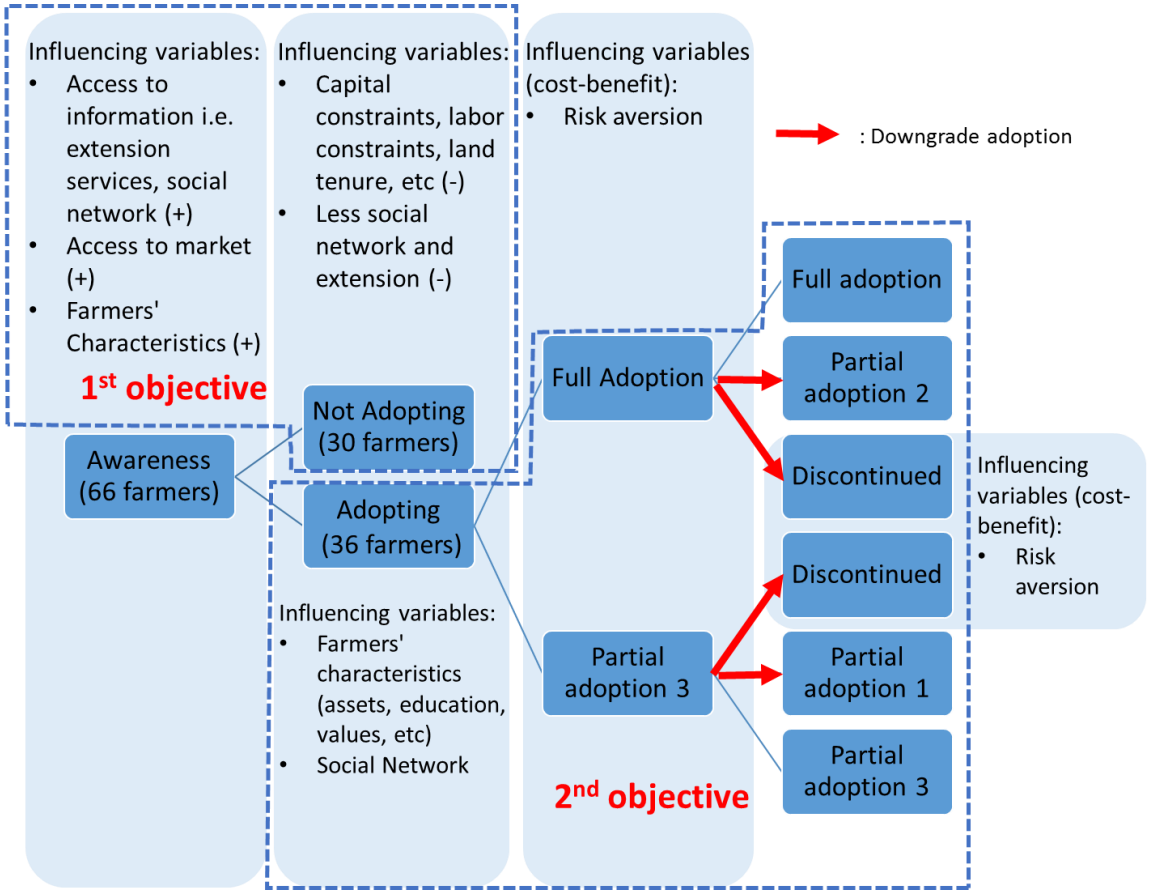

Fig 1.8 Theoretical framework

Assume each SRI Key practices as *x:*

1. Transplant young seedling
2. Plant single seedling per hill
3. Space plant farther apart
4. Use intermittent irrigation
5. Control weeds
6. Enhance soil organic

Thus, SRI adoption is described as $0 < x \leq 6$. Full adoption is described as $x \geq 6$. Partial adoption 3 is described as $x \geq 3$ which has three adopted practices such as transplant young seedling, space plant farther apart, control weeds. Partial adoption 2 is described as $x \geq 2$ which has two adopted practices such as transplant young seedling, space plant farther apart.

Partial adoption 1 is described as $x \geq 1$ which has only one adopted practice, for example, transplant young seedling. Not adopting SRI practice is described as *x* equal to zero.

CHAPTER 2

LITERATURE REVIEW

2.1 SRI around the world

SRI was initially developed in the 1980s in Madagascar by a French priest, Father Henri de Laulanie, S.J. In order to increase paddy productivity, several agricultural techniques were developed because rural Madagascar was poor. Nowadays the technique is called System of Rice Intensification (SRI). To spread the method, a local NGO which called Association Tefy Saina (ATS) was established in 1990 with Malagasy friends. It became a tool to promote SRI around the world.

As a result, SRI has been widely spread all over the world mostly Asia or Africa such as Bangladesh, Cambodia, China, India, Indonesia, Kenya, Myanmar, Senegal, Thailand, and Vietnam. It was reported that SRI improved physiological changes in rice lead to higher yield (Thakur et al, 2010). Also, India case reported that SRI reduced irrigations and pumping hours by 52% (Adusumilli and Bhagya Laxmi, 2011). But, it was found that labor use increased following SRI method (Moser and Barret, 2003).

SRI method claims to increase smallholder rice yields using less water and seed. This method recommends for crop establishment, irrigation management, weed control, and fertilization. SRI has six key practices such as (1) raising young seedlings in carefully managed; (2) transplanting young seedlings (ideally 8-15 days old); (3) widely spaced, single seedling, often planted in grid patterns (typically 25 x 25 cm or wider); (4) water management to promote moistly, aerated soil condition, sometimes including dry periods of 3-6 days; (5) early and regular weeding, typically four times at regular intervals, using a mechanical rotary weeder or by hand; (6) fertilization, preferably using organic source (Stoop et al., 2002). These practices are considering different from conventional method which seedlings transplanted in a closed area then randomly distributed in narrowly spaced rows. Also, rice fields are often kept flooded to suppress weeds by avoiding regular weeding. The idea of SRI create conditions in which rice plants can achieve their full, innate potential to grow and flourish.

SRI methods are reported to give three key benefits. First, grains yields are reported to increase, delivering a direct benefit to both subsistence and (semi-) commercial farming

households. Second, the methods are believed to increase the productivity of water and seed. Third, SRI is said to represent a more ecologically sustainable method of rice cultivation through water conservation, organic soil husbandry and lower methane emissions (Uphoff, 2007).

2.2 System of Rice Intensification (SRI) adoption problems

The generation and spread of information, economic limits, social factors, farmers' characteristics, attributes of sustainable practices, and infrastructure conditions are identified as problems to adoption (Rodriguez, J.M. et al, 2008). Obstacles related to the supply of information are about knowledge and information needs, lack of available information for farmers, and change agents' lack of information and knowledge (Norman, D. et al, 1997; Young, D.L., 1989).

Economic factors

Economic factor, which frequently mentioned in the literature as a problem, is increased labor use on SRI plots (Moser and Barret, 2003; Barret et al, 2004; Ly et al, 2012). Labor is often an expensive factor of production because it increases production cost. Farmers know the limits on their own time and energy and might be unable to provide the additional labor themselves. Additional labor cost may affect profitability (Rodriguez, J.M. et al, 2008). They also have serious concerns about whether the necessary labor will be available to hire when needed and at what cost (Schneeberger, W. et al, 2002; Antle, J.M. and Diagna, B., 2003). In addition, farmers' poor economic situation might be identified as a problem to the adoption of System of Rice Intensification (SRI) practices.

Not only labors, some other factors such as the cost of materials and equipment; uncertainty of profitability or increased risk; loss of productivity; at-risk economic situations; farm program policies also affect the adoption.

In addition, characteristics of SRI practices themselves have been identified as barriers to adoption. For example, intermittent irrigation. Farmers found it is difficult to control water because irrigation system is not properly established. They are not familiar with others SRI

practices such as narrow and shallow seed planting or frequent weeding. Farmers were always encouraged to adopt organic SRI, but it seems like they have difficulties to get organic fertilizers. It is related to availability, transportation cost, and difficult access to the paddy field.

Farmers' characteristics

Besides economic factors, farmers' characteristics are identified as a barrier to adoption. Personal characteristics such age, attitude, and beliefs are factors affecting farmers. For example, an attitude frequently identified as a barrier is the 'resistance to change' (Wandel J. and Smithers, J., 2000). Farmers have no strong reason to change the method because the conventional method is already used from generation to generation. Their way of farming is called by a custom or cultural habit. It is identified as a problem of SRI adoption.

Land tenure

Ownership and use arrangements act as barriers to adoption in the USA (Bell, M.M. et al, 2001). It is about property right issues for adoption. In developing countries, many farmers do not own their plot. They often lend it from a landlord. Because of land ownership, farmers will not take a risk to change agricultural method.

