An Economic Study of the Indonesian Rice Sector: Toward Harmonization of Structural Adjustment and Food Security

2016

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Introduction

1.1. Background of the Study

The Republic of Indonesia is an archipelago in Southeast Asia consisting of 17,000 islands (6,000 inhabited) that are straddling the equator. Indonesia has an estimated population of 257 million in 2015, of which approximately 58% lives on Java, the most populous island.

Three out of five Indonesian people live in rural areas and are dependent on farming. Agriculture is one of the most important sectors in the Indonesian economy, contributing 15% to the gross domestic product (GDP) in 2015. While the agricultural sector's share of the country's GDP declined markedly during the last five decades, it still has the largest (but declining) share of employment. Employment in the agricultural sector in 2015 is 35.76 million laborers, which represents 36% of the national employment.

Indonesia is a middle-income country with a GDP of USD 3,492 per capita (World Bank); it faces three distinct problems in its phase of economic development, namely, food security, income inequality, and food self-sufficiency that decline comparatively with agriculture (Otsuka, 2013). Even though agriculture is a not a minor sector in the Indonesian economy, structural adjustment remains essential for the welfare of the country. This is important from three perspectives (Takahashi and Honma, 2015): 1) it can contribute to maintaining the multi-functionality of agriculture; 2) it can promote trade liberalization; and 3) massive imports of food due to the low comparative advantage may affect food prices in the world market and threaten the food security of net food-importing developing countries.

In the process of economic development, the relative productivity and income in the rice sector has declined (Briones and Felipe, 2013; Takahashi and Honma, 2015). The rice sector does not only provide food, but is also the main source of income and employment for most people in rural areas of Indonesia. The majority of the rural people who work in the rice sector are small-scale, poor resourced farmers. They often do not have access to adequate resources and lack fixed capital. The rice sector's share of GDP has declined, and is lower than its share in labor and farm households. Income from off-farm employment constitutes a major contribution to the farmer income. The poverty problem in rural areas remains, even though the Indonesian economy has experienced high economic growth in the last decade. The number of rural poor in Indonesia amounted to 17.94 million in 2015, and most of them live in Java. The predominant commodity of the rural household in Indonesia is rice, which is limited by small farm size (<0.5 ha). Many people in rural areas work as informal labor and do not have their own land. They have limited access to higher education, and lack the skill to engage in occupations in other sectors. The effect of food commodities on poverty is much greater than the effect of non-food commodities, and rice is the major food commodity that influences poverty. Warr and Yusuf (2010) as well as Warr (2005) pointed out that an increase in rice prices leads to an increase in the incidence of poverty.

To achieve food security and poverty alleviation, an appropriate rice policy is needed. When the Indonesian Government removed the price stabilization mechanisms through the imposition of a rice import ban, rice prices drastically increased between 2004 and 2008 (McCulloch and Timmer, 2008; Dodge and Gamessa, 2012). The rice import ban policy was the main factor that led to an increase in the rice price, which, in turn, resulted in a bigger difference between the world price and the domestic price in 2004–2006. During this period, the poverty index also increased. Furthermore, Dodge and Gamessa (2012) found that the rice price increase resulted in food insecurity outcomes. Under the policy of full rice trade and trade within band, the calorie outcomes and overall household food security improved dramatically. This policy reflects the mistaken claim, advanced by supporters of rice industry protection (particularly in the Ministry of Agriculture) that restricting rice imports reduces poverty (Fane and Warr, 2008). Warr (2005) and McCulloch (2008) emphasized that the rice policy influenced the success of achieving poverty alleviation. The implementation of a policy that restricts imports increases poverty significantly, because of the poverty increasing effects of an increased price of rice.

To alleviate the impact of high domestic prices on the poor, the Indonesian government has implemented a cheap rice distribution program (Raskin). The distribution of rice by the Raskin program started in 1998, in the beginning of the Reformation Era and after the monetary crisis; it aims to strengthen household food security, especially in poor households. The program was initially called Special Market Operation (OPK), and was converted into

Raskin in 2002. Raskin no longer functions as an emergency program (social safety net), but as a part of a social protection program.

The agricultural adjustment problem in Indonesia is less severe for farms producing horticulture or commercial crops than for rice farms. Horticulture and plantation commodities are more profitable and have good market certainty. Thus, in this study we mainly focus on the rice sector.

1.2. Research Subjects and Originality

This study investigates whether the current Indonesian rice sector will achieve the policy targets such as global competitiveness and economies of scale of the rice sector, as well as enlargement of farm size to increase rice production, and whether it would seek an alternative policy implication if it does not achieve these targets.

For that purpose, we investigate the following three research topics. First, we investigate the competitiveness and cost efficiency of rice farming in Indonesia. From this, we find that we need to enlarge farm size in order to increase the global competitiveness of the Indonesian rice sector. Second, we examine the economies of scale of Indonesian rice production before we find the strategy on how to enlarge farm size. The government must promote liquidation of farmland, particularly in Java. To that end, we need to elucidate the determinants of farmland transactions. However, farm size enlargement seems difficult to implement for a number of reasons. Third, we investigate the constraints of farm size enlargement in the Indonesian rice sector.

Furthermore, we explain our research topics and the original contributions in more detail.

1.2.1. Competitiveness and Cost Efficiency of Rice Farming in Indonesia

In order to enhance productivity in general, there are at least three measures. The first is to improve technical and allocative efficiency; the second is to enlarge farm size to enjoy economies of scale; and the third is to develop new technologies that enhance productivity and profitability. We focus on the possibility of the first measure and investigate whether the Indonesian rice sector can improve its technical and allocative efficiency, and whether it can obtain global competitiveness through efficiency improvement. Due to the focus on global competitiveness, we do not examine economies of scale in this chapter.

As for the investigation of the competitiveness and efficiency of rice farming in Indonesia, many studies have already been conducted (Romdhon and Cahyadinata, 2004; Hidayah et al., 2013a, 2013b; Jamal and Dewi, 2009; Kusnadi et al., 2011; Makki et al., 2012; Effendy et al., 2013; Brazdik, 2006; Wikstrom and Fleyeh, 2013).

However, these studies have had serious problems in conducting a close investigation. Romdhon and Cahyadinata (2004) as well as Hidayah et al. (2013a, 2013b) focused only on local rice production, at the provincial level; therefore, their findings cannot be extended to other areas in Indonesia. In addition, most studies use a production function model for estimating the stochastic frontier function. However, the production function approach has several weak points. First, it is difficult to estimate significant coefficients of inputs due to multicollinearity. Second, if we use it, we cannot estimate the more appropriate impacts of technical and allocative efficiency on the cost of production. Finally, most of them use cross-sectional data. However, if we use the frontier function approach, it is more desirable for us to use pooled data (Kumbhakar et al., 2000). Thus, the relationship between the efficiency and competitiveness of rice production has not been well explored in the literature, even though many studies on Indonesian rice policy focus on the determinants of efficiency.

This paper makes two significant contributions. First, to the best of our knowledge, this is the first study that aims to examine the impacts of efficiency improvement on the global competitiveness of Indonesian rice. Second, this paper is among few studies that measure the cost efficiency of Indonesian rice by applying a stochastic frontier approach, not by using the production function model but by using a cost function model and PATANAS[1] data, which contain rich pooled data of production cost in the five main rice-producing provinces in Indonesia. PATANAS research was initiated in 1983 and conducted until 1987. During 1988–1993, PATANAS research was temporarily ceased; it was resumed in 1994 and continued until recently. The methods of PATANAS research are census, survey, re-census, and re-survey. The locations of PATANAS research are in nine provinces, namely, North Sumatra, Jambi, Lampung, West Java, Central Java, East Java, West Kalimantan, South Sulawesi, and West Nusa Tenggara.

1.2.2. The Economies of Scale in Indonesian Rice Production: An Economic Analysis Using PATANAS Data

The staple food of Indonesia, rice, has lost its global competitiveness in the main producing areas of Central Java and East Java, due to small farm size. In order to recover its competitiveness, some policy measures to enlarge farm size are required (Antriyandarti, 2015).

However, although achieving the economies of scale is the necessary condition for enlargement of farm size, the economies of scale might not be achieved in the Indonesian rice sector because most of the rice-growing farmers do not have their own agricultural machines but rent them from their owners. Therefore, we need to examine whether or not the economies of scale can be achieved in this sector.

The objective of this paper is to investigate whether the economies of scale can be achieved in the five main rice-growing provinces of Indonesia, using PATANAS data collected by the Indonesian Ministry of Agriculture[1].

In order to achieve the objective and the robustness of testing, we examine the existence of scale economies via three different methodologies. The first is to estimate the cost elasticity of production by regressing output on production cost, following Hayami and Kawagoe (1989). The second is to estimate the cost function derived from the production function of rice and examine the relationship between production cost and scale using the estimation results of the cost function, following Christensen and Greene (1976), and Kako (1979). The third is to estimate the profit function derived from the maximization problem of the rice farmer and test the existence of scale economies using the estimated parameters, following Lau and Yotopoulos (1971), Yotopoulos and Lau (1973), and Kako (1984).

Among the existing studies related to scale economies, Yamauchi (2014) investigates the technological progress of the Indonesian rice sectors using unique data collected from diverse areas, and finds a complementary relationship between land and machine only in the outer islands, where the average farm size is larger than those of Java. However, this study does not focus on the measurement of economies of scale in the rice sector. Only two studies focus on

[1] PATANAS (National Farmer's Panel) data is household survey, which is conducted by the Indonesian Government as a serial survey to the same respondents. PATANAS data used in this paper is 2007–2012 unbalanced panel data. Therefore, in this study, we use pooled data of rice production in the five provinces that are the main rice production areas in Indonesia. As for the detail of PATANAS data, see Antriyandarti (2015).

economies of scale in the Indonesian rice sector (Hidayah and Susanto, 2013; Hidayah et al., 2013). However, these studies focus only on the Maluku province, which is not a main rice producing area in Indonesia.

1.2.3. Constraints of Farm Size Enlargement in the Rice Sector of Central Java: A Case Study

This study attempts to explore the conditions of rice production by conducting a field survey in Central Java. Circumstances restricted us to conduct the field survey in Central Java only. The total harvested area in Central Java and the Yogyakarta Province is 1,959,811 ha or 14.2% of the total harvested area in Indonesia; more specifically, 15% of the total production comes from Central Java and the Yogyakarta Province (BPS, 2014).

This study examines whether the necessary conditions for enlargement of farm size are satisfied, and investigates the constraints of enlargement of farm size using our own data from a field survey in the Sleman and Magelang districts. We hypothesize that the constraints on farm size enlargement are surplus labor in the rural labor market, characteristics of land tenure, fragmentation of land, agricultural land law that discourages land transaction, and anticipated land price increases by expectation of conversion of agricultural land to non-agricultural land.

In order to examine whether the necessary conditions for enlargement of farm size are satisfied, we compare the production cost per weight unit. We also apply the Cobb-Douglas production function to compare the imputed return that belongs to the owned land of large-scale farms with those of small- and medium-scale farms. Thereafter we can derive the marginal value product of land. We examine the first constraint of farm size enlargement by testing the hypothesis of surplus labor through the Cobb-Douglas production function. Furthermore, we investigate the other constraints of farm size enlargement using a descriptive analysis.

The main contribution of this study is to investigate factors that restrain the enlargement of farm size even when the necessary condition for enlargement is met. To the best of our knowledge, this study is the first to explore the constraint of farm size enlargement in

Indonesian rice farming using field observation to categorize farm households into any of the three categories: small, medium, and large-scale farmers.

1.3. Organization of the Study

This dissertation comprises six main chapters. Chapter I presents the introduction of the study. The author describes the background of the study, the research topics, the originality, and the organization of the dissertation.

Chapter II provides the overview of the general situation of the rice sector in Indonesia. This chapter describes the rice production both at the national level and at the provincial level. Moreover, this chapter also illustrates the importance of the rice sector in Indonesian agriculture.

Chapter III examines the competitiveness and cost efficiency of rice farming in Indonesia. This chapter attempts to test the cost efficiency of rice farming in the main rice producing areas, and confirms the competitiveness of each area.

Chapter IV focuses on the economies of scale in Indonesian rice production. This chapter tests the existence of scale economies via three different methodologies: the cost elasticity of production, the cost function derived from the production function of rice, and the profit function derived from the maximization problem of the rice farmer.

Chapter V investigates the constraint of farm size enlargement in the rice sector of Central Java. This chapter captures the result of a field survey in Central Java, which examines the surplus labor in the rural labor market, characteristics of land tenure, fragmentation of land, agricultural land law that discourages land transaction, and expectation for the conversion of agricultural land to non-agricultural land.

Finally, Chapter VI is the conclusion. This chapter provides the major findings and conclusions of the study. Then, the author derives the policy implications to help the Indonesian Government improve the Indonesian rice sector.

Chapter II

General Situation of the Rice Sector in Indonesia

2.1. The Structural Change of the Indonesian Economy and the Income Gap between the Agricultural and Non-agricultural Sectors

Indonesia is a lower middle-income country with an economic growth that is quite volatile. The worst economic growth occurred in 1998 during the economic crisis, in which it declined dramatically to minus 13.127%; it declined in 2015 to 4.79% from 5.02% in 2014. Reduction in fuel subsidies by the new government results in an increase of inflation, in spite of increases in new public infrastructure. Figure 2.1 presents the economic growth of Indonesia.

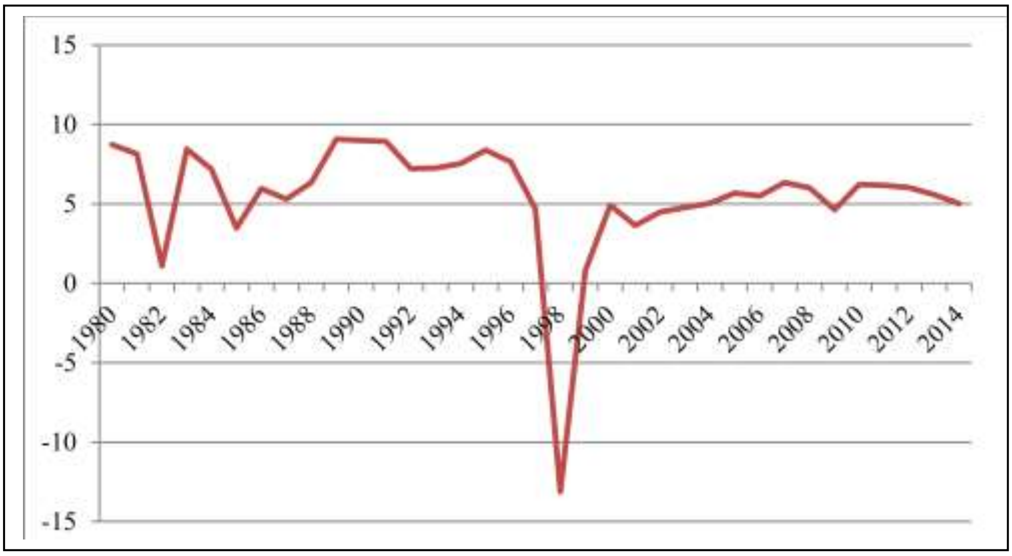

Figure 2.1. GDP Growth (annual %)
Source: World Bank, 2016

Based on the contribution of the production sectors to gross domestic product (GDP), the structure of the Indonesian economy transforms towards industry. Before 1990, the share of agricultural production in GDP was very high and it was considered as the largest contributor to the national production. The share of agricultural production is now decreasing, while that of the industrial sector is increasing. However, the agriculture sector is still the major source of employment for Indonesian people. At times when the industrial and other non-agricultural sectors have not been able to fully absorb the additional labor force, agriculture often provides employment.

Figure 2.2 shows that the industrial sector's contribution to GDP of 23.71% is the largest, while the utilities and services sectors contribute 19% and 18%, respectively. However, the agricultural sector still holds an important and strategic role in the national economy, with a contribution of 14.33% of GDP, which is dominated by food crops (Figure 2.3). The labor force of the agricultural sector still accounts for around 36.42% of the total labor force (Table 2.1).

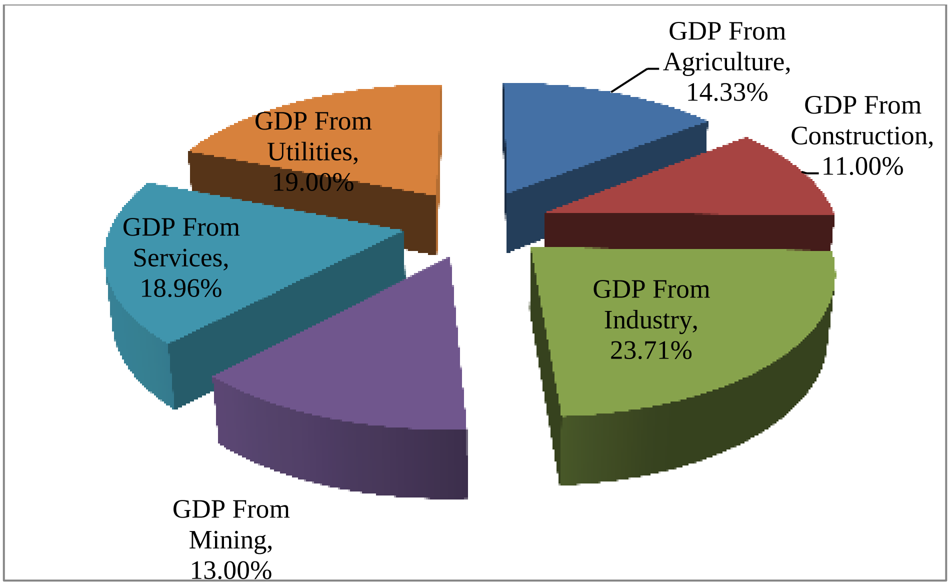

Figure 2.2. GDP Contribution by Resource Sector (%)
Source: BPS, 2016

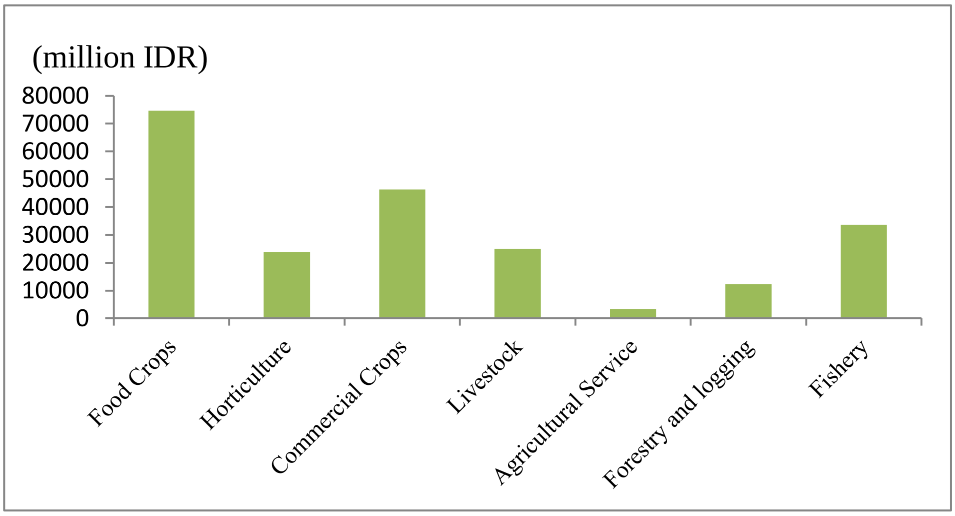

Figure 2.3. GDP Contribution by Agricultural Sector
Source: BPS, 2016

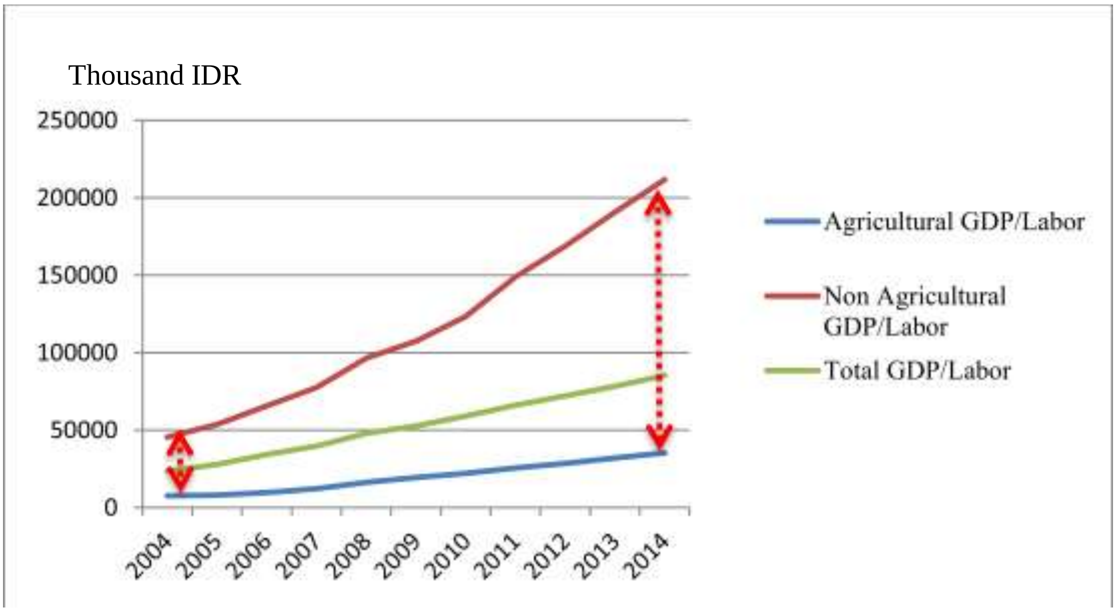

Figure 2.4. The Income Gap between the Agricultural and Non-agricultural Sector
Source: BPS, 2016

The fact that the agricultural share of GDP is lower than that of the agricultural labor force implies that the agricultural sector's labor productivity is on average lower relative to that of the country. The income gap between the agricultural and non-agricultural sectors has widened (Figure 2.4). This suggests that the relative income from agricultural labor has declined. Most of the agricultural activities in Indonesia, particularly food crop farming, are small scale, less efficient, and have low productivity, resulting in low income in the agricultural sector (Ministry of Agriculture, 2015).

