Graduate School of Development Studies

THE EFFECTIVENESS AND EFFICIENCY OF GOVERNMENT INTERVENTIONS IN RICE PRODUCTION:

(The Case of Inputs Subsidy)

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List of Acronyms

BIMAS	: Mass Extension Program
BPOM	: The National Agency of Drug and Food Control
BPS	: Statistics Indonesia
DW	: Durbin Watson
FAO	: Food and Agriculture Organization
GDM	: Generalized Difference Method
GDP	: Gross Domestic Product
HYV	: High Yield Variety
IGD	: Domestic Gas Incentive
IMF	: International Monetary Funds
INMAS	: Intensification Program
INSUS	: Special intensification program
LNG	: Liquid Natural Gas
LoI	: Letter of Intent
MoA	: Ministry of Agriculture
MoF	: Ministry of Finance
OLS	: Ordinary Least Square
RASKIN	: Rice for the poor
WHO	: World Health Organization

Abstract

The aim of this paper is to examine the effectiveness and efficiency of inputs subsidy in rice production in order to achieve food self sufficiency and food security since the major constrain of farmer is capital limitation to buy seed and fertilizers. Inputs subsidy will increase the demand of those particular goods and by increasing the demand will also increase the output of rice production.

For that purpose, this paper uses secondary data with descriptive analysis and regression analysis in order to examine the effectiveness and the efficiency of inputs subsidy. The result reveals that inputs subsidy effectively increase rice production in Indonesia up to the minimum threshold for food self sufficiency. Meanwhile in term of efficiency, inputs subsidy is less efficient for national budget since the gain from the subsidy is less than the subsidy that is given by the government.

Relevance to Development Studies

Inputs subsidy in rice production increases the output and strengthens food self-sufficiency and food security.

Keywords

Inputs subsidy, food self-sufficiency, food security

Chapter 1. Introduction

Background

Rice is the most vital goods in Indonesia since it is staple food for almost 220 million people. While rice production has been the backbone of the economic activity in rural areas; even though only 38% of the population grow rice, many of them get benefits from rice production through services, labour and trade. The successfulness of rice production depends on the government policies and interventions (Pantjar Simatupang et al. 2008). Even agriculture has involved a huge amount of labour the share of Gross Domestic Product (GDP) tends to decrease.

The main objective of this paper is to measure the effectiveness and the efficiency of the input subsidies since the government has been spending a huge amount of money for financing the subsidy. The financial source of input subsidies comes from nation budget where the performance of national budget is assessed by the effectiveness and efficiency of the program. When the program is less effective or less efficient or both, the government have to revise the program, find the weaknesses and launch the improved program. The general approach of this paper we use two approaches descriptive analysis and regression analysis. For descriptive analysis we figure out the relationship of inputs with the output by using graphical presentations. Whilst for regression analysis we use two steps as the framework, and the first step is measuring the effect of input subsidies on the demand of inputs since subsidy will be lowering the price and the effect is increasing in demand. The second approach by using production function we want to measure the magnitude of input subsidies in the production function of rice. If the magnitude is high it means that the subsidy has a good impact on rice production. The main conclusion from the empirical finding is that input subsidies work effectively to increase rice production and achieve food self sufficiency. In term of efficiency, this program is less efficient since the cost is greater than the benefit.

When we discuss about food, the most important thing is the discussion about food security and there are three definitions about food security which are national, regional and household. In the broader meaning national food security means that every citizen can access food (rice) in all time, and in broader meaning that food security in the current condition can be accessed by all individuals, families and communities in the whole country in term of quantity, quality and nutritional compositions. From the report of the international conference of Food and Agriculture Organization (FAO)/World Health Organization (WHO) in 1992, both stated that food security is defined that food for healthy life can be accessed by all people at all times whilst The Brundtland Panel states that food security means that all people have access on food even for consumption or for stock to fulfil their basic needs based on nutritional intake. In order to get that, food must be accessible and affordable for everyone (*Food 2000.* 1987).

Based on the 1996 World Food Summit the definition of food security as follows:

> 'Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life'

Whilst according to act of the Republic of Indonesia Number 7 of 1996 on food, as cited from The National Agency for Drug and Food Control (BPOM), food security is defined as

> 'Food security is the condition in which the fulfilment of food for the households is reflected by the availability of sufficient food both its quantity and quality, safe, evenly distributed and within reach'

The concept of regional food security can be defined as the fulfilment of food in such region so that the citizen of the region can get adequate access to get food with sufficient quantity, quality and nutrition (Thimm 1993). The concept of food security at the household level can be defined as the access of food, in term of quality and quantity with the minimum nutritional requirement for household member throughout the year (Smith et al. 1993). The government has been trying to achieve national food security and for rice has been achieved since 2004 even for regional and most part of households, while the next target is to achieve food security in sugar, corn and meat. Based on the target from Ministry of Agriculture (MoA) with the calculation of the total population from BPS Statistics Indonesia (BPS) that minimum threshold for national food self sufficiency is 54 million tons of dry unhusked mills. As can be seen from table 1 below that from 1999 to 2003 rice production is in deficit where the deficit is around 1.8 to 3.5 million tons and the government has to import rice. From 2004 to 2007 rice production increase and in 2007 increase up to 3 million tons.

Table 1
Calculation of Food Production and Food Self-Sufficiency (in tons)

Year	Rice Production	Minimum Threshold for Food Self-Sufficiency	Surplus/(Deficit)
1999	50,866,387	54,000,000	(3,133,613)
2000	51,898,852	54,000,000	(2,101,148)
2001	50,460,782	54,000,000	(3,539,218)
2002	51,489,694	54,000,000	(2,510,306)
2003	52,137,604	54,000,000	(1,862,396)
2004	54,088,468	54,000,000	88,468
2005	54,151,097	54,000,000	151,097
2006	54,454,937	54,000,000	454,937
2007	57,157,435	54,000,000	3,157,435

Source:

1. Ministry of Agriculture
2. BPS Statistics Indonesia www.bps.go.id

Achieving food self-sufficiency for nationwide, the government needs policy for implementing the food security program, and one of the policies for food security is input subsidies for rice production. When the government has applied kinds of policies, we have to measure the cost and benefit and the achievement of the policies. Effectiveness and efficiency of the program is important for the government whether the policies have an impact or not. When we measure of the policy first of all we have to define the definition of effectiveness and efficiency since both terminologies are related each other. Effectiveness can be defined as the level of successfulness that the resources used to achieve the objective set from the government, and it is linked with input or the output of the objective while the definition for efficiency can be define as the link to get optimal condition of inputs relates to the costs and benefits and achievement of output (Mandl et al. 2008)

Relating with the declining share of food crop and agriculture sector to GDP the table 2 below describes the share of food crop and agriculture sector to GDP from 1999 to 2007 based on the data from BPS Statistics Indonesia (BPS).

Table 2
Share of Food Crop and Agriculture Sector to Gross Domestic Product (GDP)

Year	Food Crop GDP		Agriculture Sector GDP		Total GDP
	(Rp million)	%	(Rp million)	%	(Rp million)
1999[a]	34,012.40	8.97	64,985.30	17.13	379,352.50
2000[a]	34,533.80	8.68	66,208.90	16.63	398,016.90
2001[a]	34,260.20	8.32	67,318.50	16.35	411,753.50
2002[b]	114,981.50	7.64	231,613.50	15.39	1,505,216.40
2003[b]	119,164.80	7.56	240,387.30	15.24	1,577,171.30
2004[b]	122,611.70	7.40	247,163.60	14.92	1,656,516.80
2005[b]	125,801.80	7.19	253,881.70	14.50	1,750,815.20
2006[b]	129,548.60	7.01	262,402.80	14.21	1,847,126.70
2007[b]	133,888.50	6.82	271,509.30	13.82	1,964,327.30

Source: BPS Statistics Indonesia
a: constant price 1993
b: constant price 2000
Data calculated by author based on BPS data www.bps.go.id

From the table 2 above, we know that the share of food crop to GDP tends to decrease from 8.97 per cent in the year 1999 to 6.82 per cent in 2007, even in nominal term the value of food crop is increasing. The total share of agriculture sector to GDP is also decreasing, in 1999 total share of agriculture sector to GDP is 17.13 per cent and 2007 the share is only 13.82 per cent or decrease 3.31 per cent in nine years. Since agriculture sector is the economic backbone of rural area, this is becoming the duty of the government to increase the contribution agriculture sector in term of GDP and for food self-sufficiency and food security reasons.

Another potential resource is labour force in agriculture sector, and this becomes the advantage for agriculture sector since mostly agriculture is located in rural area where there is an abundance of labour. The share of paddy field varies every year depend on the climate condition but we can estimate that the contribution of labour force is around 34 per cent from the total labour force.

Table 3
Share of Paddy Field Labour Force to Total Labour Force, 1999-2007

Year	Paddy Field Labor Force		Total Labor Force
	(in million)	%	(in million)
1999	30.28	34.10	88.81
2000	32.09	35.73	89.82
2001	31.36	34.54	90.80
2002	32.06	34.98	91.64
2003	31.59	34.80	90.78
2004	32.04	34.19	93.72
2005	32.79	34.85	94.08
2006	32.53	34.10	95.39
2007	33.06	33.28	99.34

Sources:

1. The Human Resources Profile in Indonesia, 2001
2. The Human Resources Profile in Indonesia, 2004
3. National Labour Force Survey, August 2004
4. National Labour Force Survey, February 2005
5. Cited in Simanjuntak (2010), edited by author

Since agriculture sector is mostly located in rural area and involving a huge number of people, when the government applies the policy for agriculture like subsidy, it will be benefiting them. Subsidy policy is becoming the incentive for farmer for growing rice, then like a chain reaction, will create new employment for harvest, post-harvest and distribution and generate economic growth. Besides that subsidy in agriculture can also reduce poverty and increase life expectancy

During oil boom in 1973, Indonesia got benefits from the increasing price of oil and therefore the government had a lot of money from its profits. The government could spend the money to develop the infrastructures, public services, defence and agriculture. Agriculture especially rice and rice production got attention from the government because to secure food sufficiency the government had to import rice from abroad. The government began to build infrastructures in rice production such as dams, irrigations and roads. Besides those infrastructures, the government also applied subsidies in fertilizer and seed; introduce high-yields varieties, pest management control and post-harvest systems. As a result Indonesia achieved food sufficiency in 1984 even though it was short-lived (McCulloch et al. 2008)

When the oil boom was over, government drastically reduced its subsidies and spending programmes in rice production because government lacked enough of money to finance those programmes. Dams, irrigation and roads were not well-maintained moreover the capacity of dams and the coverage of irrigation decrease, roads were broken, price of fertilizer and high-yield seed increased. Arable land for paddy field also decreased and changed into residential area and industrial area and those combinations fastened the declining in rice production.

The decline in rice production did have an impact on the food security. The government had to import again rice to secure rice availability and it would lead to instability of its foreign reserves. Low production of rice reduced economic activities in rural areas because in every step of rice production most people in rural areas were involved from cultivation to post harvest. When the government began to import rice, farmers had no incentives from it and their product was threatened by the imported one. If domestic rice production could cover for rice sufficiency, all people got benefits from it. Rice production could generate economic activities in rural area, reduce unemployment and poverty and increase enrolment rate for schooling. The most important things for agriculture sector is to transform the food producer, create food-sufficiency and perform food-sufficiency for industry and modern service (LEWIS 1954).

In the recent period from 2003, the government has tried to secure rice availability by increasing rice production and released several programs to increase rice production. The programmes are fertilizer subsidy, high yield seed subsidy, building new infrastructures and post-harvest management. These programs are continuation from the previous programs before 1998 however the government has done some improvements and added the budget. The improvements are empowering of field extension officer, land management, fertilizer distribution management, research and development of high yielding seed. The government is trying to achieve food self-sufficiency and becoming rice exporter in the future. Based on the data from Ministry of Finance (MoF) and Ministry of Agriculture (MoA), table 4 shows the trend of the amount of subsidy. The trend of fertilizers subsidy increases every year while for seed subsidy the trend is volatile.

Table 4
The Amount of Fertilizers and Seed Subsidy
(in million Rupiah)

Year	Fertilizers Subsidy	Seed Subsidy
1999	-	39,642
2000	-	43,829
2001	-	34,054
2002	-	38,590
2003	691,635	50,789
2004	1,329,215	80,900
2005	2,219,066	112,670
2006	2,588,203	106,152
2007	5,065,357	120,584

Source:

1. Ministry of Finance
2. Ministry of Agriculture

The trend of rice production from 1999 to 2004 varies every year and from 1999 to 2002 the trend is up and down while from 2003 to 2007 the trend is increasing. When the government has applied fertilizer subsidy in 2003, the trend of rice production is increasing and the highest increasing is in 2004 and 2007. In 2004 the rice production increases two million tons, while in 2007 increases three million tons. However, between 2004 and 2006 the trend is stagnant and only small increasing. As can be seen from table 5 below, from 2004 to 2006 the increasing of rice production is less than 500 thousand tons even though the amount of subsidized fertilizer is increasing at the same period.

Table 5
Rice Production 1999-2007 (in tons)

Year	Rice Production
1999	50,866,387
2000	51,898,852
2001	50,460,782
2002	51,489,694
2003	52,137,604
2004	54,088,468
2005	54,151,097
2006	54,454,937
2007	57,157,435

Source: Derived from table 1

Rice production interventions need huge amount of money for implementation, and the government has spent a lot of money to support those programmes. The effectiveness of those programmes is the key element for government to spend its money. Reporting and evaluation has been done to improve the effectiveness of those programmes and it is used as a planning for next year. Even government has spent a huge amount of money, the result of the programs have not been instantly achieved and has taken period of time for improvement. We need to know the effectiveness of the program to achieve food self-sufficiency and food security for national, regional and household and also we want to measure the efficiency of the program by using cost and benefit analysis relating input and output in monetary term.

Research Objectives and Research Questions

The main objective of this research is to analyse the effectiveness and efficiency of the input subsidies in rice production 1999-2007 in Indonesia.

Research Questions

The main questions of this research are:

Do the input subsidies work effectively and efficiently in increasing rice production?

Significance of the Study

Since agriculture especially rice production is very important for food availability, it is substantial that rice production needs special treatment for food self-sufficiency, food security, livelihood security and rural development. The policy from the government to achieve those aims is by applying subsidy for fertilizer and seed. This paper aims to do further analysis on the effectiveness and efficiency of inputs subsidy for rice production.

Scope and Limitation of the Study

It is generally known that fertilizer and seed have an important effect for rice production and that is the reason why the government gives subsidy on both inputs. Subsidized fertilizer has been applied since 2003 and divided into four types of fertilizer which are urea, SP36, NPK and ZA. Since the broad area of rice production, this paper limits the discussion only on intermediate inputs which are seed, urea, SP36 and NPK.

Organization of the Paper

This paper is divided into six chapters and chapter 1 is the introduction contains background of the research, research objective and research questions, and the organisation of the paper. Chapter 2 is the theoretical and analytical framework. Theoretical framework consists of the role of fertilizer subsidy in agriculture countries, method that they used, and analytical framework discusses about how the research will be conducted and the theory that is going to be used. Chapter 3 is the agricultural subsidy in Indonesia and contains of the background of fertilizer and seed subsidy and recent conditions. Chapter 4 is the explanation of the methodology that we are going to be used and also contains methodology and data source. Chapter 5 is the analysis of the role of agricultural subsidy on rice production and the effect of subsidy for rice production to answer the research questions on the effectiveness and the efficiency of the program. Chapter 6 is conclusion.

Chapter 2. Theoretical and Analytical Framework

Theoretical Framework

Self-sufficiency in staple food is the major goal of the government policy in many developing countries. There are various policies in order to achieve food self-sufficiency and food security and one of those policies is input subsidies. Input subsidies consist of two kinds of input which are important for food production and those are seed and fertilizer. The effect of those subsidies varies amongst countries and depends on the endowment that they have. The definition of subsidy is a payment by the government to producers or distributors in an industry to prevent the decline of that industry or an increase in the prices of its products or simply to encourage it to hire more labour (Todaro et al. 2006). If we apply the term of subsidy in inputs subsidy in agriculture sector means that subsidy is reducing the price of inputs (fertilizers and seed) and therefore farmer can buy more inputs to increase their output.

Public Sector Economics

From the perspective of public finance, subsidy is a part from expenditure side and the explanation as follows. Public sector theory can be divided into two categories which are public finance based on revenue side and expenditure side. Revenue side means that government levies tax in order to financing its expenditure. Government revenue is very important to develop its country and government tries so hard to increase its revenue every year. Government revenue is the engine for development since the bigger of revenue is the higher development rate of a country and the government can provide better public goods and public services. This step is also known as distribution function where government distributes its income and wealth to its citizens in order to reduce inequality.

Expenditure side means that the government has to spend its budget in order to provide public service and public goods for its people. Government expenditure has various functions like for education, health and defence. Rice production spending is one of the policies that have been made by the government to secure rice sufficiency. A set of government interventions on rice production is one of the government functions in the economy. The government has given subsidy to agriculture sector because agriculture especially rice production is the labour intensive sector in the economy. Moreover subsidy will help farmers to increase their rice production, stimulate economic activities in rural area, reduce unemployment and poverty, increase enrolment rate and it is supposed to aim at achieving self-sufficiency in rice production. This step is also known as allocation and stabilisation functions. Allocation function means that government plays role to allocate public goods where private sector is unable to produce those goods and services. While stabilisation function means that government has to use budget policy as a tool of maintaining high employment, a reasonable degree of price level stability, and an appropriate rate of economic growth, with allowances for effect on trade and on the balance of payment (Musgrave et al. 1989).

However, from the empirical evidence, the impact of government spending in term of subsidy on rice production is still unclear; some scholars argue that fertilizer subsidy will give positive impact on rice production and productivity of grain. While some other scholars said that fertilizer subsidy has negative significant on rice production if it is stand-alone program but if there is a combination with another program like irrigation network the role of input subsidies will have greater impact on the result of rice production.

When the government applies an intervention we have to know the effectiveness of government interventions in rice production. It is important for the government so that those interventions keep continuing in order to increase rice production and generate economic growth. By using descriptive analysis of fertilizer production, fertilizer subsidies and rice production, and this study revealed that government intervention in fertilizer effectively gave positive impact on rice production.

Production Theory/Production Function

Production is the transformation of inputs into output, and inputs which are the factors of production are land, labour and capital plus raw materials. Technology plays important role for determining the transformation of input into output, the more advanced technology is the more result will be get. Limited quantity of inputs is affecting the quantity of output and also bad quality of inputs will reduce the yield of output. The relationship between the quantities of input that are being used and the output that will be produced is called production function.

