Modelling the Spatial Economic Impact of a Natural Disaster at the Municipality Level

ARIEF HERMANA

Enschede, The Netherlands, August, 2015

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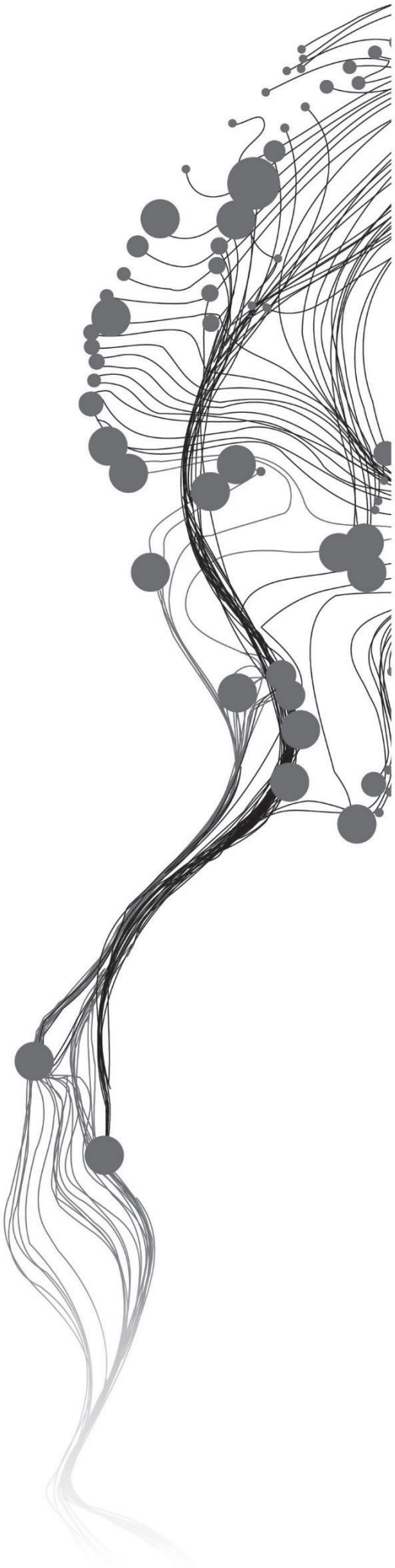

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Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.
Specialization: Urban Planning and Management

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Abstract

Natural disaster is a spatial phenomenon that cause a major shock with an overall negative impact to the economy. The study of disaster impact usually focus on the direct damages caused by the disaster, although several studies try to assess the direct and indirect impact of the disaster, the study is often done in a regional and national scale. In order to increase the accuracy of the impact assessment, the assessment should be done in a much smaller scale.

The main objective of this research is to analyze the use of Input-Output modelling for the estimation of the direct and indirect economic impact of a disaster at the municipality level. The main objective will be achieved through analyzing the spatial link between disaster impact and economic output and analyzing the direct and indirect economic impact of a natural disaster.

In order to capture the economic elements in the spatial domain, we use the overlay analysis between building map, land use map and inserting the output of each sectors we identified from the land use map to produce the output to land use ratio. The affected map were created using the overlay analysis between the building map, the land use map, the inundation map. We estimate the impact of the disaster to the economy by comparing the baseline of economic output from business as usual scenario with the economic output after disaster.

The spatial link between disaster impact and economic output was obtained through linking the classification of the land use map to the classification of the input-out table. The 12 land use classes were linked to 10 economic sectors; and resulted in 5 land uses classes and 5 economic sector that spatially linked. the direct impact of the disaster is 30 trillion rupiah in the form of output losses from five directly affected sectors, chemical industry, manufacturing industry, other type industry, commercial, and rice sectors. The cost of this impact is one third output losses of the overall Gross Domestic Product of Cilegon city. The indirect impact of the disaster is 3 trillion rupiah coming from the affected and non affected sectors supply adjustment to the reduction on the production capacity of the affected sectors and final demand consumption rationing. The sectors that experience indirect output losses are: rice sector, plantation sector, mining sector, electricity, gas and water sector, construction sector, commercial sector, transport and telecommunication sector.

There are several limitations we encounter in this study. The difference level of data aggregation between the spatial data and the economy data, the flow of goods and services between sector is not taken into account, the impact on settlement and quality of life is not taken into account, and the production structure in the economy sector is only determine by land and capital.

Based on the result. The Input-Output modelling can be used to capture the direct and indirect economic impact of a disaster in the municipality level.

Keyword : *Natural Disaster, Economic Impact, Input-Output Modelling*

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Arief Hermana

August 2015

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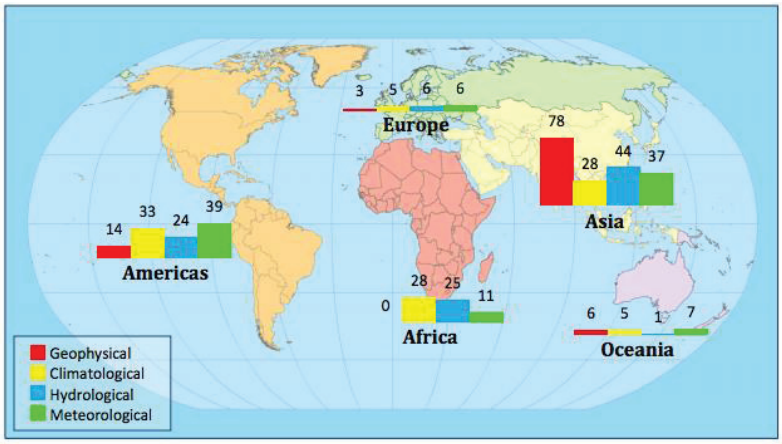
1. INTRODUCTION

1.1 Background

The rising global cost of natural disaster and the increasing share of economic activity between countries and regions has made disaster a major focal point of attention worldwide (The World Bank, 2003). The integration of global economies as a systems will increase the vulnerabilities of world economies toward disasters. As the economies of each nation and region are interconnected, a disruption in the economies of one nation due to disaster will affect the global economies as a whole. A report from the Centre for Research on the Epidemiology of Disasters (CRED) in 2012 reported that natural disasters in 2011 killed a total of 30,773 people, caused 244.7 million victims worldwide and the economic damages from natural disasters were the highest ever registered, with an estimated US$ 366.1 billion (Guha-Sapir, Vos, R, & Ponserre, 2012). In the geographical distribution of disasters, Asia was the continent most often hit by natural disasters in 2011 (44.0%), followed by the Americas (28.0%), Africa (19.3%), Europe (5.4%) and Oceania (3.3%) (Guha-Sapir, Vos, R, & Ponserre, 2012). The distribution of disaster and victims is portrayed in figure 1 and figure 2.

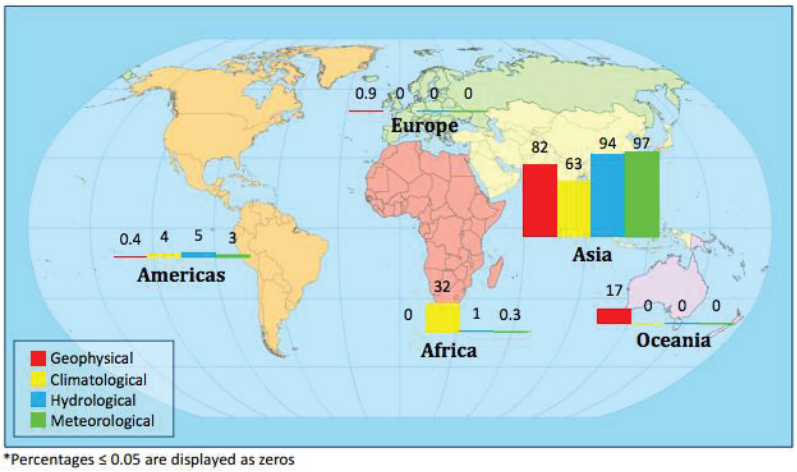
Figure 1-1 Percent share of reported occurrence by disaster sub-group and continent in 2011



SOURCE : ANNUAL DISASTER STATISTICAL REVIEW 2011 THE NUMBERS AND TRENDS (Guha-Sapir, Vos, R, & Ponserre, 2012)

The Asia and the Pacific countries are exposed to the natural hazard. Seven disaster with the highest death tolls were occurred in the Asia and Pacific region and contribute 80% of the global economic losses from the disaster event (Asia Development Bank, 2013). The rapid growth of Asian cities posed as a factor which contribute to the exposure of the population to the disaster. With an average increase of 44 million people every year, the population of urban area in Asia Pacific will increase 1.1 billion in 2030 than the figure of 2005(Asian Development Bank, 2008). With the higher population exposure is located in the urban area the disaster risk reduction strategies in the Asia-Pacific will be more focused in the urban area.

Figure 1-2 Percent share of reported victims by disaster sub-group and continent in 2011



SOURCE : ANNUAL DISASTER STATISTICAL REVIEW 2011 THE NUMBERS AND TRENDS (GUHA-SAPIR, VOS, R, & PONSERRE, 2012)

From an economic perspective, Przyluski, and Hallegatte (2011) define natural disaster as a natural event that causes a shock to the economy, with a major negative impact on assets, production factors, output, employment, or consumption. Furthermore Przyluski, and Hallegatte (2011) categorize the losses from disaster into three type: direct losses, non-market direct losses and indirect losses. In order to link the direct and indirect losses into the overall output losses to the economy Okuyama (2003) investigated the spatial and temporal dimension of economic impacts of a disaster in the regional scale using extended input-output modelling. Other frameworks to address the dynamic and spatial economic impact on disaster are also being used. Shibushawa and Miyara (2011) for example utilized a dynamic spatial computable general equilibrium (DSCGE) model to investigate the impacts of an earthquake on the economy of Tokai region. The Shibushawa and Miyara model expresses both the spatial commodity flows among regions and the dynamics of regional investments using the Multi-Regional Input Output of Japan. The DSCGE results show the indirect and distributional economic impacts before and after an earthquake. The change in the capital stock of the disaster struck region will affect the gross regional product of the surrounding region and the whole region. The two works mentioned before were trying to incorporate the spatial impact of the economy using CGE and extended I-O at the regional and national scale. In order to increase the accuracy of the impact assessment, and to incorporate the assessment into future planning in line with the building better for the future (Khasalamwa, 2009). Also to decrease the vulnerability of the community in the smallest administrative level, the assessment should be done in the smallest administration scale as possible. However the assessment is often not done at the municipal or local level often due to data limitations.

1.2 Research problem

A disruption caused by a disaster always happens in the spatial domain. Even though the impact can be measured in the economic domain the link between space and the economic activities remain not clear enough. In order to measure the impact of the disruptions which happen in the spatial domain to the economy, a link between space and the economy must be established.

1.3 Research objective

The main objective of this research is to analyze the use of Input-Output modelling for the estimation of the direct and indirect economic impact of a disaster at the municipality level. The specific objective in this research are:

1. To identify the spatial link between the impact of a disaster and the economic system

2. To analyze the direct impact of a disaster on the economic system
3. To analyze the indirect impact of a disaster on the economic system

1.4 Research questions

Based on the research problem and the research objectives the research question are:

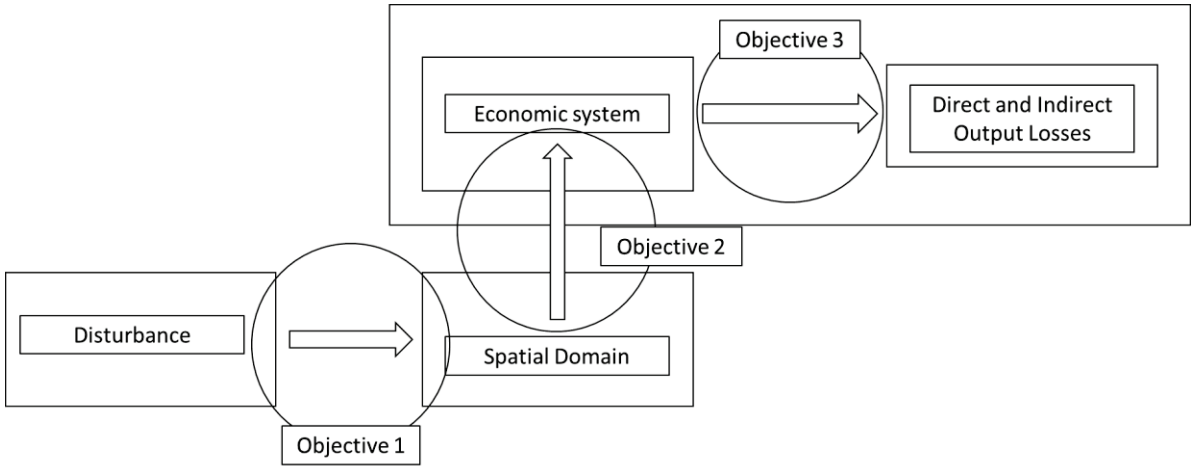
1. For Objective 1 :
    a. What type of scenario could be used to simulate an impact of a disaster?
    b. Which land uses areas will be affected by the disaster in the identified scenario?
    c. What is the link between land use and the sectors of the economy?
2. For Objective 2 :
    a. What is the direct impact of a disaster?
    b. What is the specific economic impact of a disaster?
    c. How to capture the spatial impact of disaster in the?
3. For Objective 3 :
    a. Identify the in indirect economic impact of a disaster using Input-Output Modelling
    b. Analyze the location of the economic sectors in relation to the vulnerability of the economic system for a disaster
    c. What are the potential spatial planning implications of the economic impact of a natural disaster

Based on the answer to the above research question and the analysis of the result the use of Input-Output modelling for the estimation of the economic impact of a disaster at the municipality level will be discussed.

1.5 Conceptual framework

The conceptual framework of this research is displayed in the figure 1-3.

Figure 1-3 The Conceptual Framework



1.6 Hypotheses

Based on the literature review we formulate a hypotheses as follows:

Most focus in spatial planning and risk reduction is on the direct impacts of natural disaster. The implications for spatial planning are different if the indirect economic impacts of natural disasters are also

being considered. The Input-Output model and analysis is a relevant and feasible methods to model the indirect economic impact of a disaster.

1.7 Thesis Structure

This thesis will have five chapters with the following structures:

1. Introduction
    a. Background
    b. Research problem
    c. Research objective
    d. Research questions
    e. Conceptual framework
    f. Hypotheses
    g. Thesis Structure
2. Literature Review
    a. Introduction
    b. Disaster and The Economy
    c. Cost Assessment Methods of Disaster
    d. Input-Output Analysis
    e. Land Use and factor of Production Relationship
    f. Conclusion
3. Research design
    a. Methodology
    b. Study Area
    c. Data
4. Results; analysis and discussion
5. Conclusion and recommendation

2. LITERATURE REVIEW

2.1 Introduction

The challenge of measuring the economic impact of a disaster is to incorporate the spatial characteristic of the disaster into the economic model which often did not express the spatial temporal characteristic. In this section we will try to choose a method which can connect the spatial characteristic of a disaster and the economic model. To choose the appropriate methods we will review the relationship between the economy and the disaster from the theoretical perspective. In this section we will also discuss several methods which currently used to measure the economic impact of disaster. Each of the methods have their own strengths and limitations. Eventually we will choose the appropriate approach to measure the direct and indirect economic impact of the disaster at the local level.

2.2 Disaster and The Economy

Natural disaster events can have a major impact on the economy. The impact of a disaster on the economy depends on several factors. The increasing concentration of population and the investment in vulnerable locations and inadequate risk reduction investments are major factors in the increasing impact of disasters according to Clark and Munasinghe (1994). Toya and Skidmore (2007) using 44 years of data from many countries which had experienced natural disasters found that countries with higher income, higher educational attainment, greater openness, more complete financial systems and smaller government experience fewer losses from disasters. Stromberg (2007) concludes that more people are affected and killed in the low and middle income countries in the event of disaster and the lower the income of the country the higher the aid and humanitarian relief given. Stromberg also found that the relief and humanitarian aid is also closely linked with the closeness of the donors with the affected country, it means that the closer the social structure of the affected country with the donors the higher the amount of humanitarian aid and relief will be given. Shabnam (2014) using panel dataset consist of 187 countries from 1960 to 2010 found that the annual growth rate of GDP per capita is closely related to the total number of people affected by the flood rather than the total number of death related to the flood. This was a plausible result because the floods are likely to create havoc in the livelihood rather than claim a human death toll. Another perspective on the impact of disaster to the economy is presented by Bertrand (1993). He concludes that capital loss has a small effect on the fall in the output growth and the foreign and public disaster relief is better used to help affected victims and activities rather than the conventional belief of putting the primary concern on the economic rebounds. Bertrand view is supported by the work of Horwich (2000) which take the example from the 1995 Kobe earthquake. Horwich view that the physical capital is not the fundamental factor of the economic recovery, but rather the human capital is the primary factor for the economic recovery. Horwich's assumption is based on the time needed to produce human capital which is greater than to produce physical capital. Bertrand and Horwich view on the impact of a disaster is indirectly supported by the works of Toya and Skidmore, and Stromberg. The higher the average income countries, the higher the accumulation of its human capital which leads to fewer losses and faster rebounds.

The losses of natural disasters have been an ongoing discussion among the scholar. Pelling et al. (2002) address the impact to the economy into three type of losses:

1. Direct damages: Damage to the factor of production (fixed assets, capital, raw material, and spare parts) and to the inventories of final goods and intermediate goods that occur simultaneously as a direct effect of the natural disaster. The cost of relief and emergency response is also included in this type.
2. Indirect damages and flow losses: The disruption on the production of goods and service due to the damage of the factor of production. The disruption will also affect the flow of goods and services. The increase on the operational expenditure can be expected also because of the needs to find the alternative means of production. Other losses resulting from the non-provision of goods

and services, losses of personal income in the case of total or partial loss of the means of production, business or livelihood is also included in this type.

3. Secondary effects: The overall economic impact of disaster, measured by the macro-economic variables. The secondary effect is felt during the fiscal year of the disaster but may spill over a number of years.

Lindell and Prater (2003) is focusing on the socioeconomic impact of natural disaster to the community addressing the impact of disaster into two type of losses:

1. Direct Losses: Come from the damage assets which lead to a decrease in consumption (reducing the quality of life) and reduction in investment (decreasing the economic productivity)
2. Indirect Losses: Cause by the interdependency of the community to the economy. The disaster will disrupt the flows of goods and service which will increase the amount of resource the community have to pay to get basic necessities.

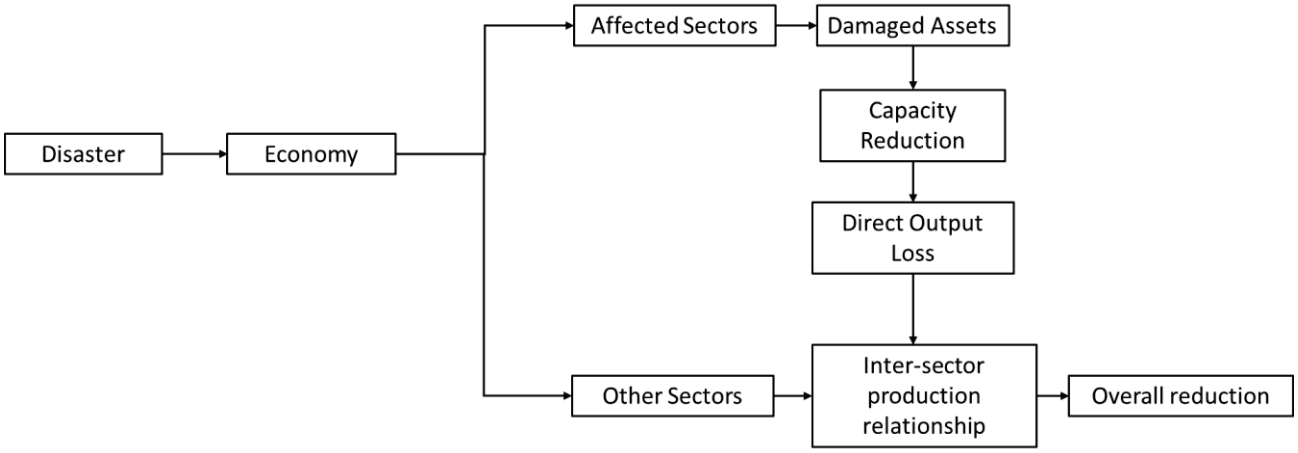
Przyluski, and Hallegatte (2011) using the typologies from the previous works of Pelling et al. (2002), Lindell and Prater (2003) and other works such as Cochrane (2004), Rose (2004) categorize the losses from disaster into three type:

1. Direct market losses: The loss of tangible asset or goods and services which can be identified directly after the disaster struck. This type of losses can quickly be quantified because the price of this type of assets or goods and services can be found on the market.
2. Direct non-market losses: The loss of intangible assets which cannot be found in the market. It is harder to quantify the losses of this kind of assets because there is no right price for this kind of assets. For example it is hard to quantify the losses of cultural heritage site or the change in landscape due to a natural disaster because there is no market price of cultural heritage and natural landscape.
3. Indirect losses: Losses which occur not from the disaster but from the consequence of disaster; to distinguish indirect losses with direct losses certain criteria are being used. First, indirect losses are caused by secondary effects, not by the hazard itself. Indirect costs can be caused by hazard destructions or by business interruptions. In addition to this obvious criterion, costs are indirect if they are spanning on a longer period of time, a larger spatial scale or affecting a different economic sector than the disaster itself.

The loss from a disaster can reduce the output of an economy through the loss of invested capital and the loss of human capital. Based on the typology of losses from Pelling et. Al; Lindell and Prater; and also Przyluski, and Hallegatte, we proposed three type of losses:

1. Direct Losses: The damaged assets on the first impact of disaster, the loss of invested capital and the human capital are included in this losses. This losses is also include the direct market losses (Building losses, machinery losses, infrastructure losses) and direct non market losses (reduction in quality of life, historical monument losses, damage of major tourism spot).
2. Direct Output Losses: The output lost following the losses from the damaged assets. The characteristic of this losses is associated with the output losses from the sectors affected by the disaster.
3. Indirect Output Losses: The output loss associated with the interconnectivity of the production mechanism. One sector product often require the input from another sectors, if there is an interruption in the particular sector it will reduce the delivery of input to another sector. Which will reduce the overall output of the economy.

Figure 2-1 Type of Losses



The objective of this research we will measure the effect of the disaster to the economy. We will focus on the direct output losses and the indirect output losses because the direct output losses and the indirect output losses will have a significant impact to the economy. By being better understanding the direct and indirect output losses; better insight could be available for the spatial planning in view of disaster risk reduction.

2.3 Cost Assessment Methods of Disaster

Natural disasters can be a major cause of economic disruption as Przyluski, and Hallegatte views of natural disaster which can cause perturbation in the economic system. There are several attempts to measure the impact of disaster to the economic system. L. Carerra et al (2013) compiled four methods to measure the impact of disaster to the economy: i. Post event economic survey; ii. Econometric model; iii. Model based approach; iv. Other model based model.

i. Post Event Survey

Post event survey and econometrics model can quantify the indirect impact of the natural disaster in the overall economic level but they cannot capture the disruption within and the connection between the affected sectors and the other sectors of the economy. Molinari et al (2014) uses ex post damage assessment to assess the impact of flood in the Umbria and Sicily region. In this case studies Molinari refers direct damage as the physical destruction and the number of casualties occurred after the disaster. The indirect damages on the other hand defined as the consequence which came after the physical destruction such as business interruption which will have further consequence to the market equilibrium and labor issues. To measure the indirect impact of the floods Molinari use the number of days the victims spent in the evacuation and the number of days for a business and industry to commence normal operation. There are several findings that Molinari mentions in his research:

1. The timing of the survey is delayed because the difficult access to the disaster site.
2. The multiple stakeholders with different backgrounds but sharing the same vision is proven to be a major advantage on conducting a survey.
3. The pre-event data availability is important to measure the impact of disaster.
4. The need to store and record the data during the process in order to link the emergency phase to the recovery phase.

The four findings that Molinari encountered is reflecting the characteristics of the post event survey methods. The first finding reflect on the problem of the timing of the post event survey must be conducted, the smaller time lag between the event of the disaster and the survey timing is better because more information can be obtained. The second finding is reflecting the efficiency of the

survey. We often found out that post event survey is carried out couple of times with different stakeholders to complete different set of objectives which is time consuming and costly. It is better to have the multiple stakeholders to cooperate and share the same vision and information. The third findings is reflecting the effectiveness of the post event survey. To do the post event survey effectively a good quality of the pre event data is needed. Because the result of the post event survey would be useless if we cannot compare the result with the pre event data. The fourth findings is reflecting the continuous characteristic of the post event survey. After the data of the disaster impact is collected the data must be stored and updated regularly to measure the process of the recovery.

ii. Econometrics Modelling

The base of the econometrics are statistical methods and the time series of an event to investigate the "mean" indirect cost of the event. In order to calculate the "mean" of the indirect cost of a disaster, a large sets of past historical event must be available. The need for large datasets is one of the limitations of the econometrics modelling but this limitation is tackled by the flexibility of the econometrics model to use real data and synthetic data. The synthetic data are created by the combination between real data with additional information. The synthetic data are often created on theoretical or empirical assumptions. If the assumption is flawed the whole model will fall apart. Guimaraes, Hefner, and Woodward (1993) examines the economic gain and loss after the Hurricane Hugo. Guimaraes et al. use a multi-sectoral econometric model with the "with and without" scenario of the storm. Guimaraes at al. compare the economic growth without the hurricane with the economic growth with the hurricane. Guimaraes found out that even though there are even some economic gains after the hurricane particularly on the construction sector, the economic gain is still below the "without hurricane" scenario. Even though the model can estimate and segregate the economic gain and losses caused by an extreme event from other type of exogenous factors, the total shocks to the region concerning the total wealth loss is still hard to assess accurately. Okuyama (Okuyama, 2011; and Okuyama, 2007) addresses some limitations on the econometrics modelling. Because the economic modelling characteristic is to investigate the "'mean" of the indirect cost, the lack of disaster data shock will distribute the mean into series of year which will underestimate the shock. A second limitation is the need for large sets of data (time-series and cross section). Moreover, the direct effect and higher order effect cannot easily be disaggregated (Rose, 2005).

iii. Model-based approaches designed for cost assessment: input-output models, computable general equilibrium models.

I-O models can represent urban contexts as well as even smaller economic entities like natural parks or cities and often reach a high analytical specificity. But they are usually missing the effect on the overall economy. Moreover I-O models are less flexible because the assumption of linearity compared with the CGE model. Rose (2005) proposed The CGE model as an alternative to the I-O model which corporate the behavioral model of producer and consumer responses to price signals in a multimarket context. The nature of nonlinearity and the responses related to substitution of inputs concerning the disruption of the economy can have an advantage over the rigidity of I-O model. However, Rose also mentions a limitation of CGE model which only captures the long-run equilibrium analysis, and a CGE models without extensive refinement generally leads to underestimation of the impact to the economy where the I-O model has a tendency to overestimating the impact of disruption to the economy. The CGE data is often available at the regional and national level while the I-O data is sometimes also available at the municipality level. Haimes and Santos (2004) attempt to predict the resulting economic losses and inoperability suffered by individual sectors resulting from a direct disruption to a particular sector (or a particular set of sectors) using the Interoperability Input-Output Model (IIM). The study of Haimes and Santos highlight four key features of the IIM.

- First, modelling and analyzing the demand pattern after the disruption.
- Second, describing the temporal behavior of the economic impact associated with the disruptive event by using a dynamic IIM.
- Third, a discussion for forecasting system-specific demand disruptions utilizing other sources of data, such as consumer confidence.
- Fourth, a visualization tool is presented for conducting a multi-criteria ranking of the most-affected systems using both economic loss and inoperability metrics.

iv. Other model-based approaches: idealized model, hybrid models

Idealized model emphasize on the mechanism underlying the economics of natural disaster. The idealized model aims to identify and investigate the role of economics in the natural disaster (Hallegatte & Dumas, 2009; Hallegatte & Ghil, 2008). The other model in this category is the hybrid model, the hybrid model try to combine the physical aspect and economy aspect of the disaster. The challenge of developing a hybrid model is to find a link between two different type of data, the physical data and the economic data.

2.4 Input-Output Analysis

Input-Output analysis is a model which involves all aspects of all account related to goods and services. The fundamental mechanism of input –output analysis is the inter-relationship between sectors in the economy represented by the intermediate output and the intermediate input and how the product of each sector is being use represented by the final demand in the figure 2-2.