2.2. Overview of the Agricultural Sector with a Special Focus on the Rice Sector

The agricultural sector also provides raw materials for industries and plays an important role, particularly when food prices rise. In other words, the agricultural sector is still the main source of food for Indonesian people. The main commodities of food crops in Indonesia are rice, corn, and soybean. Rice production increased by 1.63% per year between 2010 and 2014. Similarly, corn production increased by approximately 1.11% per year, and soybean production increased by 1.93% per year (Table 2.3).

The pattern of growth in the national production of plantation commodities during the period 2010–2014 varied. The increase in production of several commodities was caused by profitable prices, guarantee of prices, and market certainty that encouraged farmers to maintain good crops. Furthermore, government intervention through various activities, the expansion of the plantation area, and the use of high quality seed affected the increase in production. The decline in production of some of the commodities was caused by climate anomalies, reduced acreage, lower productivity, and less favorable prices.

Table 2.1. The Production of Agricultural Commodities (ton)

Commodity	2010	2011	2012	2013	2014	Growth Rate (%)
Food Crop						
- Rice	66,649,000	65,757,000	69,056,000	71,280,000	70,832,000	1.63
- Corn	18,328,000	17,643,000	19,387,000	18,512,000	19,033,000	1.11
- Soybean	907,000	851,000	844,000	780,000	954,000	1.93
Horticulture						
- Red Chili	807,160	888,852	954,310	1,012,879	926,000	3.76
- Chili	521,704	594,227	702,214	713,502	598,700	4.40
- Red onion	1,048,934	893,124	964,195	1,010,773	1,201,900	4.21
- Potato	1,060,805	955,488	1,094,232	1,124,282	1,211,400	3.77
- Mango	1,287,287	2,131,139	2,376,333	2,192,928	2,598,092	21.95
- Banana	5,755,073	6,132,695	6,189,043	6,279,279	7,070,489	5.38
- Orange	2,028,904	1,818,949	1,611,768	1,654,732	2,243,837	4.13
- Durian	492,139	883,969	883,969	888,127	846,503	19.27
- Snake fruit	749,876	1,082,125	1,035,406	1,030,401	980,969	8.68
Plantation						
- Rubber	2,734,854	2,990,184	3,012,254	3,107,544	3,204,503	4.09
- Palm oil	21,958,120	23,096,541	26,015,518	27,746,125	29,512,764	7.71
- Coconut	3,166,666	3,174,379	3,189,897	3,228,110	3,262,721	0.75
- Coffee	686,921	638,646	691,163	698,887	711,513	1.03
- Cacao	837,918	712,231	740,513	777,539	817,174	-0.23
- Tea	156,604	150,776	145,575	146,682	147,704	-1.43
- Sugar cane	2,290,116	2,267,887	2,591,687	2,550,991	2,790,000	5.28
Livestock						
- Meat	2,366,200	2,554,200	2,666,100	2,882,000	2,982,600	5.98
- Egg	1,379,600	1,479,800	1,628,700	1,728,300	1,812,800	7.08
- Milk	909,500	974,700	959,700	786,800	798,400	-2.73

(Ministry of Agriculture, 2015)

Among the agricultural commodities in Indonesia, the per capita rice consumption has been the highest and is very conspicuous compared to other commodities. The demand for rice shows a continuous slow annual increase. The per capita consumption of maize and products, sugar, and palm oil also shows a yearly increasing trend, while the per capita consumption of wheat and wheat products has decreased in 2013. The per capita consumption of cassava declined in 2011, rose slightly in 2012, and declined again in 2013.

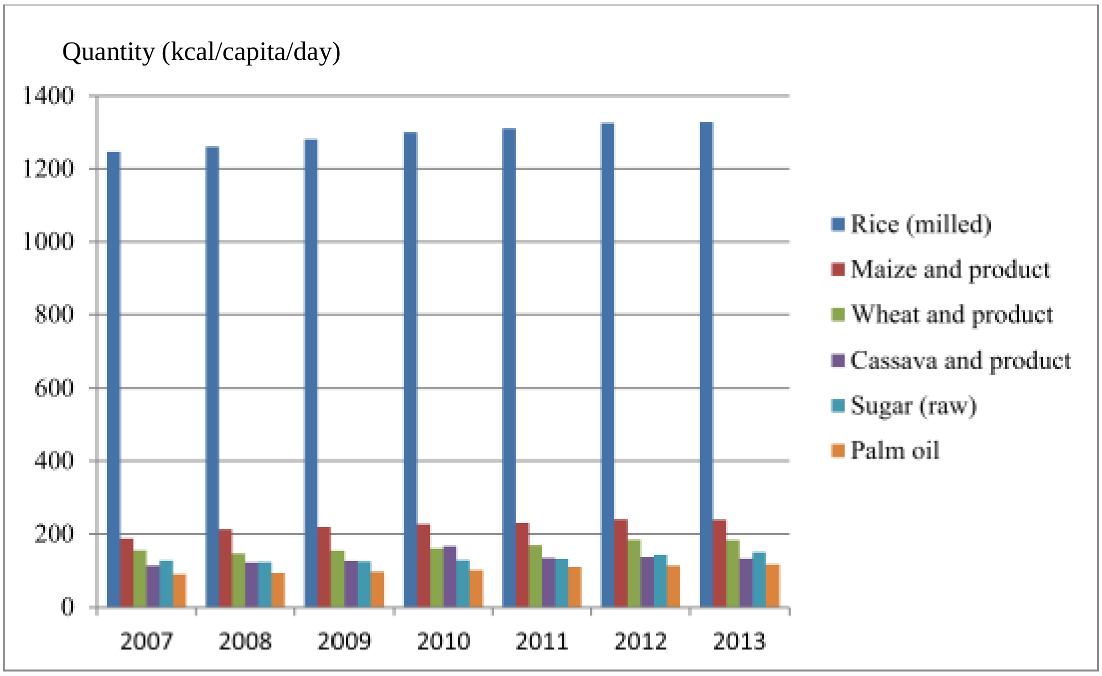

Figure 2.5. Top Commodities: Availability for Consumption 2007–2013
Source: Food and Agriculture Organization of the United Nations, 2016

The food balance sheet of the Food and Agriculture Organization of the United Nations lists a gross rice consumption of 46.36 and 46.87 million tons in 2012 and 2013, respectively. Per capita rice consumption has increased from 134.39 kilograms in 2012 to 134.62 kilograms in 2013. During the same period, domestic rice production has increased rapidly, from 46.06 million tons in 2012 to 47.54 million tons in 2013. Thus, the import of rice has decreased from 1.85 million tons in 2012 to 0.48 million tons in 2013. The supply of rice was supplemented by imports to meet the increased per capita consumption due to increased population growth.

Export performances of Indonesian agricultural commodities are dominated by plantation commodities, namely palm oil, cocoa, and coffee, while import is dominated by food crops. Main import commodities are wheat, rice, maize, and soybean. The following figures illustrate the export and import of main agricultural commodities in Indonesian agriculture.

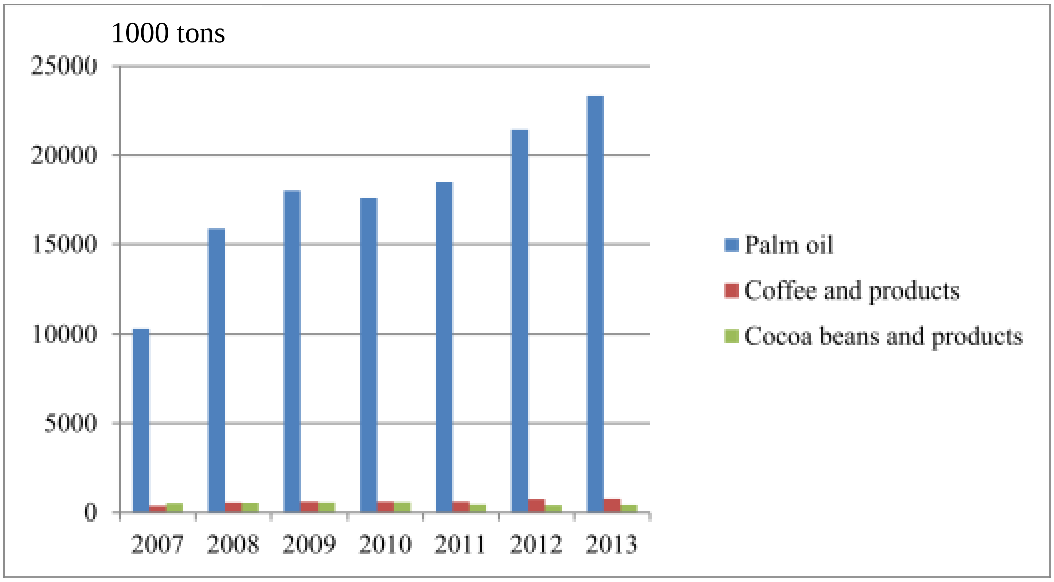

Figure 2.6. Export of Main Commodities
Source: Food and Agriculture Organization of the United Nations, 2016

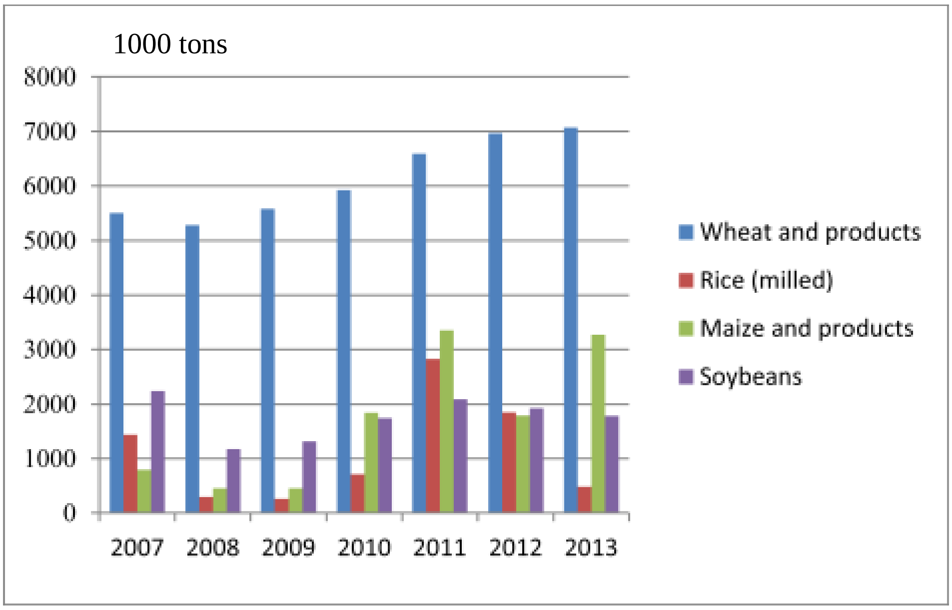

Figure 2.7. Imports of Main Commodities
Source: Food and Agriculture Organization of the United Nations, 2016

Compared to other export commodities, the export volume of palm oil is very prominent. Indonesia is the world's biggest producer and consumer of the commodity, providing about half of the world supply (Ministry of Agriculture, 2015). Import of wheat tends to increase every year. While rice and soybeans showed almost the same trend, it decreased in 2008 and then slightly increased again in 2009. In 2011, there was a sharp increase in rice imports, followed by a substantial decline in 2012 and 2013. The change in soybean import was not significant compared to the import of rice. The annual import of maize is very volatile.

In 2004–2006 and 2008–2009, the government implemented an import ban to protect domestic farmers. However, during the import ban policy, domestic rice prices abruptly rose higher than the world price. In 2014, rice imports increased again because rice production did not meet the increased demand in that year. Rice was mainly imported from Vietnam and Thailand.

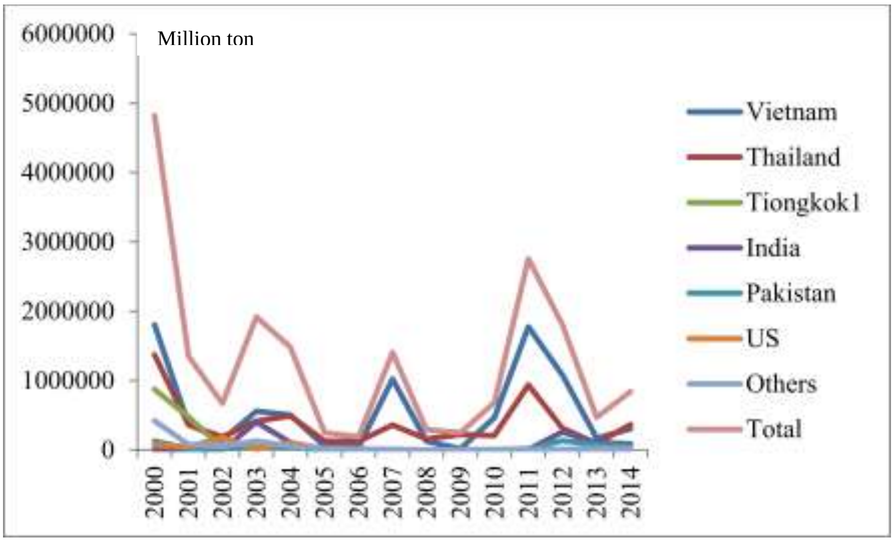

Figure 2.8. Indonesian Rice Import (2000–2014)
Source: BPS, 2016

2.3. The Importance of the Rice Sector in Indonesian Agriculture

The major food crops that contributed to GDP are rice, maize, and soybean. Approximately 60% of these major crops are produced in Java. The type of soil on Java Island is fertile and more suitable for rice farming than that of the outer island.

The rice sector and agribusiness system have a very dominant role in providing job opportunities. The sector is able to absorb a significant amount of labor, especially in Java. The aggregated rural employment structure indicates that the majority of rural employment opportunities are derived from the rice farming sector. An agricultural census conducted by BPS indicates that 75.32% of rural households in Java engage in rice farming. This situation shows that rice farming still has a dominant role in the economy of rural households, particularly in Java, where more than half the Indonesian people live (Prayitno and Arsyad, 1987; Aulia, 2008).

In the rural areas, rice is a symbol of the economic status of the household. Saliem (2001) found that the instability of food supplies and rice price fluctuations led to crimes. Experience in 1966 and 1998 showed that political turbulence could turn into a crisis of political economy, because of soaring food prices over a short period. In addition, at the time when the world food crisis occurred in 2008–2009, the food security of Indonesia was threatened. Therefore, rice is one of the important agricultural products in Indonesia and its production has been fully supported by infrastructure—including research and development, and government regulations for price stabilization.

2.4. Rice Sector

Rice production in the last decade shows an increasing trend, with a slight decline in 2014. Consumption shows a rising trend that follows population growth. Indonesian rice has not shown significant performance in the international market, to which it is exported in very small quantities. The export of Indonesian rice only slightly increased in 2013. Indonesia is an importer of rice; imports show an increasing trend, except in 2008–2009. However, since 2012, rice imports have slowly declined (BPS, FAO of the UN and Ministry of Agriculture).

The national rice storage ranges annually between 1.5 and 2 million ton, which is approximately 5–7% of the total annual production, or 20–25% of the marketed surplus between the months of March and May. The national storage of rice is controlled by Bulog. It follows the pattern of rice production, which is dominated by Java and South Sulawesi (70%); around 60% takes place during the harvest season (January to May). During 2005–2009, the national storage of rice showed an increasing trend, which mostly came from domestic production. Since 2008, domestic production increased sharply and Bulog was successful in optimizing rice storage in the country to meet the stocking needs through abundant domestic production. This successful achievement was maintained until 2009. Since 2010, the government has been importing rice to ensure that domestic demand can be met (Bulog, 2016).

Although the national rice production exceeds the amount of rice consumption, Indonesia still imports rice for national food security. Rice reserves are annually available. The purpose of the rice reserve stock policy is to reduce the risk of food insecurity due to natural calamity, disaster, and climate change, as well as to stabilize the rice price. The rice reserve increased from 4.18 million tons to 5.8 million tons in 2012 (Table 2.2).

Table 2.2. Rice Reserve of Indonesian Rice

Indicator	2010	2011	2012
Rice Reserve (Ton)	4.177.958	5.948.490	5.841.168

Source: BAPPENAS, BPS, and Ministry of Agriculture of Indonesia, 2013

All provinces in Indonesia produce rice, dominated by the largest rice-producing provinces on the island of Java. Provinces with the largest harvested areas also have the highest levels of production (see Table 2.3). The smallest rice production is on Riau Islands, which also have the smallest harvested area.

To simplify the description about rice production, hectare, and productivity, we divide the territory of Indonesia—that consists of many provinces—into two areas, namely Java and outside Java. Figure 2.9 shows a continuous increase in national rice production. Java is a dominant contributor to the provision of national rice, exceeding the contribution from outside Java. It further reinforces that Java is the major producer of rice.

However, the area of the paddy field has not increased significantly, especially in Java. The size of the paddy field in Java has declined from 3.3 million ha in 2003 to 3.2 million ha in 2013 (Figure 2.10). There are two possible reasons for this decrease. The first reason is the conversion of paddy field to non-agricultural land. Second, farmers (for some reason) do not want to enlarge their farm size.

Table 2.3. Productivity, Harvested Area, and Rice Production by Province

Province	Harvested Area (ha)	Productivity (Ku/ha)	Production (Ton)
Indonesia	13,837,213	51.52	71,291,494
Aceh	419,183	46.68	1,956,940
North Sumatera	742,968	50.17	3,727,249
West Sumatera	487,820	49.82	2,430,384
Riau	118,518	36.63	434,151
Jambi	153,243	43.36	664,535
South Sumatera	800,036	45.96	3,676,723
Bengkulu	147,680	42.17	622,832
Lampung	640,948	50.28	3,222,789
Bangka Belitung	10,205	27.81	28,384
Riau Islands	379	36.15	1,370
DKI Jakarta	1,744	58.88	10,268
West Java	2,029,891	59.53	12,083,162
Central Java	1,845,447	56.06	10,344,816
DI Yogyakarta	159,266	57.88	921,824
East Java	2,037,021	59.15	12,049,342
Banten	393,704	52.92	2,083,608
Bali	150,380	58.66	882,115
West Nusa Tenggara	438,057	50.08	2,193,698
East Nusa Tenggara	222,469	32.8	729,666
West Kalimantan	464,615	31.01	1,440,902
Central Kalimantan	247,217	32.81	811,211
South Kalimantan	479,721	42.34	2,031,029
East Kalimantan	138,768	40.63	563,850
North Sulawesi	127,413	50.1	638,373
Central Sulawesi	224,317	45.98	1,031,324
South Sulawesi	983,107	51.22	5,035,830
Southeast Sulawesi	132,945	42.23	561,361
Gorontalo	56,894	52.01	295,913
West Sulawesi	91,035	48.79	444,203
Maluku	24,399	41.74	101,835
North Maluku	19,281	37.57	72,445
West Papua	7,431	39.8	29,572
Papua	41,111	41.3	169,790