Social infrastructure

The supporting context of neighbors, kin and peer farmers shapes a farming subculture or farming style and its associated norms about acceptable agricultural practices. Adoption decisions are often based on imprecise factors such as what is considered to be socially and culturally acceptable by members. Environmental practices are often new in such subcultures and farmers may be likely to implement such new approaches (Rodriguez, J.M. et al, 2008). Infrastructural issues have been identified as a barrier to adoption of sustainable practices in the USA. Farmers were powerless to adopt management systems due to unavailability and inaccessibility of supporting resources (Nowak, P., 1991 in Rodriguez, J.M. et al, 2008). Few farmers adopted this system without assistance or support from government or other parts

of the surrounding agricultural infrastructure. A lack of marketing infrastructure is also a barrier to sustainable agriculture in the Southern United States (Khanna, M. et al, 1999 in Rodriguez, J.M. et al, 2008).

2.3 SRI in Indonesia

SRI was first introduced in Indonesia in 1999 by Indonesian agency for agricultural research and development ministry of agriculture in Sukamandi, West Java. Paddy production was 6.2 ton/ha in dry season while 8.2 ton/ha in rainy season 1999/2000 (Uphoff, 2000). SRI shows increasing productivity in comparison to the conventional method. From that moment, SRI slowly spread all over Indonesia.

SRI project in Malang introduced first in 2007 by Minister of Agriculture Malang district. According to Handono (2013), SRI farmers' expenditure was 13% higher than non SRI farmers which consist of chemical fertilizer (99%), herbicides (97%), compost (92%), labors (20%). Among SRI expenses, labors cost were the highest. SRI farmers need to pay more labors nearly two times than from conventional method. But, SRI farmers' net income were 40% higher than non-SRI (Handono, 2013). It also reported that SRI farmers need 80% less seed than conventional farmers. Moreover, paddy production was increasing up to 38% than the conventional method.

Gani et al (2002) stated some factors affecting SRI adoption in Indonesia which are water management, labors, planting young and one seedling per hill, and pests which attack young seedlings. Farmers still have difficulties to cope with those factors. Furthermore, government support is needed to make farmers adopt SRI method.

2.4 Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process or AHP, one of the widely used decision making judgment tools, is employed in this study. It is a theory of measurement through pairwise comparisons and relies on the judgment of experts to derive priority scales (Saaty, T.L., 2008). AHP works by reducing complex decisions to a series of pairwise comparisons then incorporating the results. It helps to grasp both subjective and objective aspects of a decision. In other words, AHP is an

effective method for checking the consistency of decision makers' evaluation at the same time reducing bias in decision-making process.

AHP is commonly used in various decision making process. According to Vaidya (2006), it can be used based on theme such as selection, evaluation, benefit-cost analysis, allocations, planning and development, priority and ranking, decision making, forecasting, medicine related fields, and Quality Function Deployment (QFD). AHP can be applied in wide area e.g. personal, social, manufacturing, and engineering. Also, it has been applied in some cases in business areas dealing with strategic planning, marketing applications (Wind and Saaty, 1980), design and evaluation of business and corporate strategy (Wind, 1987). AHP integrated with SWOT analysis (strengths, weaknesses, opportunities, and threats) has also been used in a Finnish case study on forest certification (Kurttila et al, 2000). In decision analysis, AHP can be used with another tool to give decision makers explicit understanding.

For this study, a free web-based AHP software developed by Dr. Klaus D. Goepel (BPMSG) is used. The purpose of using AHP is to determine the best priority to adopt SRI method successfully.

CHAPTER 3

METHODOLOGY

3.1 Participants

Data was collected through an in depth interview and questionnaire administration to the

1) Farmers
2) Experts
3) Local government officials

For this study, two professors from faculty of agriculture in Gadjah Mada University were chosen because farmers in that area said that the trainers initially were from Yogyakarta where the university is located. One professor was from Brawijaya University which has the same location as target area. One researcher was from assessment institute for agricultural technology in the same target area. Those experts were chosen because they have relationship with target area which come from training or same location with target area.

In order to get information about target area, two local government staffs were chosen. 66 interviewed farmers were chosen by snowball sampling. Initially only one or two farmers were introduced by local government staffs, then after that they introduced to another farmer friends.

3.2 Data collection method

Data were obtained through a survey with a semi-structured questionnaire (APPENDIX B), key informant interview, focus group discussion, and field observations.

3.3 Data collection period

This research period was divided into three fieldwork as follow:

1. September 9-27, 2016 (preliminary research in APPENDIX A)

Preliminary research was conducted to investigate the exact problem in Malang district. It was reported that Pagelaran area was the first area in Malang district which introduced SRI method.

2. February 6-24, 2017 (questionnaires for farmers in APPENDIX B)

   A questionnaire survey was conducted to find the reasons behind farmers' discontinuing SRI method.

3. September 11-29, 2017 (in-depth interview in APPENDIX A and C)

   In-depth interview with farmers was conducted to know further reasons why farmers adopting SRI method partially. Also, experts' interview was conducted to determine SRI method practices priority, which will be analyzed with AHP software.

3.4 Study area

This study was conducted in Indonesia. The exact fieldwork place is shown with red star mark in figure 3.1 Indonesian map below.

Fig 3.1 Indonesian map

Source: https://www.travelblog.org/Asia/Indonesia/fact-map-indonesia.html (Accessed 2018-01-15)

Fieldwork was conducted in two villages called by Karangsuko and Clumprit village in Pagelaran sub-district, Malang district, East Java, Indonesia. Pagelaran area is shown in fig 3.2 Pagelaran sub-district map.

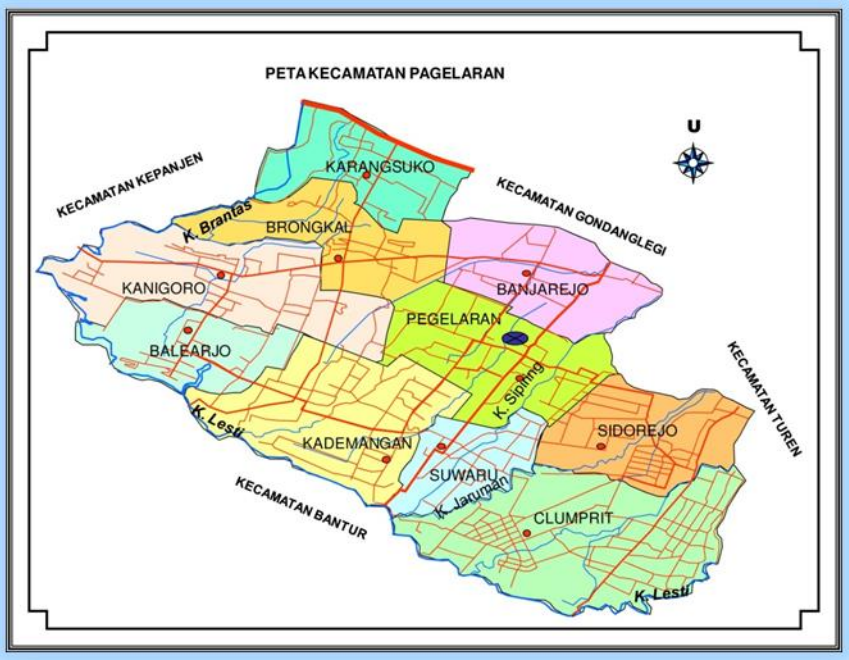

Fig 3.2 Pagelaran sub-district map

Source: Isi program penyuluhan 2016 (word file from local government)

CHAPTER 4

RESULTS

4.1 Finding 1: Interview with the experts on the first fieldwork

In the first phase of the fieldwork September 9-27, 2016. An in depth interview was conducted to examine the present situation of SRI adoption and practices in the field sites. Some experts were chosen due to the availability of contact and the relevance to the subject areas. The interviewed experts are listed below.

1. Prof. (R). Dr. Moh. Cholil Mahfud (Plant protection researcher in Assessment Institute for Agricultural Technology, East Java)
2. Ir. Didik Suprayogo, M.Sc, Ph.D. (Professor in Hydrology from Faculty of Agriculture, Brawijaya University)
3. Dr. Ir. Didik Indradewa (Professor in Crop Physiology from Faculty of Agriculture, Gadjah Mada University)
4. Dr. Ir. Benito Heru Purwanto, M.P (Professor in Soil Sciences from Faculty of Agriculture, Gadjah Mada University)

Professor Cholil, a plant protection researcher, was interviewed in the Assessment Institute for Agricultural Technology in Malang, an agricultural research center under the Ministry of Agriculture. According to him, SRI method has been modified by the Assessment Institute so that farmers can adopt it. The SRI modification is called Integrated Crop Management (ICM). Basically, ICM is similar with SRI, but with some modification added with details listed as table 4.1.