Figure 2-2 Basic Transaction Table

Use Matrix →

Make Matrix ↓

		PRODUCERS AS CONSUMERS								FINAL DEMAND			
		Agric.	Mining	Const.	Manuf.	Trade	Transp.	Services	Other	Personal Consumption Expenditures	Gross Private Domestic Investment	Govt. Purchases of Goods & Services	Net Exports of Goods & Services
PRODUCERS	Agriculture												
	Mining												
	Construction												
	Manufacturing												
	Trade												
	Transportation												
	Services												
	Other Industry												
VALUE ADDED	Employees	Employee compensation								GROSS DOMESTIC PRODUCT			
	Business Owners and Capital	Profit-type income and capital consumption allowances											
	Government	Indirect business taxes											

SOURCE : ADAPTED FROM INPUT-OUTPUT ANALYSIS AND EXTENSION SECOND EDITION (Miller & Blair, 2009)

The use matrix portrays the output from one particular sector being consumed and used by other sectors, households, government and export to other regions. While the make matrix displays the various inputs being used in the production. We can write the use matrix with simple mathematical formula:

$$\sum_{j=1\ldots n} X_{ij} = \left(X_{11} + X_{12} + X_{13} + \cdots + X_{ij}\right) + Final\ Demand \qquad (2.1)$$

The make matrix is displaying the input needed to produce one product of one particular sector, in this column we can see that the product from one particular sector is comprised of input from other sectors

and the endogenous production factors which are represented by the value added column. The employee compensation represents the labor and the capital consumption allowance represents the business owner capital. We can write the make matrix with simple mathematical formula:

$$\sum_{j=1\ldots n} X_{kj} = \left(X_{11} + X_{21} + X_{31} + \cdots + X_{ij}\right) + Value\ Added \tag{2.2}$$

The first assumption of input-output analysis is the total sum of output is always the same with the total sum of input.

$$\sum_{j=1\ldots n} X_{kj} = \sum_{j=1\ldots n} X_{ij} \tag{2.3}$$

For better explanation we imagine there are four sectors in the economy (1, 2, 3 and 4). Each of the sectors is producing one output, using parts of its own production and parts of the output from other sectors as its input. Each of these sector plays dual roles in this systems, namely as a producer and as a consumer. This system requires each sector product to fulfill exogenous demand from the part of the consumer (d1, d2, d3, d4) in formal terms, we can represent the economy just described as follows:

$$\begin{aligned} x_1 &= a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + a_{14}x_4 + d_1 \\ x_2 &= a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + a_{24}x_4 + d_2 \\ x_3 &= a_{31}x_1 + a_{32}x_2 + a_{33}x_3 + a_{34}x_4 + d_3 \\ x_4 &= a_{41}x_1 + a_{42}x_2 + a_{43}x_3 + a_{44}x_4 + d_4 \end{aligned} \tag{2.4}$$

Where the *x´*s are production levels, a_{ij} are the input-output coefficients (the intermediate requirements from industry *i* per unit of output of industry *j*), and where the *d*'s are the levels of final demand from the consumers. In matrix terms, we can write:

$$x = Ax + d \tag{2.5}$$

Where A is the technical coefficient defined by the output of sector 1 absorbed by sector 2 and 3 per unit of its total output of sector 1 is described by the symbol a11, a21 and a31 and is called the input co-efficient of product of sector i into sector j

$$a_{ij} = x_{ij} \,/\, x_j \tag{2.6}$$

This technical coefficient is displaying how much of a fraction of another sector is needed to fulfill the total input of one particular sectors.

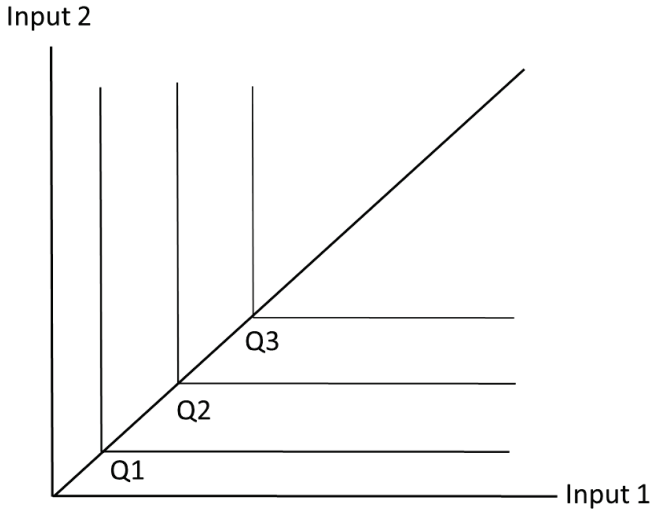
The second assumption of the input output model is the technological advance is assumed to be constant. If we express this on the cobb-douglass production function we will get:

$$Q_t = A \cdot f(K_t, L_t) \tag{2.7}$$

Qt is the amount of production for the time t, K_t and L_t is the amount of capital and labor needed to produce for the time t and A is the technological coefficient, where $A = A_0 = A_t$

The third assumption of the input-output model is the production function will use the Leontief production function which mean there will be no substitution of input, the input is at the exact amount of quantities combination extra additional amount of one input will not increase the production if the other input is not increase with the same ratio. The visualization of Leontief production can be seen on figure 2-3.

Figure 2-3 Leontief Production Function



The second and the third assumption is the underlying factors why the technical coefficient is assume constant.

After we get the technical coefficient we will need to know how much output we need from the other sectors to supply the final demand. To obtain this we will modify the equation (2.1) into this form:

$$\sum_{j=1\ldots n} X_{ij} - \left(X_{11} + X_{12} + X_{13} + \cdots + X_{ij}\right) = Final\ Demand \quad (2.7)$$

Where $X_{11} = a_{11}x_1$; $X_{12} = a_{12}x_2$ ….. $X_{ij} = a_{ij}x_j$

Substitute X_{ij} with $a_{ij}x_j$ we will obtain

$$x_1 - \left(a_{11}x_1 + a_{12}x_2 + \cdots a_{ij}x_j\right) = Final\ Demand \quad (2.8)$$

If we use the substitution on (2.8) into n sectors on (2.4) we will obtain:

$$\begin{aligned}(1 - a_{11})x_1 - \cdots - a_{1i}x_i - \cdots - a_{1n}x_n &= d_1\\ -a_{i1}x_1 - \cdots + (1 - a_{ii})x_i - \cdots - a_{in}x_n &= d_i\\ -a_{n1}x_1 - \cdots - a_{ni}x_i - \cdots + (1 - a_{nn})x_n &= d_n\end{aligned} \quad (2.9)$$

Using the equation (9) we can rewrite the matrix equation (2.5) into:

$$[I - A]x = d \quad (2.10)$$

Where I is an identity matrix $I = \begin{bmatrix}1 & \ldots & 0\\ \ldots & 1 & \ldots\\ 0 & \ldots & 1\end{bmatrix}$

So then (I-A) = $\begin{bmatrix}(1 - a_{11}) & -a_{12} & -a_{1n}\\ -a_{21} & (1 - a_{22}) & -a_{2n}\\ -a_{n1} & -a_{n2} & (1 - a_{nn})\end{bmatrix}$

To solve x on (10) we rewrite the equation on (10) to become:

$$x = [I - A]^{-1}d = Lf \quad (2.11)$$

Where $[I-A]^{-1} = L = [l_{ij}]$ is Leontief inverse or the total requirement matrix.

2.4.1 Simulating Shock to the Economy

In order to capture the shock of disaster to the economy, Steenge and Bockarjova (2007) introduce the capacity loss parameter γ_i where the value of capacity loss parameter is: $0 < \gamma < 1_i$.

The capacity loss parameter represent the fraction of the sector production capacity lost after the disaster. If we have the pre-disaster situation given by:

$$\begin{bmatrix} a_{11} & a_{12} & h_1 \\ a_{21} & a_{22} & h_2 \\ l_1 & l_2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ L \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ L \end{bmatrix} \tag{2.12}$$

Where:

a: Technical Coefficient

l_1: employment from sector 1

l_2: employment from sector 2

x_1: total output from sector 1

x_2: total output from sector 2

L: total employment

After disaster some of the production capacity have been lost. The post disaster situation would be:

$$\begin{bmatrix} a_{11} & a_{12} & h_1 \\ a_{21} & a_{22} & h_2 \\ l_1 & l_2 & 0 \end{bmatrix} \begin{bmatrix} 1-\gamma_1 & 0 & 0 \\ 0 & 1-\gamma_2 & 0 \\ 0 & 0 & 1-\gamma_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ L \end{bmatrix} = \begin{bmatrix} t_1 \\ t_2 \\ t_3 \end{bmatrix} \tag{2.13}$$

Where $\gamma_i (i = 1,2,3)$ are not all zero and the t_i (i=1,2,3) represent the row summation. In the situation when $0 < \gamma_1 = \gamma_2 = \gamma_3 = \gamma < 1$, we will have a proportionally shrunken economy

$$(1-\gamma) \begin{bmatrix} a_{11} & a_{12} & h_1 \\ a_{21} & a_{22} & h_2 \\ l_1 & l_2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ L \end{bmatrix} = (1-\gamma) \begin{bmatrix} x_1 \\ x_2 \\ L \end{bmatrix} \tag{2.14}$$

2.5 Land Use and Factor of Production relationship

In order to connect the spatial data and economic data we adapted the model from Mills (1967). Mills assumed that urban area is the place where the production take place. The production of goods is estimated using Cobb-Douglass production function:

$$X_1 = A_1 L_1^{\alpha_1} N_1^{\beta_1} K_1^{\gamma_1} \tag{2.15}$$

Where:

$$\alpha_1 + \beta_1 + \gamma_1 = H_1 \cong 1$$

A_1: Technological Coefficient

L_1: Land

N_1: Labor

K_1: Capital

$\alpha_1 : land\ coefficient$

$\beta_1 : labor\ coefficient$

$\gamma_1 : capital\ coefficient$

From equation (2.15) the production level is dependent on the combination of land area, number of labor and the number of capital. This combination is represented by the land coefficient, labor coefficient, and capital coefficient.. To elaborate this model we distinguish the economic sectors into three categories:

1. Agricultural based sectors: These sector relies more on the land area and number of labor. For these sectors the coefficient of the land area and labor are larger than the capital coefficient.
2. Industrial based sectors: For these sectors the production process relies heavily on the capital, machinery, labor and the land is the supporting factor for this sector. Thus the coefficient production is a mix between capital, land, and labor.
3. Trade and Service based sectors: These sector relies on the capital and labor. For these sectors the coefficient of capital and labor is more significant than the other production factors.

The three categories are summarized in the table 2-1.

Table 2-1 Factor of Production Coefficient

Sector Categories	Production Coefficient Weight		
	Land	Capital	Labor
Agricultural Based	High	Low	High
Industrial Based	Low	High	Medium
Trade and Service Based	Low	High	High

Because of the data availability issues we only consider two factor that will be expressed spatially: land and capital. The land can be proxied by the areal land use of the economic sector and the capital can be proxied by the building footprint map because the machinery which use in the production process is located within the building.

2.8 Conclusion

After we discussed the natural disaster and the economy in the previous section we conclude that the natural disaster has a major impact on economic development. These impact can affect the economy through three type of losses:

- Direct damage losses
- Direct output losses
- Indirect output losses

As explained in this chapter there are four common methods to assess the cost of disaster:

- Post event survey
- Econometric modelling
- Model based approach: Input-Output modelling, Computable general equilibrium
- Other model: Idealized model, Hybrid model

We will be using the Input-Output model because the Input-Output model can capture the direct and indirect output losses through the relationship between sectors in the economy. However there are several limitation of the Input-Output model such as:

- The inflexibility of the Input-Output model
- It cannot capture the change in price of a commodity
- Only suitable for short and medium run simulation

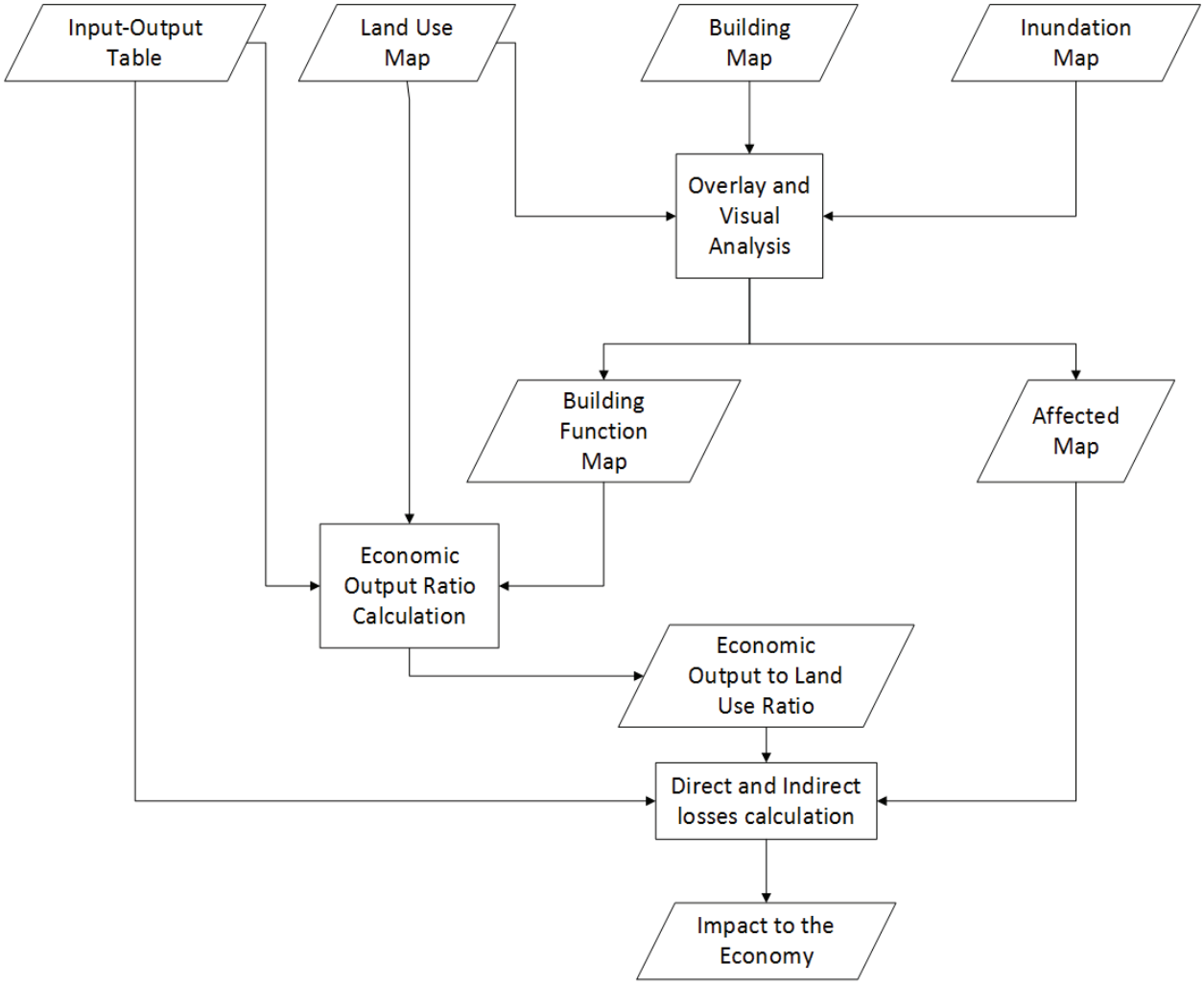
Referring to section 2.7 in order to express the factor of production in the spatial dimension we will only consider the land and the capital factor. The land area will be represented by the land use area and the capital will be represented by the building footprints.

3. RESEARCH DESIGN

3.1 Methodology

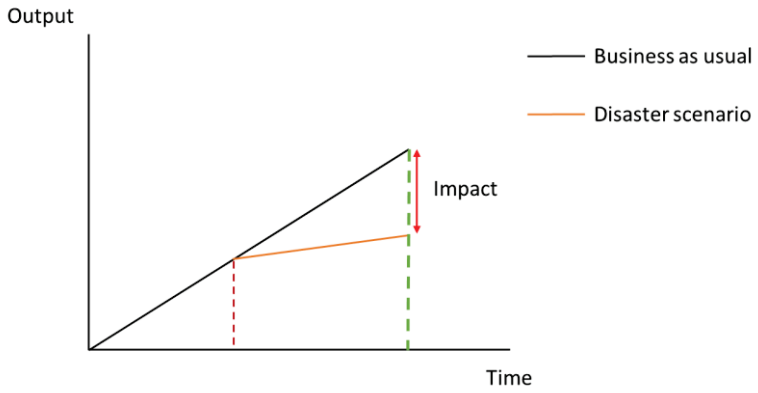
In order to capture the economic elements in the spatial domain, we use the overlay analysis between building map, land use map, and inserting the output of each sectors we identified from the land use map to produce the output to land use ratio. To produce the affected map we use the building map, the land use map, the inundation map. After we get the affected map we use the output to land use ratio and input-output analysis to calculate the direct losses and indirect losses. The flowchart of the methodology is displayed in the figure 3-1.

Figure 3-1 Methodology Flowchart



In order to estimate the impact of the disaster to the economy we compare the baseline of economic output from business as usual scenario with the economic output after disaster.

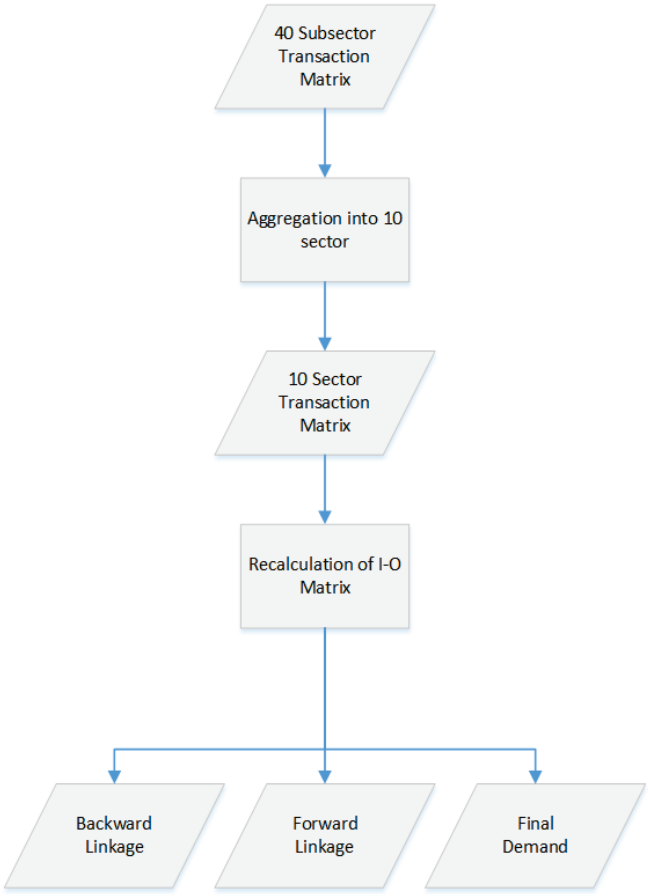
Figure 3-2 Impact of Disaster



3.1.1 Input-Output Table Aggregation and Baseline Economic Output

In order to have the same level of spatial and input output data we must aggregate the input-output table from 40 sectors into 10 sectors.

Figure 3.3 Aggregation and Baseline Scenario Output



We set up the baseline I-O matrix using the domestic transaction table. Due to the aggregation level of the land use data we must aggregate the 40 subsector I-O transaction table into 10 sector I-O transaction table. After we aggregated the transaction table we calculate the A matrix, the multiplier matrix, forward and backward linkage and the final demand multiplier matrix. The sector aggregation mapping displayed in the table 3-1

Table 3-1 Economic Sector Aggregation

Code	Sector	Aggregated Sector
1	Rice	Rice
2	Tuber Plant	Plantation
3	Vegetables and Fruit	
4	Others Food Plant	
5	Plantation Crops	
6	Livestocks	
7	Forestry	
8	Fisheries	
9	Mining	Mining
10	Food and Beverages Industry	Other Industries
11	Textile Industry	
12	The timber industry, goods from wood and the like	
13	Paper industry, paper products	
14	Chemical Industry	Chemical Industry
15	Oil Refinery	
16	Plastic goods Industry	
17	Non-Metal mineral goods industry	Manufacture Industry
18	Machinery and tools industry	
19	Basic Metal and Steel Industry	
20	Manufacture of fabricated metal products, except machinery and equipment	
21	Other Manufacturing	
22	Electricity, Gas, and Water	Electricity, Gas, and Water
23	Construction	Construction
24	Wholesale	Commercial
25	Hotel and Restaurant	
26	Railway Transport	Transportation and Telecommunication
27	Highway Transport	
28	Sea and coastal water transport	
29	Air Transport	
30	Inland water transport	
31	Port services	
32	Other transportation services	
33	Postal and telecommunication	
34	Bank	Commercial
35	Other financial institution	
36	Rental and leasing activities	
37	Government	
38	Social community services	
39	Entertainment services	
40	Individual and household services	

3.1.1.1 Input Output-Model Example

To illustrate the methodology we have been using for our 10-sector model; we will first set up and explain a hypothetical example for a four sector economy. The transaction table can be seen in the table 3-2

Table 3-2 Fictional Four Sector Economy

Sectors	1	2	3	4	Household	Government	Export	Output
1	20	10	20	40	10	10	20	130
2	30	20	10	20	20	10	10	120
3	10	10	30	30	10	20	10	120
4	10	20	30	10	20	30	30	150
Import	20	20	10	20				
Wages	30	20	10	20				
Profit	10	20	10	10				
Input	130	120	120	150				

From the transaction table we obtain the following: information: The row represents how much input is needed to produce a certain amount of output. In order to produce 130 in sector 1 it will need 20 input from its own sector, 30 input from the sector 2, 10 input from the sector 3, 10 input from the sector 4, 20 input from outside the region (i.e. import), 30 input from the labors, and the 10 for the profits. The column represents how much from the output is being consumed by other sectors and the final consumers. From the 130 output from sector 1, 20 is consumed by its own sector as an input, 10 is consumed by sector 2, 20 is consumed by the sector 3, 40 is consumed by the sector 4, 10 is consumed by the household, 10 is consumed by the government and 20 is being exported to outside the region. The same logic is applied to the other sectors.

For the technical coefficient we use the equation (2.6) thus we will get the result on table 3-3

Table 3-3 Technical Coefficient (A) Matrix

	1	2	3	4
1	0.15	0.08	0.17	0.27
2	0.23	0.17	0.08	0.13
3	0.08	0.08	0.25	0.20
4	0.08	0.17	0.25	0.07
Import	0.15	0.17	0.08	0.13
Wages	0.23	0.17	0.08	0.13
Profit	0.08	0.17	0.08	0.07
Input	1	1	1	1

From the technical coefficient matrix we can see how much of the fraction of the input to produce 1 unit of goods.

3.1.1.2 Economy Shock Simulation

A natural disaster can cause a shock to the economy through three type of losses: direct damage, direct output loss, and indirect output loss. The shock can affect either the supply side or the demand side of the

economy. In this study we will only investigate how the inter-sector transaction will react to output losses from the affected sector.

In the case of a disaster, the disaster affected sector will have a reduction in the production capacity which will lead the reduction of consumption from other sectors. If we assume that x_1 and x_3 is the output of sector 1 and 3. After the disaster the production capacity is reduced by x_{d1} and x_{d2} supply equation for sector 1 and 3 will be:

$$(x_1 - x_{d1}) = a_{11}(x_1 - x_{d1}) + a_{21}(x_1 - x_{d1}) + a_{31}(x_1 - x_{d1}) + a_{41}(x_1 - x_{d1}) + VA_1(x_1 - x_d) \quad (2.12)$$

$$(x_3 - x_{d3}) = a_{13}(x_3 - x_{d3}) + a_{23}(x_3 - x_{d3}) + a_{33}(x_3 - x_{d3}) + a_{43}(x_3 - x_{d3}) + VA_3(x_3 - x_{d3}) \quad (2.13)$$

The transaction table change displayed in the table 3-4

Table 3-4 Aftershock Disequilibrium State

Sectors	1	2	3	4	Household	Government	Export	Output
1	a_{11} (x_1-x_{d1})	a_{12} x_2	a_{13} (x_3-x_{d3})	a_{12} x_2	H_1	G_1	E_1	X_1 –((a_{11} (x_1-x_d))+ a_{13} (x_3-x_{d3}))
2	a_{21} (x_1-x_{d1})	a_{22} x_2	a_{23} (x_3-x_{d3})	a_{22} x_2	H_2	G_2	E_2	X_2 – ((a_{21} (x_1-x_{d1})+ a_{23} (x_3-x_{d3}))
3	a_{31} (x_1-x_{d1})	a_{32} x_2	a_{33} (x_3-x_{d3})	a_{32} x_2	H_3	G_3	E_3	X_3 – ((a_{31} (x_1-x_{d1})+ a_{33} (x_3-x_{d3}))
4	a_{41} (x_1-x_{d1})	a_{42} x_2	a_{43} (x_3-x_{d3})	a_{42} x_2	H_4	G_4	E_4	X_4 – ((a_{41} (x_1-x_{d1})+ a_{43} (x_3-x_{d3}))
Import	I_1 (x_1-x_{d1})	I_2 x_2	I_3 (x_3-x_{d3})	I_2 x_2				
Wages	W_1 (x_1-x_{d1})	W_2 x_2	W_3 (x_3-x_{d3})	W_2 x_2				
Profit	P_1 (x_1-x_{d1})	P_2 x_2	P_3 (x_3-x_{d3})	P_2 x_2				
Input	(x_1-x_{d1})	x_2	(x_3-x_{d3})	x_2				

The sector 1 and 3 will experience capacity reduction which will lead to a reduction of the input consumption from sector 2 and 4. This reduction in the consumption will lead sector 2 and 4 to be over supplied or:

$$Q_{d2} < Q_{s2} \; ; Q_{d4} < Q_{s4} \quad (2.14)$$

Sector 2 and 4 will have to adjust its production level through a series of adjustment based on the three basic I-O assumption.

On the other hand sectors 1 and 3 have different condition than sector 2 and 4. Sector 1 and 3 experience excess demand or:

$$Q_{d1} > Q_{s1} \; ; Q_{d3} > Q_{s3} \quad (2.15)$$

This difference is caused by the inability of the sector to cope up with the external demand. To solve this difference we left with four options either we choose only to deliver the demand to the household; or to the government; or to the export; and the last option is to reduce the delivery of demand to the three sector proportionally. Hallegate (2008) argue that if the industry cannot satisfy the demand because of the lost in the production capacity a rationing scheme will take effect with the first priority is given to the intermediate demand, the second priority is for the household demand and the last one is export.

In this section we will try to illustrate a fictional shock to the economy. We will use the four sector economy from the first example. We simulate a shock to sector 1 and sector 3 which will reduce the output of sector 1 into 100 and sector 3 into 110.

In the first round sector 1 and 3 will adjust its production distribution based on its technical coefficient based on the second and third basic assumption of the I-O model.

Table 3-5 Initial Shock Disequilibrium State

Sectors	1	2	3	4	Household	Government	Export	Output
1	15.38	10	18.33	40	10	10	20	123.72
2	23.08	20	9.17	20	20	10	10	112.24
3	7.69	10	27.50	30	10	20	10	115.19
4	7.69	20	27.50	10	20	30	30	145.19
Import	15.38	20	9.17	20				
Wages	23.08	20	9.17	20				
Profit	7.69	20	9.17	10				
Input	100	120	110	150				

We can see clearly that the economy is at a disequilibrium state because the quantity demanded is not equal with the quantity supplied. In the second round sector 2 and 4 must adjust the quantity they produce because of the reduction in consumption from sector 1 and 3 assuming that the input from outside of the region is hard to obtain because of the disaster. (see table 3-5).

Table 3-6 Second Round Equilibrium Adjustment

Sectors	1	2	3	4	Household	Government	Export	Output
1	15.38	9.35	18.33	38.72	10	10	20	121.79
2	23.08	18.71	9.17	19.36	20	10	10	110.31
3	7.69	9.35	27.50	29.04	10	20	10	113.58
4	7.69	18.71	27.50	9.68	20	30	30	143.58
Import	15.38	18.71	9.17	19.36				
Wages	23.08	18.71	9.17	19.36				
Profit	7.69	18.71	9.17	9.68				
Input	100	112.24	110	145.19				

In the second round of adjustment we see the economy is still in the disequilibrium state. The demand for sector 2 and 4 is still lower than the quantity supplied because of this the sector 2 and 4 will have to adjust its production level again in the third round. (see table 3-6).

Table 3-7 Third Round Equilibrium Adjustment

Sectors	1	2	3	4	Household	Government	Export	Output
1	15.38	9.19	18.33	38.20	10	10	20	121.11
2	23.08	18.38	9.17	19.10	20	10	10	109.73
3	7.69	9.19	27.50	28.65	10	20	10	113.04
4	7.69	18.38	27.50	9.55	20	30	30	143.13
Import	15.38	18.38	9.17	19.10				
Wages	23.08	18.38	9.17	19.10				
Profit	7.69	18.38	9.17	9.55				
Input	100	110.31	110	143.26				

In the third round of adjustment the economy is started to become closer to the equilibrium state because the difference between the supply and demand sides is become smaller (see table 3.12).

Table 3-8 Fourth Round Equilibrium Adjustment

Sectors	1	2	3	4	Household	Government	Export	Output
1	15.38	9.14	18.33	38.17	10	10	20	121.03
2	23.08	18.29	9.17	19.08	20	10	10	109.62
3	7.69	9.14	27.50	28.63	10	20	10	112.96
4	7.69	18.29	27.50	9.54	20	30	30	143.02
Import	15.38	18.29	9.17	19.08				
Wages	23.08	18.29	9.17	19.08				
Profit	7.69	18.29	9.17	9.54				
Input	100	109.73	110	143.13				

We can already stop the supply side adjustment of the equilibrium because the difference of the supply and demand in sector 2 and 4 is negligible. But as we can see that in the sector 1 and 3 the difference in the supply and demand is still quite high. We cannot use the same methods with the sector 1 and 3 adjustment because the capacity of the production in the sector 1 and 3 is already reduce by the initial shock and the inter-industry trade is already in the equilibrium state. This difference is caused by the inability of the sector to cope up with the external demand. To solve this difference we will use the rationing scheme from Hallegate (2008) explained in the previous section.

