The Relationship between Aquaculture Production and Poverty Reduction in Indonesia

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List of Acronyms

AFSPAN	Food Security, Poverty Alleviation and Nutrition
ASC	Aquaculture Stewardship Council
BPS	Badan Pusat Statistik (Indonesia Statistics Bureau)
FAO	Food and Agriculture Organization
FEM	Fixed Effect Model
FPL	Food Poverty Line
GDP	Produk Domestik Bruto (Gross Domestic Product)
GRDP	Produk Domestik Regional Bruto (Gross Regional Domestic Product)
HCI	Head Count Index
HIES	Household Income and Expenditure Surveys
IDR	Indonesian Rupiah
ILO	International Labor Organization
KKP	Kementerian Kelautan dan Perikanan (Ministry of Maritime Affairs and Fisheries)
LIFDCs	Low Income Food Deficit Countries
Kaltim	Kalimantan Timur (East Kalimantan)
MDGs	Millennium Development Goals
NAD	Nangro Aceh Darussalam
NTT	East Nusa Tenggara
NFPL	Non-Food Poverty Line
OJK	Otoritas Jasa Keuangan (Indonesia Financial Service Authority)
OLS	Ordinary Least Square
PGI	Poverty Gap Index
PSI	Poverty Severity Index
REM	Random Effect Model
P2HP	Processing and Marketing of Fisheries
UN	United Nations

Abstract

There are number of studies in developing countries which are connecting aquaculture production and poverty reduction. However, only few of them have been conducted to investigate the relationship between aquaculture and poverty though three indicators namely, percentage of poor people, poverty gap and poverty severity.

This paper aims to answer a question regarding relationship between aquaculture production and poverty reduction in Indonesia. Specifically, the paper is intended to analyse how big the impact of aquaculture production to reduce poverty in Indonesia through three indicators of poverty, namely, percentage of poor people, poverty gap and poverty severity.

In term of methodology, the research applies fixed effect and random effect model to estimate the relationship between of them. Results show that aquaculture production has positive impact in reducing poverty based on three indicators of poverty namely, percentage of poor people, poverty gap and poverty severity. However, power of this sector seems to be weak. By comparing provincial level results and districts and municipalities results, increasing in aquaculture production is only stronger in level of provinces. Taking the coefficient of the production to each poverty indicators, this sector affects reducing poverty in percentage of poor people and poverty gap in provincial level. Meanwhile, the production only affects poverty at percentage of poor people in districts and municipalities level.

Relevance to Development Studies

The potential of aquaculture in reducing poverty has been recognized through many literatures primarily published by the Food and Agriculture Organization (FAO). However, only few studies have provided empirical evidence of aquaculture in reducing poverty which are based on some indicators of poverty namely, percentage of poor people, poverty gap and poverty severity. Most of literatures only provide contribution of aquaculture sector through several assumptions, which are considered as pathways of aquaculture to affect poverty directly and indirectly. Studying the relationship of aquaculture production using three indicators of the poverty in Indonesia will give contribution for the debate.

Keywords

Aquaculture production, Percentage of Poor People, Poverty Gap, Poverty Severity, Fixed Effect and Random Effect Model.

Chapter 1
Introduction

"Life is a dream for the wise, a game for the fool, a comedy for the rich, a tragedy for the poor"

- Sholom Aleichem- a writer, (1859-1916)

1.1 Background of the study

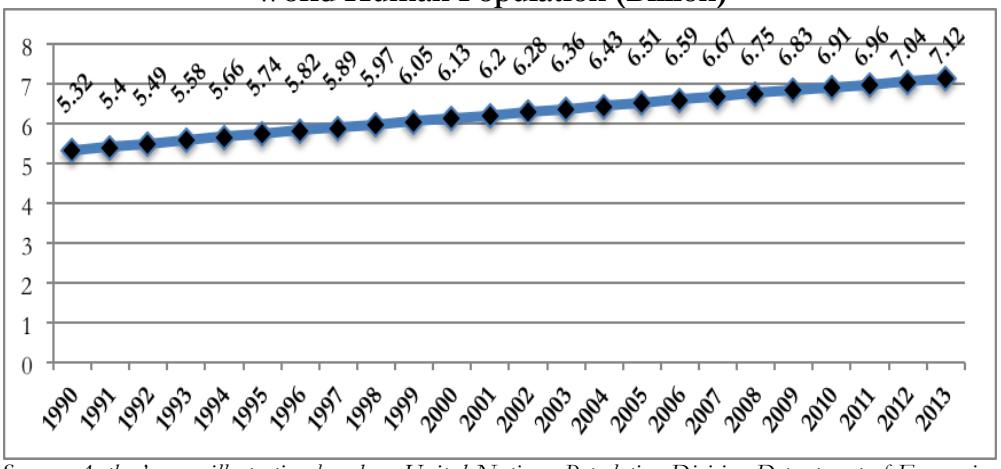
Fish is very important in human life. It has been considered as one of important sources of diet besides meat and chicken. It also provides nutrients that are needed for human body such as oil, protein and fat. According to the FAO, fish can provide daily protein between 50% and 60% required by adult in 150 g of fish. In addition, Tacon and Metian (2013) argue that fish both captured and farmed, accounting for 16.6% of the global population's intake of animal protein, 20% of average per capita intake of animal protein for more than 3 billion people, and 15% of protein for at least 4.3 billion people.

More importantly, fish is one nutritious food for low-income people in developing countries. And, they are more dependent on it compared to people in developed countries (Kent 1997)Therefore, Kent argues that decreasing in fish supply will bring serious consequences not only for nutrition to low-income communities but also for their economics. In the similar vein, one billion people have consumed fish as their main source of protein (Genschick et al. 2015). In Asia and Africa as the authors pointed out, it is found that fish, especially dried is the important food in rural areas.

It is mentioned above that fish supply is important for consumption. However, world population has been increasing over years. International organization such as the United Nations (UN) estimates that in 2015 about 7.3 billion people will inhabit the Earth[1]. The figure 1.1 below shows that the growth of world population has gradually increased. From 1990 to 2013, world population has increased by 1.4 billion. It has been predicted that by 2030, number of people will reach 8.19 billion[2].

[1] http://www.worldometers.info/world-population/, accessed on June 2015.
[2] http://esa.un.org/wpp/Excel-Data/population.htm, accessed on June 2015

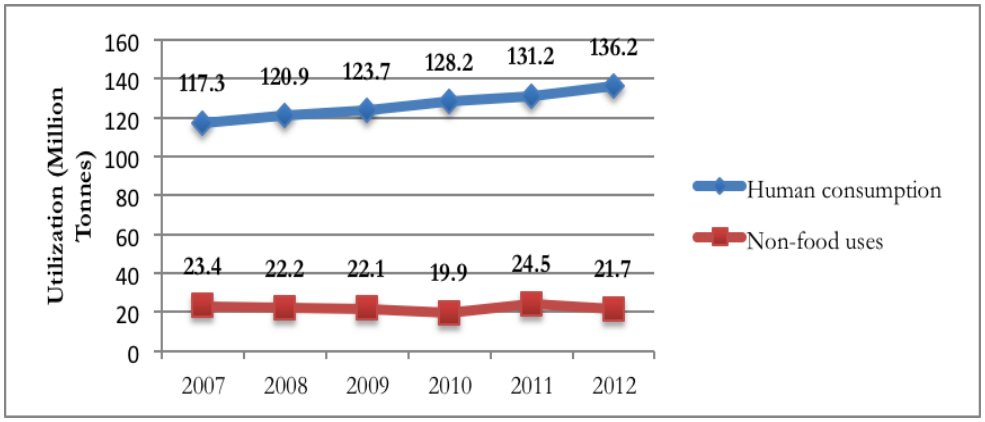
Figure 1.1
World Human Population (Billion)



Source: Author's own illustration based on United Nations, Population Division Department of Economic and Social Affairs and World Bank.

In line with the growth of world population, the number of food that is needed to meet human's consumption has also increased, especially fish. According to FAO, as shown in figure 1.2, human consumption of fish in 2012 reached 136.2 million tons. In six years since 2007, it has been increasing by 16.11%. If the needs for fish both consumption and non-consumption is combined, so in 2012 total fish needed would be 157.9 million tons. Figure 1.3 shows the world supply of fish in the same year (2012) totaling 158 million tons, the excess in fish supply globally was slightly greater than demand. Due to this stagnancy of capture fishery in the last decade and the increasing number of world population, farm fisheries have become the backbone of the world's fish supply. Naylor et al. (2000: 1017) argue that if number of population is more than 6 billion, the need for farm fish as the source of protein is vital.

Figure 1.2.
Utilization of Fisheries and Aquaculture Production in Global

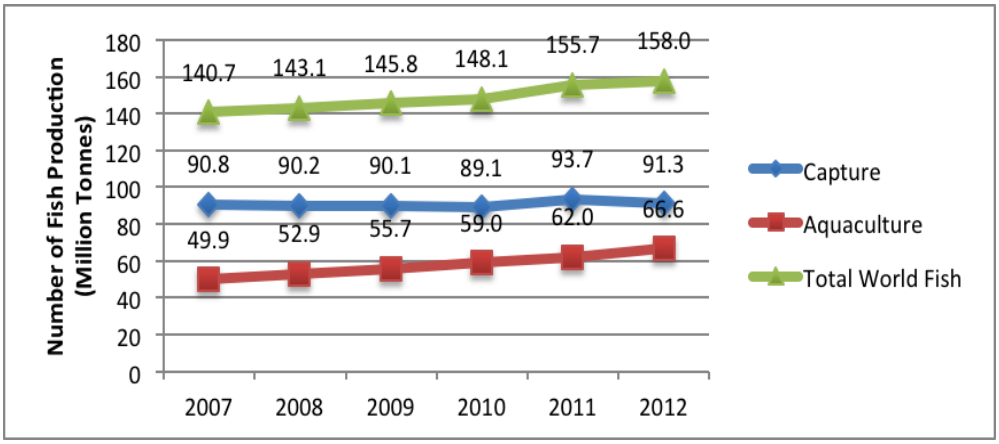


Source: Author's own illustration based on FAO "The State of World Fisheries and Aquaculture" (2014)

Aquaculture products have contributed significantly to the world's market. Figure 1.3 shows world fish production from 2007 to 2012. In 2007, aquaculture products have supplied world market with 49.9 million tons. In six years, total production has increased to 66.6 million tons in 2012 with the

growth rate of 33.46%. Meanwhile captured fish in the same period tends to be stagnant. In 2007 captured fish totaled 90.8 million tons and in 2012 it was 91.3 million tons. Compared to the growth of production in aquaculture, captured fish only grew by 0.55% in the six years from 2007 to 2012.

Figure 1.3
World Fish Production



Source: Author's own illustration based on FAO "The State of World Fisheries and Aquaculture" (2014)

Since the amount of the world-captured fish has stagnated due to decreasing number of fish, farmed fish products become an option. Farmed fish products are considered more sustainable than capture fisheries because the number of fish can be controlled, and the food stocks do not depend on the season. According to Hatch and Tai (1997), there are advantages for growing fish as a source of food comparing to other farming. First, fish production is more efficient than other animal production. For instance, catfish has weight index about 0.84, while broiler chicken and beef only have 0.48 and 0.13 respectively. Second, percentage of consumable lean flesh of catfish is nearly 81%. It is higher than chicken, which only has 65% or combination between beef and pork that only have 60.54%.

Besides the source of nutrition, fisheries sector are also considered as an important that significantly contributes to income and employment, in particular for low and middle-income countries (Genschick et al. 2015). These scholars argue that fish production has contributed to livelihood of world population by 10%. Similarly, the FAO has also noted that 10-12% of world population has been supported by fisheries sector on their livelihood. About 58.3 million people were involved in primary sector of fisheries where 84% of them concentrated in Asia. In addition, 18.9 million of people who work in the fisheries are from aquaculture.

As an important sector to meet people's need for nutrition, food diversification and the source of income, aquaculture is also expected to reduce poverty. As known, poverty is a chronic problem that has been faced by states. In common, increasing number of population, at a certain point, will have an impact on the growing number of the poor. Based on many surveys conducted by either government or academic institutions, the greatest poverty levels in de-

veloping countries are in rural areas, either in the mountains or coastal areas that are commonly undeveloped (Goldberg and Pavcnik 2004)

As noted above, there is a relation between aquaculture and poverty. In the case of effort to reduce poverty, Indonesian case as reported by Ministry of Marine Affairs and Fisheries (KKP) Republic of Indonesia states that aquaculture sector is potential sector to be developed. This sector is expected to absorb mass employment by providing more jobs, increasing income and providing cheap nutrition for low-income families. This was stated in the report that in 2014, Indonesia was producing 14.52 million tons; which was the forth-biggest country after China, India and Vietnam. However, as shown by the Indonesia Statistics Bureau (BPS), poverty is in place where aquaculture seems to be potential to develop. Studies on the relation between aquaculture and poverty remain limited. Thus, this research is about.

1.2 Problem Statement

Indonesian Bureau of Statistics recorded more than 28 million people have been categorized as poor in 2013. This number was nearly 11.37% of total population. Most of these people are living in the rural and coastal areas. With the low range of job opportunities, aquaculture sector has been seen as one of solutions to increase income.

There are few studies, which provide impact of aquaculture production on poverty reduction on macro level. Most of them indicate that the role of aquaculture production by channeling food supply, employment, income, promoting economic growth, and nutritional will benefit to communities. In fact, seldom of them have approached this issue from the view of growth of aquaculture production and its impact on reducing a percentage of poor people, gap of poverty as well as poverty severity in a country.

1.3 Objectives and Hypothesis

Based on explanation stated earlier, the objectives of this study are;

1. To understand what is the relationship between aquaculture production and poverty alleviation in Indonesia.
2. To study the expansion of aquaculture production and its impacts on the poverty.

The hypothesis of the study is that production of aquaculture might have a positive impact on reducing poverty. It means that increasing production will reduce poverty based on three indicators, namely percentage of poor people, poverty gap and poverty severity.

1.4 Limitation of the Study

Some limitations are identified in this study. The first is related with data, in particular data of poverty and of aquaculture production. BPS in 2002, started to use three indicators of poverty namely percentage of poor people, poverty gap and poverty severity at provincial level. Beforehand, poverty measurement relied only on number of poor people, which was calculated from the average monthly per capita expenditure below the poverty line. Therefore, this study

will analyze only data from 2002 to 2013 in provincial level. Second limitation, some provinces were established after 2005, and this makes structure of data more complex because in the previous years the production of new provinces was embedded into mother province. In turn, the levels of production in mother province tend to be on the lesser end. This condition will affect result of estimation.

To understand more on the impact of aquaculture production to reduce poverty in Indonesia, this study also uses districts and municipalities data for comparison. Similar to provincial level, collecting data is also limited meaning not all districts and municipalities in Indonesia have data of the aquaculture production in its area. This is due to administration issues. As a consequence, this study only covers 132 sets of data, which were collected ranging from 2008 to 2013.

1.5 Chapter Outline and Rational

The paper will be organized in six chapters. Chapter one describes background, problem statement, research question, limitation of the study and chapter outline and rational. Next, second chapter is conceptual framework and literature reviews. This will be about theory on aquaculture and on poverty. The link between aquaculture and poverty will be presented accordingly. Still in the second chapter, the subsection of it will looks at some of the empirical studies, which are related to the role of aquaculture to poverty reduction.

Afterwards, chapter three highlights Indonesia poverty overviews and its aquaculture. It then will elaborate poverty condition and potential contribution of aquaculture on reducing poverty. Following chapter three is about data and methodology. It will analyze the type of data used, how many samples and which variables used in this study. Specifically for the variables, this chapter will identify independent and dependent variables. It will also state the hypothesis for the effect of each independent variable on to dependent variable. After that, model of estimation will be presented. The last part of this chapter will present descriptive statistics, which provides some information relating with variables that are used in the study.

The fifth chapter will present result and analysis for two different levels of data (provinces and districts/municipalities). It will analyze the relationship between aquaculture production and poverty reduction by three indicators of poverty. The final chapter will be conclusion, it will summarize results of the study, policy implications, which are offered and further research.

