Cost and Benefit Analysis for Coastal Management

"A Case Study of Improving Aquaculture and Mangrove Restoration Management in Tambakbulusan Village Demak Indonesia"

MSc. Thesis Report

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Photo Cover : Mangroves in Timbulsloko village, by Lugas L. Hakim (2016)
All the photos in this report are taken and edited by Lugas L. Hakim

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Lugas Lukmanul Hakim

Abstract

The north coast of Demak has suffered from coastal erosion (abrasion) for years. The erosion destroys the aquaculture ponds and has already hit the settlements. As a consequence, many fish farmers have lost their jobs, and many people have had to leave their house. To solve this issue, the Government of Indonesia with other institutions from Indonesia and the Netherlands, initiated the project of Building with Nature-Indonesia (BwNI), the objective being the mangrove restoration along the coast of Demak. The project aims to establish a natural coastal protection by having more mangroves, as well as to improve the aquaculture practices in order to support the sustainability of living and economic activities for the coastal community. This research assesses the long term net present value (NPV) of the economic benefit of conducting mangrove restoration and aquaculture improvement using Environmental Cost-Benefit Analysis (ECBA) during a 25 year timeframe. We constructed four policy alternatives: Business as Usual (alternative 1); Improving Aquaculture without restoration (alternative 2); Mangrove Restoration without aquaculture improvement (alternative 3); mangrove restoration with aquaculture improvement (alternative 4), considering two different coastal erosion case scenarios: the worst erosion case scenario (abrasion rate is 90 m $year^{-1}$); the best erosion case scenario (abrasion rate is 45 m $year^{-1}$). The results show that the economic value of mangroves in providing aquatic organisms, brushwood (mangrove patches) and nursery function is 25.6 million, 2 million and 31.5 million IDR ha^{-1} $year^{-1}$, while having more mangroves can protect all the total village land area, which is valued approximately 5.6 billion IDR, which could be the annual benefit for mangroves as coastal protection (the value of 1 ha of mangroves is around 36 million IDR). Within the worst and the best erosion case scenario respectively, aquaculture improvement generates total NPV of 54.8 billion IDR and 71.4 billion IDR respectively, while mangrove restoration generates total NPV of 147 billion IDR and 72.8 billion IDR respectively, within 25 years and 5% discount rate. In the initial condition, Alternative 4 seems to be the best alternative, followed by Alternative 3 and 2. However, the exclusion of mangrove benefits in the calculation, and a higher discount rate, can affect the total NPV generated from each alternative, but it still results in alternative 4 as the best option. In general, restoring mangroves and improving the aquaculture in Tambakbulusan village are economically beneficial. Both activities should be conducted together as complementary activities for mitigation and as a precaution against natural threats (flood and erosion), as well as an activity to boost the productivity of local fish farmers.

Keywords: Aquaculture, Building with Nature, Environmental Cost-Benefit Analysis, Mangrove Restoration.

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List of Abbreviations

AR	Abrasion Rate
BPS	Badan Pusat Statistik (Statistic Central Bureau)
BI	Bank Indonesia (Indonesian Bank)
BTM	Benefit Transfer Method
BwNI	Building with Nature Indonesia
BV	Bequest Value
CBA	Cost Benefit Analysis
CVM	Contingent Valuation Method
Dept.	Department
DUV	Direct Use Value
ECBA	Environmental Cost-Benefit Analysis
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
IDR	Indonesian Rupiah
IUV	Indirect Use Value
MC	Mangrove Condition
MOL	Mikroorganisme Lokal (Local Fermented Feed and Manure)
NPV	Net Present Value
OV	Option Value
PV	Present Value
QBI	Question-Based Interview
RPM	Revealed preference Method
RQ	Research Question
SLR	Sea Level Rise
SPM	Stated Preference Method
TEV	Total Economic Value
TCM	Travel Cost Method
USD	United States Dollar
WTP	Willingness to Pay
XV	Existence Value

Chapter 1

Introduction

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For quality of life

Chapter 1. Introduction

1.1 Background and Problem Statement

Coastal degradation has become a concern nowadays. The degradation primarily affects vegetated areas and coastal habitats including wetlands, salt marshes, seagrass beds, kelp forests, and mangroves. Mangrove forests are considered the most degraded coastal ecosystem in the world (Kaly & Jones, 1998).

As an ecosystem, mangrove forests supply multiple ecosystem services to coastal communities. Mangrove forests provide food and raw materials (e.g. brushwood, trunks, leaves and so on) that the people can use. They also provide other services including coastal protection, erosion (abrasion) control, water purification, maintenance of fisheries, carbon sequestration, tourism, education, and recreation (Barbier et al., 2011). Hence, the degradation of mangrove ecosystem generates losses which may affect communities' livelihood.

Mangrove forests worldwide started to decline in the 1970s, and the decline accelerated in the last few decades (Barbier et al., 2011). The total mangrove area worldwide decreased from 18.8 million ha to 15.2 million ha within 25 years (1980-2005) (Northoff, 2008). FAO further highlights that one of the leading causes of declining mangroves is the large-scale conversion of mangrove areas for shrimp and fish farming (Northoff, 2008).

In Asia, mangrove forests have started to decline since 1980. More than 1.9 million ha of mangroves have disappeared. This was mainly due to changes in land use including aquaculture (Northoff, 2008). Many studies conducted in Asian couuntries, e.g. Indonesia (Bosma et al., 2012), Philippines (Janssen & Padilla, 1999), Sri Lanka (Gunawardena & Rowan 2005), Thailand (Sathirithai & Barbier, 2001) and Bangladesh (Hossain at al., 2013), indicate that one of the causes of the mangrove degradation in Asia comes from aquaculture practices.

The degradation of mangrove forests in Indonesia is closely related to the development of the brackish water aquaculture. Brackish water aquaculture expands into the intertidal zone and leads to mangrove cutting. As recorded by several studies, such as in Kalimantan (Bosma et al., 2012), South Sulawesi (Malik et al., 2015), West, East and Central Java (Setyawan et al., 2004), in the early development brackish water aquaculture was dominated by milkfish. However, shrimp farming was considered more beneficial. In the years after, shrimp culture expanded and replaced milkfish, and this also led to further mangrove degradation.

Further expansion of shrimp aquaculture occurred particularly after the success of artificial shrimp breeding and the rapid growth of investment in infrastructures (shrimp hatcheries and cold storages) in the 1970s (van Zwieten et al. 2006; Paryanti 2006). Furthermore, the banning of trawl fishing in early 1980 and the introduction of excavators replacing manual labor, led to the opening of more shrimp ponds in the 1980s and early 1990s (van Zwieten et al. 2006; Bosma et al. 2012). Shrimp culture also expanded due to the monetary crisis and the relatively high market price of tiger shrimp in Indonesian currency.

At a certain point, the productivity of brackish water aquaculture, especially shrimp culture, became heavily dependent on mangroves. The absence of mangroves affects the performance of the aquaculture production. Mangroves offer several free services that can be used for supporting aquaculture, such as seed, the input of food, clean water, replenishment of oxygen and assimilation of waste (Beveridge et al. 1997; Gunawardena & Rowan 2005). They also protect aquaculture operations against natural hazards through the protection from floods, hurricanes, and coastal erosion (Gunawardena & Rowan, 2005). If no suitable culture techniques are implemented, the productivity of brackish water aquaculture will decline due to degradation of the pond environment.

The decline in productivity has pushed some farmers to develop more intensive systems in order to have better control over the culture condition, including biosecurity measures. Several better management practices are implemented such as the integrated system (silvo-aquaculture) (Bunting et al., 2013) or multi-trophic aquaculture (Tonneijck et al., 2015). In addition to this, supporting the aquaculture sector with the restoration of the mangrove ecosystem seems to be the best way to support sustainable aquaculture production (Bosma et al., 2012).

Additionally, the absence of mangroves also leads to coastal erosion (abrasion) and floods. Sea level rise (SLR) has also worsened coastal erosion and floods (Marfai & King, 2008). With a coastline of around 88,000 km and more than 17,500 islands, Indonesia is particularly vulnerable to SLR. SLR is likely leading to further damages on infrastructure, buildings, settlements, agriculture and aquaculture crops (Marfai & King, 2008). Some urban coastal areas such as Jakarta, Semarang, and Surabaya, are already under threat and so are other regions such as small islands, wetlands, and coastal farmland areas (Marfai & King, 2008).

One of the most significant coastal erosion in Indonesia takes place in Demak, Central Java (Marfai, 2011). The erosion, as well as floods, occur as an impact of the absence of mangroves due to the conversion of mangroves into ponds (Damaywanti, 2013). Here, the erosion has already hit hundreds of buildings and aquaculture ponds (Marfai, 2011). Locally, the coastal area has been eroded for more than two kilometres inland within just a few decades, and it continues to be eroded at the rate of tens of meters per year (Cronin et al., 2015). In consequence, hundreds of families have had to be relocated since 1999 (Asiyah et al., 2015), and hundreds of hectares of ponds were destroyed (Marfai, 2011). The erosion has already led to multi-billion IDR losses (Cronin et al., 2015).

The coastal erosion is exacerbated by extreme tidal movements, such as king tides, in particular when these coincide with strong northern winds. A wave and sea tide occur due to tidal movement, and the sea tide can change the coastline (Desmawan & Sukamdi, 2012). Due to low availability of mangroves in Demak, sea tide can also potentially lead to floods. In some villages such as Sriwulan, Surodadi, Bedono, and Timbulsloko, floods occur, and it can inundated for 6-8 hours every time (Desmawan & Sukamdi, 2012). Four factors are further indicated as the cause of floods in the village: the land altitude, land subsidence, distance from the coast, and distance from the river (Kusuma et al., 2013).

Rapid shoreline degradation and coastal erosion in Demak has received much attention from the local and national government. Several methods were conducted to cope with the issue. Mitigation actions, such as the establishment of dikes and hard coastal protection were carried out to reduce the damage by the erosion (Marfai, 2011). However, artificial hard coastal protection cannot deal with the dynamics of nature, and leads to the loss of more sediment and consequently to an increased hazard of flooding and erosion (Cronin et al., 2015).

Since 2015, the Indonesian government under the Ministry of Marine Affairs and Fishery cooperating with several international Non-Government Organizations and academia from Indonesia and the Netherlands are trying to implement the Building with Nature concept to cope with the issue under the project Building with Nature-Indonesia (BwNI). BwNI offers an alternative solution for coastal security by combining engineering and ecological rehabilitation, instead of establishing conventional hard-infrastructure (Tonneijck et al., 2015). The project focusses on the restoration of mangrove greenbelts as a natural coastal protection while introducing more sustainable land use practices. The project planned and implements three methods on mangrove restoration: 1) Restoration of sediment balance; 2) Restoration of hydrology, and 3) ecosystem restoration (Tonneijck et al., 2015).

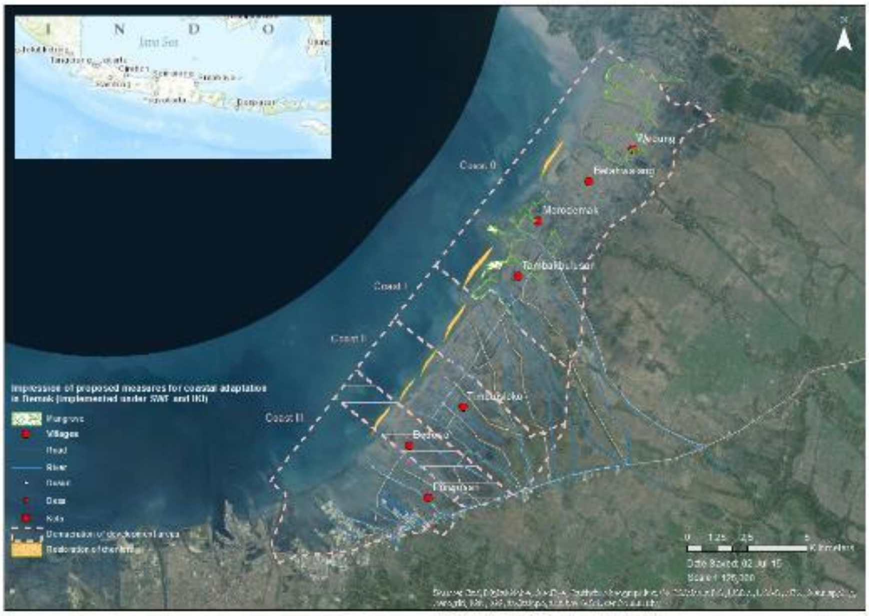

Figure 1 The Erosion Condition in Coastal of Demak, Indonesia

Source: Cronin et al. 2015

The BwNI project involves several activities such as a semipermeable dam, river normalisation and also mangrove planting (if it is needed). On one hand, the dam and river normalisation are to stabilise the coastal environments (sediment and hydrology) which are needed for the natural media for mangroves to grow. On the other hand, mangrove planting may be needed to assist natural growth and support natural regeneration. Mangrove planting may also aim to enrich the diversity of the ecosystem, especially when the original species are not available anymore or when the seeds do not reach some areas (Tonneijck et al., 2015).

In addition to mangrove restoration, improving aquaculture is part of the BwNI project. Innovations such as MOL (*Mikro-organisms Lokal* = local fermented feed and manure) and polyculture system aim at recovering the aquaculture. The use of fermented feed and manure supports better pond management. Better pond management allows the farmers to culture the shrimp. Through the polyculture system, the farmers can not only get more benefit from cultivating shrimp, but to also receive a more sustainable income, due to allowing a milkfish culture at the same time (Tonneijck et al., 2015).

Indeed restoration and improving aquaculture are beneficial. However, it requires costs. In some cases, mangrove restoration also needs several hectares of ponds to be abandoned (Lewis, 2001; Tonneijck et al., 2015). Thus, the activities of mangrove restoration and improving aquaculture practice should be considered in the analysis of cost and benefit, to assess the efficiency of the activities. In addition to this, evaluating these policies in a cost-benefit analysis needs to take into account the monetary value of the effects on the ecosystem. Knowing the net benefit of such restoration activities or improving aquaculture helps the policy maker decision-making process regarding the management of the environmental problem especially within a coastal ecosystem context and the aquaculture sector.

1.2 Research Objective

The study aims to assess the long-term net economic impact of mangrove restoration for the local community and also improved aquaculture practices through switching from monoculture milkfish to polyculture milkfish and tiger shrimp, and using MOL (local fermented feed and manure) for fish farmers in Tambakbulusan village Demak, Indonesia.

1.3 Research Questions

In this research, we formulated three specific research questions as follows;

RQ1. What is the monetary value of the relevant ecosystem services provided by the mangrove ecosystem, in the particular case of Tambakbulusan village Demak, Indonesia?

RQ2. What is the NPV of the economic benefit of investments to switch from the current aquaculture production systems (milkfish) to polyculture system (shrimp and milkfish) using MOL for fish farmers in Tambakbulusan village?

RQ3. What is the NPV of the economic benefit of investment to restore mangrove ecosystems for the local community in Tambakbulusan village?

1.4 Methodology

In general, this research will use extended cost-benefit analysis to address the research questions. We addressed RQ1 with using the economic valuation of mangrove ecosystem services: brushwood, fish, and protection against coastal erosion and flooding hazard, and also nursery function, in which we collected the data through the questionnaire. We addressed RQ2 and RQ3 through the analysis of economic data gathered from the interviews of experts regarding mangrove restoration and improving aquaculture practices. We will explain the methodology in Chapter 3.

Chapter 2

Conceptual Framework

Chapter 2. Conceptual Framework

2.1 Mangrove Ecosystem Goods and Services

The ecosystem is a natural capital (Chee, 2004). They supply life-support services of tremendous value (Daily & Matson, 2008). In a system, the natural ecosystem has characteristics based on three concepts: stocks, flows, and organisation. These components relate to the three ecology concepts: stocks refer to structural components, flows represent the environmental function, and organisation is a biological and cultural diversity (Aylward & Barbier, 1992).

Aylward & Barbier (1992) further interpreted these three concepts as goods, services, and attributes respectively. Goods are tangible, while services are intangible outputs, which on one hand the economic process of both can affect human welfare. The attributes (biological components, environmental function, ecosystem, and culture), on the other hand, may affect the value arising from these outputs into the economic system. and thus, impact on human welfare (Aylward & Barbier, 1992). In other words, ecosystem goods and services are components of nature, as final results from natural functions and processes that can be used, consumed and enjoyed by humans (Boyd & Banzhaf, 2007).

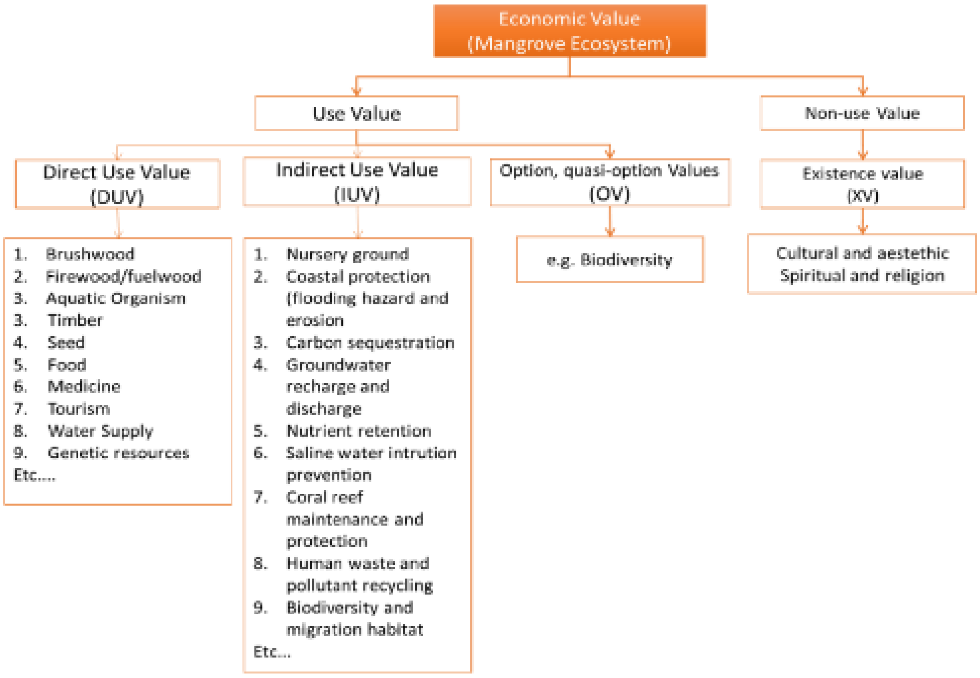

Figure 2 Value Categories of the Benefit of Mangrove Ecosystem Services

Source: adapted from Barbier 1993; Bann 1998; Barbier et al. 2011 (modified)

The concept of ecosystem goods and services involves the delivery, provision, production, protection or maintenance of goods and services that people perceive to be important (Chee, 2004). Regarding mangrove ecosystems, there are several goods and services provided. As an ecosystem, mangroves supply raw materials and foods. Besides, they also play a role in coastal protection (flood, tsunami, and coastal erosion or abrasion), water purification, maintenance of fisheries, carbon sequestration, tourism, culture, education, and research which are essential for human life (Figure 2) (Barbier et al., 2011).

2.2 Economic Valuation of Ecosystem Services

A value can be defined as a contribution of an action or object towards specific goals or conditions of the users (Farber et al., 2002). Ecosystem valuation is a method to estimate a value in ecosystem service. Total economic value (TEV) is the accumulated value of the economic benefit. TEV is the sum of economic value derived from use value and non-use value (Bann, 1998; Barbier, 1993; Sathirathai, 1995).

Use values comprise resource utilisation involving direct use value (DUV), indirect use value (IUV) and option value (OV) (Barbier, 1993; Sathirathai, 1995). Non-use values refer to the benefits which an individual may obtain from the resource without physical interaction (directly or indirectly), e.g. the satisfaction of individual due to the presence of particular species (biodiversity) which is known as existence values (XV) and bequest value (BV), which is related to the interest of future generation (Perman at al., 2011).

DUV refers to both consumptive uses (e.g. livestock, brushwood collection, fishing, and so on) and non-consumptive uses of the services (e.g. recreation, tourism, research, and so on) that are necessary for humans. IUV derives from the change in the value of consumption and production of property or activity that can protect or support human life, e.g. mangroves function of coastal protection, fisheries maintenance, and so on. OV is an attached value that reflects the value of natural resources for preserving an option (Samonte-Tan et al., 2007). In contrast to use value, XV and BV derive from the environment without using it in any way. XV is from the people’s knowledge that a resource exists without any plan to use it. BV is the value derived from the people’s desire to pass on values to future generations (Dixon & Pagiola, 1998).

In general, two main methods are often used to elicit the value of ecosystem services: 1) Revealed preference Methods (RPMs); 2) Stated preference methods (SPMs). RPMs relate to data regarding individuals’ preferences for a marketable good on real markets including environmental attributes. Several methods included are market prices, averting behavior, hedonic pricing, travel cost method, and random utility modeling. Meanwhile, SPMs use structured questionnaires to capture individuals’ preferences for a given change in a natural resource or environmental attribute. SPMs are often used to estimate non-use values for some natural resources. Methods included in this approach are contingent valuation and choice modeling (Department for Environment Food and Rural Affairs of UK, 2007). More detailed information regarding valuation methods and the approaches can be seen in Table 2 Valuation Methods Used in the Research

Pricing approaches refer to the approaches that use market price as either direct measures of the economic value of a service (e.g. market prices, aversive expenditure, damage costs avoided) or as a proxy for the value (referred to cost-based approaches) (Department for Environment Food and Rural Affairs of UK, 2007). The cost-based approaches use an estimation of total costs required to provide or replace the benefit of a good or service, in which we can directly observe from real markets (Bann, 1998; Department for Environment Food and Rural Affairs of UK, 2007).