Table 3-9 Final Equilibrium State

Sectors	1	2	3	4	Household	Government	Export	Output
1	15.38	9.13	18.33	38.17	10	8.98	0	100.00
2	23.08	18.27	9.17	19.07	20	10	10	109.58
3	7.69	9.13	27.50	28.60	10	20	7.07	110.00
4	7.69	18.27	27.50	9.53	20	30	30	143.00
Import	15.38	18.27	9.17	19.07				
Wages	23.08	18.27	9.17	19.07				
Profit	7.69	18.27	9.17	9.53				
Input	100	109.62	110	143.05				

In the final equilibrium state we can summarized the losses caused by the shock to the economy. The direct impact would be from the reduction of capacity from sector 1 and 3, from 130 to 100 in sector 1 and from 120 to 110. From those reduction the direct impact would be 40. The indirect impact come from the reaction of sector 2 and 4 in the form of supply adjustment to the direct impact on sector 1 and 3. We calculate the indirect impact from the initial output of sector 2 and 4 minus final equilibrium state output of sector 2 and 4. The summary of direct and indirect losses is displayed on table 3-10.

Table 3-10 Direct and Indirect Losses

Sectors	Initial Capacity	Direct Output Losses	Remaining Capacity	Adjusted Capacity	Indirect Output Losses	Total Losses
1	130	30	100	100.00	0.00	30.00
2	120	0	120	109.58	10.42	10.42
3	120	10	110	110.00	0.00	10.00
4	150	0	150	143.00	7.00	7.00

3.1.2 Land Use to Input-Output Mapping

The basic assumption to incorporate land use into the Input output framework is that we only use the land use that contributes to the economic activity and the land use which the economic activity is happening. The limitation of this method is dependent on the level of detail in the land use map being used. The more detailed the land use map the more detailed the economic activity can be captured. Based on the 2010 land use map of Cilegon city we identified 6 sectors of the economy within the land use map: rice sectors, plantation sectors, chemical industry sectors, manufacturing sectors, other industry sectors, and commercial sectors. For the settlement land use we cannot identify the economic activity because the settlement usually have a mix economic activity and more detailed data is needed to identify the activity.

Table 3-11 Land Use to Input-Output Sectors Mapping

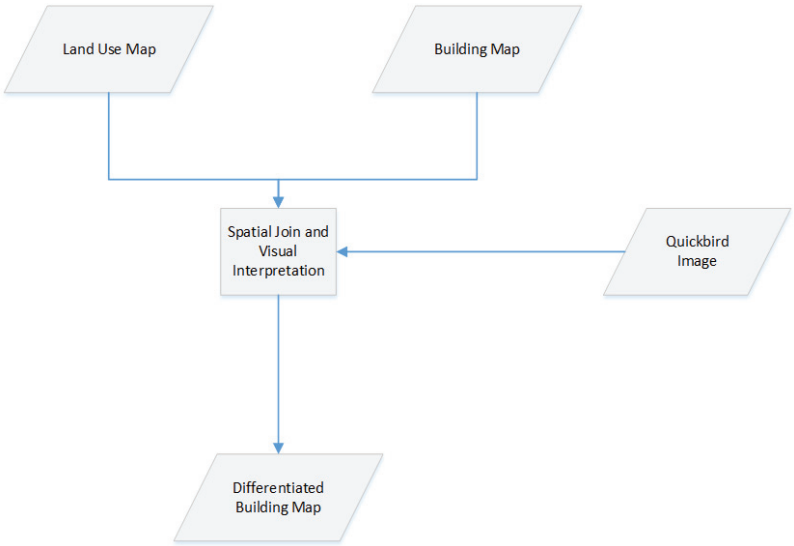
Land Use	**I-O Sectors**	**Additional Information**
Forest	None	Protected Forest
Chemical Industry	Chemical Industry	
Manufacturing Industry	Manufacturing Industry	
Other industry	Other type industry outside manufacturing and Chemical	
Plantation	Plantation	
Commercial	Commercial	
Settlement	Mix	More detailed data needed
Swamp	None	
Grass	None	
Irrigation Ricefield	Rice	
Rainfed Ricefield	Rice	
Vacant Land	None	

3.1.3 Capital and Land Differentiation

In order to capture the economic activity in the space we must connect the spatial data with the economic data. To connect these data use the cobb-douglass production function in (2.16). Our objective here is to spatially identify the production factors because the capital factor is much more static than the labor factor we only considered the capital factor in the spatial link. The assumption we're using is the capital is made

up from the land and the machinery, the machinery is represented by the building footprint within the land use. In order to get this data we differentiated the function of each building with their respective land use. To differentiate each building function we use spatial join function between building footprint map and landuse map. Image from Quickbird is also used to cross check the building function.

Figure 3-3 Building Footprint Differentiation Flowchart



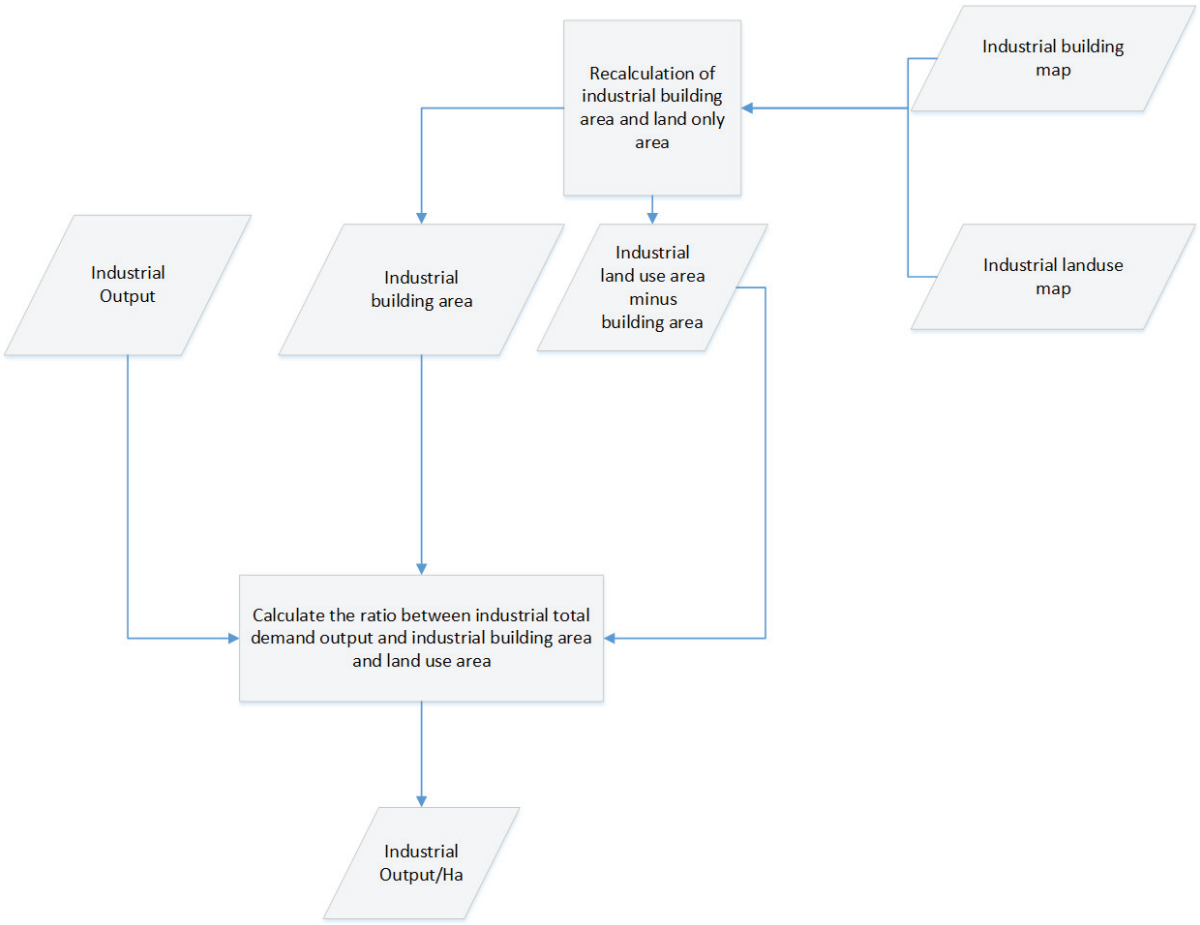
3.1.4 Industrial Sectors Output to Land Use Ratio

For the industrial output ratio we assume that the production process depends on the building and the land area. The production process mainly done in the building because all of the manufacturing machine is located within the building and the land area is use as the minor production process. Using that assumption we give the building area 80% weight from the production process and the land area 20% weight from the production process. To obtain the industrial output per hectare we use this following formulas:

$$Industrial\ output\ ratio\ building = \left(\frac{Industrial\ Output}{Building\ Area}\right) \times 0.8 \quad (3.1)$$

$$Industrial\ output\ ratio\ land = \left(\frac{Industrial\ output}{Land\ only\ area}\right) \times 0.2 \quad (3.2)$$

Figure 3-4 Industrial Output Ratio Flowchart

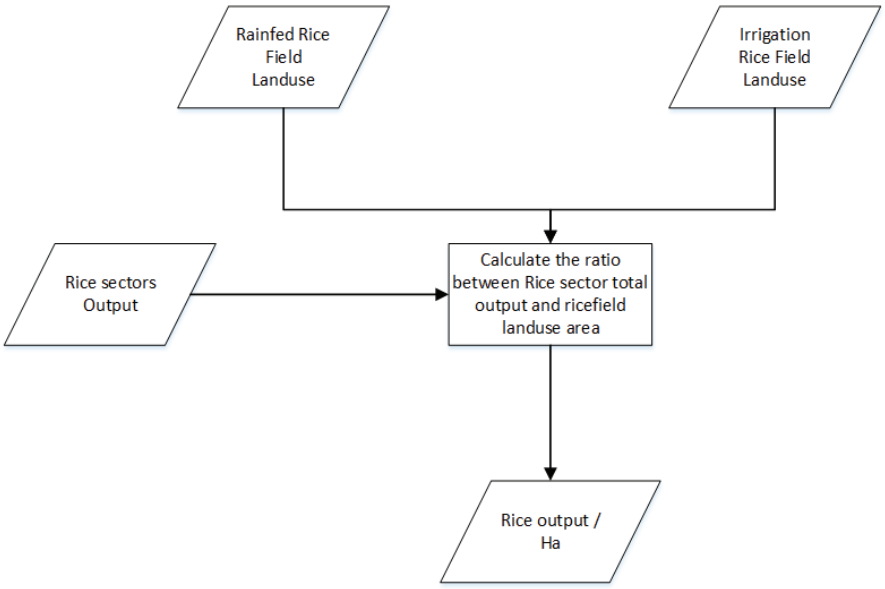


3.1.5 Rice Sectors Output to Land Use Ratio

For rice sector output ratio we assume that the rice production is depends only on the land use. Based on the land use classification there are two type of ricefield: The irrigation ricefield and the rainfed ricefield. While on the I-O table rice sector has only one output. To address the difference between the land use and the I-O table we assign weight on each land use based on the assumption of the number of harvest time between irrigation and raindfed ricefield. To obtain the output per area we use this formula:

$$Ricefield\ Output\ ratio = \left(\left(\frac{Rice\ Output}{irrigation\ land\ use\ area}\right) \times 0.67\right) + \left(\left(\frac{Rice\ Output}{Raindfed\ land\ use\ area}\right) \times 0.33\right) \quad (3.3)$$

Figure 3-5 Rice Sector Output Ratio Flowchart

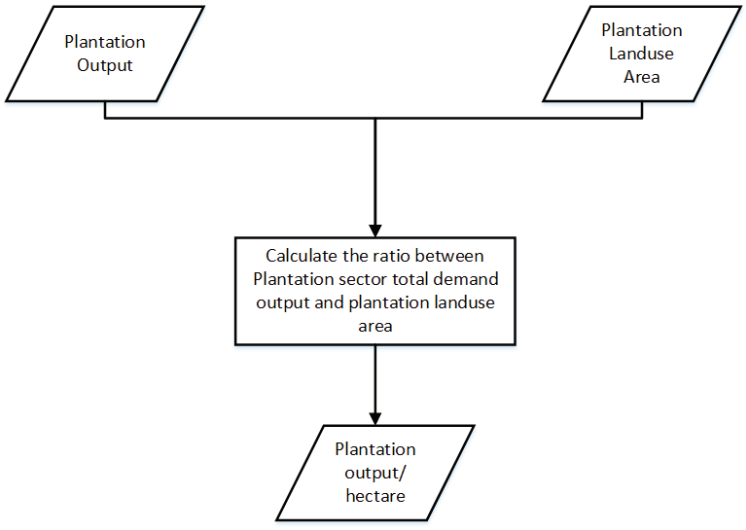


3.1.6 Plantation Sector Output to Land Use Ratio

The plantation sector has a similar characteristics with the rice sector, it relies heavily on the land area. Thus we will use this formula to estimate the plantation sector output to land use ratio:

$$Plantation\ Output\ ratio = \left(\left(\frac{Plantation\ Output}{Plantation\ land\ use\ area}\right)\right) \quad (3.4)$$

Figure 3-6 Plantation Sector Output to Land Use Ratio Flowchart

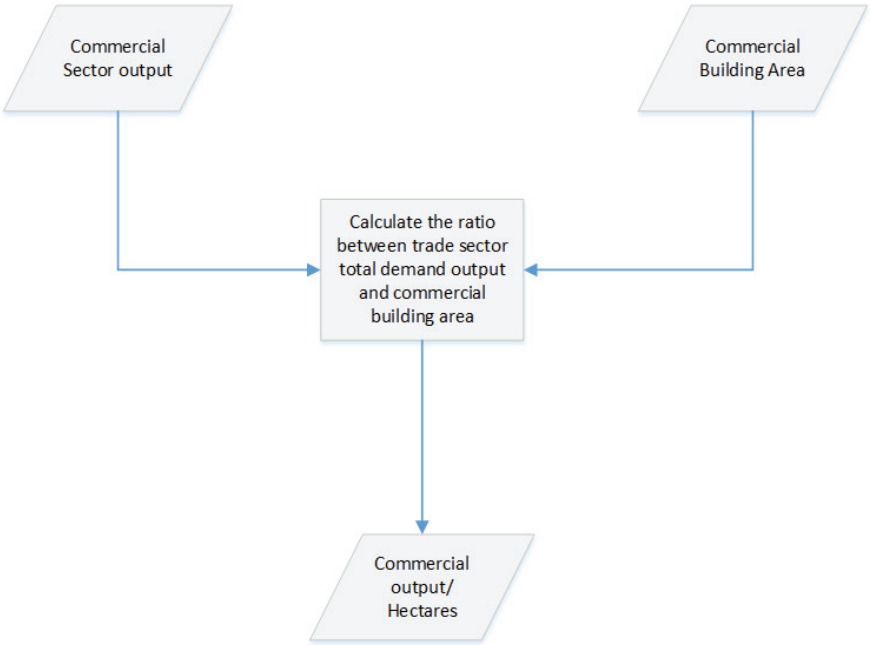


3.1.6 Commercial Output Ratio

For commercial output ratio we assume that the output is depends on the building area, the formula we use to obtain the output ratio is:

$$Commercial\ output\ ratio = \frac{Commercial\ sector\ output}{Commercial\ building\ area} \quad (3.5)$$

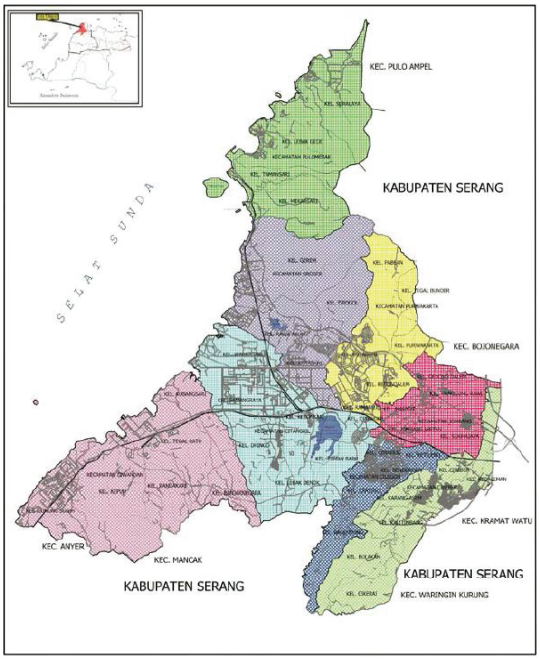
Figure 3-7 Commercial Output Ratio Flowchart



3.2 Study Area

The City of Cilegon located on the western tip of the island of Java and serves as a transportation node between the islands of Java and Sumatra. Geographically, the city is located at coordinates 5º52'24 "-6º04'07" south latitude and 105º54'05 "-106º05'11" East Longitude, with an area of 175.51 Square Km, coastline of 48.3 km and the location of the city in the coastal area the location of Cilegon can be seen in Figure 3-7.

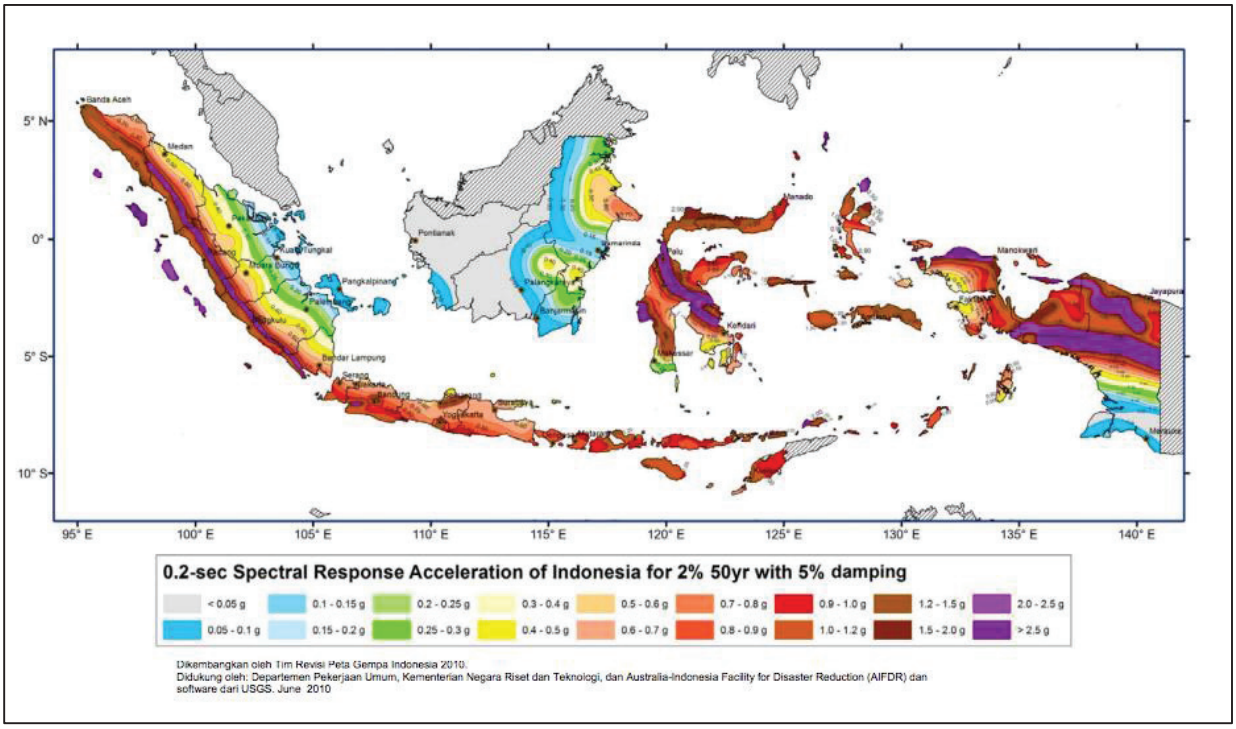
Figure 3-8 The location of Cilegon City



SOURCE : CILEGON IN NUMBERS 2013; (BAPPEDA, 2014)

Based on the Report from the Local Planning Agency in 2014 the total population of Cilegon city in 2013 are 398.304 people with the population density of 2.269 People per Sq Km. The main economic activities in Cilegon is come from the industrial sector which contribute 70% of the regional gross domestic product (Badan Perencanaan Pembangunan Daerah, 2013). The industrial area is mainly located along the coastline of Cilegon city. With a coastline that stretches from north to south region of the city of Cilegon (about 40.88 km, or approximately 43.6% of the total circumference of Cilegon City area), industry and port is the most high-intensity activity in which approximately 52.3% of the length shoreline has been filled by such activities. Based on the national spatial plan, provincial spatial plan and the master plan for acceleration and expansion of indonesia's economic development 2011-2035 (MP3EI) Cilegon city is planned to be the central of steel manufacturing and energy production in Indonesia. But at the other hand according to the revision of the earthquake map of Indonesia in 2010 Cilegon is considered to be one of the area which is exposed to the earthquake and tsunami. With the 70% of the source of regional domestic product is mainly located in the coastline the disaster caused by an earthquake and tsunami will have a major impact on the local, regional and national economy.

Figure 3-9 Indonesia Earthquake Hazard Map



SOURCE : RINGKASAN HASIL STUDI TIM REVISI PETA GEMPA INDONESIA 2010 (Irsyam, et al., 2010)

3.2.1 Macroeconomic Overview of Cilegon City

In 2010, gross value added generated by all sectors of the economy reached Rp. 29,785.99 billion. This measurement will be equal to the value of GDRP at prices prevailing in 2010. With these figures classified the economic sector in the form of primary, secondary, and tertiary, then the composition of Cilegon City's economy is the primary sector contributed the added value of Rp. 505.38 billion or 1.70 percent, the processing sector comprising of manufacturing, construction, and electricity, gas and water reached Rp. 21,772.76 billion or 73.10 percent. Activities as business services contribute added value of Rp. 7,507.85 billion or 25.21 percent of the total GDRP.

In terms of income, the composition of the remuneration of production factors generated by all economic units Cilegon City is made up of wages and salaries, operating surplus, indirect taxes, and depreciation. In 2010, wages and salaries for workers reached Rp. 9,692 billion or 32 percent of the total income, business

surplus Rp. 15,514 billion, or 52 percent, net indirect taxes amounting to Rp. 1,758 billion, or 6 percent, and the depreciation of Rp. 2,820 billion or 9 percent of all income. Business surplus is a combination of income in the form of business profits derived from the company, state-owned enterprises, cooperatives and individual businesses; interest on income; and lease land.

Table 3-12 Value Added and Income of Cilegon 2010 (in Million Rupiah)

	Primary Sector	Secondary Sectors	Tertiary Sectors	Total
Salary and wages	98,001	7,186,369	2,408,372	9,692,742
Business Surplus (Profit)	391,884	11,112,532	4,010,092	15,514,508
Depreciation	8,249	2,084,576	727,619	2,820,445
Indirect Taxes	7,243	1,389,280	361,770	1,758,293
Total	505,377	21,772,757	7,507,854	29,785,988

SOURCE : CILEGON GROSS DOMESTIC PRODUCT REPORT (BAPPEDA, 2013)

In terms of expenditure, revenue generated in the city of Cilegon spent in the form of private consumption, government, gross investment and net exports Cilegon City. Cilegon City public consumption reached Rp. 5,226 billion, or about 18. percent of the total income, government consumption Rp. 472 billion, or 1.5 percent, gross fixed capital formation of Rp. 9,451 billion, or 31 percent, net exports reached deficit. Rp 12,719.54 billion or 43 percent and inventory change of Rp. 1,916 billion or 6 percent.

Table 3-13 Expenditure by Groups of Cilegon 2010 (in Million Rupiah)

Groups	Expenditure
Household Consumption	5.226,17
Government Consumption	472,25
Capital Formation	9.451,92
Stock Difference	1.916,11
Net Export	12.719,54
Total Expenditure	**29.785,99**

SOURCE : CILEGON GROSS DOMESTIC PRODUCT REPORT (BAPPEDA, 2013)

Based on the supply and demand structure the domestic production is able to contribute 74 percent of the total supply of goods and services in the city of Cilegon, while the remaining 26 percent came from outside the city of Cilegon. Meanwhile from the demand side 41 percent of the demand comes from the production sector in Cilegon, 6 percent and is used as a domestic final consumption. The remaining amount of 52 percent of the demand coming from outside the city of Cilegon.

Table 3-14 Cilegon City's Supply-Demand Structure 2010 (in Million Rupiah)

Sectors		Intermediate Demand	Final demand		Total demand	Import	Domestic Output	Value Added	Supply
			Export	Domestic					
[1]		[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
1	Agriculture	262,223	215,921	162,750	640,894	77,828	72,273	490,793	640,894
2	Mining	21,442	-	294	21,735	3,826	3,325	14,585	21,735
3	Manufacturing Industry	25,754,539	36,822,297	3,228,149	65,804,985	14,830,218	33,614,435	17,360,332	65,804,985
4	Electricity, Gas and Water	5,924,362	5,882,070	190,201	11,996,633	5,788,380	1,924,470	4,283,783	11,996,633
5	Construction	86,526	-	188,957	275,482	54,383	92,457	128,642	275,482
6	Trade, Hotel and Restaurant	2,814,074	2,215,705	1,340,562	6,370,342	1,297,144	769,317	4,303,881	6,370,342
7	Transportation and Telecommunication	1,306,029	2,101,156	159,198	3,566,383	1,193,996	602,100	1,770,287	3,566,383
8	Finance, leasing and Business Services	921,600	85,143	160,078	1,166,822	123,704	181,365	861,752	1,166,822
9	Services	213,266	49,096	424,987	687,349	71,097	44,318	571,934	687,349
Total		37,304,061	47,371,388	5,855,176	90,530,625	23,440,576	37,304,061	29,785,988	90,530,625
		41	52	6	100	26	41	33	100

SOURCE : CILEGON GROSS DOMESTIC PRODUCT REPORT (BAPPEDA, 2013)

3.2.2 Cilegon City Land Use Overview

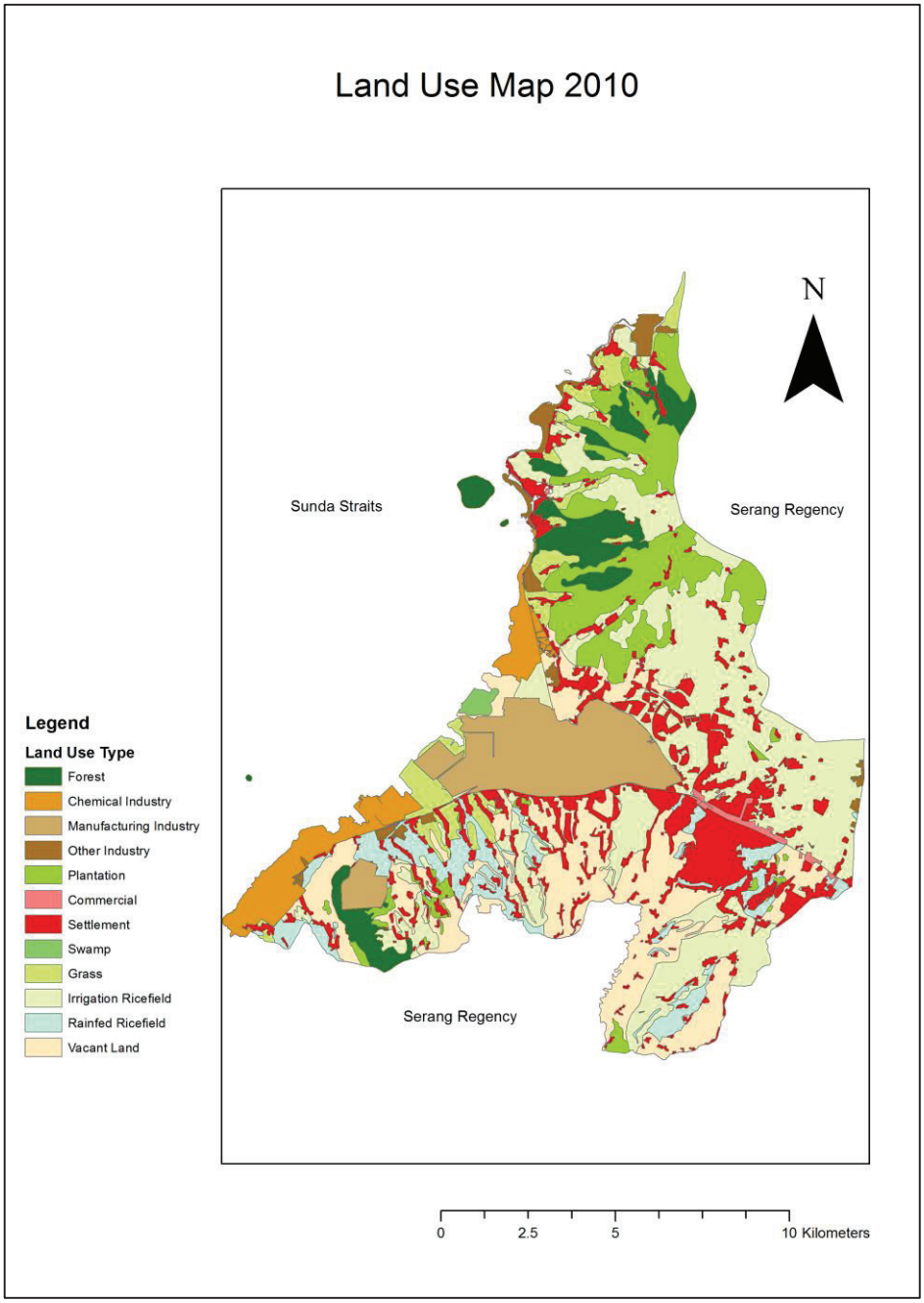
Based on the data acquired from the Spatial Agency, Cilegon city land use is classified into 12 class of usage: Forest (6%), chemical industry (5%), manufacturing industry (10%), other type of industry (2%) Plantation (11%), Commercial (0.48%), Settlement (14%), Swamp (0.52%), Grass (4%), irrigation ricefield (26%), Rainfed ricefield (5%), Vacant land (16%).