A production function shows the relationship between inputs of capital and labour and other factors and the outputs of goods and services. To simplify the model, we have chosen the model which relates the relationship between inputs and outputs into the production function form:

$$q = f(K,L,...)$$

where q represents the output of particular goods during a period, K represents capital usage during the period and L represents labour inputs, while the dots notation indicates the possibility of other variables that affecting the production process. The equation is a mathematical sense in relation with input and output and it shows the different possibilities how best to combine those inputs to get output.

Rice production needs long process from cultivation to harvest and needs inputs from seed to get rice. Rice production can be predicted by using production function equation since in the process of rice production we still need the relationship between input and output. If we apply rice production into production function model we can assume that q is the quantity of rice, while capital inputs of rice production are fertilizers and seed, land and pesticide. The labour input is the number of labour in the rice production sector. The dots is represented other inputs that uncover in the model and those are irrigation, rainfall, sunlight and other variables.

Other Studies on Inputs Subsidy

Many scholars have dealt with the study of the impact of inputs subsidy on rice production and the results of their findings are quite similar even they use different methods. Their study, by using supply and demand model, finds that fertilizer subsidy would promote improvement in rice production, stabilize fertilizer price and foster rural development. Beside that the combination of fertilizers will also increase nutrient in the soil and the government has to concern about the types of fertilizer which have to be subsidized. The variable that has significant value for rice production is nitrogen (Hedley 1989).

Another study also stated that fertilizer subsidy increase productivity of agriculture sector including rice and sugar. In their research, they used supply and demand function and also cost and benefit analysis to analyse the advantage and disadvantage of the policy in term of efficiency and equity criteria. They analysed the impact of subsidy before and after the policy of subsidy had been applied in the Philippine, and they also analysed the impact of different policies on fertilizer subsidy. According to their research that inputs subsidies such as fertilizer and seed is more beneficial than supporting product prices. By subsidizing fertilizer will increase yields in the short run and the impact in the long run will also achieve food self-sufficiency. They also mention that nitrogen, phosphor and potassium are significant to the rice production (Barker 1976).

Rosegrant and Herdt (1981) in their paper also stated that subsidized credit and fertilizer increased rice production up to 21%-30% in the Philippine but we have to consider also another input that the farmers use. They used production function model to determine the impact of subsidies on the result of rice production. The determinants are various kinds of chemical ingredients of fertilizer such as nitrogen and phosphorus, insecticide, irrigation, season (wet and dry) and credit program. Since their research was only in small area, they left out labour since they assumed that labour was held constant in their experiment.

Armas et al (2010) in their paper using time series data and Ordinary Least Square (OLS) method state that government spending on agriculture has a statistically significant on agriculture GDP per capita growth rate, while if we split public spending on agriculture into public goods spending and fertilizer subsidy the result is mixed. Public spending gives positive impact on the growth rate of agriculture per capita GDP and become the driver for growth.

Duflo et al (2008) states that application of fertilizer improves the yield of crops if the application of fertilizer is used in right quantity and use right method. Using panel data model, their research reveals that it would be more appropriate if the government gives subsidy for fertilizer or credit program since the constraint from farmers is lack of information and saving difficulties. The dependent variables of the panel data is rate of return after using certain dosage of fertilizer whilst the independent variables are land, education, hybrid seed, fertilizer before treatment, season and geographic location. The treatment of fertilizer variable is statistically significant as the determinant of food production. When the government gives more appropriate information of fertilizer and subsidy or credit program the result would be different. If the fertilizers are used in appropriate quantities farmers will be benefited and get mean returns of 36 per cent and 69.5 per cent annually.

Ricker-Gilbert et al (2009) in their research use panel data model to compare between the effects of subsidized fertilizer and unsubsidized fertilizer. The variables that are being used are subsidized fertilizers, unsubsidized fertilizer, hybrid seed, farm size, and labour. The regression analysis reveals that fertilizer at the certain amount will increase yield. They also mentioned that besides fertilizer, seed also has positive impact on yield and government should consider seed as another important input to increase food production. Hybrid seed will increase productivity comparing with common seed even the price of hybrid seed is expensive. The farmers can compensate the price of hybrid seed with the higher yield that they will get. Besides land, fertilizer and seed are also the major determinant for increasing food production especially when the government is applying subsidies on both inputs.

Romauli and Muhaimin (2008) by using production function method try to measure the efficiency of inputs by using production function of rice production in region level. The determinants of their research are land, seed, urea, SP36, ponska, pesticide and labour. The determinants that are statistically significant for rice production are land, seed, urea and ponska. While to measure the efficiency of the inputs, they use the ratio of marginal value product and price of inputs. Their study reveal that, at the region level, all determinants are not at the efficient level except labour that supposed to be reduced. Farmers have to maximize the use of land, seed, urea, SP36, ponska and pesticide based on the land that the farmer have.

From those empirical evidences above, even they use several methods the result remain the same that fertilizers and seed are the main major determinant for rice production. Fertilizers that contain nitrogen, potassium and phosphorus are statistically significant, moreover, seed is also considered as another determinant. High Yield Variety (HYV) seed and hybrid seed can produce more crops comparing with traditional seed. Those studies also reveal that subsidy from the government can fasten the achievement of food self-sufficiency and food security at nation level.

Analytical Framework

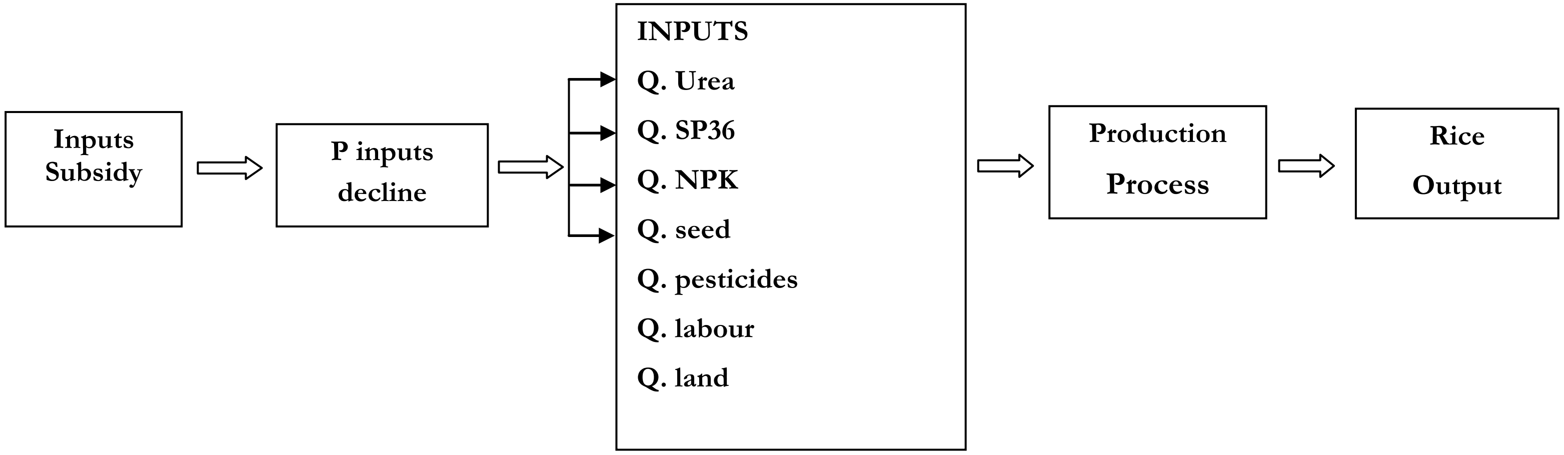
Among the goals of the public sector in development are the following; a) to put a condition where private sector can do well; b) to maintain and reallocate resources efficiently if there is a market failure; c) to reduce price misalignment amongst farmers and consumers; and the last is d) to promote agriculture growth.

Food self-sufficiency in Indonesia is the main objective of the government program in agriculture in order to secure food security. Many programs have been released by the government to help farmers increasing their rice production. When we discuss about production of goods and services, the idea of production is to maximize output with certain amount of inputs. Economist creates tool how maximize output by creating production function equation. In the production function of rice shows various inputs required in order to produce rice and these inputs are fertilizer, seed, pesticide, labour and land.

Based on our analytical framework, (see below) there are two steps that can be analysed a). the impact of subsidy on input use; and b). the impact of the increase in input on output. When the government gives subsidy on certain product as we can say in seed and fertilizers, the price of both goods will decline and the declining of those prices will lead to the increasing of the demand of both goods. This means that farmer will get more on both goods with the same amount of money, or buy more in order to maximise their land capacity. This is the first step of the mechanism of our analytical framework. The next step is concerned about the effect of increasing in input to the output in rice production. When the farmer buy more seed and fertilizer to maximise the capacity of land, logically the rice production will increase since we assume that before the subsidy has been applied the usage of fertilizer and seed are not in proper dosage.

From those steps, then, we can focus and concentrate on our research question about effectiveness and efficiency. Effectiveness can be measured as the result of the inputs on the output of rice production in physical term and it is more effective if the output increases up to the minimum threshold and less effective if the increase is below the minimum threshold for food self-sufficiency. Efficiency of the subsidy can be measure by deducting the gain of the subsidy with the cost of subsidy. If the gain is greater than the cost this means that the subsidy is more efficient in increasing rice production, while if the cost is greater than the gain we can say that the subsidy is less efficient. Based on the literature review we can use Figure 1 below to figure out analytical framework used in the research and to answer the research questions and also this paper only focuses on the subsidy on intermediate input, i.e. fertilizer and seed subsidy.

Figure 1
Analytical Framework of the Research



Chapter 3. Rice Production in Indonesia

Background of Indonesian Agricultural Sector

In Indonesia, paddy/rice is the most important agricultural commodity because most of rural household (around 18 million out of 21 million households) are paddy producers and almost all Indonesian are rice consumer. Environmentally, paddy fields plays a significant role for the environment to preserve water, micro-climate and soil conservation. Rice production and availability also determine the successful of the government performance. This is why rice is seen as a strategic commodity from political, social and economic point of views (Michael T. Rock 2002).

One of the sub sectors in agriculture is rice, and rice is the major staple food for almost Indonesia. Since 1969 rice self-sufficiency has become the ultimate policy goal for the government, many programs have been launched by Ministry of Agriculture (MoA) like Mass Extension Program (BIMAS); Intensification Program (INMAS) and Special Intensification Program (INSUS) to achieve rice self-sufficiency. In order to achieve this goal the government put this program on the first list of development and spent a huge amount of money. Then, rice production grew rapidly between 1977 and 1982 but the rice self-sufficiency itself achieved in 1984 even was only for short period. The ending of oil boom changed the rice sector policy and the government was no longer financing rice production sector heavily like the previous period. Then, as a result, the growth of rice production declined gradually afterwards until the economic crisis in 1998. When the economic crisis hit Indonesia in 1998, fertilizer price was affected by the exchange rate and the price of fertilizers became expensive and unaffordable for farmers. This condition was more acute when the government had to apply Letter of Intent (LoI) from International Monetary Fund (IMF) on April 1998 that the government had to stop fertilizer subsidy in 1999. Another reason was decentralization era, since 2001, has tended to lower in rice production because local government reduced the provision of inputs and services for rice production. The pattern has changed from rice self-sufficiency country to imported rice country (Paul A Dorosh 2008).

The idea of rice self-sufficiency is that indicates to what extend local farmer can produce food to meet consumption need. The ultimate goal for the government is to provide sufficient rice to ensure that the citizen can get proper healthy diet in carbohydrate, and then the next stage is to provide protein, vitamins and minerals. Indonesia as an agriculture country is concern about rice self-sufficiency because rice as the staple food for most of the population, and it would be better if the rice that is being consumed is produced domestically.

Seed Subsidy

Seed subsidy has been started from 1986 and the idea of seed subsidy is that qualified seed will produce more result than traditional one. The subsidized seed is HYV seed and it is recommended by Ministry of Agriculture. Another reason is to introduce high yield seed in order to replace the traditional seed, subsidized seed is also helping peasant to get better seed with lower price.

When the government is applying seed subsidy, the goals of this program are to increase rice production. Rice production is important for the government because it can achieve and maintain food self-sufficiency and food security. By using good seed food security can be easily achieved, with the higher productivity and pest resistant, the possibility to get higher yield is higher rather than using traditional seed. Seed subsidy also helps farmer to increase their welfare, if they use subsidized seed they spend less money to buy seed and can save their money for another purpose like education and health.

At the beginning the target of the seed subsidy is for farmers that never use high yield variety, they usually poor farmers which only have small land for cultivation. The government has tried to introduce HYV seed for poor farmer because the price of HYV seed is unaffordable for farmer. Comparing with subsidized fertilizer, the amount of subsidized seed is not as much as fertilizer one, in 1999 the amount of subsidy was only 99 thousand tons or only around 20 per cent from total consumption. As can be seen from table 6 below based on the data from MoA, that from 1999 to 2007 the amount of subsidized was fluctuating up and down from 99 thousand tons then in 2007 the subsidized seed reached 165 thousand tons or around 23 per cent from the total consumption.

Table 6
Subsidized Quantity of Seed, 1999-2007
(in tons)

Year	Subsidized Seed
1999	99,632
2000	102,024
2001	80,747
2002	96,476
2003	101,578
2004	115,000
2005	136,400
2006	110,500
2007	165,700

Source: Ministry of Agriculture

Relating with seed subsidy in term of monetary value, the amount of subsidy keeps increasing every year. As can be seen from table 7 below, in 1999 the amount of subsidy is Rp39,642.5 million and in 2007 reaches Rp120,584 million or increase 300 percent from initial year 1999. The increasing of subsidy is due to the increasing price of seed in 1999 the seed price is Rp1,385 while in 2007 the price is Rp4,390.

Table 7
Seed Subsidy, 1999-2007
(in million Rupiah)

Year	Seed Subsidy
1999	39,642
2000	43,829
2001	34,054
2002	38,590
2003	50,789
2004	80,900
2005	112,670
2006	106,152
2007	120,584

Source: Based on table 3

Fertilizer Subsidy

The history of chemical fertilizer had been done since 1969 when the government had introduced the use of chemical fertilizer to boost rice production. This policy had brought an impact of the increasing demand for fertilizer mostly urea. Since the concern to increase rice production, the government had applied fertilizer subsidy in 1971 for nationwide. Rice production was one of the main goals of development at the new order era to achieve food self-sufficiency. Many programs have been introduced, such as BIMAS, INMAS and INSUS to support food self-sufficiency program. All those programs had been financed by the result of oil boom price in 1970s and the result was increasing in rice production and achieving rice self-sufficiency in 1984. Since then, when the price of oil declined the government no longer gave much budget for subsidy for rice production and the government changed its orientation to industrialized sector. The achievement of food self-sufficiency was only for a while then the rice production tended to decline and started to import.

Economic crisis in 1998 was like multidimensional crisis for Indonesia, declining in economic growth, political instability, social insecurity and higher unemployment rate. The government had no option and asked financial bail out to IMF and had to conduct LoI. One of the impacts of LoI was to abolish subsidies and fertilizer subsidy was one of the abolishment. Then, all kinds of fertilizer prices were based on market price and this became the additional cost for farmer. There was a direct effect of the abolishment of fertilizer subsidy, since the price of fertilizer increased; farmer consumed less fertilizers for their crops. Another impact was there were alternative fertilizers in the market with the cheaper price but had lower quality. This fertilizer also had direct impact in lowering rice production. Another impact of fertilizer free market was that fertilizer market tended to become oligopolistic market where only a few distributors with big capital can buy fertilizer from fertilizer company and distribute to the lower level.

When the price of fertilizer and the price of Liquid Natural Gas (LNG) were increasing in 2000, to maintain the production of fertilizer the government gave subsidy for fertilizer company in term of Domestic Gas Incentive (IGD) in order to keep producing urea. The amount of this subsidy was not huge and IGD itself in National Budget was not mentioned as fertilizer subsidy. The increasing of fertilizer price urged the government to maintain the availability of fertilizer and to control fertilizer price and since 2003 the government, again, reintroduced fertilizer subsidy for rice production. The type of subsidized fertilizer is not only for urea but with the additional fertilizers which is important for rice production. The additional fertilizers are SP36 and NPK, and each of fertilizer has its own characteristic and function. In the first year the amount of subsidy was Rp691 billion and in year 2007 reached Rp5 trillion and this is a very huge amount of government spending. As can be seen from table 8 below, that the amount of subsidized fertilizer is increasing since the policy has been applied in 2003. In 2003 the total subsidized fertilizer for urea, SP36 and NPK is 2,671,519 tons and the following years the amount of subsidized fertilizer keeps increasing, and in 2007 the total amount is 5,677,547 tons more than two folds from 2003.

Table 8
Share of Subsidized Quantity of Fertilizers to Total Subsidized Fertilizer, 2003-2007

Year	Urea		SP36		NPK		Total
	in tons	%	in tons	%	in tons	%	in tons
2003	2,014,864	75.42	416,655	15.60	240,000	8.98	2,671,519
2004	3,358,106	77.14	595,221	13.67	400,000	9.19	4,353,327
2005	3,829,053	78.52	647,611	13.28	400,000	8.20	4,876,664
2006	4,300,000	79.63	700,000	12.96	400,000	7.41	5,400,000
2007	4,509,650	79.43	753,285	13.27	414,612	7.30	5,677,547

Source: Ministry of Agriculture

The consequence of increasing subsidized fertilizer is increasing in the amount of subsidy in monetary term. Table 9 reveals in 2003 the subsidy is Rp691,635 million and by using that amount the total amount of subsidized fertilizer is 2,671,518 tons. Whilst in 2007 the subsidy reaches Rp5,065,358 or increases more than five times from 2003 but the amount of subsidized fertilizer is only 5,677,547 tons or two times from 2003. This is happened because of the increasing of world fertilizer price. The increasing of fertilizer price becomes the burden of government and farmer, for government they have to spend more money to subsidize various fertilizers while for farmer they have to spend more money to buy fertilizer according to the dosage and the size of land, or we can say that the same size of land needs more money for fertilizer.

Table 9
Fertilizer Subsidy from 2003 to 2007
(in million Rupiah)

Year	Urea		SP36		NPK		Total
	in million Rupiah	%	in million Rupiah	%	in million Rupiah	%	in million Rupiah
2003	515,906	74.59	126,329	18.27	49,401	7.14	691,636

Year	Urea		SP36		NPK		Total
	in million Rupiah	%	in million Rupiah	%	in million Rupiah	%	in million Rupiah
2004	1,000,645	75.28	164,285	12.36	164,285	12.36	1,329,215
2005	1,589,531	71.63	311,003	14.02	318,532	14.35	2,219,066
2006	1,853,946	71.63	362,738	14.02	371,519	14.35	2,588,203
2007	3,628,347	71.63	709,913	14.02	727,098	14.35	5,065,358

Source: Ministry of Finance

The impact of fertilizer subsidy is not instantly achieved, takes time for the government for achieving food self-sufficiency. Many problems have been faced by the government in order to redistribute subsidized fertilizer price distortion, scarcity of fertilizer, black market and many other problems. After the application of fertilizer subsidy, rice production is increasing from year to year. In 2003 total production of rice reached 52 million tons of rice then in 2004 the production increased to 54 million tons. The target of the government to increase 2 million tons each year was achieved. Unfortunately from 2005 to 2006 the production of rice was stagnant around 54 million tons while the amount of subsidy kept increasing. Year 2007 was a good condition for rice production, with the support of government by increasing higher amounts of subsidy; rice production reached 57 million tons. It was amazing with the work hard from the government to the farmers, rice production increase 3 million tons.