Table 1 Valuation Methods for Ecosystem Services

Valuation Method	Measured Value	Ecosystem Service(s) (ESs) Valued	Benefits	Limitations
Market Prices	DUV and IUV	ES that contributes to marketed products e.g. timber, fish	Market data (available & robust)	Only for those services for which a market exists.
Cost-Based Approaches	DUV and IUV	Depends on the existence of relevant markets for the ES in question, e.g. Expenditure of building Dykes as a proxy of coastal protection of mangrove against coastal erosion.	Market data (available & robust)	Potentially lead to overestimation.
Production Function Approach	IUV	ES as input to market products e.g. fish population dynamics for fisheries production and fishing output.	Market data (available & robust)	Data missing, e.g. data on changes in services and the impact on production
Hedonic Pricing	DUV and IUV	Ecosystem services that contribute to the attributes that can be appreciated by potential consumers, e.g. air quality, visual amenity, landscape.	Market data (available & robust)	Data-intensive and limited mainly to services related to property
Travel Cost	DUV and IUV	All ESs that contribute to recreational activities.	Based on observed behavior	Technical difficulties, e.g. when trips are made to multiple destinations.
Random Utility	DUV and IUV	All ESs that contribute to recreational activities	Based on observed behavior	Limited to use values
Contingent Valuation	Use and Non-Use Value	All ESs	Able to capture use and non-use values	Bias data particularly on data regarding individuals' responses
Choice Modelling	Use and Non-Use Value	All ESs	Able to capture use and non-use values	Bias data particularly on data regarding individuals' responses

Source: Department for Environment Food and Rural Affairs of UK, (2007) (Modified)

Several methods involved under these approaches are opportunity cost; the cost of alternatives, and replacement costs (Department for Environment Food and Rural Affairs of UK, 2007). Opportunity cost takes into consideration the value of a particular environmental asset (e.g. opportunity cost of agricultural production lost if the land is retained as forest). The cost of alternatives/substitute goods considers the cost of producing another good that has a similar function to the environmental goods. For example, the valuation of flood protection service by mangroves using the basis of the costs of precaution or human-made defense. Replacement cost method considers the cost of replacing or restoring a damaged asset to its original state and uses this cost as a measure of the benefit of restoration (Department for Environment Food and Rural Affairs of UK, 2007).

Another way to value ecosystem services is using the benefit transfer method (BTM). BTM is a transposition of the environmental value estimated from one site (study site) to another location (Brouwer, 2000). The data required for BTM comes from other project data, which we adapted for the current site (Bann, 1998). The reason most widely used to apply this valuation method is cost effectiveness (Brouwer, 2000). Particularly for policies, programs and projects with multiple non-market impacts in which conducting original studies are unlikely to be feasible (Department for Environment Food and Rural Affairs of UK, 2007). However, due to the value being transposed from another site, BTM is weak on the validity and accuracy. There is a need for a better understanding of when the transfer can be implemented, as well as reviewing options that would improve the accuracy and validity (Department for Environment Food and Rural Affairs of UK, 2007; Pearce et al., 2006). More sophisticated transfers, with some adjustment and techniques, seek to control and link different attributes between the study site and the current site might be required to increase the validity and the accuracy of the valuation method (Pearce et al., 2006).

2.3 Building with Nature (BwN) Concept and the Implementation in Demak

Building with nature (BwN) is a concept established as an innovative way of thinking in the emergence of the needs of a sustainable engineering approach. BwN is a form of development concept based on ecological engineering (van den Hoek et al., 2012). It also integrates the human and natural environment for the benefit of both (Mitsch & Jørgensen, 2003). Ecological engineering uses the concept of ecosystem self-design and ecological system approach in solving environmental problems (Mitsch & Jørgensen, 2003), and BwN offers an alternative conventional approach which can cooperate with natural dynamics instead of fighting nature using hard-infrastructure engineering (Tonneijck et al., 2015).

The BwN concept has been implemented for several cases in coastal management around the world. In the Netherlands, one of the BwN concepts was applied for land reclamation in The Hague through a mega nourishment project: Delfland sand engine (van Slobbe et al., 2013; Waterman, 2010). Other land reclamation projects were also carried out in Rotterdam (The Multi-Functional Peninsula). Besides the Netherlands, several other countries implemented the BwN concept: Denmark, United Arab Emirates, Argentina, Chile and Curacao (Waterman, 2010).

In South East Asia, Indonesia has applied the BwN concept for coastal protection. One of the BwN projects which has been carried out is the securing of the eroding delta coastline in Demak (North Coast of Java) through restoring the mangrove ecosystem, by building a greenbelt along Demak’s muddy coast as a natural coastal protection (Cronin et al., 2015; Tonneijck et al., 2015). The project also aims to increase the productivity of farmers through the improvement of the aquaculture systems, by providing educational programs in order to enable communities to advance their livelihoods by sustainable management for the coastline and its natural resources (Tonneijck et al., 2015). The BwN project implemented in Demak assumed that the greenbelt could naturally secure the coastline from coastal erosion. The hypothesis is that the mangrove greenbelt is dynamic with natural sedimentation and erosion as a result of tidal and wave activity along the muddy coast (Spalding et al., 2014).

Many studies show that mangroves have the capability to reduce wave attenuation and wind along the coastline. A study carried out by Mcivor et al. (2012) revealed that mangroves enabled the reduction of the height of wind and swelled waves over a short distance by between 13% to 66% over 100 m of mangroves (McIvor et al., 2012). The rate of the reduction is due to the effect of interaction between the wind and swell wave and the structure of the mangrove tree. This concept is more beneficial and sustainable compared to the constructing of a hard coastal protection, e.g. dike or wave breaker.

BwN implemented in Demak can potentially provide several benefits. Slobbe & Lulofs (2011) indicated three benefits in implementing BwN: financial, ecological and economic. From the economic point of view, securing the eroding delta using a mangrove greenbelt will lower the cost, because building a greenbelt is cheaper and more sustainable than constructing hard coastal protection. Besides, the durability of the greenbelt will be longer than hard coastal protection (Cronin et al., 2015). In other words, no other costs are needed in the coming years to repair or reconstruct the hard coastal protection (Tonneijck et al., 2015).

Ecologically, the Greenbelt has a function as a natural ecosystem, which is crucial for the organisms, e.g. aquatic organisms, birds, so on. Particularly for aquatic biota, mangroves have a function as habitat, nursery and also feeding ground for several species (Barbier, 2003). By building the greenbelt and maintaining the mangrove forests, it is expected to preserve nature and the availability of existing biodiversity, and support fish resources.

Economically, the presence of the greenbelt and mangrove ecosystem can support local coastal community security and livelihood in Demak, which is dominated by fish farmers and fishers (Tonneijck et al., 2015). Healthy mangrove forests may enhance the provision of forest products especially non-timber products, aquaculture, fisheries and also tourism (Tonneijck et al., 2015).

2.4 The Use of Manure and Fermented feed on Ponds

The BwNI project provides a field school for interested fish farmers to help them to learn about new technologies in the cultivation. One of the technologies taught at the field school is already implemented in the ponds: making MOL (manure and fermented feed). The concept of MOL is similar to manuring pond. MOL uses manure, which is also combined with other ingredients, including bacteria starter or yeast and is added as either fertiliser or fermented feed. This could be a better management practice to support higher productivity and income, which is beneficial to small-scale fish farmers in particular.

Manure has been already used for fish farming for centuries, particularly in China (Barash & Schroeder, 1984; Zhu, Yang, Wan, Hua, & Mathias, 1990). The use of manure aims to be directly consumed by fish. Moreover, the released nutrients can be used as supporting materials for phytoplankton, also as soil fertilizer (Elsaidy et al., 2015). Nowadays, it is widely used in fish farming for intensification of fish production by balancing the ratio between carbon and other nutrients (Mlejnková & Sovová, 2012).

Several studies show that the use of manure and fermented feed can enhance yield and the gross revenue generated (Barash & Schroeder, 1984; Wohlfarth & Schroeder, 1979; Zhu et al., 1990). Barash & Schroeder (1984) indicate that the substitution of the pellets with fermented cow manure at a certain replacement rate, does not reduce the total fish yield. Furthermore, the profit per area and time are higher for the several commodities that use manure instead of feedstuffs (Wohlfarth & Schroeder, 1979).

The use of manure can increase the primary productivity in the pond (Kang'ombe et al., 2006; Knud-Hansen et al., 1991; Wohlfarth & Schroeder, 1979). Primary productivity can support the increase of pond productivity. Knud-Hansen et al. (1991) investigate that both ratio of net fish yield and gross photosynthetic productivity increase with increasing manure loading rates. The increase of manure loading rates can support the dissolved inorganic nitrogen, which also supports phytoplankton production, as a source of food in ponds (Knud-Hansen et al., 1991).

Further investigation was also conducted by Kang'ombe et. al. (2006). Kang'ombe et. al. (2006) investigates the impact of using several types of manure, to contrast with the pond without using manure. The study shows that there is a significant difference in a growth rate and yield between a manure and a non-manure pond. Higher growth rate influences the increase of yield and production, which drives the commodity to have a bigger final size at the end of the cultivation period.

2.5 Polyculture System and the Impact on Productivity of Farmers

Aquaculture is one of the main livelihoods for the coastal community in Demak. There, aquaculture production is dominated by milkfish. In 2011, the total production was close to 9000 tons, where approximately 73% were milkfish, while the total production for shrimp was only 4%, where tiger shrimp was 0.7% and white leg shrimp 3.3% (Kementerian Kelautan dan Perikanan Republik Indonesia, 2013). Specifically, in Tambakbulusan, shrimp seems to be produced less. The total area of intensive shrimp culture was only 3.3 ha out of 640 ha of total aquaculture area in 2015 (Cronin et al., 2015). Mostly, aquaculture practices which are carried out in this village focus on milkfish with extensive and semi-intensive silvo-aquaculture (Cronin et al., 2015).

In global aquaculture, the crustacean is one of the most valuable commercial commodities (Martínez-Porchas et al., 2010). Although shrimp culture is economically more profitable than milkfish culture due to the high price, it has high risk in the cultivation process. According to Lebel et al. (2009), investing in shrimp farming could be uncertain and a high-risk investment cultivation activity, in which one of the challenges comes from the technical issues in managing the pond and the health of the crops. The risk is probably also exacerbated by the disappearance of the surrounding mangrove ecosystem farming (Bunting et al., 2013; Martínez-Porchas et al., 2010). For some reasons, shrimp culture depends on the presence of mangroves, in particular for its more extensive forms since they use natural seeds from nature (Martinez-Alier, 2001).

Farmers in Demak practice a polyculture of shrimp and milkfish, or just milkfish. Polyculture is considered an alternative way to solve and minimise the problems that shrimp aquaculture has faced in latest decades (environmental pollution, disease outbreak and declining price) (Martínez-Porchas et al., 2010). Polyculture systems with multiple species in one or more linked ponds can produce more per surface area due to ecological complementarities (Rahman & Verdegem, 2007). From an economic point of view, it can offer higher productivity and income because the farmers can combine the commodities (Martínez-Porchas et al., 2010), such as tiger shrimp (highly commercial) and milkfish (less vulnerable) for extensive cultivation. Also, from an ecological point of view, polyculture systems allow stimulation in nutrient recycling and limits pollution, in particular, the effluents related to nitrogenous wastes, which potentially become toxic metabolites (Martínez-Porchas et al., 2010; Tonneijck et al., 2015). Therefore, switching from monoculture (milkfish) to polyculture (milkfish and shrimp) is considered more beneficial for the farmers.

2.6 Environmental Cost-Benefit Analysis (ECBA) for Social Decision Making

Cost Benefit Analysis (CBA) is widely accepted and used to evaluate the benefits of alternative public policies (Vo et al., 2012). Historically, CBA was aimed to be used in investment contexts instead of policy appraisal (Pearce, 1998). Nowadays, in practice, CBA has come to be used more in the policy context particularly regarding environmental decision making (Atkinson & Mourato, 2008; Pearce, 1998).

Unlike the implementation of CBA for the private sector, ECBA involves the provision of environmental services and the action of human as an object to be assessed that might directly or indirectly affect the environment, for the economic appraisal of policies and projects (Atkinson & Mourato, 2008). ECBA to social decision-making requires the estimation of appropriate monetary measures for all affected individuals (Perman et al., 2011).

For social decision-making, this CBA concept can be carried out to evaluate the economic efficiency of alternative policies that have an impact on ecosystem services (Wegner & Pascual, 2011). The economic efficiency is embodied in a well-defined objective function, such as "social welfare" (Atkinson & Mourato, 2008; Drèze & Stern, 1987). In the implementation, ECBA requires the identification, measurement, and valuation of the environmental impacts of the project (Perman et al., 2011).

In a BwN project, ecological impacts are sometimes difficult to evaluate (van Slobbe et al., 2013). The difficulties in ecological impact assessment can lead to undervaluing the ecosystem services. The undervaluation of the ecosystem services occurs due to the non-existent formal markets and prices for several services (Vo et al., 2012). The ecological impacts of ecosystem services are necessary to assess due to its contribution generating the economic benefit.

A project is feasible to conduct when the total benefits exceed the total costs (Atkinson & Mourato, 2008; Drèze & Stern, 1987). Annual net benefit is estimated to evaluate the economic efficiency of the project or policy alternatives, the impacts that occur in different years can be measured through Net Present Value (NPV). We estimated the NPV by aggregating the economic benefit within a certain time horizon. In this case, the NPV can be a single measure value of a project (Boardman et al., 2014).

Regarding the NPV, future economic benefit needs to be discounted. Discounting the economic benefit is based on the fact that future value usually weighs less in the decision-making process, rather than those occurring nearer to present time (Gunawardena & Rowan, 2005). The concept of discounting comes from two basic reasons. Firstly, through investment, a given amount of expenses can currently be transformed into a greater amount of the resources in the future. It will reflect the opportunity costs of the resources. Secondly, human impatience, in which the people prefer to consume a resource now rather than in the future (Boardman et al., 2014).

2.7 Previous Research Findings and The Research Contribution

Several studies have been conducted to estimate the economic value of mangrove ecosystems (Cabrera et al., 1998; Hussain & Badola, 2010; Sathirithai & Barbier, 2001). Furthermore, a study regarding the valuation of mangrove ecosystem services extends to the assessment of the benefit of mangrove conservation (Hussain & Badola, 2010; Wattage & Mardle, 2008) and restoration (Kairo et al., 2009; Spurgeon, 1999) or to give an economic insight on the mangrove ecosystem management, when it is dealing with the aquaculture sector (Corps, 2007; Gunawardena & Rowan, 2005; Janssen & Padilla, 1999; Malik et al., 2015).

Regarding the environmental problem, environmental impacts should be defined adequately and should also be taken into consideration in monetary terms for the CBA (Atkinson & Mourato, 2008). Sathirithai & Barbier (2001) and Gunawardena & Rowan (2005) used extended CBA, involving economic valuation method, to see the external impacts generated by mangrove conversion on the cost and benefit for the coastal community. However, they mostly focussed on directly used products such as fish resources and the potential of woods. However, in comparison to other competitive commercial sectors, such as aquaculture (in particular shrimp farming), other relevant indirect use values also related to the impacts generated by aquaculture should be internalised in the valuation for a better coastal management (Corps, 2007).

In the case of Demak, the consequences of mangrove conversion are already perceived by the people. Not only does this have an impact on the fisheries and biodiversity, but it also leads to the threat of flood and coastal erosion for the local community. Mangroves' function as coastal protection against erosion and flood, in particular, is mostly valued through replacement cost and benefit transfer methods (the cost of constructing dikes or seawall) (Malik et al., 2015; Samonte-Tan et al., 2007; Sathirathai, 1995; Sathirithai & Barbier, 2001; Wulandari, 2015). However, this may not describe the real damages and losses generated by the erosion. It is due to a questionable assumption of perfect substitutability between environmental goods and services and human-made alternatives, which are not always representative of the actual value of a resource, particularly because they tend to omit added value from the environment (Beaumont et al., 2008). Thus, it can lead to either an over-estimation or under-estimation of ecosystem goods and services.

In such a BwN project, environmental benefit analysis is the main key to see the success rate of the project. Regarding the economic impact, environmental benefit from nature is input to the system. It can influence the production of goods and service provisioning. By using the nature, the expected sustainable development goal can be achieved.

The economic study regarding the ecological-economic analysis in the context of mangrove ecosystems restoration in Indonesia is still new. Many restoration activities focus only on costs and benefits of mangrove planting, while the stabilisation of the coastal environment (Kairo et al., 2009; Spurgeon, 1999). Elements in the coastal environment, such as hydrology and sediment, are also key factors for a succeeding mangrove restoration. Restoring hydrology and sediment are considered to help natural mangrove recruitment (Kamali & Hashim, 2011; Lewis, 2001; Marchand, 2008). One of the ways is by conducting integrated restoration between establishing breakwater and mangrove planting (Kamali & Hashim, 2011).

This study makes a contribution to the literature in the following respects:

Firstly, unlike Kairo et al., (2009) and Spurgeon (1999) who only focus on the costs benefit analysis for mangrove planting, this study takes into consideration the costs of restoring sediment and hydrology as part of restoration costs.

Secondly, this study gives new information about the use of semipermeable dam (i.e. a dam that is made from brushwood and bamboo and having a similar function as mangrove roots to catch the sediment), to replace the breakwater, as explained by Kamali & Hashim (2011).

Thirdly, Unlike Wulandari (2015), Malik et al. (2015), Samonte-Tan et al. (2007), Sathirithai & barbier (2001) and Sathirathai (1995) who derive the value of Mangroves as a coastal protection through the replacement cost (e.g. from building a dam, dike or breakwater), this research will focus on the implementation of a natural based solution to establish coastal protection. This research also takes into consideration the economic value of a resource regarding land use practice (e.g. estimating the economic value of coastal erosion by estimating the possible economic impact on losing aquaculture pond or settlement) and added value from the environment (e.g. additional economic benefit by having more mangroves).

Fourthly, this study makes a contribution to the BwNI project in estimating the NPV of the economic benefit derived from the mangrove restoration and also improved aquaculture, in which the project is still running.

Chapter 3

Methodology

Chapter 3. Methodology

3.1 Study Site

Implementation of the Building with Nature concept had started in six sub-districts and will cover 15 villages in Demak, Indonesia (Cronin et al., 2015). The present study focuses on Tambakbulusan village. We selected the village because of the following criteria: having the largest mangrove cover; having both aquaculture and sylvo-aquaculture ponds; some farmers practice intensive aquaculture of tiger shrimp; and easy to access by bike or other wheeled vehicles in all seasons (Cronin et al., 2015).

Tambakbulusan village is located in the Karang Tengah subdistrict. There are around 17 villages in this sub-district. However, this village is the only village which is directly adjacent to the sea (Kusmaiwanto, 2015). There are around 800 households in this village. Among these, around 220 households have a pond, and about 171 households have a fishery or aquaculture, as the primary income source (Noor et al., 2015).

Similar to other villages, this village had no coastal safety. Here, the mangroves had already started to disappear, and the aquaculture extends into the intertidal zone (Tonneijck et al. 2015). In the early 1980’s, the mangroves grew relatively throughout the village. Mangrove cutting started to happen in 1985, when many tiger shrimp investors tried to open new ponds. After five years, the productivity of ponds declined, and it stopped the aquaculture sector in the village. As a result, this condition left deforested land due to pond conversion (Noor et al., 2015).

So far, fewer mangroves were available both as coastal greenbelt or surrounding pond dikes. The location of the village, which is bordered by two big rivers: Wonokerto River and Tuntang River, indeed allowed the village to have better sedimentation. However, the anthropogenic and industrial activities surrounding might cause a serious problem and lead to environmental degradation.

Regarding the mangrove restoration, the village had already done plan mapping. The plan mapping involved three methods of restoration processes: 1) Sediment restoration; 2) hydrological restoration, and 3) ecosystem restoration, in which none of those processes had been conducted. The process of restoration started from building a semipermeable dam. Subsequently, conducting river normalisation aimed to improve the hydrological system. In the end, planting mangrove aimed to accelerate the natural growth of mangroves.

3.2 Research Framework

This research involves four different topics: 1) identification and economic valuation of mangrove ecosystem services; 2) cost-benefit analysis (CBA) of Improving aquaculture practices (CBA for private sector); 3) Environment cost-benefit analysis (ECBA) of restoring mangrove forest; 4) Environment cost-benefit analysis (ECBA) of different policy alternatives regarding mangrove restoration and aquaculture practice (Figure 3).