Table 3-15 Cilegon City Landuse 2010

Land Use Type	Area (Hectares)	Percentage
Forest	992.36	6%
Chemical Industry	781.64	5%
Manufacturing Industry	1585.72	10%
Other industry	277.67	2%
Plantation	1865.89	11%
Commercial	80.76	0%
Settlement	2391.16	14%
Swamp	59.028	0%
Grass	715.19	4%
Irrigation Ricefield	4226.56	26%
Rainfed Ricefield	894.56	5%
Vacant Land	2703.6	16%
Total	16574.14	100%

SOURCE: CILEGON SPATIAL PLANNING 2010-2030 (BAPPEDA, 2010)

Figure 3-10 Cilegon Land Use Map 2010

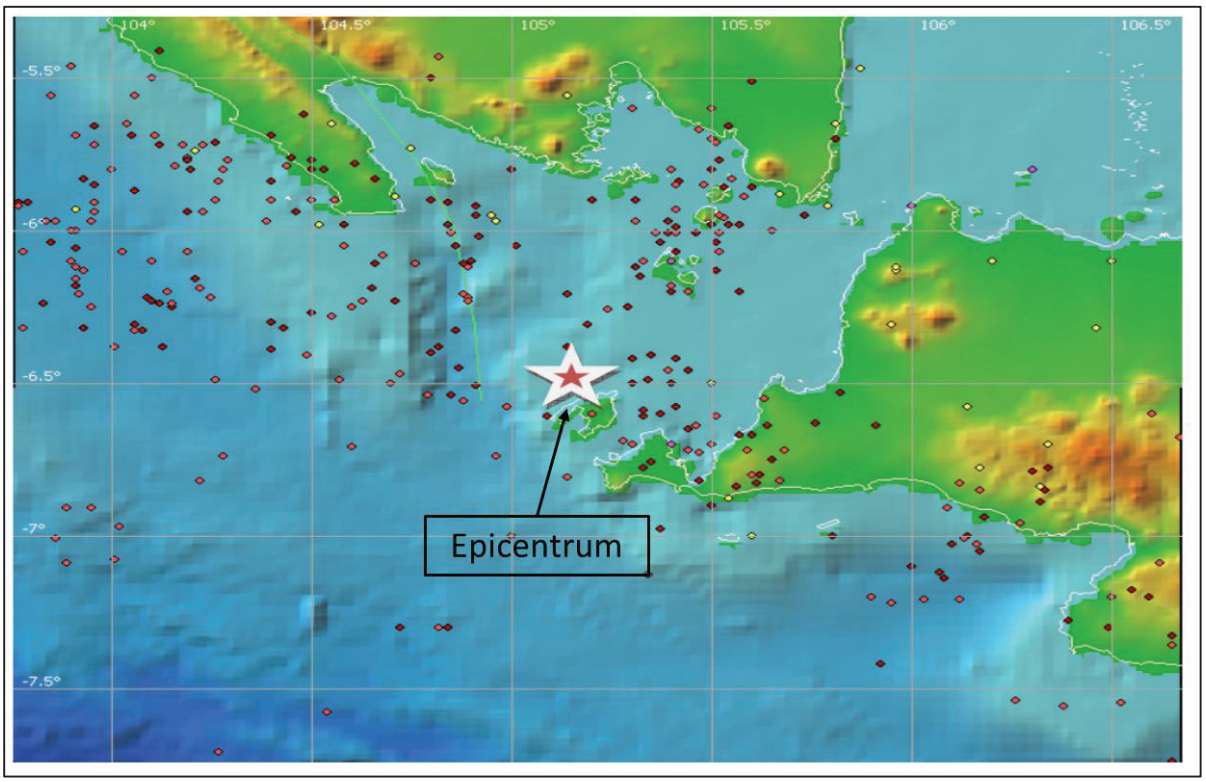


SOURCE: CILEGON SPATIAL PLANNING 2010-2030 (BAPPEDA, 2010)

3.3 Disaster Scenario

The disaster scenario is based on the 2010 Cilegon contingency plan scenario created by the planning agency. In this scenario the earthquake will happen in 6.5 South Latitude -105.5 East Longitude with the power of 7.5 Mw, 15 km of depth. The time of the earthquake in the morning at 8.00-8.30 AM. Tsunami waves are expected to reach all Cilegon City shoreline in about 20 minutes after the earthquake occurred and will sweep most of the including coastal plains region in the District Ciwandan, Citangkil, Grogol and Pulomerak. The inundation zone will be 0.5-2 Km from the shoreline depends on the topography.

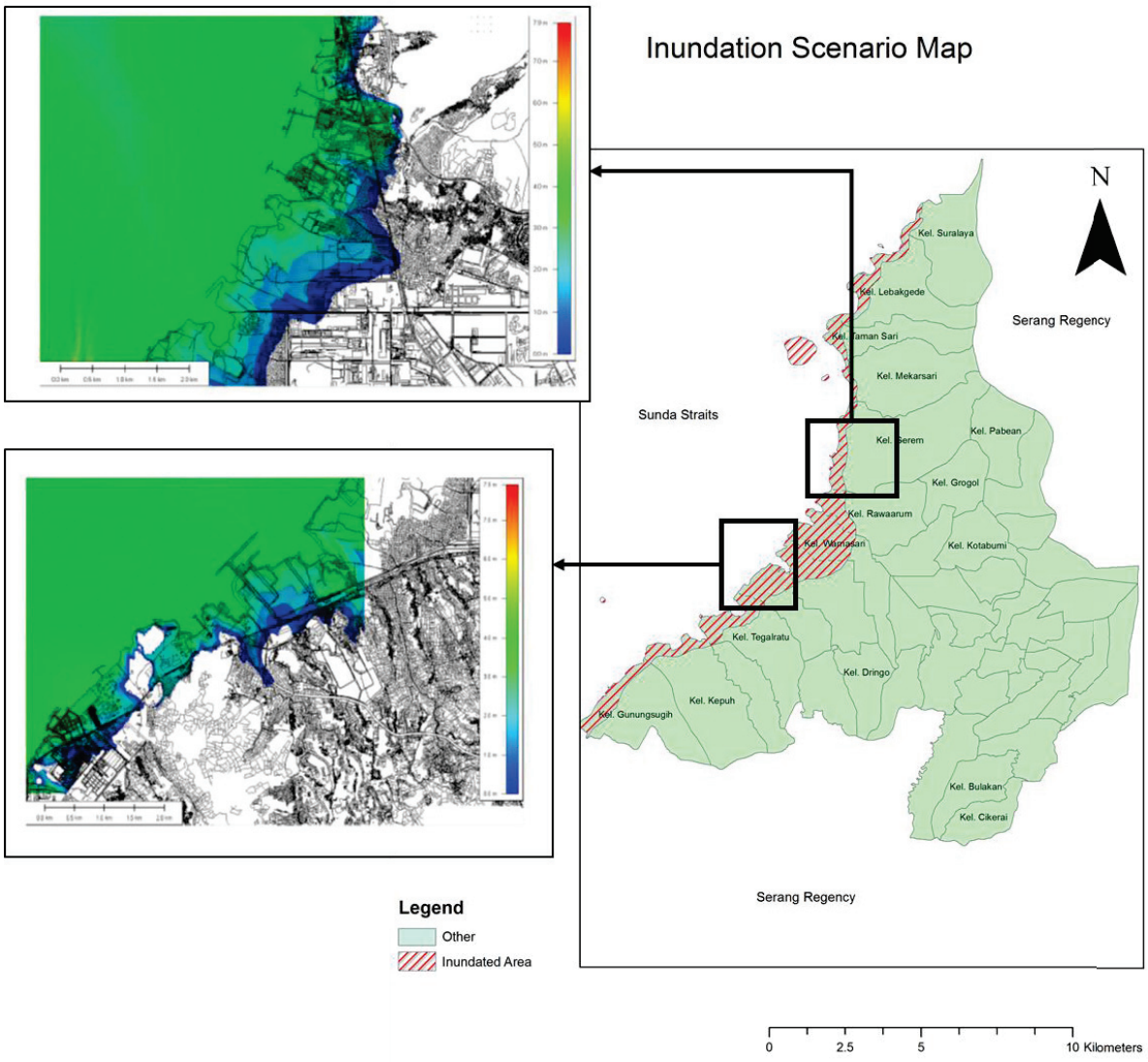
Figure 3-11 Earthquake Epicentrum Scenario



SOURCE : CILEGON CONTINGENCY PLAN 2010 (BAPPEDA, 2010)

- Location : 6.5 South Latitude -105.5 East Longitude
- Magnitude : 7.5 Richter Scale
- Depth : 15 Km

Figure 3-12 Tsunami Inundation Scenario Map



SOURCE : CILEGON CONTINGENCY PLAN 2010 (BAPPEDA, 2010)

3.4 Data

The list of data and the availability of the data is displayed in table 3-16

Table 3-16 Data Aggregation Level and Availibility

No	Data	Aggregation Level	Availability	Documentation Type
1	Population	District	2002-2012	Annual reports
2	Population	Subdistrict	2010	Census Report (10 Years)
3	GDP	Sectors	2002-2012	Annual reports
4	Spatial Planning	City	2008	Planning Document
5	Government Budget Report	Government Agency	2002-2012	Annual reports
6	Land Use	City, 12 Classes	2010	
7	Building map			
8	Quickbird Satellite Image	City	2005 and 2010	
9	Economics Input-Output Table	9 Sectors 40 Subsectors	2010	
10	Topographic Map	City		
11	Inundation Map	City	2010	Report Document

4. RESULT, ANALYSIS AND DISCUSSION

4.1 Baseline Output

Based on the aggregation methods from table 3-1 and flowchart from figure 3-3, we create the 10 sectors input-output transaction table[1], the multiplier matrix[2], the forward and backward linkage and the final demand. Total output of the economy is 90 trillion rupiah, there are five sectors with the highest output ranking. Those five sectors are: Chemical industry; manufacture industry; electricity, gas and water; commercial; other industries.

Table 4-1 10 Sectors Ranking

Ranking	Sector	Total Output
1	Chemical Industry	36,002,412.46
2	Manufacture Industry	25,816,009.51
3	Electricity, Gas, and Water	11,996,632.71
4	Commercial	8,224,512.73
5	Other Industries	3,986,563.04
6	Transportation and Telecommunication	3,566,382.70
7	Plantation, Livestocks and Fisheries	582,668.78
8	Construction	275,482.47
9	Rice	58,225.43
10	Mining	21,735.18
Total		90,530,625.01

Based on the backward linkage relationship we found out there are four sector with the high backward linkage index. Those sectors are: Other Industries; Chemical Industry; Manufacture Industry; and Construction.

Table 4-2 Backward Linkage

Sector	Backward linkage			Index	
	Direct	Indirect	Total		
Rice	1.07	0.09	1.16	0.84	Low
Plantation	1.05	0.08	1.13	0.82	Low
Mining	1.02	0.16	1.18	0.85	Low
Other Industries	1.28	0.09	1.37	0.99	Low
Chemical Industry	2.29	0.22	2.51	1.81	High
Manufacture Industry	1.18	0.30	1.48	1.07	High
Electricity, Gas, and Water	1.09	0.11	1.20	0.86	Low
Construction	1.01	0.46	1.47	1.06	High
Commercial	1.06	0.08	1.14	0.83	Low
Transportation and Telecommunication	1.07	0.13	1.21	0.87	Low

[1] The complete transaction table is provided in the appendix
[2] The multiplier matrix is provided in the appendix

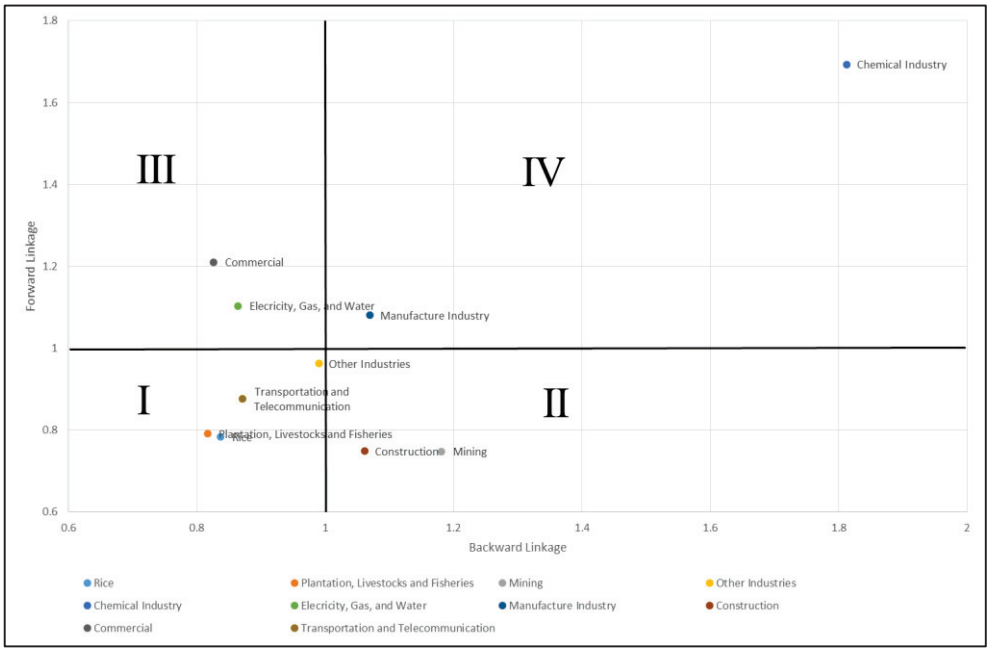
Backward linkage is the ability of one particular sectors to influence other sector by using the output of other sector as the input of the one particular sectors. Which mean if there are increase in the output from the sectors with high backward linkage it will increase its demand for input from other sectors.

Table 4-3 Forward Linkage

Sector	Forward linkage			Index	
	Direct	Indirect	Total		
Rice	1.07	0.02	1.09	0.78	Low
Plantation	1.05	0.05	1.10	0.79	Low
Mining	1.02	0.01	1.04	0.75	Low
Other Industries	1.28	0.05	1.33	0.96	Low
Chemical Industry	2.29	0.06	2.35	1.69	High
Manufacture Industry	1.18	0.31	1.50	1.08	High
Elecricity, Gas, and Water	1.09	0.44	1.53	1.10	High
Construction	1.01	0.03	1.04	0.75	Low
Commercial	1.06	0.61	1.68	1.21	High
Transportation and Telecommunication	1.07	0.14	1.21	0.88	Low

Based on the forward linkage there are four sectors with high index of forward linkage. Those sectors are: Chemical Industry; manufacture industry, electricity, gas and water; and trade, hotel and restaurant. After we analyzed the backward and forward linkage, we conclude there are two leading sectors in the Cilegon city which have high index of backward and forward linkage. Those sectors are chemical industry and manufacture industry sector.

Figure 4-1 Backward and Forward Linkage Quadrant

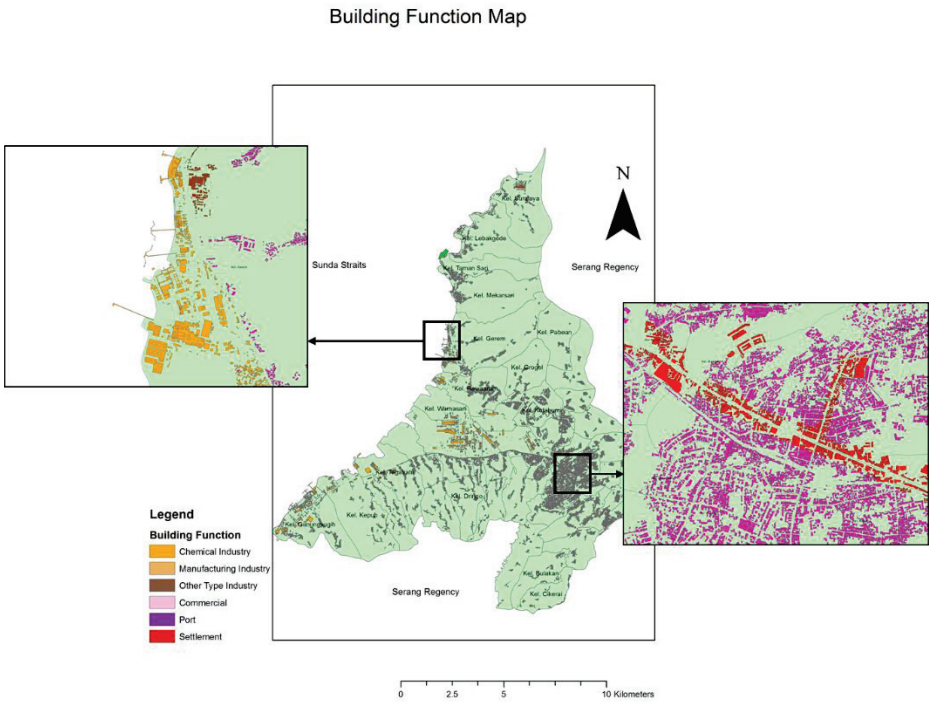


4.2 Building Function Differentiation

Based on the data from the Spatial Agency, in 2010 there are 66,880 Unit of building in Cilegon city. In order to capture the economic activity in space we must differentiate the function of each building. Using

the flow chart from the figure 3.4 we use the spatial join function to differentiate each function of the building.

Figure 4-2 Building Function Map



Using the spatial join we manage to differentiate the function of each building, 90 % of the building in cilegon city have the function of settlement, while the rest of the function is distributed quite equally from chemical industry, manufacturing industry, other type industry, port, and commercial. The distribution of each function of the building can be seen in the table 4-4.

Table 4-4 Building Function

Function	Number of Building (Unit)	Percentage	Area (Hectares)
Chemical Industry	2084	3.12%	114.38
Manufacturing Industry	1155	1.73%	119.96
Other Type Industry	1557	2.33%	43.11
Commercial	1843	2.76%	35.74
Port	1	0.00%	9.91
Settlement	60240	90.07%	741.41
Total	66880	100%	1064

4.3 Industrial Sectors Output to Land Use Ratio

Based on the flowchart figure 3-4 and the formula (3.1) and (3.2) we will determine the industrial land use ratio of each industry class.

Table 4-5 Other Type Industries Output to Land Use Ratio (million rupiah)

Other Industry Land Use	277.67	Hectares
Other Industry Building Area	43.11	Hectares
Other Industry Land area	234.56	Hectares
Other Industry Output	3,986,563.04	Rupiah
Output Generated By building	80.00	%
Output Generated by Land	20.00	%
Output Ratio Building	73,974.33	Rupiah/Hectares
Output Ratio Land	3,399.24	Rupiah/Hectares

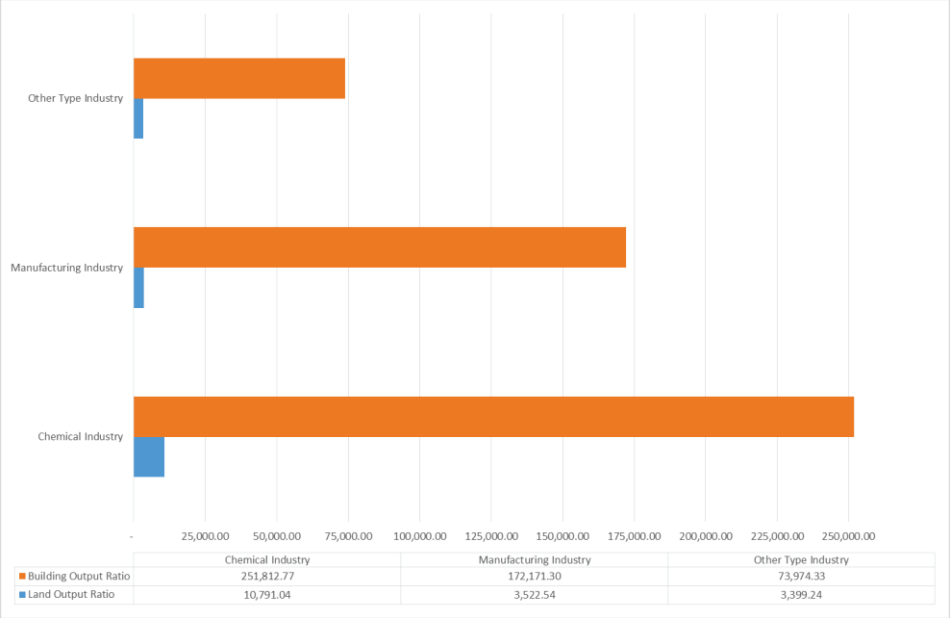
Table 4-6 Chemical Type Industries Output to Land Use Ratio (million rupiah)

Chemical Industry Land Use	781.64	Hectares
Chemical Industry Building Area	114.38	Hectares
Chemical Industry Land area	667.27	Hectares
Chemical Industry Output	36,002,412.46	Rupiah
Output Generated By building	80.00	%
Output Generated by Land	20.00	%
Output Ratio Building	251,812.77	Rupiah/Hectares
Output Ratio Land	10,791.04	Rupiah/Hectares

Table 4-7 Manufacturing Type Industries Output to Land Use Ratio (million rupiah)

Manufacturing Industry Land Use	1,585.72	Hectares
Manufacturing Industry Building Area	119.95	Hectares
Manufacturing Industry Land area	1,465.76	Hectares
Manufacturing Industry Output	25,816,009.51	Rupiah
Output Generated By building	80.00	%
Output Generated by Land	20.00	%
Output Ratio Building	172,171.30	Rupiah/Hectares
Output Ratio Land	3,522.54	Rupiah/Hectares

Figure 4-3 Industrial Output Ratio Comparison (million of rupiah)



We interpret the industrial output to land use ratio as the output generated by the industry for each hectares of land and building that has the function of industry. From the disaster perspective this is the expected output losses for each hectares of land and building that affected by the disaster. The chemical industry sectors have the highest output ratio per hectares compared with two other sectors.

4.4 Rice Sector Output to Land Use Ratio

Based on flowchart from the figure 3-5 and the formula (3.3) we will determine the rice output to land use ratio.

Table 4-8 Rice Sector Output to Land Use Ratio (in million rupiah)

Irrigation Ricefield Area	4,226.56	Hectares
Rainfed Ricefield Area	894.56	Hectares
Rice sectors Output	58,225.43	Rupiah
Irrigation Ricefield Harvest	2.00	Times/year
Rainfed Ricefield Harvest	1.00	Times/year
Irrigation Ricefield Output Ratio	9.18	Rupiah/Hectares
Rainfed Ricefield Output Ratio	21.7	Rupiah/Hectares

The irrigation rice field output ratio is 9.18 million rupiah per hectares, the rainfed rice field output ratio is 21.7 million rupiah per hectares. This mean that the expected output losses per hectare of irrigation rice field and rainfed rice field are 9.18 and 21.7 million rupiah

4.5 Plantation Sectors Output to Land Use Ratio

Based on flowchart from the figure 3-6 and the formula (3.4) we will determine the plantation output to land use ratio.

Table 4-9 Plantation Sector Output to Land Use Ratio

Plantation Landuse	1,865.89	Hectares
Plantation Output	582,668.78	Rupiah
Plantation Output Ratio	312.27	Hectares/Rupiah

The plantation sector output to land use ratio is 312.27 million rupiah per hectares. This mean the expected losses per hectares of plantation sector is 312.27 million rupiah.

4.6 Commercial Land Use Ratio

Based on flowchart from the figure 3-7 and the formula (3.5) we will determine the commercial sector output to building land use ratio.

Table 4-10 Commercial Sectors Output to Land Use Ratio

Total commercial output	8,224,512.73	Rupiah
Commercial Building area	35.74	Hectares
Output ratio	230,139.94	Rupiah/Hectares

The commercial output to building area is 230 billion rupiah. This mean that if one hectare of commercial building area is shut down, the commercial sector will lose 230 billion rupiah of output.

4.7 Affected Area Mapping

To produce affected area map and determine which sector is being affected spatially, we use intersect between the land use map and the tsunami inundation map to determine the area of land use is being affected.

Figure 4-4 Affected Land Use Map

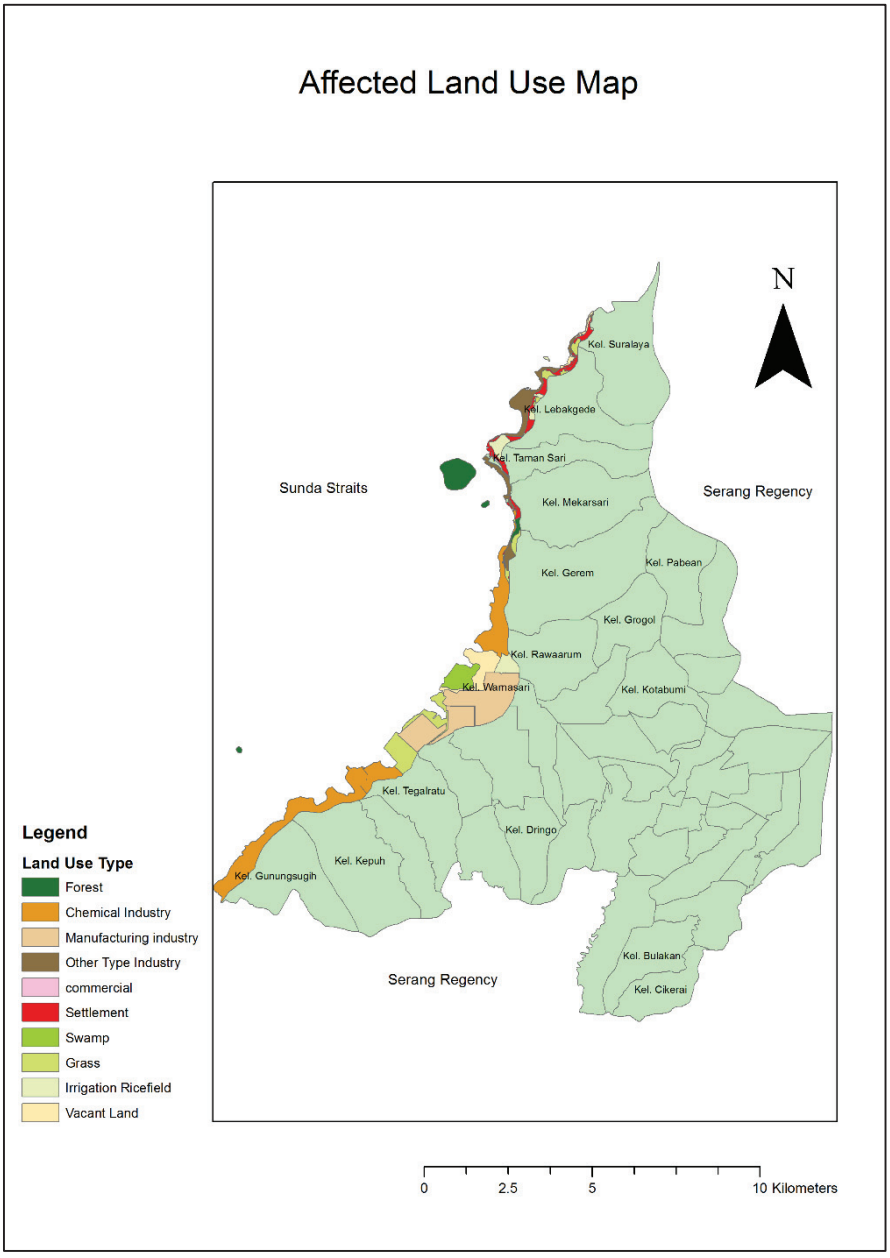


Table 4-11 Affected Land Use Type

Land Use Type	Land Use Area (Hectares)	Percentage
Forest	85.63	6%
Chemical Industry	436.03	32%
Manufacturing Industry	326.90	24%
Other type Industry	99.17	7%
Commercial	1.90	0%
Settlement	75.75	5%
Swamp	59.02	4%
Grass	142.22	10%
Irrigation Ricefield	61.86	4%
Vacant land	90.37	7%
Total	1378.85	100%

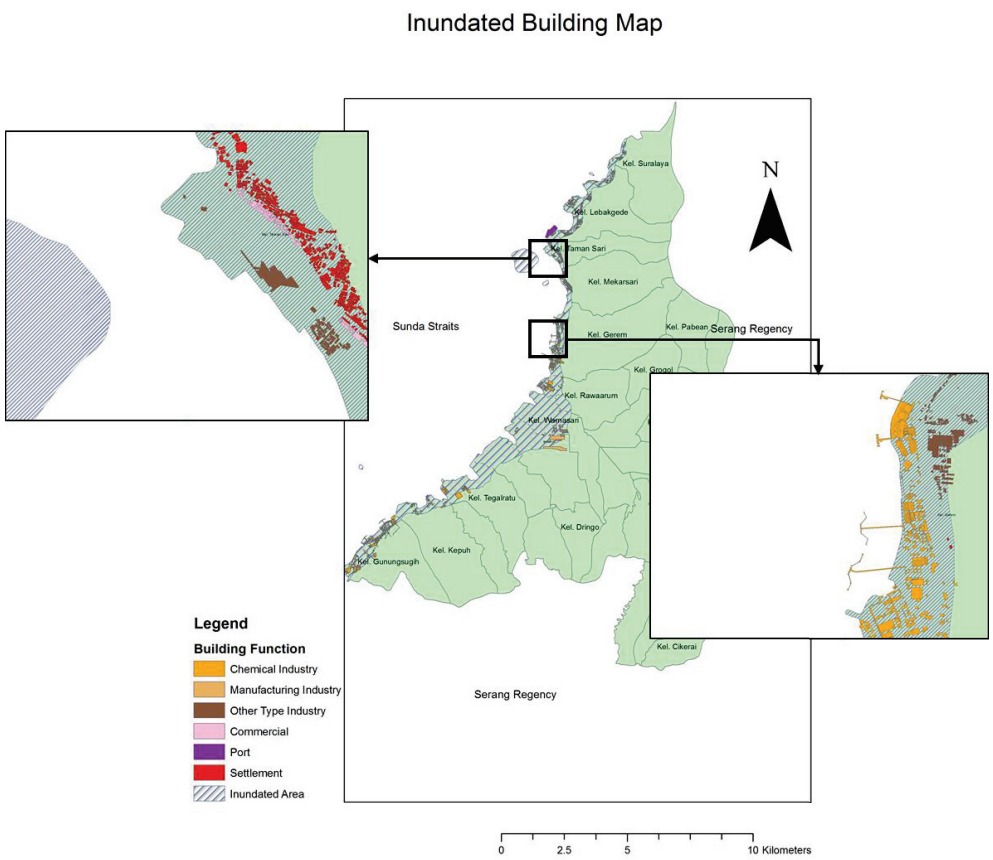
From the table 4-11 63% of the inundated area is industrial land use. The chemical industry is the most affected land use and the least affected land use would be commercial type land use.