Chapter 4. Methodology

Overview

Rice production is Indonesians prime commodity in agriculture and contributes 80% of total food crop commodity. Rice production also plays important role in rural economies since 75% of the rural population depends on rice production and rice is the major staple food for almost all Indonesian. The importance role of rice production, since 2003 the government has been spent its budget again for financing fertilizer subsidy in order to boost rice production. There are four types of fertilizer which are subsidized and those are: urea, SP36, NPK and ZA and this paper limits only for urea, SP36 and NPK whilst for seed subsidy; the government has applied the subsidy since 1986.

Research Methodology

Methodology for Answering the Main Question

The main question is: Do the input subsidies work effectively and efficiently in increasing rice production?"

As we have discussed in the chapter 2, the analytical steps that we want to use is by using descriptive analysis and regression analysis. For descriptive analysis we use graphical presentation to explain the relationship between inputs and output and those inputs are land, seed, urea, SP36, NPK, pesticide and labour. For regression analysis we use simple regression to capture the impact of inputs subsidy on production function of rice.

Descriptive Analysis

The first method for this paper is descriptive analysis and in this method we capture all inputs and plot the trend of those inputs. The most important inputs are inputs that are being subsidized such as seed, urea, SP36 and NPK. After we draw some graphical presentations, then, we make brief summary about relation of the demand inputs after those have been subsidized and the impact of subsidized inputs with rice production and also the relation of all inputs either subsidized or not to the rice production.

Regression Analysis

Secondly, we will use the model of regression analysis to find the determinants of the demand for various inputs used in rice production and we use OLS method. This will help us in showing the impact of price subsidy on the demand for inputs. Beside price inputs factor we have to capture other factors that affecting the demand of inputs like price of grain and land. We also establish the relationship between input in rice production and output of rice.

The demand for fertilizer is also based on demand equation where fertilizer demanded also depends on the price of fertilizer, price of crops and land. Kelly (2005) in her paper mentioned that demand for fertilizer depends on a) the price of fertilizer; b) the price of the grain; and c) land use. This model came from her research in Sub-Saharan Africa when she wanted to know the determinant of the demand of inputs for agriculture sector. Since the similarity of the purpose of the paper, we adopt the model to determine the determinant of the demand of seed and fertiliser in Indonesia.

The demand model of rice production inputs can be broken down into several alternative models to capture the behaviour of the farmers on how they determine the demand for seed, urea, SP36 and NPK. The model for the demand of seed is based in supply and demand model where the demand of seed is determined by price of seed, price of grain and the quantity of land. We can also plug the other inputs with similar model by changing price of seed with price of urea, SP36 and NPK. Therefore the models become like these below:

Model for quantity demanded of seed is

$$lnQ_{seed} = \alpha 0 + \alpha_1 lnp\_seed + \alpha_2 lnp\_grain + \alpha_3 lnland + \varepsilon_1 \quad \text{Eq. 1}$$

Model for quantity demanded of urea

$$lnQ_{urea} = \beta_0 + \beta 1 lnp\_urea + \beta_2 lnp\_grain + \beta_3 lnland + \varepsilon_2 \quad \text{Eq. 2}$$

Model for quantity demanded of SP36

$$lnQ_{SP36} = \gamma_0 + \gamma_1 lnp\_SP36 + \gamma_2 lnp\_grain + \gamma_3 lnland + \varepsilon_3 \quad \text{Eq.3}$$

Model for quantity demanded of NPK

$$lnQ_{NPK} = \delta_0 + \delta 1 lnp\_NPK + \delta_2 lnp\_grain + \delta_3 lnland + \varepsilon_4 \quad \text{Eq.4}$$

where:

Qseed = quantity of seed
p_seed = price of seed
Qurea = quantity of urea
p_urea = price of urea
QSP36 = quantity of SP36
p_SP36 = price of SP36
QNPK = quantity of NPK
p_NPK = price of NPK
p_grain = price of grain
q_land = area of land

The concept of the model for subsidized inputs as follows; when farmers buy seed, they consider of the seed price if the price is high they consider reducing the quantity of seed that they want to buy. Price of grain is also the determinant for the demand of seed, when the price of grain increase farmers will buy more seed in order to increase production and they will get higher profit. The next determinant is land, the more land the more seed is needed. When the area of land for cultivating paddy increases automatically the quantity of seed also increases and this idea is also hold for all fertilizers.

The expected signs of the independent variables for the demand for seed:

Price of seed has to have negative sign which means that the lower the price when the other variable are constant the more seed is demanded. Quantity of grain has to be in positive sign which means that the higher the crop at the previous period is the higher the demand of seed for the next period. Price of grain has to be positive sign which means that the higher the price of grain the more profit that the farmers get and the more seed that the farmer buy for next cultivation. Land is also the determinant of seed and has to be positive, the more land for cultivation, the more seed is needed to be cultivated.

The expected signs of the independent variables for the demand for urea, SP36 and NPK are that price of fertilizer has to have negative sign which means that the lower the price of fertilizer, when the other variable are constant, the more fertilizer is demanded. Price of grain has to be positive sign which means that the higher the price of grain the more profit that the farmers get and the more fertilizer that the farmer buy for next cultivation. Quantity of grain has to be in positive sign which means that the higher the crop is the higher the demand of fertilizer for the next period. Land is also the determinant of demand for fertilizer and has to be in positive sign.

The further step is production function model and the model is based on the paper from Romauli and Muhaimin where they conducted their research in East Java. By using Cobb Douglas Production Function they use this model for their research because with this model they can measure the amount of input, the gain from input and the efficiency of inputs. Since the similarity of the paper with the previous research, we adopt and modify the model for nationwide production function.

Production function for rice production basis for this model

$$Qrice = \delta 0 + \delta_1 lnq\_land + \delta_2 lnq\_seed + \delta_3 lnq\_urea + \delta_4 \, lnq\_SP36 + \delta_5 lnq\_NPK + \delta_6 lnq\_pest + \delta_7 lnq\_lab + \varepsilon 1$$

Where,

Qrice	= production of rice
q_land	= land
q_seed	= seed
q_urea	= urea
q_SP36	= SP36
q_NPK	= NPK
q_pest	= pesticide
q_lab	= labour

The expected sign of those variables as follow, the expected sign of land has to be positive where the larger the land the more rice will be produced. Relates to land for production, seed is the second variable for the production function, where the amount of seed is also determined by the area of land. The sign of seed variable is supposed to be positive where if we cultivate more seed, it will increase rice production. The next variable is urea where the expected sign of this variable is also positive because the proper dosage of urea will give benefit for rice production. SP36 also has the same pattern with urea where at the certain level SP36 gives positive impact for rice production. NPK is the compound fertilizer and it is supposed has positive sign, means it gives positive impact to the rice production. Preventing the paddy from the pest, farmers need pesticide, and at the certain level pesticide has positive impact to the rice production. The expected sign of labour is positive at the certain level of labour, but if we add more cultivation area means that we need more labour and it will increase rice production.

There are four kind of subsidized inputs which are seed, urea, SP36 and NPK, and from the production function analysis we can measure which input subsidies that have effective and efficient impact for the rice production in the nationwide in order to achieve food self sufficiency and food security. We have to explain the definition of effectiveness and efficiency since both terminologies are related each other. Effectiveness can be explained as the level of successfulness that the resources used to achieve the objective set from the government, and it is linked with input or the output of the objective. If we relate with the rice production, effectiveness means that input subsidy has to increase the output of rice production. The definition for efficiency can be defined as the link to get optimal condition of inputs relates to the costs and benefits and achievement of output in monetary term. And for rice production means that the program is effective if the result from output of rice multiplied by the price of rice is greater than the total subsidy that being used. Then we can consider for the next policy that government focus and concentrate on specific kinds of interventions.

The Data

The objective of this research is to analyse the impact of the input subsidies in rice production 1999-2007 in Indonesia based on the effectiveness and the efficiency. The motivation why we start from 1999 because in 1999 is the year when fertilizer is not being subsidized and we can capture the impact of fertiliser subsidy on the demand of fertilizer before and after the subsidy has been re-applied in 2003 and end in 2007 is because of the availability of the data. The data is the nationwide data with the number of observation nine years period and we divide into quarterly period in on year. The sources of the data used in the study are from Ministry of Agriculture, Ministry of Finance, Food and Agriculture Organization and BPS Statistics Indonesia. The data of subsidized seed, urea SP36 and NPK, consumption of seed, urea, SP36, NPK and pesticide and labour force are derived from Ministry of Agriculture. Data of the amount of crops and quantity of land come from BPS and the data of seed and fertilizer subsidies come from Ministry of Finance.

Since there are two kinds of prices which are market price and subsidized price for fertilizer and seed, we have to weight those prices by using weighted average method. First of all we divide prices into subsidized and market price from 1999 to 2007. After that we make weighted average price by using weighted average approach where we make percentage of the share of fertilizer and seed at market price comparing with the subsidized price. The last step is deflating weighted average price with the price index from BPS where for urea, SP36 and NPK we use index of manufacture while for seed we use index of agriculture.

The next step, based on analytical framework, is constructing the model of production function of rice, where there are several determinants of variables that being used. In this step we also use regression analysis to determine the relationship of inputs to the rice production. For production function model all independent and dependent variables that we use is in logarithmic form.

Chapter 5. Empirical Analysis

Descriptive Data Analysis

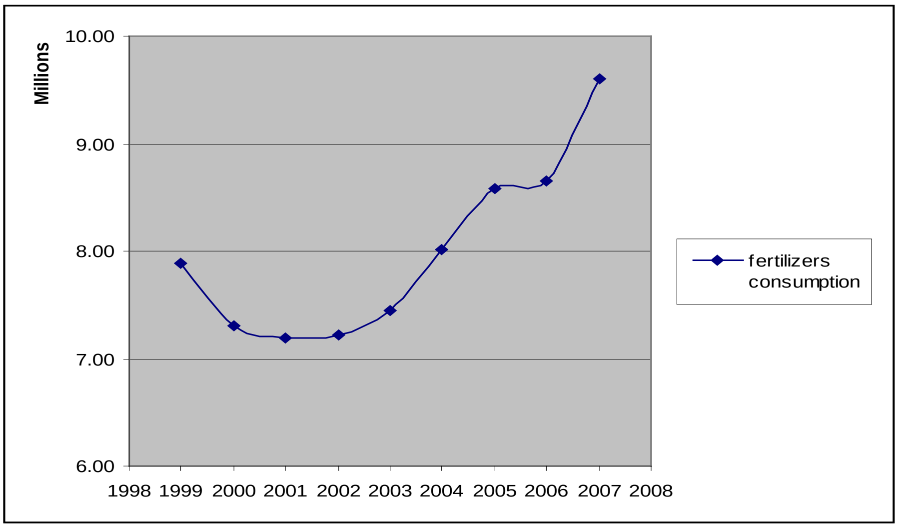
Evaluating the impact of subsidies in rice production needs treatment before and after subsidies in term of the amount of inputs that being used by farmers. From 1999 to 2002 fertilizer was unsubsidized by the government and the price was based on market price while the government still gives subsidy and then from 2003 afterwards we have two inputs which have been subsidized; fertilizer and seed.

Subsidized Inputs

Trends of Fertilizers

As can be seen from figure 2 below describes the total consumption of fertilizer in Indonesia. Starting from 1999 to 2002, the demand for fertilizer decreased after government no longer gave fertilizer subsidy based on the agreement with the IMF in 1998 that government had to lift various kinds of subsidy including fertilizer subsidy. When fertilizer subsidy has been re-applied again in 2003, the trend of fertilizer consumption has been increasing. By this figure we can also observe the pattern of the demand of fertiliser consumption after the government has applied fertiliser subsidy. Fertilizer is one of the determinants of the rice production and to increase rice production and if we assume that land is constant, fertilizer plays important role to increase rice production.

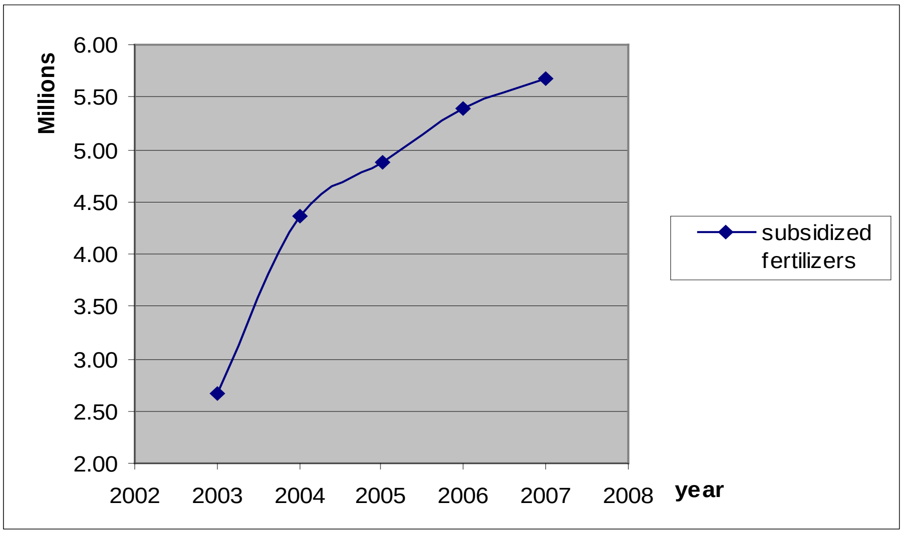
Figure 2
Total Fertilizers Consumption from 1999 to 2007
(in million tons)



Source: Ministry of Agriculture

If we look at figure 3 where fertilizer subsidy has been applied since 2003 the trend has been increasing and in year 2007 the amount of subsidized fertilizers reached almost 70 per cent from total consumption. Subsidized fertilizers is needed because with the proper fertilizer dosage, paddy plant will produce more grain then it will increase rice production.

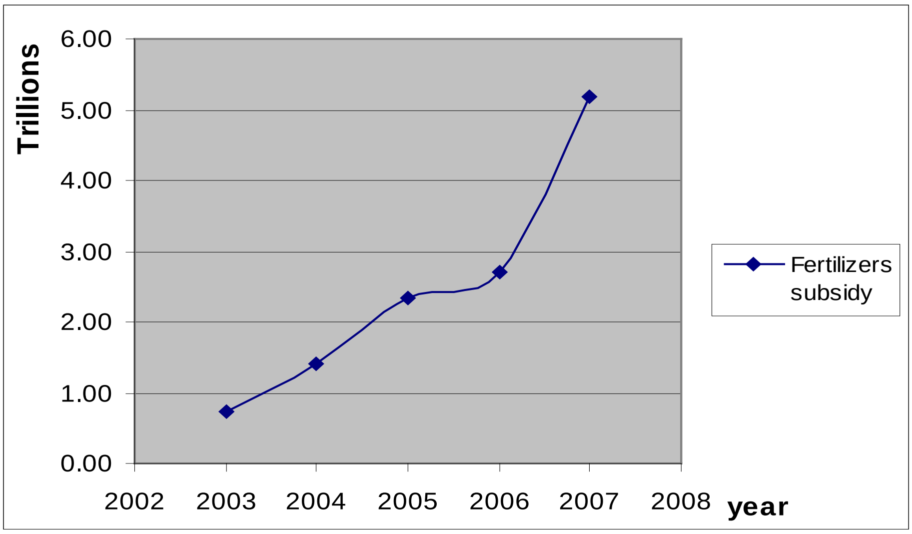
Figure 3
The Amount of Subsidized Fertilizer from 2003 to 2007
(in tons)



Source: Based on table 7

The amount of fertilizer subsidy tends to increase every year because of the target of the Ministry of Agriculture that every year rice production has to increase 2 million tons every year. Fertilizer is one of several ways to increase rice production. Relates with the amount of fertilizer subsidy, the amount of subsidy in monetary unit is increasing from year to year. With the current price the increasing of subsidy reached 650% from 2003 to 2007. This happened because of the volatility of LNG price and also the increasing of quantity demanded.

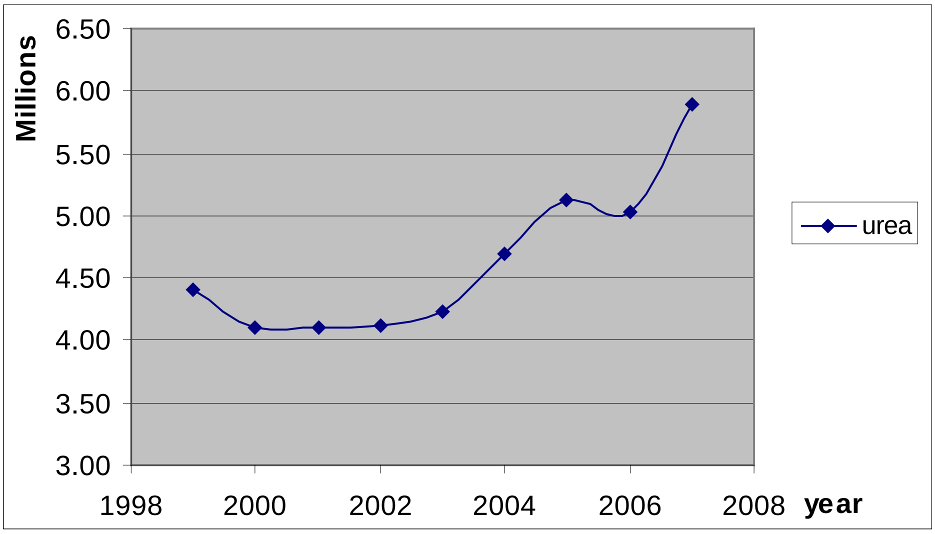
Figure 4
The Amount of Fertilizer Subsidy
(in Rupiah)



Source: based on table 8

When the government has applied urea subsidy in 2003, as can be seen at figure 5 below, the total consumption of urea has been increasing from 4.4 million tons in 2003 to 5.5 tons in 2007 or increases 25 per cent.