Source: BPS, 2013

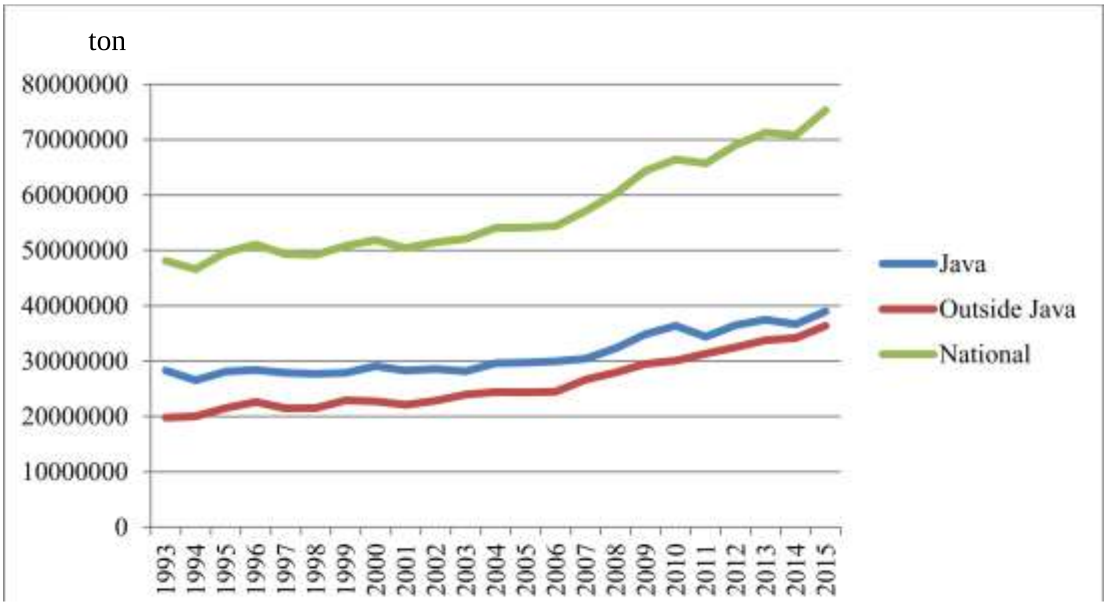

Figure 2.9. Rice Production: 1993–2015
Source: BPS, 2016

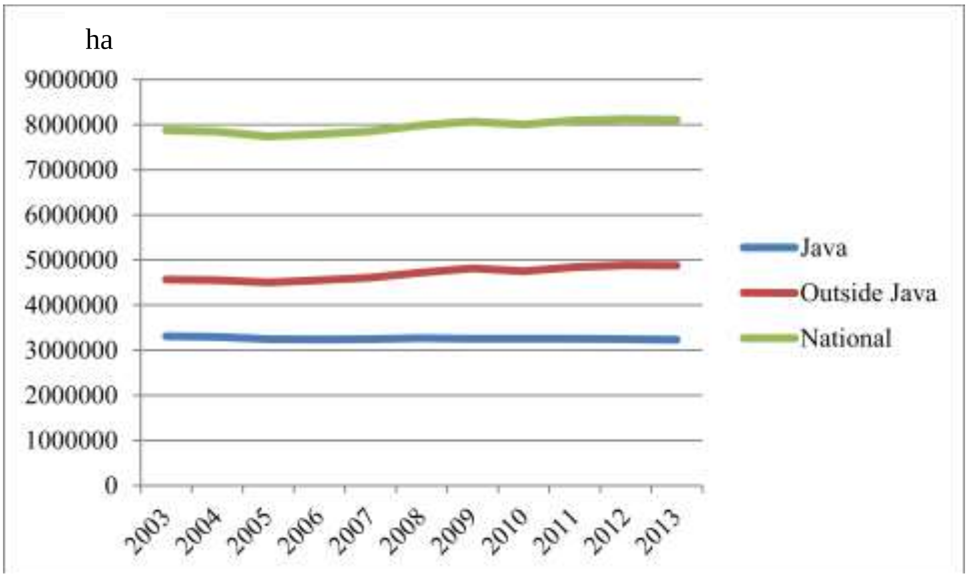

Figure 2.10. Area of Paddy Field (Hectares): 2003–2013
Source: BPS, 2016

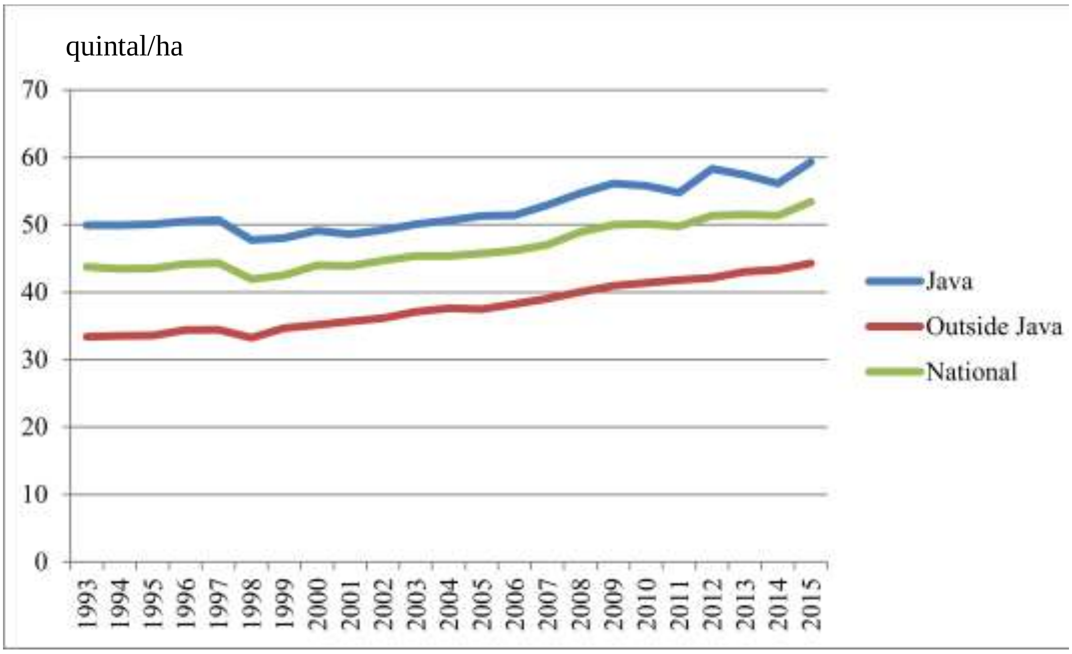

Figure 2.11. Productivity of Rice (quintal/hectare): 1993–2015
Source: BPS, 2016

Meanwhile, Figure 2.11 shows that rice productivity in Java is higher than the national productivity, and much higher than that of outside Java. In 1998, rice productivity decreased both in Java and outside Java due to the economic crisis that occurred at that time. The high productivity of rice in Java is a potential for the Indonesian rice sector to increase national rice production. If the size of the planted area in Java were expanded, it would increase the national rice production. Thus, self-sufficiency would be easily achieved.

In this study, five provinces are chosen to represent the major islands in Indonesia, North Sumatra, West Java, Central Java, East Java, and South Sulawesi. From Figure 2.13, we can see that the provinces of West Java and East Java are the highest contributors to the national rice production at 16% for both. Central Java contributed 14%, North Sumatra 5%, and South Sulawesi 7%. The remaining 40% of rice production is the accumulation of all other provinces that are not part of the surveyed area.

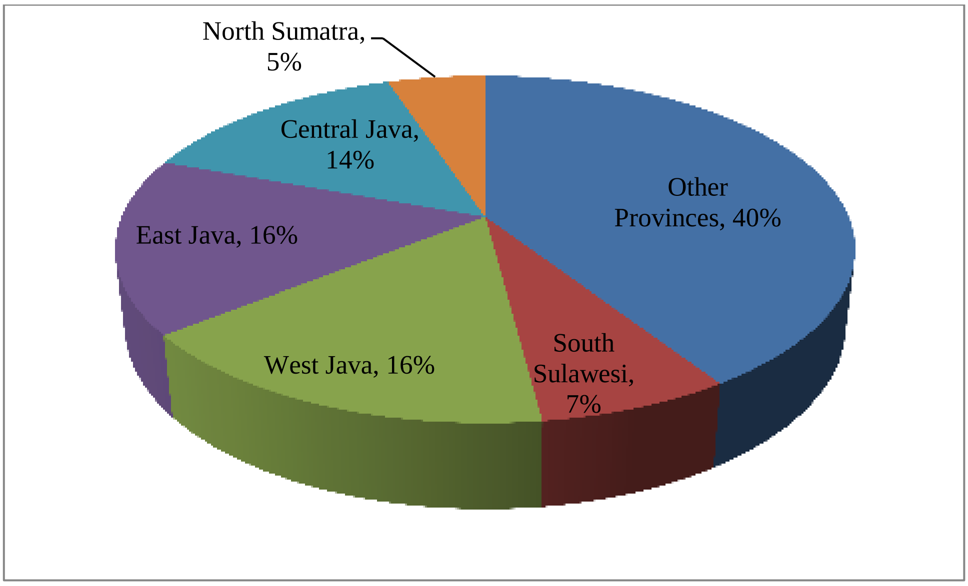

Figure 2.12. Production Share of Surveyed Area per Province
Source: BPS, 2013

Among the study areas, three provinces in Java produced around 46% of the total rice production, which amounts to 37 million tons per year on average over the three years of 2010–2012. These provinces also have the largest harvested area.

2.5. Technology of Rice Production in Main Rice Producing Area

The average fertilizer use per hectare in Central Java and East Java is very high compared to other provinces, while the lowest use of fertilizers is in South Sulawesi (Figure 2.13). The highest average use of seeds per hectare is in East Java, while the use of seed per hectare in North Sumatra is the lowest (Figure 2.14).

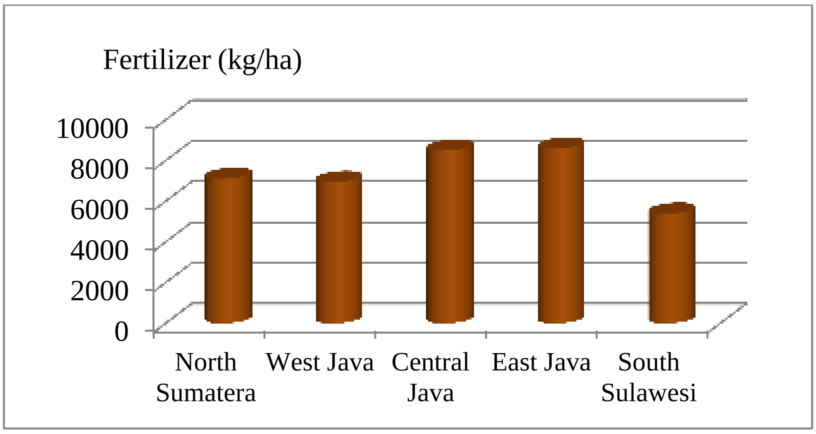

Figure 2.13. Average Fertilizer Use per Hectare by Region (PATANAS 2007–2012)

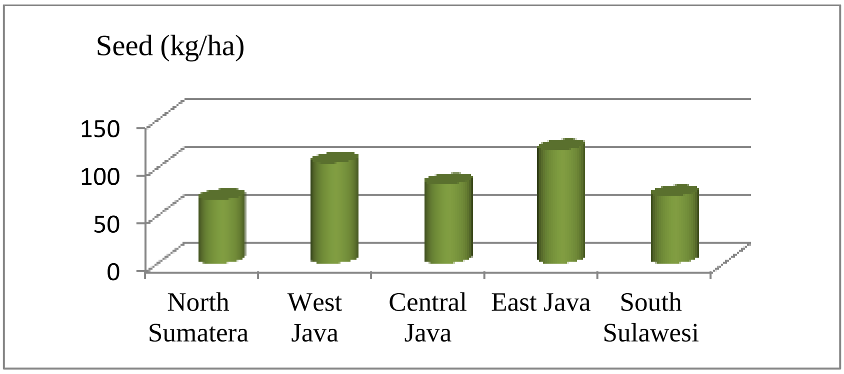

Figure 2.14. Average Seed Use per Hectare by Region (PATANAS 2007–2012)

In order to achieve the goal of self-sufficiency, the Indonesian government has developed agricultural mechanization for rice production. Thus, rice farmers can increase rice productivity and efficiency, reduce post-harvest losses, and strengthen small-, medium-, and large-scale farming (Unadi, 2011). All regions use tractors to cultivate the land, as illustrated in Figure 2.15. Some areas, such as West Java, East Java, and South Sulawesi, also use draft animals to cultivate the land. In North Sumatra, 90.7% of the farmers have been using tractors. While in West Java, only 85.4% are using tractors, and 5.2% still use draft animals to plow paddy fields. However, in Central Java, no respondents use draft animals, and 92% of respondents claimed to use tractors. East Java and South Sulawesi show similar results. In these areas, most farmers use tractors, and several farmers use draft animals. Farmers in West Java, East Java, and South Sulawesi still use draft animals because some surveyed areas are on mountain slopes that are relatively inaccessible by tractor.

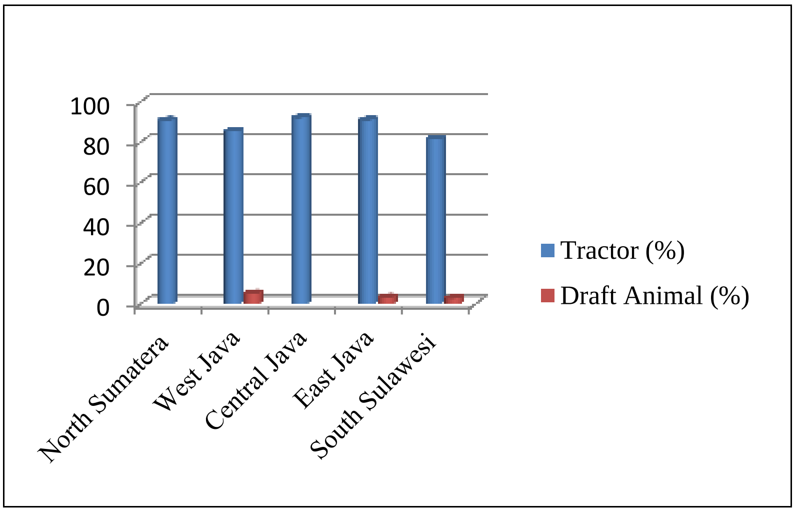

Figure 2.15. Tractorization by Region (PATANAS 2007–2012)

Figure 2.16 presents the irrigation condition. Irrigation in all regions has developed well, but it is more developed in the three provinces of Java, each of which has more than 80% technical irrigation (PATANAS 2007–2012).

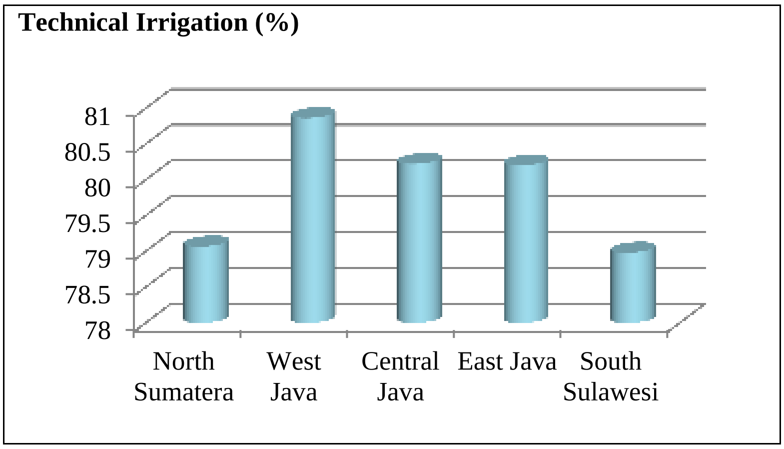

Figure 2.16. Irrigation Condition by Region (PATANAS 2007–2012)

The development of irrigation is a strategic issue in national development plans. It is expected that the improvement of irrigation systems will lead to an increase in rice production (BAPPENAS, 2013). Mulwanyi, Hutagaol, and Sinaga (2011) suggested that rice production should be increased by expanding the irrigated area and developing the infrastructure. Yao (2005) also found that there were strong benefits from the development of irrigation.

2.6. Rice Policy

Recently, the environment of agricultural socio-economics has changed rapidly due to the expansion of transportation and telecommunications. Rice trade liberalization has become more transparent, competitive, and perfectly informative in terms of market. Its impact on Indonesian rice policy is also changing rapidly to adjust to global economic conditions.

Three decades ago—around 1984–1985—as well as in 2008, Indonesia declared the achievement of self-sufficiency in rice production. Other than those years, it has been necessary for Indonesia to import rice from other countries such as Thailand and Vietnam, in spite of its known status as an agricultural country. The issue of food security is important in Indonesia. The government attaches importance to food security and plans to achieve self-sufficiency in rice production by means of a strengthened rice policy, an input subsidy program, price stabilization, government procurement and reserve, and Raskin distribution.

Self-sufficiency in rice production has become non-negotiable for every cabinet of the Indonesian Government (Sidik, 2004; Natawidjaja et al., 2012; Dodge and Gemessa, 2012).

Because the price of rice acts as a price barometer in the Indonesian economy, the government always attempts to maintain a reasonably low price for rice to guarantee that all segments of society have access to their basic staple food, while producers enjoy adequate production incentives. However, this price policy does not encourage farmers to plant rice. Indonesian rice farmers always face the problem of lower prices and higher production costs. This means that farmers are unable to compete with cheap imported rice.

The Indonesian government delegates Bulog (the National Logistics Agency) to manage price stabilization, as well as procurement and reserve. Bulog undertakes this task by using trade policy, domestic market purchases, and stockholding to set and enforce the floor and ceiling prices. Rice may be procured if domestic rice is not sufficiently available for rice stock and reserve, or to maintain the stability of the domestic rice price. During the harvest, Bulog purchases rice produced by farmers to build rice stocks and to protect farmers from declining rice prices. When rice production was low, Bulog sells the rice stock to the market to protect consumers from high rice prices (UNEP, 2005; Godoy and Dewbre, 2010; Mulwanyi et. al., 2011). Rice procurement (including import) is undertaken only by Bulog. Thus, the domestic market becomes isolated and has no direct link to the international rice market. McCulloch and Timmer, (2008); Dodge and Gamessa, (2012); and Natawidjaja et al. (2012) concluded that this current rice policy has resulted in more stable but much higher rice prices than the international price.

In addition, to alleviate the impact of the high domestic price on the poor, the Indonesian government has implemented a cheap rice distribution program (Raskin), which was started in the era of President Megawati. Bulog was ordered as the sole supplier of the rice for the poor program (Raskin) to stabilize the domestic rice price. Bulog (2016) stated that 15,530,897 poor households received Raskin, amounting to a total of 2,795,561 tons.

The government provides fertilizer subsidies to farmers for Urea, NPK, ZA, SP-18, and organic fertilizers. Farmers are required to follow a complicated procedure to obtain the fertilizer subsidy. The Ministry of Agriculture, as the main actor in the implementation of the fertilizer subsidy policy, plays an important role in determining the allocation, price, producer, and distribution of fertilizer.

The average actual distribution of subsidized fertilizer in 2010–2013 was 87.85%. The highest percentage of the realization of the fertilizer subsidy realization amounted to 115.58% in 2014, while the lowest percentage amounted to 77.61% in 2010 (Table 2.4). In 2015, the fertilizer subsidy budget allocated IDR 30.06 trillion, with a volume of 9.55 million tons.

Table 2.4. Realization of Fertilizer Subsidy 2010–2014

Year	Volume (Ton)		
	Allocation	Realization	%
2010	9,480,749	7,358,000	77.61
2011	9,733,224	8,397,134	86.27
2012	10,528,920	8,913,290	84.66
2013	8,611,050	8,858,365	102.87
2014	7,778,000	8,990,000	115.58

Source: Ministry of Agriculture, 2015

Furthermore, to increase the productivity and production of food crops, especially rice, the government increased the use of improved quality seed through the Management of Seed Supply System since 2013. The realization of empowerment rice seed is covering an area of 10,257 ha in 2013. The government also manages the budget of the seed subsidy, which aims to provide superior quality seeds in support of achieving self-sufficiency. The actual distribution of subsidized inbred rice seeds in 2013 reached 46,987 tons, which is equivalent to 1,879,484 ha. Actual distribution of subsidized hybrid rice seeds in 2013 is 1,810 tons, which is equivalent to 120,676 ha.

Meanwhile, the government also distributed agricultural tools and machines to some communities. During the years of 2011–2013, 9,794 agricultural tools and machines were distributed. This distribution acts as a stimulant to drive farmers to be more active and innovative in adapting agricultural technology in rice farming. To further support the achievement of food self-sufficiency, the government has improved the irrigation condition a 1.34 million ha rehabilitation program was implemented to improve the quality and quantity of irrigation. In addition, the government has developed reservoirs and trench dams. The expenditures on the Raskin program, the input subsidy, and agricultural infrastructure development generated a large budget deficit for the government (Sudaryanto, 2011; OECD, 2013).

Another policy that is closely related to the rice sector is the land policy. In the period 1945–1960, the policy focused on improving control and ownership of the colonialist system into a national system. In the period 1960–1965, the policies continued; they were aimed at the distribution and redistribution of land by government, and at setting legislation regarding sharing the system to protect small farmers/peasants and agricultural laborers. This period is known as the period of Land Reform. The Indonesian Government was decentralized in January 2001, at which time it allocated a larger share of revenue from natural resources to local governments. The decentralization policy gave the right, authority, and duties to the autonomous regions to set up and manage their own affairs and local communities. This included regulation of land issues in accordance with the legislation, especially in managing, utilizing, and exploring potential sources in each area. Since then, Indonesia has implemented the realignment of control, ownership, use, and utilization of land with fair land ownership (Tjondronegoro and Wiradi, 2008).

The period from 2005 to the present is still under decentralization, and land policy is directed at "ground for justice and welfare of the people." This period is characterized by the demolition of abandoned land policy, conflict resolution, land redistribution, and increasing legalization of public land assets (Mungkasa, 2014). In order to ensure the sustainability of agriculture, the government attempted to protect the farmland from being converted to non-agricultural land by issuing a law in 2009 (Masyhuri, 2015).

Chapter III

Competitiveness and Cost Efficiency of Rice Farming in Indonesia

3.1. Introduction

In Indonesia where per capita income rises up to USD 3,475 (World Bank, 2014), agriculture is one of the key strategic sectors identified by governments (OECD, 2012). In Indonesian agriculture, rice is the most important food crop. In the recent mid-term five years development plan, Indonesian government attaches importance to food security and plans to achieve rice self-sufficiency by strengthening rice policy, input subsidy program, and government procurement and reserve (Natawidjaja, et al., 2012). However, under the current protective rice policy, domestic rice price has been higher than the international rice price since mid 2000's, except during the food crisis in 2008 and 2009. This suggests that if international trade of rice will be liberalized, self-sufficiency will not be achieved.

In addition, to alleviate the impact of high domestic price on the poor, Indonesian government has implemented a cheap rice distribution program for the poor (Raskin). However, the expenditures for this program and input subsidy program generated a large budget deficit for the government (OECD, 2013).

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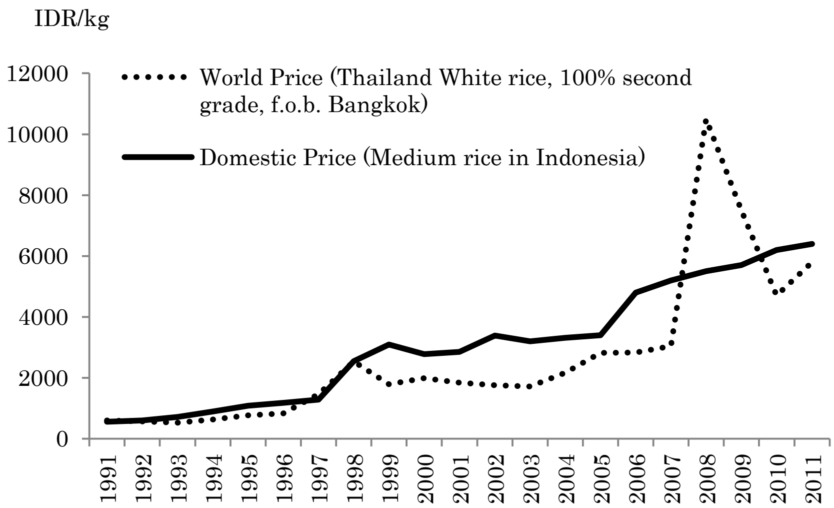

Figure. 3.1. Domestic and World Rice Prices
Source: BULOG in Natawidjaja et al. (2012)

Hadi et al. (2005), Natawidjaja et al. (2012), Irianta (2005), and Paasch et al. (2007) supported the implementation of protection policies because the policies provide a positive impact on improving the competitiveness and profitability of rice farming.