Table 4.1 SRI, conventional, and ICM method comparison

Variable	**SRI**	**Conventional method**	**ICM**
Plant age	Young seedling	More than 20 days	Maximum 21 days
Seedlings per hill	Single seedling	More than one	3 seeds

Plant spacing	Wide space (~30 cm)	Narrow space (~20 cm)	Approx. 25 cm
Irrigation method	Intermittent irrigation	Flooded	*Macak-macak**
Weed control	Frequent	If needed	Not mentioned
Soil enhancement	Organic fertilizer	Chemical fertilizer	Minimum organic fertilizer 2 ton

*(term in Javanese which means to let soil flooded with water)

Farmers in Indonesia are more used to the conventional method. It has been taught from generation to generation. Generally, conventional method paddy planting in Indonesia involves planting an old seed, mostly more than 20 days; planting more than one seed in one hole; flooding paddy field with water; using more inorganic fertilizer than SRI method; and planting space is close.

According to the farmers I interviewed at the initial phase of the study, farmers in Malang have applied SRI method, but most of them switching back into conventional method even they know that SRI method gets more benefit. This is because they have yet to get used to or failed to familiarize themselves with the SRI practices, such as planting space, controlling water, weeding; difficult to get organic fertilizer in such huge amount because it is related to availability, transportation cost, difficult access to paddy field; limited paddy field on their own because most of the farmers in Indonesia only have 0.3 hectares on average; SRI benefit only shows after 2-3 season after adoption; and they think that benefit from SRI is not worth with the effort.

Researchers from Assessment Institute for Agricultural Technology also said that they try to promote the modification of SRI method. For example, distributing leaflet publication, making one standardization paddy field, seeing other farmers that have applied SRI method, and making rice production competition. They hope that with such promotion, its application becomes wider so that rice production increase. But there are some obstacles to promote its application such as the internal conflict in the household, difficult to change behavior, and lack of support from the government.

In addition, three lecturer from Brawijaya University, Malang and Gadjah Mada University, Yogyakarta were also interviewed. Summarizing the interview, most farmers in Malang, who did SRI method, often switch back to the conventional method after they finished the program. According to him because they are not used to it. On the other hand, most farmers in Yogyakarta rarely switch back to conventional method once they have tried SRI method.

4.2 Finding 2: Interview with local government officials

To corroborate the findings from the first phase of interviews with Prof. (R). Dr. Moh. Cholil Mahfud and Ir. Didik Suprayogo, M.Sc, Ph.D., several interviews with local government officials were carried out. Some local government officials were chosen considering experts' recommendation and history of SRI in Malang district.

a. Interview result from Mrs. Dwi Pujiwati, S. Si, a local staff from Minister of Agriculture

   Mrs. Dwi is a key person that is responsible for Kepanjen area. She was interviewed at first, but unfortunately her area was not my target. She introduced me to another staff that is responsible for another area which was likely my target area. She was also interviewed regarding SRI method adoption in Malang district. In her opinion, SRI method was good, but farmers were lack of motivation to adopt it. The method itself was unfavorable and inconvenient, especially in controlling water. Farmers have to watch carefully how much water in the plot to open or close the irrigation. Also, labor availability was another factor in not adopting SRI method. According to her, Kepanjen area was lucky to have unlimited water sources but it made farmers not paying attention to their plot. In other words, farmers used the water as they like.

   Most farmers in Kepanjen do not have their own plot. They are just labors who plant the paddy. So, they do not want to take a risk with adopting new method because it is not theirs. Besides, there is still a selling method called "Tebasan" (disincentives in using the technology). It is a method that you buy paddy or others agricultural products by trading the harvested crop yield according to the closest approximation of the plot size. So, farmers never know how much their product is worth if they still use this selling method. There are many trainings courses for farmers about how to sell the product by themselves. But only a few farmers adopt it. Farmers can just sell

it directly from the plot to buyers with “Tebasan” and they can get the money as soon as the deal is made. But they have to cut the paddy, take out the grains, and find the market all by themselves if they want to sell it, compared to the “Tebasan” method. In other words, farmers never have the benefit even they adopt another method than conventional.

As information, paddy in Indonesia can be harvested 2 two times a year. April to September in dry season, while October to March in rainy season. It can be 3 times a year but still difficult because of farmers’ willingness, land leveling, labor, and other factors.

b. Interview result from Mr. Sugeng Susanto, a local staff from Minister of Agriculture

Mr. Sugeng is a key person that is responsible for Pagelaran area. He was the person that Mrs. Dwi introduced to me. Two farmer groups in two villages, called by Karangsuko and Clumprit, were introduced. In Malang district area, SRI method was first introduced in Clumprit since 2009 because of the limited water resources. After Clumprit, SRI method was introduced to surrounding village including Karangsuko. Unlike Clumprit, Karangsuko has unlimited water resources. It makes farmers in Karangsuko not adopt SRI method as a whole. SRI method is known for its intermittent irrigation.

Mr. Sugeng said that theoretically SRI method is good but farmers find it inconvenient. Paddy planting in rainy season is hard because of the excess water. Farmers have to control water to prevent weeds. Harvesting in rainy season is harder, they have to dry paddy in another room. Same as Mrs. Dwi, Mr. Sugeng also said that the selling method called “Tebasan” is the main factor in paddy plant method adoption. He said that the boss of “Tebasan” is richer than farmers because they can sell the remaining product of grains. But farmers only get money from selling their paddy. Also, they have other difficulties in adopting new method, such as labor availability, agricultural equipment inefficiency, and local tractor businessman rivalry in land leveling.

Farmers have a dilemma to start planting paddy at the same time with other farmers due to resource competition. If they plant it together with others, they have to fight for water irrigation. But if they start early, the mice will be a threat. Farmers in

Indonesia are not rich. Most of them borrow the plot. So literally, they are just labors for planting paddy. They do not have the right to decide which method will be used. It all depends on the landlord.

4.3 Finding 3: Interview with the farmers

Finally in the last phase of the fieldwork, survey questions to the farmers were administered. This fieldwork managed to interview 66 farmers who belong to 2 categories, conventional (30 farmers) and SRI method (36 farmers). Majority of SRI farmers are from Clumprit (61%) and the rest are from Karangsuko (39%). But all of the conventional farmers are from Karangsuko. All interviewed farmers were males.

In terms of age, SRI farmers average age is 52 years old while Non SRI farmers is 55 years old. Both SRI and non SRI farmers are mostly in their 50 and above, which indicated that both group of farmers may be relatively no longer at their most productive age for labor.

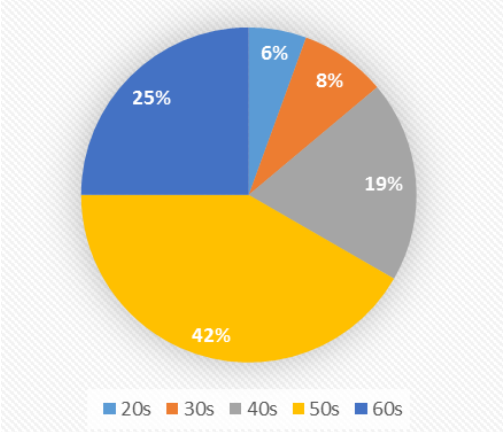

Fig 4.1 SRI farmers' age

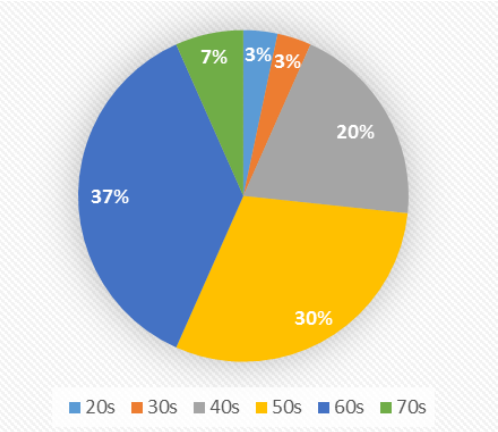

Fig 4.2 Non SRI farmers' age

A small number of SRI farmers tend to diversify their household strategy, with a fraction of 11% stated that their main income being agriculture, while all of the non SRI farmers exclusively work in agriculture.