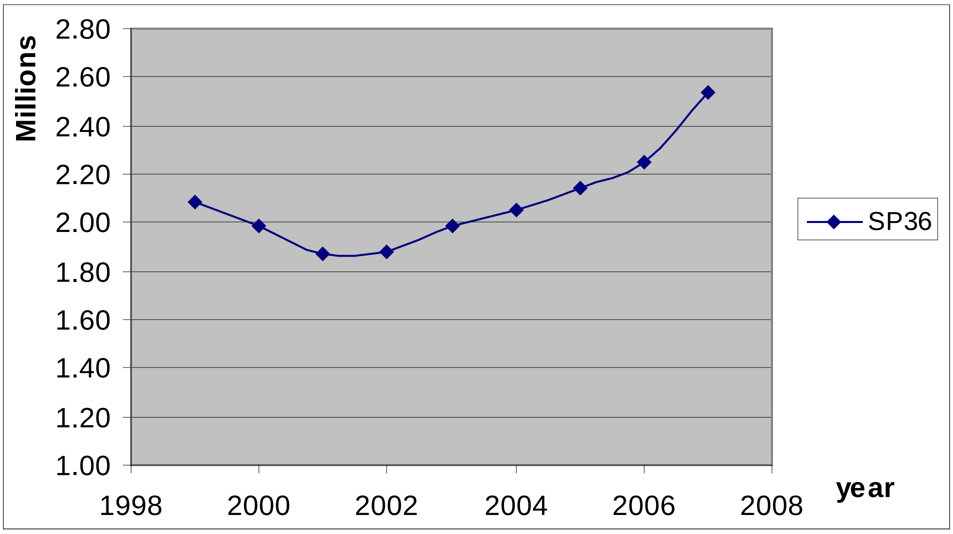
Figure 5
Urea Consumption (in tons)



Source: Ministry of Agriculture

The similar pattern also happens for SP36, where consumption of SP36 has been increasing since 2003. As can be seen from figure 6 below the consumption of SP36 has increased from 2.1 million tons to 2.5 million tons or around 20%.

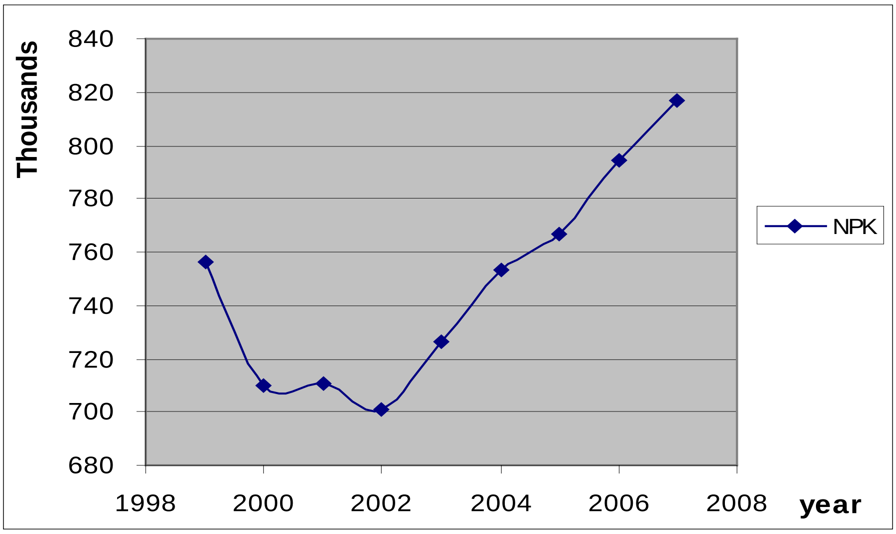
Figure 6
SP36 Consumption (in tons)



Source: Ministry of Agriculture

NPK has also the same pattern where the demand for NPK tends to decrease due to the increasing in price from 1999 to 2002 when there is unsubsidized. In 1999 the demand for NPK is around 760 thousand tons whiles in 2002 the demand drop to around 700 thousand tons. When the government has applied subsidy in 2003 the demand for NPK increases and in 2007 the demand of NPK reaches around 820 thousand tons.

Figure 7
NPK Consumption (in tons)

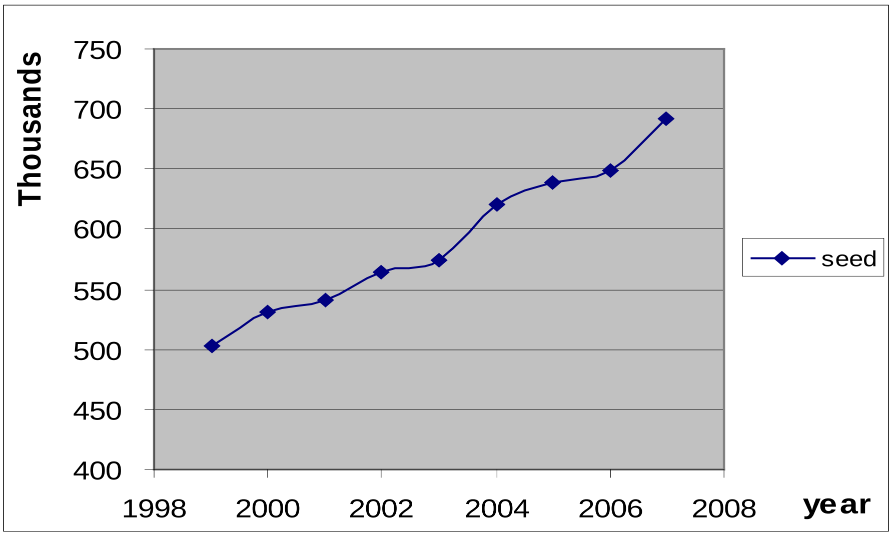


Source: Ministry of Agriculture

Trends of Seed

The amount of seed consumption has been increasing year by year even little increase and this can be happened because government has introduced high yield seed which has high return or gain to replace the conventional seed.

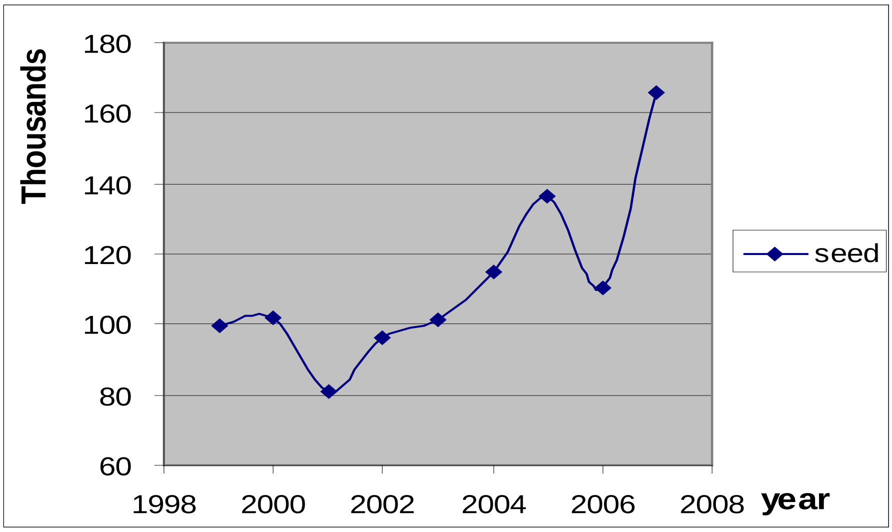
Figure 8
Seed Consumption (in tons)



Source: Ministry of Agriculture

HYV seed can boost rice production higher than conventional seed and it can increase harvest crops up to two folds. Subsidized seed which is applied by the government is high yield seed and supplied by agricultural state own enterprises. Figure 9 describes the amount of subsidized seed from 1999 to 2007; the amount of subsidy tends to increase from 2001 to 2007 even though in 2006 the amount of subsidized seed was reduced due to the decreasing of the number of paddy field.

Figure 9
The Amount of Subsidized Seed (in tons)



Source: Ministry of Agriculture

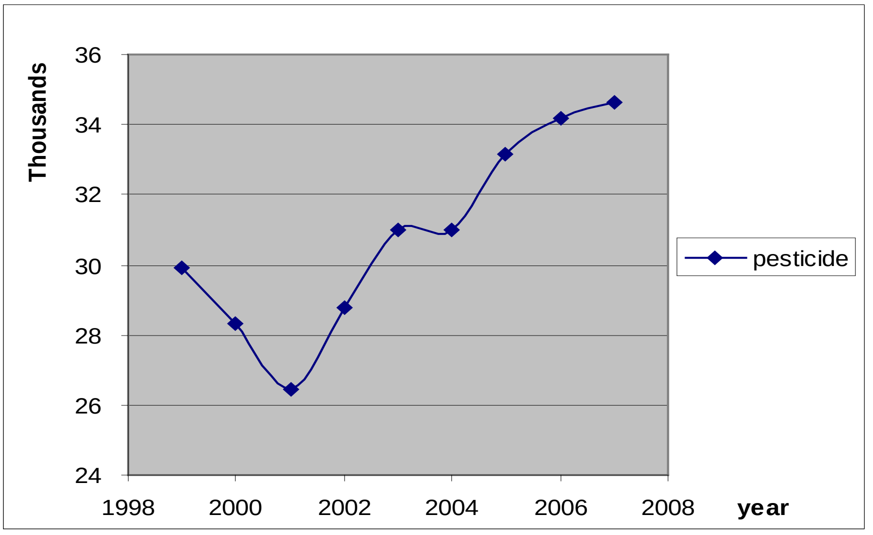
The highest percentage of subsidized seed and market price seed happened in year 2007 around 25 per cent of total seed consumption. The effect of seed subsidized in 2007 was increasing in the amount of harvest from 54 million tons to 57 million tons or around 5 per cent.

Unsubsidized Inputs

Trends of Pesticide

Since 1989 pesticide had no longer been subsidized by the government, and this could be happened because at that time farmer tended to overuse of pesticide to eradicate pest and the impact of that pesticide was to give immunity of the pest. Farmer needed higher and higher dosage to kill the pest and since then government was lifted pesticide subsidy and nowadays the price of pesticide is based on market price. The trend of pesticide consumption was more stable rather than the trend of fertilizer consumption. The growth of consumption from 1999 to 2007 was only 14% and this could happen not because of the price was not affordable but based on the proportion of land and the awareness of the overuse of pesticide. The price of pesticide is also very volatile during one year, the price goes up when the planting season is coming and going down again when harvest time is coming.

Figure 10
Pesticide Consumption (in kilo litres)

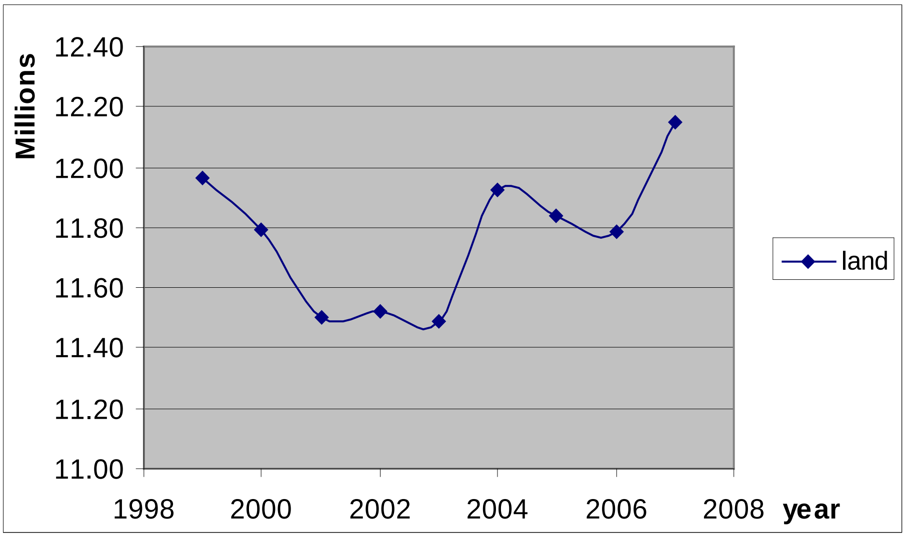


Source: Ministry of Agriculture

Trend of Land

The total area of land for rice production fluctuates because arable land for paddy depends on water availability and irrigation. When the water supply is limited farmers tend to change their crops into non rice product or horticulture product. Besides that, the changing pattern of arable land into industrial and residential also reduces the availability of land for rice production.

Figure 11
Cultivation Area (in hectares)



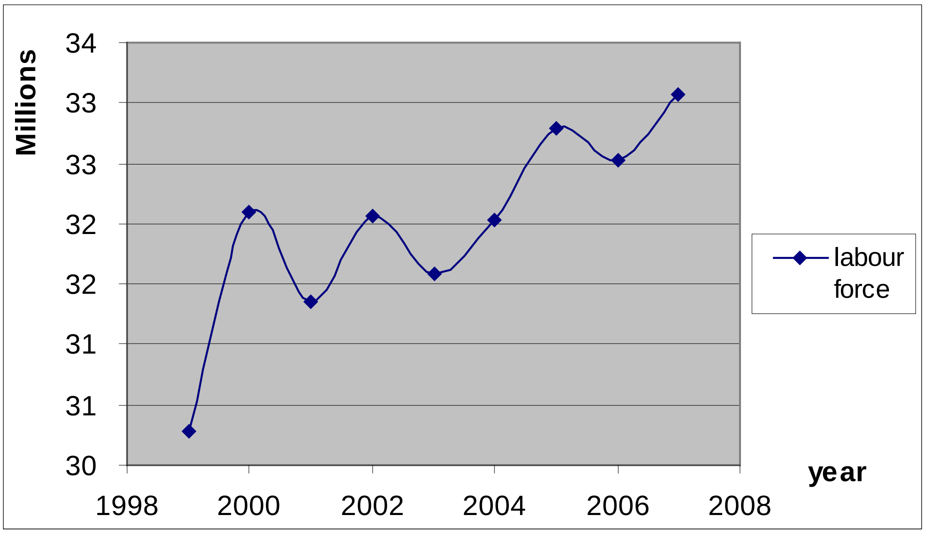
Source: BPS Statistics Indonesia www. bps.go.id

In 1999 the area for rice cultivation was around 12 million hectares then declined until 2003 was only around 11.5 million hectares and went up again in 2004 reached 11.9 million hectares. Since then the area of land was volatile around 11.8 million hectares and in 2007 reached around 12.2 million hectares. In 2007 the government launched the program to create new cultivation area for rice production outside Java. Land availability outside Java is still abundant and it also created employment in rice production. Ministry of Agriculture, Anton Apriyantono, also stated that in order to maintain food security and food self-sufficiency at least the number of land for rice production is about 15 million hectares.

Trends of Labour Force

Indonesia has abundant labour force in agriculture since most of the people live in rural area. Agriculture in general becomes the major engine of economic activity in rural area. The number of labour force in agriculture has been concentrated in Java especially in rice production provinces like Banten, West Java, Central Java and East Java.

Figure 12
Labour Forces in Rice Production



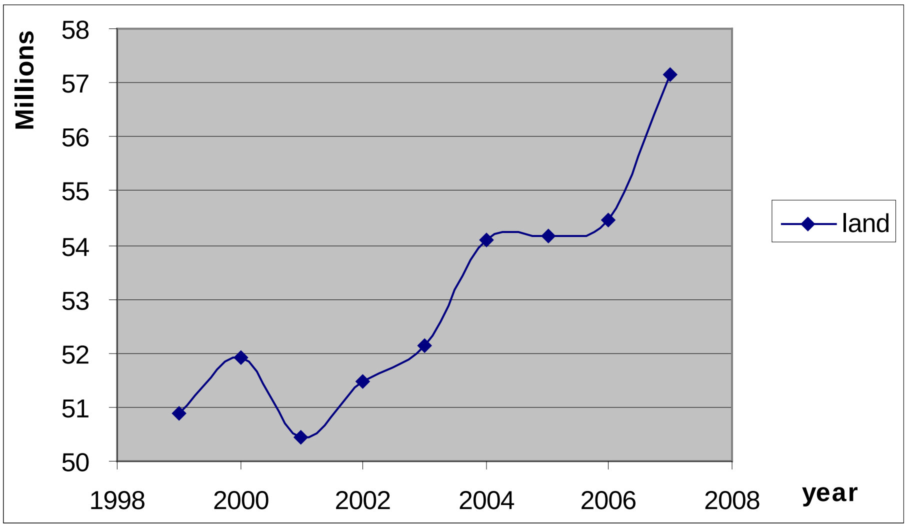
Sources: Based on table 3

The number of labour in rice production has been increasing after financial crisis hit Indonesia in 1998 where many workers were laid off. The effect of the workers laid off was the increasing of unemployment then they moved from formal sector to agriculture sector especially rice production. That is the reason why the number of labour force increased even the total land for rice production declined from 1999 to 2003. This data is derived from the compilation of the farmer groups that is coordinated by agriculture agency at the district level.

Rice Production from 1999-2007

Rice production in Indonesia tends to increase year by year from 1999 to 2007 except for year 2001 where the production was decline and the government had to import rice. The declining of rice production is caused by the increasing of fertilizer price and the declining in the number of land for rice production.

Figure 13
Rice Production from 1999-2007
(in tons)



Source: Based on table 1

The increasing of inputs gave positive impact of the rice production. By applying inputs subsidy, the goal to achieve national food security has been achieve since 2004 and it seems to suggest that inputs subsidy has some impact on rice production. This is also supported by several empirical findings that we have discussed in chapter 2 that government intervention in rice production effectively increase the production of rice. Determining which determinants that have significant impact on rice production we precede to the further analysis by using regression analysis.

Regression Analysis

Seed

After the availability of land, the next thing is the availability of seed for cultivation. For regression analysis, we run several models in relation with the demand of seed and also there are several independent variables that might be affecting the demand of seed. Those determinants are price of seed, price of grain, land, quantity of grain, price of grain with time lag and quantity of grain with time lag. From all those determinants, we want to capture the model of relationship between price and quantity demanded with simple regression. Based on demand equation, we construct the model of quantity demanded of seed in log form into four models which are:

lnQseed = f(lnp_seed, lnp_grain, lnland) Model 1

lnQseed = f(lnp_seed, lnp_grain, lnq_grain, lnland) Model 2

lnQseed = f(lnp_seed, lnp_grain, lnq_grain t-1, lnland) Model 3

lnQseed = f(lnp_seed lnp_grain t-1, lnq_grain t-2, lnland) Model 4

The result of those regression analyses can be seen at the table 10 below.