Chapter 2
Conceptual framework and Literature Reviews

This chapter explains the concept of aquaculture and poverty. In the first subchapter, the concept of aquaculture will be elaborated. The next subchapter will review the concepts of poverty and calculation of poverty line and its indicators. After that, the relationship of aquaculture and poverty reduction will be reviewed. Last, empirical evidences from previous studies will be presented.

2.1. Concepts and Scope of Aquaculture

By definition, aquaculture is a production of fish, other animals, plants, algae, and microorganism in aquatic ecosystems (Edwards 2000). According to the Law of Republic of Indonesia Number 45 in 2009 on Fisheries, "aquaculture is an activity to maintain, raise, and / or breed fish and to harvest the results in a controlled environment, including activities that use the vessel for loading, transporting, storing, cooling, handling, processing, and / or to preserve it".

There are several methods to identify type of aquaculture systems. Generally, the system of aquaculture can be divided into the use of inputs (particularly feed) and its cultivation (Edwards 1999).

The Use of Inputs

1. Extensive of aquaculture
   This system is usually used by small-farmers. Extensive aquaculture, furthermore, relies on food that is provided by nature such as plankton and other aquatic vegetation in the culture. Usually, the equipment used in this culture is simple and is not affected by high technology. As a result, production scale is low.
2. Semi-intensive of aquaculture
   As an intermediate system, semi-intensive uses combination between natural feed and other supplements. The supplements itself need higher costs compared to the extensive system. In return, level of production will be higher than extensive system. According to Dey et al. (2005b) developing countries in Asia are appropriate places to develop semi-intensive monoculture or polyculture either omnivorous or herbivorous species because characteristic of most water bodies in the regions and socioeconomic conditions that they have will support this type of aquaculture.
3. Intensive of aquaculture
   The top of the systems is intensive aquaculture. It needs technology to maintain temperature of the medium for the fish to live in. It also needs high supplements that cannot be found directly in the nature. For exporting purposes, this system is the most appropriate to reach high quantity of the production. It can also maintain quality control of the products to meet international standards. Usually, this system has been implemented by many developed countries that do not have availability of land to culture the fish.

Based on cultivation, aquaculture can be divided into three systems (Edwards 1999), namely;

1. Inland Land-based Systems

One of the advantages of aquaculture is that it can be cultured not only in the sea or lake but also farmers can create artificial environment to grow the fish. Pond is the most common medium that is used by many producer countries to culture the fish. Even for a large country such as Indonesia, paddy fields can also be used as pond. Thus, farmers can obtain more income because they get revenue both from harvesting the paddy and growing fish. Edwards (1999) found in some countries in Southeast Asia like Indonesia, Thailand, and Vietnam, farmers also cultivate fish in the irrigation. The drawback of this system is that many farmers in the developing countries tend to use pesticide to increase their paddy's production. This use of pesticide commonly will affect quality of the fish because it contains chemical elements. This is also affect human's life. Therefore, international standard of food security has banned products that contain such chemicals. These products cannot be exported to meet international market, as a consequence. On the other hand, Edwards pointed out the positive of using pond culture because it is appropriate for small-household farmers. It does not need huge capital investment and it can be applied without high technology.

2. Inland Water-based Systems

Cage and pen culture are two types of aquaculture, which are categorized into this system. According to Guerrero (1998) cage and pen culture are classified as intensive farming. It highly depends on complete feeds such as small fish and dried pelleted feeds. Also, it makes production costs of this culture higher than other cultures. However, excessive number of cage and pen culture has potential to pollute the environment and can spread disease amongst cultured fish. In contrast, this cultivation offers a wider employment for the local population and also a market for fish farmers who focus on seed breeding fish. In other words, this type of culture has a multiplier effect for fish farmers in the surrounding areas.

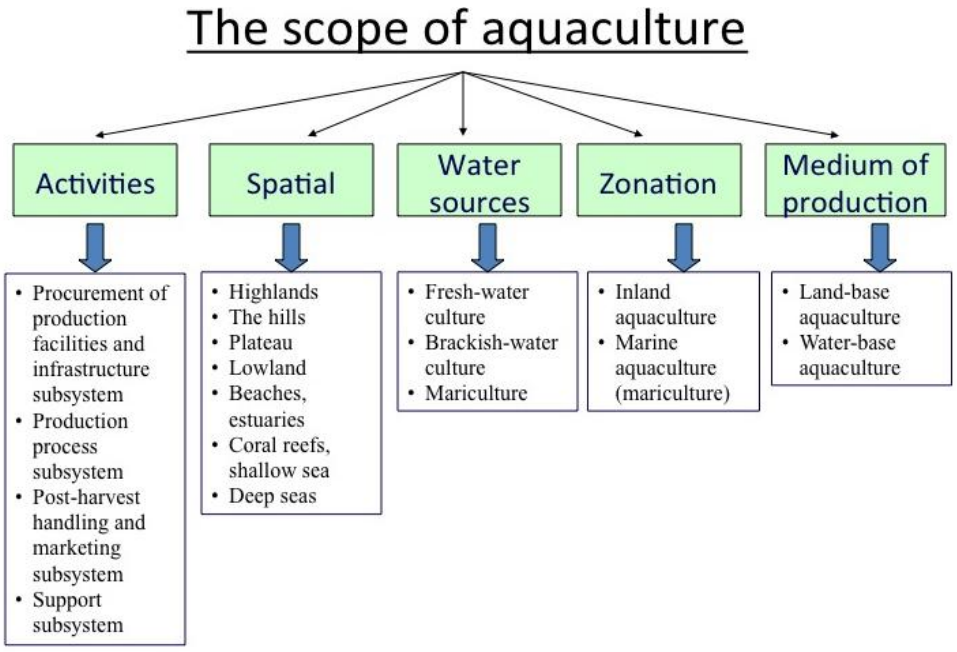
3. Coastal/marine Systems

Most of the fish, which have high sales value, are living at sea or brackish, such as shrimp, lobster, tuna, and salmon. Economically, cultivating these commodities will bring higher income for fish farmers. Nonetheless, it is undeniable that the lands, which are needed for fish farming in coastal areas, have increased rapidly. As a result, the decrease in mangrove forest conservation due to its conversion into fish farming land area threatens the survival of aquatic animals in the environment, especially for animals that are on the verge of extinction. Eng et al. (1989: 337) stated that the conversion of mangroves into brackish water aquaculture and shrimp ponds jeopardize valuable resource in that area and also creates an imbalance of mangrove ecosystems. However, recently many producer countries have placed their attention on how to deal with a negative impact of this culture on the environment such as establish-

ment of protected areas. These areas are protected by national and international law and should not be exploited for any other economic purposes.

In short, Figure 2.1 below summarizes the scope of aquaculture sector divided into five areas; the types of its activities, the place to grow the products, source of water, type of zonation, and the basis of production that are used for studies by many researchers around the world.

Figure 2.1



Sources; adapted from Edward, 2000 and The Law of Republic Indonesia Number 45 in 2009 on Fisheries.

2.2. Definition of Poverty

Poverty is the most common occurrence around the globe. Both developing and developed countries are hand in hand on trying to eradicate poverty on domestic and on international levels. So far, poverty has correlated with illiteracy, lack of nutrition and health problems that make people incapable for optimally employ the potential they have to achieve a better life. Unfortunately, there are no fixed definitions that can be used to define poverty. Various scholars define poverty differently. The following will explore.

Townsend (1979) defines poverty as the conditions faced by the individual, family or community in which their resources are not sufficient to meet a decent standard of living and considered outside the normal pattern of life. According to Hagenaars and de Vos (1988), definition of poor can be fit into one of categories as having less than an objectively defined, absolute minimum, having less than others in society or feeling as not having enough to get along. Meanwhile Goedhard et al. (1977) pointed out that poverty is a condition where command over resources falls below a certain level of "poverty line". Ravallion (2003) defines poverty as "absolute of living standard" meaning that people's survival level is based on their consumption needs by looking at purchasing power. All definitions described above refer to the conclusion that the

existence of a threshold, which is considered as the standard that determines a person or family were classified as poor or not poor.

2.2.1 Measurement of Poverty and Poverty Line

Poverty is a complex problem. Multidimensional aspects in poverty determine a condition of people who are considered poor. Income, malnutrition, illiteracy, disease, and other elements can cause poverty. In addition, poverty occurs when all these elements are under the threshold. In this sense, all elements, which are mentioned above, are used as crucial to measure poverty. Laderchi et al., (2003) argue that different elements of poverty measurement, therefore, will lead to different policy to eradicate poverty.

There are two approaches in measuring poverty namely monetary approach and capability approach. In monetary approach, either consumption or income constitutes a variable to identify poverty. If the income, which is earned or consumption to be expended were below a certain standard of living, then it is identified as poor. According to Laderchi et al., (2003) welfare as a representation of economic condition to measure poverty depends on utility maximization behavior. And it can be justified through minimum right approach (certain basic income) or other aspects of welfare such as nutrition and health.

On the other side, capability approach rejects monetary approach as poverty measurement. A reason behind this rejection is that poverty is defined as deprivation to achieve minimal or basic capabilities (Laderchi et al. 2003). Basic capability is not only viewed from an economic standpoint but also viewed from a broader view of how the ability to live in certain level can be achieved. This approach is specifically designed by Amartya Sen where freedom to live is valued by human potential to fulfill certain functions which are considered important up to a certain level. However, the latter approach is difficult to use in assessing poverty due to the role of externalities and social goods brought into the picture as other influences over capabilities. That is why monetary approach is considered as a common method in measuring poverty.

According to Ray (1998), there are some concepts that should be considered when determining poverty measurements. The concepts are;

1. Expenditure as a whole or item-by-item consumption

There two arguments on how to identify a person to be classified poor or not. Ray (ibid) has launched a question that can give direction about who will be considered as poor; people who have consumption basket under a certain threshold or people who have an overall income to be spent below the minimum required of consumption standard. This question will lead to the formula that can form the threshold itself. The advantage of this approach is easier to use especially when availability of the data is limited and in question.

2. Absolute poverty or relative poverty?

As stated by Ray (1998), there is unclear definition of the phrase of "acceptable levels of participation in the society". It means that people in different geographical areas have different understanding of ownership. For example, in

the United States, having a car is the standard of living but in Africa or Indonesia, having a car means this people already considered as a high-income community. Then, policy that will be implemented for those countries to improve people living standard will be different than in the United States. However, Ray emphasizes the notions of necessity to reach a certain standard, and to fulfill the absolute notions for being functional in society. The idea of basic needs, for example, certain level of nutrition, or a percentage of average income that should be fulfilled making the absolute threshold acceptable for every area or a country.

3. Temporary or chronic?

Consumption and income can be fluctuated in the long term. Sometimes, income or consumption of one person in certain period can be higher or lower compared to previous or future periods. Thus, it needs to be identified whether a person or a group of society is absolutely poor or just relative poor due to fluctuation of economic performance of their country. The idea of temporary or chronic poverty has been crucial because the policies required to reduce poverty will be different between temporary and chronic poverty (Ray 1998).

4. Household or individuals?

Ray (ibid) argues that macro estimation of poverty should be complemented with micro estimation. The reason behind his argument is that the household's expenditures tend to be skewed. It means, it cannot reflect the victims of poverty who are usually females or old people. Conversely, if the calculation were only based on individuals, then, it also brought a problem to a household level because family size will determine the level of consumption. Thus, bigger families will be considered as non-poor because they consume more than small size families.

Some literatures have come with the same understanding on the needs to define the poverty line as a standard to identify the poor. Here are some definitions of poverty line. Ray (1998) pointed out poverty line as expenditure threshold, which is considered as minimum standard to participate in economic life. If people are living below this line they are considered poor. Meanwhile, Goedhart et al. (1977) perceives the poverty line from minimum level of income based on family size. Then their actual income will be determined by the size of their family.

With different range in calculating poverty line, the UN in Millennium Development Goals (MDGs) has standardized the rate of poverty line which is about $1.25 per day or $2 per day in Purchasing Power Parity (PPP) in dollars globally. It means for people who live below these rates are considered to be poor. In addition, to determine the number of people who live under poverty line, each country has deliberately used their own calculation based on basic needs such as income, nutrition, housing, and consumption.

Through BPS, Indonesian government has defined poor people as those who have an average monthly per capita expenditure below the poverty line.

The poverty line is a sum of two measurements, namely, Food Poverty Line (FPL) and Non-Food Poverty Line (NFPL). FPL is the minimum food expenditure, which is equivalent to 2100 kilocalories per capita per day. Fifty-two types of commodities (grains, tubers, fish, meat, eggs and milk, vegetables, legumes, fruits, oils and fats) represent basic needs of food commodities. Then NFPL is the minimum requirement for housing, clothing, education and health. Fifty-one types of commodities in urban and 47 rural commodities represent package of non-food commodities of basic needs.

There are three indicators that can be used to capture the dimension of poverty in the national or regional level (Foster et al. 1984).

1. Percentage of poverty or poverty headcount ratio (P_0)

   It is a percentage of poor people in the proportion of population who either have income or consumption expenditure below the poverty line. This measurement is commonly used because it does not require complex calculation and data. The formula of head count index can be taken by dividing number of poor people with total population. There are three weaknesses of the index[3]. First, the headcount index does not take into account the intensity of poverty. Second, the head-count index does not indicate how poor the poor are, and therefore the index does not change if people below the poverty line become poorer or less poor. Third, the estimation of poverty should be calculated for individuals and not for the household levels. In short, this index fails to identify variation level of poor people in terms of their income or expenditure. All people who cannot fulfill the standard of living reflected by poverty line are considered as poor. Different level of income or expenditure among communities will classify them as poorer and nearly poor based on the poverty line. Implementation of policy in reducing poverty should consider these classifications to make the policy becoming right on target. In the other words, policy to be implemented between poorer and nearly poor to be lifted from the poverty line will be different.
2. Poverty gap ratio (P_1)

   Poverty gap ratio is the tool to cover the weaknesses of head count ratio. Poverty gap ratio is the ratio of the average income / or consumption needed to get all poor people to the poverty line (Ray 1998). The purpose of poverty gap ratio is not to calculate the poverty itself but to provide the measurement of resources needed to eradicate the poverty. It can also provide information on minimum and maximum costs which should be paid to the different levels of poor communities in elevating their income or expenditure above the poverty line. However, this ratio only works if the government or policy makers have a lot of information about its citizens in terms of economic condition in the household level.
3. Poverty severity (P_2)

   Poverty severity is the averages of squared poverty gap. The aim of this

[3] http://siteresources.worldbank.org/PGLP/Resources/povertymanual_ch4.pdf, accessed in July 2015.

measurement is to build a measure of the poverty that considers inequality among the poor. The difference between poverty severity and poverty gap is that the poverty gap treats the weights equal, while the poverty severity differentiates the proportion of weights to be added into the gap through squaring. The weakness of poverty severity is that this measurement lacks intuition. Thus, interpretation of the index is not simple. That is why this index is not widely used to measure the poverty. However, together with poverty gap, poverty severity has a power to explain the incidence of poverty and what types of the intervention is appropriate to be implemented in helping different groups of the poor coming out from the poverty line.

2.3. The Link between Aquaculture Production and Reducing Poverty

According to Kakwani and Pernia (2000), poverty reduction is about improving human well-being, in particular poor people. Improving of well-being is not easy because it should have clear definition of well-being itself. Sen (1976) states that well-being is about functioning and capabilities where the functioning is a reflection of achievement while capabilities are about power to achieve. It means that poor people should have the same opportunities with others to improve their life. In other words, the poor should actively participate in the economic activity and significantly benefit from it.

There is a bunch of literatures state that manufacturing sectors provide higher multiplier effects to improve living standards for people. However, agriculture sector, specifically aquaculture has some pathways to contribute in reducing poverty, especially for people who live in rural and coastal areas, which are not considered as the center of economic growth.