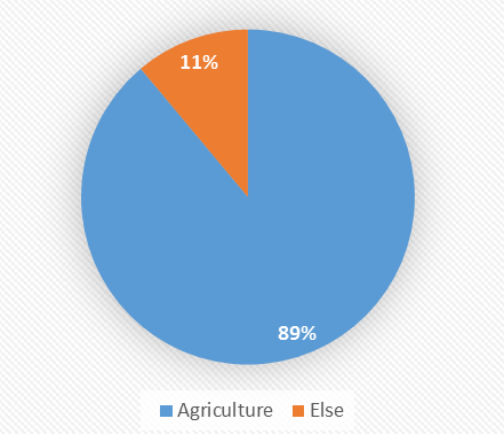

Fig 4.3 SRI farmers' main income source

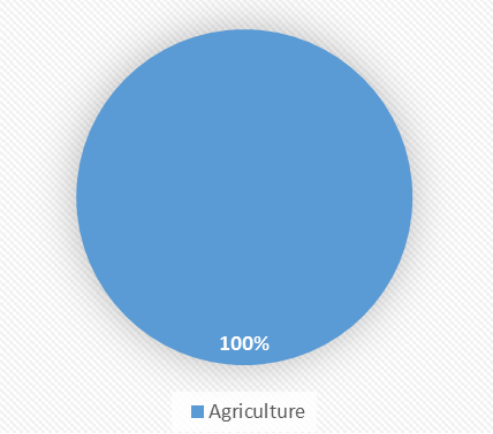

Fig 4.4 Non SRI farmers' main income source

Paddy field ownership percentage was similar between SRI and non SRI farmers (fig 4.5 and 4.6).

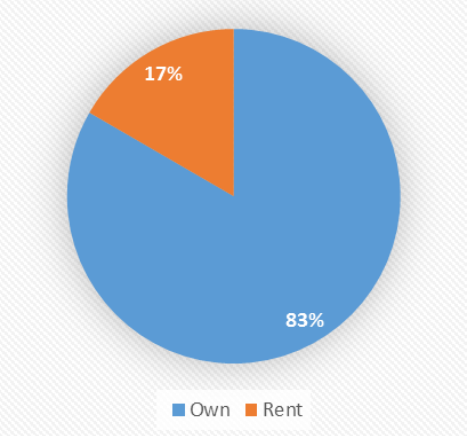

Fig 4.5 Paddy field ownership (SRI)

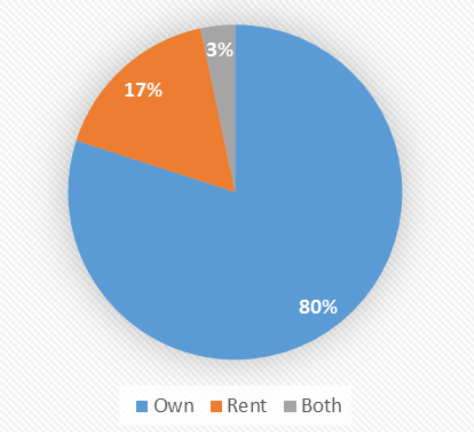

Fig 4.6 Paddy field ownership (Non SRI)

Most of SRI and non SRI farmers have more than 0.126 ha but less than 0.25 ha paddy field area (fig 4.7 and 4.8). SRI farmers have 0.419 ha paddy field area on average with median and mode 0.25 ha while non-SRI farmers have 0.381 ha paddy field area on average with same median and mode. In general, SRI farmers possess larger farmland than non SRI.

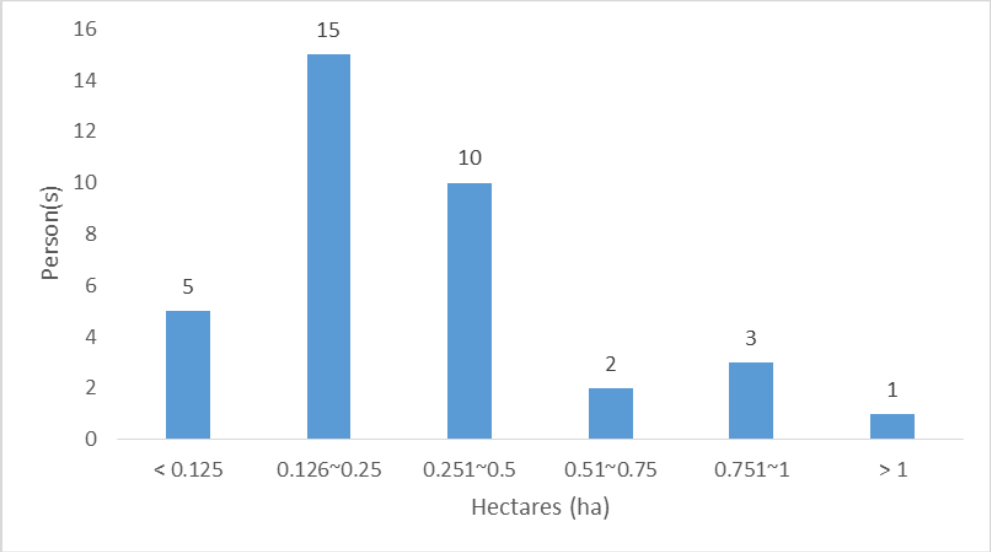

Fig 4.7 SRI farmers' paddy field area

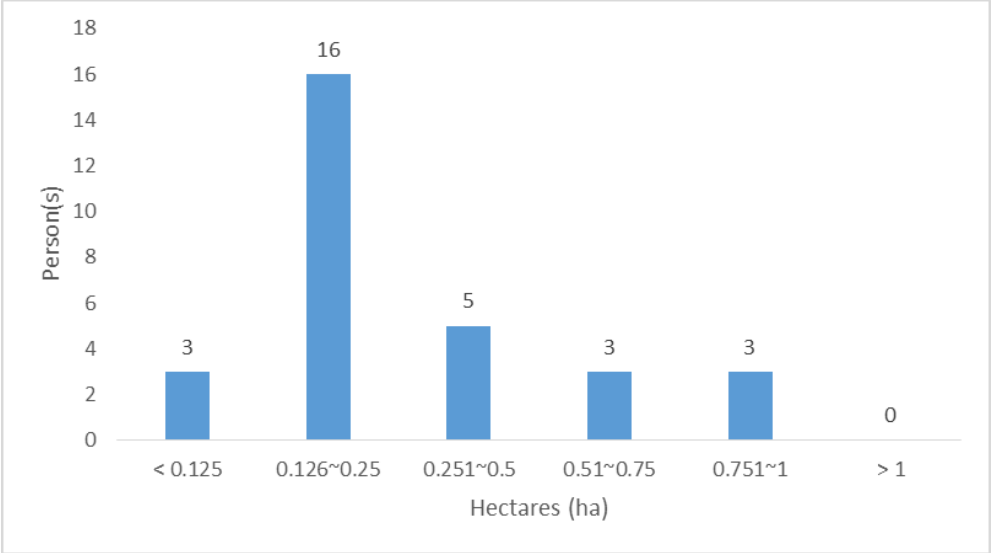

Fig 4.8 Non SRI farmers' paddy field area

83% SRI farmers planted just paddy, compared to 77% of the non-SRI (fig 4.9 and 4.10). Farmers who plant not just paddy, they also plant vegetables, sugarcane, beans, cabbage and chili. Chili was very favorable because high sale prices.

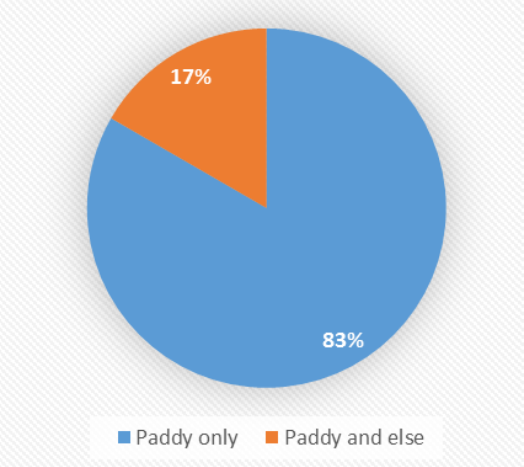

Fig 4.9 Agricultural products (SRI)

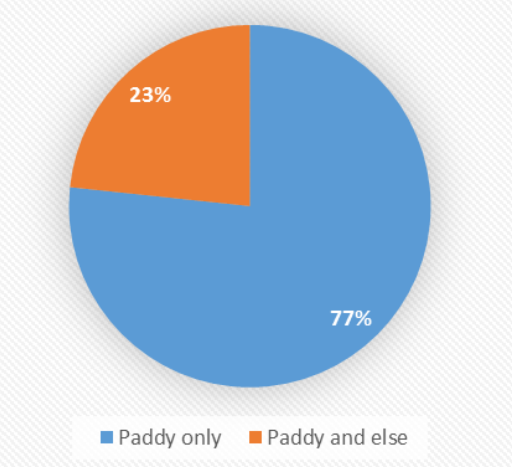

Fig 4.10 Agricultural products (Non SRI)

From 36 SRI farmers, about 30 persons responded to this question. Some farmers have more than one answer. Some of them have different answers from given options (fig 4.11). From the chart, government official recommendations are seen to be the most influential factor that influences SRI practices.