Table 10
Regression Analysis of the Determinants of the Demand of Seed

This table presents OLS regression at the nationwide level. The dependent variable is log of quantity demanded of seed, standard error are shown in the parenthesis

Dependent variable is LN(quantity demanded of seed)				
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Log price of seed	-0.1382 (0.1644)	-0.0658 (0.1079)	-0.0164 (0.1073)	-0.0579 (0.1215)
Log price of grain	0.3586*** (0.0949)	0.3518*** (0.0602)	0.3644*** (0.0648)	
Log land	1.2720*** (0.0881)	1.2239*** (0.0759)	0.8987*** (0.2167)	1.3345*** (0.0863)
Log price of grain t-1				0.3701*** (0.0771)
Log quantity of grain		0.0187 (0.0486)		
Log quantity of grain t-1			-0.2071 (0.1339)	
Log quantity of grain t-2				0.0336 (0.0493)
Number of observation	36	35	34	33
R^2	0.8868	0.9218	0.9321	0.9156
Durbin Watson test	2.95	1.90	1.49	1.97

***=significant at 1 per cent level; **= significant at 5 per cent level; * = significant at 10 per cent level

From the first model we know that the expected sign of price of seed is supposed to be negative where the lower the price is the more seed will be bought by the farmers. The expected sign of price of grain and land are positive where the higher the price of grain tends to influence farmers to grow paddy. For land, the more land that is available the more seed is needed. As can be seen from regression result that all variables have the similar sign with our expectation but price of seed is statistically insignificant while for price of rice and quantity of land is statistically significant at 1 per cent level. The insignificant of price of seed variable may be because of the number of observation, if we add more observation perhaps the result will be different. From Durbin Watson (DW) test, with the value of 2.95, means that this model has negative correlation.

At the second model we add variable the quantity of grain, the expected sign of the variables are the same with the expectation. The result is also similar with the first model and only price of rice and quantity of land which are significant. Since from the first model there is negative autocorrelation, to omit autocorrelation we transform the model by using Generalized Differences Method (GDM). The result of the transformation, this model is free from autocorrelation either positive or negative where the value of DW test is 1.90.

The third model we drop variable quantity of grain and is changed the same variable but lagged one year. The expected sign of price of seed variable and quantity of grain t-1 variable are not fit with our expectation. This model also has similar result with previous model where only price of rice and land are statistically significant at 1 per cent. This model has DW value 1.49 and we cannot conclude anything since the result of DW is in between dL-dU.

The fourth model, we change variable price of grain with variable price of grain at t-1. All variables have fit sign with our expectation and the result or regression is also similar with the previous models, where only price of rice at lag one year and quantity of land are significant and have influence for the demand of seed. Both variables are statistically significant at 1 per cent level. For DW test reveals this model is also free from autocorrelation with the DW value 1.97.

We conclude that the second model is the most fitted model because from the value all sign are exactly the same with our expectation. The notion why we choose this model is because the sign of the model is exactly the same with our expectation, price of seed has negative sign, price of grain, quantity of grain at previous period have positive sign and land. Another reason is that the demand of seed is determined by those determinants and other factors can be captured by the error term. Comparing with the fourth model; this model has higher R^2 and the number of observation. If we want to say in relation with the impact of each variable from the model, the explanation as follows:

a) Price of seed

This variable has the right sign which is negative but is statistically insignificant. This could be happened because of the limitation of the data that can lead to specification problems.

b) Price of grain

This variable has positive sign and statistically significant at one per cent level. With the regression coefficient of 0.3518 and when the other variables are constant, if the government increase the price of grain increase by 10 per cent, the demand for seed will increase 3.3 per cent.

c) Land

Variable quantity of land fits with our sign expectation which is positive. The regression coefficient of land is 1.2239 and it is statistically significant at one per cent level. This means that if we add up the quantity of land by one per cent for new cultivation, the demand for seed will increase for 1.2 per cent.

d) Quantity of grain previous period

From the regression result we know this variable has positive sign but unfortunately this variable is statistically insignificant.

Urea

Urea plays role for food self-sufficiency since paddy will grow well if farmer give them proper dosage of urea and based on the subsidized fertilizer urea is the highest percentage from the total amount of subsidy. Based on the notion of demand equation of urea we construct the model into four models which are:

lnQurea = f(lnp_urea, lnp_grain, lnland) Model 1

lnQurea = f(lnp_urea, lnp_grain, lnq_grain t-1, lnland) Model 2

lnQurea = f(lnp_urea, lnp_grain t-1, lnq_grain t-1) Model 3

lnQurea = f(lnp_urea, lnland, lnp_grain t-1, lnq_grain t-2) Model 4

The result of those regression analyses can be seen at the table 11 below.

Table 11
Regression Analysis of the Determinants of the Demand of Urea

This table presents OLS regression at the nationwide level. The dependent variable is per log of quantity demanded of urea, standard error are shown in the parenthesis.

Dependent variable is LN(quantity demanded of urea)				
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Log price of urea	-0.1732 (0.1205)	-0.1440 (0.1201)	-0.1617 (0.1236)	-0.0374 (0.1417)
Log price of grain	0.2915*** (0.0727)	0.2951*** (0.0715)		
Log land	1.3745*** (0.0848)	1.3610*** (0.0839)	1.4023*** (0.0860)	1.5156*** (0.0864)
Log price of grain t-1			0.2950*** (0.0762)	
Log price of grain t-2				0.3464*** (0.0786)
Log quantity of grain		-0.0841 (0.0575)	-0.1148 (0.0589)	
Log quantity of grain t-2				0.1032* (0.0574)
Number of observation	36	36	36	33
R^2	0.9062	0.9123	0.9140	0.9187
Durbin Watson test	2.07	2.05	1.90	2.03

****=significant at 1 per cent level; **= significant at 5 per cent level; * = significant at 10 per cent level

From the first model we know that all sign fit with our expectation but price of urea is statistically insignificant while variable price of grain and quantity of land is statistically significant at one per cent level. All variables also free from autocorrelation where DW test is 2.07.

At the second model we add variable the quantity of grain and the expected sign of the variables are the same with the expectation except new variable that has negative sign. Variable price of urea is statistically insignificant, and for variable price of grain and quantity of land both are statistically significant at 1 per cent level. Variable quantity of grain is also insignificant. The value of DW test is 2.05 and it means this model is free from autocorrelation.

The third model we change rice price variable into price of rice t-1 and the expected sign of all variables are fit with our expectation except variable quantity of grain that has negative sign. The result for regression for variable price of urea, price of grain and quantity of land are similar with the first two models, where price of urea is statistically insignificant, price of grain t-1 and quantity of grain are statistically significant at 1 per cent level. The value of DW test is 1.90 which means there is no autocorrelation among the variables.

The fourth model we make time lag for variable price of grain for 2 period and quantity of grain at 2 periods. By using GDM to omit multicollinearity and autocorrelation, the regression result describes that all variables signs match with our expectation. For significance, price of urea is statistically insignificant, while quantity of land and price of grain t-2 are statistically significant at 1 per cent level and quantity of grain t-2 is statistically significant at 10 per cent level.

We conclude that the fourth model is appropriate model to capture the behaviour of the demand for urea because the signs of all variables are the same with our expectation and have significant level at 1 and 10 per cent level. We can comment in relation with the impact of each variable when the other things constant as follows:

a) Price of urea

Urea has negative sign and fits with our expectation but unfortunately from this model price of urea is statistically insignificant. This could be happened because of limitation of the data.

b) Price of grain t-2

This variable sign fits with our expectation which is positive sign. Price of grain t-2 is statistically significant at 1 per cent level. With the regression coefficient of 0.3464 and the other variables are constant, if the price of grain t-2 increase by 10 per cent, the demand for urea will increase almost 3.5 per cent.

c) Land

Land has positive sign and is statistically significant at 1 per cent level. This variable has regression coefficient at 1.5156 and when the other things remain constant if we add 1 per cent of land the demand for urea will increase 1.5 per cent.

d) Quantity grain t-2

Quantity of grain t-2 has positive sign and as can be seen from regression analysis this variable is statistically significant at 10 per cent level. With the regression coefficient value 0.1032 if we hold the other variables constant the demand of urea will increase 0.1 per cent when the quantity of grain at t-2 increases by 1 per cent.

SP36

The second kind of fertilizer which is subsidized is SP36 and SP 36 is a complement product of urea, and if farmers use SP36 automatically they also enriches the mineral of soil together with urea. Based on the notion of demand equation, we construct the model into four models which are:

lnQSP36 = f(lnp_SP36, lnp_grain, lnland) Model 1

lnQSP36 = f(lnp_SP36,lnp_grain, lnland, lnq_grain) Model 2

lnQSP36 = f(lnp_SP36, lnland, lnp_graint-1, lnq_grain) Model 3

lnQSP36 = f(lnp_SP36, lnp_graint-1, lnq_land, lnq_graint-2, lnp_NPK)Model 4

The result of those regression analyses can be seen at the table 12 below.

Table 12
Regression Analysis of the Determinants of the Demand of SP36

This table presents OLS regression at the nationwide level. The dependent variable is log of quantity demanded of SP36, standard error are shown in the parenthesis

Dependent variable is LN(quantity demanded of SP36)				
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Log price of SP36	0.2344 (0.1096)	0.2813 (0.1086)	0.3103 (0.1170)	-0.0147 (0.1406)
Log price of grain	0.2975*** (0.0587)	0.3112*** (0.0571)		
Log land	0.7923*** (0.0639)	0.7752*** (0.0623)	0.8027*** (0.0629)	0.9094*** (0.0637)
Log price of grain t-1			0.3211*** (0.0617)	0.3423*** (0.1134)
Log quantity of grain		-0.0775 (0.0418)	-0.1156 (0.0444)	
Log quantity of grain t-2				0.1066** (0.0442)
Log price of NPK				0.0422 (0.1422)
Number of observation	36	36	35	33
R^2	0.8843	0.8958	0.8930	0.9131
Durbin Watson test	1.89	1.92	1.67	2.09

***=significant at 1 per cent level; **= significant at 5 per cent level; * = significant at 10 per cent level

The regression result from the first model reveals that the sign variable of price of SP36 has unexpected sign, it is supposed has negative sign, while the rest fit with our expectation. Price of SP36 is statistically insignificant but the other variables are statistically significant at 1 per cent level. From DW test, this model is free from autocorrelation and has 1.89 values.

At the second model we add variable the quantity of grain and from regression result we know that variable price of SP36 and quantity of grain have unexpected sign and the other variables fit with our expectation. For significance, price of SP36 and quantity of grain are statistically insignificant and for the rest variables are statistically significant at 1 per cent level. The DW test result is 1.92 and it means this model is free from autocorrelation.

The third model we change price of grain variable into price of grain t-1. The regression result shows that the expected sign for variable price of grain and quantity of grain is out of our expectation and both also are statistically insignificant. The other variables which are quantity of land and price of grain have positive sign and both are statistically significant at 1 per cent level. The value of DW test is 1.67, between the value of dL-dU and we cannot state anything.

The fourth model we add new variable of price of NPK as the substitute product of SP36 and the regression result reveals that the sign of all variables fit with our expectation. Variable price of SP36 and price of NPK are statistically insignificant and the rest variables are significant. The value of DW test is 2.09 and it means this model is free from autocorrelation.

We conclude that the fourth model is more appropriate model comparing with the first three models. The basic reason why we choose this model is due to the sign reason where all variables have similar sign with our expectation; moreover, this model is also derived from the previous study. This model is free from autocorrelation and multicollinearity since we use GDM. We can give detail explanation for each variable as follows:

a) Price of SP36

The negative sign of this variable is similar with our expectation but this variable is statistically insignificant.

b) Price of grain t-1

With the positive sign, the value of regression coefficient for price of grain is 0.3423 and it means if the price of grain t-1 increases by 10 per cent, the demand for SP36 increases by 3.4 per cent.

c) Land

This variable is statistically significant at 1 per cent level and has positive sign. This variable has regression coefficient at 0.9094 and the other variables are constant, if the land for paddy cultivation by 1 per cent, the demand for SP36 will increase almost 0.9 per cent.

d) Price of NPK

This variable is insignificant for the determinant for the demand of SP36 but this variable, as the substitute product of SP36, has the similar expected sign when the price of NPK increases the demand for SP36 increases also.

NPK

The third kind of fertilizer which is subsidized is NPK and this fertilizer has complete function as the compound fertilizer. NPK and SP36 can be substituted and if farmers use NPK automatically they also reduce the consumption of SP36.

Based on the notion of demand equation, we construct the model into four models which are:

lnQNPK = f(lnp_NPK, lnp_grain, lnland) Model 1

lnQNPK = f(lnp_NPK, lnp_grain, lnland, lnq_graint-1) Model 2

lnQNPK = f(lnp_NPK, lnland, lnp_graint-1, lnq_graint-1) Model 3

lnQNPK = f(lnp_NPK, lnp_graint-1, lnland, lnq_graint-2, lnp_SP36)Model 4

The result of those regression analyses can be seen at the table 13 below.

Table 13
Regression Analysis of the Determinants of the Demand of NPK

This table presents OLS regression at the nationwide level. The dependent variable is log of quantity demanded of NPK, standard error are shown in the parenthesis

Dependent variable is LN(quantity demanded of SP36)				
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Log price of NPK	0.0497 (0.2045)	0.1520 (0.1875)	-0.2726 (0.2483)	-0.0046 (0.2085)
Log price of grain	0.2231 (0.1518)	0.2655* (0.1372)		
Log land	1.0180*** (0.0737)	0.9869*** (0.0617)	0.9551*** (0.0957)	0.9829 *** (0.0655)

Dependent variable is LN(quantity demanded of SP36)				
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Log price of grain t-1			-0.1274 (0.1832)	0.2141 (0.1295)
Log quantity of grain		-0.1564 (0.0438)		
Log quantity of grain t-1			-0.1329 (0.0750)	
Log quantity of grain t-2				0.2213 *** (0.0499)
Log price of SP36				0.4119 ** (0.2002)
Number of observation	35	35	34	34
R^2	0.8873	0.8342	0.9071	0.9785
Durbin Watson test	1.81	1.89	1.77	1.75

***=significant at 1 per cent level; **= significant at 5 per cent level; * = significant at 10 per cent level

The regression result from the first model shows that only variable price of NPK has unexpected sign and the rest fit with our expectation. The only variable that has significance level is quantity of land where it is significant at 1 per cent level. With the DW test 1.81 this model is free from autocorrelation.

At the second model we add variable the quantity of grain, two variables have unexpected sign and those are price of NPK and quantity of grain. While for quantity of land is statistically significant at 1 per cent level and price of grain is statistically significant, both sign fit with our expectation. DW test for this model has value of 1.89 and this means the model is free from autocorrelation.

The third model we change price of grain variable into price of grain t-1 and quantity of grain variable also into t-1 and both variable has unexpected sign. In this model only one variable is statistically significant and the variable is quantity of land where it is statistically significant at 1 percent level. This model is free from autocorrelation as can be seen from DW test with the value of 1.77.

The fourth model we add variable price of SP36 as the substitute product of NPK, and from regression above we know that all variables sign based on our expectation. Price of NPK is statistically significant might be due to the number of observation. Price of grain t-1 is also statistically insignificant while quantity of land and quantity of grain t-2 both variables are statistically significant at 1 per cent level. For variable price of SP36, this variable is statistically significant at 5 per cent level.

We conclude that the fourth model is more appropriate model because all variables sign based on our expectation, higher R^2 and more significant variables. This model, like the previous variables, is also derived from previous study by Kelly and we add more variable to capture the real condition for the demand of NPK. We may say in relation to each variable as follows:

a) Price of NPK

In this model, this variable is statistically insignificant for the demand of NPK probably because of the number of observation.

b) Price of grain t-1

This variable is statistically insignificant for demand for NPK and probably has the same problem relates to the number of observation.

c) Land

Quantity of land has positive sign and it is statistically significant at one per cent level. This variable has regression coefficient at 0.9829 and when the other variables are constant, if the land for paddy cultivation by one per cent, the demand for NPK will increase almost one per cent.

d) Quantity grain t-2

This variable has positive sign and it is statistically significant at one per cent level. Quantity of grain t-2 has regression coefficient at the 0.2213 and this means if we the quantity of grain increase by 1 per cent, the demand for NPK will increase 0.22 per cent.

e) Price of SP36

The sign of this variable matches with our expectation, moreover this variable is also significant at 5 per cent level. Having regression coefficient at 0.4119 when we hold other variables constant, if we add the price of SP36 by 10 per cent the demand for NPK will increase by 4 per cent. SP36 is the substitute product of NPK.

Production Function Model

As we can predict from plotting diagram and simple regression that input subsidies increase the demand of inputs then we proceed to the next step. The second step is that we want to examine the relationship of increasing of inputs with the result of output. We also use econometric data analysis to examine the effect of increasing inputs on the output. We construct three models for production function model and the models are:

Rice Production: $\alpha o + \alpha_1 \text{lnland} + \alpha_2 \text{lnseed} + \alpha_3 \text{lnurea} + \alpha_4 \text{lnSP36} + \alpha_5 \text{lnNPK} + \alpha_6 \text{lnpest} + \alpha_7 \text{lnlab} + \varepsilon_1$ Model 1

Rice Production: $\beta o + \beta_1 \text{lnland} + \beta_2 \text{lnseed} + \beta_3 \text{lnurea} + \beta_4 \text{lnSP36} + \beta_5 \text{lnNPK} + \beta_6 \text{lnpest} + \beta_7 \text{lnlab} + \varepsilon_2$ Model 2

Rice Production: $\gamma o + \gamma_1 \text{lnlandt-1} + \gamma_2 \text{lnseedt-1} + \gamma_3 \text{lnureat-1} + \gamma_4 \text{lnSP36t-1} + \gamma_5 \text{lnNPKt-1} + \gamma_6 \text{lnpestt-1} + \gamma_7 \text{lnlabt-2} + \varepsilon_3$ Model 3

The result of those regression analyses can be seen at the table 14 below.

Table 14
Regression Analysis of the Determinants of the Quantity of Rice

This table presents OLS regression at the nationwide level. The dependent variable is log of quantity of rice production, standard error are shown in the parenthesis

Dependent variable is LN(quantity rice production)			
Independent variables	**Model 1**	**Model 2**	**Model 3**
Log land	2.4455*** (0.6842)	2.4474*** (0.7081)	
Log land t-1			0.2304*** (0.1050)
Log seed	1.3291* (0.4798)	1.3610** (0.4911)	0.3815*** (0.0264)
Log urea	-1.6757 (0.9496)	-1.6563 (0.9594)	
Log urea t-1			0.5998*** (0.1474)

Dependent variable is LN(quantity rice production)			
Independent variables	Model 1	Model 2	Model 3
Log SP36	1.1968 (1.0800)	1.2134 (1.0871)	
Log SP36 t-1			0.0385 (0.2189)
Log NPK	-0.5863 (0.4118)	-0.6099 (0.4521)	
Log NPK t-1			0.3241*** (0.1024)
Log pesticide	0.7651 (0.6935)	0.7093 (0.6965)	
Log pesticide t-2			0.1267 (0.1307)
Log labor	-3.0595 (0.6463)	-3.0564 (0.6635)	
Log labor t-2			0.4825*** (0.1270)
Number of observation	36	35	33
R^2	0.6182	0.6205	0.9928
Durbin Watson test	1.94	1.85	2.00

***=significant at 1 per cent level; **= significant at 5 per cent level; * = significant at 10 per cent level

As can be seen from regression result above, from the first model we know this model has thee variables with unexpected sign. The sign is supposed to be positive, and those variables are quantity of urea, quantity of NPK and number of labour. There are two significant variables, quantity of land is statistically significant at 1 per cent level, while quantity of seed significant at 10 per cent level. This model has DW test value 1.94 means that this model is free from autocorrelation but R^2 is only 0.61 it means to be a good model we need another variable to make the model close to reality.