After we obtain the affected land use, we want to see how many building is inundated. In order to obtain the number of building inundated, we use spatial join between the inundation scenario map with the building function map.

Table 4-12 Inundated Building Area

Building Function	Area (Hectares)	Building Number (Unit)
Chemical Industry	76.03	1160
Manufacturing Industry	27.03	118
Other type Industry	14.15	739
Commercial	0.84	94
Port	9.91	1
Settlement	21.23	2130
Total	149.19	4242

Figure 4-5 Inundated Building Map



From the building number, 50% of the inundated building is settlement, 27% is chemical industry, 13% is manufacturing industry.

4.8 Number of People Affected

We will try to estimate the number of people affected by the disaster, we will use the population of Cilegon in 2010 and the number of settlement building in 2010 as the basis of our assumption.

Table 4-13 Number of People Affected

Settlement Unit	60,240	Unit
Population	373,440	People
Average Population/Settlement Unit	6	People/Unit
Settlement Unit Affected	2,130	Unit
Population Affected	13,204	People

The number of people affected by the tsunami would be 13,204 people. As we mentioned before in the section 3.12 that the settlement has a mixed economic activity and it will be difficult to further elaborate the settlement into the input-output analysis without sufficient data regarding the settlement unique characteristic. Therefore we will not include the effect of settlement into further analysis.

4.8 Direct Output Losses

After we obtain the affected land use and the affected building we will determine the direct output losses using the affected land use area, affected building area, rice sectors land use output ratio, chemical industry land use output ratio, manufacturing land use output ratio, other type industry land use output ratio and commercial land use output ratio. We will calculate the output losses using these formula.

$$Direct\ Rice\ Sectors\ Output\ Losses = Rice\ sectors\ output\ ratio\ \times Rice\ land\ use\ \ affected\ area \quad (4.1)$$

$$Direct\ Industrial\ Output\ Losses = (Industrial\ land\ only\ output\ ratio\ \times Affected\ land\ only\ area) + (Industrial\ building\ output\ ratio\ \times Affected\ building\ area) \quad (4.2)$$

$$Direct\ Commercial\ Output\ Losses = Commercial\ output\ ratio\ \times Affected\ commercial\ building\ area \quad (4.3)$$

Using the formula (4.1), (4.2,) and (4.3) we obtain these result:

Table 4-14 Direct Output Losses (in million rupiah)

Rice Sectors (A)			
	Irrigation Ricefield Output Ratio	9.18	Rupiah/Hectares
	Irrigation Ricefield Affected Area	61.86	Hectares
	Rice Sectors Output Losses	568.16	Rupiah
Chemical Industry Sectors (B)			
	Output Ratio Building	251,812.77	Rupiah/Hectares
	Output Ratio Land	10,791.04	Rupiah/Hectares
	Affected Land Use	436.03	Hectares
	Affected Land Area	360.00	Hectares
	Affected Building Area	76.03	Hectares
	Output Loss Land	3,884,732.86	Rupiah
	Output Loss Building	19,145,111.07	Rupiah
	Output Loss Total	23,029,843.94	Rupiah
Manufacturing Industry Sectors (C)			
	Output Ratio Building	172,171.30	Rupiah/Hectares
	Output Ratio Land	3,522.54	Rupiah/Hectares
	Affected Land Use	326.90	Hectares
	Affected Land Area	299.87	Hectares
	Affected Building Area	27.03	Hectares
	Output Loss Land	1,056,318.83	Rupiah
	Output Loss Building	4,653,554.07	Rupiah
	Output Loss Total	5,709,872.90	Rupiah
Other Type Industry Sectors (D)			
	Output Ratio Building	73,974.33	Rupiah/Hectares
	Output Ratio Land	3,399.24	Rupiah/Hectares
	Affected Land Use	99.17	Hectares
	Affected Land Area	85.02	Hectares
	Affected Building Area	14.15	Hectares
	Output Loss Land	48,108.19	Rupiah
	Output Loss Building	1,046,932.15	Rupiah
	Total Output Loss	1,095,040.34	Rupiah

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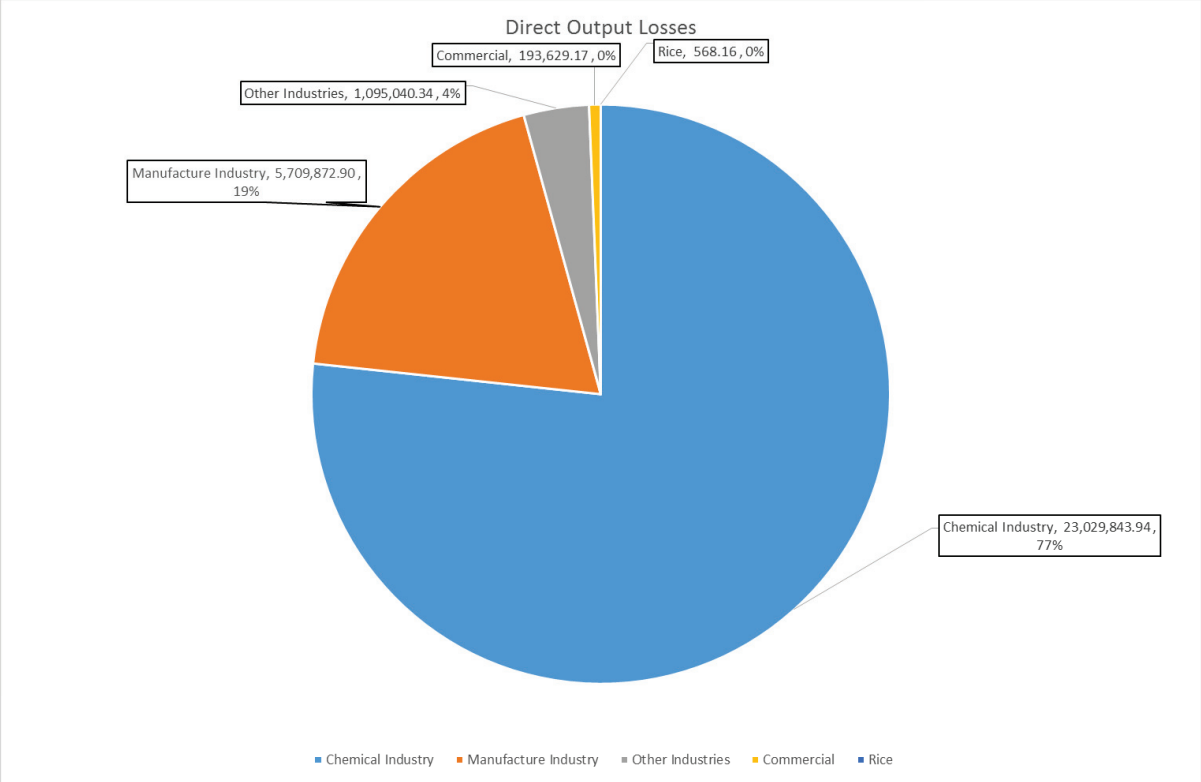
Commercial Sectors (E)			
	Output ratio	230,139.94	Rupiah/Hectares
	Affected Commercial Building Area	0.84	Hectares
	Output Loss	193,629.17	Rupiah
Total Direct Output Loss (A+B+C+D+E)		30,028,954.50	Rupiah

From 30 trillion direct output losses, the highest output losses 23 trillion come from the chemical industry sector. This result is expected because the chemical industry land use and building is the most affected from the inundation.

Figure 4-6 Direct Output Losses (in million rupiah)



4.9 Indirect Output Losses

After we obtain the direct output losses we will calculate the remaining production capacity of the affected sectors.

Table 4-15 Affected Sector Remaining Production Capacity

	Sector	Current Capacity	Loss Output	Remaining Capacity
1	Chemical Industry	36,002,412.46	23,029,843.94	12,972,568.53
2	Manufacture Industry	25,816,009.51	5,709,872.90	20,106,136.61
3	Other Industries	3,986,563.04	1,095,040.34	2,891,522.70
4	Commercial	8,224,512.73	193,629.17	8,030,883.56
5	Rice	58,225.43	568.16	57,657.27
	Total	74,087,723.17	30,028,954.50	44,058,768.66

To calculate the indirect losses we will first analyze the initial aftershock state of the economy by comparing the supply and the demand side of the economy.

Table 4-16 Initial Aftershock State

Sector	Demand	Supply	Diff	Sector State
Rice	45,971.09	57,657.27	(11,686.18)	Excess Supply
Plantation	562,750.02	582,668.78	(19,918.77)	Excess Supply
Mining	17,578.17	21,735.18	(4,157.01)	Excess Supply
Other Industries	2,900,518.62	2,891,522.70	8,995.93	Excess Demand
Chemical Industry	13,074,902.89	12,972,568.53	102,334.36	Excess Demand
Manufacture Industry	20,172,721.67	20,106,136.61	66,585.05	Excess Demand
Electricity, Gas, and Water	10,277,388.30	11,996,632.71	(1,719,244.41)	Excess Supply
Construction	259,520.29	275,482.47	(15,962.18)	Excess Supply
Commercial	7,183,279.68	8,030,883.56	(847,603.88)	Excess Supply
Transportation and Telecommunication	3,300,905.70	3,566,382.70	(265,477.01)	Excess Supply

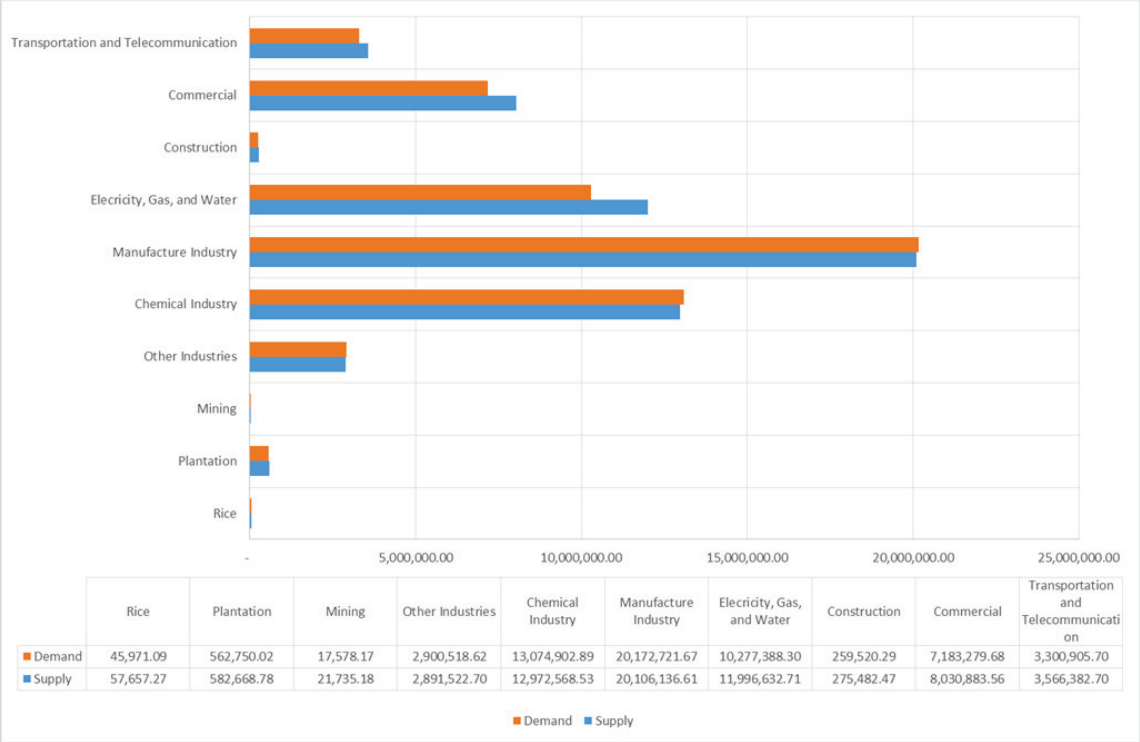
From the table 4.15 we can see that the economy is at a disequilibrium state. There are 7 sectors with an over supplied state and 3 sectors with an over demand state. Based on the methods from section 2.4.1 we will adjust the oversupply sector first with the supply side adjustment. After six time adjustment[3] the supply side is finally in equilibrium. Now we will focus on the 3 sectors with an over demand state, to equalize the demand we will use Hallegate rationing scheme. After using the Hallegate rationing scheme we managed to bring the system into the equilibrium state displayed in the table 4-17.

Table 4-17 Equilibrium State

Sectors	Demand	Supply	Diff	Sector State
Rice	45,115.91	45,115.93	(0.02)	Near Equilibrium
Plantation	544,382.47	544,383.63	(1.16)	Near Equilibrium
Mining	17,245.40	17,245.43	(0.03)	Near Equilibrium
Other Industries	2,891,522.70	2,891,522.70	-	Equilibrium
Chemical Industry	12,972,568.53	12,972,568.53	-	Equilibrium
Manufacture Industry	20,106,136.61	20,106,136.61	-	Equilibrium
Electricity, Gas, and Water	10,096,131.84	10,096,136.17	(4.33)	Near Equilibrium
Construction	253,383.09	253,383.38	(0.29)	Near Equilibrium
Commercial	7,034,357.11	7,034,362.91	(5.81)	Near Equilibrium
Transportation and Telecommunication	3,215,101.48	3,215,104.54	(3.06)	Near Equilibrium

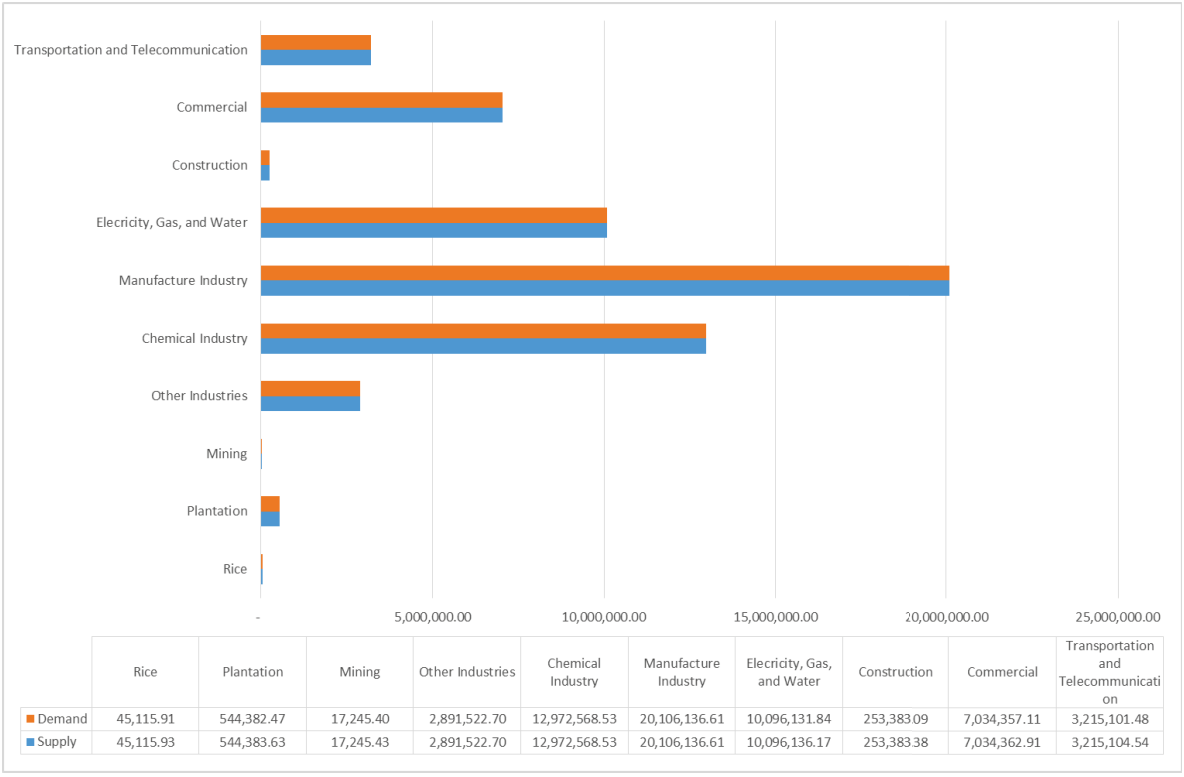
[3] Each adjustment state is provided in the appendix

Figure 4-7 Initial Disequilibrium State



	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Elecricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Demand	45,971.09	562,750.02	17,578.17	2,900,518.62	13,074,902.89	20,172,721.67	10,277,388.30	259,520.29	7,183,279.68	3,300,905.70
Supply	57,657.27	582,668.78	21,735.18	2,891,522.70	12,972,568.53	20,106,136.61	11,996,632.71	275,482.47	8,030,883.56	3,566,382.70

Figure 4-8 Final Equilibrium State



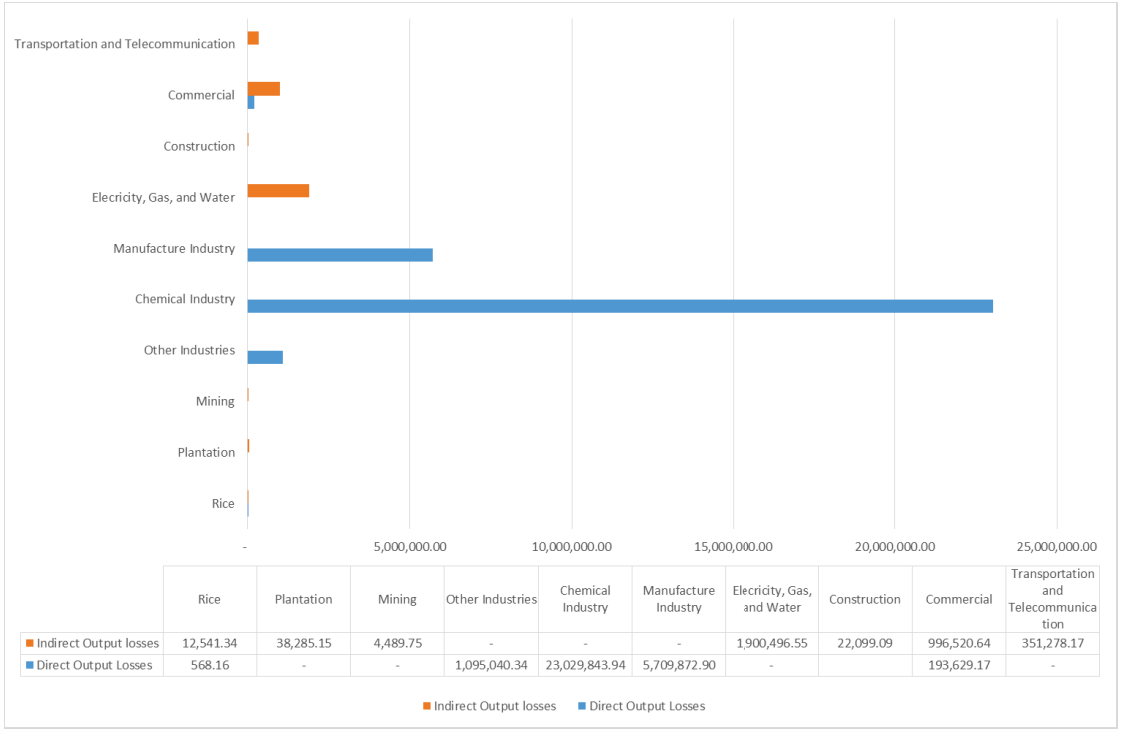
	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Elecricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Demand	45,115.91	544,382.47	17,245.40	2,891,522.70	12,972,568.53	20,106,136.61	10,096,131.84	253,383.09	7,034,357.11	3,215,101.48
Supply	45,115.93	544,383.63	17,245.43	2,891,522.70	12,972,568.53	20,106,136.61	10,096,136.17	253,383.38	7,034,362.91	3,215,104.54

After the economy is at an equilibrium state we will calculate the indirect loss from each sectors of the economy. The indirect cost of each sectors are displayed in the table 4.18

Table 4-18 Direct and Indirect Losses

Sector	Initial Capacity Xi	Direct Output Losses Xl	Remaining Capacity Xr = Xi-Xd	Adjusted Capacity Xa	Indirect Losses Xr-Xa
Rice	58,225.43	568.16	57,657.27	45,115.93	12,541.34
Plantation	582,668.78	-	582,668.78	544,383.63	38,285.15
Mining	21,735.18	-	21,735.18	17,245.43	4,489.75
Other Industries	3,986,563.04	1,095,040.34	2,891,522.70	2,891,522.70	-
Chemical Industry	36,002,412.46	23,029,843.94	12,972,568.53	12,972,568.53	-
Manufacture Industry	25,816,009.51	5,709,872.90	20,106,136.61	20,106,136.61	-
Electricity, Gas, and Water	11,996,632.71	-	11,996,632.71	10,096,136.17	1,900,496.55
Construction	275,482.47		275,482.47	253,383.38	22,099.09
Commercial	8,224,512.73	193,629.17	8,030,883.56	7,034,362.91	996,520.64
Transportation and Telecommunication	3,566,382.70	-	3,566,382.70	3,215,104.54	351,278.17
Total	90,530,625.01	30,028,954.50	60,501,670.51	57,175,959.82	3,325,710.69

Figure 4-9 Direct and Indirect Losses



	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Elecricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Indirect Output losses	12,541.34	38,285.15	4,489.75	-	-	-	1,900,496.55	22,099.09	996,520.64	351,278.17
Direct Output Losses	568.16	-	-	1,095,040.34	23,029,843.94	5,709,872.90	-		193,629.17	-

From 3 trillion total indirect losses 52% of the indirect losses is coming from the electricity, water and gas sector, 30% coming from the commercial sector and 18% is coming from other sectors. It is worth noting that in rice and commercial sector the indirect output losses is larger than the direct output losses.

4.10 Discussion

The total output losses from the disaster is 33 trillion rupiah, 30 trillion rupiah come from the direct output losses and 3 trillion rupiah is generated from the indirect output losses. This output losses is approximately one third of the total gross domestic regional product of Cilegon city. Losing one third of the economic output is a major impact for Cilegon city. If we assume that the average economic growth after the disaster is 5% every year, it will need 11 year to be able to return to pre-disaster condition. Although natural disaster can have positive economic gain in the short term, in the long term the net gain will be negative (Hallegate & Dumas 2009; Guimaraes et al 1993).

The sector that is suffering most from the direct output losses is the industrial sector, namely the chemical industry; the manufacturing and other industries (food, beverages; etc) Of these industrial the largest direct output losses is suffered by the chemical industry. The large loss from the chemical industry is expected because the chemical industry is mainly located in the coastline thus making the element at risk exposed to the tsunami higher.

The largest indirect output losses are suffered by the electricity, gas, and water sector. This result is not so strange as the indirect output losses is coming from the reduction in the intermediate demand from the affected sectors, which are the industrial sectors that are the largest power consuming sectors. It is also worth noting that there are two sector that have larger indirect losses than direct loses rice sector and commerce sectors, it means that these two sector output is rely more on the consumption from the industry sector.

The cause of direct and indirect output losses is mainly from the reduction in production capacity of the affected sectors which will lead to reduction in the consumption from other sectors and also from the failure of the affected sectors to delivers its output to be consumed by other sectors that will lead to the production bottleneck (Hallegatte, 2008). Steenge and Bockarjova (2007) also point out that the aftershock of the disaster will cause the economy to be at a disequilibrium state, which is indicated by the imbalance between the quantity demanded and the quantity supplied. In order to balance the quantity demanded and the quantity supplied there are adjustments required from either the supply side or the demand side. The adjustment from the supply side come from the capacity reduction in the other sector because of the decrease in the demand. The adjustment from the demand side will come from the rationing scheme by the affected sector to satisfy the intermediate demand and the final demand. Hallegatte (2008) gives the priority of rationing in case of the excess demand condition. The first priority is given to the intermediate demand, the second priority is for the household demand and the last one is export.

The spatial distribution of economic activities has a major contribution on the direct and indirect output losses. Based on the land use data we can see that the major industrial sector is located in the coastline. The decision of placing the industrial location is based on three principles (Rawstron, 1958), physical restriction if the product is depends on natural resource, economic restriction if the cost of location is higher than the expected profit, technical restriction if the location is limiting the industry to improve its production technique. Based on the structure of the major industry and the principle of Rawstron the decision of the location of the major industry in Cilegon is based on the second and third principle, the coastline location is preferable in order to minimize the cost of the industry especially for the large scale industry such as chemical and manufacturing industry. The other factor influencing the location of the industry in Cilegon is the agglomeration factor. The agglomeration will create economy of scale and lead to increase in technical efficiency (Canie¨ls & Romijn, 2003; Mitra & Sato, 2007). There are two major companies which have the biggest output in the chemical and manufacturing sector. The location of these two companies is the major factor why the chemical industry is concentrated in the south west coast and the manufacturing industry is concentrated in the central west coast. From the economic perspective the cost minimization and the effect of the agglomeration have a positive impact for the economy. However the location of the industry is

exposed to the tsunami hazard. The exposure of the economic activities will increase the element at risk that will lead to increase in vulnerability (van Westen, Castellanos, & Kuriakose, 2008). The increase in the vulnerability will increase the expected losses if a disaster event happen. In order to address the issue of economic versus the expected losses, the result of this study could serve as a baseline scenario for a spatial planning review and disaster mitigation measures. Furthermore knowing the direct and indirect output losses can give us the insight on how the sector of the economy react to the disaster. This information can be useful to identify the sector that have a major impact to other sector through inter-sector linkage and using this information to create a policy to prioritize which sector must be addressed first in the event of disaster.

Using the Cilegon city as a study case we succeeded to calculate the direct output losses and indirect output losses from the hypothetical tsunami disaster. However there are some assumptions and limitations that need to be addressed to qualify the final results.

1. Data availability and quality

The difference level of detail between the spatial data and the economy data give rise to the landuse classification vs economic sector classification issue. In order to match the data, the economic sector data must be aggregated from 40 sectors into 10 sectors. The aggregation will limit the inter-sector interaction into major sector only. To address this issue more detailed spatial data is needed. For example Bockarjova (2007) used parcel level data to identified the economy activity in space.

2. Spatial flow of the goods and services

Not have been possible to indicate where the indirect impact occurs. Assumption has been made that the impact is throughout the sector. The spatial linkage between the sector that is directly affected and the sectors that deliver output to the affected sector and the sectors that use output of the affected sectors is not known. To address this issue another type of data and methodology is required. For example integrating Origin-Destination matrix into the Input-Output model.

3. Impact to the settlement

Another issue is the impact to the settlement which is also heavily affected by the disaster but not taken into consideration in the Input-Output model. Settlement has a mixed type of economy activity, in order to integrate the settlement into the model detailed data and characteristics of the settlement is required.

4. The spatial dimension of the production factors

The fourth issue is we assume that the production structure of the economic sector is based on two variable: the area of the land use and the capital asset which is represented by the building footprint. The production factor labor was not considered. More detailed data on the production structure of each industry in the sector is better, because different production structure can generate different amount of output losses.

5. Issues for further consideration

The last issue is there are some materials that is not covered in this study but worth noting for further study and research such as: How the exogenous demand will adjust to the disaster and how the dynamic nature of the flow of goods and services is integrated into the input output modelling.

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The goal of this study is to analyze the use of Input-Output modelling for the estimation of the direct and indirect economic impact of a disaster at the municipality level. After carefully analyzing and discussing the result we come to the conclusion of this study. There are three specific objectives that were addressed in this study: i.e. to identify the spatial link between the impact of a disaster and the economic system, to analyze the direct impact of a disaster on the economic system, to analyze the indirect impact of a disaster on the economic system.