1. ***Food security and affordable source of nutrition***

   Aquaculture production could reduce number of people who considered as poor by food supply and nutritional benefit both as producers and consumers (Edwards 2000, Allison 2011). As a producer, poor people who have grown fish in their land can directly consume fish to fulfill their nutritional needs. They can use money that they have for other needs such as education for their children or saving it for other purposes. As a consumer, they can afford to have high nutritious food through a cheaper price.

   In economic theory, price is determined by supply and demand in the market. If demand exceeded supply, then price will go up. On the contrary, if there was an excess of supply, price goes down. By increasing fish supply in the market, fish prices will go down; in turn more people from low and middle-income families can afford to consume fish. Consumer behavior theory can be the appropriate approach to look at how people determine their level of consumption, which considers their utility[4]. Generally, to get maximum utility in consuming a certain good or service, the consumer will consider how much price they should pay because a consumer is assumed as a rational person (Zinkhan 1992). Then fluctuation in the price has be-

[4] http://eprints.bournemouth.ac.uk/10107/1/Consumer_Behaviour_Theory_-_Approaches_%26_Models.pdf, accessed in July 2015.

come crucial because in the food market, which is considered as a perfect market, every seller will try to compete in price. Compared to other nutritional source, price of cultured fish tends to be stable than beef or chicken because the supply of fish is higher than those two nutrition sources which is proved by the fast growing fish production that have been noted by FAO in the last ten years.

In addition, people are divided into three different types of groups based on income level, namely, high-income level, middle and low level income family. Each group has different type of consumption behavior. For high-level income society, their consumption pattern is determined by how much nutrition they get from particular kind of food. Meanwhile, for low-income community, price of food is a primary reason to determine which food they afford to consume. Middle-income families make their decisions in terms of food consumption based on prices of food and their nutritional needs. In general, the low and middle-income families, price is considered as one of the main determinant factors in shaping their consumption pattern because they will not afford to obtain food at higher prices.

2. ***Creating jobs and income***

By expanding this sector, there is a possibility for expansion of jobs and income. According to Ahmed and Lorica (2002), contribution of aquaculture to reduce poverty through provision of jobs and income are higher in developing countries, which places aquaculture as a leading sector. Generally, in developing countries, the type of aquaculture that they have is extensive and semi-intensive which requires a lot of labor force in its operating process. It is started from breeding, harvesting and marketing process of aquaculture products. To fill the needs of the labor force, fish farmers who are categorized as small farmers generally employ their family members. It is adequately possible because characteristic of a family size of the living families in rural and coastal areas are generally large. If they do not have enough family members they can use, they can utilize workers from the local villages or towns. In the end, it would reduce a number of unemployment in that region.

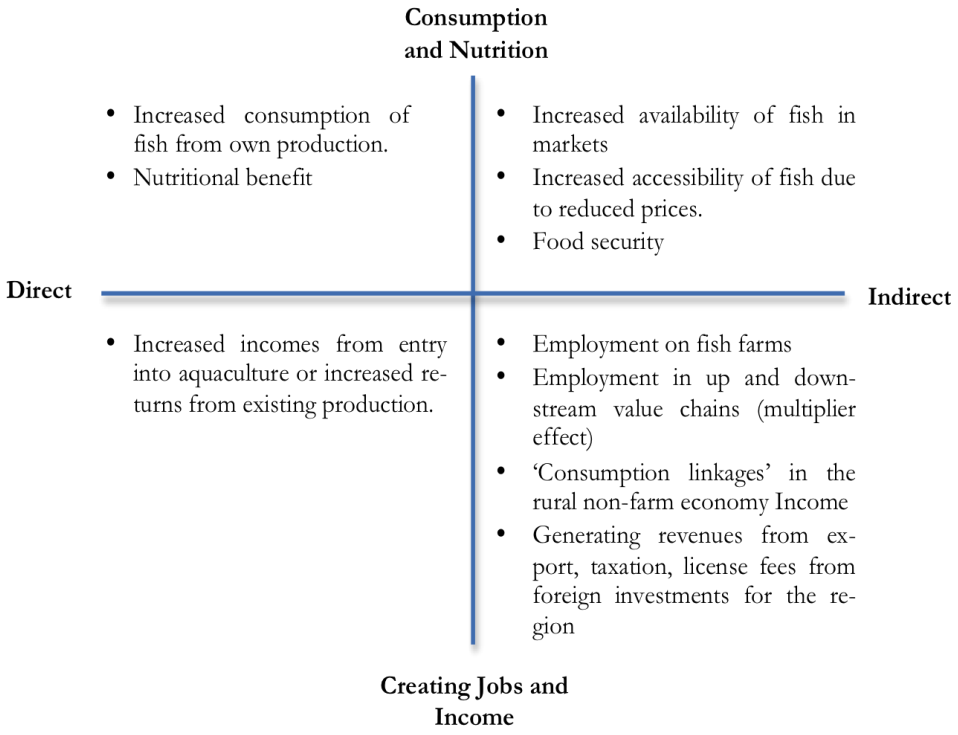
On the income side, aquaculture could provide farmers with higher revenues, gained through the sale of their products. Increasing numbers of fish consumed, should increase the demand for these products. According to Moffit and Cajas-Cano (2014), one-half of all fish consumed has been coming from aquaculture products. High demand for fish will trigger farmers to obtain more income by increasing their production. In addition, if these farmers choose to grow high- valued fish especially for exporting purposes, then, their income will be higher than the farmers who grow fish for the domestic or local markets.

3. ***Generating revenues from taxation, license fees from foreign investments and export***

On macro level, aquaculture production can contribute to a national economic performance. Allison (2011) notes that this sector also contributes on regional and national income through tax, and license fee for investment especially from foreign companies. By spending in effective way,

revenue from this sector can help to improve economic performance in the region and reduce poverty on a large scale. Many public infrastructures can be financed from this sector, especially if this sector has significant contribution to gross domestic product. In addition, this sector is sustainable because the production can be improved and quality of products can be controlled.

Figure 2.2
The link on how aquaculture contributes in reducing poverty



Source: Adapted from Toufique and Belton (2014), Allison (2011) and Edwards (2000).

2.4 Empirical Evidences

Amid the incessant promotion of FAO in raising the potential of aquaculture to reduce poverty, there is, however, little empirical evidence that shows the influence of aquaculture production on lifting people up of poverty, especially for those who inhabit in remote areas and coastal areas. Belton et al. (2012) is the one from few researchers who have been trying to figure out how the aquaculture sector can help poor people on improving their livelihood. By conducting interview and participatory appraisal in two sub districts namely Phulpur and Trishal in district Mymensingh which is recognized as central of homestead carp culture and intensive pangasius catfish culture in Bangladesh, they found that 75% of household who operate in pangasius ponds are considered as the wealthiest in the area and only two out of 130 households of pangasius farmers in the area are categorized as poor. They also disclose that pond owners of pangasius are never encountered to have problem with consuming three meals per day. At the end, they conclude that pangasius aquaculture have

brought a significant role to increase availability and accessibility of fish in the region and, particularly for low-income consumers and improving food security in the national level.

There is another study, apart from Belton et al, that is also conducted in Bangladesh. At this point, Taoufique and Belton (2014) assess on how aquaculture behaves to reduce poverty through food security. By using national data of fish consumption collected by Bangladesh Bureau of Statistics for Household Income and Expenditure Surveys (HIES) in Bangladesh in 2000, 2005 and 2010, they attempt to connect between the dynamics of fish consumption and the growth of aquaculture. The background of their research is that there is an enquiry of aquaculture power to fulfill the needs of poor people on nutritional food consumption, especially fish (Lewis 1997). They found that annual fish consumption of extreme poor (8.9%) was higher than moderate poor (5.3%). However, it was still below non-poor (21.2%) in the period between 2000 and 2010. If it was compared to the growth of fish consumption, then extreme poor communities had the highest growth of fish consumption from 0.9% in 2000 to 8% in 2010. This percentage was higher than the growth of consumption in moderate poor from 1.5% to 3.5% and non-poor from 7.4% to 12.9% in the same period. In addition, they also revealed that the growth of aquaculture products played significant role to keep the fish price closed to the price of rice as another staple food. In short, they conclude unequivocally that aquaculture had proven to be pro-poor in term of consumption pathway. In addition, increasing in fish supply due to increasing in aquaculture production has forced the price of fish to be lower and stimulating fish demand in the region.

Another study by Irz et al., (2007) which have conducted a research in the Philippines to figure out the ability of aquaculture development to reduce poverty and enhancing equity in society. They used survey methods by taking 148 households randomly in five *barangays* (smallest administrative unit or equal with a village) as samples, which spread in five coastal areas in the country. Instead of consumption, they choose income per capita as a proxy of welfare to assess whether income of fish farmers was higher in this sector or not. To see distribution of welfare among communities, the authors used the Gini coefficient. Their research, then, focused on brackish-water aquaculture, which is considered as major culture that has been developed across the country. They find that almost a third of household income is generated by aquaculture. In term of income inequality and compared to non-aquaculture, they also find aquaculture can reduce income inequality among communities better than non-aquaculture. The final finding of their research discloses both direct and indirect impact of aquaculture through income and creating jobs that have significantly support livelihood of the people in the region where they study. In particular for creating jobs, aquaculture is not only providing jobs in the upstream sector such us breeding and caretaking but also in downstream sector such as marketing of feeds, seeds and fish; transportation services for workers, inputs and outputs; and construction and maintenance of boats that are used in fishpond operation.

Based on the concept of poverty and aquaculture, and links that can connect between poverty farming sector and supported by empirical evidence that has been presented above, there is a possibility of aquaculture production to reduce poverty in the community through provision of employment, consumption and nutrition.

Chapter 3

Poverty and Aquaculture in Indonesia

The first part of the chapter will look at the poverty rate in Indonesia. It will cover number of poor people, poverty line and composition of poverty between rural and urban, which is based on percentage of poor people. Other part will look at potency of aquaculture in Indonesia which covers potential land, growth of aquaculture production, provinces which have been considered as the biggest producers, main commodities of aquaculture, number of companies and people who involve in this sector and the growth of fish consumption in Indonesia.

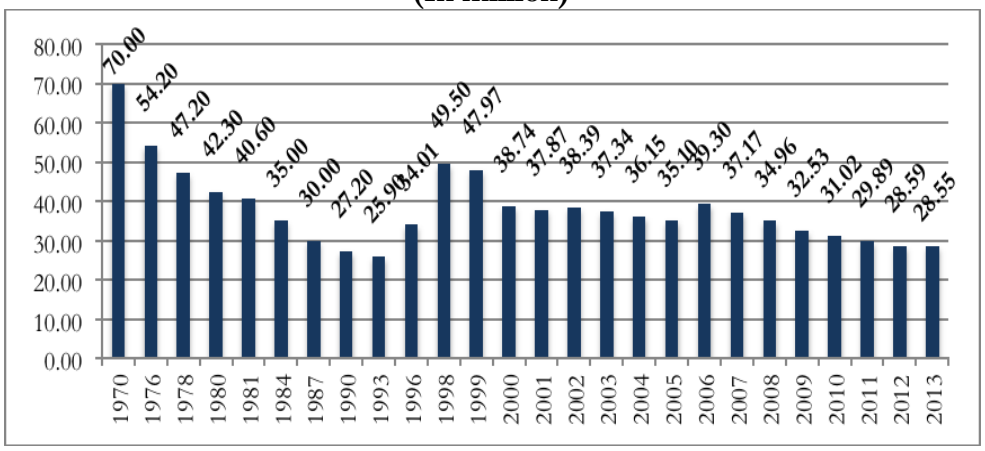
3.1 Poverty in Indonesia

Number of poor people and poverty line

From 1970 to 2013, the number of poor people in Indonesia continues to decline. In 1970, it was estimated that about 70 million people lived in poor conditions whereas at the end of 2013, the number of poor was estimated at only about 28.55 million people (figure 3.1). The sharp decline in the number of poor people occurred between 1970 and 1993 when the number of poor people was about at 25.90 million. However, in 1996, the number of poor people increased rapidly by more than 5 million people. It was continuing until 1998 when the number of poor people was about 49.5 million. This was mainly due to economic Indonesian economic crisis. It was caused by capital outflow. Furthermore, Inflation rate jumped from 11.10% to 77.63% in 1998. In addition, the currency felt down from 2,909 IDR in 1997 to 17,000 IDR in January 1998 against (the US dollar). In this time, many factories in Indonesia collapsed because they could not afford to import raw materials, followed by reduction of workforce in the manufacturing sector. Per capita income which reached 1,155 dollars/capita in 1996 and 1,088 dollars/capita in 1997, shrank to 610 dollars / capita in 1998. In 1999, according to International Labor Organization (ILO) two out of three residents of Indonesia as considered as very poor condition. In this period, number of poor people reached the highest point, after the 20 years of successful poverty reduction. At the end, the impact of economic crisis in Indonesia had forced the change of regime from President Suharto to his successor President BJ. Habibie.

Under Habibie's government, the country started to recover from its crisis. Economic performance showed better indications. Number of poor people decreased from 47.97 million to 38.38 million between 1999 and 2000. This condition continuously occurred until 2013 when the number of poor people gradually decreased to 28.55 million.

Figure 3.1
Number of Poor People in Indonesia since 1970 until 2013
(In million)

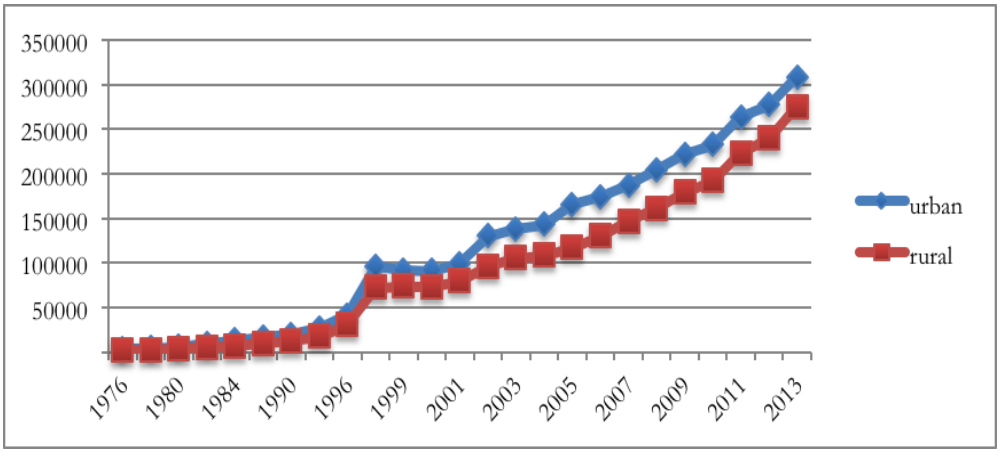


Source: Author's own illustration, BPS

Figure 3.2 shows that poverty line between rural and urban areas in Indonesia from 1976 to 2013. It can be seen than between 1976 and 1990, the poverty line in urban and rural tends to be equal. The poverty line between rural and urban in this period was about 2,849 IDR in 1976 for rural and 4,522 IDR for urban. Meanwhile, in 1990, the poverty line in the rural reached 13,295 IDR and in the urban was about 20,614 IDR.

In the post 1996, the line between urban and rural poverty were clearly seen when urban areas had higher poverty line than rural areas. In 2013, the poverty line distinction between them was about 12% higher in urban areas compared to rural areas. It meant that the minimum standard of living was bigger in urban compared to its counterpart. Although living standard in rural is lower than in urban, number of poor people is bigger in the rural areas.