The second model, to reduce multicollinearity and heteroscedasticity, we use generalized differences method. The regression result is similar with the first model where variable of quantity of urea, quantity of NPK and number of labour have negative sign. Only two variables which are statistically significant and those are quantity of land which is statistically significant at 1 per cent level and quantity of seed which is statistically significant at 5 percent level. This model also has low R^2 and is only 0.6205 and DW test 1.85 which means that need more variable to capture the reality.

For the third model we use time lag since the behaviour of agriculture process takes time from cultivation to harvest time. As can be seen from regression result all variables have positive sign and from seven variables, five of them are statistically significant at 1 per cent level. Those variables are quantity of land, quantity of seed, quantity of urea, quantity of NPK and quantity of labour. The variables which are statistically insignificant are quantity of SP36 and quantity of pesticide. For autocollinearity test we use DW test and the value is 2.00 and it means there is no autocorrelation.

Determining how to choose the good models above we have to the notion of every model. The first model is based on the study of Romauli and Muhaimin where those variables are captured as the determinant of rice production in certain region in Indonesia. We use this model for nation-wide production function but the result is not proper for estimating the production function. The result is different from the previous study and only two variables that is statistically significant and perhaps due to time differentiation is excluded from this model. This model also has multicollinearity because has mean of Variable Inflation Factor greater than 10 and this is the argument why we leave out this model. The second model we also use the same model but to reduce multicollinearity and heteroscedasticity we treat this model by using GDM. The regression result remains the same with the first model and only land and seed that is statistically significant. The last model, since the data is in quarterly data, it will be better if we introduce time lag for all variables because from cultivation to harvest time takes 3 to 4 months. We also apply GDM to reduce the effect of multicollinearity from each variable.

Based on the argument and the regression analysis above we know that the third model is the proper model because it shows that all variables have similar expected sign. Moreover this model has many significant variables and all are statistically significant at 1 per cent level. From each variable we can comment in relation of each variable individually that:

a) Land

This variable has positive sign and fits with our expectation and from regression analysis this variable has regression coefficient 0.2304 means that if we add land for paddy plantation by 1 per cent, the result of rice production will increase for 0.2 per cent.

b) Seed

Variable of seed has positive sign and similar with our expectation. The regression coefficient value of seed is 0.3815 and we can conclude that if we add 1 percent of seed, when the other variables remain constant, the rice production will increase 0.38 per cent.

c) Urea

Urea has positive sign and matches with our expectation; moreover, this variable is also statistically significant at 1 per cent level. If we add one per cent of urea, with the coefficient regression 0.5998 and other variables remain constant, rice production will increase by 0.59 per cent.

d) SP36

The expectation of this variable is exactly the same with the sign from regression but unfortunately this variable is statistically insignificant in increasing rice production. This could be happened perhaps due to the substitute fertilizer which is NPK.

e) NPK

NPK is the third types of fertilizer and from regression analysis and this variable has positive sign similar with our expectation. From the regression result it has regression coefficient 0.3241. If we add up by 1 per cent of NPK and remain variables are constant, rice production will increase by 0.32 per cent.

f) Pesticide

The sign of this variable is positive and matches with our expectation but unfortunately this variable is statistically insignificant for rice production.

g) Labour

Having positive sign and statistically significant, this variable has the same sign with our expectation. With the regression coefficient value at 0.4825 when the other variables remain constant if we add up the number of labour by 1 per cent the rice production will increase by 0.48 per cent.

From the regression of production function above, the next step that the government has to focus and concentrate on all inputs that are being subsidized for rice production. Subsidized seed, from the regression analysis, is important for rice production even the seed that being subsidized is not the hybrid one. The addition 1 per cent of seed will increase rice production for 0.38 per cent. If the government consider giving the subsidy on the hybrid seed the result might be different because hybrid seed produces higher output. For the future the government has to consider subsidizing hybrid seed because it produces more output than HYV seed.

Rice production needs fertilizer for better growing, and urea is the most common fertilizer that being used. The government gives huge amount of money for subsidizing fertilizer. The amount of urea that is being subsidized is around 70 per cent from the total amount of subsidized fertilizer. Whilst for SP36 the amount of subsidy reaches 12 per cent for the total amount of subsidy. The third kind of fertilizer for rice production is NPK and this fertilizer is complement product for urea and can be a substitute product for SP36. The regression analysis reveals that both urea and NPK are statistically significant to the rice production and the government has to maintain the subsidy in order to increase the output of rice and achieve food self-sufficiency

The Effectiveness and Efficiency of the Inputs Subsidy

Answering the research question about the effectiveness of input subsidy in rice production, the effectiveness of the subsidy can be measure by the achievement of the goal, and the government goal for rice production is to achieve food self-sufficiency. The minimum threshold of rice production is about 54 million tons. From the descriptive analysis, before the government has launched fertilizer subsidy, the rice production in 2002 was 51,489,694 tons, while in 2003, the first year of subsidized fertilizer, the rice production was 52,137,604 tons. One year after the application of fertilizer subsidy, in 2004 finally Indonesia achieved food self-sufficiency with the rice production around 54 million tons. Since 2004 Indonesia has achieved food self-sufficiency even the production from 2005 to 2006 was stagnant at around 54 million tons.

The achievement of food security can be differentiate into three stages which are a) national, b)regional and c)households. In term of national and regional food security, for rice, this goal has been achieved since 2004 with the total crops more than 54 million tons. While for household's point of view, the concept of food security has not been achieved yet, since there still a lot poor household that cannot provide food for consumption three times a day for more than 240 days (Aswatini et al 2006). Moreover the government up to now provides rice for poor social security (RASKIN) in order to give enough calories for poor people.

Relates with the methodology that we are going to use, we have 2 steps in measuring the effectives and efficiency. The first step we look at the relationship between subsidy and the increasing demand of input. Based on the regression analyses that we have done, we can measure the simulation of the increasing demand of input, and as can be seen from the table 15 below we can measure the effect of subsidy in relation with the demand of inputs. From the table 15, based on the calculation from regression analysis, we can see that when the government implies subsidy on seed, the demand of seed increase fluctuate from 8 to 10 thousand tons. The impact of subsidy on seed gives benefit to farmer since farmer can buy more seed with the cheaper price and increase in demand of seed.

Urea is the major fertilizer for rice production, and that is why the government focus on urea. The amount of subsidized urea increase every year since the policy has been applied in 2003. Based on the calculation from regression model, we know that the effect of subsidy will increase the demand of urea. In the first year of subsidy, in 2003, the demand of urea increases 26 thousand tons and keeps increasing up to 2007 which reaches 238 thousand tons of urea. Urea subsidy is benefiting the farmer and they can buy more fertilizer in order to fulfil their need of urea for rice production.

SP36 is an additional fertilizer for rice production and the demand of SP36 based on the calculation from regression model is increasing, as can be seen from table 15 that the increasing demand of SP36 is small. In 2003 the increasing demand of SP36 is only 3.399 tons and up to the last observation in 2007 the increasing of demand of SP36 is 29 thousand tons. Similar like SP36, NPK is also additional fertilizer for rice production and the demand of NPK by using the simulation from regression analysis increases from 768 tons in 2003 to almost 5.5 thousand tons in 2007. The calculation of table 14 is derived from appendix 1, 2, 3 and 4.

Table 15
Increasing Demand of Inputs
(in tons)

Period	Seed			Urea			SP36			NPK		
	Demand w/o Subsidy	Demand with Subsidy	Variance	Demand w/o Subsidy	Demand with Subsidy	Variance	Demand w/o Subsidy	Demand with Subsidy	Variance	Demand w/o Subsidy	Demand with Subsidy	Variance
1999	639,046	649,804	10,758	5,289,031	5,289,031	-	1,894,129	1,894,129	-	773,925	773,925	-
2000	659,343	670,164	10,822	5,347,313	5,347,313	-	1,974,460	1,974,460	-	774,952	774,952	-
2001	683,062	694,134	11,072	5,456,379	5,456,379	-	2,062,141	2,062,141	-	819,836	819,836	-
2002	707,366	718,291	10,925	5,698,182	5,698,182	-	2,136,828	2,136,828	-	825,803	825,803	-
2003	705,042	717,463	12,420	5,655,822	5,682,538	26,716	2,157,561	2,160,960	3,399	832,970	833,739	768
2004	742,808	754,127	11,319	6,029,544	6,120,363	90,819	2,273,924	2,279,726	5,802	968,373	969,762	1,389
2005	737,017	745,995	8,978	5,980,209	6,139,982	159,773	2,295,604	2,306,900	11,296	1,018,050	1,020,018	1,969
2006	820,279	830,459	10,179	6,768,686	6,939,050	170,364	2,605,335	2,615,948	10,613	1,077,908	1,080,247	2,339
2007	873,787	881,992	8,205	7,332,711	7,571,615	238,904	2,839,819	2,868,889	29,070	1,374,860	1,380,307	5,447

Source: Calculated by author based on regression analysis

The second step of this paper we use production function analysis to simulate the impact of rice production from each subsidized input by isolating other inputs constant or *ceteris paribus*. From table 16 we can see that if we plug the figure from the demand of seed into the production function, the variance of rice production between using subsidized seed and unsubsidized seed is volatile from 11 to 16 thousand tons of rice. In 1999 the rice production increased around 15.5 thousand tons by using additional 10 thousand of seed. Then the trend of rice production decline until 2002 and in 2003 the rice production increase around 16 thousand tons by adding 12 tons of seed. After 2003 the rice production decline and reached the lowest point in 2007 and only increased 12.8 thousand tons.

The impact of urea on rice production by using the same method is increasing from 2003 to 2007. From table 16 below, in 2003 the rice production increased only 7.7 thousand tons by adding 26 thousand tons of urea while up to the last observation in 2007, the rice production increased 73 thousand tons if we applied subsidized urea by adding 238 thousand tons of urea. The same trend is also happened for other subsidized fertilizers; SP36 and NPK. If we look at table 15, the impact of additional SP36 increases the rice production from 2003 to 2007 and the increasing is from 139 to 1,299 tons. This pattern is almost the same with the impact of additional urea on rice production. By adding 3 thousand tons of SP36 only gain 139 tons of rice in 2003 and in 2007 the production increases 1,299 tons. The additional of NPK has the same impact on rice production, based on the simulation from production function model, in 2003, when we add 768 tons of NPK the impact of rice production increase 708 tons of rice. This pattern is similarly happened every year until last observation in 2007. In 2007 when we add around 5.5 thousand tons of NPK the impact on rice production is only 4.9 thousand of rice.

When we discuss about effectiveness of the program, as can be seen from descriptive analysis, food self sufficiency is successfully achieved when the government applies inputs subsidy, and also based on the calculation from production function that every year rice production increases with the application of subsidy either by using seed subsidy from 1999 to 2002 or by using seed and fertilizers subsidy from 2003 to 2007. The calculation of table 15 is derived from appendix 5, 6, 7 and 8.

Table 16
Rice Production with and without Subsidy
(in tons)

Period	Seed			Urea			SP36			NPK			Total Output
	Output w/o Subsidy	Output with Subsidy	Variance	Output w/o Subsidy	Output with Subsidy	Variance	Output w/o Subsidy	Output with Subsidy	Variance	Output w/o Subsidy	Output with Subsidy	Variance	
1999	2,437,430	2,453,004	15,574	2,483,114	2,483,114	-	2,214,842	2,214,842	-	2,239,951	2,239,951	-	15,574
2000	2,352,815	2,367,473	14,658	2,539,354	2,539,354	-	2,164,308	2,164,308	-	2,228,064	2,228,064	-	14,658
2001	2,323,793	2,338,092	14,299	2,518,463	2,518,463	-	2,132,659	2,132,659	-	2,225,899	2,225,899	-	14,299
2002	2,401,489	2,415,572	14,083	2,674,484	2,674,484	-	2,213,762	2,213,762	-	2,323,902	2,323,902	-	14,083
2003	2,474,968	2,491,512	16,544	2,722,600	2,730,306	7,706	2,295,679	2,295,818	139	2,370,825	2,371,534	708	25,098
2004	2,765,088	2,781,088	16,000	2,995,717	3,022,700	26,984	2,589,407	2,589,661	254	2,761,771	2,763,054	1,283	44,520
2005	2,980,231	2,994,029	13,797	3,096,036	3,145,387	49,352	2,829,700	2,830,235	535	3,051,117	3,053,028	1,911	65,595
2006	3,107,688	3,122,344	14,657	3,393,199	3,444,170	50,971	2,856,463	2,856,910	447	3,091,530	3,093,702	2,172	68,247
2007	3,606,298	3,619,179	12,881	3,762,969	3,836,032	73,063	3,313,458	3,314,757	1,299	3,852,964	3,857,905	4,941	92,185

Source: calculated by author based on regression from production function

Relates with the effectiveness of the government policy, the goal of achieving food self-sufficiency is successful with the input subsidies, but we have also to measure the efficiency of the subsidies. Efficiency means that such program is related with monetary term, and the inputs subsidy program needs money for financing various policies. The money that is being used comes from national budget where the government has to make several loans to cover whole national budget. Measuring efficiency we can use cost and benefit analysis where we can calculate total inputs in monetary term and compare with the growth of rice production and we break down for each input. As can be seen from table 17 below that total seed subsidy from 1999 to 2007 is Rp627 billion while the total gain can be calculated from the total output of rice production multiplied by the price of rice is Rp219 billion. Total profit or loss can be measure by deducting total gain with total subsidy and in total seed subsidy is inefficient because there is a total loss around Rp428 billion. The complete calculation of table 17 is produced from appendix 9, 10, 11 and 12.

The simulation results of efficiency calculation of fertilizer subsidy vary among each fertilizer. Urea subsidy in total from 2003 to 2007 reached Rp8.5 trillion and the total loss, by the same calculation with seed, reached Rp463 million. There is a loss around Rp8.1 trillion by using this calculation and this means urea subsidy is inefficient in increasing rice production. The simulation for SP36 reveals that input subsidy SP36 gives same benefit for rice production and comparing input with output which is multiplied by price of rice the total loss is Rp1.6 trillion. This result comes from the total gain Rp6.1 billion minus the subsidy Rp1.7 trillion. The last fertilizer subsidy is NPK and from 2003 to 2007 the total subsidy is Rp1.6 trillion. The total output from the subsidy from 2003 to 2007 is Rp25 billion and there is a total loss around Rp1.6 trillion and this means that NPK subsidy is inefficient in increasing rice production. From table 16, from 2003 to 2007 the gain is less than the amount of subsidy in every year.

Table 17
Calculation of Cost Efficiency in Rice Production
(in million Rupiah)

Period	Seed			Urea			SP36			NPK			Total gain/(loss)
	Subsidy	Gain	Variance	Subsidy	Gain	Variance	Subsidy	Gain	Variance	Subsidy	Gain	Variance	
1999	39,643	15,340	(24,303)	-	-	-	-	-	-	-	-	-	(24,303)
2000	43,830	16,637	(27,193)	-	-	-	-	-	-	-	-	-	(27,193)
2001	34,055	19,661	(14,394)	-	-	-	-	-	-	-	-	-	(14,394)
2002	38,590	21,392	(17,198)	-	-	-	-	-	-	-	-	-	(17,198)
2003	50,789	25,643	(25,146)	515,906	11,945	(503,961)	126,329	216	(126,113)	49,401	1,098	(48,303)	(703,523)
2004	80,900	25,839	(55,061)	1,000,645	43,578	(957,067)	164,285	410	(163,875)	164,285	2,073	(162,212)	(1,338,214)
2005	112,670	23,180	(89,490)	1,589,531	82,911	(1,506,621)	311,003	898	(310,105)	318,532	3,210	(315,322)	(2,221,537)
2006	106,152	35,689	(70,463)	1,853,946	124,114	(1,729,832)	362,738	1,089	(361,649)	371,519	5,290	(366,229)	(2,528,174)
2007	120,584	35,359	(85,225)	3,628,347	200,558	(3,427,789)	709,913	3,567	(706,345)	727,098	13,563	(713,534)	(4,932,894)
Total	**627,212**	**218,740**	**(408,472)**	**8,588,376**	**463,106**	**(8,125,270)**	**1,674,267**	**6,180**	**(1,668,087)**	**1,630,835**	**25,234**	**(1,605,601)**	**(11,807,430)**

Source: calculated by author based on regression analysis

If we want to calculate the total effect of all subsidies that relate to the total gain from rice production, we can look at from table 18. The total subsidy from 1999 to 2007 is Rp12.5 trillion and total return from the input is Rp713 billion. In term of loss and profit, there is a loss around Rp11.8 trillion or we can say, in general, that inputs subsidy is less efficient to national budget.

Table 18
Total Efficiency Calculation of Subsidy from 1999-2007 (in Rupiah)

Year	Input	Output	Total Gain/(Loss)
	Total Subsidy	Total Production	
1999	39,642,500,000	15,339,964,113	(24,302,535,887)
2000	43,829,600,000	16,636,710,285	(27,192,889,715)
2001	34,054,800,000	19,660,798,143	(14,394,001,857)
2002	38,590,400,000	21,392,295,112	(17,198,104,888)
2003	742,424,851,362	38,901,754,974	(703,523,096,388)
2004	1,410,115,000,000	71,900,563,524	(1,338,214,436,476)
2005	2,331,736,300,950	110,198,996,887	(2,221,537,304,063)
2006	2,694,355,000,000	166,181,494,484	(2,528,173,505,516)
2007	5,185,941,569,292	253,047,455,602	(4,932,894,113,690)
Total	**12,520,690,021,604**	**713,260,033,124**	**(11,807,429,988,480)**

Source: calculated by author based on table 17

We can conclude that input subsidy is appear to increase rice production in physical term and contributes to policy objective in achieving national food self sufficiency and food security. All inputs, based on the calculation from production function, have an impact on rice production. For economic efficiency of the government budget, all subsidies are less efficient in increasing rice production since the input is greater than the output. Based on the simulation we can also give recommendation for the government about which subsidy that is supposed to be applied. The government can change HYV seed into hybrid seed which has higher output and perhaps gives subsidy for hybrid seed, then for fertilizers the government has to keep giving fertilizers subsidy in order to maintain rice self-sufficiency and security.