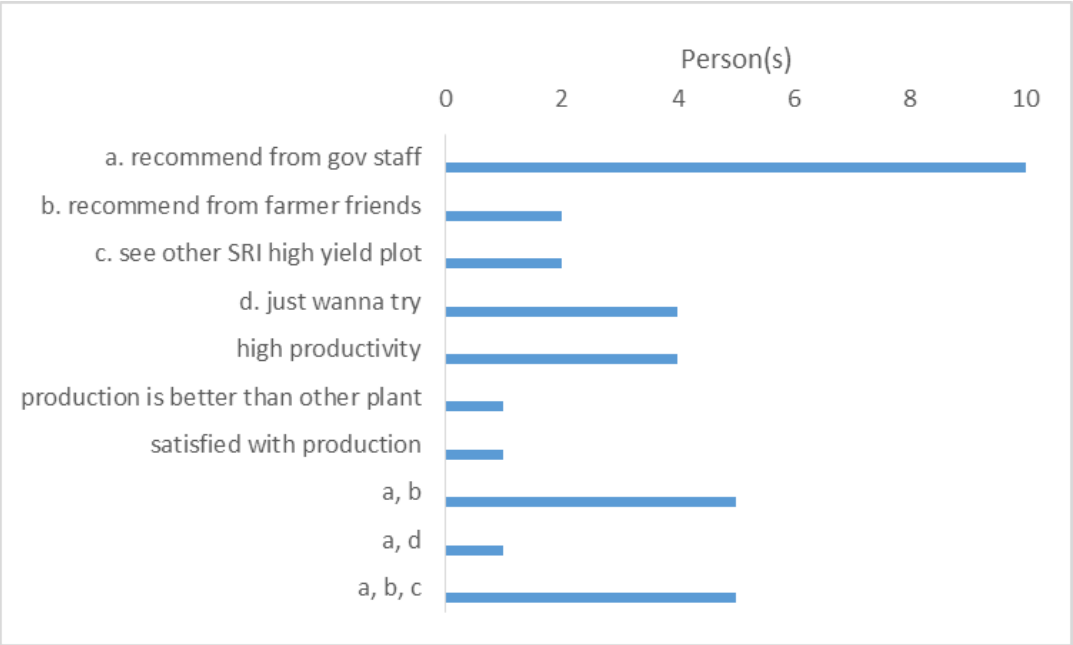

Fig 4.11 Farmers' reason to adopt SRI method

SRI farmers were interviewed to examine how they adopt the method. All interviewed SRI farmers adopted SRI method partially. Seeds were planted about 10 to 12 days. Water management was not strictly controlled as SRI recommendation. Water just leave to be drained but not to dry the plot because of weeds. It was also reported that fully adopting SRI method make them weed every 10-14 days because weeds grow faster which means increasing labor for farmers. A weeder machine was granted to them but it was not useful because of soil characteristics differences between machine manufacturer standard and this area. It has reported that even the machine was used, weeds need to be cleaned manually by bare hand. Frequent weeding was inconvenient for them. 1-3 seedlings per hill were planted because of the fear of dead seed if just putting one seed per hill. 25-28 cm plant spacing was used. As they adopt SRI method, organic fertilizer was encouraged to use as much as possible. It came in ratio 3:2 of organic to chemical fertilizer. 100% organic fertilizer was not used because organic rice grain market is still not secure. Inconvenient SRI method practices such as water management, extensive plant spacing, and one seedling per hill were the reasons why conventional method farmers were unwilling to adopt it.

Based on questionnaires results, various reasons to continue adopting SRI method were found. Two farmers said SRI method has three advantages which increases rice productivity, reduces seed cost, and needs less water. Five farmers said SRI method increases rice productivity and reduces seed cost. Four farmers said it has less effect of strong rice winds on rice. But in majority, 14 farmers who continue adopting SRI method said that SRI method increases rice productivity. While the rest of them said that its production is better than other plant and satisfied with production.

Conventional farmers need 10 kg/ha seeds while SRI farmers need 2.5-5 kg/ha seeds. Most of farmers buy the seeds by themselves although government has subsidies for it because seeds from government has low quality. Ciherang is the most favorable paddy variety for farmers. Most farmers are using dry nursery preparation at home for 12-15 days but few of them still doing wet nursery at paddy field. Fertilizer are not used in farmers' paddy field.

Farmers, which always belong to a group in certain area, are ploughing the soil in the same time with their group. They always plough paddy field in a group to avoid a fight between farmers. Different time of soil ploughing can cause serious pest emergence to other farmers. Because soil ploughing depends on the group, all farmers plough the soil two times per season.

Farmers need 24 persons per hectare to transplant the paddy from 7 to 10 am in a day. Paddy has to be planted in the same time as possible to get them grow in the same time. So, transplanting day is just a day. Average cost for paddy planting is IDR 25,000/person. For watering, it depends on paddy field condition. Most farmers have not difficulties in finding water because water canal mostly next to their field or less than 50 meter.

All farmers are using manual weeding for their paddy field. Many of them weed two or three times per season. 20-24 laborers are needed to weed. Weeding hours are from 6 to 10 am but other farmers weed 2-4 hours in average. Average cost for weeding is IDR 20,000/person. Farmers are using pesticides to help paddy growth. Amount for pesticides are 0.5-1 L. Cost per liter is IDR 90,000/liter. Frequency depends on condition, but it will be higher if paddy get infected (1x/week or at least 1x/month) especially in rainy season. Farmers give pesticides 2-6 times per season on average.

Harvesting needs 5-20 persons, but sometimes farmers harvest it with just family or by themselves. In that case, laborers are not counted. Harvesting has to be done in two days. One day for taking all the paddy, the other day for drying it. Farmers need 4-8 hours per day. Harvesting fee is not money but some grains. It is common in this area to give harvesting group 1/16 of harvested paddy. On average, 6-8 ton/ha in rainy season will be harvested while 10-12 ton/ha in dry season. Productivity tends to increase in dry season because it has less water. Usually farmers' paddy field has distance from nearest road. Transportation cost will occur depending on how far paddy field from nearest road but on average it is about IDR 2,000-15,000 per sack (sack size 40 kg). Fee is not always money. It can be tobacco or lunch depending on deals between owner and labors.

For market selling method, some of farmers sell rice through middleman while some of them sell it themselves. Farmers in this area do not sell rice grains but unhusked rice to milling place. Some of it is for sale while some of it is for are for self-consumption. Even if unhusked rice is to be sold, farmers not selling it all at once. They save some in case they need money urgently. Unhusked rice will be stored for 3 months at the longest. Farmers are selling on average, IDR 4,500/kg for unhusked rice while IDR 9,000/kg for rice grain.

In addition, some farmers have cows, goats or chicken breeds to support both their agriculture and family financially.

4.4 Finding 4: SRI adoption evaluation

Based on the survey which was conducted among 36 SRI farmers in February 2017, adoption results were evaluated as shown below (Table 4.2).

Table 4.2 Field survey results in February 2017

	Variable	**Conventional method**	***SRI recommendation**	**Farmers' adoption method**	**Rate of adoption by farmers**
a.	**Plant age**	More than 20 days	7-14 days	10-12 days	78%
b.	**Seedlings per hill**	Countless	1 seedling	1-2 seedlings	67%
c.	**Plant spacing**	20 x 20 cm	25-30 cm	25-28 cm	100%
d.	**Irrigation method**	Flooded	Intermittent irrigation	*Macak-macak* (0.5 cm water depth)	0%
e.	**Weed control**	2 times per season	Frequent	2-4 times per season	55%
f.	**Soil enhancement**	Using only chemical fertilizer	Using organic fertilizer as much as possible	3:2 (organic to chemical fertilizer ratio)	55%

*SRI recommendation is based on Uphoff, Norman. (2015). The System of Rice Intensification (SRI): Responses to Frequently Asked Questions. Cornell University, NY.