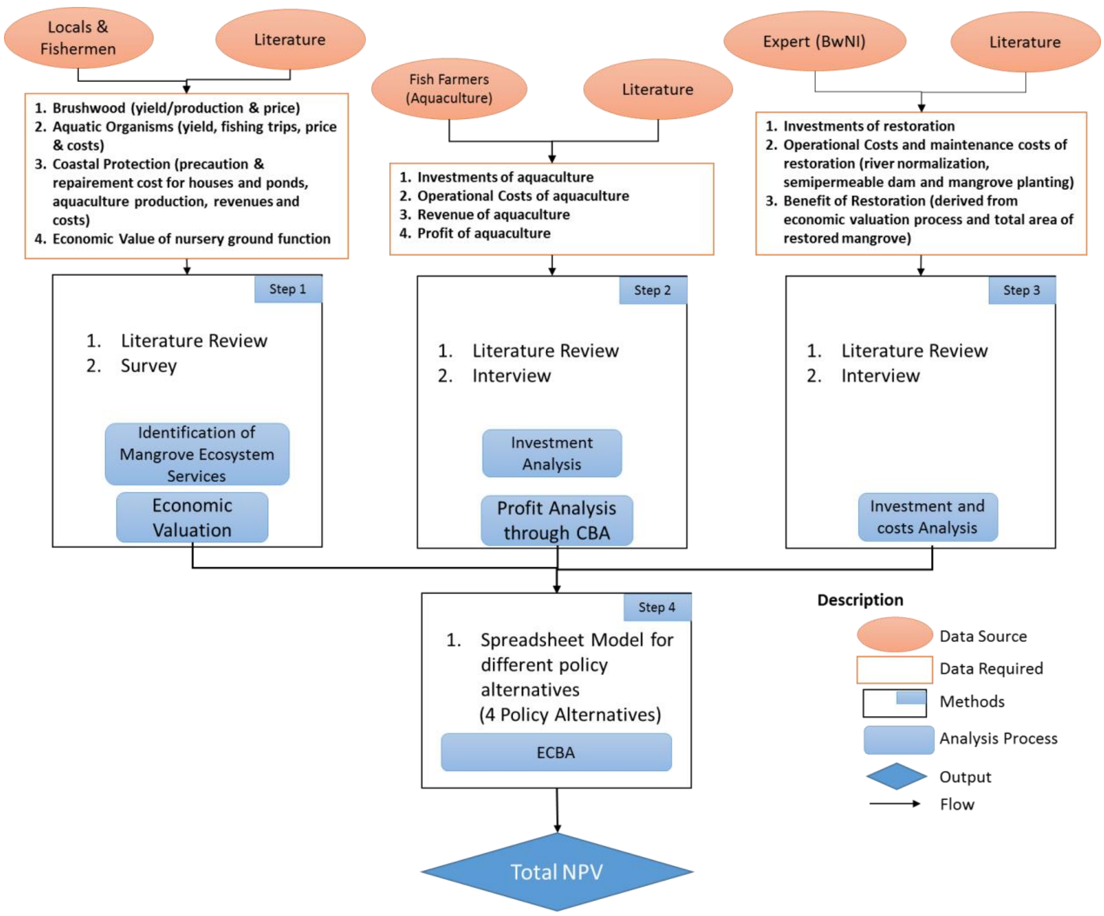

Figure 3 Research Framework

3.3 Research Method

3.3.1 Determination of Variables of the Economic Valuation

Variables used in the economic valuation relate to the costs and the benefit derived from both aquaculture production and mangrove restoration. The benefits of mangrove restoration were obtained from mangrove ecosystem services, while the benefit of improved aquaculture production arose from the profit of aquaculture production after switching the commodity system and using MOL.

Mangrove ecosystem provides several goods and services such as brushwood, seeds, aquatic organisms, coastal protection, nursery ground function, carbon sequestration (Barbier 1993; Bann 1998; Barbier et al. 2011). In this study, we restricted the provision of mangrove ecosystem goods and services to brushwood, aquatic organisms (fish and crustacean); coastal protection (flooding hazard and coastal erosion); and nursery ground function. The economic value of fish, brushwood and nursery function, we explicitly measured in IDR ha^{-1} (mangrove) $year^{-1}$. This is due to brushwood and fish being the traded products in the village. Thus, we used the market price approach. Regarding coastal protection, we implicitly calculated the economic value in the alternatives-ECBA by comparing the economic impacts generated between protective and non-protective policy alternative (with and without mangrove restoration). Nursery ground function was assessed using Benefit Transfer Method (BTM) (Table 2).

Table 2 Valuation Methods Used in the Research

No	Mangrove Ecosystem Services	Method used	Data Needs
1	Brushwood	Market prices, and Benefit Transfer Method	Brushwood production, the price of brushwood.
2	Aquatic Organisms	Market prices	Aquatic organisms production (fish and other aquatic organisms), fishing trips by fishers by fishers, the price of fish, and fishing costs.
3	Coastal Protection against flood	Implicitly in Policy Alternatives-ECBA scenario	Costs of Restoration, aquaculture production and profit, damage costs and precaution costs (aquaculture ponds and settlements).
4	Coastal Protection against erosion	Implicitly in Policy Alternatives-ECBA scenario	Costs of Restoration, aquaculture production and profit, damage costs and precaution costs (aquaculture ponds and settlements).
5	Maintenance of fisheries: nursery ground function	Benefit Transfer Method	The ability of mangrove to support the nursery function per hectare of mangrove

We measured the productivity of improved aquaculture by estimating the profit generated on the polyculture system using MOL, to contrast with the economic benefit of aquaculture in BAU condition. The data required, regarding the aquaculture production analysis, were additional costs to switch commodity system and to make MOL, operational costs and revenue from both cultivation commodity systems. We obtained all the data through farmer surveys and expert interviews (see chapter 3.3.2).

Regarding the mangrove restoration, the net benefit of the restoration derived from the subtraction of the costs of restoring mangroves from the benefit of having more mangroves (after restoration). The analysis required several data, such as initial restoration costs (construction dam, farmer compensation for river normalisation and mangrove planting), maintenance costs and benefit of mangroves. We assessed the advantage of having more mangroves from the total economic value of mangroves after restoration (by multiplying the economic value of mangroves with the total area of mangrove after restoration), while the data regarding costs were obtained through interview with experts (see chapter 3.3.2).

3.3.2 Data Collection

We did data collection through fieldwork and literature review. The fieldwork was conducted between the 7th of November and the 18th of December 2016, involving survey and interviews. The survey and interviews aimed to get primary data, particularly regarding the restoration and to improve the aquaculture sector. The literature review aimed to get secondary data on a general overview of the project and location, which we obtained from the previous BwNI project reports, relevant reports from local village government, the Central

Bureau of Statistics (BPS), the Department of Marine Affairs and Fisheries. We also collected more information on the economic value of mangroves as a nursery ground and the production of brushwood from other research publications as secondary data.

We conduct the survey through a questionnaire. We designed the questionnaire on a questioned based interview (QBI) (Appendix 2), which we carried out in the local communities. We used purposive sampling to select the respondents. The respondents were the residents with several criteria: 1) the people who worked dependently on mangrove ecosystem, and 2) the people who might be impacted by flood and coastal erosion. Based on this criteria, we targeted several groups of individuals as respondents: 1) Inland and near shore fishers; 2) Aquaculture farmers; 3) residents (all the people who lived there).

During the fieldwork, we interviewed to experts from the local village, and BwNI project actors (Appendix 1) using a structured list of questions regarding mangrove restoration and improving aquaculture practices. We used purposive sampling to select the respondents. Furthermore, we also used snowball sampling to help identify other related informants. The respondents selected were the principal actors of the BwNI project, such as consultants, fish farmers and local experts on mangrove planting. These were selected because they knew the project and its expenditures to support the project (both for mangrove restoration and improving aquaculture). In the end, we found four people from two institutions included in the criteria: one person from Witteveen&Bos, and three people from the Local Village Government (including a local expert on mangrove rehabilitation and aquaculture practice). In order to receive broader information, we also personally communicated with related actors, such as residents and the NGOs: Wetland International Indonesia and Blue Forest Indonesia.

3.4 Data Analysis

We used the results from all surveys and interviews as an input in the cost-benefit analysis (CBA). We processed all the survey outputs in MS Excel. Meanwhile, we used the data from the personal communication to construct the scenario and storyline. We also constructed separate spreadsheets of the four policy alternatives in MS Excel to calculate the Net Present Value (NPV):

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+\delta)^t} with\ t\ (time) = 1,2,3 \dots n$$

t denotes the year, B_t is total benefit in time t, C_t is total costs in time t, *n* is the time horizon, δ is the discount rate, while $\frac{1}{(1+\delta)^t}$ is called discount factor.

To see the long terms total NPV, we used 3 different discount rates 5%, 10% and 15%. We further assumed a time horizon of 25 years in the ECBA. The determination of the rates was based on the real condition of the Indonesia discount rate, estimated by International

Monetary Fund from 2003 to 2013[1] (International Monetary Fund retrieved from FRED Federal Reserve Bank of St. Louis, n.d.).

We calculated the total NPV within two erosion case scenarios, which we named the worst erosion case scenario and the best erosion case scenario (see Chapter 4). We also carried out sensitivity analysis on several input parameters: 1) nursery ground function value; 2) aquatic organisms value; 3) the impact of fisheries (no increment benefit derived from aquatic organisms and nursery ground function after restoration); 4) no benefit of flooding hazard (no impact after restoration); 5) the most pessimistic condition (no benefit on flooding hazard, and fisheries after restoration), to see the changes on total NPV in all policy alternatives.

[1] The rates fluctuate within the range 5,75%-12,75%.

Chapter 4

Scenario Construction

Chapter 4. Scenario Construction

4.1 Improving Aquaculture Practices

The BwNI project was trying to implement polyculture milkfish and shrimp using MOL as aquaculture improvement. Improved aquaculture practices were beneficial for farmers, and the BwNI project aimed to generate higher productivity. However, it also requires several costs.

In the implementation, improving aquaculture did not increment any additional investment costs. This occurred as both monoculture and polyculture practices would be conducted in the existing pond. Thus, it incurred additional operational costs only for seeds, either for shrimp or milkfish and MOL, for each cycle.

4.2 Mangrove Restoration

The restoration in Tambakbulusan village has not yet been conducted. However, the project has already conducted a village plan mapping (Figure 4). This study used the projected mapping as a basis information for the restoration planning. The plan mapping involved several processes of restoration, such as building a semipermeable dam, river normalisation, and mangrove planting.

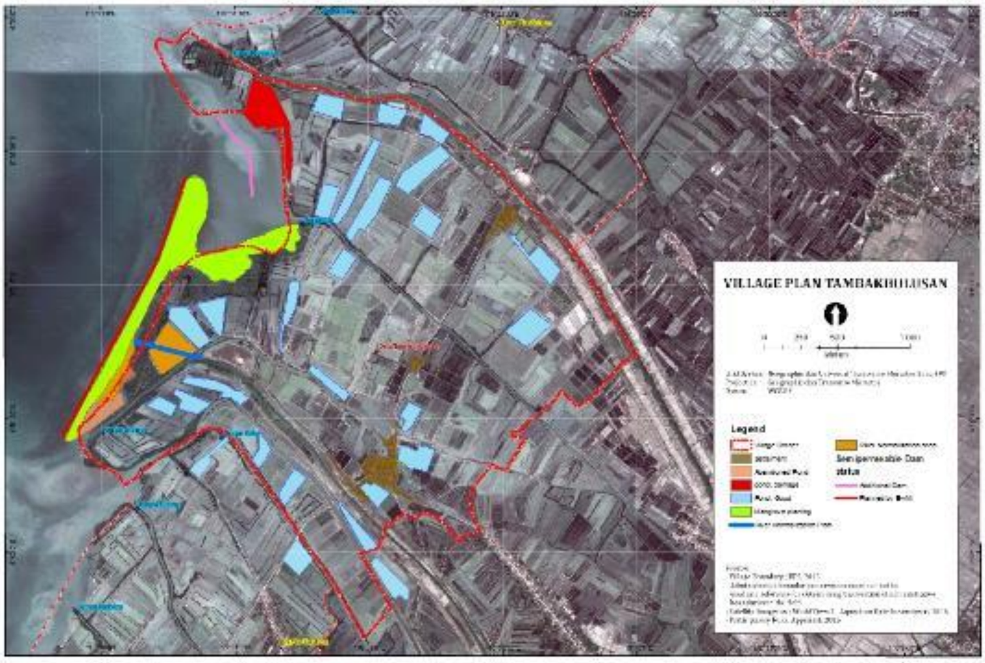

Figure 4 Plan Mapping of Tambakbulusan Village

Source: Wetland International Indonesia (Modified)[2]

[2]The map was obtained from an unpublished file from Wetland International Indonesia during personal communication.

According to the village plan mapping, the project required 1.8 km of dam near to the planting area (coloured in green area in Figure 4). Bearing in mind the importance of securing the damaged pond area (coloured in red area in Figure 4), we considered that a complementary semipermeable dam of 0.7 km might be required. In total, 2.6 km of dam[3] was necessary for the restoration.

The semipermeable dam should remain in place for some years to have a more stable sediment. The period would vary, depending on the location, natural sedimentation and the dynamic of the sea, however,this study assumed that the dam should stay for 6 years. After the installation, the dam requires annual maintenance. The maintenance of the dam involves the adding of filling materials (brushwood or bamboo), the replacement of rotten poles and re-attaching these together. Ideally, it must be conducted once a year. However, re-filled and re-attached dams might be less strong compared to the newly installed ones. After heavy storms, building a complete new dam might be needed.

River normalisation must abandon several hectares of ponds. From figure 4, we estimated river normalisation has to abandon around 6 hectares of the pond (coloured orange area in Figure 4). Abandoning ponds aims for better land use management. For instance, shallow aquaculture ponds are less useful for cultivation, but easier and more useful for mangrove restoration (red area on Figure 4) (Tonneijck et al., 2015). Moreover, it is also essential for improving hydrological conditions. It can provide a better hydrological system and support the stabilisation of the sediment, in order for the mangrove to grow (coloured orange area in Figure 4) (Tonneijck et al., 2015).

Mangrove planting was a complementary restoration activity, after the sediment stabilisation recovery process. The duration of the sediment stabilising process might be different per location depending on the natural process and condition. However, due to the relatively good natural sedimentation in Tambakbulusan, we deliberately assumed that the additional planting was possible to conduct after a year of sediment and hydrological recovery. Referring to figure 4, mangrove recovery and complementary planting is carried out, along with the shoreline. These locations are symbolised by the red area (8.8 ha) and the pink area (7.4 ha). However, due to the importance of having a riverine greenbelt, we also assumed that additional planting might be needed. It would be carried out along the rivers and creeks in the village.

4.3 Land Use Distribution

Current land use distribution in Demak was already analysed by Fisheries Department, at the Diponegoro University (UNDIP) Semarang. This was conducted in 2015 as part of the project. The results show that the total area of the village is around 717 ha. Among these, around 640 ha are indicated as ponds. These 640 ha ponds consist of 636 ha of the silvo-aquaculture pond and only 3.8 ha of non-silvo aquaculture. However, only 631 ha out of 636 ha of ponds are still productive (Noor et al., 2015; Tonneijck et al., 2015), while coastal erosion has damaged the other 8.8 ha of ponds. Also around 10 ha of ponds had already been

[3] The number was estimated using GIS.

abandoned by fish farmers. The total area of the settlement was 13.6 ha. Total existing mangrove area was only 53.2 ha (Table 3).

The restoration needed to abandon around 34 ha of ponds: river normalisation required 6 ha, and riverine greenbelt required around 28 ha. We estimated the total area of the riverine greenbelt by multiplying the total area of productive ponds (i.e. 631 ha) by 30% (i.e. estimation of total pond area near to the creeks and rivers by the project) and 15% (i.e. only 15% of total pond area will be transformed into mangroves). We used the percentage of 15% due to the target of the project to implement mix-mangrove pond, which was 85% of the pond and 15% of mangrove (mix mangrove will not be further discussed in this study). Thus, the total productive pond area after restoration changed from 631 ha to 597 ha (Table 3).

The restoration changes the actual land distribution. It will increase the total area of land towards the sea due to mangrove planting (green coloured area in Figure 4). The most changes occur on the total area of aquaculture ponds and mangrove patches. The total mangrove area after restoration will be 155.5 ha. The 155.5 ha of mangrove patches consists of existing mangrove patches (53.2 ha) and planting area from village plan mapping (73.9 ha) (green area in Figure 4 Plan Mapping of Tambakbulusan Village also including damaged and abandoned ponds by 19.2 ha), and additional riverine greenbelt (28.4 ha). Thus, the restoration will change the total area of land due to additional coastal greenbelt, from 717.2 ha to 771.9 ha.

Table 3 Coastal Land Use Distribution in Tambakbulusan with and without Mangrove Restoration

No	Land use distribution	Total Area of Village (ha)	Mangroves (ha)				Productive pond (ha)	Damaged Productive Pond due to Erosion (ha)	Abandoned pond due to Erosion (ha)	Abandoned pond due to Restoration (ha)	Settlement (ha)
			Initial Mangrove Area	Additional Riverine Mangroves	Additional Mangroves (Greenbelt)	Total Area of Mangroves					
1	Without restoration	717.2	53.2	0	0	53.2	631	8.8	10.4	0	13.6
2	With restoration	771.9	53.2	28.4	73.9	155.5	597	0	0	34	13.6

Source: UNDIP in (Cronin et al., 2015) & Wetland International Indonesia (Analysed).

In this study, we made two assumptions regarding the land use distribution: 1) we considered all the aquaculture ponds as traditional silvo-aquaculture; 2) all the buildings in the settlement are assumed as private property (houses). We made these assumptions due to the lack of data, and time availability during the survey.

4.4 The Impacts of the Absence of Mangrove Ecosystem

Regarding the coastal erosion, we deliberately assumed that if no intervention (mangrove restoration) was conducted, the villages would dissappear within 25 years. This assumption considered the constant annual erosion or abrasion rate (AR) of 90 m inland. This hypothesis was based on the prediction from the project, which predicted that the entire coastal area might be gone within decades (another village in Demak such as Bedono, dissappeared within 10 years) (Cronin et al., 2015).

In this study, we divided the impacts of the coastal erosion into five phases based on the period: 1) erosion I (0-450 metres between 1 and 5 years); 2) erosion II (451-900 metres between 5 and 10 years); 3) erosion III (901-1,350 metres between 11 and 15 years); 4) erosion IV (1,351-1,800 metres between 16 and 20 years); 5) erosion V (1,801-2,250 metres between 21 and 25 years) (Figure 5).

During the early years, the erosion destroys the aquaculture ponds, but later the erosion would hit the settlement. Since the settlement was located around 1-2 km from the coastline (analysed by GIS), we assumed that the erosion would damage the settlement within ten years, between the middle of the third phase (erosion III) to the middle of fifth phase (erosion V) or from 2029 to 2038. This scenario case used 10% from the total settlement area as annual settlement reduction. We present the erosion scenario in Figure 5.

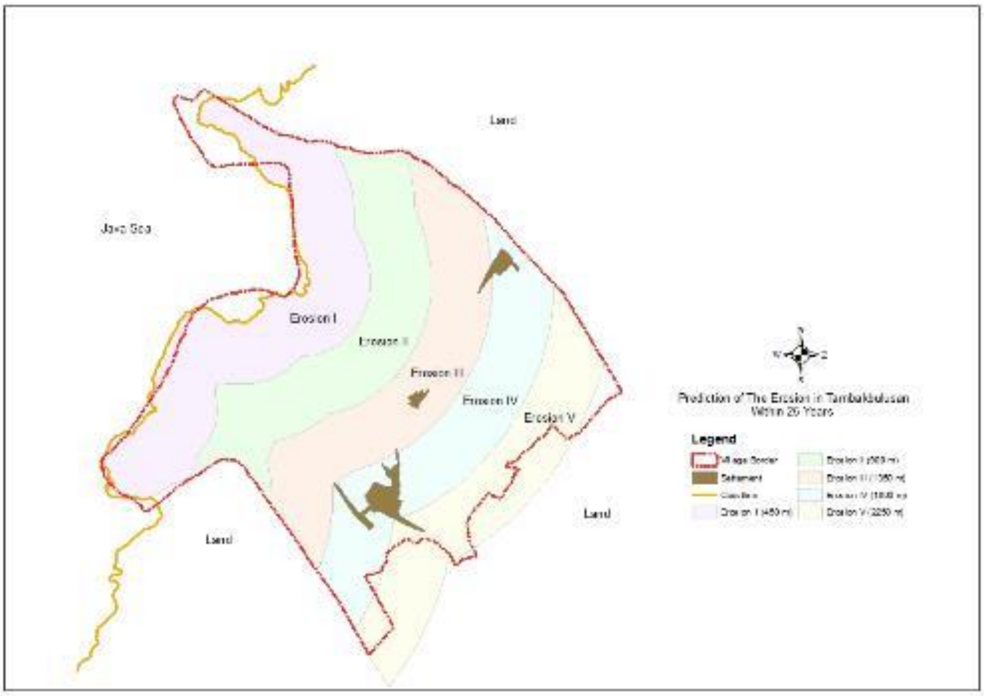

Figure 5 Prediction of the Erosion (The Worst Erosion Case Scenario) in Tambakbulusan village.

Flood also threatened both the aquaculture sector and the settlement. Tidal flood was related to the land subsidence. The reduced or absent mangrove exacerbated the flood. Mangroves are considered capable of accreting land and increasing the elevation and the slope of shore (McIvor et al., 2012). Thus the absence of mangroves might be a reason why floods always occur. The flood was also predicted to worsen annually during 25 years.

In this study, we also assessed the combined impact of coastal erosion and flood. The economic implications of the flood would worsen annually. However, it would decrease at a certain point and went towards zero because all land would have disappeared due to the erosion.

4.5 The Best Erosion Case Scenario

We also assessed another scenario with a different AR in order to see a different possibility of the economic losses generated. The alternative scenario applied another constant annual AR of 45 meters instead of 90 meters. In this erosion case scenario, the erosion would not hit all the village area within 25 years. It took around 50 years, or twice as long as the first duration from the worst erosion case scenario (AR was 90 m per year). By the end of the 25th year, the erosion in the best erosion case scenario only hit the settlement in the several sub-villages and predicted increment caused a less economic impact. However, due to no guarantee of coastal security, the flood and erosion were predicted to continue until the village disappeared, which might increment more economic losses on a longer time horizon.