- The theoretical relationship between economic development and the disaster was obtained through linking the classification of the land use map to the classification of the input-out table. The 12 land use classes were linked to 10 economic sectors; and resulted in 5 land uses classes and 5 economic sector that spatially linked. The spatial link was made for the following sectors by using an output ratio between the economic output and land use area of the economic activity.
- For the second specific objective, the direct impact of the disaster is 30 trillion rupiah in the form of output losses from five directly affected sector, chemical industry, manufacturing industry, other type industry, commercial, and rice sectors. The cost of this impact is one third output losses of the overall Gross Domestic Product of Cilegon city. This result is to be expected because the four affected sectors: chemical industry, manufacturing industry, other type industry and commercial. Are among the top five highest contributing sectors to the economy of Cilegon city.
- To achieve the third specific objective, the indirect impact of the disaster is 3 trillion rupiah coming from the affected and non affected sectors supply adjustment to the reduction on the production capacity of the affected sectors in case of excess supply and final demand consumption rationing in case of excess demand. The sectors that experience indirect output losses are: rice sector, plantation sector, mining sector, electricity, gas and water sector, construction sector, commercial sector, transport and telecommunication sector.

This study is done with the main assumption of Input-Output model (i.e, input is always the same with output in the equilibrium state, it uses Leontief production function, technological level is constant). Another main assumption that we used in this study is the production function in space is represented by the land use area and the building area which belong to the particular sector in the economy.

There are several limitations we encounter in this study. These limitation are: the difference level of data aggregation between the spatial data and the economy data, the flow of goods and services between sector is not taken into account, the impact on settlement and quality of life is not taken into account, and the production structure in the economy sector is only determine by land and capital.

Based on the specific objective achieved, the main assumption we used and the limitation of this study. We can conclude that the Input-Output modelling can be used to capture the direct and indirect economic impact of a disaster.

5.2 Recommendation

In this study we managed to obtain the spatial link between economy data and the spatial data, with that spatial link we managed to capture the direct impact and the indirect impact of a natural disaster using Input-Output model approach. The result of this study can be used specifically as a baseline scenario for mitigation measures especially in the context of setting a priority for the sector in the economy. The spatial link between economy data and the spatial data also can be used as an element of cost and benefit analysis in the spatial planning review.

The limitation of this study can also become an opportunity for future studies. Such as: the integration between input-output model and the flow of goods and services, the relationship between quality of life, household consumption and the final demand.

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7. APPENDIX

Table A-1 Input-Output Sector Code

1	Rice	**21**	Other Manufacturing
2	Tuber Plant	**22**	Elecricity, Gas, and Water
3	Vegetables and Fruit	**23**	Construction
4	Others Food Plant	**24**	Wholesale
5	Plantation Crops	**25**	Hotel and Restaurant
6	Livestocks	**26**	Railway Transport
7	Forestry	**27**	Highway Transport
8	Fisheries	**28**	Sea and coastal water transport
9	Mining	**29**	Air Transport
10	Food and Beverages Industry	**30**	Inland water transport
11	Textile Industry	**31**	Port services
12	The timber industry, goods from wood and the like	**32**	Other transportation services
13	Paper industry, paper products	**33**	Postal and telecommunication
14	Chemical Industry	**34**	Bank
15	Oil Refinery	**35**	Other financial institution
16	Plastic goods Industry	**36**	Rental and leasing activities
17	Non-Metal mineral goods industry	**37**	Government
18	Machinery and tools industry	**38**	Social community services
19	Basic Metal and Steel Industry	**39**	Entertainment services
20	Manufacture of fabricated metal products, except machinery and equipment	**40**	Individual and household services

Table A-2 Input-Output Value Added and Final Demand Code

Value Added		Final Demand	
190	Intermediate Input	Household Consumption	**301**
200	Import	Government Consumption	**302**
201	Wages	Investment	**303**
202	Profits	Inventory Change	**304**
203	Depreciation	Export	**305**
204	Indirect taxes	Final Demand	**309**
205	Subsidy	Total demand	**310**
209	Value Added		
210	Total Input		

Table A-3 40 sectors Input-Output Table (2010) (in Million Rupiah.)

Sektor	1	2	3	4	5	6	7	8	Sektor
1	4.499,82	-	-	-	-	786,40	-	-	1
2	-	185,34	-	-	-	378,41	-	29,60	2
3	-	-	17.052,04	-	-	346,99	-	20,40	3
4	-	1,12	23,98	20.476,29	-	510,37	-	13,42	4
5	545,57	5,75	61,92	-	413,55	97,15	-	-	5
6	327,68	111,78	3.155,71	5.114,63	14,85	4.192,97	-	88,59	6
7	-	1,73	82,73	52,92	5,04	156,16	-	223,71	7
8	-	-	-	-	-	26,23	-	557,01	8
9	-	-	-	-	-	-	-	-	9
10	-	-	-	-	-	10.943,28	-	2.003,38	10
11	-	-	29,52	64,22	-	-	-	-	11
12	-	0,74	612,92	22,73	14,43	269,48	-	171,43	12
13	-	-	104,74	6,67	16,88	202,07	-	88,65	13
14	6.031,67	212,89	18.289,86	16.810,95	490,19	1.324,49	-	1.352,48	14
15	10,01	0,48	1.066,76	22,15	74,23	515,01	-	892,91	15
16	220,64	70,39	421,99	979,10	16,10	195,69	-	260,32	16
17	-	-	-	-	1,48	8,28	-	2,65	17
18	4,84	0,02	51,95	8,39	41,16	155,73	-	1.069,32	18
19	-	-	-	-	-	-	-	-	19
20	108,92	28,06	906,78	339,23	48,10	63,00	-	115,69	20
21	26,32	3,12	748,13	118,52	11,97	29,65	-	226,71	21
22	-	-	647,87	23,59	37,88	2.526,79	-	295,65	22
23	47,30	20,64	216,41	915,07	141,92	424,90	-	215,48	23
24	-	-	-	-	-	-	-	-	24
25	-	3,14	212,53	857,37	5,03	20,87	-	75,75	25
26	-	-	-	-	0,28	0,43	-	-	26
27	524,29	38,05	406,79	4.084,29	34,19	20,87	-	6,91	27
28	-	-	-	-	-	-	-	-	28
29	-	-	-	-	-	28,27	-	0,26	29
30	-	-	-	-	5,23	8,82	-	0,24	30
31	-	-	-	-	0,67	2,23	-	0,06	31
32	-	-	-	-	0,49	1,61	-	0,04	32
33	-	-	88,82	-	4,66	326,99	-	32,08	33
34	-	-	-	-	-	-	-	-	34
35	1.078,65	24,12	126,85	1.221,72	147,34	117,98	-	260,06	35
36	121,31	0,82	164,03	326,91	8,89	55,96	-	171,90	36
37	-	-	-	-	-	-	-	-	37
38	-	-	108,61	-	3,13	33,46	-	66,22	38
39	-	-	-	-	-	-	-	-	39
40	673,31	116,16	175,78	4.735,05	192,32	338,90	-	40,00	40
190	14.220,34	824,34	44.756,74	56.179,82	1.730,01	24.109,46	-	8.280,90	190
200	-	-	-	-	-	-	-	-	200
201	9.308,09	1.285,93	29.970,76	41.056,82	2.541,82	9.979,13	-	2.008,22	201
202	33.399,95	5.759,72	176.119,66	122.748,02	4.308,59	31.958,09	-	6.126,20	202
203	765,77	77,73	1.740,41	2.583,96	345,35	1.082,78	-	557,37	203
204	531,28	76,66	2.114,86	3.078,73	85,30	681,56	-	499,84	204
205	-	-	-	-	-	-	-	-	205
209	44.005,09	7.200,04	209.945,68	169.467,53	7.281,06	43.701,56	-	9.191,63	209
210	58.225,43	8.024,38	254.702,42	225.647,35	9.011,08	67.811,02	-	17.472,53	210

Sektor	9	10	11	12	13	14	15	16	Sektor
1	-	45.296,78	-	-	3,93	985,04	-	-	1
2	-	5.253,31	-	-	-	-	-	-	2
3	-	25.917,47	-	-	-	7.001,54	-	-	3
4	-	39.230,36	-	-	14,03	820,55	-	-	4
5	-	14.266,02	6,26	146,66	-	115.356,16	-	10.756,08	5
6	-	22.862,71	5,04	-	-	4.720,82	-	-	6
7	1,43	420,29	-	34.797,14	138,67	670.691,59	-	373,63	7
8	-	7.041,27	-	-	-	473,50	-	-	8
9	2.062,52	98,32	2,95	15,75	8,00	178.021,46	118.615,84	1.303,00	9
10	-	2.358.243,09	3,27	106,09	5,62	363.470,78	-	-	10
11	-		1.048,54	227,06	72,22	289.277,46	299,97	5.782,82	11
12	2,08	6.977,84	3,71	18.489,51	13,85	15.910,17	-	99,70	12
13	69,59	26.654,06	7,85	392,22	1.688,42	327.802,19	2,13	1.182,31	13
14	262,88	14.957,67	-	3.902,50	299,65	21.507.383,18	140,89	135.307,15	14
15	1.131,38	9.246,26	25,85	1.385,73	159,02	1.079.312,49	233.993,41	4.335,15	15
16	8,49	21.472,47	43,60	512,12	33,55	304.276,50	-	52.810,17	16
17	-	7.091,57	0,27	93,19	0,09	57.718,09	-	196,22	17
18	525,64	13.067,27	6,48	1.729,28	19,04	789.945,22	20,32	7.542,62	18
19	-	-	-	-	-	-	-	-	19
20	25,40	1.241,84	2,28	182,68	15,76	42.088,00	-	2.940,93	20
21	312,60	1.151,03	1,87	532,10	8,60	23.855,38	0,03	32.268,99	21
22	455,27	59.801,63	59,05	7.758,01	106,75	1.581.700,23	11.437,49	11.120,60	22
23	195,18	2.773,09	25,11	521,28	7,37	10.950,15	3.717,03	3.542,39	23
24	-	-	-	-	-	-	-	-	24
25	47,26	482,07	128,53	594,22	25,63	393.205,14	579,46	1.540,88	25
26	1,80	12,56	-	34,99	0,76	43.319,24	74,50	179,40	26
27	67,62	15.734,82	17,59	914,94	13,27	133.380,83	6.195,96	937,29	27
28	31,45	5,17	-	241,59	1,29	75.938,06	7.720,35	24,92	28
29	226,69	319,38	-	35,56	5,76	54.650,28	8,56	465,84	29
30	4,20	5,07	-	26,09	0,80	4.769,65	23,42	6,62	30
31	6,45	95,29	-	107,46	1,59	2.771,61	326,77	108,99	31
32	4,66	68,92	10,42	84,04	1,15	2.004,86	63,42	78,85	32
33	224,55	197,08	29,51	258,44	38,19	88.247,53	1.600,97	3.196,78	33
34	-	11.545,47	4,39	1.020,96	28,91	125.074,32	5.274,35	1.328,17	34
35	601,89	863,10	-	-	-	-	12,95	-	35
36	664,59	624,52	5,55	567,01	35,64	242.221,48	374,56	1.877,45	36
37	-	-	-	-	-	-	-	-	37
38	15,49	958,22	4,24	61,76	1,54	99.245,79	0,80	225,55	38
39	10,25	107,31	-	-	-	-	0,18	-	39
40	191,23	22.635,50	7,11	154,36	72,87	56.067,98	2,54	6.095,00	40
190	7.150,59	2.736.718,81	1.449,46	74.892,72	2.821,97	28.692.657,25	390.485,90	285.627,49	190
200	-	-	-	-	-	-	-	-	200
201	1.850,23	426.813,07	853,14	15.803,36	774,15	2.180.901,12	62.489,40	28.096,85	201
202	11.463,66	420.481,99	1.506,69	25.130,58	1.570,42	2.729.903,23	127.341,78	59.318,66	202
203	1.095,95	163.426,48	100,51	3.418,86	107,86	724.027,51	24.625,74	14.403,67	203
204	174,74	109.629,63	37,98	1.005,05	20,31	661.176,15	12.434,15	8.923,56	204
205	-	-	-	-	-	-	-	-	205
209	14.584,58	1.120.351,17	2.498,32	45.357,85	2.472,74	6.296.008,01	226.891,08	110.742,73	209
210	21.735,18	3.857.069,97	3.947,78	120.250,57	5.294,71	34.988.665,26	617.376,98	396.370,22	210

Sektor	17	18	19	20	21	22	23	24	Sektor
1	-	-	-	-	-	-	-	15,02	1
2	-	-	-	-	-	-	-	-	2
3	-	-	-	-	-	-	-	198,51	3
4	-	-	-	-	-	-	59,08	9,36	4
5	-	-	-	-	2.928,55	-	168,00	52,58	5
6	77,47	-	-	-	125,68	-	-	-	6
7	411,87	-	-	-	257,95	-	8.800,11	-	7
8	-	-	-	-	6,08	-	-	26,00	8
9	65.134,24	3.418,74	1.390.663,49	1.446,44	21,79	2.730.229,08	9.243,34	-	9
10	2.135,36	-	-	-	302,05	-	-	651,56	10
11	-	4.916,07	12.983,12	1.427,43	888,73	1.784,23	27,40	7.876,79	11
12	464,81	3.174,88	-	8.675,07	785,37	-	15.717,79	7.913,00	12
13	8.546,10	5.160,66	28.837,96	7.981,17	916,78	123.935,49	403,87	55.479,73	13
14	11.699,24	18.545,01	2.079.690,77	15.960,13	6.381,62	269.298,71	1.199,11	56.131,26	14
15	14.374,96	689,67	888.579,66	14.461,84	760,75	991.357,01	8.447,64	49.221,62	15
16	3.195,95	6.496,41	29.767,66	5.936,23	1.508,17	1.847,58	3.495,10	34.730,59	16
17	6.708,83	7.269,32	21.195,40	1.413,18	2.195,99	1.793,15	49.790,34	1.611,44	17
18	1.954,72	82.439,51	407.032,97	25.854,26	608,65	1.396.840,11	7.818,57	22.488,54	18
19	-	93.597,74	5.918.824,66	190.059,74	-	-	13.164,72	-	19
20	368,17	233.202,80	136.751,01	104.968,34	6.526,77	124.248,25	18.370,07	377,02	20
21	15,58	14.615,52	-	744,44	20.133,12	92.380,36	212,60	6.176,03	21
22	24.703,72	54.485,40	2.924.217,73	21.772,88	2.029,86	934.303,04	2.641,17	79.825,94	22
23	3.053,97	4.494,55	4.855,72	483,12	609,77	12.459,94	2.380,18	4.893,60	23
24	-	-	-	-	-	-	-	-	24
25	3.668,39	1.030,55	496.434,96	2.443,00	111,49	92.568,97	436,90	167.363,84	25
26	152,06	216,02	7.804,54	132,64	20,27	2.444,12	11,91	1.185,44	26
27	2.520,52	7.274,43	186.367,70	5.648,59	639,11	52.010,82	636,03	76.862,66	27
28	644,81	1.248,21	43.026,03	2.721,04	141,15	259.425,96	90,27	219,63	28
29	625,80	509,33	2.700,44	896,23	20,27	11.962,26	161,59	8.419,71	29
30	51,55	210,07	2.963,46	371,06	637,12	2.363,60	1,29	236,11	30
31	600,02	632,20	33.224,57	1.847,70	21,29	1.777,84	2,31	2.925,72	31
32	434,00	457,80	2.108,26	1.336,56	15,20	1.546,37	1,68	5.059,37	32
33	684,69	3.180,82	11.358,34	2.113,49	536,26	32.721,59	399,77	37.760,42	33
34	-	5.622,42	236.177,35	3.890,58	601,40	18.236,37	591,95	49.814,61	34
35	2.249,04	-	-	-	-	-	-	-	35
36	1.541,92	10.711,33	125.182,86	12.557,63	721,75	400.043,74	2.001,13	71.843,72	36
37	-	-	-	-	-	-	-	-	37
38	364,59	929,42	3.024,60	541,07	108,96	39.683,71	301,68	1.922,26	38
39	-	-	-	-	-	-	-	-	39
40	991,22	1.942,28	51.776,19	4.142,72	216,90	117.587,90	264,68	48.724,51	40
190	157.373,60	566.471,16	15.045.549,42	439.826,56	50.778,85	7.712.850,20	146.840,27	800.016,60	190
200	-	-	-	-	-	-	-	-	200
201	39.369,53	64.727,33	2.651.341,27	56.209,90	6.762,35	1.590.957,61	61.270,00	914.504,08	201
202	69.991,09	106.361,11	5.282.214,94	114.588,40	12.638,77	2.118.883,29	42.600,83	2.297.008,04	202
203	11.893,92	13.898,42	522.312,44	26.967,80	1.578,99	563.024,97	14.788,78	146.328,03	203
204	4.531,50	9.114,84	552.252,78	8.424,05	830,51	10.916,64	9.982,59	178.885,23	204
205	-	-	-	-	-	-	-	-	205
209	125.786,03	194.101,70	9.008.121,42	206.190,15	21.810,62	4.283.782,52	128.642,19	3.536.725,36	209
210	283.159,63	760.572,86	24.053.670,84	646.016,72	72.589,47	11.996.632,71	275.482,47	4.336.741,96	210

Sektor	25	26	27	28	29	30	31	32	Sektor
1	-	-	-	-	-	-	-	-	1
2	570,17	-	-	322,56	-	-	-	-	2
3	194.347,71	-	-	695,88	-	-	-	-	3
4	773,85	-	-	459,93	-	-	-	-	4
5	27.519,89	-	-	606,28	-	-	-	-	5
6	113.957,02	-	-	4.953,79	-	-	-	-	6
7	1.128,78	-	-	-	-	-	-	-	7
8	46.363,09	-	-	4.345,46	-	-	-	-	8
9	0,71	307,97	-	-	-	-	-	-	9
10	605.205,73	11,95	0,23	89.612,75	-	10.617,99	3.633,67	58,41	10
11	6.792,63	31,15	0,24	18.720,95	-	-	177,57	15,36	11
12	689,34	-	9,47	895,47	-	-	-	68,11	12
13	9.961,96	494,40	1,41	19.622,77	-	5.414,75	1.187,73	268,13	13
14	1.722,78	848,07	440,34	26.182,34	-	1.693,72	730,91	139,00	14
15	106.965,22	8.346,05	125.025,93	302.515,06	-	88.533,72	24.291,46	1.278,47	15
16	9.878,02	850,42	0,49	43.965,28	-	12.644,69	5.745,48	436,06	16
17	541,44	22,73	4,95	173,21	-	-	-	24,80	17
18	6.163,92	6.389,93	1.648,16	187.940,87	-	23.101,06	11.459,64	1.637,57	18
19	-	-	-	-	-	-	-	-	19
20	235,22	1.180,73	3.448,74	901,94	-	2.178,02	122,69	49,35	20
21	331,97	268,76	2.647,83	6.988,58	-	3.586,26	1.148,58	527,29	21
22	52.109,17	1.859,34	2.219,32	54.871,13	-	7.679,64	2.767,20	950,70	22
23	4.869,82	3.510,52	1.742,24	2.798,36	-	1.754,92	1.717,22	2.076,17	23
24	-	-	-	-	-	-	-	-	24
25	25.506,27	1.441,11	5.281,37	7.051,29	-	1.579,41	438,55	602,69	25
26	137,87	20,93	0,25	1.881,54	-	372,55	99,19	7,45	26
27	14.345,21	1.227,10	4,35	9.820,21	-	6.026,72	177,57	351,24	27
28	663,29	4,59	2,39	29.462,31	-	6.080,27	3.480,89	5,23	28
29	43,32	37,88	0,37	2.690,89	-	399,53	164,45	187,69	29
30	127,08	1,14	0,79	6.758,62	-	9.246,96	3.521,42	0,12	30
31	537,06	160,37	7.558,63	57.173,25	-	28.859,08	14.623,65	521,93	31
32	385,60	116,01	3.187,39	10.291,18	-	8.863,80	6.458,71	519,31	32
33	12.970,62	341,29	6,53	28.973,49	-	9.222,52	1.459,22	1.885,57	33
34	-	1.037,57	-	56.292,86	-	2.337,20	1.765,85	-	34
35	258,40	487,94	22,39	78,80	-	-	-	246,17	35
36	21.004,29	310,94	9,44	71.908,49	-	8.638,07	4.367,49	795,30	36
37	-	-	-	-	-	-	-	-	37
38	24,30	33,79	15,12	17.119,85	-	2.255,33	597,78	478,97	38
39	143,89	336,90	0,85	78,80	-	189,15	33,93	273,01	39
40	168,54	471,91	153.967,88	188,43	-	221,81	33,93	475,32	40
190	1.266.444,19	30.151,52	307.247,11	1.066.342,62	-	241.497,17	90.204,77	13.879,39	190
200	-	-	-	-	-	-	-	-	200
201	237.623,64	13.528,58	116.660,68	226.491,26	-	118.092,71	43.762,59	11.360,88	201
202	354.403,12	2.229,25	222.516,17	285.912,95	-	113.178,23	67.351,54	21.479,69	202
203	121.790,00	3.779,37	75.793,70	185.239,60	-	57.418,41	19.760,90	4.125,13	203
204	53.338,98	687,29	10.952,87	78.889,33	-	5.395,55	1.084,40	400,71	204
205	-	-	-	-	-	-	-	-	205
209	767.155,74	20.224,49	425.923,42	776.533,15	-	294.084,90	131.959,43	37.366,41	209
210	2.033.599,93	50.376,02	733.170,53	1.842.875,77	-	535.582,08	222.164,19	51.245,80	210

Sektor	33	34	35	36	37	38	39	40	Sektor
1	-	-	-	-	-	2,09	-	-	1
2	-	-	-	-	-	65,74	-	-	2
3	-	-	-	-	-	578,72	-	-	3
4	-	-	-	-	-	40,80	-	-	4
5	-	-	-	-	-	205,05	20,08	371,62	5
6	-	-	-	-	-	50,04	-	-	6
7	-	-	-	-	-	-	10,14	187,59	7
8	-	-	-	-	-	53,18	-	-	8
9	-	-	-	-	-	-	-	-	9
10	16,57	374,56	4,12	354,25	-	1.424,91	1,04	19,24	10
11	-	554,57	-	-	-	223,72	311,83	5.770,54	11
12	62,01	151,17	6,09	523,32	-	134,09	18,21	336,95	12
13	2.936,36	10.325,79	128,40	11.031,35	-	304,74	57,77	1.068,99	13
14	169,75	1.730,90	27,76	2.385,18	-	4.104,73	405,74	7.508,36	14
15	2.859,68	1.681,65	89,95	7.728,00	-	1.244,10	79,66	1.474,09	15
16	58,35	300,18	26,45	2.272,54	-	264,38	16,13	298,54	16
17	244,23	67,13	1,19	102,61	-	265,03	45,52	842,39	17
18	1.555,48	27.935,89	323,05	27.755,48	-	637,08	1.690,19	31.277,21	18
19	-	-	-	-	-	-	55,40	1.025,14	19
20	108,11	60,11	4,38	376,22	-	264,38	26,22	485,21	20
21	409,43	1.560,63	26,72	2.295,25	-	24,28	11,54	213,46	21
22	6.084,04	8.636,14	429,86	36.381,29	-	7.659,96	1.167,04	21.596,28	22
23	3.271,86	3.514,82	81,54	3.005,87	-	151,83	55,71	1.030,84	23
24	-	-	-	-	-	-	-	-	24
25	1.294,92	56.067,91	113,60	9.756,43	-	909,66	6,34	117,37	25
26	97,20	20,39	4,31	370,66	-	7,15	0,13	2,39	26
27	1.581,67	1.196,13	16,29	1.399,90	-	52,32	5,22	96,66	27
28	777,41	16,79	1,58	135,98	-	2,79	0,28	5,23	28
29	1.097,09	1.087,23	50,75	3.864,85	-	237,88	9,21	170,36	29
30	8,07	145,48	0,16	14,16	-	8,72	-	-	30
31	117,69	27,06	7,69	660,67	-	4,88	6,21	114,86	31
32	116,93	236,31	5,56	477,93	-	3,49	4,49	83,09	32
33	13.844,86	2.972,22	103,50	8.892,12	-	668,33	66,96	1.239,03	33
34	-	1.114,05	-	29.748,65	-	-	-	34,50	34
35	5.911,41	140,18	346,83	1.093,37	-	1.155,34	1,86	-	35
36	2.290,78	504,88	129,57	11.131,87	-	1.366,54	63,73	1.179,34	36
37	-	-	-	-	-	-	-	-	37
38	947,77	118,13	18,01	1.547,24	-	724,14	19,06	352,70	38
39	211,39	237,05	3,35	288,16	-	10.909,40	-	-	39
40	699,98	7.660,98	127,56	10.959,38	-	519,39	4,55	84,24	40
190	46.773,05	128.438,35	2.078,30	174.552,75	-	34.268,87	4.160,26	76.986,25	190
200	-	-	-	-	-	-	-	-	200
201	26.946,41	212.355,26	656,98	56.444,68	347.383,61	15.542,87	3.435,90	63.581,91	201
202	28.401,16	243.707,78	3.150,76	270.700,61	-	14.158,21	4.404,17	81.490,71	202
203	27.477,07	23.596,97	268,78	23.092,25	24.817,27	5.922,79	420,88	7.788,25	203
204	1.370,63	5.559,15	255,64	21.963,34	-	2.929,39	2,97	54,92	204
205	-	-	-	-	-	-	-	-	205
209	84.195,27	485.219,15	4.332,16	372.200,88	372.200,88	38.553,25	8.263,92	152.915,80	209
210	130.968,32	613.657,51	6.410,46	546.753,63	372.200,88	72.822,13	12.424,18	229.902,05	210

Sektor	180	301	302	303	304	305	309	Sektor
1	-	-	-	87,38	11.208,53	11.295,92	-	1
2	4.035,15	-	-	(330,38)	5.939,90	9.644,66	4.035,15	2
3	265.722,86	-	-	-	9.304,94	275.027,79	265.722,86	3
4	7.495,62	-	-	361,36	198.961,55	206.818,52	7.495,62	4
5	19.584,26	-	-	(7.229,76)	-	12.354,50	19.584,26	5
6	104.571,41	352,60	9.091,13	(25.301,08)	11.033,21	99.747,26	104.571,41	6
7	18.739,72	-	-	2.272,71	-	21.012,43	18.739,72	7
8	136.770,25	-	-	-	3.271,31	140.041,56	136.770,25	8
9	26.867,51	-	-	-	-	26.867,51	26.867,51	9
10	1.432.615,76	-	-	36.193,61	2.287.928,56	3.756.737,93	1.432.615,76	10
11	262.795,37	2.403,78	536,48	-	-	265.735,62	262.795,37	11
12	44.912,72	107,13	37.301,17	-	80.733,05	163.054,07	44.912,72	12
13	100.406,04	9.911,99	-	-	-	110.318,03	100.406,04	13
14	213.127,22	2.363,17	-	1.004.483,82	14.908.329,21	16.128.303,42	213.127,22	14
15	289.722,12	4.099,46	-	(21.012,47)	613.376,98	886.186,09	289.722,12	15
16	4.650,88	1.923,90	-	1.039,17	312.926,63	320.540,57	4.650,88	16
17	142.257,20	1.443,46	113.690,34	5.549,38	156.177,88	419.118,25	142.257,20	17
18	130.689,63	3.527,13	8.916.490,19	-	-	9.050.706,95	130.689,63	18
19	-	-	-	911.936,75	20.494.195,66	21.406.132,41	-	19
20	175.313,62	2.466,18	149.462,43	10.895,69	286.523,19	624.661,11	175.313,62	20
21	4.749,98	-	67.156,61	(2.835,70)	47.456,35	116.527,24	4.749,98	21
22	184.932,99	5.268,24	-	-	5.882.069,87	6.072.271,10	184.932,99	22
23	27.910,31	2.849,85	158.196,42	-	-	188.956,58	27.910,31	23
24	-	-	-	-	-	-	-	24
25	618.390,60	2.184,16	-	-	150.354,26	770.929,02	618.390,60	25
26	5.577,39	303,21	-	-	2.753,41	8.634,01	5.577,39	26
27	128.369,78	2.557,06	-	-	24.371,03	155.297,87	128.369,78	27
28	5.904,10	1.550,89	-	-	1.202.879,01	1.210.333,99	5.904,10	28
29	12.385,95	370,98	-	-	-	12.756,93	12.385,95	29
30	3.541,38	1.544,34	-	-	388.509,40	393.595,12	3.541,38	30
31	2.473,30	693,61	-	-	38.524,91	41.691,82	2.473,30	31
32	4.356,37	759,43	-	-	3.135,41	8.251,20	4.356,37	32
33	244.701,57	3.424,35	-	-	117.184,82	365.310,74	244.701,57	33
34	18.984,08	277,92	-	-	59.556,61	78.818,61	18.984,08	34
35	2.063,20	-	-	-	4.256,07	6.319,27	2.063,20	35
36	346.797,15	5.270,79	-	-	21.330,59	373.398,52	346.797,15	36
37	9.552,38	383.978,19	-	-	28.461,93	421.992,50	9.552,38	37
38	143.942,94	23.878,20	-	-	20.634,22	188.455,35	143.942,94	38
39	31.790,77	4.836,29	-	-	-	36.627,07	31.790,77	39
40	49.469,48	3.900,34	-	-	-	53.369,82	49.469,48	40
190	5.226.171,05	472.246,62	9.451.924,77	1.916.110,46	47.371.388,46	64.437.841,36	5.226.171,05	190
200								200
201								201
202								202
203								203
204								204
205								205
209								209
210								210