Figure 3.2
Poverty Line between Rural and Urban Area in Indonesia between 1976 and 2013

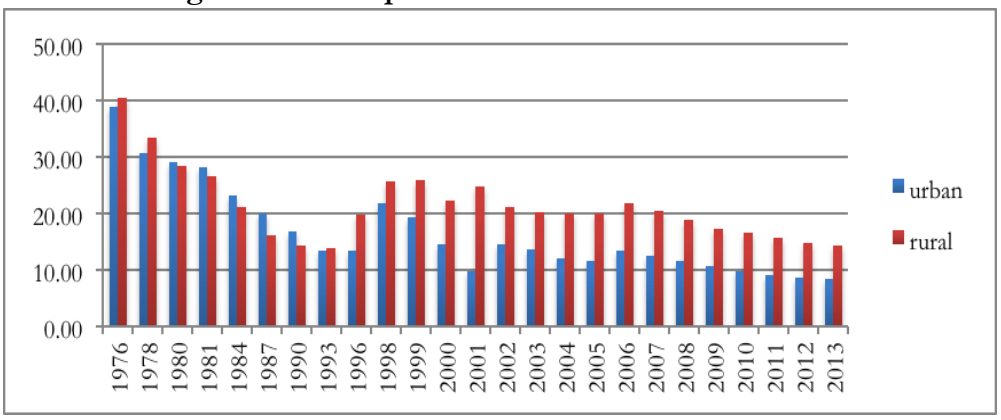


Source: Author's own illustration, BPS

Composition of poor people between rural and urban area

Since 1976, the percentage of poor people in Indonesia has been concentrated in urban areas. But after 1993, this condition changed when the number of poor people shifted to being higher in the rural. This changing poverty map in Indonesia from urban to rural, according to Professor Mubyarto (populist economic experts in Indonesia), is caused by rapid development in urban areas, which contribute to increased income[5]. The figure 3.3 below shows that after 1993, the percentage of poor people living in rural areas is higher than in urban. In 2001, the difference in the percentage of poor between urban and rural areas was the highest, when only 9.79% of the poor were living in the urban where as the percentage of poor people in rural areas reached 24.84%. However, after 2006 the percentage of the poor in rural decreased dramatically with only 14.42% of the poor lived in the rural in 2013. In the end of 2013, the percentage of urban poor people was just 8.52%. A decline in the percentage of poor people in rural areas is suspected because of equality in local development.

Figure 3.3
Percentage of Poor People in Indonesia between 1976 and 2013



Source: Author's own illustration, BPS

3.2 The Potency of Indonesian Aquaculture in Reducing Poverty

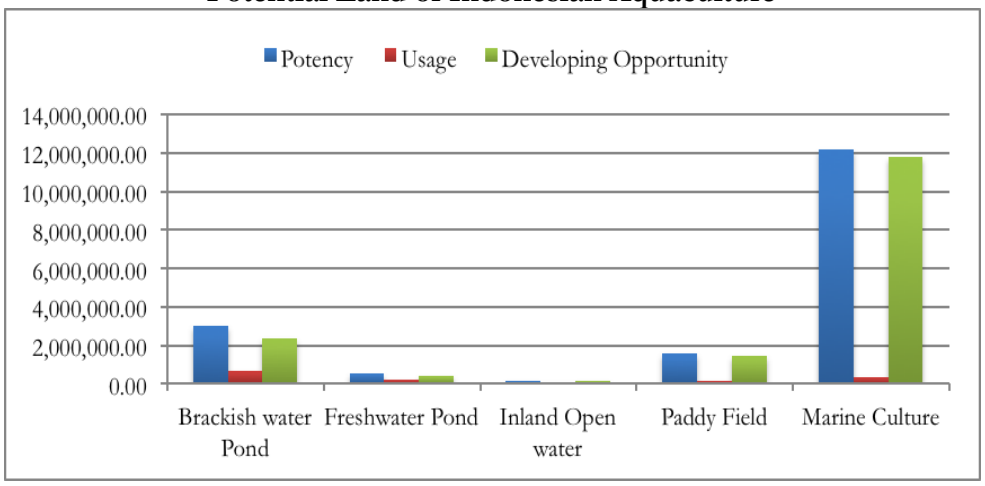
As described in the previous chapter, aquaculture has offered several opportunities to reduce poverty through multiple pathways. As known, poverty remained persistent in the areas that are far away from center of growth. Fish culture might be the best solution to increase wellbeing in terms of income and consumption. Surrounded by more than 95,181 km of coastlines and 84,289 of reservoirs, Indonesia has potential to increase its production in fisheries, especially aquaculture. The FAO has been acknowledging that in six-year period from 2007 until 2012, Indonesia has become the forth-largest producer after China, India and Vietnam in aquaculture production. With the average growth of production 25.14% per year, whereas China only has average growth by 5.56% per year, Indonesia has a chance to compete China's production in the future.

[5] http://www.library.ohiou.edu/indopubs/1997/08/14/0022.html, accessed July 2015

Potential areas

Figure 3.4 shows the potential lands of Indonesian aquaculture. There are six types of place that have been used by Indonesian fish farmers in aquaculture namely: brackish water, freshwater pond, inland open water, paddy field, and marine culture. From these six places, marine culture is the highest, which is potential to be developed. With more than 12 million hectares, only 325.9 thousand hectares have been used, while the rest of 11.8 million remain unused. The second biggest is the brackish water ponds that covers nearly 3 million hectares of potential land which only 650.5 thousand hectares have been cultured by the farmers. Meanwhile, 2.3 million hectares have been waiting to be developed. The third is a paddy field. KKP has noted that paddy field can be used to grow fish during the cultivations. It will give value added for paddy farmers to improve their income. In terms of location, Sumatera, Kalimantan, and Sulawesi are three biggest islands, which have a large potential land, which is undeveloped for inland land and water based system.

Figure 3.4
Potential Land of Indonesian Aquaculture

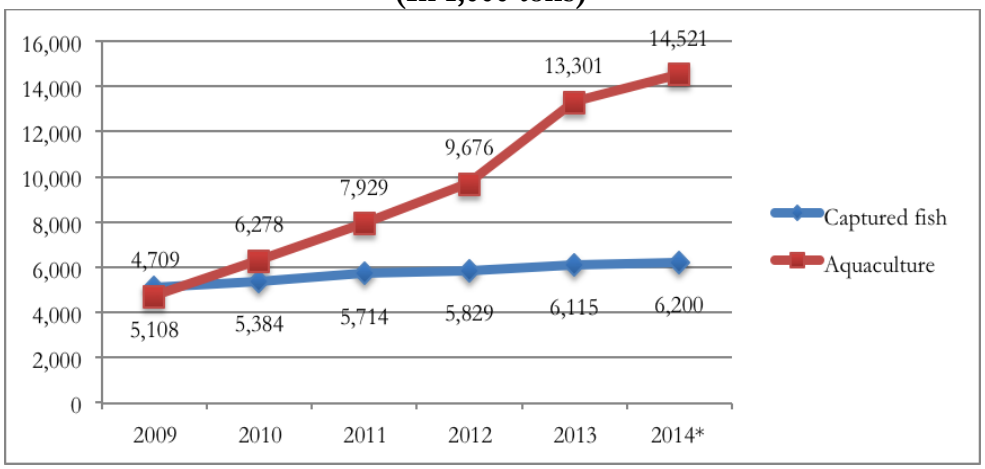


Source: Directorate General of Aquaculture, KKP, Republic of Indonesia

Comparison between captured fisheries and aquaculture production

The growth of aquaculture has shown remarkable improvement on its production in the last six years (2006 until the fourth quarter of 2014). In 2006, total production in this sector was only about 4.7 million tons. However, in 2014, total production was about 14.5 million tons. On average, the production has increased by 1.6 million tons or 34.75% in six years. If this number is compared with captured fish production in the same period, then aquaculture is seen to be superior. Within the period of six years, captured fisheries do not show any significant increase in production. By 2006, captured fisheries produced 5.1 million tons while in the fourth quarter of 2014 the production reached only 6.2 million tons. Having seen from the growth of production, captured fisheries only grew at an average of 180 thousand tons per year or at about 3.59 % (figure 3.5).

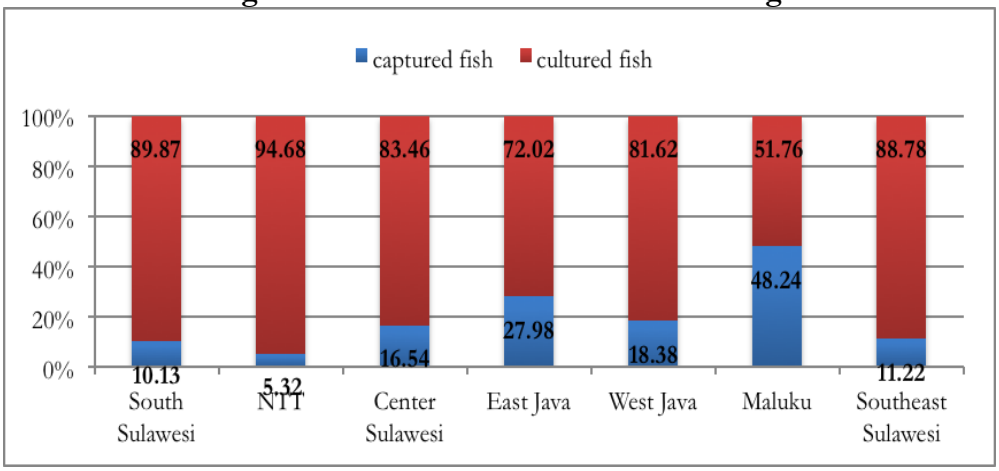
Figure 3.5
Volume of Indonesian Fish Production, 2009-2014
(In 1,000 tons)



Source: Marine and Fisheries in figures 2014
*Note; *) Preliminary figures which are updated until 4th quarter of 2014*

According to KKP, the highest producers in producing farmed fish in 2013 were dominated by provinces from eastern part of Indonesia. Figure 3.6 shows East Nusa Tenggara (NTT) dominated by producing farmed fish, which was about 94.68% from its production. It was followed by South Sulawesi that was contributing about 89.87% from its production. Southeast Sulawesi, Center Sulawesi and Maluku followed the earlier two that produced 88.78%, 83.46% and 51.76% respectively. On the other hand, only two provinces from western part of Indonesia namely West and East Java prioritized aquaculture as the main sector in the fisheries. By producing about 81.62% and 72.06% from its total production, these two provinces generally export its production abroad to countries such as the United States, China, Thailand, Japan, and Vietnam.

Figure 3.6
The Seven Highest Producers Fisheries based on Region in 2013



Source: KKP Republic of Indonesia

Main commodities of aquaculture

Seaweed is the top commodity of aquaculture in Indonesia (table 3.1). In 2004, the production reached 410.5 thousand tons. After 2006, the production of this product has shown remarkable development. In seven years from 2006

until 2013, the production has increased more than 7 million tons from 1.37 million to 9.29 million tons. Mostly, this product is developed to meet international demand where 75% of the production has been exported while only 25% are sold in fulfilling domestic need. China, the Philippines and Vietnam are the three biggest countries which are importing seaweed from Indonesia. Meanwhile the rest of the main commodities are only sold for domestic consumption. Only seaweed, according to KKP that can compete in international market. In contrast, Other commodities are difficult to compete due to the fact that Indonesian fish farmers cannot fulfill the food safety standard which has been imposed by the importing countries. Indeed, the KKP should reduce this barrier by supporting the farmers with sufficient knowledge on how to nurture the fish that can fulfill the international standard. This effort is being crucial in helping fish farmers in Indonesia to expand the market.

Table 3.1
The Six Main Commodities of Aquaculture Products, 2004-2014
(In tons)

Commodities	Year										
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	2014
Seaweed	410,570	910,636	1,374,462	1,766,198	2,145,060	2,963,556	3,915,017	5,170,201	6,514,854	9,298,474	10,234,357
Milkfish	241,438	254,067	212,883	263,138	277,471	328,288	421,757	467,449	518,939	627,333	621,393
Shrimps	238,857	280,568	327,052	358,625	409,590	338,060	380,972	400,385	415,703	645,955	592,219
Common Carp	192,462	216,920	247,693	264,351	242,322	249,279	282,695	332,206	374,366	412,703	484,110
Nile Tilapia	98,102	151,363	179,934	206,906	291,037	323,389	464,191	567,078	695,063	914,778	912,263
Catfish	55,595	69,386	77,332	91,736	114,371	144,755	242,811	337,577	441,217	543,774	613,120

Source: Directorate General of Aquaculture, KKP Republic of Indonesia

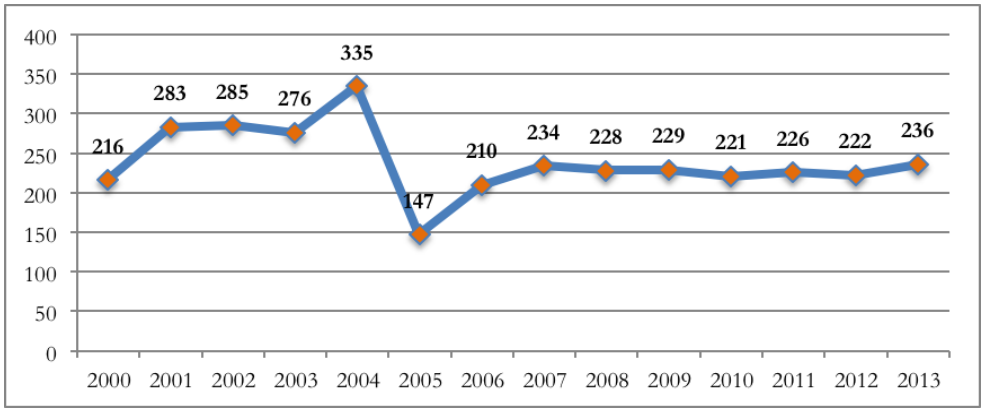
Based on the KKP, most of fish farming in the country have been operated in extensive and semi-intensive mode. It means that most of aquaculture have been operated in traditional ways or labor intensive which is started from feeding, caretaking until processing and marketing. The advantage of these is that the farms need lots of labor on its production. In other words, these types of aquaculture can absorb excess labor, which is generally occurring in developing countries. However, there is a drawback of these systems. Production scale and quality of the products tend to be lower and difficult to compete with other intensive culture, especially when the product is aimed for export.

The number of farms and employment in aquaculture

From 2000 to 2013, the number of fish farming companies tended to be stable. In 2000, it was around 216 companies, while in 2013, the number of fish farmers increased to 236 companies. In 2004, the aquaculture sector experienced a golden age marked by the number of companies engaged in this industry that reached 335. But in 2005, the number engaged in aquaculture has decreased sharply to 147. Significant decrease occurred in companies, which engaged in fishpond and hatchery. In 2004 the number of companies engaged in embankment was 193, while in 2005 the number of companies that operate

was only 91. In hatchery sector, the decline of number of firms, which were operating even greater than the decline in the embankment. If in 2004 the number of companies engaged in the hatchery business was about 104 companies, then in 2005 the number of firms only 30. Unfortunately, there is no research that can explain the causes for a decline in the number of fish farming companies in that year (Figure 3.7).

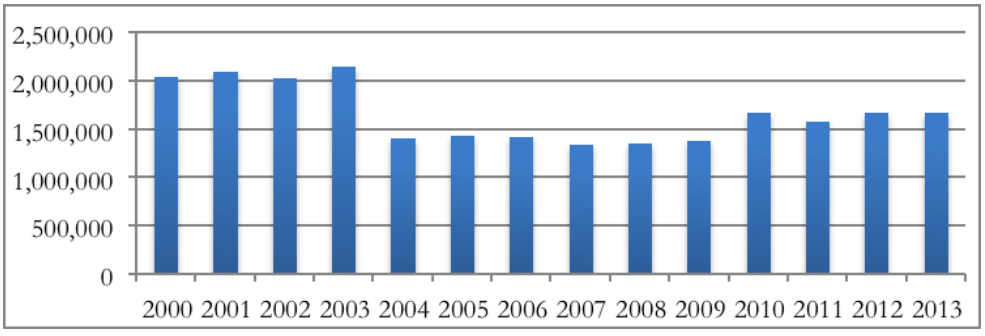
Figure 3.7
The Number of Fish Farming Company in Indonesia between 2000 and 2013



Source: BPS

Decrease in the number of companies engaged in the aquaculture sector is in line with the decrease in the number of households' aquaculture in Indonesia from 2000 to 2013. In 2000, the number of aquaculture households reached 2.05 million, however, in 2004 a decline in the number of households' aquaculture was 1.4 million households (figure 3.8). In fact, from 2005 to 2013 there was a slight increase in the number of aquaculture households from 1.43 million to 1.66 million households.