In the best erosion case scenario, the erosion only hit the settlement in the last two years (Figure 6). We assumed the erosion would hit the settlement at the end of the fifth phase (erosion V) only at several locations. In this case, we deliberately assumed that the rate of settlement reduction due to erosion was only 5% per year from all total settlement area.

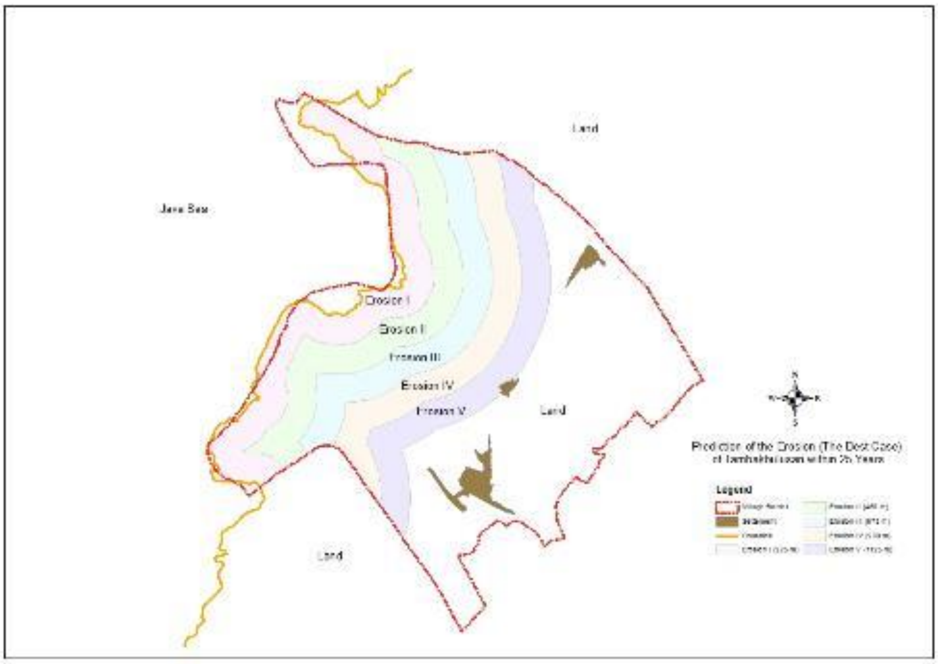

Figure 6 Prediction of the Erosion (The Best Erosion Case Scenario) in Tambakbulusan village

4.6 Policy Alternatives

We made four policy alternatives including the current situation (Business as Usual). We assessed the benefit switching aquaculture practices in alternative 2, and 4, while we analysed the benefit of mangrove restoration in alternative 3 and 4 (Table 4). In the end, we carried out the ECBA for each condition to see the economic impact among alternatives.

Table 4 Design of the Policy Alternatives

			Aquaculture Commodities →	
			Monoculture (Milkfish)	**Polyculture (Milkfish & Shrimp) & MOL**
Mangrove Area ↓	**Intervention (Mangrove Restoration)**	Without mangrove	Alternative 1 Business as Usual Aquaculture: Monoculture Milkfish Without Rehabilitation (semipermeable dam & Mangrove Restoration)	Alternative 2 Improving Aquaculture Practices without Mangrove Restoration Aquaculture: Polyculture (Milkfish & Shrimp), Using MOL, Without Rehabilitation (semipermeable dam & Mangrove Restoration)
		With mangrove restoration	Alternative 3 Monoculture Milkfish with Mangrove Restoration Aquaculture: Monoculture Milkfish With Mangrove Rehabilitation (semipermeable dam & Mangrove Restoration)	Alternative 4 Improving Aquaculture Practices with Mangrove Restoration Aquaculture: Polyculture (Milkfish & Shrimp), Using MOL, With Rehabilitation (semipermeable dam & Mangrove Restoration)

4.6.1 Alternative 1: Business as Usual (BAU)

The Business as Usual (BAU) situation was the first policy alternative adapted from the current condition in Tambakbulusan. BAU was the first policy alternative where no mangrove restoration and improving aquaculture practice was conducted. Because most aquaculture traditionally conducted milkfish culture, we assumed that all the aquaculture practices were traditional milkfish. Regarding the impact of fewer mangroves, flood and coastal erosion continued to occur and worsen annually (Figure 5 & Figure 6), so that the benefits from aquaculture and mangroves also would decline annually.

4.6.2 Alternative 2: Improving Aquaculture Practices without Mangrove Restoration

The alternative 2 was constructed to see an economic impact of improving aquaculture practices only. In this policy alternative, we assumed that all aquaculture ponds would be converted to polyculture milkfish and tiger shrimp using MOL. As in the case of the BAU, no restoration was conducted. Thus, it still led to land degradation and the decline of benefits due to flood and coastal erosion.

4.6.3 Alternative 3: Initial Aquaculture Condition with Mangrove Restoration

Policy Alternative 3 involved mangrove restoration without improving aquaculture practices, neither switching commodity system nor using MOL. The alternative was constructed to see an economic impact of mangrove restoration only. In this alternative, we assumed the natural threat such as erosion would stop after the restoration. While flooding was assumed to be minimised in the 7th year after restoration (the 6th year after mangrove planting) and would be stopped in the 16th year of restoration (from 2022 to 2031). This was determined based on the assumption that the restoration could support the mangrove to naturally grow the 5th year (no semipermeable dam needed) and give full benefit the 10th year after mangrove ecosystem had been settled (the 15th year after mangrove restoration) (see Appendix 7, details in Appendix 7.3 and 7.4). We also deliberately assumed that it would take approximately 5 years after planting for the mangroves to be settled and resistant against common coastal dynamic. Thus, mangrove replanting would be conducted only within 4 years, from 2018 to 2021.

The restoration also led to the increment production of mangrove ecosystem goods and services. In the calculation, the increase of the benefits was not perceived completely by the first year of restoration. The increase occurred until the benefit of the mangrove reached a stable condition. We purposefully determined that the increase of mangrove benefit would start in the 7th year and would become stable in the 16th year after mangrove planting (a decade from 2022 to 2031).

4.6.4 Alternative 4: Improving Aquaculture Practices with Mangrove Restoration

Policy-Alternative 4 involves both improving aquaculture practices and the mangrove restoration. The alternative was designed to see the possible economic impact of both activities. The benefit generated was the combination of the benefit from both aquaculture sector and mangrove restoration. In the calculation, all benefits and costs regarding both activities were assessed economically to indicate the long terms economic impact.

Chapter 5

Economic Value of Mangrove Ecosystem services

Chapter 5. Economic Value of Mangrove Ecosystem services

5.1 Brief Overview of Survey Result

In total, we surveyed 43 respondents during the fieldwork. The distribution of those surveyed' in age, gender and jobs are presented in Figure 7.

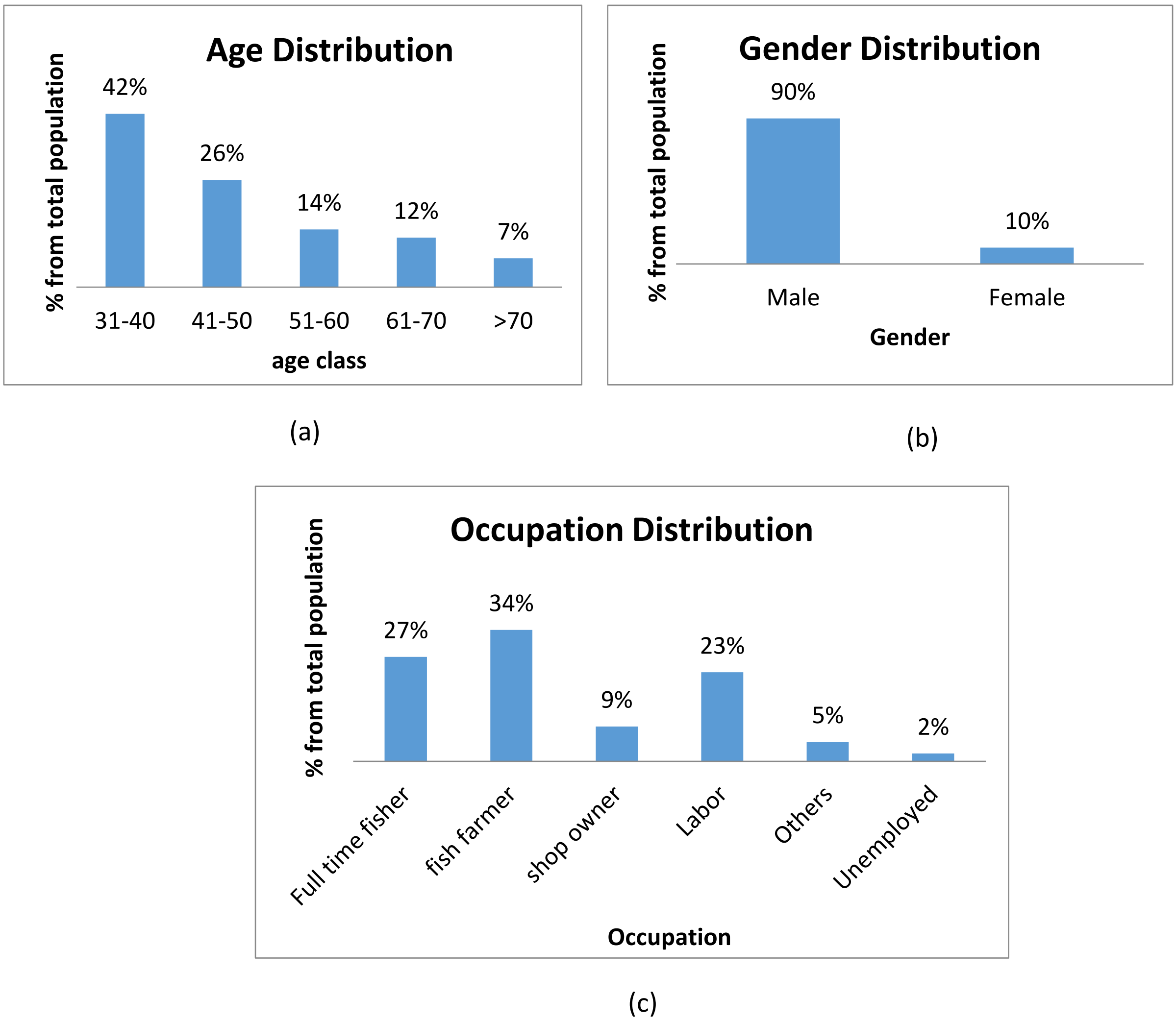

Figure 7 The Distribution of (a) ages; (b) gender; (c) Occupation, of the respondents

During the survey, we found 15 respondents worked as fish farmers, and 25 respondents worked as fishers. Among the 25 respondents, not all the fishers were full-time fishers. There were two types of fishers that we found during the fieldwork: 1) full-time fishers (12 people); 2) part-time fishers (13 people). Full-time fishers were the people who did not have another alternative job, and they went fishing almost every day (4 to 6 days a week). While part-time fishers were the people who had another occupation (such as industrial labor, farmers and shop owner), and they went fishing only during a certain fish season (e.g. crab fisher) or only for additional income. Part-time fishers did not invest in a boat, but they might invest in fishing gear such as hand line and traps. Part-time fishers went fishing only one or two days a week, or every day during peak season (e.g. peak season for crabs from November to February).

During the survey, almost all of the respondents were willing to be interviewed. Only one respondent refused our interview. Moreover, the village government was also very cooperative. They helped us by providing information regarding the current condition of the project and the village; they also helped us in the process of interview. The openness of the respondents might be due to the fact that residents were already familiar with the BwNI project. BwNI programs such as field schools, had helped fish farmers to recognise the environmental issues in their ponds. Indeed, not all of fish farmers or respondents participated in the field school, but they had already heard about it, from other fish farmers.

5.2 Brushwood

During the survey, 8 of out 43 respondents indicated that local people used to use brushwood for firewood, particularly for cooking. Currently, residents preferred to use liquefied petroleum gas (LPG) instead of mangrove brushwood. Some individuals in the village still use brushwood for firewood as an additional fuel, in particular for events with many guests, such as weeding party.

During the interview, a local expert (Interview 2) indicated that the potential of brushwood came from silvo-aquaculture (mangrove planted ponds) and also from mangrove patches around the villages. The people were not allowed to cut down the trees and use the mangrove trunk. They could only collect fallen brushwood or gather brushwood from the dead trees. Cutting down the tree was only possible for mangroves located in a pond as a part of the maintenance activity of the pond (e.g. thinning the trees when they got denser). It is forbidden because a mangrove plantation around the river or for a coastal greenbelt is part of a rehabilitation program which was ratified by the government as local village regulation (Perdes).

Out of 43 respondents, only eight respondents gathered brushwood. Five of these eight people gathered brushwood from their own pond, and the other three people collected the brushwood from mangrove patches. From this survey, those who collected the brushwood from mangroves patches got the brushwood from the dead trees and fallen wood. They did not cut the tree due to the local regulation. Additionally, they sometimes also collected the brushwood from other pond's owners. They asked permission to the pond owners, who did not use the wood, if they could collect the brushwood.

The frequency of brushwood collection by people varied from once a month to four days a week. The most species collected were *Rhizophora* sp. and *Avicennia* sp. with branches as the most product collected. Based on the survey, five respondents (fish farmers) collected approximately two bundles of woods, for a total weight of approximately 3 to 4 kg for each bundle, roughly every one to two months. They collected brushwood between one and eight times a month.

On average, a fish farmer could gather around 164 kg year^{-1} with the mean of the pond of 2 hectares. Considering that total area of silvo-aquaculture is around 631 ha (Table 3). Thus the economic value of mangroves from 1 ha of the pond is 191.4 thousand IDR ha^{-1} year^{-1}. In total, the potential of brushwood from the silvo-aquaculture is around 47 thousand kg year^{-1} (appendix 3, details in Appendix 3.2).

Moreover, local non-fish farmers collected the brushwood more often, circa 3 to 4 times a week. They collected around 3 to 4 kg (1 to 2 bundles) per time. On average, a brushwood collector can get approximately 528 kg year^{-1} person^{-1} from a 53 ha of existing mangrove patches. Nevertheless, due to the total number of mangrove users being unknown, we estimated the total potential of brushwood by the current literature.

We used a study from Chow (2015) to assess the potential of brushwood due to several reasons: 1) the wood potential in the study came from artificial planting; 2) the study focused on non-timber materials, such as fuelwood, due to the restriction of cutting down the tree; 3) the study involved a retrospective benefit-cost from existing plantations and the benefit-cost ratios for new plantations. According to Chow (2015), mangroves can produce around 800 kg ha^{-1} year^{-1}. As the total area of mangrove patches were approximately 53 ha then the annual total value is 43 thousand kg year^{-1}.

In Tambakbulusan, mangrove timber and brushwood were not commonly traded. Mostly, local people used the collected mangrove wood only for their own personal use/need. From 8 respondents, only four people gave information regarding the price. Additional information was gathered from the trader in the next village (Surodadi village), in order to get precise information. A bundle of mangrove costs around 8,000 IDR to 10,000 IDR, for a bundle weighing 3 to 5 kg. On average the price per bundle (IDR/bundle) was 9,000 IDR or equal to 3,000 IDR kg^{-1}.

Considering these prices and the estimated brushwood production on ponds and mangrove patches of 47,391 kg year^{-1} and 42,560 kg year$^{-1,}$ respectively, the estimated economic value from both locations is 118.5 million IDR year^{-1} and 106.4 million IDR year^{-1}, or 2 million and 191.4 thousand IDR ha^{-1} year^{-1} respectively.

5.3 Aquatic Organisms

The use of aquatic organisms involved fish and other aquatic organisms (non-fish) produced. According to the survey, both fishers and fish farmers extracted fish resources. Fish farmers extracted fish resources through side catches, using traps or nets as complementary activities to their farming. They extracted fish from their ponds and irrigation channels or creeks. Thus, we considered both groups as aquatic organisms' users.

Noor et al. (2015) indicate that around 391 people in the village are aquatic organisms' users. Among these, 220 people work as fish farmers and have their own pond, and 171 people work as fishers. Only 142 out of 171 fishers use specific fishing gears: trammel net & gill net (45 people), dredge gear (4 people), dredge gear without a boat (6 people), mini trawl (3 people), mini longline (5 people), trap for crab (75 people), and fishnet (4 people). According to the survey, there were some individuals in the village that used hand-lines. Therefore, we assumed the fishers, other than those 142 fishers, as handline fishers.

To simplify a high variation of the users, we deliberately categorised aquatic organisms users into five different classes, based on the fishing area, the distance from mangroves and the gear used. Based on Noor et al. (2015), we categorised the aquatic organisms users in the village as follows: 1) seasonal fishers (75 people); 2) full-time fishers without a boat (39 people); 3) full-time fishers with boat & passive gear (50 people); 4) full-time fishers with boat & active gear (7 people); 5) fish farmers (220 people) (Appendix 4, see Appendix 4.1).

During the fieldwork, we surveyed 40 fish resource users, including 25 full and part-time fishers and 15 fish farmers. We surveyed 25 fishers with eight different types of fishing gears. Among these, we found 5 net fishers also used traps for crabs. In total, we found 25 respondents with 30 different types of fishing gears: trammel net & gill net (7 people), dredge gear with boat (1 person), dredge gear without boat (1 person), mini trawl (2 people), mini longline (2 people), trap for crabs (8 people), fishnet (2 people), handline (7 people). Based on the categories, We found the number of the fish resource users: seasonal fishers (8 people), full-time fishers without boat (10 people), full-time fishers with boat & passive gear (9 people), full-time fishers with boat & passive gear (3 people), fish farmers (13 people).

During the survey, we could not define precisely the season of the fish. The fishers indicated specific fish season through the condition of tidal, waves, current, and wind direction, which could fluctuate monthly, or even daily. The fishers also seemed to be more adaptable to the nature and the season of the fish. Trammel and gillnet fishers, in particular, they mostly had more than one type of net for each different season, to enable them to catch fish in every season. They mostly used the modified net (e.g. the mesh size or a number of the layer with more suitable fishing methods.

Wulandari (2015) indicate several fish species, which depend on mangrove ecosystems and have become the most targeted species caught: greenback mullets (*Valamugil suheli*), white shrimp *(Penaeus merguiensis*), jinga shrimp (*Metapenaeus affinis*), Mysis *(Metapenaeus* sp.*)*, milkfish *(Chanos chanos)*, mangrove crab *(Scylla serrata)*, Estuarine catfish *(Mystus gulio)*, spotted scat *(Scatophagus argus)*, Eel-tailed catfish *(Tandanus tandanus*), swamp eel *(Monopterus albus)*, snapper *(Lutjanus campechanus)*, green mussel *(Mytilus viridis)*, blood cockle *(Anadara granosa)*, mudskipper *(Periopthalmus argentilieatus)*. During the survey, we found that all fishers mostly caught the fish species mentioned above. We could not find any fishers that targeted green mussel, blood cockle, and mudskipper. However, we further found some other fish species targeted, which are still correlated to mangroves: swimming blue crabs (*Portunus* sp.), barramundi (*Lates calcarifer*) and whiting (*Sillago sihama*). From what we found during field work, we assume that all fishers caught mangrove related species. Furthermore, due to the mixed-fishery and the high variation of seasonal patterns, we estimated the productivity of the fishers through the average revenue.

On average, each category of fisher could catch between 1 and 30 kg, and generated a revenue of between 40 thousand IDR and 1 million IDR, depending on the season, their fishing grounds and fishing methods. To minimise the significant gap of the revenue generated among the fishers, we estimated the revenue produced by each fisher based on their fishing gears.

To estimate annual total costs and revenue, we made an assumption that all fishers made the same fishing trip every year and they extracted fish resources in the same quantity every trip or fishing activity. However, in the calculation, we excluded fishers with boat categories (for both active and passive gear) due to several reasons: 1) those fishers were able to migrate chasing fish; 2) they have a high probability of catching other fish instead of mangrove related fish species. In addition to this, we also assumed that all the pond owners also extracted the same fish resources as a complement to their farming, using a certain number of fishing activities in a year.

We estimated the annual total revenue by summing up all the revenue generated by each fisher category. The annual total fishing costs were obtained from the sum of total annual operational costs and also maintenance costs of investments (such as maintenance expenses of the boat, fishing gear, and the engines) from all fisher categories. Then, we estimated total annual profit by subtracting the total annual costs from the total annual revenues. Subsequently, we calculated the value of mangroves in aquatic organisms by dividing the total annual profit generated from all categories by the current total area of mangroves in the village (around 53 ha).

Based on the calculation, one hectare of mangroves in the village could contribute the benefit of around 25.6 million IDR ha^{-1} $year^{-1}$ (Table 5). Thus, the total economic value per year of aquatic organisms was 1.4 billion IDR $year^{-1}$ for the area of existing mangrove of approximately 53 ha.

Table 5 Economic Value of Aquatic Organism for Each User Category (Fishers' Profit)

No	Variables	Value (million IDR/ha/year)
1	Seasonal Fishers Without Boat (Crab)	4.8
2	Fishers Without Boat	12.4
3	Fish Farmers (Side Catches)	8.5
Total (for Inland + Shore Fishers)		25.6

5.4 Flooding Hazard

Based on the information through personal communication with the local village government and local people, we found that floods happened annually. The floods happened due to tide and storms, and land subsidence exacerbated the impact of this. Rainy season, which occurs from October to April, also contributed to worsening the flood. The worst flooding occurred mostly during the rainy season, when the creeks were full with the combination of saltwater or brackish water from the estuarine (when the tide is high) and fresh water from the rain and the river. Then, it spills over and damages the settlement, ponds and crops production. The worst tidal floods happen mostly around September- November, and the local people called it "Rob Kesongo" or the king tide.