In contrast, international organization and Western economists criticized the policy packages, including import ban, rice procurement and stock reserve by BULOG, input subsidy program, and Raskin program. Moreover, they also forecasted that if the government continues these policies in the future, the global competitiveness of rice sectors in which small scale farms will be persistent under those policies will be declining. As a result, the government will have to increase expenditure for the rice sector and the poor (Timmer, 2004; McCulloch, 2008; OECD, 2012; OECD, 2013; Warr, 2005). Warr (2011) also suggested that a preferable strategy for achieving self-sufficiency is not to provide input subsidies but to promote productivity in the rice sector.

The fact that domestic rice price is always higher than world price implies that the Indonesian rice sector does not have global competitiveness. Therefore, the opinion that the current protective rice policies improved global competitiveness is not acceptable. McCulloch and Timmer (2008) asserted that reliance exclusively on domestic production results in much higher domestic rice prices, which increase poverty and make it harder for poor households, including farmers, to ensure their own food security.

If Indonesian Government makes a free trade agreement with ASEAN countries in the near future as scheduled, it cannot help liberalizing the strict current protection policy, such as import ban (Yonekura, 2014). In such a situation, Indonesia will have to make efforts to enhance the productivity of rice if it tries to enjoy the benefits of Free Trade Agreements.

3.2. Method of Study

3.2.1. Estimation of Technical Inefficiency Using Stochastic Frontier Cost Function

To estimate the technical inefficiency of rice production in Indonesia, we apply the stochastic frontier function approach. The word frontier may appropriately apply to each case because the function sets a limit to the range of possible observation. The amount by which a farmer lies below its production frontier and the amount by which it lies above its cost frontier can be regarded as the measures of inefficiency. All deviations from the frontier are assumed to be the result of technical inefficiency (Coelli et al., 2005).

The study does not use the DEA approach because this study uses information, assumptions, and large samples. Statistical conclusions cannot be drawn when using nonparametric method. Parametric approach enters random error on the frontier, while the DEA approach does not incorporate random error. As a consequence, the stochastic frontier approach can consider the inefficiency factors such as land tenure, number of plots, and off farm occupation. This is the strong point of stochastic frontier analysis comparison to DEA in which it takes into account measurement errors and other noise in the data (Kumbhakar et al., 2000; Coelli et al., 2005). This point is very important for studies of farm households in developing economies like Indonesia as data generally include measurement errors. We use a Cobb–Douglas stochastic frontier model because if we use translog model, we face results that will not be good.

This study follows the method of estimating a stochastic frontier cost function proposed by Aigner et al. (1977), Coelli et al. (2005) Kumbhakar et al. (2000), Debertin (1986) and Hidayah et al. (2013b). The cost function is specified as:

$$lnC = \alpha_0 + \alpha_1 lnPx_1 + \alpha_2 lnPx_2 + \alpha_3 lnPx_3 + \alpha_4 lnPx_4 + \alpha_5 lnPx_5 + \alpha_6 lnPx_6 + \alpha_7 lnPx_7 + \alpha_8 lnPx_8 + (V_i + U_i) \quad (3.1)$$

where

C = Total production cost (IDR)

Px_1 = Land rent (IDR/ha)

Px_2 = Seed price (IDR/kg)

Px_3 = Labor wage (IDR/HOK)

Px_4 = Fertilizer price (IDR/kg)

Px_5 = Tractor rent cost (IDR/HOK)

Px_6 = Draft animal rent cost (IDR/HOK)

Px_7 = Irrigation cost (IDR/ha)

Px_8 = Production (kg)

U_i = Farmer specific characteristics related to cost inefficiency

V_i = Statistical disturbance term

We estimate the Cobb–Douglas frontier cost function with heteroscedasticity. The frontier model allows heteroscedasticity in either error term as a linear function of a set of covariates. We specify covariates for both variance of the U_i and V_i. The component of inefficiency and statistical disturbance term are heteroscedastic (Kumbhakar et al., 2000; Greene, 2005).

The cost efficiency is the possible minimum cost ratio with specific inefficiency level toward actual total cost (Coelli et al., 2005; Kumbhakar et al., 2000). The cost efficiency index eU is calculated from the inverse of $eU = q/f(x)$; q: actual cost, $f(x)$: cost on the frontier function. Therefore, the cost efficiency is defined as the percentage achievement of production cost by best practice. Thus, the estimated cost efficiency indices calculated from frontier function of one province can be compared with the cost efficiency indices of another province. Next, we use cost efficiency as an explanatory variable to examine the competitiveness of rice farming of all provinces.

Cost inefficiency effects model is an extension of the more usual stochastic error component frontier function which allows for identification of factors which may explain differences in efficiency levels between observed (Coelli et al., 2005; Kumbhakar et al., 2000; Kumbhakar and Lovell, 2003). From that model, we can identify determinants of the inefficiency in the production cost. To identify the determinants of cost inefficiency, we estimate the following regression equation.

$$|U_i| = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8 + \delta_9 Z_9 + e \quad (3.2)$$

Where

U_i = Cost inefficiency effects due to farmer's socioeconomic characteristics such as age, education, number of family member, farm size, etc.

Z_1 = Age of household head (years)

Z_2 = Education of household head (years)

Z_3 = Number of family member (person)

Z_4 = Kind of land (if paddy land with technical irrigation = 1; others = 0)

Z_5 = Location of land (if the location of paddy land is same village with farmer's house = 1; otherwise = 0)

Z_6 = Land tenure (if the status of paddy land is owned land = 1; others = 0)

Z_7 = Off Farm Occupation (if farmer engages offfarm activity = 1; otherwise = 0

Z_8 = Farm size of farmer (ha)

Z_9 = Number of Household's Plot (the number of plot of paddy land, farmer usually cultivates some plots of paddy land)

e = Error term

3.2.2. Measurement of DRC and Estimation of Impacts of Technical Efficiency on DRCs

This section aims to estimate the relationship between cost efficiency and global competitiveness. Therefore, we use DRC as an indicator of global competitiveness, as suggested by Sadoulet and de Janvry (1995). The DRC is the ratio of the cost in domestic resources and nontraded inputs (valued at their shadow prices) of producing the commodity domestically to the net foreign exchange earned or saved by producing the good domestically.

$$DRCi = \frac{\sum_{j=k+1}^{n} a_{ij} p_j^*}{p_i^b - \sum_{j=1}^{k} a_{ij} p_j^b} \tag{3.3}$$

Where:

j = 1,....,k are traded inputs

j = k + 1,..., n are the domestic resources and the nontraded intermediate inputs

p_j^* is the shadow price of domestic resources and nontraded intermediate inputs,

p_i^b is the border price of the traded output i measured at the shadow exchange rate, i

p_j^b is the border price of the traded input j, also measured at the shadow exchange rate.

DRC measures whether a commodity is more profitable when produced domestically or imported. DRC < 1 indicates that the commodity is more profitable when produced domestically; meanwhile, DRC > 1 indicates that it is less profitable to produce it domestically.

Production costs are all expenses either in cash or calculated (computed), yielding the final form of commodity to be sold or consumed. In the allocation of production costs, the components of domestic input cost include seed, manure, labor wages, capital interest, and land rent, while the components of foreign input cost include chemical fertilizers and pesticides. The allocation of production costs into the cost of domestic and foreign components used in this study is based on Indonesian input–output tables in 2005 (Table 3.1).

Table 3.1. Allocation of Component Input for Rice Farming

No.	Production Cost	Domestic Cost (%)	Foreign Cost (%)
1.	Seed	100	0
2.	Fertilizer of Urea and TSP	0	100
3.	Fertilizer of KCL	0	100
4.	Liquid fertilizer	0	100
5.	Dung Fertilizer	100	0
6.	Pesticide	0	100
7.	Labor	100	0
8.	Draft Animal	100	0
9.	Land rent	100	0
10.	Agricultural Equipment/Machine: Tractor	0	100
11.	Other costs (irrigation, land tax, selametan)	100	0

Source: Table of Input–Output Indonesia (2005)

3.2.2.1. Trading Cost

In this study, trading cost is calculated from the entire costs from the production area to the port for export. It is applicable for the entire cost from the port of import to local consumers. The allocation of the cost of trading system from both domestic and foreign cost components is based on the Indonesian input–output table in 2005 (Table 3.2).

Table 3.2. Allocation of Production Cost for Domestic and Foreign Components

No.	Component of Trading Cost	Domestic (%)	Foreign (%)	Tax (%)
1.	Transportation	44.32	54.47	1.21
2.	Handling			
a.	Loading and unloading	100	0	0
b.	Packaging	86	12	2
c.	Storage	60.15	39.58	0.27

Source: Table of Input–Output Indonesia (2005)

3.2.2.2. Shadow Price

3.2.2.2.1 Shadow Price of Input-Output

Shadow price of inputs used in this study is the border price (border price), f.o.b (free on board) prices and c.i.f (cost insurance freight). The f.o.b price is used for the exported output or export potential in the future, while the c.i.f price is used for the imported output. Thus, the determination of shadow prices for exported commodities is defined by multiplying the f.o.b price and a shadow price of exchange rate plus the trading cost. Meanwhile, the determination of shadow prices for imported commodities is calculated by multiplying the c.i.f and the shadow prices of exchange rate plus the trading cost.

The tradable inputs are valued based upon its borders, while the non-tradable inputs are based on market prices in the country. The calculation of the shadow price of urea fertilizer uses the f.o.b price, while the calculation of shadow prices of SP36 fertilizer, ZA fertilizer KCL fertilizer, pesticides, and herbicides uses the c.i.f price. The calculation of the shadow price of seed is calculated using a formula that is proposed by Hariyanto (1996) in Hartono (2003), as follows:

$$\textit{Shadow Price of Seed} = \textit{Actual Seed}/\textit{Actual Output} \times \textit{Shadow Price of Output} \qquad (3.4)$$

3.2.2.2.2 Shadow Price of Labor

Labor wage rate in the agricultural sector cannot be directly used as the shadow price of labor. This is because the labor used in agriculture is generally not educated (unskilled). The shadow price of labor in the agricultural sector of this study is set at 80% of the market wage rate. According to Margono (1997) and Hartono (2003), the shadow price of labor for food crop farming in Java is 80% of the market wage rate.

3.2.2.2.3 Shadow Price of Land

Gittinger (1986) finds that the estimation on shadow price of land can be determined by the value of land rent, buying price, or direct estimation of the net income of the best crop. However, usually, the buying price and direct estimation do not show the real *opportunity cost* of agriculture field because the buying price and direct estimation are strongly affected by the investment security factor or prestige, which can increase the price of agriculture field. In this research, the shadow price of land refers to the land rent price.

3.2.2.2.4 Shadow Price of Exchange Rate

The determination of the shadow price of the exchange rate in this study uses equilibrium exchange rate, which can be approximated using the Standard Conversion Factor (SCF) as a correction factor to the prevailing official exchange rate. Gittinger (1986) suggested the SCF formula as follows:

$$SER = \frac{OER}{SCF} \quad (3.5)$$

where

SER = Shadow exchange rate

OER = Official exchange rate

SCF = Standard conversion factor

The value of SCF is calculated by the following formulation:

$$SCF = \frac{M + X}{(M + Tm) + (X - Tx)} \quad (3.6)$$

where

M = Value of Import

X = Value of Export

Tm = Import Tariff

Tx = Export Tax

SCF = Standard conversion factor

In order to estimate the relationship between the competitiveness of rice and the cost efficiency of rice farming, this study applies the linear regression analysis with the simple regression model as follow:

$$lnDRC_i = a + b_1ln(CE_i) + b_2ln(CPI_t) + b_3ln(ER_t) + b_4ln(FS_i) + e \quad (3.7)$$

where

DRC_i = Domestic resource cost of farmer i

CE_i = Cost efficiency of farmer i

CPI_t = Consumer price index in year t

ER_t = The exchange rate of the USD to IDR (Indonesian Rupiah) in year t

FS_i = Farm size of farmer i (ha)

e = Error term

3.3. Results and Discussion

Table 3.3 presented the input prices and production per plot in the surveyed area. The estimation result of Cobb–Douglas Frontier Cost Function is shown in Table 3.4. Variable of land rent is significantly positive in North Sumatra, West Java, East Java, and South Sulawesi. The coefficient of seed price is significantly positive in South Sulawesi. The coefficient of labor wage is significantly positive in all regions. The increase in labor wage leads to an increase in the total cost. Fertilizer price are significant positive in all regions except in West Java and South Sulawesi. The tractor cost was also significantly positive in all regions. Similarly, the coefficients of draft animal are significantly positive in West Java, East Java, and South Sulawesi. The coefficients of irrigation cost are significantly positive in West Java, Central Java, and South Sulawesi.

Table 3.3 Input Prices and Production per Plot

Variable	North Sumatra	West Java	Central Java	East Java	South Sulawesi
Production/ha (kg)	5,519	6,535	6,182	6,513	5,199
Total Cost (IDR)	1,773,168	3,241,608	1,498,079	1,404,210	1,704,945
Production Cost/kg (IDR/kg)	816	986	1041	853	781
Land Rent (IDR/ha)	1,348,805	2,700,545	3,363,138	1,847,569	2,318,297
Seed Price (IDR/kg)	12,767	7,232	6,810	8,450	4,020
Labor Wage (IDR/HOK)	17,982	23,361	22,723	23,231	32,685
Fertilizer Price (IDR/kg)	1,713	1,740	1,611	1,577	1,606
Tractor Rent Cost (IDR)	247,853	327,517	189,485	158,599	305,444
Draft Animal Rent Cost (IDR/HOK)		169,107		66,578	158,403
Irrigation Cost (IDR/ha)	140,745	109,900	227,513	92,873	31,800

Source : PATANAS 2007–2012
Notes : 1) IDR = Indonesian Rupiah
2) USD 1 = IDR 9,272 (in 2012)
3) HOK = Workday of labor

Table 3.4. Estimation of Cobb–Douglas Frontier Cost Function

Variable	North Sumatra		West Java		Central Java	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Land Rent	0.4448***	0.0689	0.2142*	0.1180	0.0476	0.0439
Seed	−0.0373	0.0568	−0.0275	0.0369	−0.0309	0.0356
Labor Wage	0.1589***	0.0307	0.1737***	0.0437	0.1109***	0.0341
Fertilizer	0.5841 ***	0.1171	0.1479	0.1150	0.2660***	0.0925
Tractor	0.1498**	0.0613	0.4328***	0.0486	0.4488***	0.0449
Draft Animal			0.1884***	0.0653		
Irrigation	0.0117	0.0213	0.0508**	0.0225	0.0789***	0.0172
Production	0.7381***	0.0578	0.6159***	0.0347	0 .4029***	0.0242
Constant	−4.7632	1.3099	−2.7791*	1.4678	1.5626*	0.8627
Number of obs.	215		439		622	
Log likelihood	−46.4066		−235.8139		−375.4097	
Sigma–square	0.2916		0.2474		0.4130	
Wald $chi^2(7)$ Prob > chi^2	1506.73 0.0000		Wald $chi^2(8)$=2150.30 0.0000		1254.96 0.0000	
Average CE	0.4846		0.5881		0.6557	

Variable	East Java		South Sulawesi	
	Coefficient	SE	Coefficient	SE
Land Rent	0.1849 **	0.0869	0.1595**	0.0721
Seed	0.0328	0.0366	0.1653***	0.0466
Labor Wage	0.1301***	0.0344	0.1874***	0.0340
Fertilizer	0.4173***	0.1379	0.0616	0.0985
Tractor	0.1625***	0.0421	0.1899***	0.0414
Draft Animal	0.2738**	0.1194	0.9928***	0.1250
Irrigation	0.0301	0.0248	0.1473***	0.0357
Production	0.4614***	0.0269	0.5551***	0.0382
Constant	−1.5129	0.9346	−12.363***	1.2742
Number of obs.	586		295	
Log likelihood	−408.8667		−45.9371	
Sigma–square	0.6279		0.2089	
Wald $chi^2(8)$ Prob > chi^2	946.43 0.0000		1323.19 0.0000	
Average CE	0.6142		0.4382	

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

The coefficient of production is significantly positive in all regions. These results suggest that an increase in production increases the total cost. Thus, the estimation results are mostly plausible and consistent with the theory.

The result of efficiency analysis shows that average cost efficiency is 0.4846 (North Sumatra), 0.5881 (West Java), 0.6557 (Central Java), 0.6142 (East Java), and 0.4382 (South Sulawesi), indicating that the rice farming system in Central Java has the highest cost efficiency.

The farm household characteristics used for estimation (3.2) are illustrated in Table 3.5.

Table 3.5. Potential Determinants of Cost Inefficiency

Variable	North Sumatra	West Java	Central Java	East Java	South Sulawesi
Age: Age of Household Head (year)	44	47	50	48	45
Eduation: Education of household head (year)	7	7	8	7	8
Family Member:Number of family member (person)	5	4	4	4	5
Kind of Land: % of HH using paddy land with technical irrigation: - Land lord (person) - Tenant (person)	79 153 62	81 294 145	80 479 143	80 492 94	79 206 89
Location of Land: % of land is the same village with HH's house	93	82	95	96	92
Land Tenure: % of land is HH's owned land - All owned (person) - Mixed (owned and rent) (person) - All rent (person)	71 140 60 25	67 259 141 39	77 429 134 59	84 437 96 53	70 181 89 25
Off-farm Occupation: % of HH engage offfarm activity	79	67	83	77	75
Farm Size (ha)	0.396	0.572	0.344	0.349	0.43
Plot: Number of Household's Plot	3	4	4	3	4

Source: PATANAS 2007−2012

The result of the determinants of cost inefficiency is presented in Table 3.6. We apply linear regression model with White−robust standard error in the presence of heteroscedasticity (Baum, 2006). We explain only the results related to the discussion in the latter part. The age of household head has negative effect on inefficiency in Central Java and East Java. The older household head is more experienced and able to make efficient decision on rice farming. However, the estimated coefficient of age of household in South Sulawesi is significantly positive. This seemingly contradictive result can be explained if younger household heads are more adaptable to accept and implement the new innovation technology of rice farming that can achieve high efficiency. In Java, many young people prefer working in cities than in the agriculture sector.

The education of household head has negative influence on the inefficiency of rice farming in East Java. The result indicates that a farmer who has higher education can manage rice farming more efficiently. The number of family members has positive effect on the inefficiency in North Sumatra and West Java. The household with larger family members will face the larger expenditure that make the household difficult to focus on rice farming. The coefficient of type of paddy land is significantly negative in West Java. If the farmers can utilize more developed irrigation system, inefficiency will be reduced. This is because farmers can manage paddy in a better manner if the irrigation system is improved (Mulwanyi et al., 2011).

Table 3.6. Determinants of Cost Inefficiency

Variable	North Sumatra		West Java		Central Java	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Age	0.0008	0.0014	−0.0002	0.0011	−0.0033**	0. 0016
Education	−0.0011	0.0036	0.0003	0.0026	−0.0022	0.0045
Family Member	0.0144*	0.0087	0.0151*	0.0082	0.0029	0.0106
Kind of Land	0.0532	0.0379	−0.0550**	0.0247	−0.0260	0.0430
Location of Land	−0.0247	0.0481	−0.0043	0.0261	0.0047	0.0514
Land Tenure	0.1233***	0.0212	0.0508***	0.0195	0.1121***	0.0355
Off Farm Occupation	−0.0480	0.0308	−0.0178	0.0208	−0.0394	0.0363
Farm Size	−0.0167	0.0428	−0.0616***	0.0217	0.0154	0.0395
Plot	0.0107	0.0066	0.0011	0.0043	0.0134**	0.0062
Constant	0.2372	0.1186	0.4954***	0.0831	0.1213	0.1266
Number of obs.	215		439		622	
F Calculated	10.5930***		16.7880***		29.43***	
R^2	0.2815		0.2905		0.3227	
Variable	East Java		South Sulawesi			
	Coefficient	SE	Coefficient	SE		
Age	−0.0058*	0.0033	0.0024**	0.0011		
Education	−0.0052*	0.0028	0.0025	0.0026		
Family Member	0.0013	0.0229	0.0044	0.0059		
Kind of Land	0.0458	0.0838	−0.0142	0.0124		
Location of Land	−0.1923***	0.0693	0.0206	0.0271		
Land Tenure	−0.1010	0.0786	0.0461**	0.0206		
Off Farm Occupation	−0.0969	0.0864	−0.0205	0.0218		
Farm Size	−0.1861**	0.0898	−0.1113***	0.0388		
Plot	0.0144	0.0111	−0.0010	0.0027		
Constant	0.8103***	0.2154	0.1972***	0.0751		
Number of obs.	586		295			
F Calculated	57.53***		11.96***			
R^2	0.4184		0.3809			

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

The location of land also has a negative influence on the inefficiency of rice farming in East Java. If the location of the farmland is the same village with the farmer's house, the farmer can manage the rice farming more easily. Land ownership has a positive effect on inefficiency in all regions, excluding East Java. This is highly related to farmer behavior in the study area, where tenant farmers have a higher motivation and productivity compared to land owners. The tenant farmers strive to manage production in a professional manner and are receptive to new technology; therefore, they can improve their production and increase their income. This finding is consistent with Mailena et.al (2014), who find a negative effect of land ownership on the efficiency of rice farming; it is also in accordance with observations by Fukui et al. (2002) in Central Java that the production efficiency of land under tenancy is not lower than that of the owned land. Off-farm occupation does not have an effect on the cost inefficiency of rice farming. The estimated coefficients of farm size are significantly negative in West Java, East Java, and South Sulawesi. These show that the larger farm size will increase the efficiency of rice farming. The estimated coefficient of plot number in Central Java is significantly positive. This suggests the dispersion of small plot is one of the determinants of cost inefficiency.

The data description and estimation result of the regression analysis between the competitiveness of rice and cost efficiency in rice farming are illustrated in Table 3.7 and 3.8.