Sektor	310	409	509	600	700			Sektor
1	62.885,00	-	4.659,58	58.225,43	62.885,00			1
2	16.449,79	5.609,67	2.815,75	8.024,38	16.449,79			2
3	521.187,04	243.021,46	23.463,16	254.702,42	521.187,04			3
4	269.251,66	2.745,56	40.858,75	225.647,35	269.251,66			4
5	185.881,67	173.572,49	3.298,10	9.011,08	185.881,67			5
6	259.506,06	160.122,31	31.572,73	67.811,02	259.506,06			6
7	738.753,93	728.481,22	10.272,71	0,00	738.753,93			7
8	198.933,39	175.487,14	5.973,72	17.472,53	198.933,39			8
9	4.527.461,14	4.503.908,06	1.817,89	21.735,18	4.527.461,14			9
10	7.205.937,83	3.301.376,21	47.491,64	3.857.069,97	7.205.937,83			10
11	625.039,78	619.599,98	1.492,02	3.947,78	625.039,78			11
12	245.267,81	73.023,62	51.993,62	120.250,57	245.267,81			12
13	762.602,11	756.050,89	1.256,51	5.294,71	762.602,11			13
14	40.342.065,30	3.342.865,24	2.010.534,81	34.988.665,26	40.342.065,30			14
15	4.858.363,13	4.117.377,99	123.608,16	617.376,98	4.858.363,13			15
16	865.596,40	328.859,25	140.366,92	396.370,22	865.596,40			16
17	578.542,98	178.639,84	116.743,51	283.159,63	578.542,98			17
18	12.139.447,10	11.020.201,53	358.672,71	760.572,86	12.139.447,10			18
19	27.622.859,81	2.045.559,58	1.523.629,39	24.053.670,84	27.622.859,81			19
20	1.307.021,54	378.167,29	282.837,53	646.016,72	1.307.021,54			20
21	330.140,47	243.202,06	14.348,94	72.589,47	330.140,47			21
22	11.996.632,71	-	-	11.996.632,71	11.996.632,71			22
23	275.482,47	-	-	275.482,47	275.482,47			23
24	-	-	(4.336.741,96)	4.336.741,96	-			24
25	2.042.931,92	9.331,99	-	2.033.599,93	2.042.931,92			25
26	67.246,98	21.393,26	(4.522,30)	50.376,02	67.246,98			26
27	685.936,07	13.242,59	(60.477,05)	733.170,53	685.936,07			27
28	1.642.452,95	7.841,40	(208.264,22)	1.842.875,77	1.642.452,95			28
29	103.834,65	103.834,65	-	-	103.834,65			29
30	425.112,26	30.627,75	(141.097,57)	535.582,08	425.112,26			30
31	196.517,61	12.879,05	(38.525,63)	222.164,19	196.517,61			31
32	52.278,72	9.112,36	(8.079,45)	51.245,80	52.278,72			32
33	630.957,98	499.989,66	-	130.968,32	630.957,98			33
34	630.360,54	16.703,03	-	613.657,51	630.360,54			34
35	22.765,68	16.355,22	-	6.410,46	22.765,68			35
36	1.368.923,94	822.170,31	-	546.753,63	1.368.923,94			36
37	421.992,50	49.791,62	-	372.200,88	421.992,50			37
38	360.308,61	287.486,48	-	72.822,13	360.308,61			38
39	49.450,71	37.026,53	-	12.424,18	49.450,71			39
40	546.098,23	316.196,18	-	229.902,05	546.098,23			40
190	125.182.478,46	34.651.853,45	0,00	90.530.625,01	125.182.478,46			190
200								200
201								201
202								202
203								203
204								204
205								205
209								209
210								210

Table A-4 10 Sectors Transaction Table

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry	Elecricity, Gas, and Water
		1	2	3	4	5	6	7
1	Rice	3,741.75	720.13	-	42,377.74	902.05	-	-
2	Plantation, Livestocks and Fisheries	120.11	27,390.30	-	41,116.83	8,455.73	269.08	-
3	Mining	-		522.14	4.31	358.13	17,753.96	-
4	Other Industries	-	547.08	4.64	877,618.28	18,372.20	4,534.73	192.97
5	Chemical Industry	104.26	900.07	4.43	2,632.80	20,274,349.29	211,831.47	645.18
6	Manufacture Industry	56.79	901.99	31.70	885.32	20,781.48	3,921,678.16	256,228.19
7	Elecricity, Gas, and Water	-	3,531.77	455.27	67,725.43	1,604,258.32	3,027,209.58	934,303.04
8	Construction	47.30	1,934.43	195.18	3,326.85	18,209.56	13,497.13	12,459.94
9	Commercial	3,235.40	23,184.27	1,963.56	61,605.92	980,780.20	1,743,901.49	402,357.82
10	Transportation and Telecommunication	560.91	5,296.60	147.65	12,731.38	283,674.47	353,593.32	318,283.08
190	Intermediate Input	7,866.52	64,406.65	3,324.56	1,110,024.85	23,210,141.43	9,294,268.91	1,924,470.23
200	Import	6,354	71,474.63	3,826	1,705,858.12	6,158,629.22	6,965,730.69	5,788,380
201	Wages	9,308	86,842.69	1,850	444,243.71	2,271,487.36	2,818,410.38	1,590,958
202	Profits	33,400	347,020.27	11,464	448,689.67	2,916,563.67	5,585,794.30	2,118,883
203	Depreciation	766	6,387.60	1,096	167,053.71	763,056.92	576,651.57	563,025
204	Indirect taxes	531	6,536.94	175	110,692.97	682,533.86	575,153.67	10,917
205	Subsidy	-	-	-	-	-	-	-
209	Value Added	44,005	446,788	14,585	1,170,680	6,633,642	9,556,010	4,283,783
210	Total Input	58,225	582,669	21,735	3,986,563	36,002,412	25,816,010	11,996,633

Code	Sector	Construction	Commercial	Transport and Telecommunication	Intermediate Demand
		8	9	10	180
1	Rice	-	15.83	-	47,757.50
2	Plantation, Livestocks and Fisheries	60.64	134,013.55	3,039.40	214,465.65
3	Mining	2,799.77	0.01	3.19	21,441.50
4	Other Industries	6,696.27	45,605.05	7,142.22	960,713.44
5	Chemical Industry	643.75	8,276.79	9,620.07	20,509,008.11
6	Manufacture Industry	59,424.67	8,302.48	16,527.00	4,284,817.79
7	Elecricity, Gas, and Water	2,641.17	207,805.68	76,431.37	5,924,361.62
8	Construction	2,380.18	17,604.04	16,871.28	86,525.88
9	Commercial	16,952.12	475,312.05	239,647.79	3,948,940.61
10	Transportation and Telecommunication	858.91	98,064.97	232,817.41	1,306,028.68
190	Intermediate Input	92,457.48	995,000.43	602,099.74	37,304,060.78
200	Import	54,383	1,491,945.15	1,193,995.90	23,440,576
201	Wages	61,270	1,851,528.92	556,843.11	9,692,742
202	Profits	42,601	3,269,023.40	741,068.98	15,514,508
203	Depreciation	14,789	354,025.22	373,594.18	2,820,445
204	Indirect taxes	9,983	262,989.61	98,780.79	1,758,293
205	Subsidy	-		-	-
209	Value Added	128,642	5,737,567	1,770,287	29,785,988
210	Total Input	275,482	8,224,513	3,566,383	90,530,625

Code	Sector	Household Consumption	Government Consumption	Investment	Inventory Change	Export	Final Demand	Total demand
		301	302	303	304	305	309	310
1	Rice	-	-	-	56.06	10,411.87	10,467.93	58,225.43
2	Plantation, Livestocks and Fisheries	169,948.63	282.75	2,502.45	(10,039.99)	205,509.28	368,203.13	582,668.78
3	Mining	293.68	-	-	0.00	-	293.68	21,735.18
4	Other Industries	663,013.61	794.26	20,574.50	13,178.44	2,328,288.80	3,025,849.60	3,986,563.04
5	Chemical Industry	580.69	355.70	-	949,668.92	14,542,799.04	15,493,404.35	36,002,412.46
6	Manufacture Industry	119,745.43	1,272.65	599,446.47	859,517.86	19,951,209.31	21,531,191.72	25,816,009.51
7	Electricity, Gas, and Water	184,932.99	5,268.24	-	-	5,882,069.87	6,072,271.10	11,996,632.71
8	Construction	27,910.31	2,849.85	158,196.42	-	-	188,956.58	275,482.47
9	Commercial	1,214,066.13	354,834.30	273,995.29	82,731.84	2,349,944.58	4,275,572.12	8,224,512.73
10	Transportation and Telecommunication	151,778.88	7,419.41	-	-	2,101,155.72	2,260,354.02	3,566,382.70
190	Intermediate Input	2,532,270.36	373,077.16	1,054,715.12	1,895,113.13	47,371,388.46	53,226,564.23	90,530,625.01
200	Import	2,693,900.69	99,169.46	8,397,209.64	20,997.33	-	11,211,277.13	34,651,853.45

Table A-5 Technical Coefficient Matrix (A)

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry	Electricity, Gas, and Water	Construction	Commercial	Transport and Telecommunication
		1	2	3	4	5	6	7	8	9	10
1	Rice	0.064	0.001	-	0.011	0.000	-	-	-	0.000	-
2	Plantation, Livestocks and Fisheries	0.002	0.047	-	0.010	0.000	0.000	-	0.000	0.016	0.001
3	Mining	-	-	0.024	0.000	0.000	0.001	-	0.010	0.000	0.000
4	Other Industries	-	0.001	0.000	0.220	0.001	0.000	0.000	0.024	0.006	0.002
5	Chemical Industry	0.002	0.002	0.000	0.001	0.563	0.008	0.000	0.002	0.001	0.003
6	Manufacture Industry	0.001	0.002	0.001	0.000	0.001	0.152	0.021	0.216	0.001	0.005
7	Electricity, Gas, and Water	-	0.006	0.021	0.017	0.045	0.117	0.078	0.010	0.025	0.021
8	Construction	0.001	0.003	0.009	0.001	0.001	0.001	0.001	0.009	0.002	0.005
9	Commercial	0.056	0.040	0.090	0.015	0.027	0.068	0.034	0.062	0.058	0.067
10	Transportation and Telecommunication	0.010	0.009	0.007	0.003	0.008	0.014	0.027	0.003	0.012	0.065

Table A-6 Leontief Inverse Matrix $(A\text{-}I)^{-1}$

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry	Elecricity, Gas, and Water	Construction	Trade,Hotel and Restaurant	Transport and Telecomunication
		1	2	3	4	5	6	7	8	9	10
1	Rice	1.069	0.001	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000
2	Plantation, Livestocks and Fisheries	0.003	1.050	0.002	0.014	0.002	0.002	0.001	0.002	0.018	0.002
3	Mining	0.000	0.000	1.025	0.000	0.000	0.001	0.000	0.011	0.000	0.000
4	Other Industries	0.001	0.002	0.001	1.283	0.002	0.001	0.000	0.032	0.008	0.003
5	Chemical Industry	0.005	0.004	0.001	0.002	2.289	0.023	0.001	0.011	0.003	0.007
6	Manufacture Industry	0.002	0.003	0.005	0.001	0.005	1.184	0.028	0.258	0.003	0.008
7	Elecricity, Gas, and Water	0.003	0.009	0.027	0.025	0.114	0.155	1.090	0.047	0.030	0.029
8	Construction	0.001	0.004	0.010	0.001	0.002	0.001	0.001	1.009	0.002	0.005
9	Trade, Hotel and Restaurant	0.064	0.046	0.101	0.024	0.073	0.093	0.043	0.089	1.065	0.079
10	Transportation and Telecommunication	0.012	0.011	0.010	0.006	0.024	0.023	0.032	0.010	0.015	1.072

Table A-7 Initial Disequilibrium State

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry
		1.00	2.00	3.00	4.00	5.00	6.00
1	Rice	2,899	720.13	-	30,737	325	-
2	Plantation	93	27,390.30	-	29,823	3,047	210
3	Mining	-		522.14	3	129	13,827
4	Other Industries	-	547.08	4.64	636,552	6,620	3,532
5	Chemical Industry	103	900.07	4.43	1,910	7,305,354	164,980
6	Manufacture Industry	56	901.99	31.70	642	7,488	3,054,298
7	Elecricity, Gas, and Water	-	3,531.77	455.27	49,122	578,054	2,357,665
8	Construction	47	1,934.43	195.18	2,413	6,561	10,512
9	Commercial	3,204	23,184.27	1,963.56	44,684	353,400	1,358,193
10	Transportation and Telecommunication	555	5,296.60	147.65	9,234	102,215	275,387
190	Intermediate Input	7,790	64,406.65	3,324.56	805,120	8,363,194	7,238,603
200	Import	6,292	71,474.63	3,826	1,237,288	2,219,108	5,425,081
201	Wages	9,217	86,842.69	1,850	322,218	818,474	2,195,047
202	Profits	33,074	347,020.27	11,464	325,442	1,050,911	4,350,353
203	Depreciation	758	6,387.60	1,096	121,167	274,948	449,110
204	Indirect taxes	526	6,536.94	175	80,288	245,934	447,944
205	Subsidy	-	-	-	-	-	-
209	Value Added	43,576	446,788	14,585	849,114	2,390,267	7,442,453
210	Total Input	57,657	582,669	21,735	2,891,523	12,972,569	20,106,137

Code	Sector	Electricity, Gas, and Water	Construction	Commercial	Transport and Telecomunication	Intermediate Demand
		7.00	8.00	9.00	10.00	180
1	Rice	-	-	15	-	34,697.21
2	Plantation	-	60.64	130,858	3,039.40	194,521.01
3	Mining	-	2,799.77	0	3.19	17,284.49
4	Other Industries	192.97	6,696.27	44,531	7,142.22	705,817.90
5	Chemical Industry	645.18	643.75	8,082	9,620.07	7,492,242.29
6	Manufacture Industry	256,228.19	59,424.67	8,107	16,527.00	3,403,705.45
7	Electricity, Gas, and Water	934,303.04	2,641.17	202,913	76,431.37	4,205,117.21
8	Construction	12,459.94	2,380.18	17,190	16,871.28	70,563.70
9	Commercial	402,357.82	16,952.12	464,122	239,647.79	2,907,707.55
10	Transportation and Telecommunication	318,283.08	858.91	95,756	232,817.41	1,040,551.68
190	Intermediate Input	1,924,470.23	92,457.48	971,575	602,099.74	20,072,208.49
200	Import	5,788,380	54,383	1,456,820	1,193,995.90	23,440,576
201	Wages	1,590,958	61,270	1,807,938	556,843.11	9,692,742
202	Profits	2,118,883	42,601	3,192,061	741,068.98	15,514,508
203	Depreciation	563,025	14,789	345,690	373,594.18	2,820,445
204	Indirect taxes	10,917	9,983	256,798	98,780.79	1,758,293
205	Subsidy	-	-	-	-	-
209	Value Added	4,283,783	128,642	5,602,488	1,770,287	29,785,988
210	Total Input	11,996,633	275,482	8,030,884	3,566,383	73,298,773

Code	Sector	Household Consumption	Government Consumption	Investment	Inventory Change	Eksport	Final Demand	Total demand
		301	302	303	304	305	309	310
1	Rice	-	-	-	56.06	10,411.87	10,467.93	45,165
2	Plantation	169,948.63	282.75	2,502.45	(10,039.99)	205,509.28	368,203.13	562,724
3	Mining	293.68	-	-	0.00	-	293.68	17,578
4	Other Industries	480,421.42	575.52	14,908.33	9,549.13	1,687,084.25	2,192,538.66	2,898,357
5	Chemical Industry	205.48	125.87	-	336,050.88	5,146,130.77	5,482,513.01	12,974,755
6	Manufacture Industry	93,157.69	990.08	466,348.04	668,674.33	15,521,331.39	16,750,501.52	20,154,207
7	Elecricity, Gas, and Water	184,932.99	5,268.24	-	-	5,882,069.87	6,072,271.10	10,277,388
8	Construction	27,910.31	2,849.85	158,196.42	-	-	188,956.58	259,520
9	Commercial	1,214,066.13	354,834.30	273,995.29	82,731.84	2,349,944.58	4,275,572.12	7,183,280
10	Transportation and Telecommunication	151,778.88	7,419.41	-	-	2,101,155.72	2,260,354.02	3,300,906
190	Intermediate Input	2,532,270.36	373,077.16	1,054,715.12	1,895,113.13	47,371,388.46	53,226,564.23	
200	Import	2,693,900.69	99,169.46	8,397,209.64	20,997.33	-	11,211,277.13	

Table A-8 First Round Adjustment

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry
		1.00	2.00	3.00	4.00	5.00	6.00
1	Rice	2,954	696	-	30,737	325	-
2	Plantation	95	26,454	-	29,823	3,047	210
3	Mining	-	-	422	3	129	13,827
4	Other Industries	-	528	4	636,552	6,620	3,532
5	Chemical Industry	82	869	4	1,910	7,305,354	164,980
6	Manufacture Industry	45	871	26	642	7,488	3,054,298
7	Elecricity, Gas, and Water	-	3,411	368	49,122	578,054	2,357,665
8	Construction	37	1,868	158	2,413	6,561	10,512
9	Commercial	2,554	22,392	1,588	44,684	353,400	1,358,193
10	Transportation and Telecommunication	443	5,116	119	9,234	102,215	275,387
190	Intermediate Input	6,211	62,205	2,689	805,120	8,363,194	7,238,603
200	Import	5,017	69,031	3,094	1,237,288	2,219,108	5,425,081
201	Wages	7,349	83,874	1,496	322,218	818,474	2,195,047
202	Profits	26,370	335,157	9,271	325,442	1,050,911	4,350,353
203	Depreciation	605	6,169	886	121,167	274,948	449,110
204	Indirect taxes	419	6,313	141	80,288	245,934	447,944
205	Subsidy	-	-	-	-	-	-
209	Value Added	34,744	431,514	11,795	849,114	2,390,267	7,442,453
210	Total Input	45,971	562,750	17,578	2,891,523	12,972,569	20,106,137

Sector	Elecricity, Gas, and Water	Construction	Commercial	Transport and Telecomunication	Intermediate Demand
	7.00	8.00	9.00	10.00	180
Rice	-	-	14	-	34,725.92
Plantation	-	57	117,047	2,813	179,545.46
Mining	-	2,638	0	3	17,022.16
Other Industries	165	6,308	39,831	6,611	700,151.02
Chemical Industry	553	606	7,229	8,904	7,490,490.88
Manufacture Industry	219,508	55,981	7,251	15,297	3,361,407.83
Elecricity, Gas, and Water	800,408	2,488	181,497	70,742	4,043,755.31
Construction	10,674	2,242	15,375	15,615	65,457.08
Commercial	344,696	15,970	415,137	221,809	2,780,421.79
Transportation and Telecommunication	272,670	809	85,650	215,487	967,129.66
Intermediate Input	1,648,673	87,100	869,032	557,280	19,640,107.11
Import	4,958,844	51,232	1,303,063	1,105,116	23,440,576
Wages	1,362,957	57,720	1,617,123	515,392	9,692,742
Profits	1,815,225	40,132	2,855,161	685,905	15,514,508
Depreciation	482,338	13,932	309,205	345,784	2,820,445
Indirect taxes	9,352	9,404	229,695	91,428	1,758,293
Subsidy	-	-	-	-	-
Value Added	3,669,871	121,188	5,011,184	1,638,509	29,785,988
Total Input	10,277,388	259,520	7,183,280	3,300,906	72,866,671

Code	Sector	Household Consumption	Government Consumption	Investment	Inventory Change	Eksport	Final Demand	Total demand
		301	302	303	304	305	309	310
1	Rice	-	-	-	56.06	10,411.87	10,467.93	45,194
2	Plantation	169,948.63	282.75	2,502.45	(10,039.99)	205,509.28	368,203.13	547,749
3	Mining	293.68	-	-	0.00	-	293.68	17,316
4	Other Industries	480,421.42	575.52	14,908.33	9,549.13	1,687,084.25	2,192,538.66	2,892,690
5	Chemical Industry	205.48	125.87	-	336,050.88	5,146,130.77	5,482,513.01	12,973,004
6	Manufacture Industry	93,157.69	990.08	466,348.04	668,674.33	15,521,331.39	16,750,501.52	20,111,909
7	Elecricity, Gas, and Water	184,932.99	5,268.24	-	-	5,882,069.87	6,072,271.10	10,116,026
8	Construction	27,910.31	2,849.85	158,196.42	-	-	188,956.58	254,414
9	Commercial	1,214,066.13	354,834.30	273,995.29	82,731.84	2,349,944.58	4,275,572.12	7,055,994
10	Transportation and Telecommunication	151,778.88	7,419.41	-	-	2,101,155.72	2,260,354.02	3,227,484
190	Intermediate Input	2,532,270.36	373,077.16	1,054,715.12	1,895,113.13	47,371,388.46	53,226,564.23	
200	Import	2,693,900.69	99,169.46	8,397,209.64	20,997.33	-	11,211,277.13	

Table A-9 Second Round Adjustment

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry
		1.00	2.00	3.00	4.00	5.00	6.00
1	Rice	2,904	677	-	30,737	325	-
2	Plantation	93	25,749	-	29,823	3,047	210
3	Mining	-	-	416	3	129	13,827
4	Other Industries	-	514	4	636,552	6,620	3,532
5	Chemical Industry	81	846	4	1,910	7,305,354	164,980
6	Manufacture Industry	44	848	25	642	7,488	3,054,298
7	Elecricity, Gas, and Water	-	3,320	363	49,122	578,054	2,357,665
8	Construction	37	1,818	155	2,413	6,561	10,512
9	Commercial	2,511	21,795	1,564	44,684	353,400	1,358,193
10	Transportation and Telecommunication	435	4,979	118	9,234	102,215	275,387
190	Intermediate Input	6,106	60,547	2,649	805,120	8,363,194	7,238,603
200	Import	4,932	67,191	3,048	1,237,288	2,219,108	5,425,081
201	Wages	7,225	81,638	1,474	322,218	818,474	2,195,047
202	Profits	25,925	326,223	9,133	325,442	1,050,911	4,350,353
203	Depreciation	594	6,005	873	121,167	274,948	449,110
204	Indirect taxes	412	6,145	139	80,288	245,934	447,944
205	Subsidy	-	-	-	-	-	-
209	Value Added	34,156	420,011	11,619	849,114	2,390,267	7,442,453
210	Total Input	45,194	547,749	17,316	2,891,523	12,972,569	20,106,137

Code	Sector	Elecricity, Gas, and Water	Construction	Commercial	Transport and Telecomunication	Intermediate Demand
		7.00	8.00	9.00	10.00	180
1	Rice	-	-	14	-	34,657.43
2	Plantation	-	56	114,973	2,751	176,700.92
3	Mining	-	2,586	0	3	16,963.89
4	Other Industries	163	6,184	39,126	6,464	699,157.31
5	Chemical Industry	544	595	7,101	8,706	7,490,119.51
6	Manufacture Industry	216,062	54,880	7,123	14,957	3,356,366.75
7	Elecricity, Gas, and Water	787,841	2,439	178,281	69,168	4,026,253.39
8	Construction	10,507	2,198	15,103	15,268	64,572.79
9	Commercial	339,284	15,656	407,781	216,875	2,761,742.00
10	Transportation and Telecommunication	268,389	793	84,132	210,694	956,376.24
190	Intermediate Input	1,622,788	85,386	853,633	544,885	19,582,910.25
200	Import	4,880,987	50,224	1,279,973	1,080,535	23,440,576
201	Wages	1,341,557	56,584	1,588,468	503,929	9,692,742
202	Profits	1,786,725	39,343	2,804,568	670,648	15,514,508
203	Depreciation	474,765	13,658	303,726	338,093	2,820,445
204	Indirect taxes	9,205	9,219	225,625	89,394	1,758,293
205	Subsidy	-	-	-	-	-
209	Value Added	3,612,252	118,804	4,922,388	1,602,064	29,785,988
210	Total Input	10,116,026	254,414	7,055,994	3,227,484	72,809,474

Code	Sector	Household Consumption	Government Consumption	Investment	Inventory Change	Eksport	Final Demand	Total demand
		301	302	303	304	305	309	310
1	Rice	-	-	-	56.06	10,411.87	10,467.93	45,125
2	Plantation	169,948.63	282.75	2,502.45	(10,039.99)	205,509.28	368,203.13	544,904
3	Mining	293.68	-	-	0.00	-	293.68	17,258
4	Other Industries	480,421.42	575.52	14,908.33	9,549.13	1,687,084.25	2,192,538.66	2,891,696
5	Chemical Industry	205.48	125.87	-	336,050.88	5,146,130.77	5,482,513.01	12,972,633
6	Manufacture Industry	93,157.69	990.08	466,348.04	668,674.33	15,521,331.39	16,750,501.52	20,106,868
7	Elecricity, Gas, and Water	184,932.99	5,268.24	-	-	5,882,069.87	6,072,271.10	10,098,524
8	Construction	27,910.31	2,849.85	158,196.42	-	-	188,956.58	253,529
9	Commercial	1,214,066.13	354,834.30	273,995.29	82,731.84	2,349,944.58	4,275,572.12	7,037,314
10	Transportation and Telecommunication	151,778.88	7,419.41	-	-	2,101,155.72	2,260,354.02	3,216,730
190	Intermediate Input	2,532,270.36	373,077.16	1,054,715.12	1,895,113.13	47,371,388.46	53,226,564.23	
200	Import	2,693,900.69	99,169.46	8,397,209.64	20,997.33	-	11,211,277.13	

Table A-10 Third Round Adjustment

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry
		1.00	2.00	3.00	4.00	5.00	6.00
1	Rice	2,900	673	-	30,737	325	-
2	Plantation	93	25,615	-	29,823	3,047	210
3	Mining	-	-	415	3	129	13,827
4	Other Industries	-	512	4	636,552	6,620	3,532
5	Chemical Industry	81	842	4	1,910	7,305,354	164,980
6	Manufacture Industry	44	844	25	642	7,488	3,054,298
7	Electricity, Gas, and Water	-	3,303	361	49,122	578,054	2,357,665
8	Construction	37	1,809	155	2,413	6,561	10,512
9	Commercial	2,507	21,682	1,559	44,684	353,400	1,358,193
10	Transportation and Telecommunication	435	4,953	117	9,234	102,215	275,387
190	Intermediate Input	6,097	60,232	2,640	805,120	8,363,194	7,238,603
200	Import	4,924	66,842	3,038	1,237,288	2,219,108	5,425,081
201	Wages	7,214	81,214	1,469	322,218	818,474	2,195,047
202	Profits	25,885	324,529	9,102	325,442	1,050,911	4,350,353
203	Depreciation	593	5,974	870	121,167	274,948	449,110
204	Indirect taxes	412	6,113	139	80,288	245,934	447,944
205	Subsidy	-	-	-	-	-	-
209	Value Added	34,104	417,830	11,580	849,114	2,390,267	7,442,453
210	Total Input	45,125	544,904	17,258	2,891,523	12,972,569	20,106,137

Code	Sector	Electricity, Gas, and Water	Construction	Commercial	Transport and Telecomunication	Intermediate Demand
		7.00	8.00	9.00	10.00	180
1	Rice	-	-	14	-	34,649.22
2	Plantation	-	56	114,669	2,741	176,253.33
3	Mining	-	2,577	0	3	16,953.50
4	Other Industries	162	6,163	39,022	6,442	699,007.74
5	Chemical Industry	543	592	7,082	8,677	7,490,064.17
6	Manufacture Industry	215,688	54,689	7,104	14,907	3,355,728.94
7	Electricity, Gas, and Water	786,478	2,431	177,809	68,938	4,024,160.96
8	Construction	10,489	2,191	15,063	15,217	64,446.10
9	Commercial	338,697	15,601	406,701	216,152	2,759,176.19
10	Transportation and Telecommunication	267,924	790	83,909	209,992	954,957.50
190	Intermediate Input	1,619,980	85,090	851,373	543,069	19,575,397.64
200	Import	4,872,542	50,049	1,276,585	1,076,935	23,440,576
201	Wages	1,339,236	56,387	1,584,263	502,250	9,692,742
202	Profits	1,783,633	39,206	2,797,144	668,414	15,514,508
203	Depreciation	473,943	13,610	302,922	336,967	2,820,445
204	Indirect taxes	9,189	9,187	225,027	89,096	1,758,293
205	Subsidy	-	-	-	-	-
209	Value Added	3,606,002	118,391	4,909,356	1,596,726	29,785,988
210	Total Input	10,098,524	253,529	7,037,314	3,216,730	72,801,962

Code	Sector	Household Consumption	Government Consumption	Investment	Inventory Change	Eksport	Final Demand	Total demand
		301	**302**	**303**	**304**	**305**	**309**	**310**
1	Rice	-	-	-	56.06	10,411.87	10,467.93	45,117
2	Plantation	169,948.63	282.75	2,502.45	(10,039.99)	205,509.28	368,203.13	544,456
3	Mining	293.68	-	-	0.00	-	293.68	17,247
4	Other Industries	480,421.42	575.52	14,908.33	9,549.13	1,687,084.25	2,192,538.66	2,891,546
5	Chemical Industry	205.48	125.87	-	336,050.88	5,146,130.77	5,482,513.01	12,972,577
6	Manufacture Industry	93,157.69	990.08	466,348.04	668,674.33	15,521,331.39	16,750,501.52	20,106,230
7	Electricity, Gas, and Water	184,932.99	5,268.24	-	-	5,882,069.87	6,072,271.10	10,096,432
8	Construction	27,910.31	2,849.85	158,196.42	-	-	188,956.58	253,403
9	Commercial	1,214,066.13	354,834.30	273,995.29	82,731.84	2,349,944.58	4,275,572.12	7,034,748
10	Transportation and Telecommunication	151,778.88	7,419.41	-	-	2,101,155.72	2,260,354.02	3,215,312
190	Intermediate Input	2,532,270.36	373,077.16	1,054,715.12	1,895,113.13	47,371,388.46	53,226,564.23	
200	Import	2,693,900.69	99,169.46	8,397,209.64	20,997.33	-	11,211,277.13	