According to the survey, only 19 out of 33 respondents were impacted by the last flood that happened in November. Eleven of them had their aquaculture impacted, and the other eight had an impact on their settlement. The impact of the flood was not fully experienced by the entire local community. It hit almost all fish ponds, while only in several parts of the settlement. We indicated that the flood hit the area, either the ponds or the settlement near the creeks.

At some point, the impact of the flood required the residents to invest in precaution costs. Precaution actions were required and conducted by several residents for their house and some fish farmers to avoid crop losses, which might require extra cost. We found that several precaution actions were undertaken by the local community, such as heightening the dike of the pond, installing mini water barrier, heightening the ground floor of their house or their ground yard. Particularly on the settlement, some residents had to conduct precaution actions also because of land subsidence. Several precautions fully worked and they avoided damage. However, some of them were only able to minimise the damage.

Regarding the aquaculture sector, on average a flood could damage the crops and reduced the production by around 70% to 100%. A fish farmer could have economic losses of around 3.8 million to 28 million IDR, depending on the pond size and the aquaculture commodity. The flood also hit several ponds and incremented additional damage costs of around 300 thousand IDR to 10 million IDR per fish farmer, depending on the level of the damage suffered.

Based on the survey, all fish farmers indicated that cultivation practices consisted of 2 cycles in a year. The first cycle was mostly during the dry season (after April). The second cycle was mostly conducted around August or September, when rainy season started (more details can be found in chapter 6.1 and chapter 6.2). In the study, we assumed that the impact of tidal and flood would require precaution actions. Regarding to the damage cost on aquaculture crops, it occurs only on the second cycle in which rainy season is ongoing.

While on the settlement, we found that the flood damage generated an accumulation of economic losses as much as 5 million to 20 million IDR for 5 years, or between 1 million and 4 million IDR per year . This value is an estimated cost considering how bad the damage on the house (e.g. damage to the doors, windows, floors, and walls) and how much the lowest possible costs, which the people could afford. Moreover, the flood also required annual precaution activities and costs between 1 million to 2.5 million IDR per household per year.

Figure 8 The damage and a precaution action due to flooding hazard (a) After the flood due to different height level between road and settlement, (b) mini water barrier as a precaution

(a) **(b)**

Based on the information, we made an assumption that the damage perceived and the cost incurred was the accumulation costs from the last five years. Thus, we obtained the annual average damage cost incurred from the accumulation costs divided by 5. From the calculation, a flood might generate annual total damage costs per resident of around 1.9 million IDR per household.

Due to the high possibility of the damage generated, we deliberately categorised flood damage into three groups: 1) No flooding hazard (no impact at all, no costs required); 2) Mild flooding hazard (precautions were needed to prevent the damage: only precaution costs required); 3) Severe flooding hazard (precautions only minimised the damage, while the people would still perceive the flood impact, thus it required precaution costs, and damage costs incurred). The categorisation considered the facts found during the survey, which showed that only 12 respondents were impacted by the flood on their settlement so far. From these 12 respondents, only 7 respondents implemented precaution actions. One out of seven respondents indicated that her house was still impacted by the flood after conducting precaution, while the other 6 people did not say. The categorisation also presented the scenario of the process of how floods would worsen in the coming years. No-flooding hazard already occurred for settlement and ponds, and it would get worse annually, to mild flooding hazard and severe flooding hazard after several years within the 25-year timeframe.

In 2012, around 30% of household suffered from the flood (Soetrisno 2012). We used this number as a basis for both the settlement and aquaculture sector. However, considering that there were possibilities in the change of household numbers and the capability of residents on adaptation, mitigation and precaution against worsened flood annually, we decided to still use 30% as a percentage for the household suffered from the flood in 2016.

To estimate the value of mangroves as coastal protection against flood, implicitly estimation was conducted through the ECBA scenario. The benefit of mangroves in coastal protection against flood was the total damage derived by summing up the average of damage and precaution costs either in ponds and settlement and the economic losses of aquaculture production (Appendix 5). This benefit was presented by the declined damage and precaution cost, plus the increase in the aquaculture revenue within the first 7 years after the restoration (Appendix 7.3 and 7.4).

5.5 Coastal Erosion

During the interview, a local expert (Interview 2) indicated that the coastal erosion only occurred on specific sites. So far, the erosion only hit the ponds close to the coastline. The coastal erosion damaged neither settlement nor ponds far from coastline. Then, the condition of the village was still safe. However, similar to other villages, Tambakbulusan had no permanent coastal safety. In the study, we designed the impact of the erosion in the scenarios. It was categorised differently within the worst erosion case scenario and the best erosion case scenario (see chapter 4).

The scenario assumed that the erosion would erode the land and threaten the ponds and settlements. We estimated the economic impact of coastal erosion by comparing the economic impact generated by the policy alternative with and without restoration. The value estimation involved the value of land for different land use (for aquaculture, settlement or mangrove patches). We calculated the value of land through the value of the house, aquaculture and brushwood production from ponds (silvo-aquaculture), and ecosystem services provided by mangrove patches.

Regarding the economic value of a house, we found one respondent who bought a house as large as 72 m^2 cost around 50 million IDR in 2006. The value corresponds to 91.14 million IDR in 2016[4]. We also got additional information through personal communication with an officer from the village government regarding land price and the building costs of a new house. The officer said that to build a new house; averagely it cost between 100 million and 250 million IDR for around 81 m^2. The costs depended on materials used and the location. The most incurred costs were for labors and transporting the materials to the village. The land price was estimated at 5,000 to 8,000 IDR per m^2 for the settlement and around 10,000 IDR per m^2 for productive land (e.g. land for aquaculture pond)[5].

We estimated the value of the house through an estimation cost to build the new house. We did it through the survey, by asking the respondents about the possible minimum costs required to build a new house in the village. Based on the survey, we got the estimated total costs to build a house varied from 70 million to 150 million IDR for 60 m^2 to 130 m^2. We used the average value as representative of the costs to build a new house in the village. From the calculation, the average total costs to build a new house were around 1.263 million IDR per m^2.

Regarding the aquaculture production, we estimated the economic benefit of mangroves for coastal protection through the profit generated by silvo-aquaculture ponds. Silvo-aquaculture ponds produce aquaculture commodities and brushwood from the trees planted in the ponds. Thus, the value of mangroves is the combined profit from aquaculture commodities and brushwood production. We estimated the yield, revenue, and profit for both monoculture milkfish and improved polyculture milkfish and tiger shrimp (using MOL) system.

From the calculation, we found that the profit per hectare per cycle (IDR ha^{-1} $cycle^{-1}$) generated by the monoculture milkfish system was around 2.52 million IDR ha^{-1} $cycle^{-1}$ (5.04 million IDR ha^{-1} $year^{-1}$). The profit generated by improved polyculture milkfish and tiger shrimp (using MOL) was around 6.17 million IDR ha^{-1} $cycle^{-1}$ (12.34 million IDR ha^{-1} $year^{-1}$) (see chapter 6.2). The brushwood potential was around 229,680 IDR ha^{-1} $year^{-1}$. More details regarding aquaculture production, costs and benefit will be discussed in chapter 6.1 and 6.2.

Ecosystem goods and services provisioning on brushwood, aquatic organisms and nursery ground function are also declining. We predicted that the erosion would also hit the mangrove patches and destroy the ecosystem. Therefore, the provisioning of services would decline. More details on brushwood and aquatic organisms were already explained in chapter 5.2 and 5.3, while nursery ground function will be explained more detail in chapter 5.6.

Similar to the flooding hazard (see chapter 5.5), the total benefit of mangroves is implicitly estimated through the ECBA scenario. We obtained the benefit of mangroves as coastal protection against erosion from the total value of the settlement, silvo-aquaculture production and goods and services provisioning from mangrove patches. In the ECBA, we deliberately assumed different annual declining services provisioning rate by 4% for the worst erosion

[4] The value was Estimated using credit calculator and inflation data from Indonesia Statistic Bureau from http://www.simulasikredit.com/simulasi_past_value.php. Applies to all values that need to be adjusted

[5] The data was obtained through the personal communication to the village officer during the survey and fieldwork.

case and 2% for the best erosion case scenario. These percentages represented the declining rate from the total economic value within the initial year (2016). In addition to this, the decreasing rate used for the settlement was different. We used 10 % and 5% declining rate from the surface area in 2016 for the worst and the best erosion case scenario respectively. We made this assumption considering location of the settlement, the timeframe used (25 years) and the possibility of erosion hitting the land (Figure 5 & Figure 6) (linearity assumption between area and goods or services provisioning).

Considering the land used distribution as presented in Table 3, we estimated that the total damage of the erosion on settlements within 25 years for the worst erosion case scenario was 74 billion IDR, 34 billion IDR and 16 billion IDR with 5%, 10%, 15% discount rate, respectively. The best erosion case scenario only generated economic losses around 5 billion IDR, 2 billion IDR and 0.6 billion IDR for 5%, 10%, and 15% discount rate, respectively. The erosion damage on silvo-aquaculture ponds and mangrove patches was implicitly presented in the ECBA by the declining of the annual production of crops, brushwood from the pond also several services (brushwood, aquatic organisms and nursery ground function) from mangrove patches.

5.6 Maintenance of Fisheries (Mangroves as Nursery Ground)

Mangroves have a role on biological supporting function for the fishery sector. Valuing a supporting function of mangroves referred to assessing a service as an input to produce a good. In other words, the valuation involves the effect of mangroves on the flow of output from fisheries sector (Barbier & Strand, 1998).

Fish and other aquatic invertebrates may use the mangroves in some ways: some are only occasional visitors, some reside in the mangroves permanently, and some use them only at certain life stages (Manson et al., 2005). Different ways of interaction create different dependency levels between aquatic organisms and mangroves. Several studies have discussed the interaction process, such as mangroves for habitat (Rönnbäck, 1999), mangroves for breeding ground and nursery (Barbier, 2000; Barbier & Strand, 1998), and mangroves for nutrient retention and feeding ground (Barbier, 2000). However, we only focussed on the nursery ground function in this study.

We estimated the nursery ground function using the benefit transfer method (BTM). We used a study from Malik et al. (2015) in this research. We used the value from Malik et al. (2015) due to several reasons: 1) the study was conducted in Indonesia, and 2) the writer used the forgone benefit by estimating the loss of fishery production following the disappearance of mangrove. Malik et al. (2015) estimates the economic value of mangroves in South Sulawesi Indonesia to enable the comparison with the benefit generated by aquaculture sector. Malik et.al (2015) estimated the monetary value of the nursery function of mangrove forests at 2,292 USD ha^{-1} or 30.51 million[6] IDR ha^{-1}. Adjusted for the inflation in Indonesia, then the economic value regarding nursery function is 31.53 million IDR ha^{-1} $year^{-1}$.

[6] 1 USD is equal to 13.310 IDR. The value was obtained from the average value of IDR-USD rate from January 2016 to January 2017 from Bank Indonesia (BI). It applies to all values that need to be converted from IDR to USD.
Available at http://www.bi.go.id/en/moneter/informasi-kurs/transaksi-bi/Default.aspx

Chapter 6

Improving Aquaculture, and the Mangrove Restoration

Chapter 6. Improving Aquaculture and the Mangrove Restoration

6.1 Additional Costs for Improving Aquaculture Practices

To improve aquaculture practice, fish farmers needed to spend more cost: 1) costs of seeds (either milkfish or tiger shrimp); 2) costs of making MOL.

To switch commodity system to polyculture, the farmers have to buy either milkfish or shrimp seeds. Based on the interview with a local expert (Interview 3), most farmers preferred to have tiger shrimp instead of white leg shrimp. The fish farmers preferred to have tiger shrimp due to their better life performance and higher survival rate, even though they have a lower growth rate. In addition to this, white leg shrimp also require more intensive maintenance. Its vulnerability to the water quality (particularly the temperature), makes it difficult to be cultivated together with milkfish, especially during the rainy season. Thus, tiger shrimp could be an appropriate option as a complementary commodity for polyculture practices in the village.

Based on the interview (Interview 3), we found that fish farmers were used to stocking milkfish and tiger shrimp, which averagely was around 10 thousand heads for each commodity in 3 ha of ponds. Stocking milkfish and tiger shrimp costs around 1 million IDR and 500 thousand for milkfish and tiger shrimp seeds, respectively. Subsequently, we obtained that the costs of seeds per ha is 333 thousand IDR ha^{-1} $cycle^{-1}$ for milkfish and 167 thousand IDR ha^{-1} $cycle^{-1}$ for tiger shrimp.

Regarding MOL, the use of MOL is similar to the use of manure in the pond. During the survey, we found that all fish farmers already recognised the use of manure, but only 4 out of the 13 fish farmers used it. They used raw manure before the cultivation to maintain the nutrient on the soil. Unlike raw manure, MOL contains microbes that allow the fermentation. A local expert (Interview 3) also indicated several required materials to make MOL: barrels, plastic, rope and other supporting materials. Most fish farmers already have these materials. Thus, we did not take into consideration the costs of these materials as investment costs for making MOL.

A local expert (Interview 3) also said that MOL was made of several ingredients, such as rotten vegetables or fruits, goat or cow manure, yeast or bacteria seed, bran, and molasses (glucose). In the implementation, fish farmers added MOL to the pond as a natural fertiliser and fermented feed. The local expert also indicated that MOL could stabilise the water quality. It could increase the water temperature when the temperature decreases. Thus, fish farmers also used the MOL during rearing period, especially during the rainy season.

The previous BwNI report indicated that making MOL cost around 1,5 million IDR ha^{-1} (Rejeki et al., 2016). It already involved the use of MOL as manure (natural fertiliser) and fermented feed. In the calculation of ECBA, this cost would be incremental costs inserted in the operational costs for improving aquaculture practices (Scenario 2 and 4) (appendix 7).

6.2 The Benefit of Improving Aquaculture Practices

To value the improvement of aquaculture practices: firstly, total production of aquaculture system both with and without improvement must be estimated. Secondly, the production will be multiplied by the commodity price, thus arriving at the gross revenue. Thirdly, we subtracted the total costs from the gross income to calculate the profit. In this way, we assumed that the estimation disregarded optimum stocking density of milkfish and tiger shrimp. The stocking density used was only based on the experience of the farmers.

During the survey, all fish farmers indicated that they cultivated fish in 2 cycles per year. Each cycle lasted 4 to 5 months in which 1 month for preparation and 3 to 4 months for the rearing period. The first cycle was mostly conducted during the dry season (around April), while the second cycle was during the rainy season.

Furthermore, they also indicated that from stocking around 20,000 to 15,000 for both milkfish or tiger shrimp seeds, fish farmers could produce 400 to 500 kg per cycle of milkfish and around 80 to 100 kg of tiger shrimp from 2 to 3 ha of ponds or around 200 to 250 kg milkfish and 40 to 50 kg tiger shrimp per hectare. They further indicated that the average size of milkfish and tiger shrimp harvested was around 145 gr and 40 gr per species respectively. From these numbers, we estimated that the average survival rate for milkfish and tiger shrimp was 31.5% and 20% respectively.

A local expert said that the monoculture milkfish system was less vulnerable compared to monoculture shrimp. Even though cultivating shrimp could give high income, it is susceptible to diseases, also induced by extreme weather, and sudden floods. The polyculture system enables fish farmers to cultivate milkfish and shrimp at the same time. Thus fisher's productivity would increase. The polyculture system is considered able to boost economic value, as well as reduce the risk of shrimp culture.

The use of MOL also generated higher productivity. From the interview (Interview 3), we found that it is the extreme climate that mostly responsible for low productivity, such as a drop in temperature or flooding, which can lower the survival rate. UNDIP already assessed the impact of MOL in improved aquaculture under the BwNI project. They indicated that the use of MOL could increase the survival rate to 50% and 43% for milkfish and tiger shrimp respectively (Rejeki et al., 2017). In the analysis, these numbers will be used as a measured parameter to estimate the benefit of improving the aquaculture practice.

Table 6 Total Costs, Revenue and Profit on Aquaculture Practices with and without Improvement without discount rate.

No	Variable(s)	Initial aquaculture practices* (million IDR ha^{-1} $cycle^{-1}$)	Improved Aquaculture Practices** (million IDR ha^{-1} $cycle^{-1}$)
1	Total operational costs	1.5	2.1
2	Total Revenue	4.0	10.0
3	Profit	2.5	7.9

*Monoculture milkfish without MOL

**Polyculture milkfish and tiger shrimp with MOL (Based on Rejeki et al., 2016)

From the calculation, we found that improved aquaculture practices could increase aquaculture profit to 7.9 million IDR ha^{-1} $cycle^{-1}$ (Table 6). Considering that the total area of aquaculture is around 631 ha, hence, the total annual profit for initial and improved aquaculture practice is 3.2 billion IDR and 10 billion IDR per year.

6.3 Investments and Costs of Mangrove Restoration

6.3.1 Semipermeable Dams

The semipermeable dams consist of several sets of dam stretched along 45 m to 75 m for each dam. The building of semipermeable dams aims to trap the sediment carried by tides and the sea water current. The ability of the dam to trap the sediment varies depending on the location. During the interview (Interview 1), the expert indicated that the dam could accrete sediment up to 50 cm within three months and 80 cm in half year. The accretion is expected to be between 150 cm and 180 cm in one year.

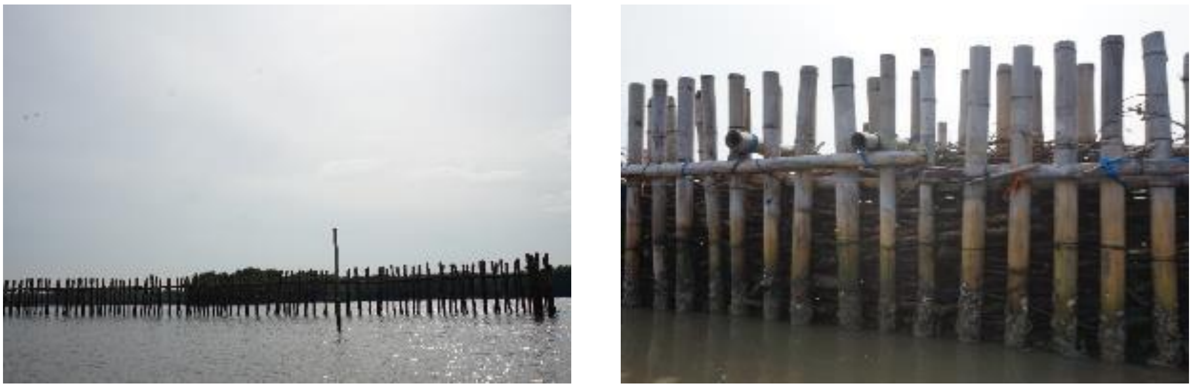

Figure 9 Construction of Semipermeable Dam

Regarding the restoration, the project already predicted that the dam might stay for 5 to 10 years, with consideration 2 to 5 years for accreting the sediment and 3 to 5 years for mangrove recovery. Afterward, the dam could be replaced by the function of mangroves (Tonneijck et al., 2015). Thus, considering that the natural sedimentation in the village is still good, we deliberately assumed that the dam needs to stay in place for 6 years (see chapter 4.2).

The investment costs include the preparation phase, which consisted of measurement, land preparation, and design. The preparation phase costs around 24 million IDR, while the supply materials and the installation cost 995 thousand IDR and 416 thousand IDR per meter. From chapter 4.2, we found that 2.6 km of the semipermeable dam was required to restore the sediment. We also know that building a completely a new dam is required as maintenance. Thus, for the annual maintenance of the dam, an equal amount was accounted without costs for preparation (Table 7).

Table 7 Total Costs and Annual Maintenance Costs of Building Semipermeable Dam

No	Description	Total costs in 1st year (Million IDR)	Costs of building Dam/ Annual Maintenance Costs (Million IDR)
1	Preparation	24	-
2	Supply Material	2,594	2,594
3	Installation of the Permeable Dam	1,086	1,086
Total Costs (1st year)		3,705	-
Annual Total Costs		-	3,681

6.3.2 Mangrove Planting and Replanting

Mangrove planting was already conducted by the local community in several villages along the coast of Demak. However, this was mainly on the dikes of ponds and along canals, and this does not provide coastal protection. Mangrove planting requires investment costs regarding several items such as seeds, labors and other materials. From the survey, the planting of 1 ha land needed 10,000 seedlings with a planting density of 1 seedling/m^2. These seedlings required 10,000 pieces of bamboo and also 2 kg of rope. Planting 1 ha of land required around 6 labourers per 1 working day and also a boat to carry the mangrove seeds from one site to another site. From this information, we estimated that the cost of planting 1 ha of mangrove is approximately 12 million IDR.

Also, for a successful mangrove planting, replanting mangroves was needed. Based on the interview (interview 2), local expert indicated that from experience, replanting required costs of 10% from the total planting costs. The local expert used this percentage after considering the good condition of natural sedimentation in the village. Thus, we estimated that the total cost of replanting was about 10% of the planting cost. Because the establishment of mangroves required almost five years, mangrove replanting should be conducted after initial planting for every year during four year period (2018-2021).