Figure 3.8
Number of Aquaculture Households in Indonesia between 2000 and 2013

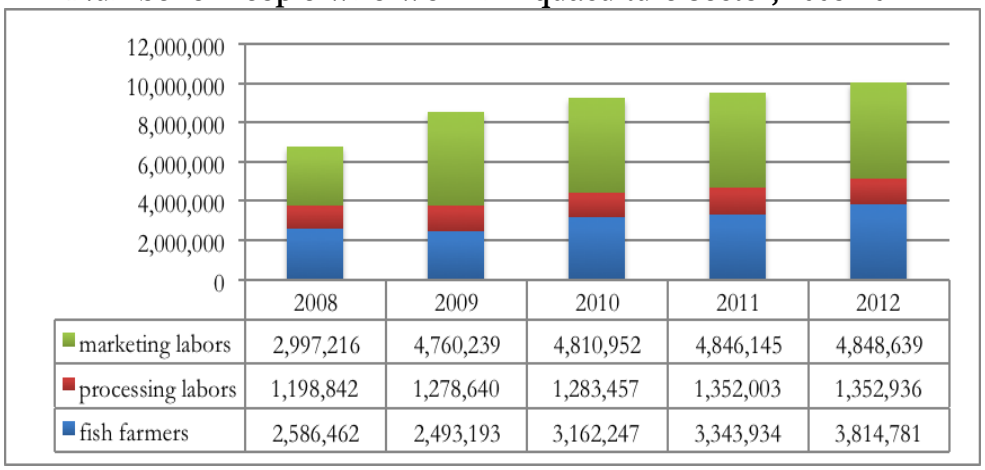


Source: BPS

Overall, number of people who are working in aquaculture sector increased every year (figure 3.9). In 2008, fish farmers accounted for 2.58 million people. Although in 2009 this number was decreased to 2.49 million, since 2010 until 2012, people who have been working on aquaculture especially in upstream side increased from 3.16 million to 3.81 million respectively. Meanwhile, in downstream side such as in processing and marketing, number of labors has slightly increased. For the processing sector, in 2006, 1.19 million

people were involved and in 2012 the number increased to 1.35 million people. In marketing sector, KKP noted that people who were working amounted to 2.99 million. And in 2012, the marketing employment increased to 4.84 million. In total, the sector has attracted 6.78 million people to work either as farmers, processors or sellers in 2008 while in the year 2013, this number increased significantly to 10.01 million workers. It has become evident that the aquaculture sector deserves to be developed into a major supporting sector to improve people's lives in terms of job creation.

Figure 3.9
Number of People Who Work in Aquaculture Sector, 2008-2012



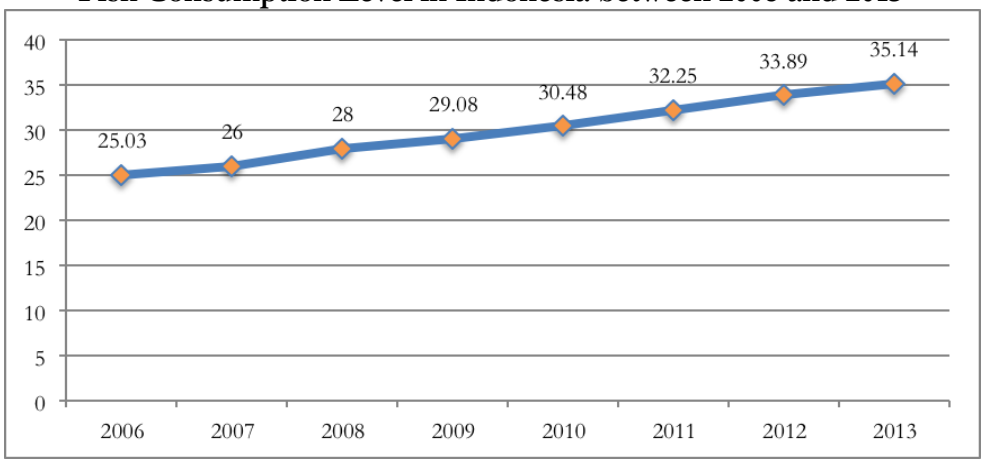
	2008	2009	2010	2011	2012
marketing labors	2,997,216	4,760,239	4,810,952	4,846,145	4,848,639
processing labors	1,198,842	1,278,640	1,283,457	1,352,003	1,352,936
fish farmers	2,586,462	2,493,193	3,162,247	3,343,934	3,814,781

Source; KKP, Republic of Indonesia

Level of fish consumption in Indonesia

Any production activity requires market to accommodate the results of the production. It is not different with aquaculture. It implies that it takes the participation of the community to consume the fish production from aquaculture. If compared to other countries that are producing fisheries such as China, Thailand and Malaysia, level of fish consumption in Indonesia is still below those countries. However, if we look at the level of fish consumption, the number has been increasing every year. In 2006, Indonesia's per capita fish consumption amounted to 25.03 kg/capita/year. In 2013, the level of consumption rose to 35.14 kg/capita/year, which means there is a growth in consumption of 40.39% (figure 3.10). If this figures in Indonesia keeps rising, then domestic market for fish product would be sustainable. At the end, increasing on fish consumption will benefit both for producers and consumers. For the producers, they will have sustainable markets for their products and for consumers; they will afford to consume cheap food with high nutrition.

Figure 3.10
Fish Consumption Level in Indonesia between 2008 and 2013



Source: Directorate General of Processing and Marketing of Fisheries (P2HP), KKP Republic of Indonesia

This chapter concludes that there is a possibility of relationship between aquaculture and poverty reduction in Indonesia. From the explanation mentioned above, this relation is possible because of the following two reasons, namely, supply side and demand side. For the supply side, Indonesia still has unused potential lands to be developed and available work forces to be employed. On demand side, Indonesian large population can be considered as promising markets.

Chapter 4
Data and Methodology

This chapter represents data and methodology that are used in the study. First sub chapter explains data and variables. Next is about methodology, which explains the model and type of analysis. The last will explain descriptive of statistics.

4.1 Data

This study uses secondary data with samples from 33 provinces in Indonesia in the period of 2002 to 2013. The data will be organized into an annual balanced panel data. This data was collected from the KKP of the Republic of Indonesia and BPS.

To compare, this study will employ data from districts and municipalities, collected from province from various years started from 2008 until 2013. However, because not all provinces provide data of production for each districts and municipalities into their administrative documents, this part only use data from 132 districts and municipalities from 9 provinces in Indonesia, which are spread out from western to eastern part of Indonesia.

4.2 Methodology

To measure the relationship between aquaculture productions and poverty alleviation in Indonesia, this study will employ total production of aquaculture as the main independent variable. The reason of this is due the fact that it represents how production is aquaculture sector is in the region in terms of quantity of the products.

To capture leverage of other variables, which are influencing the poverty in the region, Gross Regional Domestic Product (GRDP) and total population will be employed as control variables. The decision to employ GRDP and population is because the literatures have proved that such variable can influence poverty in the region (Kelley and Schmidt 1995, Roemer and Gugerty 1997, Dollar and Kraay 2002, Lanjouw and Ravallion 1995, Fosu 2009). However, the impact of these two controlling variables can be positive or negative in the regional poverty. Roemer and Gugerty (1997) argue that there is positive correlation between economic growth and income growth of the poor. It means that increasing in economic growth will increase living standard of the people in the region (reducing number of poor people). In addition, Dollar and Kraay (2002) state that the poor will be benefit from the growth on average equal with all members of societies. On the other hand, Justin Forsyth (Policy Director of Oxfam) through its paper in "The Economist" strongly stated that the growth and globalization acting as a brake on poverty reduction because the growth and globalization have made income disparities wider among societies[6]. Taking China and India as examples for this argument, he argues that the

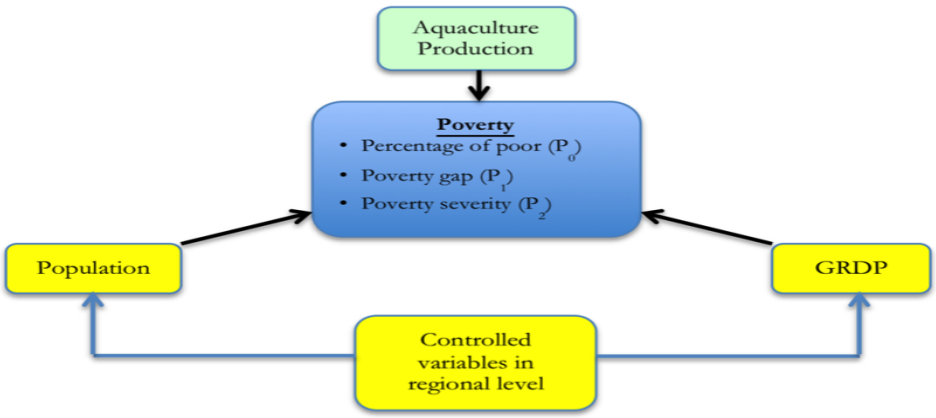
[6] http://www.economist.com/node/315409, accessed July 2015

relationship between the growth and poverty reduction is weakening when inequalities between rich and poor in the region are wider. In line with the point of view by Justin Forsyth, Fosu (2009) also argues that the response of poverty reduction to economic growth is small. It means that growth does not have a capacity to reduce poverty. He also emphasizes, moreover, that higher rate of income inequality inclines to exacerbate the poverty.

It is also true with variable of population. There are contradicting points of view on the role of population to affect poverty. Malthus and his proponents have argued that population has positive correlation with poverty. They argue that saving, which is initially allocated for infrastructure and development must be diverted to provide food, health care, housing and education needs when there is a boom in population (Merrick 2002). On the other hand, some economists believe that population could have negative correlation to poverty. It means poor people tend to have more children because it symbolizes the wealth, providing more labors for household, and for caring for parents in the old age (Ibid). In addition, Lanjouw and Ravalion (1995) argue that the relationship between poverty and household size vanish in certain point of cost of living (case study of Pakistan). Besides all independent variables mentioned above, this study also uses dummy variables of year as another independent variable to capture unobserved variables in particular year that can influence the rate of poverty in Indonesia such as education, health, inflation, investment and social welfare programs.

This study applies three different indicators of poverty, which are considered as absolute poverty as dependent variables. These three indicators are percentage of poor people (P_0), poverty gap (P_1) and poverty severity (P_2). The reason to apply these three indicators altogether is that percentage of poor people (P_1) alone cannot provide in-depth information on poverty. By combining with two other indicators, this study has more justification on the impact of aquaculture production in reducing poverty. In addition, these three indicators are commonly used in representing extreme poverty.

Figure 4.1
Empirical Framework of Aquaculture Production in Reducing Poverty



Based on figure 4.1, it has been developed a model that can be used to investigate on how aquaculture can affect poverty in a region as represented in

equation below. The model will be differentiated into two levels of data, provincial level and districts and municipalities level.

For provincial level the equation 1 will represent the model that will be used.

$$Y_{it} = \alpha_i + \beta_1 \text{ tot\_aqprod}_{it} + \beta_2 \text{ pop}_{it} + \beta_3 \text{ grdp}_{it} + \beta_4 \text{ year}_t + u_{it} \quad \ldots\ldots \text{ (eq. 1)}$$

Where:

Y	= poverty indicators, which consist of;
P_0	= Percentage of poor people /Head Count Index (HCI)
P_1	= Poverty Gap Index (PGI)
P_2	= Poverty Severity Index (PSI)
Tot_aqprod	= total production of aquaculture
pop	= population per province
grdp	= gross regional domestic product in constant price
α	= intercept
β	= coefficient of each independent variable
year	= dummy time
u_{it}	= the error term.

Subscripts *i* for province, *t* for year.

For districts and municipalities level the equation 2 will be used.

$$Y_{it} = a_i + b_1 \text{ tot\_aqprod}_{it} + b_2 \text{ pop}_{it} + b_3 \text{ grdp}_{it} + b_4 \text{ year}_t + u_{it} \quad \ldots\ldots \text{ (eq. 2)}$$

Where:

Y	= poverty indicators, which consist of;
P_0	= Percentage of poor people /Head Count Index (HCI)
P_1	= Poverty Gap Index (PGI)
P_2	= Poverty Severity Index (PSI)
tot_aqprod	= total production of aquaculture
pop	= population in districts and municipalities
grdp	= gross regional domestic product in constant price
a	= intercept
b	= coefficient of each independent variable
year	= dummy time
u_{it}	= the error term.

Subscripts *i* for districts and municipalities, *t* for year.

Table 4.1 shows relationship of each independent variable to each poverty measurement. Total production of aquaculture is expected to be positive

to reduce poverty (negative to poverty measurement; P_0, P_1 and P_2) for both provincial level and districts/ or municipalities level. It is similar with total production; GRDP for all level is expected to be negative to indicators of poverty. Meanwhile for population, the sign is expected to be positive to poverty. It means increasing in population will also increase indicators of poverty.

Table 4.1.
Summary and Hypothesis of Each Variable

Type of variables	Name of variables	Details	Expected sign	Source of Data
Dependent variables	P_0	Percentage of poor people from each province, district and municipality		BPS
	P_1	Poverty gap from each province, district and municipality		
	P_2	Poverty severity from each province, district and municipality		
Independent Variables	Total aquaculture production	A number of total production of aquaculture from each province, district and municipality	Negative	Ministry of Maritime Affairs and Fisheries for provincial level and province in figures for districts and municipalities level.
	GRDP	Gross of Regional Domestic Product from each province, district and municipality	Negative	BPS for provincial level and GRDP districts and municipalities in Indonesia in various years for districts and municipalities level.
	Population	A number of population from each province, district and municipality	Positive	BPS for provincial level and province in figures for districts and municipalities.

4.3. Descriptive Statistics

This subchapter describes general information of each variable both independent and dependent variables which are applied in the study. This analysis will be separated into two types of data namely provincial and districts and municipalities. The reason to differentiate these data is because the provincial data is started from 2002 until 2013, while districts and municipalities data is started from 2008 until 2013.

4.3.1 Provincial Level

In general, percentages of poor people (P_0) from each province vary from 3.18% to 41.8% with the average percentage of poor people about 15.93%. For the gap of poverty (P_1), the lowest gap is about 0.39% and the highest gap is about 12.97% with the mean 2.95%. Meanwhile, poverty severity (P_2) is about 0.07% for the lowest and 5.66% for the highest. Most provinces that have higher poverty problem based on the three indicators of poverty are located in the eastern part of Indonesia such as West Papua (41.34% for P_0, 12.97% for P_1 and 5.66% for P_2), Gorontalo (32.13% for P_0, 7.02% for P_1 and 2.43% for P_2). Only one province in west part Indonesia which still has this problem, namely Nanggroe Aceh Darussalam (NAD). Meanwhile for the middle part of Indonesia, the rate of poverty is in the average range.

On average, Indonesia has been producing 149,422.2 tons from 2002 until 2013. By having various productions for each province, the smallest production was produced by West Papua province in 2005, which was about 38 tons. Meanwhile, the highest production of aquaculture was owned by South Sulawesi in 2013 by 2,592,136 tons.

By population, West Papua also has the smallest number compared to other provinces. BPS noted that in 2008, number of population in West Papua was around 68,495 people. The highest population is West Java in 2013 by more than 45,3 million people. Meanwhile, as the capital city of Indonesia, DKI Jakarta has the highest GRDP among the provinces. Its GRDP in 2013 was about 477 trillion Indonesian Rupiah (IDR), while the lowest GRDP about 1.655 trillion IDR owned by Gorontalo in 2002 (see table 4.2).