Table 3.7. Data Description of Indonesian Rice Competitiveness and Cost Efficiency of Rice Farming

Variable	North Sumatra				West Java				Central Java			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
DRC	0.811	0.203	−8.71	9.5	0.647	0.12	−2.07	5.2	1.635	0.88	−8.03	13.3
CE	0.485	0.294	0.092	0.92	0.588	0.30	0.039	0.99	0.656	0.39	0.04	0.97
Consumer Price Index	135.28	14.82	121	150.5	134.0	12.6	121	150.5	133.4	13.13	121	150.5
Exchange Rate (IDR)	9109	25.55	9085	9136	9196	263	8779	9678	9136	221.5	8779	9678
Farm size (ha)	0.396	0.278	0.08	1.4	0.572	0.47	0.042	3	0.344	0.313	0.012	3
Number of Obs.	215				439				622			

Variable	East Java				South Sulawesi			
	Mean	SD	Min	Max	Mean	SD	Min	Max
DRC	1.988	0.93	−7.22	11.4	0.823	0.3	−1.9	9.2
CE	0.614	0.17	0.05	0.94	0.438	0.2	0.11	0.87
Consumer Price Index	133	13.2	115.1	150.5	131	14	115.1	150.5
Exchange Rate (IDR)	9206	323	8779	10399	9312	460	8779	10399
Farm size (ha)	0.349	0.27	0.02	1.54	0.43	0.26	0.025	2
Number of Obs.	586				295			

Notes: 1) Farm size is endogenous variable
2) Endogeneity is untested due to data unavailability

The cost efficiency is negatively significant in influencing the Domestic Resource Cost (DRC) in all regions at 1% level. If the cost efficiency increases 10%, DRC will decrease by 6.35% in North Sumatra, 10.5% in West Java, 5.52% in Central Java, 6.95% in East Java, and 9.47% in South Sulawesi. The price index is significantly affecting DRC in West Java, Central Java, and South Sulawesi. Price Index in Central Java is negatively affected the DRC. We do not have enough information to explain the estimation results. However, one possible interpretation is that the former effect is smaller than the latter effect in Central Java, because the DRC is greater than one there, while it is smaller than one in West Java and South Sulawesi.

The variable of exchange rate is significantly positive to DRC in Central Java and East Java. Further, as the proxy of economy scale, the farm size is negatively significant to DRC in all regions, excluding West Java.

Table 3.8. Estimation Result of Indonesian Rice Competitiveness and Cost Efficiency of Rice Farming

Variable	North Sumatra		West Java		Central Java	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
lnCE	−0.6359***	0.0798	−1.0489***	0.07352	−0.5517***	0.0500
lnConsumer Price Index	−0.3154	0.3059	1.0293***	0.3745	−1.0947***	0.3035
lnExchange Rate	(omitted)		0.5509	1.3099	2.3074**	1.2435
lnFarm size	−0.0847*	0.0491	−0.1732***	0.0420	−0.137675***	0.0403
Constant	0.6094	1.5024	−10.8452	11.7707	−15.6576	11.1744
Number of Obs.	215		439		622	
F Calculated	21.79***		64.01***		40.74***	
R^2	0.2365		0.3711		0.2089	
Average DRC	0.8110		0.6468		1.6347	
Average CE	0.4846		0.5881		0.6557	
Variable	East Java		South Sulawesi			
	Coefficient	SE	Coefficient	SE		
lnCE	−0.6949***	0.0393	−0.9473***	0.0550		
lnConsumer Price Index	0.1397	0.2534	0.5229**	0.2329		
lnExchange Rate	2.6626***	0.7353	0.7038	0.5287		
lnFarm size	−0.2175**	0.0318	−0.1582***	0.0373		
Constant	−25.6627	6.9622	−9.7892*	5.4178		
Number of Obs.	586		295			
F Calculated	95.59***		79.68***			
R^2	0.3969		0.5236			
Average DRC	1.9884		0.8228			
Average CE	0.6142		0.4382			

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

To improve competitiveness, the farm household should enlarge their farm size. However, the rice growing farmers' behavior in rural Central Java and East Java show that they are usually not willing to sell their land (Iwamoto and Hartono, 2009). Large-scale farmers have succeeded to expand the land that they inherited from their ancestors. Inherited land is very dominant in Indonesian rice farming. Some owner-farmers enlarge their farm size by renting land on a fixed term basis, share cropping, or pawning. In addition, some farmers receive gifts of redistributed land from government. Some farmers purchase the land and use the forest; farmers who cultivate crop in forest areas are called "*pesanggem*" in Java. Farm size is not a new policy subject for Indonesia. The Basic Agrarian Law imposed a limit in the size of agricultural land holdings, with a minimum and maximum size of 2 and 20 ha, respectively. In general, the number of farmers producing food crops in Indonesia since then has increased while the size of land holding is small, particularly in Java. Enlargement of farm size without radical institutional changes is only possible on the outer Java island where the land is not as fertile as that of Java.Farm size in Java was much smaller (0.66 ha) than in the outer islands

(>1.22 ha). After the colonization and transmigration program, farmers in Java continue the agricultural cultivation intensively. At the same time, the growth of the industrial sector and urban centers in Java has increased the demand for land. The accelerated conversion of paddy fields to non-agricultural uses has far-reaching implications for the future performance of the agricultural sector in Indonesia. This situation implies that the transaction cost of any land in Java is very costly (Anwar and Pakpahan, 1990).

DRCs of rice farming in North Sumatra, West Java, and South Sulawesi are less than 1. This finding is consistent with Mantau et al. (2014), stating that rice commodities in Sulawesi have comparative and competitive advantage. In contrast, the DRCs of rice farming in Central Java and East Java are larger than 1. This indicates that rice farming in these regions do not have a comparative advantage. In addition, even if the cost efficiency of rice farming in Central Java and East Java increases to 1, rice sectors in these areas will not obtain global competitiveness.

The estimated DRCs have a large inter-regional difference that is influenced by a number of factors, of which the difference in farm size is the most important. A large farm size is associated with large DRCs. West Java has the highest DRCs due to having the largest farm sizes compared to other provinces. The irrigation condition in West Java is more developed than that of Central and East Java. The government is always concerned and pays closer attention to rice farming in West Java due to its proximity to the capital city. Moreover, there is an industrial area in West Java that is located in the middle of rice barn regions such as Karawang and Indramayu, where PATANAS research also takes place. The industrial area is built on infertile land rather than on converted farmland; surplus labor is therefore reduced, since many small-scale farmers lease their land and choose to work in the factory. As a result, large-scale farmers can expand their farm size. Therefore, rice farming in West Java is more dynamic than in Central and East Java.

A commodity will be competitive if efficiency and productivity are high. In order to examine this condition more comprehensively, it is also necessary to review the rural economy. However, we do not have sufficient data to assess the rural economy in more detail.

3.4. Conclusion

This study aims to examine the effects of production efficiency improvement on the global competitiveness of rice sector in major rice growing areas of Indonesia. The main findings are mentioned below:

First, the production cost is positively influenced by the input prices, particularly the impacts of land rent, fertilizer price, and tractors cost on the production cost are the largest. This implies that the reduction of land rent, fertilizer price, and tractor cost are more effective in decreasing the production cost of rice farmers.

Second, the cost efficiency is the highest in Central Java and East Java where the farm sizes are relatively small. The ownership of paddy land has a negative effect on cost efficiency in North Sumatra, West Java, Central Java, and South Sulawesi where share tenancy system is widely observed, but it does not have a significant effect on the cost efficiency in East Java. This is not consistent with the results reported by Jamal and Dewi (2009) but consistent with those reported by Mailena, et.al (2014). Moreover, this finding implies that land tenancy does not have negative effects on cost efficiency. The modern irrigation system has a positive effect on cost efficiency in West Java, Central Java, and South Sulawesi but not in the other provinces.

Third, the rice farming in Central Java and East Java, which are the main rice producing areas do not have a comparative and competitive advantage.

Fourth, the competitiveness of rice is positively influenced by the cost efficiency of rice farming. If the cost efficiency increases by 10%, DRC will decrease by 6.35% (North Sumatra), 10.5% (West Java), 5.52% (Central Java), 6.95% (East Java), and 9.47% (South Sulawesi). However, even if rice farming in Central Java and East Java can achieve the best cost efficiency, rice sectors in these areas cannot obtain global competitiveness.

Fifth, the farm size has a positive effect on competitiveness.

From these findings, we can draw some policy implications. In order to achieve food security, which is one of the key strategic policies under the pressure of trade liberalization, Indonesian government will have to reform the current protective rice policies. The results of investigation in this paper imply that if it liberalizes the rice policy, rice farmers in the major rice growing areas, such as Central Java and East Java will have the largest negative effects because they do not have global competitiveness due to small farm sizes. And the policies for the improvement of cost efficiency are not sufficient for them to achieve global competitiveness. For the purpose of achieving global competitiveness in Central Java and East Java, the government needs to implement some policy mix, which aims not only to decrease the cost inefficiency but to facilitate rice farmers to enlarge the farm size. To improve the cost efficiency, improving the irrigation conditions and land consolidation are effective. To enlarge the farm sizes, facilitating transactions in land rental market will be more feasible than promoting land transactions through buying and selling in rural Central Java and East Java because rice growing farmers are usually not willing to sell their lands (Iwamoto and Hartono, 2009).

However, the constructions of an irrigation system and land consolidation are expensive, and cost performance must be examined. Since there is high transaction cost in the land rental market of rural Central Java and East Java where large surplus labor still exists, there may be obstacles to facilitate renting land.

Thus, it is not so easy for Indonesian government to devise effective policy measures for reducing the cost inefficiency and improving global competitiveness in the rice sector. The government may have to do it to overcome this difficulty.

Chapter IV

Economies of Scale in Indonesian Rice Production: An Economic Analysis Using PATANAS Data

4.1. Introduction

Indonesia has achieved remarkable economic growth in the past decade. If Indonesia continues to grow at the same pace, the country could become a middle-income country by 2020. However, if Indonesia becomes an upper middle-income country, its agricultural sector would face structural adjustment problems similar to those experienced by Asian forerunners, Japan and South Korea. From the viewpoint of food security (Otsuka, 2013), rural-urban income disparity (ADB, 2012), and industrial sector development (Fukui, 2008), solving the structural adjustment problem of the agricultural sector is one of the most important policy issues for the Indonesian government.

The staple food of Indonesia, rice, has lost global competitiveness in the main producing areas of Central Java and East Java, due to small farm sizes. In order to recover rice competitiveness, indispensable policy measures to enlarge farm sizes are required (Antriyandarti, 2015).

However, although achieving economies of scale is a necessary condition for enlargement of farm size, economies of scale might not be achieved in the Indonesian rice sector, because most rice-growing farmers do not own agricultural machinery but rent it from owners. Therefore, we need to examine whether economies of scale can be achieved in this sector.

Among the existing studies related to scale economies, Yamauchi (2014) investigates the technological progress of the Indonesian rice sectors, using unique data collected from wide areas, and finds a complementary relationship between land and machinery only in the outer islands, where the average farm size is larger than that of Java. Llewelyn and Williams (1996) examines the technical efficiency of multiproduct food-crop producing farms in Indonesia, not only rice, and some of the factors associated with inefficiency. They found that the majority of farms are technically and scale efficient, operating at constant returns to scale, while most farms that are scale inefficient are operating at decreasing returns to scale. There are only two studies that focus on economies of scale in the Indonesian rice sector (Hidayah and Susanto, 2013; Hidayah, et al., 2013), although these studies examine the scale economies of rice production in the Maluku province only, which is not a main rice producing area in Indonesia.

The present study does not focus on measuring scale economy in the rice sector. The empirical methodology which we used in this study is not new. The previous studies on scale economy of Indonesian rice sector (Hidayah and Susanto, 2013; Hidayah, et al., 2013; Yamauchi, 2014; and Llewelyn and Williams, 1996) have never found scale economy in Java. These findings have an important significance when we consider structural adjustment policy for Indonesian rice sector. The objective of this study is to investigate whether economies of scale can be achieved in the five main rice-growing provinces of Indonesia, using National Farmers' Household Panel Survey (PATANAS[1]) data collected by the Indonesian Ministry of Agriculture.

In order to achieve the study objective and robustness of testing, we examine the existence of scale economies via three different methods. First, we estimate the cost elasticity of production by regressing output on production cost, following Hayami and Kawagoe (1989). Second, we estimate the cost function derived from the production function of rice, and examine the relationship between production cost and scale, using the estimation results of cost function, following Christensen and Greene (1976), and Kako (1979). Third, we estimate the profit function derived from the maximization problem of the rice farmer and test the existence of scale economies using the estimated parameters, following Lau and Yotopoulos (1971), Yotopoulos and Lau (1973), and Kako (1984).

4.2. Method of Study

4.2.1. Cost Elasticity of Scale

We use the following regression equation to estimate the cost elasticity of scale (output elasticity), following Hayami and Kawagoe (1989).

$$lnC_{ij} = \alpha + \beta lnQ_{ij} + \varepsilon_{ij} \qquad (4.1)$$

Here,

C = Production cost of paddy (IDR)

Q = Production of paddy (kg)

ε = Random disturbance

i,j = Farm household, province

4.2.2. Cost Function Approach

Next, we assume that rice-growing farmers try to minimize the production cost to achieve some level of output and estimate the cost function of input prices and fixed inputs derived from such cost minimization problem.

After estimating the cost function, we calculate the production costs per unit weight by farm size stratum. And we illustrate the relationship between the cost and scale by graphical method[2].

For the estimation of cost function, the simultaneous estimation of Translog cost function and factor share equations is more appropriate because it does not need to impose any constraint on estimated parameters, and we can get more efficient estimation (Kako,1979). However, we could not get any significant parameter value of quadratic terms. Therefore, we estimate Cobb-Douglas cost function, which is a special case of Translog function under the assumption that all the parameters of quadratic terms are equal to zero.

The regression equation is as follows;

$$lnC_{ij} = \alpha + \beta_1 lnQ_{ij} + \beta_2 lnL_{ij} + \beta_3 lnS_{ij} + \beta_4 lnF_{ij} + \beta_5 lnR_{ij} + \beta_6 lnTr_{ij} + \beta_7 lnI_{ij} + \varepsilon_{ij} \tag{4.2}$$

Then, we estimate Cobb-Douglas factor cost share function. By applying Shephard's lemma (Shephard 1970) and differentiating logarithmically, we obtain the cost-minimizing factor cost shares:

$$\partial \ln C / \partial \ln P_k = \frac{P_k X_k}{C} = S_k \tag{4.3}$$

Here,

C = Production Cost of Paddy (IDR)

S_k = The cost share of the kth-factor input

Q = Production (kg)

[2] Here, we follow the methods by Christensen and Greene (1976), and Kako (1979), but our method differs from it in the points that we use Cobb Douglas factor cost share function and that we also use the average of costs predicted from cost function of the farmers within each farm size stratum.

L = Labor wage (IDR/HOK)

S = Seed price (IDR/kg)

F = Fertilizer price (IDR/kg)

R = Land rent (IDR/ha)

Tr = Tractor rent cost (IDR)

I = Irrigation cost (IDR/ha)

ε = Random Disturbance

Note: HOK = Workday of labor

4.2.3 Profit Function Approach

Next, we apply a profit function approach to examine economies of scale. For that purpose, we simultaneously estimate a Cobb–Douglas unit output price profit function and factor demand functions derived from conditions of profit maximization, following Lau and Yotopoulos (1971), Yotopoulos and Lau (1973), and Kako (1984). The profit function with the Cobb-Douglass form assumes that the production function also has Cobb-Douglas form. The profit function can be specified as equation 4.4.

$$ln\pi_{ij} = lnA^{*}_{ij} + \beta_T lnT_{ij} + \alpha_L lnL_{ij} + \alpha_S lnS_{ij} + \alpha_F lnF_{ij} + \beta_{Tr} lnTr_{ij} + \varepsilon_{ij} \quad (4.4)$$

Here,

π = Real profit (IDR)

A^*= Constant term in natural logarithms of profit function and composed of the level of technology in production function, the parameters of variable inputs, and the ratio of marginal product of input to input price

T = Farm size (ha)

L = Labor wage/rice price (IDR/HOK/rice price)

S = Seed price/rice price (IDR/kg/rice price)

F =Fertilizer price/rice price (IDR/kg/rice price)

Tr = Tractor rent cost divided by rice price (IDR/rice price)

ε = Random disturbance

The following input factor demand functions are derived from profit maximization behavior by applying Hotelling's lemma (Yotopoulos and Lau, 1973; Kuroda, 1979). The input demand function is defined by equation 4.5.

$$-\frac{P_i X_i}{\pi} = \alpha_i^* \ (i = L, S, F) \qquad (4.5)$$

Here, P_i is the price of input and X_i is the quantity of input. α_i^* denotes a parameter of input i, which satisfies the conditions of profit maximization. However, there is some debate about the hypothesis of profit maximization in Java (Benjamin, 1992; Mulyo and Fukui, 2006).

Therefore, we estimate two types of models. One has a profit maximization restriction, and the other does not ($\alpha_i^{'}$). We statistically examine which type of model is more appropriate [H_0 : $\alpha_i^* = \alpha_i^{'}$ for i = L,S,F (profit maximization)]. We calculate the F-ratio by using the estimated residuals of the restricted and unrestricted equations. The profit function and derived system of input demand are estimated simultaneously by applying the seemingly unrelated regression method.

We then test the null hypothesis of constant returns to scale, as follows:

$$\beta_{Tr}^* + \beta_T^* = 1 \qquad (4.6)$$

Here, β^*_{Tr} is the estimated parameter of the machinery, and β^*_T is that of the land. Then, we examine the scale economies, according to equation (4.7) (Lau and Yotopoulos, 1971; Yotopoulos and Lau, 1973; Kuroda, 1979; and Kako, 1984).

$$\beta_{Tr}^* + \beta_T^* \lesseqgtr 1 \qquad (4.7)$$

4.3 Results and Discussion

4.3.1. Cost Elasticity of Scale

The estimation results of cost elasticity of scale are shown in Table 4.1. According to Table 4.1, the estimated cost elasticity of output is less than 1 in all the provinces. In particular, in three of Java's provinces, these values are significantly smaller than 1. This implies that economies of scale can be achieved in Java.

Table 4.1. Estimation of Cost Elasticity of Rice Production in Indonesia

Variable	North Sumatra		West Java		Central Java	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Q	0.9814***	0.0283	0.7063***	0.0302	0.6420***	0.0193
Constant	6.7905***	0.2209	9.1997***	0.2401	9.5035***	0.1353
Number of Obs.	215		439		622	
F-Value	1201.22***		546.16***		1101.39***	
R^2	0.8494		0.5555		0.6398	
F(β=1)	13.20***		159.66***		260.78***	
Variable	East Java		South Sulawesi			
	Coefficient	SE	Coefficient	SE		
Q	0.6635***	0.0250	0.8841***	0.0363		
Constant	9.1410***	0.1764	7.4846***	0.2721		
Number of Obs.	586		295			
F-Value	702.43***		592.90***			
R^2	0.5460		0.6693			
F(β=1)	250.60***		20.19***			

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

4.3.2. Cost Function Approach

The estimation results of cost function are shown in Table 4.2 and 4.3. From Table 4.2 we can see that the estimated parameter of production is significantly positive in all provinces at 1% significance level.

Table 4.2. Estimation Results of Cobb-Douglas Cost Function

Variable	North Sumatra		West Java		Central Java	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Production	0.8975***	0.0309	0.6749***	0.0336	0.6767***	0.0179
Labor Wage	0.0539*	0.0320	0.2530***	0.0662	0.0664*	0.0345
Seed	0.0227	0.0606	−0.0785*	0.0442	−0.0697*	0.0386
Fertilizer	−0.1049	0.1021	0.4754***	0.1322	0.1427	0.1055
Land Rent	0.2568***	0.0738	0.0773	0.0949	0.0758	0.0490
Tractor	0.0296	0.0493	0.2974***	0.0703	0.3279***	0.0399
Irrigation	−0.0546	0.0358	0.0353	0.0482	0.0567**	0.0229
Constant	4.2277***	1.1086	−0.9859	1.8088	2.4431**	1.0353
Number of Observation	215		439		622	
F-Value	219.41***		137.45***		307.45***	
R^2	0.8812		0.6906		0.7780	
F(Cobb-Douglas)	1.03		1.18		1.67	
Variable	East Java		South Sulawesi			
	Coefficient	SE	Coefficient	SE		
Production	0.5911***	0.0239	0.8158***	0.0374		
Labor Wage	0.0776**	0.0373	0.1460***	0.0422		
Seed	0.0120	0.0312	0.3332***	0.0645		
Fertilizer	0.2221	0.1434	0.3199**	0.1453		
Land Rent	0.8917***	0.1915	−0.0795	0.1738		
Tractor	0.2807***	0.0460	0.0641	0.0601		
Irrigation	−0.0067	0.0281	0.1261**	0.0548		
Constant	−8.8821***	2.4787	0.5362	2.5100		
Number of Observation	586		295			
F-Value	173.87***		109.96***			
R^2	0.6780		0.7284			
F(Cobb-Douglas)	1.41		0.96			

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

The estimated parameter of labor wage is also significantly positive in all provinces. Estimated parameter of seed is significantly negatively in West Java and Central Java, while in South Sulawesi it is significantly positive. This suggested that in both West and Central Java Provinces, high quality of seed was used, but in South Sulawesi, standard quality of seed was used.