Table 8 Investments and Maintenance Costs of Mangrove (Re)Planting

No	Variables	Planting Costs (Million IDR)	Annual Replanting costs (Maintenance) (Million IDR)
1	Mangrove Seed	102.3	10.2
2	Bamboo	128	12.8
3	Rope	3.7	0.4
4	Labour	972	97.2
5	Boat + fuel	15.3	1.5
Total Cost		1,221	122.1

Based on Table 3 Coastal Land Use Distribution in Tambakbulusan with and without Mangrove Restoration, the village required around 102 ha of additional mangrove coverage area, consisting of an additional coastal greenbelt (74 ha) and riverine greenbelts (28 ha). In total, the cost for mangrove planting in Tambakbulusan was around 1,221 million IDR, and total annual replanting cost was around 122 million IDR (without discount rate) (Table 8).

6.3.3 Incremental Costs due to River Normalisation and Mangrove Planting

Table 3 indicates that the restoration must abandon 34 hectares of ponds. Abandoning ponds would incur an economic loss for fish farmers. The economic loss was due to the loss of productivity as the land is taken out of production. Thus, we estimated the economic loss using the value of land from the silvo-aquaculture production.

The profit generated by initial aquaculture (silvo-aquaculture) came from the yield of aquaculture and brushwood. As previously discussed in chapter 5.2 and 6.2, the economic value of brushwood from ponds and aquaculture production is 0.19 IDR ha^{-1} and 2.5 million IDR ha^{-1} $cycle^{-1}$ (5.04 million IDR ha^{-1} $year^{-1}$), respectively. Based on these numbers, we calculated the incremental costs of abandoning the pond by multiplying total abandoned pond area by the value. The annual economic losses from abandoning ponds are 180.2 million IDR $year^{-1}$.

6.4 The Benefit of Mangrove Restoration

Regarding coastal protection, we estimated that more mangroves could protect all of the total land area, of which the value is 5.6 billion IDR, and this could be the annual economic benefit generated. However, protecting the land requires costs. Also, the provisioning of environmental goods and services would increase as an impact of having more mangroves. Thus we implicitly calculated the value of mangroves as coastal protection in ECBA.

We estimated the NPV of the economic benefit of mangrove restoration by subtracting the total costs of restoration from the benefit of total mangroves. Regarding the impact of having more mangrove, we made an assumption that the change of the total area of mangrove would give a linear increment on the ecosystem services, meaning for example: doubling the total area of Mangrove would double the economic value.

The total area of mangroves generally would increase all the goods and services provided. However, the production of brushwood from silvo-aquaculture ponds would decline as an impact of the restoration. Regarding flood damages, mangroves cannot stop immediately the damages. They can only minimise the damages after the restoration, while the installation of the semipermeable dam could prevent the coastal erosion from the first years.

Based on Table 3, the total area of mangroves after restoration changed from 53.2 ha to 155.5 ha. Thus the annual economic benefit of having more mangroves would change as presented in Table 9.

Table 9 Net Benefit of Having Mangroves before and After Restoration

Ecosystem Goods and Services	**Net Benefit of Mangroves per ha** (million IDR $ha^{-1}year^{-1}$)	**Total Benefit of Mangroves before Restoration** (million IDR $year^{-1}$)	**Total Benefit of Mangroves after Restoration** (million IDR $year^{-1}$)
Brushwood from silvo-aquaculture ponds	2	118.5	114
Brushwood from mangrove patches	0.2	106.4	311
Aquatic Organisms	25.6	1,362	3,981.5
Coastal Protection against Flood	Implicitly calculated in the CBA	Incrementing losses (no benefit)	Reducing flood damages on ponds and settlements
Coastal Protection against Erosion	Implicitly calculated in the CBA	Incrementing losses (no benefit)	No economic loss (no erosion occurred)
Nursery Function	31.5	1,677	4,902.7

Chapter 7

Economic Appraisal and Policy Alternatives

Chapter 7. Economic Appraisal of Policy Alternatives

7.1 Economic Appraisal of the Worst Erosion Case Scenario

When 90 m year^{-1} erosion occurred, alternative 1 would generate a negative economic impact. We estimated economic losses of 40.6 billion IDR within 25 years, using a 5% discount rate. In contrast, the alternatives 2, 3 and 4 would generate a positive net economic impact of 14.2 billion IDR, 106.4 billion IDR, and 204.2 billion IDR, respectively, for a 5% discount rate (Table 10).

Table 10 Sensitivity Analysis of Net Present Value (NPV) for the Worst Erosion Case Scenario

No.	Discount Rate	Alternative 1 (BAU) (billion IDR)	Alternative 2 (billion IDR)	Alternative 3 (billion IDR)	Alternative 4 (billion IDR)
1	5%	- 40.6	14.2	106.4	204.2
2	10%	-4.7	37.7	57.2	121.7
3	15%	9.4	44.1	34.1	81.5

The sensitivity analysis shows that alternative 4 is the best policy alternative in all discount rate scenarios, while alternative 3 is the second best solution for the 5% and 10% discount rate. However, within the 15% discount rate, conducting mangrove restoration (alternative 3) seems worth less than conducting aquaculture improvement (alternative 2). This is indicated by higher total NPV generated by alternative 2 in comparison with the total NPV in alternative 3. This is likely because of the large investments during the early years of the restoration, and the benefit is perceived as less because it occurred later. However, due to the erosion, the aquaculture improvement might not provide any economic benefit after 25 years. Mangrove restoration could be an effective way in securing the land, and the long terms economic benefit of improving aquaculture.

7.2 Economic Appraisal of the Best Erosion Case Scenario

All the policy alternatives in the best erosion case scenario showed a positive economic impact during the 25 years, within all discount rate scenarios (Table 11). Alternative 4 is the best option, while alternative 2 is the second best solution for all discount rate scenarios. Alternative 3 is valued less than alternative 2, but still worth more than alternative 1. This could mean that, in this scenario, investing a high amount of money for mangrove restoration could be less economically beneficial than improving the aquaculture. However, considering that erosion can still occur after 25 years, and that the mangrove restoration was also intended for long term coastal protection, hence, investing in mangrove restoration might still be required. Thus, conducting aquaculture improvement together with mangrove restoration is an effective way to boost the productivity of the farmers, as well as securing the land and sustaining a long term, positive economic impact on the village.

Table 11 Sensitivity Analysis of Net Present Value (NPV) for the Best Case Scenario

No.	Discount Rate	Alternative 1 (BAU) (billion IDR)	Alternative 2 (billion IDR)	Alternative 3 (billion IDR)	Alternative 4 (billion IDR)
1	5%	33.7	105.1	106.4	204.2
2	10%	31.1	82.2	57.2	121.7
3	15%	27.6	67.4	34.1	81.5

7.3 Sensitivity Analysis on ECBA Input parameters

Besides erosion, there were several input parameters that might risk leading to an underestimation or overestimation of the ECBA result. An under or overestimation could be caused by the estimation of the mangrove ecosystem goods and services (e.g. Brushwood, aquatic organisms, coastal protection against flood and nursery ground function). In this chapter, we also did a sensitivity analysis to see the impacts of changes in the input parameter. However, due to time constraints, we restricted the analysis to only three parameters: nursery ground function, aquatic organisms, and flooding hazard.

7.3.1 No Benefit on Nursery Ground function

We developed the value of the nursery ground, in this research, from the benefit transfer methods (see Chapter 5.6). To see the impact of the nursery ground function in ECBA, we excluded this value from the analysis, which means nursery ground function benefit before and after restoration was 0 IDR.

In general, the exclusion of the nursery ground function will decrease the total NPV in all policy alternatives, as presented in Table 12. The analysis showed that Alternative 4 was still the best alternative, by generating a total NPV of 157.5 billion IDR in a 5% discount rate (Table 12). While in the best erosion case scenario, alternative 3 was still worth less than alternative 2. This could mean that the best way to do the restoration is to this together with the aquaculture improvement, then the benefit of both activities can be perceived optimally.

Table 12 The Impact of Changing Nursery Ground Parameter Value on the Policy Appraisal

No	Discount Rate	Alternative 1 (billion IDR)		Alternative 2 (billion IDR)		Alternative 3 (billion IDR)	Alternative 4 (billion IDR)
		TWC	TBC	TWC	TBC		
1	5%	-56.8	11.4	-1.9	82.8	59.7	157.5
2	10%	-17.3	15.6	25.1	66.7	30.2	94.7
3	15%	-0.9	15.8	33.8	55.6	16.5	63.9

[7]*TWC: the worst erosion case scenario; TBC: the best erosion case scenario*

[7] also applied for table 13-15

7.3.2 Reduction in Aquatic Organisms Value

Considering the multi-fishery condition and that we estimated the fishers' productivity from the revenue, there was always a possibility for the fishers to catch other fish species (non-mangrove related species). Thus, we conducted a sensitivity analysis by decreasing the economic value of aquatic organisms by 50%, to see its impact on the ECBA.

In general, the reduction of aquatic organisms' value by 50% would decrease the overall total NPV in all policy alternatives, and discount rates used. Based on the analysis, alternative 4 was still the best alternative in all discount rate scenarios. Alternative 3 was the second best alternative within the worst erosion case scenario, but it was worth less than the alternative 2 in best erosion case scenario (Table 13).

Table 13 The Impact of Changing Aquatic Organisms Parameter Value on the Policy Appraisal

No	Discount Rate	Alternative 1 (billion IDR)		Alternative 2 (billion IDR)		Alternative 3 (billion IDR)	Alternative 4 (billion IDR)
		TWC	TBC	TWC	TBC		
1	5%	-47.2	24.6	7.6	96.1	87.5	185.2
2	10%	-9.8	24.8	32.6	75.9	46.2	110.8
3	15%	5.2	22.8	39.9	62.6	26.9	74.4

7.3.3 No Increment Benefit on Fisheries after Restoration

The benefit of the mangrove restoration on fisheries (aquatic organisms and nursery ground function) was assumed linear to the total area of mangroves. Given that the relation between mangroves and fisheries is nearly impossible to be linear, many factors could also affect the fisheries productivity (not only mangroves). Thus we did a sensitivity analysis by considering no impact on fisheries after restoration (i.e. the benefit of mangrove before and after restoration was the same). We conducted this analysis to see the sensitivity of the economic impact of the restoration due to the possibility of fisheries benefit generated.

Table 14 The Impact of No Increment Benefit on Fisheries after Restoration on the Policy Appraisal

No	Discount Rate	Alternative 1 (billion IDR)		Alternative 2 (billion IDR)		Alternative 3 (billion IDR)	Alternative 4 (billion IDR)
		TWC	TBC	TWC	TBC		
1	5%	-40.6	33.7	14.2	105.1	67.7	165.4
2	10%	4.7	31.1	37.7	82.2	38.9	103.4
3	15%	9.4	27.6	44.1	67.4	24.8	72.2

The analysis in Table 14 shows that Alternative 4 was still generating the highest NPV in all discount rates for both erosion cases. When there is no increment of benefit of the fisheries sector after restoration, then Alternative 3 was the second best alternative in the worst erosion case scenario (only in 5% and 10% discount rate), while the alternative 2 was the second best alternative within the best erosion case scenario (in all discount rate scenarios).

7.3.4 No Benefit on Flooding Hazard

In this research, we assumed that flooding would stop after the restoration. However, the fact is that flooding was not only caused by having fewer mangroves. Land subsidence also made the village vulnerable. Thus, we did a sensitivity analysis to see the economic benefit of mangrove restoration when the restoration gave no benefit on coastal protection against floods.

When the restoration gave no benefit on flood protection, Alternative 4 was still the best alternative in all discount rates. Alternative 3 seemed to be the second best alternative to the worst erosion case scenario. However, in 10% and 15% discount rate, the total NPV of Alternative 3 was less than Alternative 2. Alternative 2 was the second best alternative to the best erosion case scenario (Table 15) within all discount rate scenarios.

Table 15 The Impact of No Benefit on Flooding Hazard after Restoration on the Policy Appraisal

No	**Discount Rate**	**Alternative 1 (billion IDR)**		**Alternative 2 (billion IDR)**		**Alternative 3 (billion IDR)**	**Alternative 4 (billion IDR)**
		TWC	TBC	TWC	TBC		
1	5%	-40.6	33.7	14.2	105.1	62.8	135.6
2	10%	-4.7	31.1	37.7	82.2	34.8	86.5
3	15%	9.4	27.6	44.1	67.4	21.4	61.5

7.3.5 The Most Pessimistic Condition

We also did a sensitivity analysis on the most pessimistic conditions, by considering that the mangrove restoration would only give a benefit for erosion but would have no impact on fisheries and flood prevention. It was conducted to see the minimum benefit that could be generated by the mangrove restoration.

Table 16 The Most Pessimistic Condition on the Policy Appraisal

No	**Discount Rate**	**Alternative 1 (billion IDR)**		**Alternative 2 (billion IDR)**		**Alternative 3 (billion IDR)**	**Alternative 4 (billion IDR)**
		TWC	TBC	TWC	TBC		
1	5%	-40.6	33.7	14.2	105.1	24.1	96.8
2	10%	-4.7	31.1	37.7	82.2	16.5	68.2
3	15%	9.4	27.6	44.1	67.4	12.1	52.1

The result showed that the Alternative 4 was still the best option within all discount rates used. In the worst erosion case scenario and 5% discount rate, Alternative 3 was still the second best, followed by the Alternative 2. However, in 10% and 15% discount rates, the Alternative 2 was the second best option (Table 16).

In the best erosion case scenario, the Alternative 3 generated the least economic benefit in comparison with other alternatives. However, the economic benefit generated in Alternatives 1 and 2 was not sustainable due to the erosion. Thus, mangrove restoration was still required to guarantee the sustainable economic benefit, even though no added benefit from fisheries and flood prevention was generated.

7.4 Net Present value (NPV) of the Economic Benefit

7.4.1 NPV of Improved Aquaculture

The economic benefit of improving aquaculture practices was calculated by subtracting the total NPV in Alternative 1 (BAU) from the NPV in Alternative 2 (improving aquaculture practices without mangrove restoration). Improving aquaculture would incur a positive economic impact (Table 17).

The best erosion case scenario generated a higher NPV in all discount rates. This is likely due to the fact there would still be productive ponds available after 25 years, while on the worst erosion case scenario there would be no more productive ponds after 25 years. The NPV also declined by the increase in the discount rate. However, it still showed a positive economic value, which could mean that improving the aquaculture could still be beneficial in every condition of discount rate and erosion.

Table 17 NPV of the Economic Benefit of Improved Aquaculture Practices within Different Discount Rates

NO	Discount Rate	The Worst Erosion Case Scenario (billion IDR)	The Best Erosion Case Scenario (billion IDR)
1	5%	54.8	71.5
2	10%	42.4	51.1
3	15%	34.7	39.8

7.4.2 NPV of Mangrove Restoration

We estimated the economic benefit of mangrove restoration by subtracting the total NPV of Alternative 1 (BAU) from the total NPV from Alternative 3 (Initial Aquaculture Condition with Mangrove Restoration).

In general, the analysis showed that mangrove restoration would give a positive economic impact in both erosion case scenarios (Table 18) within all discount rates. The negative economic impact was only derived in the most pessimistic condition, and also within 15% discount rate, when mangrove restoration gave neither fisheries benefit nor protection against the flooding hazards. Besides the erosion, the analysis showed that flooding hazard (FH) was the most influencing parameter, followed by fisheries (F). This could mean that when mangrove restoration would neither provide support to the fisheries nor protection against flooding hazard nor both benefits, the restoration would require an adjustment of the restoration technique to develop a better cost efficiency. Also, regarding flooding hazards, further activity for the prevention and mitigation might be required to solve the issue, e.g. resolve the land subsidence issue. In this matter, it might need more subvention from the government, as well as participation from other parties.

Table 18 NPV of the Economic Benefit of Mangrove Restoration within Different Discount Rates

No	Discount Rate	The Worst Erosion Case Scenario (billion IDR)						The Best Erosion Case Scenario (billion IDR)					
		I	NG	AO	F	FH	P	I	NG	AO	F	FH	P
1	5%	147.0	116.5	134.6	108.3	65.4	64.7	72.8	48.3	62.8	33.9	29.2	-9.6
2	10%	61.9	47.5	56.0	43.6	21.5	21.2	26.1	14.6	21.4	7.8	3.7	-14.6
3	15%	24.7	17.4	21.7	15.4	2.8	2.7	6.5	0.7	4.1	2.8	-6.2	-15.5

[8]*I: Initial condition (without changes on input parameter); NG: Changes on nursery ground function input parameter; AO: Changes on aquatic organisms input parameter; F: Changes on fisheries benefit after restoration (no added advantage from aquatic organisms and nursery ground function after restoration); FH: Changes on flooding hazard benefit after restoration (no additional flooding protection benefit after restoration); P: The most Pessimist condition (no added benefit from fisheries and protection against flood).*

7.4.3 NPV of Improved Aquaculture and Mangrove restoration

We estimated the economic benefit of improving aquaculture and mangrove restoration by subtracting the total NPV in the 1st scenario (BAU) from the total NPV in the 4th scenario (improving aquaculture with mangrove restoration).

Table 19 NPV of the Economic Benefit of Improving Aquaculture and Mangrove Restoration within Different Discount Rates

No	Discount Rate	The Worst Erosion Case Scenario (billion IDR)						The Best Erosion Case Scenario (billion IDR)					
		I	NG	AO	F	FH	P	I	NG	AO	F	FH	P
1	5%	244.8	214.2	232.4	206.0	138.2	137.4	170.5	146.1	160.6	131.7	101.9	63.1
2	10%	126.4	112.0	120.6	108.1	73.1	72.9	90.6	79.2	85.9	72.3	55.4	37.1
3	15%	72.1	64.8	69.1	62.8	42.8	42.7	53.9	48.1	51.6	44.6	33.9	24.5

[8] Also applied for Table 19

In general, conducting mangrove restoration and aquaculture improvement would generate a positive economic impact on all erosion case scenarios and for all discount rates (Table 19). The analysis showed that flooding hazards still became the most influential parameter, followed by fisheries benefit. When restoration gave no benefit on flooding hazard, the restoration only gave an economic benefit of 138.2 billion IDR and 101.9 billion IDR (at a 5% discount rate). When mangrove restoration would not give fisheries any benefit, the NPV derived was 206 billion IDR and 131.7 billion IDR (at a 5% discount rate) for the worst and the best erosion case scenarios, respectively. The result further showed that even in the most pessimistic condition, the NPV generated was still positive. All the positive values presented in Table 19 indicated that within all the conditions mentioned, conducting the mangrove restoration together with aquaculture improvement was important and could be the best alternative to secure the delta and improving fish farmers' productivity, even in the most pessimistic condition.

Chapter 8

Discussion and Conclusion

Chapter 8. Discussion and Conclusion

8.1 Research Overview and Findings

This research presents the economic appraisal of policy alternatives for coastal management (mangrove restoration and improving aquaculture) in Tambakbulusan village, Demak, Indonesia. Four policy alternatives in two different conditions of coastal erosion were assessed using an ECBA. In the ECBA, we used three methods in economic valuation (market price approach, benefit transfer methods and avoided damage cost method) to estimate the economic value of mangrove ecosystem goods and services. We used a cost-benefit analysis for estimating the profit on aquaculture as an ECBA input parameter. Using these values, we conducted an ECBA to estimate the economic appraisal of policy alternatives. We calculated the economic benefit of improved aquaculture and mangrove restoration by subtracting the total NPV in Alternative 1 from Alternative 2, 3, and 4.

Under different conditions, we found that both improving aquaculture and mangrove restoration were economically beneficial. It was indicated that the total NPV generated in Alternatives 2, 3 and 4 was higher than the first policy Alternative (BAU) (see chapter 7.1 & chapter 7.2). A decrease in the ECBA input parameter could generally decrease the NPV generated (see chapter 7.3 and 7.4). NPV of mangrove restoration was also highly dependent on the benefit of mangroves on flooding hazard and the fisheries sector (see Table 18). However, the result was robust, seen from the changes in each input parameter, Alternative 4 was still the best option. It was also supported by the total NPV, generated by improving aquaculture and mangrove restoration within all discount rates, and this was always the highest (see Table 19), in comparison with NPV for only either aquaculture improvement (Table 17) or mangrove restoration (Table 18).

In addition to this, the result also showed that when neither restoration nor aquaculture improvement was conducted, the village might suffer multibillion IDR economic losses (see Chapter 7.1). However, implementing the improvement of the aquaculture and mangrove restoration could generate a multi-billion IDR economic benefit, if both were conducted at the simultaneously (see Chapter 7.4.3). These numbers demonstrate the reasons for conducting the restoration and aquaculture improvement.

8.2 Economic Value of Mangrove Ecosystem

The different total value of mangroves could describe various goods and services involved in the valuation. Mostly, the services involved might refer to the main services used by the people. For instance, several studies derived the economic value of wood and brushwood by means of a survey to the community, because most people still used the products, for example as fuelwood (Cabrera et al., 1998; Costanza et al., 1998; Gunawardena & Rowan, 2005)

Even though the recent research has similar potential, our surveys found that only eight out of 43 people (18.60%) are still producing brushwood. Among them, only 3 people or 6.98% are extracting brushwood from mangrove patches (see chapter 5.2). This condition may occur due to the people having less interest in brushwood and thus, perceiving it as less necessary.

Therefore, the frequency and the yield of brushwood production is less than it is supposed to be. However, during our survey, we also found that another potential of brushwood is as filling materials for the semipermeable dam. These conditions show that although people already perceive brushwood as less valuable in their daily life, it may still have a value for another function. Thus, we estimated possible production generated by mangroves using the BTM and multiply it by the brushwood price to get its economic value.