Table 4.2 shows SRI method variables which are plant age, seedlings per hill, plant spacing, irrigation method, weed control, and soil enhancement. Rate of adoption is calculated based on SRI farmers' respond to its key practices (see appendix B question number 10). For the first variable which is plant age, farmers plant it in the conventional method for more than 20 days. But SRI recommendation is 7 to 14 days. Farmers' adoption is 10 to 12 days. Out of 36 farmers, 28 farmers adopt the method, so rate of adoption is 78%. It means that most farmers adopt the following SRI recommendation.

Next variable which is seedlings per hills, conventional method farmers take the seedlings as much as their hand gets it or countless while SRI recommends to just plant only one seedling per hill. Farmers in this area plant 1 to 2 seedlings per hill. 24 farmers adopt this variable which resulted 67% rate of adoption.

For third variable, farmers are using 20 cm plant spacing. But SRI suggests making the space bigger around 25 to 30 cm. Farmers adopt it in 25 to 28 cm. In this variable, all farmers follow SRI recommendation which makes 100% adoption rate.

For irrigation method, farmers always flooded their plot in the conventional method, but SRI recommends them to do intermittent irrigation. Farmers' adoption keeps the water depth about 0.5 cm which is usually called by *macak-macak*, the terms in Javanese which means to let soil flooded with water. In this case, farmers' rate of adoption evaluated as 0% because they are never dry the plot.

Next variable is weed control. Farmers are doing two times weeding in the conventional method, but SRI recommends to weed frequently. Farmers adopt 2-4 times weeding per season.

For the last variable which is soil enhancement. Farmers are using only chemical fertilizer in conventional method. On the other hand, SRI method encourages farmers to use organic fertilizer as much as possible. At the end, farmers use the ratio of organic to chemical fertilizer is 3 to 2. Both weed control and soil enhancement have same 55% adoption rate which means 20 farmers adopt this variable.

4.5 Finding 5: irrigation system

Regarding SRI adoption which related to agriculture, irrigation system in this area has been observed. Irrigation is mostly not scheduled hence farmers have no control over it, as the irrigation is performed by the waterman. Waterman is the person who responded to open or close irrigation canal. He judges by himself whether farmers' plot need water or not. Water depth is around 2-4 cm, then *macak-macak* (term in Javanese which means to let soil flooded with water) is about 0.5 cm. There are no differences along the year because Indonesia is tropical country. Except, waterman should pay more attention to draining water from the plot in the rainy season. Also, farmers never dry the plot to avoid rats and mice threat. Irrigation map in fieldwork area is shown in fig 4.12.

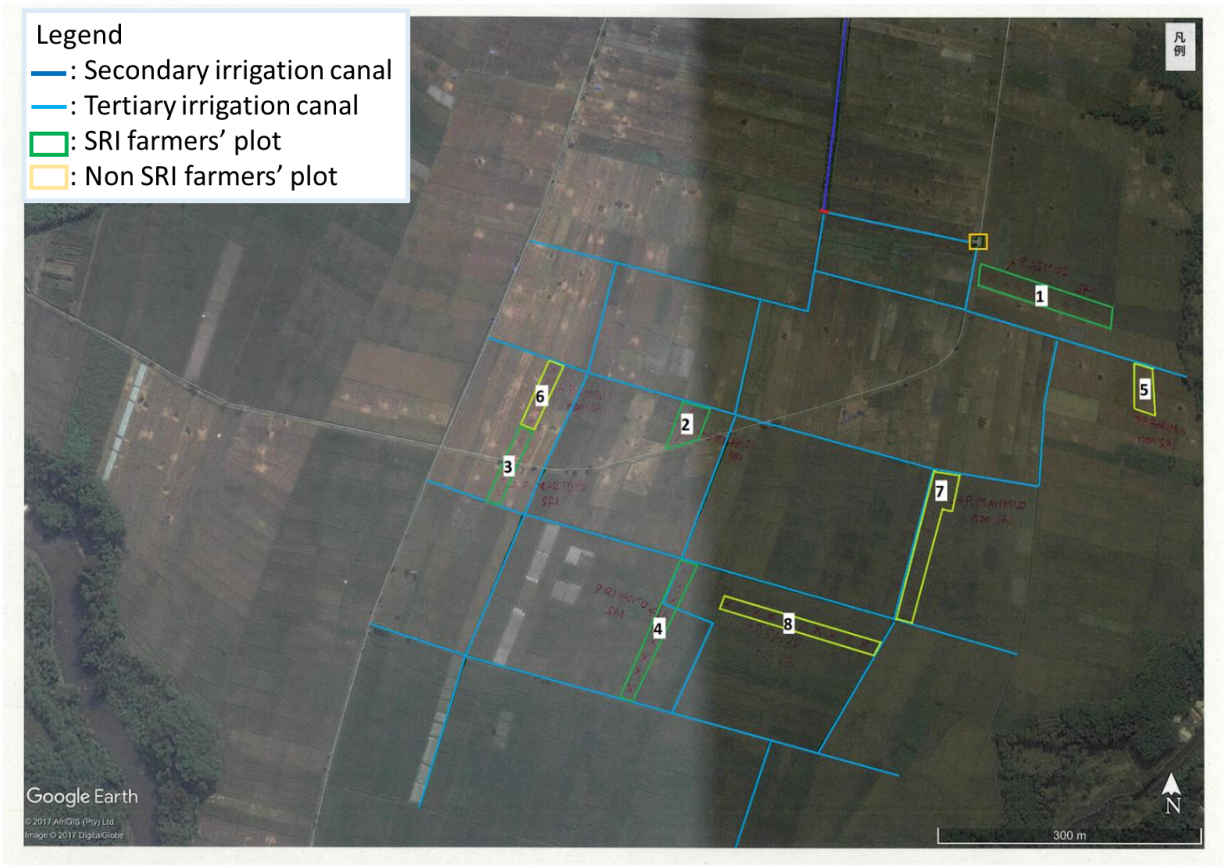

Fig 4.12 Irrigation map in fieldwork area

4.6 Finding 6: Analytic Hierarchy Process (AHP)

AHP Analytic Hierarchy Process (EVM multiple inputs)

K. D. Goepel Version 11.10.2017 Free web based AHP software on: http://bpmsg.com

Only input data in the light green fields and worksheets!

n=	6	Number of criteria (2 to 10)	Scale:	1	AHP 1-9
N=	3	Number of Participants (1 to 20)	α:	0.1	Consensus: 90.5%
p=	0	selected Participant (0=consol.)	2	7	Consolidated

Objective: Calculate weights for pairwise comparison of six criteria

Author: Nisa

Date: 8-Jan-18 Thresh: 1E-07 Iterations: 5 EVM check: 7.8E-09

Table	Criterion	Comment	Weights	Rk
1	Criterion 1	Plant age	21.6%	3

Fig 4.13 Summary AHP in excel file

AHP Analytic Hierarchy Process n= 6 Input 3

Objective: Calculate weights for pairwise comparison of six criteria

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Plant age	23%
2	Criterion 2	Plant single seedling per hill	23%
3	Criterion 3	Plant spacing	7%
4	Criterion 4	Intermittent irrigation	21%
5	Criterion 5	Weeds control	6%
6	Criterion 6	Soil organic enhancement	21%
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 3	1	12/19/2017	α: 0.1	CR: 2%	1
Name	Weight	Date		Consistency Ratio	Scale

		Criteria			more important ?	Scale
i	j	A		B	A or B	(1-9)
1	2	Criterion 1		Criterion 2	A	1
1	3			Criterion 3	A	5
1	4			Criterion 4	A	1
1	5			Criterion 5	A	3
1	6			Criterion 6	A	1

Fig 4.14 Participant judgement sample in excel file

Interviewed experts for AHP is listed as shown below:

1. **Prof. (R). Dr. Moh. Cholil Mahfud** (Plant protection researcher in Assessment Institute for Agricultural Technology, East Java)
2. **Dr. Ir. Didik Indradewa** (Professor in Crop Physiology from Faculty of Agriculture, Gadjah Mada University)
3. **Dr. Ir. Benito Heru Purwanto, M.P** (Professor in Soil Sciences from Faculty of Agriculture, Gadjah Mada University)

SRI practices are ranked by priority based on experts' judgment. Results are shown in table 4.3 below.