Table 4.3.1. Estimation Results of Cobb-Douglas Factor Cost Share Function in North Sumatra

Variable	No Restriction		3 Restriction	
Cost Function	Coefficient	SE	Coefficient	SE
Constant	21.3961***	3.0440	20.0074***	3.0593
Production	0.1266*	0.0555	0.1298*	0.0623
Labor Wage	0.2039**	0.0880	0.2285***	0.0884
Seed	0.2598*	0.1245	0.1820*	0.0556
Fertilizer	0.2916*	0.1821	0.3152*	0.1835
Land Rent	−0.3172	0.2020	−0.2852	0.2031
Tractor	−0.0684	0.1363	−0.0608	0.1370
Irrigation	−0.0375	0.0988	−0.0179	0.0993
R^2	0.1654		0.1676	
Cost Share Function				
Labor Cost	0.6541***	0.0127	0.2285***	0.0884
R^2	0.9251		0.9251	
Seed Cost	0.0595***	0.0017	0.1820*	0.0556
R^2	0.8477		0.8477	
Fertilizer Cost	0.1372***	0.0044	0.3152*	0.2835
R^2	0.8150		0.8150	
Number of Observation	215			
F--Value	1.4419 (cost minimization)			

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

Table 4.3.2. Estimation Results of Cobb-Douglas Factor Cost Share Function in West Java

Variable	No Restriction		3 Restriction	
Cost Function	Coefficient	SE	Coefficient	SE
Constant	2.4872	1.7110	1.3376	1.8297
Production	0.7875***	0.0264	0.7586***	0.0276
Labor Wage	0.2670***	0.0628	0.2920***	0.0673
Seed	0.1233***	0.0416	0.1679***	0.0447
Fertilizer	0.4276***	0.1260	0.4837***	0.1350
Land Rent	0.0627	0.0895	0.0845	0.0960
Tractor	0.0204	0.0731	0.0124	0.0785
Irrigation	0.0103	0.0452	0.0115	0.0485
R^2	0.6685		0.6878	
Cost Share Function				
Labor Cost	0.7267***	0.0311	0.2920***	0.0673
R^2	0.5081		0.5081	
Seed Cost	0.0315***	0.0046	0.1679***	0.0447
R^2	0.1243		0.1243	
Fertilizer Cost	0.1295***	0.0034	0.4837***	0.1350
R^2	0.7376		0.7376	
Number of Observation	439			
F--Value	5.1513***(no cost minimization)			

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

Table 4.3.3. Estimation Results of Cobb-Douglas Factor Cost Share Function in Central Java

Variable	No Restriction		3 Restriction	
Cost Function	Coefficient	SE	Coefficient	SE
Constant	1.8581*	1.0243	1.8731*	1.0245
Production	0.6607***	0.0180	0.6599***	0.0179
Labor Wage	0.0682**	0.0336	0.0708**	0.0337
Seed	0.0540***	0.0072	0.0600***	0.0071
Fertilizer	0.1158***	0.0033	0.1155***	0.0034
Land Rent	0.0665	0.0560	0.0656	0.0480
Tractor	0.4059***	0.0437	0.4080***	0.0437
Irrigation	0.0496**	0.0225	0.0503**	0.0224
R^2	0.7568		0.7838	
Cost Share Function				
Labor Cost	0.5486***	0.0055	0.0708**	0.0337
R^2	0.9411		0.9411	
Seed Cost	0.0450***	0.0013	0.0600***	0.0071
R^2	0.6706		0.6706	
Fertilizer Cost	0.1426***	0.0038	0.1155***	0.0034
R^2	0.6941		0.6941	
Number of Observation	622			
F--Value	5.9618***(no cost minimization)			

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

Table 4.3.4. Estimation Results of Cobb-Douglas Factor Cost Share Function in East Java

Variable	No Restriction		3 Restriction	
Cost Function	Coefficient	SE	Coefficient	SE
Constant	−7.5795***	2.4421	−8.8821***	2.4617
Production	0.5904***	0.0236	0.6911***	0.0137
Labor Wage	0.0725**	0.0368	0.0776**	0.0370
Seed	0.0273	0.0307	0.0420*	0.0209
Fertilizer	0.2905**	0.1312	0.3222**	0.1424
Land Rent	0.7414***	0.1886	0.8917***	0.1902
Tractor	0.3116***	0.0453	0.2807***	0.0357
Irrigation	0.0016	0.0277	−0.0067	0.0179
R^2	0.6772		0.6870	
Cost Share Function				
Labor Cost	0.5626***	0.0132	0.0776**	0.0370
R^2	0.7478		0.7478	
Seed Cost	0.0465***	0.0025	0.0420*	0.0209
R^2	0.3647		0.3647	
Fertilizer Cost	0.1551***	0.0052	0.3222**	0.1424
R^2	0.5766		0.5766	
Number of Observation	586			
F--Value	3.4665***(no cost minimization)			

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

Table 4.3.5. Estimation Results of Cobb-Douglas Factor Cost Share Function in South Sulawesi

Variable Cost Function	No Restriction Coefficient	 SE	3 Restriction Coefficient	 SE
Constant	0.4948	2.3208	0.8097	2.3618
Production	0.6959***	0.0431	0.6865***	0.0437
Labor Wage	0.1143***	0.0394	0.1199***	0.0402
Seed	0.3149***	0.0601	0.4142***	0.0611
Fertilizer	0.2976**	0.1369	0.2084***	0.0393
Land Rent	−0.1583	0.1608	−0.1181	0.1636
Tractor	0.2838***	0.0525	0.2753***	0.0534
Irrigation	0.1221**	0.0508	0.1103**	0.0517
R^2	0.7492		0.7599	
Cost Share Function				
Labor Cost	0.6046***	0.0169	0.1199***	0.0402
R^2	0.8158		0.8158	
Seed Cost	0.0313***	0.0021	0.4142***	0.0611
R^2	0.4021		0.4021	
Fertilizer Cost	0.1150***	0.0052	0.2084***	0.0393
R^2	0.5957		0.5957	
Number of Observation	295			
F-Value	3.7577***(no cost minimization)			

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

The estimated parameters are by and large consistent with prediction by economic theory. Then, we calculate the predicted production costs per unit weight of sample farmers using the parameter values and also calculate the average cost by farm size stratum. The relationship between farm size and production cost per unit weight is illustrated in Figure 4.1. According to Figure 4.1, the production cost declines as the farm size increases in all the provinces. These results are consistent with the results of cost elasticity of scale.

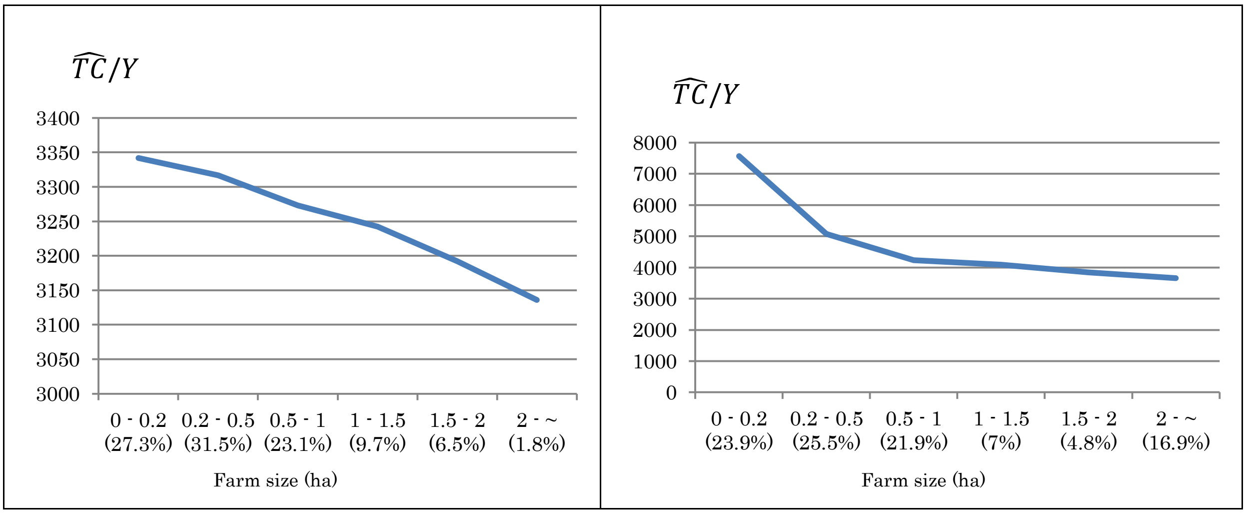

Figure 4.1.1. Cost Curve of Rice Farming in North Sumatra and West Java

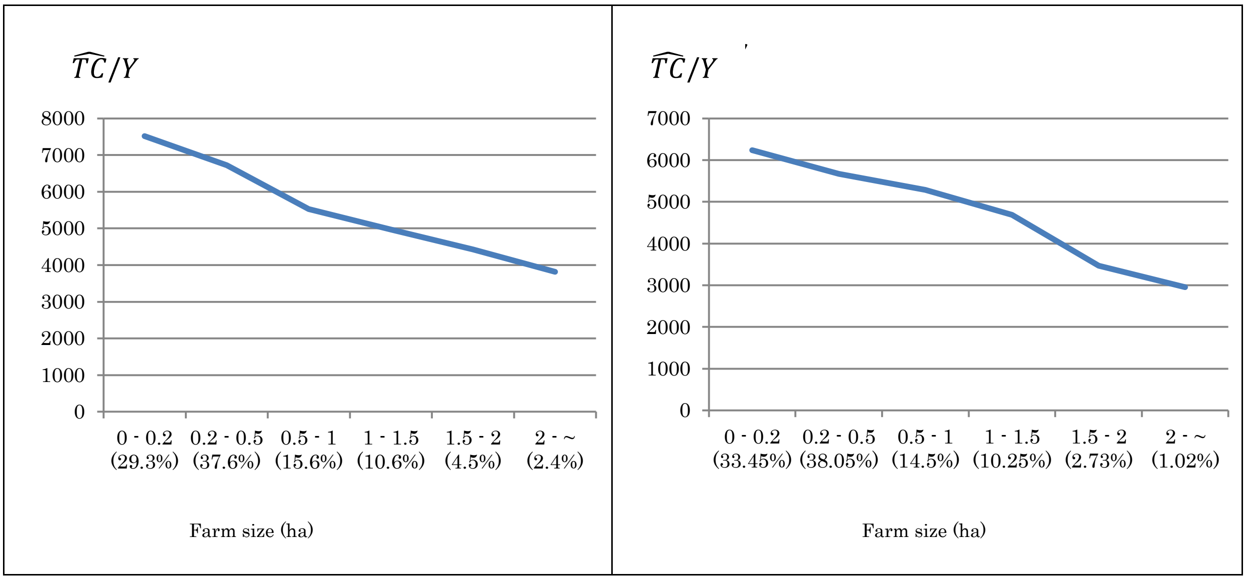

Figure 4.1.2. Cost Curve of Rice Farming in Central Java and East Java

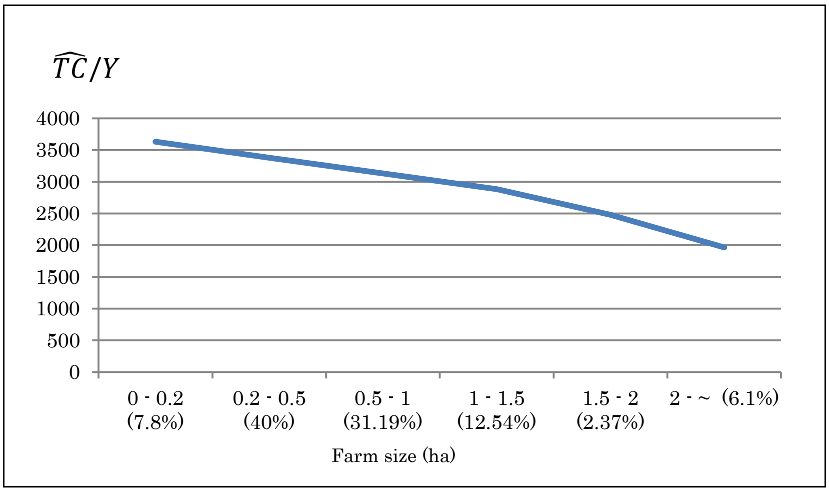

Figure 4.1.3. Cost Curve of Rice Farming in South Sulawesi

4.3.3. Profit Function Approach

The estimation results of profit functions and factor demand functions with restriction of profit maximization, as well as those without it, are shown in Table 4.4. From the F-values shown in Table 4.4, we find that the null hypothesis of profit maximization is rejected for all the provinces, except North Sumatra. This indicates that rice-growing farmers do not maximize their profits, with the exception of farmers in North Sumatra. Rice growing farmers in West Java, Central Java, East Java and South Sulawesi do not perfectly maximize their profit with respect to their utilization of variable inputs (seed, fertilizer, and labor). In other words, rice farmers do not equate the marginal value products of the variable inputs to their market prices. It is highly possibility because Indonesian rice farmers which dominated by small-scale farmer do not sell their entire product to the market but keep it for their self-consumption. The transaction system of rice may lead the sub-optimal behavior. Some farmers will sell the product before harvesting and receive the cheaper price, when they need money immediately for emergency expenditure. Therefore, the null hypothesis of constant returns to scale is rejected for all provinces, where the estimated sum of the parameters ($\beta^*_T+\beta^*_{Tr}$) is larger than 1. All provinces show the existence of scale economies. These results are somewhat consistent with the results of cost function.

Table 4.4. Cobb-Douglas Profit and Factor Demand Functions by Seemingly Unrelated Regression

Variable	North Sumatra		West Java		Central Java	
Profit Function	3 Restriction αi*= αi*'(i = L,S,F)		No Restriction		No Restriction	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Constant	8.0188***	0.3546	8.1096***	0.4438	7.0193***	0.5056
Ln Farm size	1.0745***	0.0529	1.9580***	0.0415	1.3735***	0.0612
Ln Labor wage/rice price	−0.1645***	0.0458	−0.1103***	0.0084	−0.3639***	0.0770
Ln Seed price/rice price	−0.1703**	0.0960	−0.2389***	0.0599	−0.3438***	0.0854
Ln Fertilizer price/rice price	−0.2962**	0.1058	−0.1979***	0.0380	−0.9189***	0.1502
Ln Tractor rent cost/rice price	0.1358**	0.0767	0.1365**	0.0088	0.0495	0.1086
R^2	0.7256		0.5866		0.4533	
Factor Demand Function						
Labor Demand	−0.1645***	0.0458	−0.0138***	0.0024	−0.0641***	0.0066
R^2	0.8202		0.2727		0.4013	
Seed Demand	−0.1703**	0.0960	−0.0521***	0.0016	−0.0106***	0.0059
R^2	0.7361		0.067		0.2770	
Fertilizer Demand	−0.2962**	0.1058	−0.0294***	0.0016	−0.0129***	0.0019
R^2	0.6538		0.5160		0.3426	
Number of Obs.	215		439		622	
F-Value	0.31		4.71***		5.80***	
Chi2($\beta^*_{Tr}+\beta^*_T=1$)	13.75***		39.06***		5.09**	

Variable	East Java		South Sulawesi	
Profit Function	No Restriction		No Restriction	
	Coefficient	SE	Coefficient	SE
Constant	5.6594***	0.4365	7.5131***	0.3997
Ln Farm size	1.7420***	0.0576	1.3926***	0.0422
Ln Labor wage/rice price	−0.0142	0.0726	−0.1007*	0.0538
Ln Seed price/rice price	−0.0313	0.0586	−0.1703***	0.0554
Ln Fertilizer price/rice price	−0.2927***	0.0978	−0.4154**	0.1679
Ln Tractor rent cost/rice price	0.4630***	0.0848	0.1453**	0.0787
R^2	0.4393		0.6814	
Factor Demand Function				
Labor Demand	−0.0243***	0.0060	−0.0428***	0.0013
R^2	0.1622		0.2684	
Seed Demand	−0.0231***	0.0042	−0.0419***	0.0012
R^2	0.1405		0.2414	
Fertilizer Demand	−0.0244***	0.0020	−0.0204***	0.0056
R^2	0.3284		0.2812	
Number of Obs.	586		295	
F-Value	8.78***		8.66***	
Chi2($\beta^*_{Tr}+\beta^*_T=1$)	29.54***		9.14***	

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

4.4. Conclusion and Recommendation

The Indonesian government is set to face structural adjustment problems for agriculture under the pressure of trade liberalization (Yonekura, 2014). In addition, current rice policies of Indonesia (e.g., import bans and input subsidies) are criticized by some international organizations, as well as Western economists, because these policies could potentially increase the budget deficit and lead to inefficient resource allocation (McCulloch, 2008; OECD, 2013; Warr, 2011).

Thus, the enlargement of farm sizes in the rice sector is one of the most important policy measures to cope with the problem of structural adjustment problems and trade liberalization in the agricultural sector. The achievement of economies of scale is a necessary condition to enlarge farm sizes in rice production.

This study incorporated three different methods to examine economies of scale in the Indonesian rice sector, using the PATANAS data of main rice-producing areas.

From the analysis results, we found that economies of scale could be achieved in almost all provinces, even in areas where average farm size is very small, and where most farmers rent machinery. These findings are contrary to those of Hidayah and Susanto (2013), who studied the rice sector in Maluku province. Furthermore, the finding that economies of scale can be achieved in Java is inconsistent with Yamauchi (2014), who could not find a complementary relationship between land and machinery in the Java islands, where the average farm size is extremely small. Our findings suggest that if there were an increase in farm size, profit would increase more than proportionally to the increase of land and fixed capital, even in Java. This difference is caused by the definition of fixed capital. We assume the rental cost of machinery is also a fixed cost. However, Yamauchi (2014) does not.

In addition, the findings suggest that a necessary condition for the enlargement of farm sizes has already been met in Java. This leads us to pose the following question. Why have farm sizes not been enlarged, even though the necessary conditions have been met? To answer this question, we need to conduct further research for the case of Indonesia. This is a forthcoming challenge for us.

Chapter V

Constraints of Farm Size Enlargement in the Rice Sector of Central Java: A Case Study

5.1. Introduction

Rice is the most important food crops commodity in Indonesia. However, the Indonesian rice sector seems to lose global competitiveness, and the government intervenes in the market to achieve food self-sufficiency.

Particularly, in the main rice producing areas of Central and East Java, the rice sector does not have a comparative and competitive advantage (Antriyandarti, 2015). Furthermore, Antriyandarti (2015) as well as Antriyandarti and Fukui (2016) found (based on PATANAS data) that small farm size is one of the important determinants of cost inefficiency in Central and East Java, even though scale economies can be achieved.

This leads us to pose the following question: Why have farm sizes not been enlarged, if the necessary conditions for it were met? To answer this question, we first need to explore whether the condition related to economies of scale as well as the other conditions are satisfied in Central and East Java. Then, if we find that those conditions are satisfied, we must investigate the reasons why the farm sizes of rice producers are still small.

In Indonesia, most rice-growing farmers have small farms and rent agricultural machines. Therefore, economies of scale may not be achieved for technical reasons. According to Collier and Dercon (2014), small farmers who do not have their own fixed capital can achieve economies of scale due to lower transaction costs of finance; continued access to capital; and government interventions into the organization and logistics of trading, marketing, and storage. There is evidence that market imperfections would actually result in scale economies in agriculture.

Economies of scale will create a situation where large-scale farmers are much more cost-efficient than small-scale farmers. This gap may encourage large-scale farmers to increase their farm size (Deininger et al., 2007). In addition, if there is surplus labor in rural areas, farmers would have difficulty finding job opportunities in sectors other than farming. In such a case, they prefer to cultivate rather than sell or lease their land. Therefore, the absence of surplus labor is another necessary condition for farm size enlargement (Deininger et al., op. cit.).

However, Japan has already faced a similar problem as an Asian forerunner, and found that farm sizes in the rice sector have not increased significantly, even after the necessary conditions have been satisfied. Arimoto and Nakajima (2010) pointed out six constraints for farm size liquidation by reviewing existing literature[3].

This study attempts to explore the rice production condition by conducting a field survey in Central Java. Due to some circumstances, we could only conduct the field survey in Central Java. The total harvested area in Central Java and Yogyakarta Province is 1,959,811 ha or 14.2% of the total harvested area in Indonesia; more specifically, 15% of the total production comes from Central Java and Yogyakarta Provinces (BPS, 2014).

In this study, we examine whether or not the necessary conditions for the enlargement of farm sizes are satisfied, and investigate the constraints to enlargement of farm sizes using data from our own field survey in the Sleman and Magelang districts. We hypothesize that the constraints of farm size enlargement are surplus labor in the rural labor market, characteristics of land tenure, fragmentation of land, agricultural land law that discourages land transactions, and an expectation for the conversion of agricultural land to non-agricultural land. We do not examine the "Hold up problem" and "Transaction Cost."

In order to examine whether or not the necessary conditions for enlargement of farm sizes are satisfied, we compare the production cost per weight unit. We also apply the Cobb-Douglas production function to compare the imputed return that belongs to owned land of large-scale farms with those of small- and medium-scale farms. Then, we derive the Marginal Value Product of Land. We examine the first constraint of farm size enlargement by testing the hypothesis of surplus labor through the Cobb-Douglas production function. Furthermore, we investigate the other constraints of farm size enlargement using descriptive analysis.

[3] The constraints are: 1) characteristics of agricultural land (Agricultural land is a family asset, not a commercial asset; externality and non-removability) which cause difficulties in the transaction of land; 2) property rights; 3) investment and cost (the conditions of "Relation specific investment" and "Hold up problem" make tenants hesitant to lease in and owners hesitant to lease out); 4) transaction costs; 5) expectation of land diversion; and 6) fragmentation of land (Arimoto and Nakajima, 2010).
After Arimoto and Naksjima op. cit., Takahashi (2012) interpreted the slow progress in farmland liquidation in the agricultural sector of Japan, focusing on the transaction costs related to farmland lease. Kusakari and Nakagawa (2013) also explained the slow liquidation of farmland in Japan from the viewpoint of transaction cost and the expectation of land diversion.

We also investigate the main restraints on enlargement of farm sizes in rural Central Java. For that purpose, we hypothesize that the factors which restrain enlargement of farm size are surplus labor in the rural labor market, fragmentation of land, relationship-specific investment, agricultural land law that discourages land transactions, and expectations for the conversion of agricultural land to non-agricultural land.

5.2. Study Area

We selected two typical rice-growing areas of the Central Java and Yogyakarta Provinces—which account for 15% of the total rice production in Indonesia—as our study areas. About 222 rice farm households were selected for interviews through the random sampling method. The two areas belong to the Magelang and Sleman districts of the Central Java and Yogyakarta Provinces.

5.2.1. Geographical Condition

The topographies of Magelang and Sleman are similar because both are basin-shaped plateaus that are surrounded by six mountains (Merapi, Merbabu, Andong, Telomoyo, Sumbing, and Menoreh) so that most of the territory is a water catchment area. The soil was fertile because of the volcanic ash and the abundant water resources. The topography of the Magelang and Sleman districts is lowland with the altitude around 320 m above sea level. The distance from the Mungkid and Godean sub-districts from the central district is 7 km and 10 km, respectively. The total area of the Mungkid sub-district is 3,740 ha, and the total area of the Godean sub-district is 2,684 ha (BPS Magelang Regency, 2014*;* Godean Sub-District in Figure, 2015).