Table A-11 Fourth Round Adjustment

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry
		1.00	2.00	3.00	4.00	5.00	6.00
1	Rice	2,899	673	-	30,737	325	-
2	Plantation	93	25,594	-	29,823	3,047	210
3	Mining	-	-	414	3	129	13,827
4	Other Industries	-	511	4	636,552	6,620	3,532
5	Chemical Industry	81	841	4	1,910	7,305,354	164,980
6	Manufacture Industry	44	843	25	642	7,488	3,054,298
7	Electricity, Gas, and Water	-	3,300	361	49,122	578,054	2,357,665
8	Construction	37	1,808	155	2,413	6,561	10,512
9	Commercial	2,507	21,664	1,558	44,684	353,400	1,358,193
10	Transportation and Telecommunication	435	4,949	117	9,234	102,215	275,387
190	Intermediate Input	6,096	60,183	2,638	805,120	8,363,194	7,238,603
200	Import	4,923	66,787	3,036	1,237,288	2,219,108	5,425,081
201	Wages	7,213	81,147	1,468	322,218	818,474	2,195,047
202	Profits	25,881	324,262	9,097	325,442	1,050,911	4,350,353
203	Depreciation	593	5,969	870	121,167	274,948	449,110
204	Indirect taxes	412	6,108	139	80,288	245,934	447,944
205	Subsidy	-	-	-	-	-	-
209	Value Added	34,098	417,486	11,573	849,114	2,390,267	7,442,453
210	Total Input	45,117	544,456	17,247	2,891,523	12,972,569	20,106,137

Code	Sector	Electricity, Gas, and Water	Construction	Commercial	Transport and Telecomunication	Intermediate Demand
		7.00	8.00	9.00	10.00	180
1	Rice	-	-	14	-	34,648.14
2	Plantation	-	56	114,627	2,740	176,189.23
3	Mining	-	2,575	0	3	16,951.96
4	Other Industries	162	6,160	39,008	6,439	698,987.13
5	Chemical Industry	543	592	7,079	8,673	7,490,056.64
6	Manufacture Industry	215,643	54,662	7,101	14,900	3,355,647.04
7	Electricity, Gas, and Water	786,315	2,429	177,744	68,908	4,023,898.63
8	Construction	10,486	2,189	15,057	15,210	64,429.04
9	Commercial	338,627	15,593	406,553	216,057	2,758,835.40
10	Transportation and Telecommunication	267,869	790	83,879	209,899	954,774.16
190	Intermediate Input	1,619,645	85,047	851,063	542,830	19,574,417.38
200	Import	4,871,532	50,024	1,276,119	1,076,460	23,440,576
201	Wages	1,338,959	56,359	1,583,685	502,028	9,692,742
202	Profits	1,783,264	39,186	2,796,124	668,119	15,514,508
203	Depreciation	473,845	13,603	302,812	336,818	2,820,445
204	Indirect taxes	9,188	9,182	224,945	89,057	1,758,293
205	Subsidy	-	-	-	-	-
209	Value Added	3,605,255	118,332	4,907,566	1,596,022	29,785,988
210	Total Input	10,096,432	253,403	7,034,748	3,215,312	72,800,982

Code	Sector	Household Consumption	Government Consumption	Investment	Inventory Change	Eksport	Final Demand	Total demand
		301	**302**	**303**	**304**	**305**	**309**	**310**
1	Rice	-	-	-	56.06	10,411.87	10,467.93	45,116
2	Plantation	169,948.63	282.75	2,502.45	(10,039.99)	205,509.28	368,203.13	544,392
3	Mining	293.68	-	-	0.00	-	293.68	17,246
4	Other Industries	480,421.42	575.52	14,908.33	9,549.13	1,687,084.25	2,192,538.66	2,891,526
5	Chemical Industry	205.48	125.87	-	336,050.88	5,146,130.77	5,482,513.01	12,972,570
6	Manufacture Industry	93,157.69	990.08	466,348.04	668,674.33	15,521,331.39	16,750,501.52	20,106,149
7	Electricity, Gas, and Water	184,932.99	5,268.24	-	-	5,882,069.87	6,072,271.10	10,096,170
8	Construction	27,910.31	2,849.85	158,196.42	-	-	188,956.58	253,386
9	Commercial	1,214,066.13	354,834.30	273,995.29	82,731.84	2,349,944.58	4,275,572.12	7,034,408
10	Transportation and Telecommunication	151,778.88	7,419.41	-	-	2,101,155.72	2,260,354.02	3,215,128
190	Intermediate Input	2,532,270.36	373,077.16	1,054,715.12	1,895,113.13	47,371,388.46	53,226,564.23	
200	Import	2,693,900.69	99,169.46	8,397,209.64	20,997.33	-	11,211,277.13	

Table A-12 Fifth Round Adjustment

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry
		1.00	2.00	3.00	4.00	5.00	6.00
1	Rice	2,899	673	-	30,737	325	-
2	Plantation	93	25,591	-	29,823	3,047	210
3	Mining	-	-	414	3	129	13,827
4	Other Industries	-	511	4	636,552	6,620	3,532
5	Chemical Industry	81	841	4	1,910	7,305,354	164,980
6	Manufacture Industry	44	843	25	642	7,488	3,054,298
7	Electricity, Gas, and Water	-	3,300	361	49,122	578,054	2,357,665
8	Construction	37	1,807	155	2,413	6,561	10,512
9	Commercial	2,507	21,661	1,558	44,684	353,400	1,358,193
10	Transportation and Telecommunication	435	4,949	117	9,234	102,215	275,387
190	Intermediate Input	6,095	60,176	2,638	805,120	8,363,194	7,238,603
200	Import	4,923	66,779	3,036	1,237,288	2,219,108	5,425,081
201	Wages	7,212	81,138	1,468	322,218	818,474	2,195,047
202	Profits	25,880	324,224	9,096	325,442	1,050,911	4,350,353
203	Depreciation	593	5,968	870	121,167	274,948	449,110
204	Indirect taxes	412	6,108	139	80,288	245,934	447,944
205	Subsidy	-	-	-	-	-	-
209	Value Added	34,097	417,437	11,572	849,114	2,390,267	7,442,453
210	Total Input	45,116	544,392	17,246	2,891,523	12,972,569	20,106,137

Code	Sector	Electricity, Gas, and Water	Construction	Commercial	Transport and Telecomunication	Intermediate Demand
		7.00	8.00	9.00	10.00	180
1	Rice	-	-	14	-	34,648.00
2	Plantation	-	56	114,621	2,740	176,180.50
3	Mining	-	2,575	0	3	16,951.75
4	Other Industries	162	6,159	39,006	6,439	698,984.40
5	Chemical Industry	543	592	7,079	8,673	7,490,055.65
6	Manufacture Industry	215,637	54,658	7,101	14,899	3,355,636.46
7	Electricity, Gas, and Water	786,294	2,429	177,736	68,904	4,023,865.07
8	Construction	10,486	2,189	15,057	15,210	64,426.80
9	Commercial	338,618	15,592	406,533	216,045	2,758,790.79
10	Transportation and Telecommunication	267,862	790	83,875	209,887	954,750.52
190	Intermediate Input	1,619,603	85,041	851,022	542,799	19,574,289.93
200	Import	4,871,406	50,021	1,276,057	1,076,399	23,440,576
201	Wages	1,338,924	56,355	1,583,609	501,999	9,692,742
202	Profits	1,783,217	39,184	2,795,988	668,081	15,514,508
203	Depreciation	473,833	13,603	302,797	336,799	2,820,445
204	Indirect taxes	9,187	9,182	224,934	89,052	1,758,293
205	Subsidy	-	-	-	-	-
209	Value Added	3,605,161	118,324	4,907,328	1,595,931	29,785,988
210	Total Input	10,096,170	253,386	7,034,408	3,215,128	72,800,854

Code	Sector	Household Consumption	Government Consumption	Investment	Inventory Change	Eksport	Final Demand	Total demand
		301	**302**	**303**	**304**	**305**	**309**	**310**
1	Rice	-	-	-	56.06	10,411.87	10,467.93	45,116
2	Plantation	169,948.63	282.75	2,502.45	(10,039.99)	205,509.28	368,203.13	544,384
3	Mining	293.68	-	-	0.00	-	293.68	17,245
4	Other Industries	480,421.42	575.52	14,908.33	9,549.13	1,687,084.25	2,192,538.66	2,891,523
5	Chemical Industry	205.48	125.87	-	336,050.88	5,146,130.77	5,482,513.01	12,972,569
6	Manufacture Industry	93,157.69	990.08	466,348.04	668,674.33	15,521,331.39	16,750,501.52	20,106,138
7	Electricity, Gas, and Water	184,932.99	5,268.24	-	-	5,882,069.87	6,072,271.10	10,096,136
8	Construction	27,910.31	2,849.85	158,196.42	-	-	188,956.58	253,383
9	Commercial	1,214,066.13	354,834.30	273,995.29	82,731.84	2,349,944.58	4,275,572.12	7,034,363
10	Transportation and Telecommunication	151,778.88	7,419.41	-	-	2,101,155.72	2,260,354.02	3,215,105
190	Intermediate Input	2,532,270.36	373,077.16	1,054,715.12	1,895,113.13	47,371,388.46	53,226,564.23	
200	Import	2,693,900.69	99,169.46	8,397,209.64	20,997.33	-	11,211,277.13	

Table A-13 Sixth Round Adjustment

Code	Sector	Rice	Plantation	Mining	Other Industry	Chemical Industry	Manufacturing Industry
		1.00	2.00	3.00	4.00	5.00	6.00
1	Rice	2,899	673	-	30,737	325	-
2	Plantation	93	25,591	-	29,823	3,047	210
3	Mining	-	-	414	3	129	13,827
4	Other Industries	-	511	4	636,552	6,620	3,532
5	Chemical Industry	81	841	4	1,910	7,305,354	164,980
6	Manufacture Industry	44	843	25	642	7,488	3,054,298
7	Electricity, Gas, and Water	-	3,300	361	49,122	578,054	2,357,665
8	Construction	37	1,807	155	2,413	6,561	10,512
9	Commercial	2,507	21,661	1,558	44,684	353,400	1,358,193
10	Transportation and Telecommunication	435	4,949	117	9,234	102,215	275,387
190	Intermediate Input	6,095	60,175	2,638	805,120	8,363,194	7,238,603
200	Import	4,923	66,778	3,036	1,237,288	2,219,108	5,425,081
201	Wages	7,212	81,137	1,468	322,218	818,474	2,195,047
202	Profits	25,880	324,219	9,096	325,442	1,050,911	4,350,353
203	Depreciation	593	5,968	870	121,167	274,948	449,110
204	Indirect taxes	412	6,107	139	80,288	245,934	447,944
205	Subsidy	-	-	-	-	-	-
209	Value Added	34,097	417,431	11,572	849,114	2,390,267	7,442,453
210	Total Input	45,116	544,384	17,245	2,891,523	12,972,569	20,106,137

Code	Sector	Electricity, Gas, and Water	Construction	Commercial	Transport and Telecomunication	Intermediate Demand
		7.00	8.00	9.00	10.00	180
1	Rice	-	-	14	-	34,647.98
2	Plantation	-	56	114,621	2,740	176,180.07
3	Mining	-	2,575	0	3	16,951.72
4	Other Industries	162	6,159	39,006	6,439	698,984.29
5	Chemical Industry	543	592	7,079	8,673	7,490,055.56
6	Manufacture Industry	215,637	54,658	7,101	14,899	3,355,635.14
7	Electricity, Gas, and Water	786,292	2,429	177,736	68,903	4,023,861.87
8	Construction	10,486	2,189	15,057	15,210	64,426.60
9	Commercial	338,617	15,592	406,533	216,043	2,758,787.56
10	Transportation and Telecommunication	267,861	790	83,875	209,886	954,747.99
190	Intermediate Input	1,619,597	85,041	851,022	542,795	19,574,278.78
200	Import	4,871,390	50,020	1,276,057	1,076,391	23,440,576
201	Wages	1,338,919	56,355	1,583,609	501,996	9,692,742
202	Profits	1,783,212	39,183	2,795,988	668,076	15,514,508
203	Depreciation	473,831	13,602	302,797	336,796	2,820,445
204	Indirect taxes	9,187	9,182	224,934	89,051	1,758,293
205	Subsidy	-	-	-	-	-
209	Value Added	3,605,149	118,323	4,907,328	1,595,919	29,785,988
210	Total Input	10,096,136	253,383	7,034,408	3,215,105	72,800,843

Code	Sector	Household Consumption	Government Consumption	Investment	Inventory Change	Eksport	Final Demand	Total demand
		301	**302**	**303**	**304**	**305**	**309**	**310**
1	Rice	-	-	-	56.06	10,411.87	10,467.93	45,116
2	Plantation	169,948.63	282.75	2,502.45	(10,039.99)	205,509.28	368,203.13	544,383
3	Mining	293.68	-	-	0.00	-	293.68	17,245
4	Other Industries	480,421.42	575.52	14,908.33	9,549.13	1,687,084.25	2,192,538.66	2,891,523
5	Chemical Industry	205.48	125.87	-	336,050.88	5,146,130.77	5,482,513.01	12,972,569
6	Manufacture Industry	93,157.69	990.08	466,348.04	668,674.33	15,521,331.39	16,750,501.52	20,106,137
7	Electricity, Gas, and Water	184,932.99	5,268.24	-	-	5,882,069.87	6,072,271.10	10,096,133
8	Construction	27,910.31	2,849.85	158,196.42	-	-	188,956.58	253,383
9	Commercial	1,214,066.13	354,834.30	273,995.29	82,731.84	2,349,944.58	4,275,572.12	7,034,360
10	Transportation and Telecommunication	151,778.88	7,419.41	-	-	2,101,155.72	2,260,354.02	3,215,102
190	Intermediate Input	2,532,270.36	373,077.16	1,054,715.12	1,895,113.13	47,371,388.46	53,226,564.23	
200	Import	2,693,900.69	99,169.46	8,397,209.64	20,997.33	-	11,211,277.13	

Table A-14 First Round Adjustment Summary

Sector	Demand	Supply	Difference	State
Rice	45,193.85	45,971.09	(777.24)	Excess Supply
Plantation	547,748.60	562,750.02	(15,001.42)	Excess Supply
Mining	17,315.84	17,578.17	(262.33)	Excess Supply
Other Industries	2,894,851.75	2,891,522.70	3,329.05	Excess Demand
Chemical Industry	13,073,151.49	12,972,568.53	100,582.96	Excess Demand
Manufacture Industry	20,130,424.05	20,106,136.61	24,287.43	Excess Demand
Elecricity, Gas, and Water	10,116,026.40	10,277,388.30	(161,361.90)	Excess Supply
Construction	254,413.66	259,520.29	(5,106.62)	Excess Supply
Commercial	7,055,993.92	7,183,279.68	(127,285.76)	Excess Supply
Transportation and Telecommunication	3,227,483.68	3,300,905.70	(73,422.02)	Excess Supply

Figure A-1 First Round Adjustment Summary

	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Elecricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Demand	45,971.09	562,750.02	17,578.17	2,891,522.70	12,972,568.53	20,106,136.61	10,277,388.30	259,520.29	7,183,279.68	3,300,905.70
Supply	45,971.09	562,750.02	17,578.17	2,891,522.70	12,972,568.53	20,106,136.61	10,277,388.30	259,520.29	7,183,279.68	3,300,905.70

Table A-15 Second Round Adjustment Summary

Sectors	Demand	Supply	Diff	Sector State
Rice	45,125.12	45,193.85	(68.73)	Excess Supply
Plantation	544,904.06	547,748.60	(2,844.54)	Excess Supply
Mining	17,257.57	17,315.84	(58.27)	Excess Supply
Other Industries	2,893,858.04	2,891,522.70	2,335.34	Excess Demand
Chemical Industry	13,072,780.11	12,972,568.53	100,211.58	Excess Demand
Manufacture Industry	20,125,382.97	20,106,136.61	19,246.35	Excess Demand
Electricity, Gas, and Water	10,098,524.49	10,116,026.40	(17,501.91)	Excess Supply
Construction	253,529.38	254,413.66	(884.29)	Excess Supply
Commercial	7,037,314.13	7,055,993.92	(18,679.79)	Excess Supply
Transportation and Telecommunication	3,216,730.26	3,227,483.68	(10,753.42)	Excess Supply

Figure A-2 Second Round Adjustment Summary

	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Elecricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Demand	45,125.12	544,904.06	17,257.57	2,893,858.04	13,072,780.11	20,125,382.97	10,098,524.49	253,529.38	7,037,314.13	3,216,730.26
Supply	45,193.85	547,748.60	17,315.84	2,891,522.70	12,972,568.53	20,106,136.61	10,116,026.40	254,413.66	7,055,993.92	3,227,483.68

Table A-16 Third Round Adjustment Summary

Sectors	Demand	Supply	Diff	Sector State
Rice	45,117.15	45,125.12	(7.97)	Excess Supply
Plantation	544,456.46	544,904.06	(447.59)	Excess Supply
Mining	17,247.18	17,257.57	(10.40)	Excess Supply
Other Industries	2,893,708.46	2,891,522.70	2,185.77	Excess Demand
Chemical Industry	13,072,724.77	12,972,568.53	100,156.24	Excess Demand
Manufacture Industry	20,124,745.16	20,106,136.61	18,608.55	Excess Demand
Electricity, Gas, and Water	10,096,432.06	10,098,524.49	(2,092.43)	Excess Supply
Construction	253,402.68	253,529.38	(126.69)	Excess Supply
Commercial	7,034,748.31	7,037,314.13	(2,565.82)	Excess Supply
Transportation and Telecommunication	3,215,311.52	3,216,730.26	(1,418.74)	Excess Supply

Figure A-3 Third Round Adjustment Summary

	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Elecricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Demand	45,117.15	544,456.46	17,247.18	2,893,708.46	13,072,724.77	20,124,745.16	10,096,432.06	253,402.68	7,034,748.31	3,215,311.52
Supply	45,125.12	544,904.06	17,257.57	2,891,522.70	12,972,568.53	20,106,136.61	10,098,524.49	253,529.38	7,037,314.13	3,216,730.26

Table A-17 Fourth Round Adjustment Summary

Sectors	Demand	Supply	Diff	Sector State
Rice	45,116.08	45,117.15	(1.07)	Excess Supply
Plantation	544,392.36	544,456.46	(64.10)	Excess Supply
Mining	17,245.64	17,247.18	(1.54)	Excess Supply
Other Industries	2,893,687.86	2,891,522.70	2,165.16	Excess Demand
Chemical Industry	13,072,717.24	12,972,568.53	100,148.72	Excess Demand
Manufacture Industry	20,124,663.26	20,106,136.61	18,526.65	Excess Demand
Electricity, Gas, and Water	10,096,169.72	10,096,432.06	(262.34)	Excess Supply
Construction	253,385.62	253,402.68	(17.06)	Excess Supply
Commercial	7,034,407.53	7,034,748.31	(340.78)	Excess Supply
Transportation and Telecommunication	3,215,128.18	3,215,311.52	(183.34)	Excess Supply

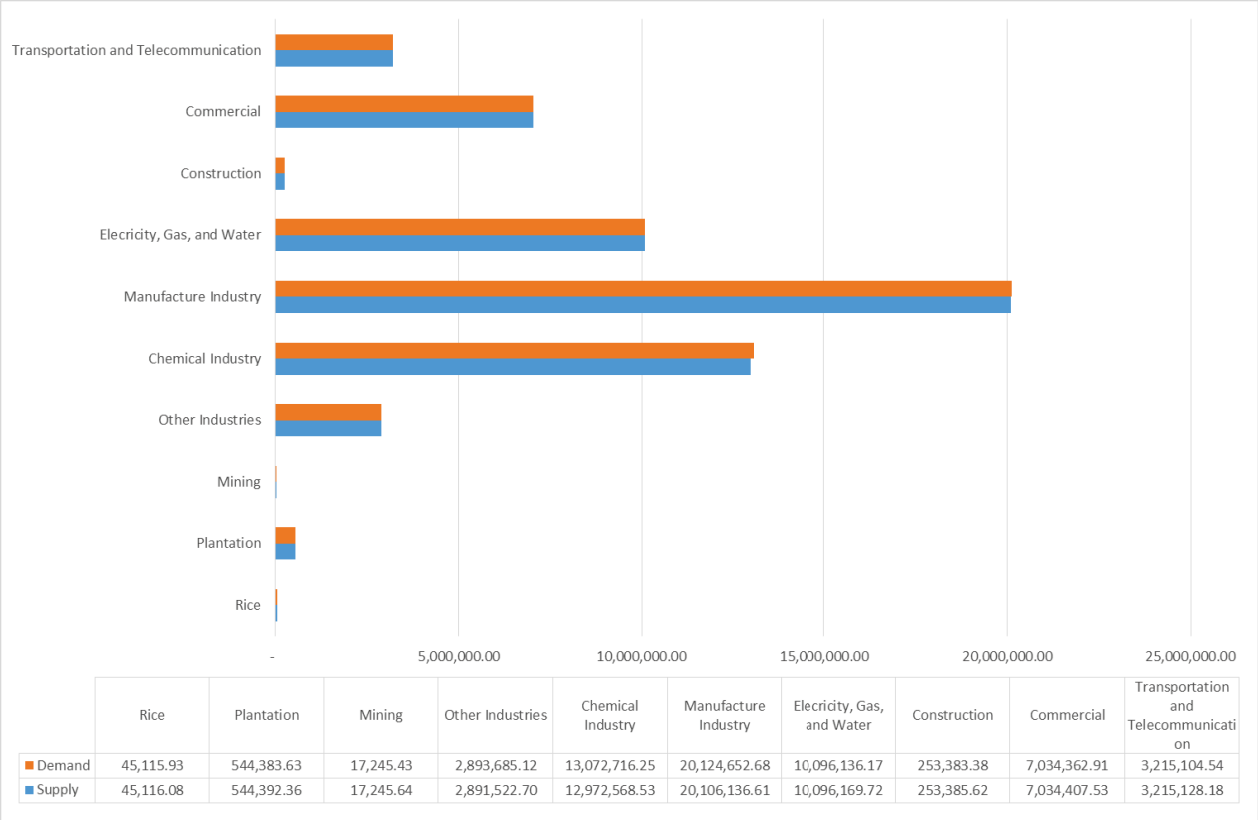
Figure A-4 Fourth Round Adjustment Summary

	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Electricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Demand	45,116.08	544,392.36	17,245.64	2,893,687.86	13,072,717.24	20,124,663.26	10,096,169.72	253,385.62	7,034,407.53	3,215,128.18
Supply	45,117.15	544,456.46	17,247.18	2,891,522.70	12,972,568.53	20,106,136.61	10,096,432.06	253,402.68	7,034,748.31	3,215,311.52

Table A-18 Fifth Round Adjustment Summary

Sectors	Demand	Supply	Diff	Sector State
Rice	45,115.93	45,116.08	(0.15)	Excess Supply
Plantation	544,383.63	544,392.36	(8.73)	Excess Supply
Mining	17,245.43	17,245.64	(0.21)	Excess Supply
Other Industries	2,893,685.12	2,891,522.70	2,162.43	Excess Demand
Chemical Industry	13,072,716.25	12,972,568.53	100,147.72	Excess Demand
Manufacture Industry	20,124,652.68	20,106,136.61	18,516.07	Excess Demand
Elecricity, Gas, and Water	10,096,136.17	10,096,169.72	(33.55)	Excess Supply
Construction	253,383.38	253,385.62	(2.24)	Excess Supply
Commercial	7,034,362.91	7,034,407.53	(44.61)	Excess Supply
Transportation and Telecommunication	3,215,104.54	3,215,128.18	(23.65)	Excess Supply

Figure A-5 Fifth Round Adjustment Summary

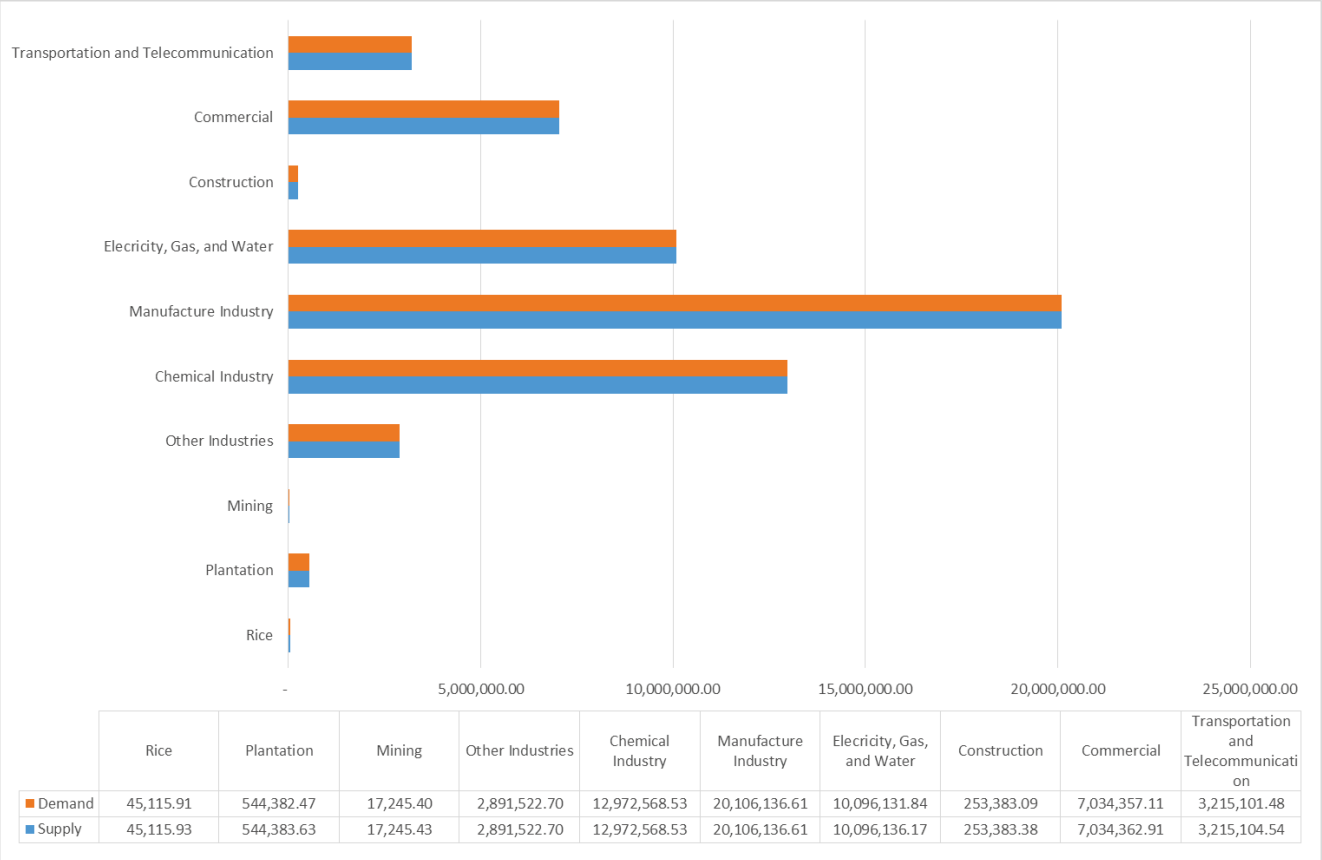


	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Elecricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Demand	45,115.93	544,383.63	17,245.43	2,893,685.12	13,072,716.25	20,124,652.68	10,096,136.17	253,383.38	7,034,362.91	3,215,104.54
Supply	45,116.08	544,392.36	17,245.64	2,891,522.70	12,972,568.53	20,106,136.61	10,096,169.72	253,385.62	7,034,407.53	3,215,128.18

Table A.19 Sixth Round Adjustment Summary

Sectors	Demand	Supply	Diff	Sector State
Rice	45,115.91	45,115.93	(0.02)	Near Equilibrium
Plantation	544,382.47	544,383.63	(1.16)	Near Equilibrium
Mining	17,245.40	17,245.43	(0.03)	Near Equilibrium
Other Industries	2,891,522.70	2,891,522.70	-	Equilibrium
Chemical Industry	12,972,568.53	12,972,568.53	-	Equilibrium
Manufacture Industry	20,106,136.61	20,106,136.61	-	Equilibrium
Electricity, Gas, and Water	10,096,131.84	10,096,136.17	(4.33)	Near Equilibrium
Construction	253,383.09	253,383.38	(0.29)	Near Equilibrium
Commercial	7,034,357.11	7,034,362.91	(5.81)	Near Equilibrium
Transportation and Telecommunication	3,215,101.48	3,215,104.54	(3.06)	Near Equilibrium

Figure A-6 Sixth Round Adjustment Summary



	Rice	Plantation	Mining	Other Industries	Chemical Industry	Manufacture Industry	Elecricity, Gas, and Water	Construction	Commercial	Transportation and Telecommunication
Demand	45,115.91	544,382.47	17,245.40	2,891,522.70	12,972,568.53	20,106,136.61	10,096,131.84	253,383.09	7,034,357.11	3,215,101.48
Supply	45,115.93	544,383.63	17,245.43	2,891,522.70	12,972,568.53	20,106,136.61	10,096,136.17	253,383.38	7,034,362.91	3,215,104.54