Chapter 6. Conclusion

Rice is the staple food for most of Indonesia people and it is important for the government to secure the availability of rice stock. Rice can be produced domestically or imported from abroad. In order to produce rice domestically and achieve sufficient level, the government has launched the program for seed subsidy and re-launched the program for fertilizers subsidy. A huge amount of money has been involved for this program and it is financed by national budget.

The effectiveness and the efficiency of those programs is the focus of this paper and by this paper we want to examine the effectiveness and the efficiency of inputs subsidy on rice production, since the government has spent a huge amount of money to achieve food self-sufficiency. From the empirical evidences, with different method and calculation, reveal that inputs subsidy effectively increase the demand of inputs and also increase the yield of crops.

Using secondary data from Ministry of Agriculture, Ministry of Finance, and BPS we want to analyse the effectiveness of input subsidy on rice production. Based on descriptive analysis it seems that the demand of fertilizers increase after the government has applied fertiliser subsidy, while for seed the demand is volatile. We can see also that the increase in inputs seems to suggest that input subsidy has some impact on rice production and achieved self-sufficiency on rice in 2004. By using simulation based on demand of inputs and production function regression analysis, the demand of inputs increase after the government has applied the subsidy and from production function, rice production also increases after the demand of inputs increases. This is in line with the previous study as we have discussed in chapter 2 and we can conclude that inputs subsidy is more effective to increase rice production than when there is no input subsidy.

Calculating the efficiency of the national budget, the gain of subsidy is more efficient if the gain is greater than the subsidy and is less efficient if the gain is less than the subsidy. From the simulation based on production function regression analysis, when we multiply the output with the price of rice, the gain is less than the input that has been spent. In other word we can conclude that input subsidy is less efficient for national budget.

The policy recommendation for seed subsidy is that the government keeps giving subsidy on seed and also can change HYV seed into hybrid seed in which has higher output and perhaps gives subsidy for hybrid seed. Then for fertilizers the government has to keep giving fertilizers subsidy in order to maintain rice self-sufficiency and security.

Appendices

Appendix 1
Demand of Seed with and without Subsidy Based on Regression Analysis of Seed

Without Subsidy

Period	Constant	p_seed	p_seed coeff	p_grain	p_grain coeff	q_land	q_land coeff	q_grain	q_grain coeff	Demand w/o subsidy
1999	0.7718	1,785	-0.0658	985	0.3518	11,963	1.2239	50,866	0.0187	639,046
2000	0.7718	1,825	-0.0658	1,135	0.3518	11,793	1.2239	51,898	0.0187	659,343
2001	0.7718	1,845	-0.0658	1,375	0.3518	11,499	1.2239	50,460	0.0187	683,062
2002	0.7718	1,925	-0.0658	1,519	0.3518	11,521	1.2239	51,489	0.0187	707,366
2003	0.7718	2,145	-0.0658	1,550	0.3518	11,488	1.2239	52,137	0.0187	705,042
2004	0.7718	2,435	-0.0658	1,615	0.3518	11,922	1.2239	54,088	0.0187	742,808
2005	0.7718	2,975	-0.0658	1,680	0.3518	11,839	1.2239	54,151	0.0187	737,017
2006	0.7718	3,920	-0.0658	2,435	0.3518	11,786	1.2239	54,454	0.0187	820,279
2007	0.7718	5,060	-0.0658	2,745	0.3518	12,147	1.2239	57,157	0.0187	873,787

With Subsidy

Period	Constant	p_seed	seed coefficient	p_grain	p_grain coeff	q_land	q_land coeff	q_grain	q_grain coeff	demand w/ subsidy	variance
1999	0.7718	1,385	-0.0658	985	0.3518	11,963	1.2239	50,866	0.0187	649,804	10,758
2000	0.7718	1,425	-0.0658	1,135	0.3518	11,793	1.2239	51,898	0.0187	670,164	10,822
2001	0.7718	1,445	-0.0658	1,375	0.3518	11,499	1.2239	50,460	0.0187	694,134	11,072
2002	0.7718	1,525	-0.0658	1,519	0.3518	11,521	1.2239	51,489	0.0187	718,291	10,925
2003	0.7718	1,645	-0.0658	1,550	0.3518	11,488	1.2239	52,137	0.0187	717,463	12,420
2004	0.7718	1,935	-0.0658	1,615	0.3518	11,922	1.2239	54,088	0.0187	754,127	11,319
2005	0.7718	2,475	-0.0658	1,680	0.3518	11,839	1.2239	54,151	0.0187	745,995	8,978
2006	0.7718	3,250	-0.0658	2,435	0.3518	11,786	1.2239	54,454	0.0187	830,459	10,179
2007	0.7718	4,390	-0.0658	2,745	0.3518	12,147	1.2239	57,157	0.0187	881,992	8,205

Appendix 2
Demand of Urea with and without Subsidy Based on Regression Analysis of Urea

without subsidy

period	constant	p_urea	p_urea coeff	p_grain	p_grain coeff	q_land	q_land coeff	q_grain	q_grain coeff	Demand w/o subsidy
1999	0.1324	518	-0.0374	985	0.3464	11,963	1.5156	50,866	0.1032	5,289,031
2000	0.1324	850	-0.0374	1,135	0.3464	11,793	1.5156	51,898	0.1032	5,347,313
2001	0.1324	974	-0.0374	1,375	0.3464	11,499	1.5156	50,460	0.1032	5,456,379
2002	0.1324	878	-0.0374	1,519	0.3464	11,521	1.5156	51,489	0.1032	5,698,182
2003	0.1324	1,191	-0.0374	1,550	0.3464	11,488	1.5156	52,137	0.1032	5,655,822
2004	0.1324	1,566	-0.0374	1,615	0.3464	11,922	1.5156	54,088	0.1032	6,029,544
2005	0.1324	2,125	-0.0374	1,680	0.3464	11,839	1.5156	54,151	0.1032	5,980,209
2006	0.1324	2,041	-0.0374	2,435	0.3464	11,786	1.5156	54,454	0.1032	6,768,686
2007	0.1324	2,828	-0.0374	2,745	0.3464	12,147	1.5156	57,157	0.1032	7,332,711

with subsidy

period	constant	p_urea	p_urea coeff	p_grain	p_grain coeff	q_land	q_land coeff	q_grain	q_grain coeff	demand w/ subsidy	variance
1999	0.1324	518	-0.0374	985	0.3464	11,963	1.5156	50,866	0.1032	5,289,031	-
2000	0.1324	850	-0.0374	1,135	0.3464	11,793	1.5156	51,898	0.1032	5,347,313	-
2001	0.1324	974	-0.0374	1,375	0.3464	11,499	1.5156	50,460	0.1032	5,456,379	-
2002	0.1324	878	-0.0374	1,519	0.3464	11,521	1.5156	51,489	0.1032	5,698,182	-
2003	0.1324	1,050	-0.0374	1,550	0.3464	11,488	1.5156	52,137	0.1032	5,682,538	26,716
2004	0.1324	1,050	-0.0374	1,615	0.3464	11,922	1.5156	54,088	0.1032	6,120,363	90,819
2005	0.1324	1,050	-0.0374	1,680	0.3464	11,839	1.5156	54,151	0.1032	6,139,982	159,773
2006	0.1324	1,050	-0.0374	2,435	0.3464	11,786	1.5156	54,454	0.1032	6,939,050	170,364
2007	0.1324	1,200	-0.0374	2,745	0.3464	12,147	1.5156	57,157	0.1032	7,571,615	238,904

Appendix 3
Demand of SP36 with and without Subsidy Based on Regression Analysis of SP36

without subsidy

period	constant	p_sp36	p_sp36 coeff	p_grain	p_grain coeff	q_land	q_land coeff	q_grain	q_grain coeff	p_NPK	p_NPK coeff	Demand w/o subsidy
1999	8.9840	1,217	-0.0147	985	0.3423	11,963	0.9094	50,866	0.1066	1,543	0.0422	1,894,129
2000	8.9840	1,162	-0.0147	1,135	0.3423	11,793	0.9094	51,898	0.1066	1,665	0.0422	1,974,460
2001	8.9840	1,302	-0.0147	1,375	0.3423	11,499	0.9094	50,460	0.1066	1,893	0.0422	2,062,141
2002	8.9840	1,238	-0.0147	1,519	0.3423	11,521	0.9094	51,489	0.1066	1,757	0.0422	2,136,828
2003	8.9840	1,280	-0.0147	1,550	0.3423	11,488	0.9094	52,137	0.1066	1,955	0.0422	2,157,561
2004	8.9840	1,665	-0.0147	1,615	0.3423	11,922	0.9094	54,088	0.1066	2,185	0.0422	2,273,924
2005	8.9840	1,955	-0.0147	1,680	0.3423	11,839	0.9094	54,151	0.1066	2,435	0.0422	2,295,604
2006	8.9840	1,846	-0.0147	2,435	0.3423	11,786	0.9094	54,454	0.1066	2,563	0.0422	2,605,335
2007	8.9840	3,099	-0.0147	2,745	0.3423	12,147	0.9094	57,157	0.1066	4,134	0.0422	2,839,819

with subsidy

period	constant	p_sp36	p_sp36 coeff	p_grain	p_grain coeff	q_land	q_land coeff	q_grain	q_grain coeff	p_NPK	p_NPK coeff	demand w/ subsidy	variance
1999	8.9840	1,217	-0.0147	985	0.3423	11,963	0.9094	50,866	0.1066	1,543	0.0422	1,894,129	-
2000	8.9840	1,162	-0.0147	1,135	0.3423	11,793	0.9094	51,898	0.1066	1,665	0.0422	1,974,460	-
2001	8.9840	1,302	-0.0147	1,375	0.3423	11,499	0.9094	50,460	0.1066	1,893	0.0422	2,062,141	-
2002	8.9840	1,238	-0.0147	1,519	0.3423	11,521	0.9094	51,489	0.1066	1,757	0.0422	2,136,828	-
2003	8.9840	1,150	-0.0147	1,550	0.3423	11,488	0.9094	52,137	0.1066	1,955	0.0422	2,160,960	3,399
2004	8.9840	1,400	-0.0147	1,615	0.3423	11,922	0.9094	54,088	0.1066	2,185	0.0422	2,279,726	5,802
2005	8.9840	1,400	-0.0147	1,680	0.3423	11,839	0.9094	54,151	0.1066	2,435	0.0422	2,306,900	11,296
2006	8.9840	1,400	-0.0147	2,435	0.3423	11,786	0.9094	54,454	0.1066	2,563	0.0422	2,615,948	10,613
2007	8.9840	1,550	-0.0147	2,745	0.3423	12,147	0.9094	57,157	0.1066	4,134	0.0422	2,868,889	29,070

Appendix 4
Demand of NPK with and without Subsidy Based on Regression Analysis of NPK

without subsidy

period	constant	p_NPK	p_NPK coeff	p_grain	p_grain coeff	q_land	q_land coeff	q_grain	q_grain coeff	p_sp36	p_sp36 coefficient	Demand w/o subsidy
1999	0.0875	1,543	-0.0046	985	0.2141	11,963	0.9829	50,866	0.2213	1,217	0.4119	773,925
2000	0.0875	1,665	-0.0046	1,135	0.2141	11,793	0.9829	51,898	0.2213	1,162	0.4119	774,952
2001	0.0875	1,893	-0.0046	1,375	0.2141	11,499	0.9829	50,460	0.2213	1,302	0.4119	819,836
2002	0.0875	1,757	-0.0046	1,519	0.2141	11,521	0.9829	51,489	0.2213	1,238	0.4119	825,803
2003	0.0875	1,955	-0.0046	1,550	0.2141	11,488	0.9829	52,137	0.2213	1,253	0.4119	832,970
2004	0.0875	2,185	-0.0046	1,615	0.2141	11,922	0.9829	54,088	0.2213	1,588	0.4119	968,373
2005	0.0875	2,435	-0.0046	1,680	0.2141	11,839	0.9829	54,151	0.2213	1,788	0.4119	1,018,050
2006	0.0875	2,563	-0.0046	2,435	0.2141	11,786	0.9829	54,454	0.2213	1,707	0.4119	1,077,908
2007	0.0875	4,134	-0.0046	2,745	0.2141	12,147	0.9829	57,157	0.2213	2,640	0.4119	1,374,860

with subsidy

period	constant	p_NPK	p_NPK coeff	p_grain	p_grain coeff	q_land	q_land coeff	q_grain	q_grain coeff	p_sp36	p_sp36 coefficient	demand w/ subsidy	variance
1999	0.0875	1,543	-0.0046	985	0.2141	11,963	0.9829	50,866	0.2213	1,217	0.4119	773,925	-
2000	0.0875	1,665	-0.0046	1,135	0.2141	11,793	0.9829	51,898	0.2213	1,162	0.4119	774,952	-
2001	0.0875	1,893	-0.0046	1,375	0.2141	11,499	0.9829	50,460	0.2213	1,302	0.4119	819,836	-
2002	0.0875	1,757	-0.0046	1,519	0.2141	11,521	0.9829	51,489	0.2213	1,238	0.4119	825,803	-
2003	0.0875	1,600	-0.0046	1,550	0.2141	11,488	0.9829	52,137	0.2213	1,253	0.4119	833,739	768
2004	0.0875	1,600	-0.0046	1,615	0.2141	11,922	0.9829	54,088	0.2213	1,588	0.4119	969,762	1,389
2005	0.0875	1,600	-0.0046	1,680	0.2141	11,839	0.9829	54,151	0.2213	1,788	0.4119	1,020,018	1,969
2006	0.0875	1,600	-0.0046	2,435	0.2141	11,786	0.9829	54,454	0.2213	1,707	0.4119	1,080,247	2,339
2007	0.0875	1,750	-0.0046	2,745	0.2141	12,147	0.9829	57,157	0.2213	2,640	0.4119	1,380,307	5,447

Appendix 5
Production Function based on Seed

without subsidy

period	constant	q_land	q_ land coeff	q_seed	q_seed coeff	q_urea	q_urea coeff	q_sp36	q_sp36 coeff	q_NPK	q_NPK coeff	q_pest	q_pest coeff	q_lab	q_lab coeff	Prod. Func w/o subsidy
1999	25.2308	11,963	0.2304	639	0.3815	4,398	0.5998	2,084	0.0385	756	0.3241	29,908	0.1267	30,278	0.4825	2,437,430,147
2000	25.2308	11,793	0.2304	659	0.3815	4,098	0.5998	1,985	0.0385	709	0.3241	28,304	0.1267	32,092	0.4825	2,352,815,096
2001	25.2308	11,499	0.2304	683	0.3815	4,109	0.5998	1,867	0.0385	710	0.3241	26,449	0.1267	31,356	0.4825	2,323,793,125
2002	25.2308	11,521	0.2304	707	0.3815	4,123	0.5998	1,876	0.0385	700	0.3241	28,802	0.1267	32,058	0.4825	2,401,488,526
2003	25.2308	11,488	0.2304	705	0.3815	4,233	0.5998	1,983	0.0385	726	0.3241	31,017	0.1267	31,591	0.4825	2,474,968,461
2004	25.2308	11,922	0.2304	743	0.3815	4,698	0.5998	2,054	0.0385	753	0.3241	30,999	0.1267	32,037	0.4825	2,765,088,291
2005	25.2308	11,839	0.2304	737	0.3815	5,125	0.5998	2,145	0.0385	767	0.3241	33,149	0.1267	32,790	0.4825	2,980,231,422
2006	25.2308	11,786	0.2304	820	0.3815	5,032	0.5998	2,250	0.0385	794	0.3241	34,180	0.1267	32,528	0.4825	3,107,687,828
2007	25.2308	12,147	0.2304	874	0.3815	5,889	0.5998	2,540	0.0385	817	0.3241	34,620	0.1267	33,063	0.4825	3,606,297,750

with subsidy

period	constant	q_land	q_ land coeff	q_seed	q_seed coeff	q_urea	q_urea coeff	q_sp36	q_sp36 coeff	q_NPK	q_NPK coeff	q_pest	q_pest coeff	q_lab	q_lab coeff	Prod. Func w/ subsidy	variance
1999	25.2308	11,963	0.2304	650	0.3815	4,398	0.5998	2,084	0.0385	756	0.3241	29,908	0.1267	30,278	0.4825	2,453,003,715	15,573,568
2000	25.2308	11,793	0.2304	670	0.3815	4,098	0.5998	1,985	0.0385	709	0.3241	28,304	0.1267	32,092	0.4825	2,367,472,991	14,657,895
2001	25.2308	11,499	0.2304	694	0.3815	4,109	0.5998	1,867	0.0385	710	0.3241	26,449	0.1267	31,356	0.4825	2,338,091,888	14,298,762
2002	25.2308	11,521	0.2304	718	0.3815	4,123	0.5998	1,876	0.0385	700	0.3241	28,802	0.1267	32,058	0.4825	2,415,571,670	14,083,144
2003	25.2308	11,488	0.2304	717	0.3815	4,233	0.5998	1,983	0.0385	726	0.3241	31,017	0.1267	31,591	0.4825	2,491,512,332	16,543,872
2004	25.2308	11,922	0.2304	754	0.3815	4,698	0.5998	2,054	0.0385	753	0.3241	30,999	0.1267	32,037	0.4825	2,781,087,829	15,999,537
2005	25.2308	11,839	0.2304	746	0.3815	5,125	0.5998	2,145	0.0385	767	0.3241	33,149	0.1267	32,790	0.4825	2,994,028,916	13,797,495
2006	25.2308	11,786	0.2304	830	0.3815	5,032	0.5998	2,250	0.0385	794	0.3241	34,180	0.1267	32,528	0.4825	3,122,344,470	14,656,642
2007	25.2308	12,147	0.2304	882	0.3815	5,889	0.5998	2,540	0.0385	817	0.3241	34,620	0.1267	33,063	0.4825	3,619,179,022	12,881,272