5.2.2. Agriculture Condition

The irrigation conditions are better in Godean than in Mungkid. The farmers in the Godean district enjoy technical irrigation from the Mataram Canal throughout the year, and rice farming as well as triple cropping is possible. On the other hand, in Mungkid—where irrigation is semi-technical from Semaren and Gremeng—water resources supply sufficient water, and double cropping during the year or five cropping over a two-year period is common.

The main crop in Godean and Mungkid is paddy. In Sidorejo village, a Godean sub-district, all farmers only plant paddy. However, in Senden village, a Mungkid sub-district, some farmers plant chili, cassava, and papaya. There are three cropping patterns in Sidorejo Village. The first pattern is paddy to paddy to paddy, which means that farmers plant paddy three times in one year (110 plots or 74% of the total plots in Sidorejo). This pattern is dominant in Sidorejo. Some farmers plant paddy five times every two years. Around 23% of total plots in Sidorejo (i.e., 34 plots) apply this pattern. The third pattern is "no crop" to paddy to "no crop" (four plots or 3% of total plots). Farmers cultivate paddy only in the second dry season.

Crop rotation in Senden is more complicated than in Sidorejo; there are four crop rotation patterns in Senden. The first pattern is paddy to paddy to paddy. In this case, the water supply is abundant throughout the year. Therefore, the farmers cultivate paddy all year long. There are 57 plots implementing this pattern. The second crop rotation pattern is the dominant pattern in Senden, which is that a farmer plant paddy five times every two years. 180 plots or around 70% of total plots apply this pattern. The third pattern is to plant paddy only once per year (nine plots). The fourth pattern is cultivating paddy in two seasons of the year and cultivate other crops such as corn, chili, cassava, and bean in the other season. There are 12 plots that practice this pattern.

5.2.3. Farm Household Characteristics

This study uses 222 sample households, comprising 84 households for Sidorejo and 138 household for Senden. Table 5.1 shows the characteristics of sample households. The overwhelming majority of the sample households are engaged in farming. Some households engage off-farm jobs, such as traders, roof tile makers, craftsmen, public servants, daily unskilled laborers, etc.

Table 5.1. Farm Household Characteristics

Characteristics	Sidorejo Village	Senden Village
Number of Households	84	138
Age of household (HH) (year)	56.04	55.82
Education of HH (year)	8.08	7.85
Main occupation of HH (person)		
- Farmer (person)	64	116
- Non-farm self-employed (person)	12	1
- Daily unskilled labor (person)	3	5
- Permanent off-farm job (person)	5	16
Subsidiary occupation of HH (person)		
- Farmer (person)	19	22
- Non-farm self-employed (person)	23	4
- Daily unskilled labor (person)	6	8
Permanent off-farm job (person)	4	5
Family member (person)	3.9	3.9
Number of plot	1.77	1.89
Farm size (ha)	0.3919	0.3278
Production (kg/HH)	3259	2424
Self-consumption (kg)	1196.87	719.13
Remittance (thousand IDR)	343.4524	244.7464
Asset for rice farming (million IDR)	219.935	146.386

Source: Farm Household Survey, 2015
Note: Exchange rate in 2015 is USD 1= IDR 13,820

5.2.4. Current Situation of Farmland Liquidation in the Study Area

We divide the farmers by farm size into three groups (Figure 5.1). The first group comprises farmers who have farm sizes under 0.5 ha, called small-scale farmers. This type is dominant in the study area, and is represented by about 80.20% of all farmers.

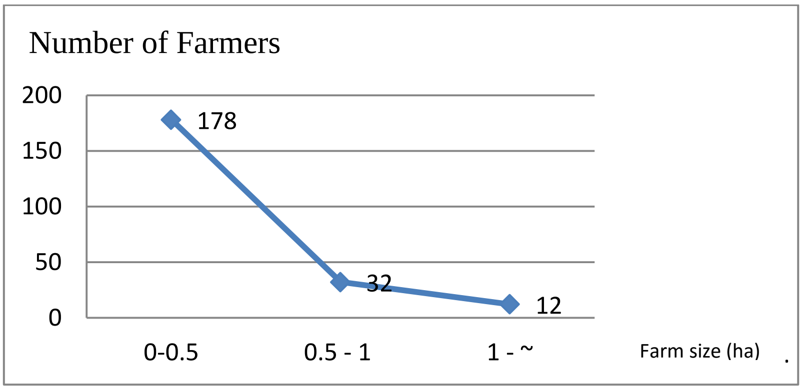

Figure 5.1. Distribution of Farmers by Farm Size

The second group comprises farmers with farm sizes between 0.5 and 1 ha, called medium-scale farmers. The number of farmers defined as medium-scale farmers is 14.40%.

The last group comprises farmers have farm sizes of more than one ha, and is defined as large-scale farmers. Only 5.40% of total farmers are included in this group.

The majority of rice farmers in Sidorejo and Senden Villages rented paddy field from the owner. Approximately 60 % of total paddy lands is rented, and around 40% is owned. Figure 5.2 illustrates the condition of farmland liquidation in study area.

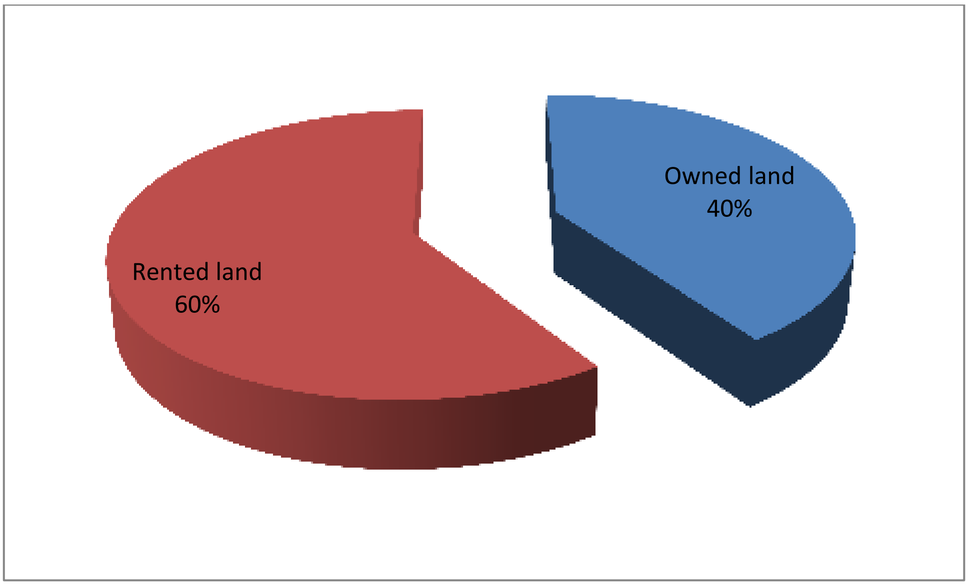

Figure 5.2. Farmland Liquidation in Study Area

5.3. Scale Economy and Economic Surplus of Rice Production

The necessary condition for the development of large-scale tenant farming is as follows (Kajii, 1973):

$$\text{Surplus}_{\text{large-scale farmer}} \geq \text{Income}_{\text{small-scale farmer}} - \text{utility of family labor used in small-scale farms} \quad (5.1)$$

If this equation holds, the economic advantage of large farms over small ones is sufficient for large-scale farmers to pay sufficiently high rents to induce small-scale farmers to stop farming and rent out their land.

In order to examine whether or not the necessary conditions for enlargement of farm size are satisfied, we firstly compare the Marginal Productivity of Labor for large-scale farmers with that for small-scale farmers. We also compare the surplus of large-scale farmers with that of small-scale farmers. Finally, we compare the production cost of large-scale farmers with that of small-scale farmers.

5.3.1. Marginal Productivity of Land

We apply the Cobb-Douglas production function to compare the imputed return that belongs to owned lands of large-scale farmers with those of small- and medium-scale farmers. Then, we can get the Marginal Value Product of Land (Allen, et.al, 2014) through the Cobb-Douglas production function defined as equation (5.2).

$$lnY_i = \alpha_T lnT_i + \alpha_L lnL_i + \alpha_S lnS_i + \alpha_F lnF_i + \alpha_{Tr} lnTr_i + \varepsilon_i \quad (5.2)$$

Here,

Y = Production per year (kg)

T = Farm size (ha)

L = Total labor (HOK)

S = Amount of seed (kg)

F = Amount of fertilizer (kg)

Tr = Tractor and draft animal (HOT)

ε = Random disturbance

Note: HOK = Workday of labor
HOT = Workday of tractor or draft animal

The marginal value product (MVP) of land is estimated by size class. The economic condition of land liquidation is written as (Kusakari and Nakagawa, 2013)

$$MVP_{\text{large-scale farmer}} > MVP_{\text{small-scale farmer}} \quad (5.3)$$

The estimation result of the Cobb-Douglas Production function is shown in Table 5.2. Variables of farm size, labor, seed, and fertilizer are positively significant to the rice production at the 1% significance level.

Table 5.2. Estimation result of Cobb-Douglas Production Function

Variable	Coefficient	Standard Error
lnFarm size	0.2667***	0.0656
lnLabor	0.3820***	0.0638
lnSeed	0.2216***	0.0656
lnFertilizer	0.1919***	0.0483
Lntractor + draft animal	-0.0210	0.0499
Constant	2.1049***	0.3885
Number of Obs.	222	
R^2	0.7062	
F calculated	103.84***	
Value Marginal Product of land - 0–0.5 - 0.5–1 - 1 – ~	 771.91 774.08 784.46	
Marginal Value Product of labor H0: VMPL = 50000; t	45268.59 -2.6254**	

Source: Farm Household Analysis, 2015

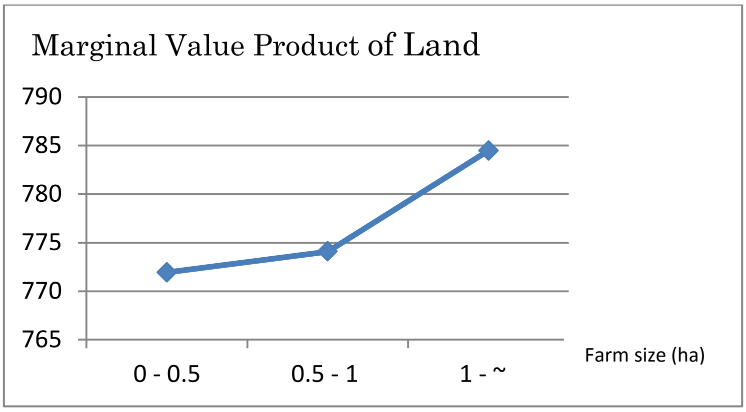

Figure 5.3. Marginal Value Product of Land

The marginal value product of land increases as farm size increases. This result supports the existence of the necessary condition for scale economies. Large-scale farmers can expand their farm size by borrowing land from small-scale farmers.

5.3.2. Surplus of Rice Farmers

The surplus produced by rice farmers to whom land belongs is illustrated by Figure 5.4. The surplus produced by large-scale farmers who have farm sizes of more than one ha is more than that of medium- and small-scale farmers. This indicates that the necessary condition of scale economies is satisfied. Large-scale farmers can use the surplus to borrow farmland from small-scale farmers to expand their farm sizes (Kajii's hypothesis).

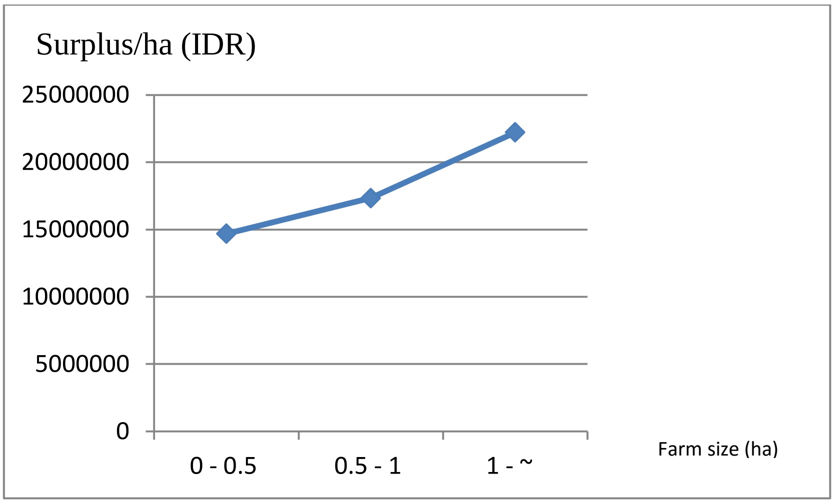

Figure 5.4. Surplus per Hectare in Study Area

5.3.3. Production Cost/Unit

The relationship between farm size and production cost per weight unit is illustrated in Figure 5.5. The production cost per unit will decline along with increasing farm size. This means that economies of scale is achieved in the study area. Scale economies are achieved because large-scale farmers have draft animals and/or agricultural machines, such as tractors, hand tractors, threshers, and rice mills.

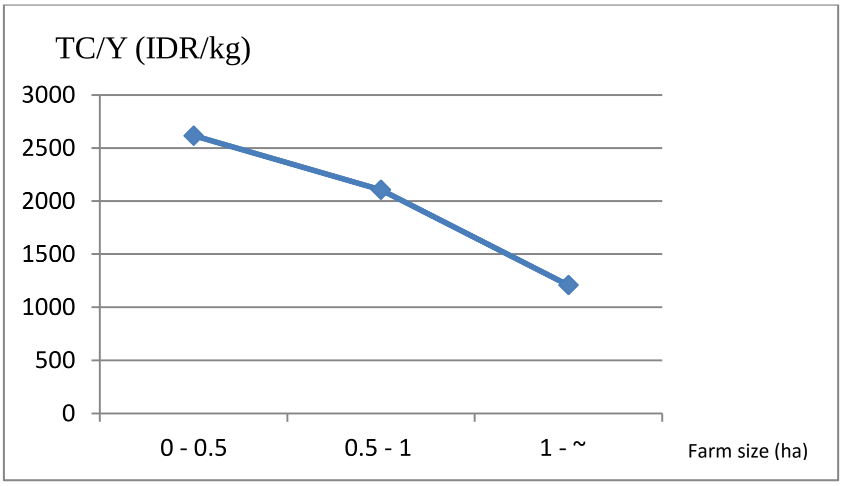

Figure 5.5. Production Cost/Unit

5.3.3.1. Seed Cost/Unit

This paper also compares the costs of inputs of large farmers with those of medium and small farmers to capture the transaction process of each category of farmers. According to Mahipal (1992), large-scale farmers have bargaining power that enables them to buy inputs such as seeds, chemical fertilizers, and so on at cheaper rates, while small-scale farmers cannot do so. Therefore, we observe this evidence to support the examination of the existence of scale economies in the study areas.

The seed cost per weight unit decreases as farm size increases (Figure 5.6). According to Table 5.3, large-scale farmers more easily get discounts for seed transactions. This suggests that large-scale farmers have stronger bargaining power in seed purchasing than small-scale farmers.

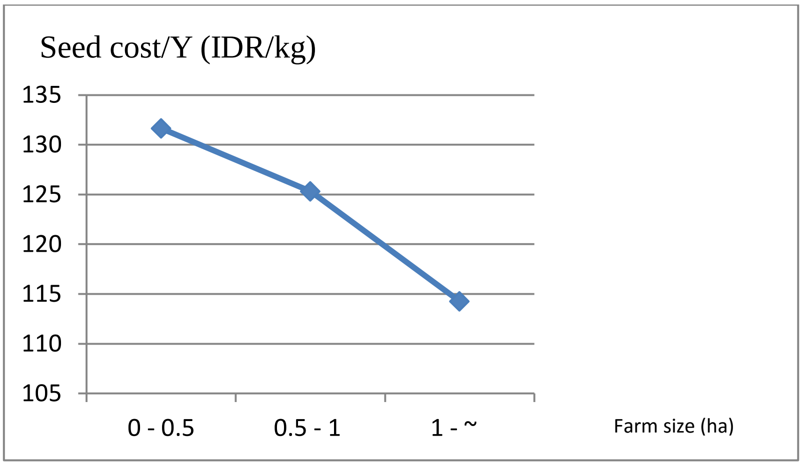

Figure 5.6. Seed Cost/Unit

Table 5.3. Seed Transactions in Study Area

How to buy seed	0–0.5 ha	0.5–1 ha	1 ha–~
Prepared by himself	30.9%	28%	8.33% The farmer also gets free seed from the government
Agriculture shop	59% 6.7% of farmers get a discount of IDR 600–2,000/kg	69% 13.6% of farmers get a discount of IDR 8,000/10 kg	75% 44.4% of farmers get a discount of IDR 8,000–10,000/10 kg
Farmer group	2.8% 80% of farmers get subsidies 3–10 kg	–	8.33% of farmers get a discount of IDR 10,000/5 kg
Neighbor	5%	3%	–
Agriculture cooperative (KUD)	1.1% All farmers get subsidies of 10 kg	–	8.33% of farmers get a discount of IDR 2,000/kg
Hamlet storage	0.6% of farmers get a subsidy of IDR 2,000/kg	–	–
Seed center	0.6% of farmers get subsidies of 10 kg	–	–

Source: Farm Household Survey, 2015

5.3.3.2. Fertilizer Cost/Unit

Similar cases occur in fertilizer input. The fertilizer cost per weight unit also decreases as farm size increases (Figure 5.7). Some small-scale farmers prefer to make their own fertilizer (manure) rather than to purchase chemical or organic fertilizers at the shop or farmer group

(Table 5.4). Although the Ministry of Agriculture manages the fertilizer subsidy, farmers do not access this facility automatically. If the farmer is an active member of a farmer group, the subsidy is easily accessible (which is the main motivation for a farmer to join a farmer group). However, complicated administration systems regulate access to subsidies through farmer groups. Therefore, most farmers buy fertilizers at agriculture shops. Large-scale farmers have stronger bargaining power to access subsidies and discount facilities than small-scale farmers.

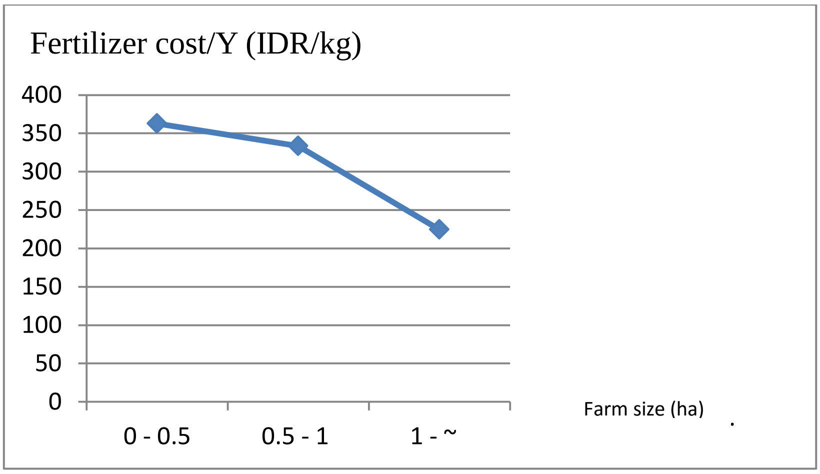

Figure 5.7. Fertilizer Cost/Unit

Table 5.4. Fertilizer Transactions in Study Area

How to buy fertilizer	0–0.5 ha	0.5–1 ha	1 ha–~
Made by himself	7.3%	–	–
Agriculture shop	85.4% 30.9% of farmers get a subsidy of IDR 5,000–15,000/50 kg	94% 33% of farmers get a subsidy of IDR 5,000–15,000/50 kg	75% 55.5% of farmers get a subsidy of IDR 5000–15000/50 kg
Farmer group	4.5% Farmers get a subsidy of IDR 5,000–30,000/50 kg	6% Farmers get a subsidy of IDR 5,000/50 kg and IDR 30,000/50 kg	8.33% Farmer gets a discount of IDR 30,000/50 kg
Distributor	2.2% 75% of farmers get a subsidy of IDR 100/kg and IDR 3,000/50 kg	–	–
Agriculture cooperative (KUD)			8.33% Farmer gets a discount of IDR 30,000/50 kg
Hamlet head	0.6% Farmer gets subsidy for urea of IDR 50,000/50 kg and for phonska of IDR 30,000/50 kg	–	8.33% Farmer gets subsidy of IDR 40,000/50 kg

Source: Farm Household Survey, 2015

5.3.3.3. Pesticide Cost/Unit

Similar to seed and fertilizer, the pesticide cost per weight unit also declines along with increasing farm size (Figure 5.8).

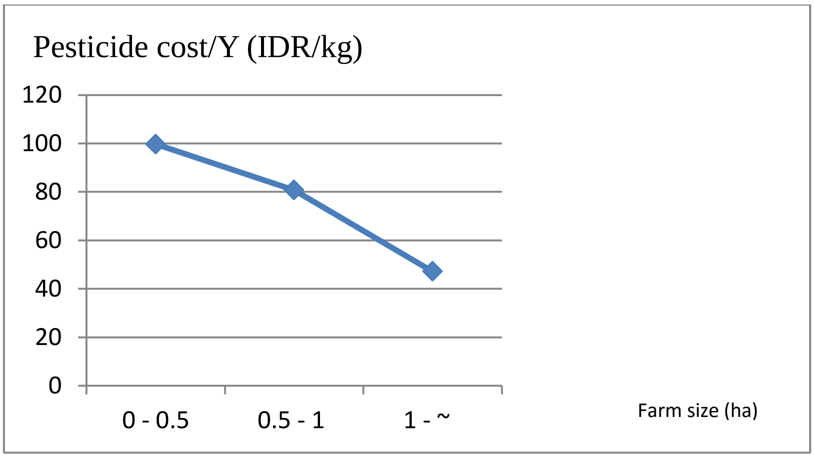

Figure 5.8. Pesticide Cost/Unit

5.3.3.4. Labor Cost

The relationship between farm size and labor cost per weight unit is illustrated in Figure 5.9. Large-scale farmers have the bargaining power to determine a hired labor wage that is less than the standard wage (Figure 5.10). Thus, the labor cost per weight unit declines as farm size increases.