Table 4.2
Summary Statistics of Provincial Level

Variable	Obs	Mean	Std. Dev	Min	Max
P_0	385	15.93257	8.446433	3.18	41.8
P_1	385	2.958023	2.148069	.39	12.97
P_2	385	.8570649	.8025769	.07	5.66
tot_aqprod	387	149422.2	292173.2	38	2592136
pop	393	6993892	9957026	68495	45340799
grdp	392	60827.45	91119.36	1655.328	477285.3

4.3.2 Districts and Municipalities Level

According Summary statistics below (Table 4.3), mean of percentage of poor people (P_0) is about 14.76%. The lowest percentage of poor people (P_1) is about 2.48% which is located in Balikpapan, East Kalimantan (Kaltim) Province in 2013, while the highest percentage is about 34.53% situated in Sampang, East Java (Jawa Timur) Province in 2008. The lowest poverty gap is about 0.25% in Balikpapan, East Kalimantan (Kaltim) Province in 2013 while the highest is about 11.06% is situated in West Aceh (Aceh Barat), NAD province in 2008. In term of poverty severity (P_2), Balikpapan city, East Kalimantan province had the lowest poverty severity in 2011 about 0.03%. Thus, the highest poverty severity happened in West Aceh, NAD province in 2008 was about

4.83%.

Between 2008 and 2013, the mean of aquaculture production in districts and municipalities level was about 16,373.09 tons with the smallest production occurred in Subulussalam city, NAD Province in 2010 about 0.9 tons. Thus the highest production was reached at about 571,059.7 tons by Sumenep district, East Jawa (Jawa Timur) province in 2013.

In terms of the number of people who inhabits a region, Tana Tidung district had the smallest population in 2008. Indonesia Statistics Bureau noted that Tana Tudung only inhabited around 14.57 thousand people. The highest population was noted in East Jakarta (Jakarta Timur), DKI Jakarta province in 2013 inhabited by 2.79 million people. Furthermore, Seribu Island (Kepulauan Seribu) had a lowest GRDP compared to other districts and municipalities in Indonesia. It has been calculated in 2008 that the GRDP in Seribu Island was 152 million IDR. Meanwhile, Central of Jakarta (Jakarta Pusat), DKI Jakarta province in 2013 had the highest GRDP by 125 trillion IDR (see table 4.3).

Table 4.3
Summary Statistics of Districts and Municipalities Data

Variable	Obs	Mean	Std. Dev	Min	Max
P_0	787	14.76329	6.542865	2.48	34.53
P_1	787	2.482344	1.473777	0.25	11.06
P_2	787	.6601398	.4853866	.03	4.83
tot_aqprod	783	16373.09	57743.09	.9	571059.7
pop	792	533.5951	573.5193	14.57989	2791
grdp	790	7251650	1.76e+07	152073.4	1.25e+08

Chapter 5
Results and Discussion

In this chapter the results of estimation using poverty indicators as dependent variables and aquaculture production as primary independent variable are presented. Started from provincial level then continued to district and municipalities level, impact of aquaculture production in reducing poverty will be analyzed using Fixed Effect and Random Effect Models.

5.1 The impact of aquaculture production on poverty in provincial level

5.1.1 Validity of the model

In order to get a valid model, it requires a test. The test is named Hausman test. The aim of this test is to examine which model between Fixed Effect (FEM) and Random Effect Model (REM) is more appropriate. The difference between FEM and REM is that the FEM captures the characteristics of each individual and the time accommodated in the intercept, however, random effect model captures differences in individual characteristics and time be accommodated in the error of the model. Furthermore, FEM is an expansion of the use of Ordinary Least Square (OLS) with the use of dummy variables, then REM using generalized least squares (GLS) which is assumed that unobservable individual effects are not correlated with the independent variables or in other words to be random

The Hausman test is also used to assess the inconsistencies on estimation of random effects by comparing the slope parameter (slope) fixed effect and random effect. This test follows the Chi Square statistic distribution with degree of freedom as much as k, where k is the number of independent variables. If the probability of Chi square is smaller than the critical value, H_0 is rejected and the appropriate model is Fixed Effect conversely when probability of Chi square is greater than the critical value, the exact model is Random Effect.

Table 5.1.
Result of Hausman Test for Provincial Level

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Fixed effect Model	11.53	14	0.6440

Based on the results in table 5.1, the best estimate of the model is the Random Effect Model (REM) with probability 0.6 which is higher than critical value H_0. It means that the used of FEM can be rejected because the difference in coefficients is not systematic.

5.1.2 Result of Estimations

In this subchapter, result of estimation will be discussed. Hausman test has proved that the best model to be used is REM. However, for analytical purpose both FEM and REM are presented.

Table 5.2
Impact of Aquaculture production on Poverty using FEM and REM in provincial level

	FEM			REM		
	Dependent Variables			Dependent Variables		
Independent Variables	**(P_0)**	**(P_1)**	**(P_2)**	**(P_0)**	**(P_1)**	**(P_2)**
Ln (total aquaculture production)	-0.4519**	-0.1098**	-0.0387*	-0.3772**	-0.1016**	-0.039
	(0.19)	(0. 05)	(0.02)	(0.18)	(0. 06)	(0.02)
Ln (grdp)	2.91	- 0.082	-0.25	-0.29	- 0.426	-0.21
	(3.57)	(0. 99)	(0.44)	(1.96)	(0. 42)	(0.13)
Ln (population)	0.089	0.117	0.051	-0.043	0.094	0.42
	(0. 29)	(0.07)	(0.03)	(0. 56)	(0. 12)	(0.05)
Y2 (Dummy 2003)	-0.92***	0.23*	0.14*	-0.77***	0.25*	0.14**
	(0.23)	(0.13)	(0.07)	(0.19)	(0.13)	(0.07)
Y3 (Dummy 2004)	-1.61***	0.02	0.12	-1.37***	0.05	0.12
	(0.31)	(0.14)	(0.10)	(0.26)	(0.13)	(0.10)
Y4 (Dummy 2005)	-1.58***	0.11	0.13	-1.20***	0.15	0.12*
	(0.45)	(0.15)	(0.08)	(0.35)	(0.13)	(0.06)
Y5 (Dummy 2006)	-0.76	0.19	0.16	-0.26	0.25	0.16
	(0.65)	(0.19)	(0.11)	(0.46)	(0.17)	(0.10)
Y6 (Dummy 2007)	-2.01**	0.18	0.20	-1.36**	0.25	0.19*
	(0.80)	(0.29)	(0.15)	(0.59)	(0.21)	(0.11)
Y7 (Dummy 2008)	-3.46**	-0.15	0.08	-2.65***	-0.07	0.07
	(1.01)	(0.28)	(0.14)	(0.77)	(0.18)	(0.08)
Y8 (Dummy 2009)	-4.63***	-0.36	0.03	-3.64***	-0.25	0.02
	(1.22)	(0.34)	(0.16)	(0.88)	(0.21)	(0.08)
Y9 (Dummy 2010)	-5.29***	-0.58	-0.02	-4.13***	-0.45	-0.03
	(1.43)	(0.43)	(0.21)	(1.06)	(0.28)	(0.12)
Y10 (Dummy 2011)	-6.59***	-0.80	-0.07	-5.24***	-0.65**	-0.09
	(1.63)	(0.47)	(0.23)	(1.20)	(0.28)	(0.11)
Y11 (Dummy 2012)	-7.25***	-0.91*	-0.10	-5.71***	-0.74**	-0.11
	(1.75)	(0.50)	(0.05)	(1.27)	(0.29)	(0.11)
Y12 (Dummy 2013)	-7.91**	-1.10*	-0.17	-6.18***	-0.92**	-0.19
	(2.29)	(0.59)	(026)	(1.77)	(0.37)	(0.12)
Constant	-6.76	3.45	3.05	26.53*	7.18**	2.79*
	(32.80)	(9.19)	(4.19)	(13.79)	(3.51)	(1.47)
Number of observation	385	385	385	385	385	385
Number of group	33	33	33	33	33	33
R-squared	0.175	0.073	0.127	0.127	0.151	0.128
F-test	44.87***	20.97***	12.26***	614.46***	310.12***	171.64***

*Standard errors in parentheses; *** p < 0.01, ** p < 0.05, *<0.1*

As we can see from the table above, the appropriate model is REM. Thus, the result from the model will be applied to asses how the impact of aquaculture production for different indicators of poverty in Indonesia.

Impact of aquaculture production on percentage of poor people (P_0)

From table 5.2, we can see that aquaculture production has negative impact on percentage of poor people (positive to reduce number of poor people) both in FEM and REM models. It means increasing in the production can reduce percentage of poor people. This finding fits with literatures that support the role of aquaculture in reducing poverty (Allison 2011, Belton et al. 2012, Edwards 2000, Toufique and Belton 2014). With the significant level at 95%, if the production increases by 10% then people who live under poverty line will be reduced by 3.7% for REM model (column 4, row 1).

For variable of GRDP, the impact is not significant, however, the sign is expected with the study, which is conducted by Roemer and Gugerty (1997). However, for variable of population is questioned because the sign is negative which means that increasing in population will reduce percentage of poor people. However, when FEM is applied, the sign of population's coefficient changes to be positive. Here, the variable cannot be justified whether the impact is positive or negative because it is suspected there is endogeneity problem between population data and percentage of poor people in random effect model. For this study, endogeneity problem for population is not really essential because the variable itself has been considered as a control variable that is functioning to capture other factors than can affect poverty.

For time dummy variables, the coefficient seems to have significant negative impact to percentage of poor people (P_0). It is proven by value of the coefficient is bigger over time with significant level at 99% with a basis year in 2002. Thus, we can conclude that percentage of poor people reduces over time.

Impact of aquaculture production on poverty gap (P_1)

When estimation employs poverty gap (P_1) as dependent variable, the results also support the first estimation (both in FEM and REM models). With significant level at 95%, aquaculture also supports in reducing the gap of average expenditure of each the poor from the poverty line. The aquaculture will decrease the gap of poverty by 1% if the production is improved by 10% (column 2, row 1 in random effect model). Similar with the result of estimation when it is tested by percentage of poor people, GRDP and population do not have the significant impact, although the sign is also negative and positive respectively which are suitable with the literatures.

Meanwhile dummy time variables show the effect of aquaculture is negative significant at 95 percent started in 2011 until 2013. It means that the gap of poor people from the poverty line has been narrowing since 2011. Although its values increasing over time, the coefficient of dummy variable in poverty gap is not as big as in percentage of poor people (P_1).

Impact of aquaculture production on poverty severity (P_2)

For this indicator, aquaculture has no significant impact at all. It means increasing or decreasing in the production will not influence poverty severity in the regions. However, the sign is still negative (positive to reduce poverty se-

verity in the region). Insignificant impact of aquaculture production also happens on GRDP and population, although the sign of each variable to poverty severity suitable with the literatures.

5.2 The impact of aquaculture production on poverty in Districts and Municipalities Level

5.2.1 Validity of the model

Similar with provincial level, in this subchapter Hausman test will be applied to decide which model is better whether FEM or REM. According to the result of Hausman test, Random Effect Model is better than Fixed Effect Model (table 5.3). It can be seen from the probability of Chi Square by 0.0019 smaller than critical value. It means we can reject the hypothesis that said random effect model is better.

Table 5.3.
Result of Hausman Test for Districts and Municipalities Level

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Fixed effect Model	24.44	8	0.0019

5.2.2 Result of Estimations

According the table 5.3 shows that Fixed Effect Model is appropriate compared to REM. Thus, for districts and municipalities level, analysis will be conducted based on FEM model.

Table 5.4

Impact of Aquaculture production on Poverty using FEM and REM in districts and municipalities level

	FEM			**REM**		
	Dependent Variables			**Dependent Variables**		
Independent Variables	**(P_0)**	**(P_1)**	**(P_2)**	**(P_0)**	**(P_1)**	**(P_2)**
Ln (total aquaculture production)	-0.1133**	-0.0212	-0.0069	-0.0753	-0.0107	-0.0011
	(0.05)	(0.03)	(0.01)	(0.05)	(0.02)	(0.008)
Ln (grdp)	-0.946	- 1.115	-0.206	-4.210***	- 0.782***	-0.192***
	(1.66)	(1.02)	(0.30)	(0.59)	(0.11)	(0.03)
Ln (population)	9.066***	1.290	0.014	4.210***	0.685***	0.141***
	(2.34)	(1.43)	(0.66)	(0.84)	(0.17)	(0.04)
Y2 (Dummy 2009)	-1.73***	-1.01***	-0.42***	-1.50***	-1.02***	-0.42***
	(0.10)	(0.12)	(0.04)	(0.08)	(0.11)	(0.04)
Y3 (Dummy 2010)	-2.90***	-1.13***	-0.45***	-2.33***	-1.15***	-0.46***
	(0.23)	(0.17)	(0.05)	(0.15)	(0.13)	(0.05)
Y4 (Dummy 2011)	-3.60***	-1.31***	-0.52***	-2.73***	-1.35***	-0.54***
	(0.33)	(0.24)	(0.07)	(0.20)	(0.15)	(0.05)
Y5 (Dummy 2012)	-4.27***	-1.43***	-0.57***	-3.11***	-1.49***	-0.60***
	(0.45)	(0.30)	(0.09)	(0.23)	(0.15)	(0.05)
Y6 (Dummy 2013)	-4.59***	-1.40***	-0.56***	-3.15***	-1.47***	-0.59***
	(0.55)	(0.35)	(0.10)	(0.27)	(0.15)	(0.05)

Constant	-20.25	13.32	4.08	54.52	11.06***	3.11***
	(26.98)	(15.64)	(5.13)	(5.35)	(1.00)	(0.28)
Number of observation	781	781	781	781	781	781
Number of group	132	132	132	132	132	132
R-squared	0.0093	0.2665	0.2624	0.3186	0.3039	0.3126
F-test	66.20***	28.10***	26.05***	558.31***	246.48***	235.24***

*Standard errors in parentheses; *** p < 0.01, ** p < 0.05, *<0.1*

In this subchapter, the impacts of aquaculture production are not as stronger as in provincial level. Total production of aquaculture only has capacity in reducing percentage of poor people (see table 5.4). With the significant level at 95%, if the production would be increased by 10% then percentage of poor people in districts and municipalities will decrease by 1.1% (column 1, row 1). Population variable in this model also has significant impact to increase percentage of poor people (P_0) with significant level at 99%. It means that increasing in 10% of population in the districts and municipalities will increase percentage of poor people by 90%. Meanwhile, for another controlling variable, GRDP does not have significant impact on the percentage of poor people, however, the sign has been following the literatures that have been mentioned in previous chapter. For dummies, here represents the change of the percentage of poor people every year from 2008 to 2013, has shown reduction with significant level at 99%. With time base 2008, the coefficient is getting larger every year. It means percentage of poor people in districts and municipalities level has been decreasing in six year.

For poverty gap (P1) and poverty severity (P2), impact of aquaculture production is not significant (column 1, row 2 and 3). This is also found in other control variables; GRDP and population. When dummies time are employed into these two indicators of poverty, the impact is significant at 99%. It means that poverty gap and poverty severity have decreased every year. However, the sign of each coefficient (poverty gap, poverty severity, GRDP and population) follow the literatures.

In short, aquaculture production only has a power to reduce percentage of poor people in districts and municipalities level but not for poverty gap and poverty severity in the areas.

5.3 Analysis of The Results

In general, aquaculture production has indicated positive impact to reduce poverty in Indonesia, which is proven by negative sign on each production coefficients for all indicators of poverty both in provincial and districts and municipalities level. This finding is supported by empirical findings from previous studies, which were conducted in Bangladesh, the Philippines, and Sub-Saharan Africa (Irz et al. 2007, Belton et al. 2012, Toufique and Belton 2014, Kaliba et al. 2007). Although most of these studies did not directly link between production and poverty indicators, however, their results showed that through several

channels such as consumption, jobs and income, poor people have benefited from increased production.

Impact of aquaculture is stronger in reducing percentage of poor people (P_0) both in the provincial level and in districts and municipalities level (significant at 95%). It means that every time increasing in the production will affect to reduce the percentage of poor people in Indonesia. When this study employs other indicators of poverty; poverty gap (P_1) and poverty severity (P_2), the impact seems not as strong as in percentage of poor people. In provincial level, aquaculture has still significant impact on poverty gap (P_1), however, for districts and municipalities level, it does not have significant impact. For the last indicator of poverty, poverty severity (P_2), the impact of aquaculture production is not significant both for provincial and districts and for municipalities level.