Appendix 6
Rice Production Function based on Urea

without subsidy

period	constant	q_land	q_ land coeff	q_seed	q_seed coeff	q_urea	q_urea coeff	q_sp36	q_sp36 coeff	q_NPK	q_NPK coeff	q_pest	q_pest coeff	q_lab	q_lab coeff	Prod. Func w/o subsidy
1999	25.2308	11,963	0.2304	502	0.3815	5,289	0.5998	2,084	0.0385	756	0.3241	29,908	0.1267	30,278	0.4825	2,483,113,693
2000	25.2308	11,793	0.2304	530	0.3815	5,347	0.5998	1,985	0.0385	709	0.3241	28,304	0.1267	32,092	0.4825	2,539,353,575
2001	25.2308	11,499	0.2304	540	0.3815	5,456	0.5998	1,867	0.0385	710	0.3241	26,449	0.1267	31,356	0.4825	2,518,463,351
2002	25.2308	11,521	0.2304	564	0.3815	5,698	0.5998	1,876	0.0385	700	0.3241	28,802	0.1267	32,058	0.4825	2,674,484,277
2003	25.2308	11,488	0.2304	574	0.3815	5,656	0.5998	1,983	0.0385	726	0.3241	31,017	0.1267	31,591	0.4825	2,722,599,714
2004	25.2308	11,922	0.2304	619	0.3815	6,030	0.5998	2,054	0.0385	753	0.3241	30,999	0.1267	32,037	0.4825	2,995,716,704
2005	25.2308	11,839	0.2304	639	0.3815	5,980	0.5998	2,145	0.0385	767	0.3241	33,149	0.1267	32,790	0.4825	3,096,035,551
2006	25.2308	11,786	0.2304	648	0.3815	6,769	0.5998	2,250	0.0385	794	0.3241	34,180	0.1267	32,528	0.4825	3,393,198,810
2007	25.2308	12,147	0.2304	692	0.3815	7,333	0.5998	2,540	0.0385	817	0.3241	34,620	0.1267	33,063	0.4825	3,762,968,859

with subsidy

period	constant	q_land	q_ land coeff	q_seed	q_seed coeff	q_urea	q_urea coeff	q_sp36	q_sp36 coeff	q_NPK	q_NPK coeff	q_pest	q_pest coeff	q_lab	q_lab coeff	Prod. Func w/ subsidy	variance
1999	25.2308	11,963	0.2304	502	0.3815	5,289	0.5998	2,084	0.0385	756	0.3241	29,908	0.1267	30,278	0.4825	2,483,113,693	-
2000	25.2308	11,793	0.2304	530	0.3815	5,347	0.5998	1,985	0.0385	709	0.3241	28,304	0.1267	32,092	0.4825	2,539,353,575	-
2001	25.2308	11,499	0.2304	540	0.3815	5,456	0.5998	1,867	0.0385	710	0.3241	26,449	0.1267	31,356	0.4825	2,518,463,351	-
2002	25.2308	11,521	0.2304	564	0.3815	5,698	0.5998	1,876	0.0385	700	0.3241	28,802	0.1267	32,058	0.4825	2,674,484,277	-
2003	25.2308	11,488	0.2304	574	0.3815	5,683	0.5998	1,983	0.0385	726	0.3241	31,017	0.1267	31,591	0.4825	2,730,306,213	7,706,499
2004	25.2308	11,922	0.2304	619	0.3815	6,120	0.5998	2,054	0.0385	753	0.3241	30,999	0.1267	32,037	0.4825	3,022,700,248	26,983,544
2005	25.2308	11,839	0.2304	639	0.3815	6,140	0.5998	2,145	0.0385	767	0.3241	33,149	0.1267	32,790	0.4825	3,145,387,057	49,351,506
2006	25.2308	11,786	0.2304	648	0.3815	6,939	0.5998	2,250	0.0385	794	0.3241	34,180	0.1267	32,528	0.4825	3,444,169,655	50,970,845
2007	25.2308	12,147	0.2304	692	0.3815	7,572	0.5998	2,540	0.0385	817	0.3241	34,620	0.1267	33,063	0.4825	3,836,031,901	73,063,042

Appendix 7
Rice Production Function based on SP36

without subsidy

period	constant	q_land	q_ land coeff	q_seed	q_seed coeff	q_urea	q_urea coeff	q_sp36	q_sp36 coeff	q_NPK	q_NPK coeff	q_pest	q_pest coeff	q_lab	q_lab coeff	Prod. Func w/o subsidy
1999	25.2308	11,963	0.2304	502	0.3815	4,398	0.5998	1,894	0.0385	756	0.3241	29,908	0.1267	30,278	0.4825	2,214,842,136
2000	25.2308	11,793	0.2304	530	0.3815	4,098	0.5998	1,974	0.0385	709	0.3241	28,304	0.1267	32,092	0.4825	2,164,308,060
2001	25.2308	11,499	0.2304	540	0.3815	4,109	0.5998	2,062	0.0385	710	0.3241	26,449	0.1267	31,356	0.4825	2,132,659,189
2002	25.2308	11,521	0.2304	564	0.3815	4,123	0.5998	2,137	0.0385	700	0.3241	28,802	0.1267	32,058	0.4825	2,213,762,413
2003	25.2308	11,488	0.2304	574	0.3815	4,233	0.5998	2,158	0.0385	726	0.3241	31,017	0.1267	31,591	0.4825	2,295,678,940
2004	25.2308	11,922	0.2304	619	0.3815	4,698	0.5998	2,274	0.0385	753	0.3241	30,999	0.1267	32,037	0.4825	2,589,406,870
2005	25.2308	11,839	0.2304	639	0.3815	5,125	0.5998	2,296	0.0385	767	0.3241	33,149	0.1267	32,790	0.4825	2,829,700,339
2006	25.2308	11,786	0.2304	648	0.3815	5,032	0.5998	2,605	0.0385	794	0.3241	34,180	0.1267	32,528	0.4825	2,856,462,674
2007	25.2308	12,147	0.2304	692	0.3815	5,889	0.5998	2,840	0.0385	817	0.3241	34,620	0.1267	33,063	0.4825	3,313,457,936

with subsidy

period	constant	q_land	q_ land coeff	q_seed	q_seed coeff	q_urea	q_urea coeff	q_sp36	q_sp36 coeff	q_NPK	q_NPK coeff	q_pest	q_pest coeff	q_lab	q_lab coeff	Prod. Func w/ subsidy	variance
1999	25.2308	11,963	0.2304	502	0.3815	4,398	0.5998	1,894	0.0385	756	0.3241	29,908	0.1267	30,278	0.4825	2,214,842,136	-
2000	25.2308	11,793	0.2304	530	0.3815	4,098	0.5998	1,974	0.0385	709	0.3241	28,304	0.1267	32,092	0.4825	2,164,308,060	-
2001	25.2308	11,499	0.2304	540	0.3815	4,109	0.5998	2,062	0.0385	710	0.3241	26,449	0.1267	31,356	0.4825	2,132,659,189	-
2002	25.2308	11,521	0.2304	564	0.3815	4,123	0.5998	2,137	0.0385	700	0.3241	28,802	0.1267	32,058	0.4825	2,213,762,413	-
2003	25.2308	11,488	0.2304	574	0.3815	4,233	0.5998	2,161	0.0385	726	0.3241	31,017	0.1267	31,591	0.4825	2,295,818,090	139,150
2004	25.2308	11,922	0.2304	619	0.3815	4,698	0.5998	2,280	0.0385	753	0.3241	30,999	0.1267	32,037	0.4825	2,589,660,927	254,057
2005	25.2308	11,839	0.2304	639	0.3815	5,125	0.5998	2,307	0.0385	767	0.3241	33,149	0.1267	32,790	0.4825	2,830,235,149	534,810
2006	25.2308	11,786	0.2304	648	0.3815	5,032	0.5998	2,616	0.0385	794	0.3241	34,180	0.1267	32,528	0.4825	2,856,909,782	447,108
2007	25.2308	12,147	0.2304	692	0.3815	5,889	0.5998	2,869	0.0385	817	0.3241	34,620	0.1267	33,063	0.4825	3,314,757,411	1,299,475

Appendix 8
Rice Production Function based on SP36

without subsidy

period	constant	q_land	q_ land coeff	q_seed	q_seed coeff	q_urea	q_urea coeff	q_sp36	q_sp36 coeff	q_NPK	q_NPK coeff	q_pest	q_pest coeff	q_lab	q_lab coeff	Prod. Func w/o subsidy
1999	25.2308	11,963	0.2304	502	0.3815	4,398	0.5998	2,084	0.0385	774	0.3241	29,908	0.1267	30,278	0.4825	2,239,950,926
2000	25.2308	11,793	0.2304	530	0.3815	4,098	0.5998	1,985	0.0385	775	0.3241	28,304	0.1267	32,092	0.4825	2,228,064,057
2001	25.2308	11,499	0.2304	540	0.3815	4,109	0.5998	1,867	0.0385	820	0.3241	26,449	0.1267	31,356	0.4825	2,225,898,632
2002	25.2308	11,521	0.2304	564	0.3815	4,123	0.5998	1,876	0.0385	826	0.3241	28,802	0.1267	32,058	0.4825	2,323,901,539
2003	25.2308	11,488	0.2304	574	0.3815	4,233	0.5998	1,566	0.0385	833	0.3241	31,017	0.1267	31,591	0.4825	2,370,825,249
2004	25.2308	11,922	0.2304	619	0.3815	4,698	0.5998	1,459	0.0385	968	0.3241	30,999	0.1267	32,037	0.4825	2,761,770,950
2005	25.2308	11,839	0.2304	639	0.3815	5,125	0.5998	1,498	0.0385	1,018	0.3241	33,149	0.1267	32,790	0.4825	3,051,116,869
2006	25.2308	11,786	0.2304	648	0.3815	5,032	0.5998	1,550	0.0385	1,078	0.3241	34,180	0.1267	32,528	0.4825	3,091,529,822
2007	25.2308	12,147	0.2304	692	0.3815	5,889	0.5998	1,787	0.0385	1,375	0.3241	34,620	0.1267	33,063	0.4825	3,852,964,019

with subsidy

period	constant	q_land	q_ land coeff	q_seed	q_seed coeff	q_urea	q_urea coeff	q_sp36	q_sp36 coeff	q_NPK	q_NPK coeff	q_pest	q_pest coeff	q_lab	q_lab coeff	Prod. Func w/ subsidy	variance
1999	25.2308	11,963	0.2304	502	0.3815	4,398	0.5998	2,084	0.0385	774	0.3241	29,908	0.1267	30,278	0.4825	2,239,950,926	-
2000	25.2308	11,793	0.2304	530	0.3815	4,098	0.5998	1,985	0.0385	775	0.3241	28,304	0.1267	32,092	0.4825	2,228,064,057	-
2001	25.2308	11,499	0.2304	540	0.3815	4,109	0.5998	1,867	0.0385	820	0.3241	26,449	0.1267	31,356	0.4825	2,225,898,632	-
2002	25.2308	11,521	0.2304	564	0.3815	4,123	0.5998	1,876	0.0385	826	0.3241	28,802	0.1267	32,058	0.4825	2,323,901,539	-
2003	25.2308	11,488	0.2304	574	0.3815	4,233	0.5998	1,566	0.0385	834	0.3241	31,017	0.1267	31,591	0.4825	2,371,533,635	708,386
2004	25.2308	11,922	0.2304	619	0.3815	4,698	0.5998	1,459	0.0385	970	0.3241	30,999	0.1267	32,037	0.4825	2,763,054,285	1,283,334
2005	25.2308	11,839	0.2304	639	0.3815	5,125	0.5998	1,498	0.0385	1,020	0.3241	33,149	0.1267	32,790	0.4825	3,053,027,699	1,910,830
2006	25.2308	11,786	0.2304	648	0.3815	5,032	0.5998	1,550	0.0385	1,080	0.3241	34,180	0.1267	32,528	0.4825	3,093,702,248	2,172,426
2007	25.2308	12,147	0.2304	692	0.3815	5,889	0.5998	1,787	0.0385	1,380	0.3241	34,620	0.1267	33,063	0.4825	3,857,905,095	4,941,076

Appendix 9
Simulation of Efficiency Calculation of Seed Subsidy

1	2	3	4	5	6	7	8	9	10	11
year	INPUT				OUTPUT					
	seed subsidy (in Rupiah)	total demand use w/o subsidy	total demand use w subsidy	variance 5 = 4 - 3	Total output w/o subsidy	Total output w subsidy	variance 8 = 7 - 6	p rice	gain 10 = (8 * 9)	total profit/(loss) 11 = 10 - 2
1999	39,642,500,000	639,046	649,804	10,758	2,437,430,147	2,453,003,715	15,573,568	985	15,339,964,113	(24,302,535,887)
2000	43,829,600,000	659,343	670,164	10,822	2,352,815,096	2,367,472,991	14,657,895	1,135	16,636,710,285	(27,192,889,715)
2001	34,054,800,000	683,062	694,134	11,072	2,323,793,125	2,338,091,888	14,298,762	1,375	19,660,798,143	(14,394,001,857)
2002	38,590,400,000	707,366	718,291	10,925	2,401,488,526	2,415,571,670	14,083,144	1,519	21,392,295,112	(17,198,104,888)
2003	50,789,000,000	705,042	717,463	12,420	2,474,968,461	2,491,512,332	16,543,872	1,550	25,643,001,022	(25,145,998,978)
2004	80,900,000,000	742,808	754,127	11,319	2,765,088,291	2,781,087,829	15,999,537	1,615	25,839,253,030	(55,060,746,970)
2005	112,670,000,000	737,017	745,995	8,978	2,980,231,422	2,994,028,916	13,797,495	1,680	23,179,790,955	(89,490,209,045)
2006	106,152,000,000	820,279	830,459	10,179	3,107,687,828	3,122,344,470	14,656,642	2,435	35,688,922,292	(70,463,077,708)
2007	120,584,000,000	873,787	881,992	8,205	3,606,297,750	3,619,179,022	12,881,272	2,745	35,359,092,682	(85,224,907,318)
Total	627,212,300,000								218,739,827,634	(408,472,472,366)

Appendix 10
Simulation of Efficiency Calculation of Urea Subsidy

1	2	3	4	5	6	7	8	9	10	11
	INPUT				OUTPUT					
year	seed subsidy (in Rupiah)	total demand use w/o subsidy (in tons)	total demand use w subsidy (in tons)	variance 5 = 4 - 3	Total output w/o subsidy	Total output w subsidy	variance 8 = 7 - 6	p rice	gain 10 = (8 * 9)	total profit/(loss) 11 = 10 - 2
1999	-	5,289,031	5,289,031	-	2,483,113,693	2,483,113,693	-	985	-	-
2000	-	5,347,313	5,347,313	-	2,539,353,575	2,539,353,575	-	1,135	-	-
2001	-	5,456,379	5,456,379	-	2,518,463,351	2,518,463,351	-	1,375	-	-
2002	-	5,698,182	5,698,182	-	2,674,484,277	2,674,484,277	-	1,519	-	-
2003	515,906,397,840	5,655,822	5,682,538	26,716	2,722,599,714	2,730,306,213	7,706,499	1,550	11,945,072,846	(503,961,324,994)
2004	1,000,645,000,000	6,029,544	6,120,363	90,819	2,995,716,704	3,022,700,248	26,983,544	1,615	43,578,423,688	(957,066,576,312)
2005	1,589,531,073,250	5,980,209	6,139,982	159,773	3,096,035,551	3,145,387,057	49,351,506	1,680	82,910,530,470	(1,506,620,542,780)
2006	1,853,946,000,000	6,768,686	6,939,050	170,364	3,393,198,810	3,444,169,655	50,970,845	2,435	124,114,007,534	(1,729,831,992,466)
2007	3,628,347,314,395	7,332,711	7,571,615	238,904	3,762,968,859	3,836,031,901	73,063,042	2,745	200,558,050,224	(3,427,789,264,171)
Total	8,588,375,785,485								463,106,084,761	(8,125,269,700,724)

Appendix 11
Simulation of Efficiency Calculation of SP36 Subsidy

1	2	3	4	5	6	7	8	9	10	11
	INPUT				OUTPUT					
Year	seed subsidy (in Rupiah)	total demand use w/o subsidy (in tons)	total demand use w subsidy (in tons)	variance 5 = 4 - 3	Total output w/o subsidy	Total output w subsidy	variance 8 = 7 - 6	p rice	gain 10 = (8 * 9)	total profit/(loss) 11 = 10 - 2
1999	-	1,894,129	1,894,129	-	2,214,842,136	2,214,842,136	-	985	-	-
2000	-	1,974,460	1,974,460	-	2,164,308,060	2,164,308,060	-	1,135	-	-
2001	-	2,062,141	2,062,141	-	2,132,659,189	2,132,659,189	-	1,375	-	-
2002	-	2,136,828	2,136,828	-	2,213,762,413	2,213,762,413	-	1,519	-	-
2003	126,328,534,035	2,157,561	2,160,960	3,399	2,295,678,940	2,295,818,090	139,150	1,550	215,683,034	(126,112,851,001)
2004	164,285,000,000	2,273,924	2,279,726	5,802	2,589,406,870	2,589,660,927	254,057	1,615	410,301,656	(163,874,698,344)
2005	311,003,299,153	2,295,604	2,306,900	11,296	2,829,700,339	2,830,235,149	534,810	1,680	898,480,394	(310,104,818,759)
2006	362,738,000,000	2,605,335	2,615,948	10,613	2,856,462,674	2,856,909,782	447,108	2,435	1,088,708,226	(361,649,291,774)
2007	709,912,504,533	2,839,819	2,868,889	29,070	3,313,457,936	3,314,757,411	1,299,475	2,745	3,567,058,968	(706,345,445,565)
Total	1,674,267,337,721								6,180,232,278	(1,668,087,105,443)

Appendix 12
Simulation of Efficiency Calculation of NPK Subsidy

1	2	3	4	5	6	7	8	9	10	11
	INPUT				OUTPUT					
Year	seed subsidy (in Rupiah)	total demand use w/o subsidy (in tons)	total demand use w subsidy (in tons)	variance 5 = 4 - 3	Total output w/o subsidy	Total output w subsidy	Variance 8 = 7 - 6	p rice	Gain 10 = (8 * 9)	total profit/(loss) 11 = 10 - 2
1999	-	773,925	773,925	-	2,239,950,926	2,239,950,926	-	985	-	-
2000	-	774,952	774,952	-	2,228,064,057	2,228,064,057	-	1,135	-	-
2001	-	819,836	819,836	-	2,225,898,632	2,225,898,632	-	1,375	-	-
2002	-	825,803	825,803	-	2,323,901,539	2,323,901,539	-	1,519	-	-
2003	49,400,919,487	832,970	833,739	768	2,370,825,249	2,371,533,635	708,386	1,550	1,097,998,072	(48,302,921,415)
2004	164,285,000,000	968,373	969,762	1,389	2,761,770,950	2,763,054,285	1,283,334	1,615	2,072,585,150	(162,212,414,850)
2005	318,531,928,547	1,018,050	1,020,018	1,969	3,051,116,869	3,053,027,699	1,910,830	1,680	3,210,195,069	(315,321,733,478)
2006	371,519,000,000	1,077,908	1,080,247	2,339	3,091,529,822	3,093,702,248	2,172,426	2,435	5,289,856,432	(366,229,143,568)
2007	727,097,750,364	1,374,860	1,380,307	5,447	3,852,964,019	3,857,905,095	4,941,076	2,745	13,563,253,728	(713,534,496,636)
Total	1,630,834,598,398								25,233,888,451	(1,605,600,709,947)

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