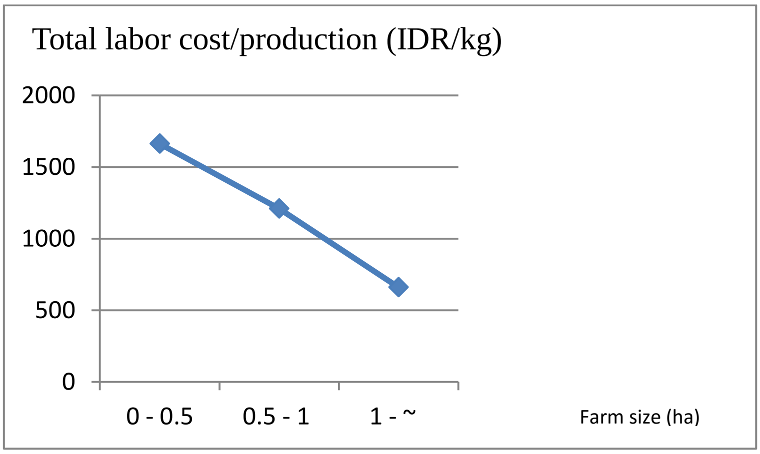

Figure 5.9. Labor Cost/Unit

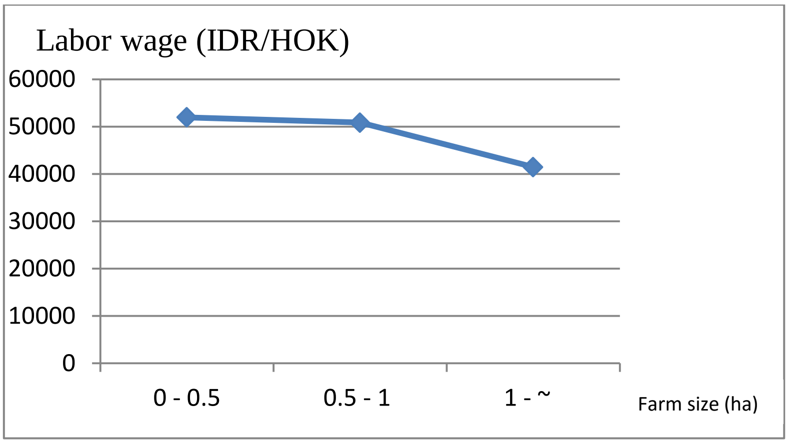

Figure 5.10. Labor Wage/HOK
Note: HOK = Workday of labor

5.3.3.5. Tractor Cost and Draft Animal Cost

Tractor cost per weight unit decreases as farm size increases. Some medium- and large-scale farmers have hand tractors, big tractors, or draft animals for rice production.

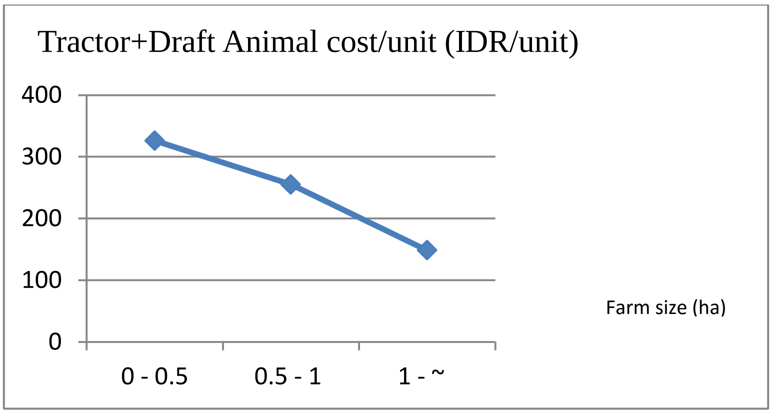

Figure 5.11. Tractor and Draft Animal Cost/Unit

5.3.3.6. Land Rent

According to Figure 5.12, the land rent per hectare declines as farm size increases due to the stronger bargaining power of large-scale farmers.

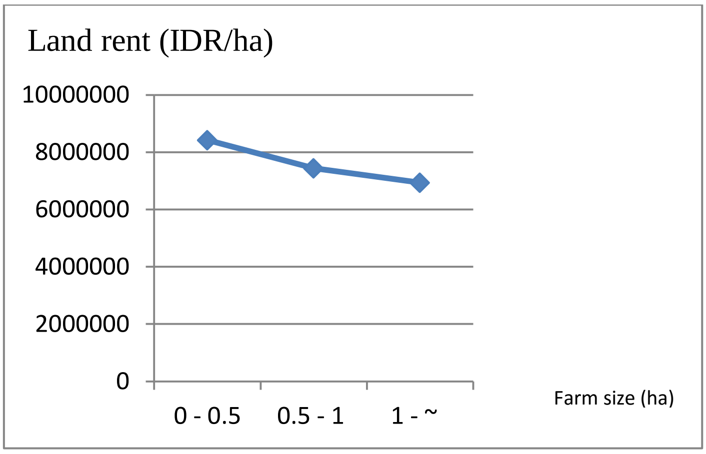

Figure 5.12. Land Rent/Unit

5.4. Investigation of Constraints on Farm Size Enlargement

5.4.1 Surplus Labor

Deininger et al. (2007) concluded that the existence of surplus labor in rural areas restrains farm size enlargement. Therefore, we need to examine the existence of surplus labor in study areas. From the empirical model of the Cobb Douglas production function in equation 5.2, we test the hypothesis of surplus labor (Ranis, 1997). Surplus labor exists when the Marginal Value Product of Labor is below the market wage rate. In this study, we test the null hypothesis that the Marginal Value Product of Labor equal to the market wage rate amounted to IDR 50,000.

The estimation result in Table 5.2 shows that the null hypothesis is rejected at the 5% significance level. Thus, the Marginal Value Product of Labor is smaller than the market wage rate. This indicates a surplus of labor in the study area.

5.4.2 Characteristics of Land Tenure System

Arimoto and Nakajima (2010) stated that the characteristics of agricultural land tenure are a constraint (1) of farm size enlargement. In order to investigate this constraint, we observe the characteristics of land tenure in the study areas. We found that the majority of plots are leased in, amounting to 98 plots in Sidorejo and 104 plots in Senden. Most of the farmers lease the plot from their neighbors. The second choice is to lease the land from their relatives. Farmers tend to lease farmland only from a person with whom they have a close relationship. This behavior is similar when farmland is leased out. Farmers only rent the land to relatives or neighbors. In Sidorejo village, farmers lease out the land only to their relatives. Some farmers lease in the land with the status "tanah bengkok" or village land.

According to Fukui (2009), the personal relationship between landlord and tenant in Central Java influences the tenancy contract decision. In Sidorejo village, three cases are fixed-rent contracts, and 95 cases are "maro" contracts. Meanwhile in Senden village, there are nine fixed-rent contracts, five "moro telu" contracts, and 128 "maro" contracts. "Maro" is a share tenancy contract in which the sharing rate of the tenant is fifty percent of the gross output. "Moro telu" is a share contract in which the sharing rate of the tenant is one third of the gross output. The forms of tenancy are mainly determined by personal relationships, rather than commercial relationships. This indicates that the land market is not competitive.

Table 5.5. Land tenure in study area

	Sidorejo Village	Senden Village
Owned Land (plot)	49	109
Lease in (plot)	98	144
Relation to owner:		
- Friend	14	1
- Neighbor	48	87
- Relative	31	53
- Tanah Bengkok (village land)	2	2
- others	3	1
Lease out (plot)	2	8
Relation to tenant:		
- Neighbor	–	5
- Relative	2	3
Total (plot)	149	261

Source: Farm Household Survey, 2015

5.4.3 Land fragmentation

Constraint (6) of Arimoto and Nakajima (2010) is fragmentation of land. Thus, we also investigate the fragmentation of land in the study areas. Land fragmentation is not always disadvantageous, though there are more disadvantages than advantages. Land fragmentation creates economic and production problems because of increased time, work, and organization required by the plots' distance (Lusho and Papa, 1998). In the study area, most of the farmers have all their land in only one plot. Table 5.6 shows the number of farm holdings by level of fragmentation in each village and hamlet.

Table 5.6. Land Fragmentation by Village and Hamlet

Village	Number of holdings by plot fragmentation					
Hamlet	1	2	3	4	5	6
Sidorejo	37	33	7	4	1	–
- Kwagon	23	21	4	2	1	–
- Pare 2	1	4	–	–	–	–
- Pare 3	11	8	1	2	–	–
- Pare 4	2	2	2	–	–	–
Senden	67	38	21	7	3	2
- Senden	12	3	3	1	1	1
- Ngabean	6	5	3	2	–	1
- Butuh	7	9	4	1	–	–
- Loning	8	7	3	1	–	–
- Bangsan	12	5	1	–	1	–
- Kempulan	12	4	3	–	–	–
- Brogo	10	5	4	2	1	–

Source : Farm Household Survey, 2015

Table 5.7. Land Fragmentation by Size and Village

Village	Number of holdings by plot fragmentation					
Farm size categories (ha)	1	2	3	4	5	6
Sidorejo						
- 0–0.5	33	27	3	2	–	–
- 0.5–1	4	4	2	1	–	–
- 1–~	–	4	2	1	1	
Senden						
- 0–0.5	65	32	13	3	–	–
- 0.5–1	2	5	7	4	2	1
- 1–~	–	1	1	–	1	1

Source : Farm Household Survey, 2015

From the Table 5.7, we can see that the farmlands of large-scale farmers are fragmented into two to six plots in both villages.

5.4.4 Land Law

This constraint relates to constraint (2) of Arimoto and Nakajima (2010). We also need to investigate the current land law in Indonesia. The land policy period of 1945–1960 focused on improving control and ownership of the colonialist system, and transform it into a national system. In 1960, the Indonesian government set legislation regarding sharing the system to protect small farmers and agricultural laborers. This land reform was implemented until 1965. Then, in 2001, Indonesia implemented the realignment of control, ownership, use, and utilization of land (land reform) to be fair with land ownership. Furthermore, the government established a decentralized form of authority at the national, provincial, district, and village levels to allocate and manage agricultural and natural resources. Policies give autonomy to villages in Indonesia, especially in Java, to regulate land issues in accordance with the situation and local culture (Tjondronegoro and Wiradi, 2008). Since 2009, the Indonesian government has issued a law in protection of farmland to ensure sustainability of agriculture (Masyhuri, 2015).

Under the current land law in Indonesia, in the new era of decentralization, rice farmers are encouraged to expand their farm size. Land law is implemented in a relatively fair manner for both tenant and owner. Thus, land law does not constrain farm size enlargement.

5.4.5. Expectation for Conversion of Agricultural Land to Non-agricultural Land

When farmland is converted to non-agricultural use, the price of land is 30–140 times higher than its earning capacity under agricultural use. This reflects farmers' expectations of capital gain from farmland conversion, and farmers therefore do not have motivation to lease out the land for farming (Godo, 2007; Arimoto and Nakajima, 2010). Table 5.8 illustrates the trend of land prices in both villages.

Table 5.8. Average Price and Earning Capitalized Value of Land in Sidorejo and Senden Village 2010–2015

Year	Sidorejo (IDR/1000 m^2)		Senden (IDR/1000 m^2)	
	Price of land	Earning capitalized value of land	Price of land	Earning capitalized value of land
2015	300,000,000	160,868	200,000,000	151,050

Source : Sidorejo and Senden Villages, 2015

Table 5.8 shows that the price of land is much higher than the earning capitalized value of land. This leads to farmers not wanting to lease out their farms; they have an economic incentive to keep their land.

5.5. Conclusion

The purpose of this paper is to examine whether or not the necessary conditions for farm size enlargement are satisfied, and to investigate the constraints on farm size enlargement using our field survey data. The results show that there is some evidence for the existence of economies of scale in the study that benefits the enlargement of farm size. The economic condition of the lease of farmland is satisfied, since the large-scale farmer's surplus is greater than that of the small-scale farmer. However, rice farmers in Central Java do not choose to enlarge farm size. We observed many cases of land tenancy in the study areas. Farmland liquidation is widely observed in rural Java. The possible reasons why farmland enlargement has not progressed are: 1) there is a surplus of labor in rural Central Java—therefore, they do not lease out the farmland; 2) the existence of "tanah bengkok" or village; 3) the land market is not competitive—the land tenancy occurs between neighbors and where there is a close relationship between owner and tenant; large-scale farmers do not get incentives to enlarge farm size; 4) fragmentation of land of large-scale farmers; 5) expectation for conversion of agricultural land to non-agricultural land. The land law in Indonesia is not a constraint of farmland enlargement.

The main fact findings are in line with the constraints which Deininger et al. (2007) as well as Arimoto and Nakajima (2010) present. Constraints (2) and (3) are related to constraint (1) of Arimoto and Nakajima (2010). Constraints (4) and (5) are also related to constraints (6) and (5) of Arimoto and Nakajima (2010), respectively; constraint (1) is related to Deininger et al. (2007).

The Indonesian government faces the difficult problem of promoting farm size enlargement. It may implement an alternative mixed policy to overcome this difficulty. The Indonesian government needs to facilitate the development of off-farm jobs in rural areas to properly reduce the surplus labor. Therefore, small-scale farmers prefer to lease out their farmland. This is also an imperative from the perspective of poverty reduction, because small-scale farmers can receive higher income. Moreover, irrigation and land consolidation should be developed to reduce land fragmentation. To control land conversion, which is the main factor of fragmentation of paddy field in sub-urban areas, regulations for agricultural land utilization should be established. Efforts to reduce the rate of conversion of agricultural land for the future are about how to protect agricultural land through spatial planning and control, how to increase optimization, rehabilitation and extension of the land, how to increase productivity and efficiency of farming, as well as how to control population growth.

Chapter VI

Conclusion

Indonesia is a middle-income country, which has achieved remarkable economic growth in the past decade. In the process of economic development, Indonesia faces agricultural adjustment problems, namely income disparity between the agricultural sector and other sectors, and the decline of global competitiveness in the agricultural sector. Therefore, solving the structural adjustment problem of the agricultural sector is one of the most important policy issues for the Indonesian government.

The rice sector is the most important food crop in Indonesian agriculture. However, the relative productivity and income in the rice sector has declined. The share of GDP of the rice sector has also declined. On the other hand, the Indonesian government attaches importance to food security and plans to achieve rice self-sufficiency by strengthening the protective policy import ban, the input subsidy program, and government procurement and reserve. As a result, under the current rice policy the domestic rice price has been higher than the international rice price since the mid-2000s, except during the food crisis in 2008 and 2009.

This suggests that if international trade of rice will be liberalized, self-sufficiency will not be achieved.

The Indonesian Government needs to implement an appropriate rice policy to achieve food security and poverty alleviation. International organizations and some economists criticized the policy packages, including the import ban, rice procurement, and stock reserve by BULOG, the input subsidy program, and the Raskin program. Even though Indonesia could achieve food security and poverty alleviation, the government spends a significant amount of money on the rice sector and the poor (Timmer, 2004; McCulloch, 2008; Sudaryanto, 2011; OECD, 2012; OECD, 2013; Warr, 2005).

Therefore, this study aims to investigate how the Indonesian government can achieve policy targets such as global competitiveness of the rice sector and food security under a more liberalized trade regime.

6.1. Major Findings

First, we investigated the competitiveness and cost efficiency of rice farming in Indonesia by using PATANAS Data collected by the Ministry of Agriculture. From this study, we obtained the following results:

The reduction of land rent, fertilizer price, and tractor cost are more effective in decreasing the production cost for rice farmers, since it is positively influenced by the input prices. Moreover, the impacts of land rent, fertilizer price, and tractor cost on production costs are the largest.

The ownership of paddy land has a negative effect on cost efficiency in North Sumatra, West Java, Central Java, and South Sulawesi, in which a shared tenancy system is widely observed, but it does not have a significant effect on the cost efficiency in East Java. It is in accordance with the findings presented by Mailena et al. (2014) and Fukui et al. (2002), but is not in line with those presented by Jamal and Dewi (2009) that land tenancy does not have negative effects on cost efficiency. Meanwhile, the modern irrigation system has a positive effect on cost efficiency in West Java, Central Java, and South Sulawesi but not in the other provinces.

Finally, this study concludes that rice farming in Central Java and East Java, which are the main rice producing areas, do not have a comparative and competitive advantage. The competitiveness of rice is positively influenced by the cost efficiency of rice farming. Although the cost efficiency in Central Java and East Java is the highest, rice sectors in these areas cannot obtain global competitiveness (Table 3.8). This is due to the relatively small farm sizes, which have a positive effect on the competitiveness.

Next, we examined the economies of scale of Indonesian rice production, before we find the strategy on how to enlarge the farm size. We obtained the following findings:

The results presented in Table 4.1, Figure 4.1, and Table 4.4 indicate the existence of economies of scale in all provinces, even in areas where the average farm size is very small and where most farmers rent machinery. These findings are opposed to those of Hidayah and Susanto (2013) and Yamauchi (2014). The estimated parameters in Table 4.3 are consistent with the prediction via economic theory.

From the F-values shown in Table 4.4, we can conclude that rice-growing farmers do not maximize their profits, except for farmers in North Sumatra, since the null hypothesis of profit maximization is rejected for all the provinces, except for North Sumatra.

The estimated sum of the parameters ($\beta^{*}_{T}+\beta^{*}_{Tr}$) is larger than 1 (Table 4.4); therefore, the null hypothesis of constant returns to scale is rejected for all provinces. Moreover, the findings imply that a necessary condition for the enlargement of farm size has already been met in Java.

We also tried to investigate the constraints of farm size enlargement in the Indonesian rice sector by using the data from the field survey that we conducted in Central Java. We found the following:

There is some evidences for the existence of scale economies in the study area and for the benefit of enlarging farm size. The economic condition of farmland lease is satisfied, since the large-scale farmer's surplus is greater than that of the small-scale farmer. However, farmland enlargement in Central Java showed no progress due to reasons such as the following: a) there is surplus labor in rural Central Java and, therefore, they do not lease out the farmland; b) the existence of "*tanah bengkok*" or village land; c) the land market is not competitive, the land tenancy occurs within neighborhoods, and a close relationship between owner and tenant exists, thus large-scale farmers do not get incentives to enlarge farm sizes; d) fragmentation of land of large-scale farmers; and e) expectation of the conversion of agricultural land to non-agricultural land. Land law in Indonesia does not constrain farmland enlargement since its implementation is relatively fair for both tenant and owner.

The main fact findings in this study are consistent with the constraints which Deininger et al. (2007) and Arimoto and Nakajima (2010) present. Constraints (2) and (3) are related to constraint (1) of Arimoto and Nakajima (2010). Constraints (4) and (5) are also related to constraints (6) and (5) of Arimoto and Nakajima (2010), respectively; constraint (1) is related to Deininger et al. (2007).

6.2. Policy Recommendation

From the results of our studies, we can make some policy recommendations. In order to achieve food security, which is one of the key strategic policies under the pressure of trade liberalization, the Indonesian government will have to reform the current protective rice policies. In general, these recommendations focus on three factors: improving the global competitiveness of the rice sector, reforming current rice policies, and strengthening the priority of agricultural policies for facilitating farm size enlargement

The results of the investigation in this study imply that if the Indonesian Government liberalizes the rice policy, rice farmers in the major rice-growing areas such as Central Java and East Java will have the most significant negative effects; this is due to their lack of global competitiveness, which is related to small farm sizes. Policies for the improvement of cost efficiency are not sufficient for the achievement of global competitiveness. For achievement of global competitiveness in Central Java and East Java, the government needs to implement a policy mix, which aims not only to decrease the cost inefficiency but to facilitate rice farmers to enlarge farm sizes. To improve the cost efficiency, improving the irrigation conditions and land consolidation are effective. To enlarge the farm size, facilitating transactions in the land rental market will be more feasible than promoting land transactions through buying and selling in rural Central Java and East Java.

However, the constructions of an irrigation system and land consolidation are expensive, and cost performance must be examined. Since there is a high transaction cost in the land rental market of rural Central Java and East Java where large surplus labor still exists, there may be obstacles to facilitating land rentals. Thus, it is not so easy for the Indonesian government to devise effective policy measures for reducing the cost inefficiency and improving global competitiveness in the rice sector. Facilitating farm size enlargement is one of the measures for improving global competitiveness. It may implement an alternative mixed policy to promote farm size enlargement. One of the alternative policies is facilitating the development of off-farm jobs in rural areas to properly reduce the surplus labor; thus, the small-scale farmers prefer to lease out their farmland. Godoy and Dewbre (2010), De Janvry et al. (2005), and Babatunde and Qaim (2009) argued that off-farm jobs play an important role in reducing rural poverty because small-scale farmers can receive higher incomes. The experience of West Java where industrial areas were built in the middle of the rice barn region may be implemented in Central Java and East Java. Thus, the off-farm jobs in those areas would be more developed.

In addition, the government should control land conversion, which is the main factor in the fragmentation of paddy fields in sub-urban areas by strengthening the regulations for sustainable agricultural land utilization. Even though the regulation to protect agricultural land has been issued since 2009, it seems that it has not been implemented well because the rate of land conversion is increasing by about 100,000 hectares per year (Ministry of Agriculture, 2015). The regulation for land conversion may reduce the expectation for conversion of agricultural land to non-agricultural land.

The role of hamlets and villages for efficient and sustainable agricultural land use can be considered to encourage farm size enlargement, following the experience of the Rural Shareholding Cooperatives, which facilitated farm size enlargement in some regions in China (Ito, 2016). Tjondronegoro and Wiradi (2008) asserted that, beyond the decentralization policy, agricultural land use can be allocated and managed by government authorities in such hamlets and villages. We should investigate whether or not it is possible (with local wisdom in the hamlet) for hamlet officials to promote and facilitate farm size enlargement in their territories.

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