By combining impact of aquaculture production for three indicators of poverty (P_0, P_1 and P_2) both in provincial and districts and municipalities level, it can infer that the impact of the production of aquaculture seem to be weak. By observing the coefficient of total production for each dependent variable (P_0, P_1 and P_2), the numbers are also small. This finding is in line with Final technical report of Aquaculture, Food Security, Poverty Alleviation and Nutrition (AFSPAN) which states that "aquaculture is not a strong element in the dynamics of poverty alleviation at the macro level in Low Income Food Deficit Countries (LIFDCs) compared to much larger agriculture sector"[7]. It is caused by labor absorption on aquaculture activities which is not as big as crop agriculture or animal husbandry (Ahmed and Lorica 2002). It is proved by number of people who work in this field by only 3.8 million in 2012 (see figure 3.9). By comparing with the total number of labor force in Indonesia in the same year about 118 million people, aquaculture sector only absorbed 3.2% of them. Low absorption of this sector is caused by type of work offered is temporary which is only required at the time of harvest whereas at the time of caretaking, small farming companies prefer to optimize their family members to reduce production costs, particularly wages.

In addition, according to BPS, aquaculture sector also has low quality of human resource that work in this field. This statement is inline with Pontoh (2014) which is found in North Sulawesi Province, especially in Tandengan Village Minahasa Regency. He found that almost 60% of fish farmers were only graduated from senior high school, 20% graduated of junior high school, 10% of the primary schools and only 10% equivalent to bachelor. Low quality of human resources will affect productivity and quality of the product yielded on this sector. That is why Indonesian fish products are difficult to compete with other products in international markets. It is because many farming do not use a good quality of seeds and do not know how the way to grow the fish based on international standard of safety food.

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[7] http://www.afspan.eu/publications/reports/afspan-final-technical-report-d8.2.pdf (p. 11), accessed July 2015.

Compared to the quality of fish from other countries such as China, Vietnam and Thailand, quality of Indonesian products remains low. It makes Indonesian products less competitive in the international markets. For example, although Indonesia and Vietnam are producers of pangasius, however, international markets prefer to import Vietnamese products. It is proved by number of pangasius farms that have been acknowledged to export their products, Indonesian farming companies have been left behind. Compared to Vietnam which have 45 pangasius farms that have been certified by Aquaculture Stewardship Council (ASC) standard, Indonesia until now does not have any pangasius farm which is fulfilled such standard[8]. This condition is also happening to seaweed and shrimp, which is the flagship Indonesian aquaculture. Export of seaweed and shrimps are still hampered by the low quality of products in the international market. Especially for shrimps, Indonesia only has two companies that have been certified by ASC while Vietnam has 14 companies that have met the certification of ASC for their shrimps. As a result, it is very rare to find Indonesian products in international markets such as in Europe and America. Most of the products are only sold in domestic market.

Besides the low exporting market for aquaculture products, financial support from banks for aquaculture business in Indonesia is still low. According to Banking Monitoring Report - first quarter (Laporan Profil Industri Perbankan – Triwulan I) 2015 by Indonesia Financial Service Authority (OJK), per December 2014, fisheries sector (capture fisheries and aquaculture) only got 0.20% of the total credits disbursed by the banking industry during 2014. This amount is equivalent to 18.1 trillion rupiah from 3,702.2 trillion rupiah loans disbursed by the Indonesian banking industry during 2014[9]. This number is very small if compared to manufacturing sector 18.27% of total credit disbursed the banking industry in the period or equivalent with 676.3 trillion rupiah or compared to Wholesale & Retail Trade which was gaining 19.61% or around 726 trillion rupiah (ibid). A reason why the banking industry is not keen to support this sector since aquaculture sector is considered less profitable and have a high risk of failure.

Low level education of the farmers, lack of the market and financial support have made the development of aquaculture as the backbone of alleviating poverty in the rural and coastal areas in Indonesia is getting difficult. According to Shang (1985)to develop the potential economy of aquaculture, it needs to consider internal and external factors.

Shang has been identifying five major areas that affect the development of aquaculture namely;

> (1) the relative economics of rearing and marketing various species; (2) the comparative advantages of rearing and marketing aquaculture species which compete with those raised in other regions in either domestic or foreign markets; (3) the relative economics

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[8] http://www.asc-aqua.org/index.cfm?act=tekst.item&iid=4&iids=204&lng=1#yneqpzhsulog, accessed July 2015.

[9] http://www.ojk.go.id/laporan-profil-industri-perbankan-triwulan-i-2015, accessed July 2015.

> of aquaculture versus other economic activities, for instance animal husbandry, that either require the same inputs or compete in the same product markets; (4) the expansion of other economic activities that produce positive or negative externalities for aquaculture; and (5) the existing regulations and institutions related to aquaculture development (Shang 1985: 299).

This is in line with the Minister of Indonesian Coordinating for Maritime Ministry which was stating that there are six things that must be laid out in developing aquaculture in Indonesia, the location or the zoning arrangement; availability of seeds fisheries; availability of feed fisheries; antiviral drugs; aquaculture technologies such as floating cages or cages step; and marketing[10].

[10] http://www.mongabay.co.id/2015/04/21/sudah-saatnya-indonesia-fokus-bangun-sektor-perikanan-budidaya/, accessed July 2015.

Chapter 6
Conclusion and Further Research

6.1 Conclusion

The study is aimed to investigate the connection between aquaculture production and poverty reduction in Indonesia represented by three indicators of poverty, namely, percentage of poor people (P_0), poverty gap (P_1) and poverty severity (P_2). By using two different models, Fixed effect Model and Random Effect Model and also by using two different levels of data, at level of provinces and districts and municipalities level, this study has provided a proof of the positive role of aquaculture production in reducing poverty in Indonesia. Indication of the role of this sector can be seen from negative sign of each coefficient of indicators of poverty (P_0, P_1 and P_2) both for provincial and districts and municipalities level.

However, the expansion of production is not big enough to reduce poverty. Increasing in the total production by 10% only reduces the percentage of poor people by 3.7% for provincial level and 1.1% for districts and municipalities level. Impact of the production to poverty gap only works in provincial level and does not work in districts and municipalities level. Even, for poverty severity (P_2), aquaculture production does not have significant impact at all. In this sense, aquaculture production has limited contribution to reduce poverty in Indonesia.

The small impact of aquaculture production in reducing poverty in Indonesia is caused by the low level of education of fish farmers so that they do not have adequate knowledge to meet international standards in fish breeding. This is compounded by the use of poor-quality fish seed that produced low-quality products as well. The low quality of products in turn will be difficult to penetrate the international market, which is very strict in setting food safety standards that can be consumed. As a result, most of the products are only traded in local markets which make economic benefit that they gained is not as big as when they export the products into abroad. In addition, most of fish farming in Indonesia which are categorized as small enterprises find obstacles to access financial support from banking industries to expand their production because banking industries consider that aquaculture sector is less profitable and have a high risk of failure. Combination of these constraints has made it difficult for farmers to expand production scale in high quality. In turn, the absorption of employment in this sector will be low.

To increase the role of aquaculture sector in reducing poverty needs a lot of efforts from the farmers, stakeholders and government. For farmers, they should improve the quality of their products in order to meet food safety standards that are applied internationally so that their products can compete with products from other countries. Improving the quality of products can be started with the use of quality seeds and application of breeding method in accordance with the standards set by the importing country.

In addition, farmers must also be willing to increase the quality of their human resources so that every technological breakthrough is generated by the stakeholders and government can be applied without any resistance from the farmers who are generally afraid to try new fishing technology. It aims to reduce the big negative impact of aquaculture to the quality of the environment such as waste management of the culture is often damaging to the environment.

For stakeholders, such as salespeople and traders should be able in looking for new fish markets for export purposes that can accommodate large production so that farmers do not fear their products are not absorbed by the market. For scholars and the researchers, should be able to create the high quality of seed and feed which have resistant to environmental conditions because most of these items are generally imported from other countries such as fish meal from Chile are of course very expensive so that aquaculture is generally a small business can not afford to buy such seed and feed.

For the government, they can support the researchers and scholars through funding the research in creating high quality of seed and feed in cheaper price. So that the farmer can afford to use these inputs in improving their quality of the products. In addition, the government should have to provide some applied trainings to improve knowledge of the farmers in breeding and maintaining negative impacts of aquaculture sector to the environment. In taking the international markets, the governments can create memorandum of understanding (MoU) with importing countries to expand exporting markets for the farmers.

In short, aquaculture has the potential to reduce poverty in Indonesia. However, it needs a joint effort from all parties to increase the potential of aquaculture in Indonesia to be not only temporary, but it can be sustainable in reducing poverty in Indonesia.

6.2 Further Research

It has been known that quality and availability of data from aquaculture production is difficult to find. It is also happening with this research where data for districts and municipalities level in Indonesia only recorded by a few of districts and municipalities. For this study, it can only collect data from 132 districts and municipalities of 509 districts and municipalities in Indonesia. In addition, the years of the study is also limited from 2008 until 2013. Low quality and limited of the data for this level have made results and analysis also limited. It needs further research with higher quality of the data to assess the impact of aquaculture production in reducing poverty and to see which one is bigger the advantage of aquaculture production in economic side or negative externalities of aquaculture to environment. For impact of population to poverty, it also needs to be studied further, because it has been suspected that there is endogeneity problem among population data and aquaculture production data that make the result of estimation in provincial level especially for percentage of poor people is negative which opposes the common theory.

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Appendices

Appendix 1

Hausman Test for Provincial Level

```
. hausman fem .
```

	Coefficients (b) fem	(B) rem	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
l_total	-.4519482	-.3772465	-.0747017	.0155543
l_pop	.0890929	-.0434358	.1325287	.1483481
l_grdp	2.912974	-.2973527	3.210327	1.054626
Y2	-.9231589	-.7796861	-.1434727	.
Y3	-1.611114	-1.379471	-.2316437	.0327327
Y4	-1.583164	-1.206323	-.3768408	.104128
Y5	-.7646543	-.264401	-.5002533	.1596486
Y6	-2.817729	-1.362607	-.6551225	.2105215
Y7	-3.466716	-2.659173	-.8075429	.2623753
Y8	-4.634008	-3.646118	-.9878894	.3317125
Y9	-5.291237	-4.130325	-1.160912	.393241
Y10	-6.594723	-5.244685	-1.350038	.4581358
Y11	-7.252452	-5.71337	-1.539082	.522801
Y12	-7.913257	-6.187375	-1.725882	.5869151

```
                b = consistent under Ho and Ha; obtained from xtreg
     B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

           chi2(14) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                    =       11.53
         Prob>chi2 =      0.6440
         (V_b-V_B is not positive definite)
```

Appendix 2

Result of Estimation in Provincial Level using Fixed Effect Model (FEM) for Each Indicator of Poverty

```
. xtreg  p0 l_total l_pop l_grdp Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 Y11 Y12, robust fe cluster(prov_id)

Fixed-effects (within) regression               Number of obs      =       385
Group variable: prov_id                         Number of groups   =        33

R-sq:  within  = 0.6570                         Obs per group: min =         8
       between = 0.1586                                        avg =      11.7
       overall = 0.0175                                        max =        12

                                                F(14,32)           =     44.87
corr(u_i, Xb)  = -0.5598                        Prob > F           =    0.0000

                                (Std. Err. adjusted for 33 clusters in prov_id)
```

p0	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
l_total	-.4519482	.1901583	-2.38	0.024	-.8392879	-.0646085
l_pop	.0890929	.294498	0.30	0.764	-.5107799	.6889657
l_grdp	2.912974	3.576437	0.81	0.421	-4.37199	10.19794
Y2	-.9231589	.2308203	-4.00	0.000	-1.393324	-.4529933
Y3	-1.611114	.3152409	-5.11	0.000	-2.253239	-.9689896
Y4	-1.583164	.4548767	-3.48	0.001	-2.509718	-.6566105
Y5	-.7646543	.6546831	-1.17	0.251	-2.0982	.5688915
Y6	-2.017729	.8085393	-2.50	0.018	-3.66467	-.3707887
Y7	-3.466716	1.011416	-3.43	0.002	-5.526904	-1.406529
Y8	-4.634008	1.226245	-3.78	0.001	-7.131787	-2.136228
Y9	-5.291237	1.433601	-3.69	0.001	-8.211387	-2.371087
Y10	-6.594723	1.633259	-4.04	0.000	-9.921562	-3.267884
Y11	-7.252452	1.756483	-4.13	0.000	-10.83029	-3.674614
Y12	-7.913257	2.298783	-3.44	0.002	-12.59573	-3.230788
_cons	-6.769117	32.80547	-0.21	0.838	-73.59167	60.05344
sigma_u	10.170559					
sigma_e	1.9242778					
rho	.9654402	(fraction of variance due to u_i)				

```
. xtreg  p1 l_total l_pop l_grdp Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 Y11 Y12, robust fe cluster(prov_id)

Fixed-effects (within) regression               Number of obs      =       385
Group variable: prov_id                         Number of groups   =        33

R-sq:  within  = 0.5098                         Obs per group: min =         8
       between = 0.0023                                        avg =      11.7
       overall = 0.0738                                        max =        12

                                                F(14,32)           =     20.97
corr(u_i, Xb)  = 0.0041                         Prob > F           =    0.0000

                                  (Std. Err. adjusted for 33 clusters in prov_id)
```

p1	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
l_total	-.1098893	.0526357	-2.09	0.045	-.2171047	-.0026739
l_pop	.117937	.072042	1.64	0.111	-.0288077	.2646818
l_grdp	-.0828214	.99002	-0.08	0.934	-2.099426	1.933783
Y2	.2367648	.1310524	1.81	0.080	-.0301801	.5037098
Y3	.0275898	.1407516	0.20	0.846	-.2591118	.3142914
Y4	.1123144	.1572119	0.71	0.480	-.2079157	.4325446
Y5	.1991943	.1980714	1.01	0.322	-.204264	.6026526
Y6	.1821758	.2906301	0.63	0.535	-.4098183	.7741699
Y7	-.1599722	.2824767	-0.57	0.575	-.7353585	.415414
Y8	-.3630359	.3442921	-1.05	0.300	-1.064336	.3382642
Y9	-.5846841	.4364254	-1.34	0.190	-1.473654	.3042854
Y10	-.8032538	.4772852	-1.68	0.102	-1.775452	.1689444
Y11	-.9103223	.5097409	-1.79	0.084	-1.948631	.127986
Y12	-1.1079	.5963691	-1.86	0.072	-2.322664	.1068639
_cons	3.45234	9.196681	0.38	0.710	-15.28069	22.18537
sigma_u	2.0994154					
sigma_e	.58487988					
rho	.9279766	(fraction of variance due to u_i)				

```
. xtreg  p2 l_total l_pop l_grdp Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 Y11 Y12, robust fe cluster(prov_id)

Fixed-effects (within) regression               Number of obs      =       385
Group variable: prov_id                         Number of groups   =        33

R-sq:  within  = 0.3392                         Obs per group: min =         8
       between = 0.0904                                        avg =      11.7
       overall = 0.1277                                        max =        12

                                                F(14,32)           =     12.26
corr(u_i, Xb)  = -0.1020                        Prob > F           =    0.0000

                                 (Std. Err. adjusted for 33 clusters in prov_id)
```

p2	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
l_total	-.0387197	.022802	-1.70	0.099	-.0851658	.0077265
l_pop	.0514941	.0367066	1.40	0.170	-.0232749	.1262631
l_grdp	-.2554848	.4459799	-0.57	0.571	-1.163916	.6529465
Y2	.1464527	.073908	1.98	0.056	-.004093	.2969984
Y3	.1273252	.1061149	1.20	0.239	-.0888237	.3434742
Y4	.1324937	.0827227	1.60	0.119	-.036007	.3009943
Y5	.1697685	.1128154	1.50	0.142	-.0600289	.3995659
Y6	.200711	.1554478	1.29	0.206	-.1159258	.5173478
Y7	.0875503	.1415024	0.62	0.540	-.2006807	.3757813
Y8	.0312953	.1619199	0.19	0.848	-.2985247	.3611153
Y9	-.0249425	.2138077	-0.12	0.908	-.4604546	.4105696
Y10	-.0789969	.2303995	-0.34	0.734	-.5483052	.3903115
Y11	-.1016284	.2445727	-0.42	0.681	-.5998066	.3965499
Y12	-.1717799	.2681542	-0.64	0.526	-.7179923	.3744324
_cons	3.0508	4.190704	0.73	0.472	-5.485384	11.58698
sigma_u	.75241832					
sigma_e	.27614912					
rho	.88128996	(fraction of variance due to u_i)				