Table 4.3 AHP scoring by experts

Rank	SRI practices	Weights
1	Soil organic enhancement	30.0 %
2	Intermittent irrigation	21.7 %
3	Plant age	21.6 %
4	Plant single seedling per hill	15.9 %
5	Plant spacing	6.2 %
6	Weeds control	4.6 %

According to the experts, successful SRI practices necessitate the following steps in priority: the soil organic, intermittent irrigation, planting of young seedlings, single seedling per hill, sufficient spacing, and weeds control. Looking back at what most farmers have done and what they are lacking: farmers found no difficulties in performing the planting of young seedlings and planting in space, which are considered the third and fifth priorities by the experts. Farmers mostly gained knowledge regarding SRI from government officials who are the agricultural experts, and interviewed with them confirmed that they understand the benefits of SRI. However, most farmers only adopted SRI partially or completely not adopting

because they failed to perform intermittent irrigation, the single seedling per hole, provide organic fertilizer, and control weeds. Intermittent irrigation is difficult to perform due to many factors, mostly contributed to the availability of infrastructures and technicalities. Due to the labor-intensive nature of performing single seedling per hole and weeds control, farmers, who are small scale in general, are faced by the labor constraints to sustain the practices in their farmland. Moreover, farmers who are mostly smallholders, may not be able to invest an organic fertilizer due to the capital constraints. This is aggravated by the fact that they are faced by the risk of crop failure because they tend to sell the harvested crop on a pre-determined fixed price by the traders. Farmers may not be able to consider the cost-benefit analysis of using SRI as this practice makes them to be risk-averse. This finding supports the first hypothesis, that farmers actually have the knowledge on SRI but are unwilling to adopt due to capital and labor constraints to make the intended investment.

Further, interview with the farmers and government officials found that farmers in general are influenced by extension officials and fellow farmers in making the decision of adopting the SRI. They are also aware of perceived benefits of SRI. However, they could not take the risk of adopting SRI due to the traditional ways of selling the harvested yield to the traders: to agree on pre-determined fixed price according to the farmland size. Farmers have little options to sell their crops at better prices (marketing constraints). Moreover, as SRI is generally beneficial on economies of scale basis, farmers who are in small-scale in nature, may not be able to fully maximize the return of SRI practices. Farmers' age, which are mostly above 50 years old and way above the recommended productive age, in addition to their household strategy that is exclusively agriculture, makes it difficult to take the risk to adopt SRI. Farmers are mostly just agricultural laborers who do not own the land and therefore tend to avoid the risk. It was found that farmers understand the perceived benefits and have the large network but they cannot take the risk due to conservative mind, or have the SRI return smaller than expected due to the traditional ways of selling the crop yield, in which the second hypothesis is supported.

CHAPTER 5

DISCUSSIONS AND CONCLUSIONS

A problem has been stated that most farmers in Malang who tried SRI method often switch back to the conventional method after they finished the program. This is because they are not used to it, as found in the first phase of fieldwork. To support the first findings, some interviews with local government were completed. It was found that SRI method was good but farmers were lacking motivation to adopt it. The method itself was unfavorable and inconvenient, especially in controlling water because farmers have to closely watch the water amount to open or close the irrigation. Also, labor availability and paddy field ownership were other factors in not adopting SRI. A selling method called “Tebasan” which hindrances in using the technology was also huge obstacle to promote SRI. Furthermore, farmers have difficulties in adopting new method, for example, labor availability, agricultural equipment inefficiency, and local tractor businessman rivalry in land levelling.

From farmers’ interview, it was found that most farmers in both categories were old which no longer at their productive age for labor. They tend to diversify their household strategy which having income from other than agriculture. Surprisingly, SRI farmers possess larger farmland than non SRI in general. SRI farmers’ reason in adopting the method to be specific, and government official recommendations are seen to be the most influential factor that influences SRI practices. SRI farmers were interviewed to examine how they adopt SRI.

To recommend farmers appropriate strategies in adopting SRI method, Analytical Hierarchy Processes (AHP) were performed. Experts scored the soil organic as the most factors to be concerned. Intermittent irrigation was the second priority. Then weed control had least priorities to successfully adopt SRI.

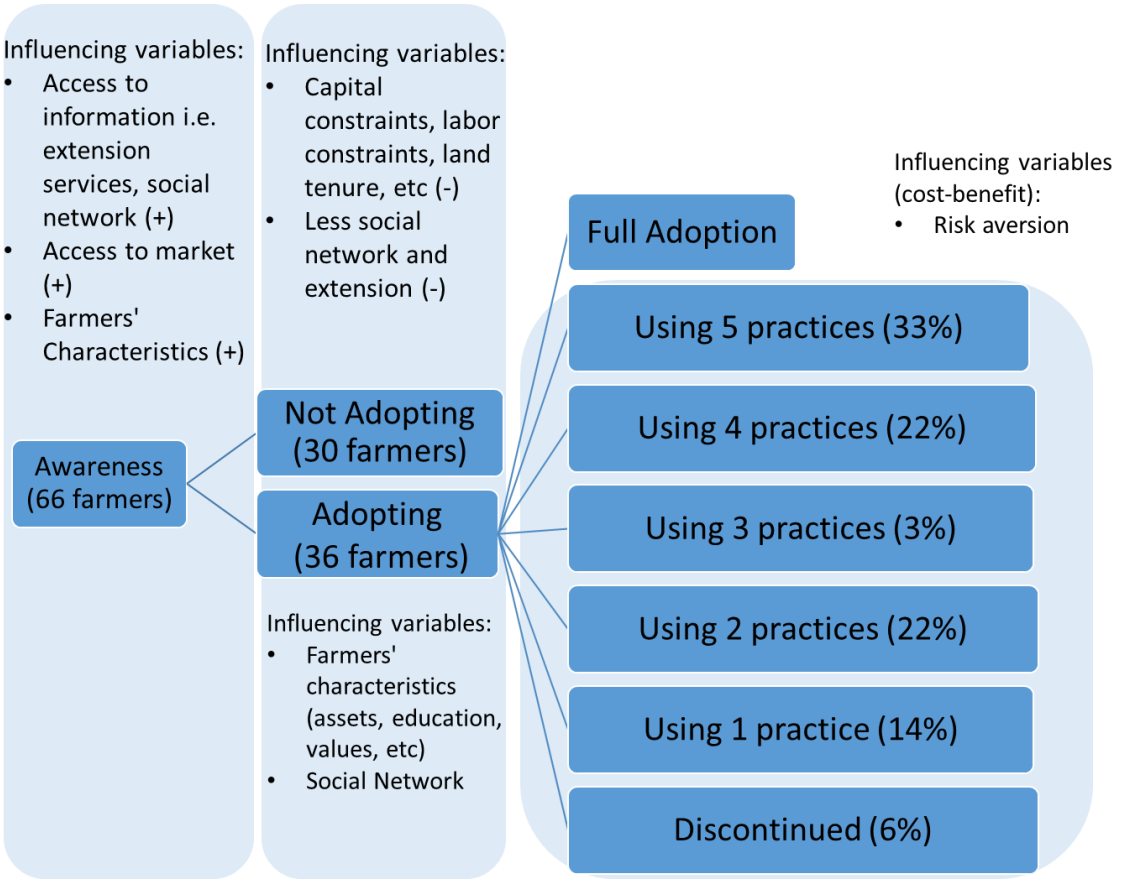

Fig 4.15 Framework based on results

Farmers' unwillingness to adopt SRI method because they are not familiar with SRI practices such as shallow seed planting, 'L' letter like planting technique, intermittent irrigation, wider plant spacing, frequent weeding; low average plot ownership; labor availability; water availability; organic fertilizer availability; SRI method benefit; and rats and mice threat are identified as farmers' reason in downgrading SRI method adoption.

This study found that farmers are faced by difficulties to fully adopt SRI due to the inability to perform the necessitated steps, namely intermittent irrigation, the single seedling per hill, organic fertilizer, and weed control.

Soil organic enhancement is identified as the most important stage to implement. Lack of knowledge in soil and excessive chemical fertilizer usage in the conventional method are considered as factors hindered in adopting SRI. Also, intermittent irrigation is an important step to perform, but the unavailability of the infrastructure makes them unable to do so. Local government should coordinate better to connect village instruments (government officials,

watermen) and the farmers. Then watermen and farmers should respond by providing suitable water intake. In the initial phase, local government should make a scheduled meeting for better coordination. Village instruments and farmers can make new innovations such water request by call. It is possible to do considering many farmers can use mobile phone these days.

Labor constraints are also the problem faced by farmers, as planting seedlings per hill and weed control need extra labor to perform. Farmers are also old, which hampered them to perform the intensive work. It can be solved by inviting more young people to return to the village or hiring seasonal labor. Local government should provide subsidies for labor to help farmers. Furthermore, capital constraints to obtain organic fertilizer. Government should provide subsidized fertilizer or loans.