Studies from Barbier et al., (2011); Costanza et al., (1998); Gunawardena & Rowan, (2005) indicate the economic value of aquatic organisms from between 466 USD ha^{-1} $year^{-1}$ to 585 USD ha^{-1} $year^{-1}$. This study calculated/used an economic value of aquatic organisms of 1,924 USD ha^{-1} $year^{-1}$ (25.6 million IDR ha^{-1} $year^{-1}$). Compared to another study, this research used a higher economic value in aquatic organisms. The latter may be because most studies of the ecosystem service valuation on capture fisheries focused on only a few commercial species in a particular type of fishery (Rönnbäck, 1999). While this study involved the estimation of 13 mangrove-dependent species including fish, penaeid, and crabs. The vast subject studied in this research provides the possibility to estimate the economic value of different fish. In other words, involving a bigger scope of the fishery, which is still related to mangroves, can likely prevent the undervaluation, but it also risks for overvaluing the ecosystem services at the same time.

Regarding coastal protection against erosion and flood, this study estimated the value implicitly in the ECBA. We did not use replacement costs from the expenses of building a dike, dam or other hard coastal protection as done by Wulandari (2015), Malik et al. (2015), Samonte-Tan et al. (2007), Sathirithai & barbier (2001) and Sathirathai (1995). It was due to the replacement costs cannot capture the real value of mangroves. We need the actual value of mangroves because BwNI used a nature-based solution (i.e. by having more mangroves for coastal protection), which can give more benefit not only in financial and economic perspectives but also in ecological terms. Therefore, we used avoided damage cost method to see the impact when no restoration conducted.

We estimated the real value of mangroves through the value of productive lands on silvo-aquaculture ponds, settlements and mangrove patches. In the study, we calculated the profit from fisheries (aquatic organisms) and silvo-aquaculture production to estimate the value of mangrove patches. Estimated price and market price were also used to assess the damages in settlements and silvo-aquaculture ponds. In this context, we put mangrove as an input into the production flow to generate the benefit, at the same time we also calculated the possible avoided damages by having mangroves as coastal protection. Thus, the real value of mangroves as natural protector can be implicitly captured by the ECBA.

8.3 Comparison with Other Mangrove Restoration Project

Mangrove restoration is widely carried out as a potential tool for the management of coastal ecosystem around the world. In Kenya, the restoration of mangrove ecosystem costs around 1,548.6 USD, with preparation and planting costs, and 143 USD for annual thinning and maintenance costs (Kairo et al., 2009). In a developed country such as the USA, the cost of mangrove restoration ranges from between 200 USD and 216,000 USD per ha, disregarding the cost of the land (Lewis, 2005). This study estimated the restoration costs around 20,934

USD ha^{-1}. The use of techniques involving restoration of hydrology and sediment, also conducting mangrove planting, led to high total costs. These three activities are considered crucial for a successful restoration rather than only conducting reforestation because unstable sediment and hydrological factors can lead to a low success rate of restoration (Lewis, 2001; Kamali & Hashim, 2011; Marchand, 2008).

The total economic benefit of mangroves varies between 2,700 to 149,200 USD ha^{-1} $year^{-1}$ [9] (Kairo et al., 2009). This research estimates the total NPV of the economic benefit of mangroves after restoration (it already involves the mangrove restoration costs and increment benefits due to having more mangroves) of between 72.8 billion IDR and 147 billion IDR for 25 years or between 1,407 USD and 2,841 USD ha^{-1} $year^{-1}$ (see chapter 7.4.2). Total economic benefit of mangroves in each case may vary due to different inclusion of ecosystem goods and services estimated. Such as Kairo et al. (2009), who included carbon sequestration, which we did not estimate in this research. In contrast, this research estimated the value of mangrove in coastal protection against flooding hazard, which is not estimated by Kairo et al. (2009). Indeed, ecosystem function is complex, and an estimation of the value of all ecosystem goods and services can lead to an enormous economic value. Therefore, the inclusion of goods and services in the estimation needs to be adjusted based on the urgency of the restoration. In other words, the measurement of the mangrove ecosystem benefit in each restoration project may be different due to different consideration in the inclusion of ecosystem goods and services estimated.

8.4 The Benefit of Improved Aquaculture

This study used the survival rate approach in the estimation to assess the impact generated by improved aquaculture. A higher survival rate, due to the use of MOL, will promote more production that can lead to more income. Moreover, allowing fish farmers to cultivate tiger shrimp would generate a higher income. Supported by a higher survival rate, polyculture milkfish, and tiger shrimp may be economically beneficial, particularly because MOL allows two commodities to have higher survival rate, thus it leads to having higher pond productivity and more income security.

8.5 The Result of Sensitivity Analysis

The sensitivity analysis result showed that changes in ECBA input parameter could influence the economic impact generated (see chapter 7). Modifying the value of the parameter, e.g. economic value of nursery ground and aquatic organisms, would change the whole total NPV in all policy alternatives (see chapter 7.3.1, and 7.3.2). Thus, it resulted in the change of NPV particularly for the mangrove restoration (see chapter 7.4, particularly chapter 7.4.2 and 7.4.3). The analysis result also indicated that the impact of the discount rate used could increase, as well as decrease the total NPV and NPV, and this depends on the value perceived of the economic loss and benefit occurring in the coming years. The different value seen in

[9] These numbers are obtained from a comparison between study by Kairo et al. (2009) and other studies in Kairo et al. (2009).

total NPV may be due to the concept of discount rate, which makes the value in the future worth less than the value in the present (see all tables in chapter 7).

The NPV of mangrove restoration is also quite sensitive to the ECBA input parameter. Given that mangrove restoration would not always succeed, and it might not always be able to give full benefit, either excluding several input parameters or decreasing the benefit of mangroves after restoration seemed to have a huge impact on the NPV. Based on the analysis, the biggest influence of the ECBA input parameter for mangrove restoration is erosion, followed by flooding hazard and impact of fisheries (see chapter 7.4.2).

The sensitivity analysis result showed that the Alternative 4 (improving aquaculture and mangrove restoration) could be the best policy alternative in every condition. It was robust considering that the total NPV generated by Alternative 4 (chapter 7.3) also the NPV generated by improving aquaculture and mangrove restoration (chapter 7.4.3) was always the highest within every condition and all discount rates. Conducting mangrove restoration only (alternative 3) has been already able to generate positive economic impacts (highlighted on the situation when it has neither flood benefit nor fisheries, see chapter 7.4.2) while implementing Alternative 2 would lead to more economic losses in the coming years. Improving aquaculture can be used as an additional way to boost the productivity of ponds, as well as to increase the economic impact of mangrove restoration. Therefore, implementing Alternative 4 (improving aquaculture and mangrove restoration) seems the best option in order to secure the delta in Tambakbulusan village.

8.7 Limitations

This study presented the impacts of mangrove restoration and improved aquaculture practices as planned in the BwNI project. However, this research had several limitations, which can influence the results and may have adverse consequences for the project: 1) exclusion of public property value in the economic valuation; 2) possible overvalued mangrove ecosystem goods and services; 3) exclusion of the ecological complexity of mangrove ecosystem; 4) exclusion of other supporting factors on aquaculture performance, and 5) the use of market wages of labour costs

8.7.1 Exclusion of Public Property Value in the Economic Valuation

Regarding the coastal protection value, this research disregards the possible damage generated on public property. Our assumption only concerns the private property disregarding the potential damage to public infrastructures such as bridges, main roads, village roads, mosques, offices, and schools. Excluding the damage and economic losses of public infrastructures leads to the underestimation of mangrove’s value. Thus, further research involving assessments on the damage and economic losses to public property may be needed to estimate a more precise economic value of the mangrove ecosystems. Thus it may allow the government (from village to district level) to allocate the budget for mangroves maintenance.

8.7.2 Possible Overestimation of Mangrove Ecosystem Goods and Services

Overestimation may come from the economic value of aquatic organisms. This study used average revenue generated by fishers assuming that all the fishers would extract mangrove-dependent fishery resources. This assumption disregards the possibility of fishers catching other species that are not related to the mangrove ecosystem. This assumption can obviously overvalue the aquatic organisms. We used this assumption due to the condition of the multi-fishery, in which we had difficulties to indicate the fishery season and targeted species by fisher, and this results in the difficulties to estimate the profit generated. Therefore, further research should be able to indicate the species targeted, as well as fishery season to enable the estimation of fishermen's profit and the value of aquatic organisms.

The overestimation of goods and services may also come from the value of brushwood and nursery function of the fisheries, which we estimated through the benefit transfer method (BTM), which has a huge risk of overestimation. The use of BTM is considered as a quick and dirty analysis but is simple in practice (Preston, 2015). The use of BTM remains the intrinsic value as an incalculable element of the benefit accruing from the ecosystem restoration or rehabilitation (Spurgeon, 1999). In addition to this, the underlying attributes of resource and ecosystem are space specific. This means that a mangrove ecosystem in one place may be different from a mangrove ecosystem in another location. This difference can also result in a difference in provisioning goods and services, which might be due to biotic and abiotic components and the interaction between them. This study used the BTM more due to the time constraint. Further research, especially regarding the nursery function, is needed in the specific case of Demak. Then, the ecological benefit can be defined properly, also the economic benefit can be estimated.

8.7.3 Exclusion of the Biological Complexity of Mangrove Ecosystem

The research assumes a linear interaction between the mangrove ecosystem and the ecosystem goods and services provided. Firstly, the linearity is a spatial relation between the benefit of mangrove restoration (especially DUV) and the total area of mangroves (i.e. we estimated the benefit of mangrove restoration by multiplying the total benefit of mangroves and total mangroves area). Secondly, the linearity is a temporal relation between the declining annual rate of ecosystem goods and services provisioning (e.g. 4% declining rate for aquatic organisms, brushwoods and nursery ground function in the worst erosion case scenario), and the timeframe used in the research (i.e. declining rate of goods and services provisioning based on 25 years of timeframe used, e.g. annual percentage by 4% would be 100% within 25 years). These linearity assumptions disregard the dynamic and the stochasticity of the mangrove ecosystem, which could misinterpret the economic value (Barbier et al., 2008), as well as overvalued net benefit.

Another disregarded biological complexity in this study is the time when mangroves start to give their ecological benefit after the restoration, and then when they reach a stable point. The assumption used is that the mangrove restoration starts giving benefits in the 7th year after restoration (5th year after planting) and becomes stable in the 16th year of restoration. We used this assumption based on the possible timeframe of the mangrove development, which could reach a stable point (i.e. also less vulnerable to natural dynamic condition) in the 5th

year after planting (based on interview result with a local expert: interview 2). However, the increase of ecosystem goods and services provided is not only because of the condition of mangroves. It may occur due to the dynamic of the estuarine environment in combination with the mangrove condition, also with other biotic and abiotic factors. Disregarding this biological complexity could overestimate the result. It becomes riskier when we use the concept of discount rate, in which the period when mangroves start providing goods and services, as well as reaching a stable point could misinterpret the net present value perceived. It seems to be important because the benefit, which comes later will be seen less, even though the incoming benefit is more than the benefit in the previous year. Hence, further research with further elaborate the biological complexity, which could help give a more precise benefit calculation.

8.7.4 Exclusion of Other Factors in Aquaculture Performance

For the aquaculture sector, this research only focused on higher survival rate and final gross revenue generated to estimate the net benefit of an improved aquaculture system. The increase of survival rate was an expression of a better aquaculture performance. However, this research disregards other factors that may influence the productivity, e.g. better growth rate and reduced costs due to healthier shrimp and earlier harvesting and marketing. Better growth rate could shorten the cultivation period, which results in enabling earlier harvesting and marketing thus towards a higher cost-efficiency. Disregarding these factors may lead to undervaluing the impact of the aquaculture production. Thus, further research regarding both factors to estimate the economic benefit of improved aquaculture is required because they can influence the result of ECBA.

8.7.5 The Use of Market Wages of Labour Costs

Several activities, such as mangrove planting and aquaculture (e.g. for harvesting) needed labor. This research used market wages for labor costs, at 80 thousand IDR per working hour. We used this cost from the experience of local experts (local expert on mangrove and fish farmer). However, this cost might be a minimum wage rate due to high unemployment in the village. The expenditure on labor may be a benefit to those newly employed, thus the opportunity cost in this context should be given 0 (New Zealand Treasury, 2015). In other words, this cost may not represent the real labor costs and the opportunity costs of labor in the village.

In addition to this, we still used this labor cost for analysing the economic impact generated by the mangrove restoration. In economic impact assessment (EIA), the expenditure of labor employment can be disregarded and treated as a contribution, and therefore as a benefit. Thus the inclusion of labor costs in the ECBA could underestimate the economic benefit of mangrove restoration. Further research should carefully determine the input data for ECBA analysis in order to obtain a better result (New Zealand Treasury, 2015).

8.8 Implications

Considering that the village has fewer mangroves and several villages surrounded (e.g. Bedono, Timbulsloko and Sayung) were already hit by floods and coastal erosion, the restoration may still be the best option for establishing long-term natural security. It could be a part of a mitigation and precaution action against the erosion and flood, not only in Tambakbulusan village but also in other coastal villages in the Demak District. Investing in the mangrove restoration and aquaculture improvement in Tambakbulusan is worthwhile, as proven by the positive net benefit generated in both erosion case scenarios, within all conditions and all discount rates. Thus, either governments, residents, or other parties should invest in it. The high investment cost in the starting years and the perception of the economic impacts of the restoration will take several years; this may implicate that investing huge investments in the restoration is not worthwhile. Therefore, the restoration in the village should be re-adjusted especially towards cost efficiency, or more subvention from government may be needed.

8.9 Conclusions and Recommendations

The findings of this research, regarding the research questions, are:

RQ1. What is the monetary value of the relevant ecosystem services provided by the mangrove ecosystem in the particular case of Tambakbulusan village, Demak, Indonesia?

Several mangrove ecosystem goods and services provided by the mangrove ecosystem in Tambakbulusan village were estimated, including aquatic organisms, brushwood, nursery ground function, coastal protection against erosion and flood. The economic value of aquatic organisms, brushwood (mangrove patches) and nursery function are 25.6 million, 2 million and 31.5 million IDR ha^{-1} $year^{-1}$ respectively. Regarding coastal protection, we estimated that more mangroves could protect all the total land area, in which the value of the land was 5.6 billion IDR (the value of 1 ha of mangroves is around 36 million IDR). However, this benefit also required costs for restoration. Thus, the net benefit of mangroves for coastal protection against erosion and flood was estimated implicitly using the ECBA through the productivity of silvo-aquaculture pond, as well as through the avoided potential damages incurred during the construction of ponds and settlement.

RQ2. What is the NPV of the economic benefit of investments to switch from the current aquaculture production systems (milkfish) to polyculture system (shrimp and milkfish) using MOL for fish farmers in Tambakbulusan village?

The NPV of improved aquaculture practices varies between 54.8 billion IDR and 71.5 billion IDR within 25 years for a 5% discount rate, or between 2.2 billion IDR and 2.9 billion IDR $year^{-1}$.

RQ3. What is the NPV of the economic benefit of investment to restore mangrove ecosystem for the local community in Tambakbulusan village?

The NPV of investing in mangrove restorations is between 147 billion IDR and 72.8 billion IDR within 25 years and 5% discount rate, or between 5.9 billion IDR and 2.9 billion IDR $year^{-1}$ when the erosion/abrasion (abrasion rate) is between 45 m and 90 m $year^{-1}$.

Either different erosion (AR) or discount rates induce different benefit perceived. A higher AR induces lower benefits, while a higher discount rate decreases the value of the net benefit. Decreasing or reducing the value of the ECBA input parameter for the mangrove ecosystem goods and services can reduce the NPV of the mangrove restoration. The most influencing parameter is erosion, followed by flooding hazard and fisheries impact.

In general, restoring mangroves and improving aquaculture are beneficial. Thus, both activities might become mitigation and a precaution activity for the residents against natural threats (flood and erosion), as well as an activity to boost the productivity of local fish farmers. However, if no mangrove restoration is conducted, the coastal area could be more vulnerable. Sea levels rise due to global warming, and land subsidence in the village would exacerbate this condition. Thus, further steps to secure the land of Demak may be required.

For further research, several points may improve the ECBA. The ECBA used in this research can be elaborated further regarding the: (1) ecological complexity from the mangrove ecosystem, (2) economic data from the improved aquaculture pond, (3) value of the public property, (4) the economic value of brushwood and nursery ground function. A better approach to estimate the latter two, may be needed because they can influence the long terms economic impacts in the ECBA.

Due to the high investment costs and perception of the economic impacts generated by the restoration, that will take several years, the mangrove restoration in the village should receive more subvention from government. The governments should involve residents and other parties in investing in it, in order for it to succeed. Also, the government should solve the land subsidence issue in the village, as floods in the village also occur because of land subsidence, and not only due to having less mangroves for coastal protection.

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Appendix 1. List of Interviewees and Topic of Interview

No	Name	Code	Institution	Position	Topics of Interview
1	Tom Willems	Interview 1	Witteveen&Bos	Expert	1. Construction of Semipermeable Dam 2. Investment Costs and Maintenance Costs of the Dam
2	Mat Fattullah and Dul Fattah (Made)	Interview 2	Mangrove Conservation Association	Local Expert on Mangrove, (Mat Fatullah is also working in village government)	1. Mangrove Planting 2. Investments on Mangrove Planting 3. Investment Costs and Maintenance Costs of Mangrove Planting
3	Ghofur	Interview 3	Local Fish Farmer	Local Expert on aquaculture	1. Costs of Switching from Monoculture Milkfish to Polyculture Milkfish and Tiger Shrimp. 2. Costs of Making MOL (mixed local fermented feed) 3. Operational Costs and the Revenue of Aquaculture Sector for Both monoculture and Polyculture systems.

A. Polyculture Farmers

1. What is the reason to choose this commodity?

2. What are the difficulties to produce this commodity?

3. What do the steps need to do and what do the investments need to have if you want to change your commodity system from monoculture milkfish to polyculture milkfish and shrimp system? *Please also indicate with the price and cost?
   (For ex-milkfish farmer that already become polyculture farmer)

Activities/Steps	Investments	Amount of unit	Price/unit	Total Cost
1.Recovering the land				
2.				
3.				
4.				

4. What are the difficulties to switch the commodity from monoculture milkfish to polyculture milkfish and shrimp?

B. Expert from BwNI project (Witteveen&Bos and Local Expert on Mangrove Planting)

1. How is the mangrove restoration project from BwNI?

2. What steps need to be done from the current land use for doing mangrove restoration? What is the cost needed? (e.g. Building semipermeable dam and its maintenance) please explain in detail and also indicate the costs?

Steps/activities	Explanation	Cost/unit (IDR)	Estimated Cost (IDR)
1) Building semipermeable dams 2) Maintenance of Dams 3) Repairing dams 4) Mud/sand nourishment 5) .... 6)			

3. (make sure first the plan to do replanting is true) What are investments needed to do mangrove replantation? And how much the cost needed?

Variables of Investment	Amount of units	Cost/unit (IDR)	Estimated Cost (IDR)
1) Mangrove Seeds 2) Planting labour 3) Other materials 4) Others............. 5) .... 6)			

4. What is the maintenance needed to keep the mangrove forests until it reaches maximum protection capacity? What is the cost needed to do the maintenance?

Maintenance Activities	Variables needed in maintenance	Amount of units	Cost/unit (IDR)	Estimated Cost (IDR)

5. How long does it take (from the first year of replanting) until the forest reaches its maximum protection capacity? (No more maintenance cost needed)

6. When do the people can start perceiving the benefit of mangrove? (Please indicate how many years needed from the first year of replanting)?
   Collecting Firewood:

   Collecting Fishes (Aquatic organisms)

   Perceiving Coastal Protection

7. When do the mangrove forests can reach its maximum capacity to provide its services? (Please indicate how many years needed from the first year of replanting)?
   Collecting Firewood:

   Collecting Fishes (Aquatic organisms)

   Perceiving Coastal Protection

Appendix 2. Questionnaires

Number : .... (G-1) Date : .... (G-2) Sub-village : .... (G-3)	Name of HH-heads : .... (G-4) Major Occupation : ....(G-5) Age : ....(G-6)

A. Respondent Condition

1. Family condition (A-1):
   a) How many people are living in the household? .... (A-1a)
   b) How many people in your household who work as (A-1b)
      Farmer... Person (A-1b1)
      Fisherman................................... Person(s) (A-1b2)
2. Land and house condition (A-2):
   a) Status of the land and house (A-2a):
      ☐ Rent ☐ self-owned
      **If rent,* how much do you cost the land? .... (A-2a1)
      (if rent, go directly to question 3 about house condition)
   b) Land and house-owning (A-2b)
      * Total area of land............................ m^2 (A-2b1)
      * When did you buy your land and house? (A-2b2)
      * How much did you pay for your land and house? (A-2b3)
      * How much would you pay if you have to buy this land and house recently? Or how much would you be willing to sell it if you have to sell this land and house recently? (A-2b4)
   c) Main material of house: ☐ Bamboo ☐ Wood ☐ Concrete ☐ mix.......... (A-2c)
   d) Estimated value of house.. IDR (A-2d)
3. How long is your family living here in the village and having this land? (A-3)
4. Could you describe the history of the family livelihood activities (A-4):
   a) Before 1990 (Before massive mangrove cutting) (A-4a)
   b) After 1990 (After massive mangrove cutting) (A-4b)
   c) Current Situation (A-4c)

B. Mangrove Benefits

	Before 1990 (B-1a)	Now (B-1b)
1. Do/did you get any goods from mangrove vegetation?	Yes/No/Don't know	Yes/No/Don't know

(If they say yes since before 1990, fill both tables)

Before 1990 (risky)

Benefit (B-1a1)	*Mangrove parts (B-1a2)	Species (B-1a3)	Frequency (B-1a4)		Quantity (kg/time) (B-1a5)	
			(days/week) (B-1a4a)	(Days/month) (B-1a4b)	(bundles/day) (B-1a5a)	(kg/bundle) (B-1a5b)
Food	F/L/B/T/R					
Firewood	F/L/B/T/R					
Fodder	F/L/B/T/R					
Building material	F/L/B/T/R					
Furniture	F/L/B/T/R					
Fishing gear	F/L/B/T/R					
Medicine	F/L/B/T/R					
Others........						