Appendix 3

Result of Estimation in Provincial Level using REM for Each Indicator of Poverty

```
. xtreg  p0 l_total l_pop l_grdp Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 Y11 Y12, robust re cluster(prov_id)

Random-effects GLS regression                   Number of obs      =       385
Group variable: prov_id                         Number of groups   =        33

R-sq:  within  = 0.6514                         Obs per group: min =         8
       between = 0.0197                                        avg =      11.7
       overall = 0.1031                                        max =        12

                                                Wald chi2(14)      =    614.46
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                                (Std. Err. adjusted for 33 clusters in prov_id)
```

p0	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
l_total	-.3772465	.1833248	-2.06	0.040	-.7365565	-.0179365
l_pop	-.0434358	.5642659	-0.08	0.939	-1.149377	1.062505
l_grdp	-.2973527	1.963844	-0.15	0.880	-4.146416	3.55171
Y2	-.7796861	.1936802	-4.03	0.000	-1.159292	-.4000799
Y3	-1.379471	.2620816	-5.26	0.000	-1.893141	-.8658
Y4	-1.206323	.3571426	-3.38	0.001	-1.90631	-.5063366
Y5	-.264401	.4655267	-0.57	0.570	-1.176817	.6480147
Y6	-1.362607	.5938026	-2.29	0.022	-2.526439	-.1987751
Y7	-2.659173	.7743152	-3.43	0.001	-4.176803	-1.141543
Y8	-3.646118	.8857809	-4.12	0.000	-5.382217	-1.91002
Y9	-4.130325	1.065785	-3.88	0.000	-6.219225	-2.041425
Y10	-5.244685	1.202877	-4.36	0.000	-7.602281	-2.887088
Y11	-5.71337	1.278996	-4.47	0.000	-8.220156	-3.206585
Y12	-6.187375	1.7737	-3.49	0.000	-9.663762	-2.710987
_cons	26.53522	13.79426	1.92	0.054	-.5010255	53.57146
sigma_u	7.7091179					
sigma_e	1.9242778					
rho	.94134882	(fraction of variance due to u_i)				

```
. xtreg  p1 l_total l_pop l_grdp Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 Y11 Y12, robust re cluster(prov_id)

Random-effects GLS regression                   Number of obs      =       385
Group variable: prov_id                         Number of groups   =        33

R-sq:  within  = 0.5088                         Obs per group: min =         8
       between = 0.0965                                        avg =      11.7
       overall = 0.1517                                        max =        12

                                                Wald chi2(14)      =    310.12
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                                  (Std. Err. adjusted for 33 clusters in prov_id)
```

p1	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
l_total	-.1016197	.0547843	-1.85	0.064	-.2089949	.0057554
l_pop	.0941149	.126648	0.74	0.457	-.1541107	.3423404
l_grdp	-.4269151	.4311422	-0.99	0.322	-1.271938	.4181081
Y2	.252304	.1368273	1.84	0.065	-.0158726	.5204807
Y3	.0526764	.1371047	0.38	0.701	-.2160439	.3213966
Y4	.1523527	.130867	1.16	0.244	-.104142	.4088474
Y5	.2546727	.1794411	1.42	0.156	-.0970255	.6063709
Y6	.2535948	.2129845	1.19	0.234	-.1638472	.6710367
Y7	-.0725597	.1898653	-0.38	0.702	-.4446888	.2995695
Y8	-.255274	.2141309	-1.19	0.233	-.6749629	.1644149
Y9	-.4583306	.2826089	-1.62	0.105	-1.012234	.0955727
Y10	-.6565476	.2897051	-2.27	0.023	-1.224359	-.088736
Y11	-.7432515	.2985886	-2.49	0.013	-1.328474	-.1580286
Y12	-.9206548	.3720179	-2.47	0.013	-1.649796	-.1915132
_cons	7.188083	3.510686	2.05	0.041	.3072647	14.0689
sigma_u	2.0472678					
sigma_e	.58487988					
rho	.92454113	(fraction of variance due to u_i)				

```
. xtreg  p2 l_total l_pop l_grdp Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 Y11 Y12, robust re cluster(prov_id)

Random-effects GLS regression                   Number of obs      =       385
Group variable: prov_id                         Number of groups   =        33

R-sq:  within  = 0.3391                         Obs per group: min =         8
       between = 0.0895                                        avg =      11.7
       overall = 0.1289                                        max =        12

                                                Wald chi2(14)      =    171.64
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                                (Std. Err. adjusted for 33 clusters in prov_id)
```

p2	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
l_total	-.0396431	.0251753	-1.57	0.115	-.0889857	.0096995
l_pop	.0425907	.0535979	0.79	0.427	-.0624593	.1476407
l_grdp	-.2132679	.1390155	-1.53	0.125	-.4857332	.0591974
Y2	.1447683	.0753008	1.92	0.055	-.0028186	.2923552
Y3	.1246685	.1047898	1.19	0.234	-.0807157	.3300528
Y4	.1273627	.0673595	1.89	0.059	-.0046595	.2593848
Y5	.1653358	.1009184	1.64	0.101	-.0324606	.3631321
Y6	.1935572	.1136053	1.70	0.088	-.0291051	.4162195
Y7	.0780812	.0889621	0.88	0.380	-.0962814	.2524437
Y8	.0206314	.0880395	0.23	0.815	-.1519228	.1931857
Y9	-.0377093	.1266862	-0.30	0.766	-.2860098	.2105912
Y10	-.0941087	.1199969	-0.78	0.433	-.3292982	.1410809
Y11	-.1190658	.1188194	-1.00	0.316	-.3519475	.1138159
Y12	-.1914581	.1280078	-1.50	0.135	-.4423488	.0594326
_cons	2.790362	1.475528	1.89	0.059	-.1016191	5.682344
sigma_u	.76193034					
sigma_e	.27614912					
rho	.88389345	(fraction of variance due to u_i)				

Appendix 4

Hausman Test for Districts and Municipalities Level

```
. hausman fem1 .
```

	Coefficients (b) fem1	(B) rem1	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
l_tot	-.1133036	-.0753222	-.0379814	.0098095
l_pop	9.066038	4.240762	4.825276	1.393176
l_grdp	-.9463174	-4.210652	3.264335	.8882413
Y2	-1.732958	-1.504303	-.2286549	.0407319
Y3	-2.908104	-2.332652	-.5754515	.1182404
Y4	-3.601235	-2.738809	-.8624256	.1816985
Y5	-4.271661	-3.114683	-1.156978	.2466128
Y6	-4.596801	-3.155768	-1.441033	.3082551

```
                b = consistent under Ho and Ha; obtained from xtreg
     B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

           chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                   =       24.44
         Prob>chi2 =      0.0019
         (V_b-V_B is not positive definite)
```

Appendix 5

Result of Estimation in Districts and Municipalities Level using Fixed Effect Model (FEM) for Each Indicator of Poverty

```
. xtreg  p0 l_tot l_pop l_grdp Y2 Y3 Y4 Y5 Y6, robust fe cluster(districts_id)

Fixed-effects (within) regression               Number of obs      =       781
Group variable: districts_id                    Number of groups   =       132

R-sq:  within  = 0.6408                         Obs per group: min =         3
       between = 0.0148                                        avg =       5.9
       overall = 0.0093                                        max =         6

                                                F(8,131)           =     66.20
corr(u_i, Xb)  = -0.8047                        Prob > F           =    0.0000

                                    (Std. Err. adjusted for 132 clusters in districts_id)
```

p0	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
l_tot	-.1133036	.0564699	-2.01	0.047	-.2250145	-.0015927
l_pop	9.066038	2.340453	3.87	0.000	4.436064	13.69601
l_grdp	-.9463174	1.669825	-0.57	0.572	-4.24963	2.356995
Y2	-1.732958	.1062042	-16.32	0.000	-1.943055	-1.52286
Y3	-2.908104	.235878	-12.33	0.000	-3.374727	-2.441481
Y4	-3.601235	.331723	-10.86	0.000	-4.257462	-2.945007
Y5	-4.271661	.4500878	-9.49	0.000	-5.162042	-3.38128
Y6	-4.596801	.5567307	-8.26	0.000	-5.698147	-3.495455
_cons	-20.25089	26.98851	-0.75	0.454	-73.6406	33.13883
sigma_u	10.901605					
sigma_e	1.1784671					
rho	.9884493	(fraction of variance due to u_i)				

```
. xtreg  p1 l_tot l_pop l_grdp Y2 Y3 Y4 Y5 Y6, robust fe cluster(districts_id)

Fixed-effects (within) regression               Number of obs      =       781
Group variable: districts_id                    Number of groups   =       132

R-sq:  within  = 0.4537                         Obs per group: min =         3
       between = 0.1947                                        avg =       5.9
       overall = 0.2665                                        max =         6

                                                F(8,131)           =     28.10
corr(u_i, Xb)  = -0.1797                        Prob > F           =    0.0000

                                  (Std. Err. adjusted for 132 clusters in districts_id)
```

p1	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
l_tot	-.0212131	.0340195	-0.62	0.534	-.0885118	.0460856
l_pop	1.290551	1.436355	0.90	0.371	-1.550903	4.132005
l_grdp	-1.115861	1.028834	-1.08	0.280	-3.15114	.9194181
Y2	-1.012326	.1293383	-7.83	0.000	-1.268188	-.7564637
Y3	-1.135175	.1762967	-6.44	0.000	-1.483932	-.7864184
Y4	-1.284403	.2337536	-5.49	0.000	-1.746823	-.8219825
Y5	-1.438734	.3028996	-4.75	0.000	-2.037942	-.8395261
Y6	-1.407297	.3560831	-3.95	0.000	-2.111714	-.7028795
_cons	12.5606	15.4996	0.81	0.419	-18.10132	43.22251
sigma_u	1.1269146					
sigma_e	.67592364					
rho	.73542374	(fraction of variance due to u_i)				

```
. xtreg  p2 l_tot l_pop l_grdp Y2 Y3 Y4 Y5 Y6, robust fe cluster(districts_id)

Fixed-effects (within) regression               Number of obs      =       781
Group variable: districts_id                    Number of groups   =       132

R-sq:  within  = 0.4382                         Obs per group: min =         3
       between = 0.1523                                        avg =       5.9
       overall = 0.2624                                        max =         6

                                                F(8,131)           =     26.05
corr(u_i, Xb)  = -0.2684                        Prob > F           =    0.0000

                                  (Std. Err. adjusted for 132 clusters in districts_id)
```

p2	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
l_tot	-.0069931	.0138766	-0.50	0.615	-.0344443	.020458
l_pop	.0148688	.6600816	0.02	0.982	-1.29093	1.320668
l_grdp	-.2067853	.3083971	-0.67	0.504	-.8168683	.4032977
Y2	-.4249787	.0466866	-9.10	0.000	-.5173359	-.3326215
Y3	-.4548395	.0577203	-7.88	0.000	-.569024	-.340655
Y4	-.5219652	.0748132	-6.98	0.000	-.6699635	-.3739668
Y5	-.5783444	.092251	-6.27	0.000	-.760839	-.3958499
Y6	-.566169	.1073625	-5.27	0.000	-.7785576	-.3537804
_cons	4.084342	5.137613	0.79	0.428	-6.079081	14.24777
sigma_u	.35607515					
sigma_e	.27054252					
rho	.63400219	(fraction of variance due to u_i)				

Appendix 6

Result of Estimation in Districts and Municipalities Level using REM for Each Indicator of Poverty

```
. xtreg  p0 l_tot l_pop l_grdp Y2 Y3 Y4 Y5 Y6, robust re cluster(districts_id)

Random-effects GLS regression                   Number of obs      =       781
Group variable: districts_id                    Number of groups   =       132

R-sq:  within  = 0.6284                         Obs per group: min =         3
       between = 0.2917                                        avg =       5.9
       overall = 0.3186                                        max =         6

                                                Wald chi2(8)       =    558.31
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                                  (Std. Err. adjusted for 132 clusters in districts_id)
```

p0	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
l_tot	-.0753222	.0541646	-1.39	0.164	-.1814828	.0308384
l_pop	4.240762	.8436681	5.03	0.000	2.587203	5.894321
l_grdp	-4.210652	.5913839	-7.12	0.000	-5.369744	-3.051561
Y2	-1.504303	.0826627	-18.20	0.000	-1.666319	-1.342287
Y3	-2.332652	.158921	-14.68	0.000	-2.644132	-2.021173
Y4	-2.738809	.2070438	-13.23	0.000	-3.144607	-2.333011
Y5	-3.114683	.23029	-13.53	0.000	-3.566043	-2.663323
Y6	-3.155768	.2761073	-11.43	0.000	-3.696928	-2.614607
_cons	54.52995	5.35319	10.19	0.000	44.03789	65.02201
sigma_u	5.2880473					
sigma_e	1.1784671					
rho	.95268555	(fraction of variance due to u_i)				

```
. xtreg  p1 l_tot l_pop l_grdp Y2 Y3 Y4 Y5 Y6, robust re cluster(districts_id)

Random-effects GLS regression                   Number of obs      =       781
Group variable: districts_id                    Number of groups   =       132

R-sq:  within  = 0.4530                         Obs per group: min =         3
       between = 0.2327                                        avg =       5.9
       overall = 0.3039                                        max =         6

                                                Wald chi2(8)       =    246.48
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                          (Std. Err. adjusted for 132 clusters in districts_id)
```

p1	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
l_tot	-.0107975	.0240484	-0.45	0.653	-.0579315	.0363365
l_pop	.6856196	.1732399	3.96	0.000	.3460756	1.025164
l_grdp	-.7828011	.1138544	-6.88	0.000	-1.005952	-.5596506
Y2	-1.019407	.1180654	-8.63	0.000	-1.250811	-.7880035
Y3	-1.152109	.129922	-8.87	0.000	-1.406751	-.8974665
Y4	-1.317636	.1364912	-9.65	0.000	-1.585154	-1.050119
Y5	-1.485431	.1506431	-9.86	0.000	-1.780686	-1.190176
Y6	-1.462477	.1488725	-9.82	0.000	-1.754261	-1.170692
_cons	11.12503	1.002564	11.10	0.000	9.160036	13.09002
sigma_u	1.035821					
sigma_e	.67592364					
rho	.7013509	(fraction of variance due to u_i)				

```
. xtreg  p2 l_tot l_pop l_grdp Y2 Y3 Y4 Y5 Y6, robust re cluster(districts_id)

Random-effects GLS regression                   Number of obs      =       781
Group variable: districts_id                    Number of groups   =       132

R-sq:  within  = 0.4378                         Obs per group: min =         3
       between = 0.2076                                        avg =       5.9
       overall = 0.3126                                        max =         6

                                                Wald chi2(8)       =    235.24
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                                  (Std. Err. adjusted for 132 clusters in districts_id)
```

p2	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
l_tot	-.00117	.0082462	-0.14	0.887	-.0173322	.0149923
l_pop	.1410738	.0494576	2.85	0.004	.0441388	.2380089
l_grdp	-.1927167	.0317171	-6.08	0.000	-.2548811	-.1305522
Y2	-.4297943	.0480862	-8.94	0.000	-.5240415	-.3355471
Y3	-.4686128	.0529985	-8.84	0.000	-.5724879	-.3647376
Y4	-.5408934	.0541326	-9.99	0.000	-.6469914	-.4347954
Y5	-.6006125	.0595617	-10.08	0.000	-.7173513	-.4838736
Y6	-.5901487	.0591759	-9.97	0.000	-.7061313	-.474166
_cons	3.112088	.2873821	10.83	0.000	2.548829	3.675347
sigma_u	.30243806					
sigma_e	.27054252					
rho	.55549405	(fraction of variance due to u_i)				