The most important thing is that the farmers' labor union needs to abolish the practice of "Tebasan". But this system has already been in society for a long time which has nearly zero possibility to terminate it. Government should do something related to it, work with NGO, and give advice and awareness of fair trade practices. Also, more training could be given to the farmers, not only about the technicalities and pre-harvest knowledge, but also post-harvest such as how to weigh the cost-benefits, how to market the products, and how to deal with marketing constraints.

To summarize, farmers should improve their knowledge in soil as well as intermittent irrigation performance and less concerned about weeds. Furthermore, in order to increase the adoption rate of SRI method, farmers should be given a proper training to raise their understanding of sustainable paddy planting and researcher should guide appropriate SRI method on site.

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APPENDICES

APPENDIX A. List of interview questions

A-1. List of questions: Malang district local government staffs

1. Agriculture Training system in Indonesia especially in Malang district or the village, please make a scheme!
2. Do you have any textbook related to the training?
3. Why did government decide to give such training in the village?
4. Did they give the farmers some incentives such as subsidy on fertilizer or seed?
5. What kind of training that they gave in Kepanjen back before?
6. Did farmers go to some training places? Or the trainers came to farmers to teach?
7. Were they (local government staff) full-time SRI method trainers or just part-time (they also teach about other method or not just paddy)? Where, how, when they learned SRI method?
8. Do you know what kind of irrigation (water control) that farmers use? Please explain a little about it!

Ask if …

9. All farmers in that village joined the SRI method training, how many farmers?
10. Why do you think farmers joined the training at that time?
11. Do you know that some farmers stop adopting SRI method after the project finished?
12. What do you think the factors that affecting farmers stop adopting SRI method in their plot?
13. Do you know what condition of the village after 2013 (2016) project?
14. Is there any follow-up project after that?
15. What do you think farmers condition after the project?
16. What are you suggesting to farmers with that condition?

A-2. List of questions: in depth-interview for farmers

A-2-1. SRI modifications farmers

1. What is the size of your plot?
2. How did you know SRI method? From a friend or training?
3. Why do you apply SRI method to your plot?
4. How long have you been the method of your plot?
5. Is it difficult to get water for your plot?
6. How far your plot from irrigation? (in meters)
7. What the most difficult things in adopting SRI method? Why do you think so?

A-2-2. Non-SRI farmers

1. What is the size of your plot?
2. Is it difficult to get water for your plot?
3. How far your plot from irrigation? (in meters)
4. Why are you not adopting SRI method to your plot?
5. What are the most difficult things in adopting SRI method?

APPENDIX B. Questionnaire form for farmers

February 2017

Survey for SRI method adoption

Interview date:

Location of interview:

District:

Village name:

Farmer's detail

Name:

Number of family members:

Education (how many years of schooling):

Gender: M / F

Age:

Q0. Do you or your family member have any other job than agriculture? YES NO

Q1. If YES, which is your household main income? Agriculture Any other business (details)

Q2. Do you have your own plot or rent it? YES NO

Q3. If YES, How many hectares paddy field that you have (land area)?

Q4. How many hectares the field that you planted with paddy (planted area)?

Q5. Do you have any other crops besides paddy?

Q6. Please state your method in paddy plants after the project until now!

Please fill it with (O) if you do SRI method and (X) if you do not adopt SRI method on that season! *S: Season

2016	2017

S1	S2	S1

Q7. Why did you start to adopt SRI method?

a. Recommendation from government staff
b. Recommendation from farmer friends
c. See another field that adopts SRI method. It gets high yield
d. I just want to try SRI method
e. Other reason ( )

Q8. Then, has anyone come to you for information on SRI?

Q9. Do you know why they ask you about SRI method? Please explain it a little if you know!

Q10. SRI Key practices

Do you adopt SRI key practices as shown below?

Please circle Yes if you adopt it, then circle No if you do not adopt it. Please state the reason why you adopt those practices!

	Variable	Adoption	(No) Reason
a.	Transplant young seedling	Yes No	
b.	Plant single seedling in one hole	Yes No	
c.	Space plants farther apart (How many centimeters?)	Yes No	
d.	Watering depends on plot condition	Yes No	
e.	Control weeds	Yes No	
f.	Enhance soil organic	Yes No	

Q11. Did you want to continue or stop adopting SRI method? Please choose from the option below for the reason. You can state your own reason if it is not available.

- **Continue** adopting SRI method

Reason: a. It increases rice productivity

b. It reduces seed cost

c. It needs less water

d. It has less effect of strong winds on rice

e. ( )

- **Stop** adopting SRI method

Reason: a. Difficult in weeding (weed menace, availability of mechanical weeder, high labor requirement, etc)

b. Difficult in controlling irrigation water (poor land drainage, etc)

c. Difficult to get organic fertilizer

d. Yield is less expectation

e. The SRI method itself is difficult to apply

f. ( )

Q12. Please fill table below if you adopt SRI method ONLY the year before!

	Activity	Previous (2016)		Present (2017)	
		SRI	Cost (IDR)	SRI or Conventional	Cost (IDR)
a.	Seeds a. How many kgs per hectares?				

	b. Where did you get the seed? (government or by yourself) c. How many seed varieties do you use?				
b.	Nursery a. How did you prepare your nursery (we-bed/dry-bed/mat nursery)? b. Do you use fertilizer to prepare nursery (yes/no)?				
c.	Land preparation costs a. Rotation/plowing? b. Levelling (how many times)?				
d.	Transplanting a. How many people? b. How long did it take? c. Cost per person per day?				
e.	Watering a. How many times? b. Distance from water (meter/minutes)?				

	c. How do people get water (irrigation pipe/canal)?				
f.	Weeding a. Did you use manual or weeder? b. How many times did you weed? c. How many people? d. How long did it take? e. Cost per person				
g.	Pesticides a. How many liters? b. Cost per liter c. How many times?				
h.	Harvesting a. How many people did you employ? b. How many hours did it take for one person (average)? c. Cost per person **d. How many kgs per hectares?**				

	e. Cost of transport from plot to the nearest road				
i.	Market a. How do you sell the product? Through middleman or not? b. How many kgs to sell in the market? c. Price per kg d. How many kgs for self-consumption? (is it enough for you? If not, how many kgs do you but to fulfill your needs)				
j.	Others a. Do you have any livestock? Describe it				

APPENDIX C. Analytic hierarchy process questionnaire form for experts

To Professor……

The undersigned below,

Name : Zahratunnisa Ekaputri

University : University of Tokyo

Degree : M2

Ask a request to fill table 1 regarding SRI practices judgment. SRI practices are plant age (7-14 days), plant single seedling per hill, plant spacing (25-30 cm), intermittent irrigation, weeds control (4x/season), and soil organic enhancement.

This judgement results will be used in completing my master thesis. It will be analyzed with Analytic Hierarchy Process (AHP). The results will be used as a suggestion in adoption SRI method for farmers.

Thereby, my request is made for appropriate use.

Best regards,

Zahratunnisa Ekaputri

SRI practices judgement using *Analytic Hierarchy Process (AHP)*

Analytic Hierarchy Process (AHP) is an effective tool for dealing with complex decision making. It may aid the decision maker to set priorities and make the best decision. AHP works by reducing complex decisions to a series of pairwise comparisons then synthesizing the results.

How to give a score:

1. First, determine which one is more important, A or B?
2. Then, how do you describe that criterion to another criterion with a scale (intensity of importance)? Please see table 2 for scale score

Table 1 SRI practices scoring

Criteria		Which one is more important?	Scale
A	B	A or B	(1-9)
Plant age (7-14 days) (Criterion 1)	Plant single seedling per hill (Criterion 2)		
	Plant spacing (25-30 cm) (Criterion 3)		
	Intermittent irrigation (Criterion 4)		
	Weeds control (4x/season) (Criterion 5)		
	Soil organic enhancement (Criterion 6)		

Plant single seedling per hill (Criterion 2)	Plant spacing (25-30 cm) (Criterion 3)		
	Intermittent irrigation (Criterion 4)		
	Weeds control (4x/season) (Criterion 5)		
	Soil organic enhancement (Criterion 6)		
Plant spacing (25-30 cm) (Criterion 3)	Intermittent irrigation (Criterion 4)		
	Weeds control (4x/season) (Criterion 5)		
	Soil organic enhancement (Criterion 6)		
Intermittent irrigation (Criterion 4)	Weeds control (4x/season) (Criterion 5)		
	Soil organic enhancement (Criterion 6)		
Weeds control (4x/season) (Criterion 5)	Soil organic enhancement (Criterion 6)		

Table 2 Fundamental scale table

Intensity of importance (Scale)	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another, its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the

		highest possible order of affirmation

Note: 2, 4, 6, 8 can be used to express intermediate values