**F: fruit; L: leaf; B: branch; T: trunk; R: root.*

Now (2016)

Benefit (B-1b1)	*Mangrove parts (B-1b2)	Species (B-1b3)	Frequency (B-1b4)		Quantity (kg/time) (B-1b5)		Price/kg (IDR/kg) (B-1b6)
			(days/week) (B-1b5)	(Days/month) (B-1a5a)	(bundles/day) (B-1b5a)	(kg/bundle) (B-1b5b)	
Food	F/L/B/T/R						
Firewood	F/L/B/T/R						
Fodder	F/L/B/T/R						
Building material	F/L/B/T/R						
Furniture	F/L/B/T/R						
Fishing gear	F/L/B/T/R						
Medicine	F/L/B/T/R						
Others........							
....							

Before 1990 (B-2a) Now (B-2b)

2. Do/did you also get side catches from your pond? ....Yes/No/N.A........... Yes/No/N.A
(Ask this question to farmers only) (B-2)

Before 1990 (Risky)

Gears (B-2a1)	Species (B-2a2)	Frequency (B-2a3)			Quantity (kg/catch) (B-2a4)		
		Days/week (B-2a3a)	Days/month (B-2a3b)	Days/year (B-2a3c)	Total (B-2a4a)	Consumed (%) (B-2a4b)	Sold (%) (B-2a4c)

Now (2016)

Gears (B-2b1)	Species (B-2b2)	Frequency (B-2b3)			Quantity(kg/catch) (B-2b4)			Price/kg (B-2b5)
		Hours/day (B-2b3a)	Days/mounth (B-2b3b)	Days/year (B-2b3c)	Total (B-2b4a)	Consumed (%) (B-2b4b)	Sold (%) (B-2b4c)	

C. Impact on Fisheries

1. What kind of fishers are you? How are you fishing? (C-1)
   *Categories : ☐ boat with engine ☐ boat without engine (C-1a)
   ☐ without boat ☐ others ....
   *Local Name : .... (C-1b)

2. Status of the fishers (C-2)
   ☐ boat-owner ☐ On-board crew
   (if labor, go directly to question 4)
3. How long have you been working as Fisher? (C-4)
4. How far is/was your fishing ground from the shore mangrove area? (C-5)
   (Before 1990) ....km (C-5a); (now) .... km
5. Has your fishing routine changed from before 1990 and now? ....Yes/No/N.A (C-6)
   (Ask this question of whom already lived there since before 1990, **if yes*, indicate the answer to question 9-14 in both "before 1990" and "Now" section)
   Before 1990 Now
6. In which month do/did you go fishing (C-7)? .... (month) (C-7a) ....(month) (C-7b)
7. In which month do/did you not go fishing (C-8)? ....(month) (C-8a) ....(month) (C-8b)
   Why?.. (C-8c)
8. What kind of fishing gear do/did you use (C-9)? .... (gear) (C-9a) .... (gear) (C-9b)

No.	Fishing Gear	Estimated Price (IDR) Now (C-9c)	Before 1990 (C-9a)		Now (C-9b)	
			Fishing gear (C-9a1)	Replacement time (C-9a2)	Fishing gear (C-9b1)	Replacement time (C-9b2)
1	Net					
2	Hand Line					
3	Fish Trap					
4	Seine					
5	Others					

Before 1990 Now

9. What time do/did you go fishing (C-10)? .... AM/PM (C-10a)......... AM/PM (C-10b)
10. What time do/did you return from fishing (C-11)? .... AM/PM (C-11a) ....AM/PM (C-11b)
11. How many times do/did you go fishing? (C-12)
    **estimated:* in a week .... trip/week (C-12a1) .... trip/week (C-12a2)
12. What kind of fishes do you catch? And how many the average of total catches? (C-13)

Before 1990 (C-13a)

No.	Species (C-13a1)	Amount of catch (C-13a2)			Average total production (C-13a4)	Average total revenue (C-13a5)
		Low season (C-13a2a)	High season (C-13a2b)	Average (C-13a2c)		
1						
2						
3						
4						
5						
6						

Now (2016) (C-13b)

No.	Species (C-13b1)	Amount of catch (C-13b2)			Average Price (C-13b3)	Average total production (C-13b4)	Average total revenue (C-13b5)
		Low season (C-13b2a)	High season (C-13b2b)	Average (C-13b2c)			
1							
2							
3							
4							
5							
6							

13. Looking at the changes that you indicated in the previous questions (on months fishing, catch, and so on), what was the factor to trigger those changes? (like changes in technology, your own age, changes in the family, changes in fish abundance) (C-14)

14. Estimated cost (current cost) (C-15)
    - What are the fixed costs needed? (C-15a)

Variables (C-15a1)	Cost/month (IDR/month) (C-15a2)	Estimated cost/year (IDR/year) (C-15a3)
Maintaining boat (MB)		
Maintaining machine (MM)		
Machine Oil (MO)		
Maintaining fishing gear (MFG)		
Others............................ (O1)		
.... (O2)		
.... (O3)		
.... (O4)		

- What are the Variable/Operational Costs needed per trip? (C-15b)

Variables (C-15b1)	Amount of unit (C-15b2)	Price/unit (IDR/unit) (C-15b3)	Estimated cost per trip (IDR/trip) (C-15b4)
Fuel (F)			
Ice Cube (IC)			
Logistic (L)			
Bait (B)			
Others...................... (O1)			
.... (O2)			
.... (O3)			
.... (O4)			

D. Impact as Coastal Protection

-worst flood

(Do not forget to make sure that all the respondents will refer to one flood accident)

1. Did you perceive any impact from the flood in 2012? .... Yes/No/N.A (D-1)

(Please fill the table)

Impact (D-1a)		Item (D-1b1) and (D-1b2)	Number of lost/damaged (D-1c1) and (D-1c2)	Estimated cost/damage or loss (D-1d1) & (D-1d2)	Total Cost/ damage or loss (D-1e1) & (D-1e2)
	Loss of Property (D-1a1)	House (H)			
		Boats (B)			
		Fishing gears (traps) (FG)			
		Ponds (P)			
		Others ..... (O1)			
		.... (O2)			
		....			
		....			
	Damaged property (D-1a2)	House (H)			
		Boats (B)			
		Fishing gears (traps) (FG)			
		Ponds (P)			
		Others ..... (O1)			
		.... (O2)			
		....			
		....			

2. Do you do any precautions to minimize the impacts of the flood? ....Yes/No/N.A. (D-2)
3. *If yes*, how much do you pay for the precautions? .... IDR (D-3)

E. Aquaculture Production

5. Profile of farmer and aquaculture: *(E-1)*

a) Commodity(E-1a)

☐ Monoculture Milkfish (E-1a1) *☐ Monoculture White Shrimp (E-1a2)*

☐ Polyculture milkfish and tiger shrimp (E-1a3)

b) Pond Size .... ha (E-1b)

c) Density: milkfish.................................... (seed) (E-1c1)

Shrimp.................................... (seed) (E-1c2)

d) Average of Survival rate: milkfish.......................... % (E-1d1)

Shrimp............................ % (E-1d2)

6. What are the investments and costs need to do this practice? *(E-2)*

a) Investments and other fixed costs(E-2a)

Variables of investment *(E-2a1)*	Ammount of units *(E-2a2)*	Price/cost per unit *(E-2a3)*
1) Land 2) Water pumps 3) Shelter for pond keeper 4) Net 5) Sluice 6) Other construction tools 7)		

b) Operational/variables Cost (E-2b)

Variables *(E-2b1)*	Amount of units/ cycle *(E-2b2)*	Price/unit *(E-2b3)*	Total cost *(E-2b4)*
1) Taxes 2) Pond Rehabilitation 3) Daily Labour 4) Additional labour (preparation period) 5) Additional labour (harvest period) 6) Pond rental fee 7) (if they rent the pond) 8) Rates from investment loan 9) Rates from loan per cycle 10) Shrimp seeds 11) Daily Labour 12) Fertilizer (Manure) 13) Fertilizer TSP 14) Feed 15) Fuel 16) Electricity 17) Chalk (alkaline) 18) Pesticide 19) Probiotic 20) .... 21) .... 22) .... 23)			

7. How many kg(s)/tonnes the production in one cycle? And what is the revenue generated per cycle?* *(E-3)*

Commodity *(E-3a)*	Yield/cycle (kg/tonnes) *(E-3b)*	
	Total *(E-3b3)*	Price/ kg *(E-3c)*
1. Milkfish *(E-3a1)*		
2. Shrimp *(E-3a2)*		
3.		

**Indicate also productivity per hectare*

4. How many months need for one cycle?*(E-4)*
5. How many cycles in a year? *(E-5)*

Appendix 3. Brushwood Production and the Economic Value

Appendix 3.1 Estimation of the Economic Value of Brushwood per Hectare Mangrove per Year

No	**Weight Of Bundle Sold (Kg/Bundle)**	**Price/Kg (IDR/Kg)**	**Frequency Of Production Per Year (Times)**	**Production Per Time (Kg)**	**Production Per Year (Kg/Year)**	**Brushwood Production From Ponds**		**Brushwood Production From Mangrove Patches**			**Economic Value Of Brushwood/Ha/Year (IDR/Ha/Year)**	
						the total area of the pond (ha)	production per year per ha (kg/ha/year)	the total area of mangroves (ha) (survey)	production per year per ha (kg/ha/year) (survey)	Chow (2015) (Literature) average Kg/ha/year	from ponds	from mangrove patches
1	-	-	144	3	432	-	-	53	8	800	Rp 191,400	Rp 2,000,000
2	3	Rp 3,333	192	3	576	-	-	53	11			
3	4	Rp 2,000	96	1,5	144	2	72	-	-			
4	5	Rp 2,000	96	2	192	2.5	77	-	-			
5	3	Rp 2,667	144	4	576	-	-	53	11			
6	-	-	12	15	180	2	90	-	-			
7	-	-	12	6	72	1	72	-	-			
8	-	-	24	6	144	2	72	-	-			
Ave*	3.75	Rp 2,500	48	6	146	2	77					
Ave**	3.75	Rp 2,500	160	3	528	-	-	53	10			

***average of firewood used by the aquaculture farmer (ponds); ** average of firewood used by the local farmer (outside the pond)**

Appendix 3.2 Estimation of the Economic Value of Brushwood per Year with and without Mangrove Restoration

Estimated Potency Of Brushwood From Ponds (Kg/Year)		Estimated Economic Benefit Of Brushwood Potency From Ponds (IDR/Year)		Estimated Potency Of Brushwood From Mangrove Patches (Kg/Year)		Estimated Economic Benefit Of Brushwood Potency From Mangrove Patches (IDR/Year)	
Before Restoration	After Restoration	Before Restoration	After Restoration	Before Restoration	After Restoration	Before Restoration	After Restoration
48,707	41,875	Rp 121,768,680	Rp 104,688,144	42,560	113,952	Rp 106,400,000	Rp 284,880,000

Appendix 4. Aquatic Organisms Production and the Economic Value

Appendix 4.1 Category of Aquatic Organism Users

Fishing gear	Numbers	Unit	Categories	fishing ground indicated
Fishers	171	people	all gears	everywhere
Nets (trammel net and gill net)	45	People	with boat, passive gears	along the river, near the shore (< 1km)
Mini Longline	5	People		
Dredge Gear	4	People	with boat, active gears	inshore (1-4 km)
Mini Trawl	3	people		
Dredge Gear without boat	6	People	without boat	along the river and near the shore (<1km)
Fish Net	4	people		
Trap (for crabs)	75	people	Seasonal	inland (mangroves) and along pond irrigation
Others (handline and with hand)	29	people	without boat	along the river and near the shore (<1km)

Fishers with boat and passive gears = 50 people

Fishers with boat and active gears = 7 people

Fishers without boat = 39 people

Seasonal Fishers (for crabs) = 75 people

Farmers (Side Catches fishing = 220 people

Appendix 4.2 Profit Calculation of Seasonal Fishers

No	G-1	Production (kg/trip)	Total fixed cost (IDR/year)	Total operational Cost (IDR/trip)	Total Revenue (IDR/trip)	Trips/year	Total production/year (Kg/year)	Total cost/year (IDR/year)	Total Revenue/year (IDR/year)	profit/year
1	2	1.5	Rp 425,000	Rp 21,000	Rp 120,000	80	120	Rp 1,680,000	Rp 9,600,000	Rp 7,920,000
2	22	1.5	Rp 500,000	Rp 25,000	Rp 100,000	56	84	Rp 1,400,000	Rp 5,600,000	Rp 4,200,000
3	25	1	Rp 340,000	Rp 17,000	Rp 70,000	40	40	Rp 680,000	Rp 2,800,000	Rp 2,120,000
4	27	1	Rp 350,000	Rp 20,000	Rp 80,000	48	48	Rp 960,000	Rp 3,840,000	Rp 2,880,000
5	28	1	Rp 350,000	Rp 20,000	Rp 80,000	48	48	Rp 960,000	Rp 3,840,000	Rp 2,880,000
6	29	1,5	Rp 425,000	Rp 21,000	Rp 85,000	60	90	Rp 1,260,000	Rp 5,100,000	Rp 3,840,000
7	30	1	Rp 350,000	Rp 20,000	Rp 80,000	48	48	Rp 960,000	Rp 3,840,000	Rp 2,880,000
8	32	1,5	Rp 425,000	Rp 20,000	Rp 130,000	32	48	Rp 640,000	Rp 4,160,000	Rp 3,520,000

Average income/year			Average income/ha (mangroves)/year		
Total Cost/year	Total Revenue/year	Profit/year	Total Cost/year	Total Revenue/year	Profit/year
(IDR/year)	(IDR/year)	(IDR/year)	(IDR/year)	(IDR/year)	(IDR/year)
Rp 73,762,500	Rp 327,562,500	Rp 253,800,000	Rp 1,386,513	Rp 6,157,190	Rp 4,770,677

Average income/year (without rehabilitation)			Average Income/year (with rehabilitation)		
Total Cost/year	Total Revenue/year	Profit/year	Total Cost/year	Total Revenue/year	Profit/year
(IDR/year)	(IDR/year)	(IDR/year)	(IDR/year)	(IDR/year)	(IDR/year)
Rp 73,762,500	Rp 327,562,500	Rp 253,800,000	Rp 197,494,934	Rp 877,030,122	Rp 679,535,188

Appendix 4.3 Profit Calculation of Fishers without Boat

No	G-1	Production (kg/trip)	Total fixed cost (IDR/year)	Total operational Cost (IDR/trip)	Total Revenue (IDR/trip)	Trips/year	Total production/year (Kg/year)	Total cost/year (IDR/year)	Total Revenue/year (IDR/year)	profit/year
1	5	2	Rp 100,000	Rp 3,000	Rp 40,000	96	192	Rp 388,000	Rp 7,680,000	Rp 7,292,000
2	6	5	Rp 275,000	Rp 30,000	Rp 100,000	192	960	Rp 6,035,000	Rp 96,000,000	Rp 89,965,000
3	10	2	Rp 200,000	Rp 10,000	Rp 70,000	96	192	Rp 1,160,000	Rp 13,440,000	Rp 12,280,000
4	16	4	Rp 275,000	Rp 30,000	Rp 100,000	192	768	Rp 6,035,000	Rp 61,440,000	Rp 55,405,000
5	21	1,5	Rp 150,000	Rp 8,000	Rp 50,000	96	144	Rp 918,000	Rp 7,200,000	Rp 6,282,000
6	37	2	Rp 100,000	Rp 10,000	Rp 70,000	96	192	Rp 1,060,000	Rp 13,440,000	Rp 12,380,000
7	38	1,5	Rp 80,000	Rp 12,000	Rp 50,000	96	144	Rp 1,232,000	Rp 7,200,000	Rp 5,968,000
8	39	2,5	Rp 80,000	Rp 4,000	Rp 50,000	96	240	Rp 464,000	Rp 12,000,000	Rp 11,536,000
9	40	2	Rp 100,000	Rp 3,000	Rp 40,000	96	192	Rp 388.000	Rp 7,680,000	Rp 7,292,000
10	40	15	Rp 600,000	Rp 31,500	Rp 120,000	160	2400	Rp 5,640,000	Rp 19,200,000	Rp 13,560,000

Profit/year			profit /ha (mangroves)/year			
Handline	Fishnet	Dredge gear (Oyor)	Handline	Fishnet	Dredge gear (Oyor)	All Gear
Rp 261,124,286	Rp 314,880,000	Rp 81,360,000	Rp 5,969,919	Rp 14,616,541	Rp 1,529,323	Rp 22,115,784

profit /year (without restoration)				profit /year (without restoration)			
Handline	Fishnet	Dredge gear (Oyor)	All Gear	Handline	Fishnet	Dredge gear (Oyor)	All Gear
Rp 261,124,286	Rp 314,880,000	Rp 81,360,000	Rp 1,176,559,714	Rp 850,355,325	Rp 2,081,980,150	Rp 217,836,812	Rp 3,150,172,288

Appendix 4.4 Profit Calculation of aquatic organisms caught by fish farmers

No	G-1	Impes & posong (trap)				Net						Total profit/ year
		jinga shrimp				trip/year	Tilapia fish	whiting	seabass	total	Profit	
		yield	trip/year	yield/year	Profit		yield/year	yield/year	yield/year	yield/year		
1	7	0.5	80	40	Rp 1,200,000	12	9,6	6	0	15.6	Rp 174,000	Rp 1,374,000
2	8	1	80	80	Rp 2,400,000	12	12	12	0	24	Rp 240,000	Rp 2,640,000
3	11	2	40	80	Rp 2,400,000	4	20	0	0	20	Rp 300,000	Rp 2,700,000
4	12	0.1	120	12	Rp 360,000	4	4	4	0	8	Rp 80,000	Rp 440,000
5	13	1	80	80	Rp 2,400,000	4	12	8	0	20	Rp 220,000	Rp 2,620,000
6	15	1	40	40	Rp 1,200,000	6	9	6	0	15	Rp 165,000	Rp 1,365,000
7	20	0.5	80	40	Rp 1,200,000	3	0	3	3	6	Rp 105,000	Rp 1,305,000
8	22	1	120	120	Rp 3,600,000	6	0	6	6	12	Rp 210,000	Rp 3,810,000
9	24	1	80	80	Rp 2,400,000	8	0	16	8	24	Rp 320,000	Rp 2,720,000
10	26	0.8	120	96	Rp 2,880,000	6	6	3	3	12	Rp 195,000	Rp 3,075,000
11	33	0.7	80	56	Rp 1,680,000	6	9	0	0	9	Rp 135,000	Rp 1,815,000
12	36	1	40	40	Rp 1,200,000	8	5,6	0	0	5,6	Rp 84,000	Rp 1,284,000
13	42	1	40	40	Rp 1,200,000	12	6	6	6	18	Rp 300,000	Rp 1,500,000
Ave				61,85	Rp 1,855,385					14.55	Rp 194,462	Rp 2,049,846

Appendix 4.5.1 Profit Calculation of aquatic organisms caught by fish farmers with and without mangrove restoration

profit/ year	profit/ha (mangroves) /year	profit/year (before restoration)	profit/year (after restoration)
Rp 450,966,154	Rp 8,476,807	Rp 450,966,154	Rp 1,207,436,447

Appendix 5. Damage and Precaution Costs of Flooding

Appendix 5.1 Damage and Precaution Costs of Flooding on Pond

No	G-1	D-1a2			pond			E-1a			E-1b	cost/ha		Damage costs only	Damage cost & precaution costs
		Pond			D-2		D-3	E-1a1	E-1a2	E-1a3		costs of pond damage/ha	costs of precaution/ha		
		D-1c2	D-1d2	D-1e2											
1	7	25	Rp80,000	Rp 2,000,000	Yes, raising pond dyke	pond	Rp 1,120,000	v	-	-	2	Rp 1,000,000	Rp 560,000	-	Rp 1,560,000
2	8		-	-	Yes, raising pond dyke	pond	Rp 960,000	v	-	-	2	-	Rp 480,000	Rp 480,000	-
3	11	15	Rp80,000	Rp 1,200,000	Yes, raising pond dyke	pond	Rp 800,000	v	-	-	2	Rp 600,000	Rp 400,000	-	Rp 1,000,000
4	12	4	Rp80,000	Rp 320,000	yes, raising pond dyke	pond	Rp 200,000	v	-	-	0,4	Rp 800,000	Rp 500,000	-	Rp 1,300,000
5	13	-	-	Rp 10,000,000	yes, raising pond dyke	pond	Rp 2,240,000	v	-	-	2,5	Rp 4,000,000	Rp 896,000	-	Rp 4,896,000
6	15	-	-	Rp 2,500,000	yes, raising pond dyke	pond	Rp 1,200,000	-	v	-	2	Rp 1,250,000	Rp 600,000	-	Rp 1,850,000
7	20		-	-	Yes, raising pond dyke	pond	Rp 1,200,000	v	-	-	2	-	Rp 600,000	Rp 600,000	-
8	22	20	Rp80,000	Rp 1,600,000	Yes, raising pond dyke	pond	Rp 1,200,000	-	-	v	2,5	Rp 640,000	Rp 480,000	-	Rp 1,120,000
9	24	10	Rp80,000	Rp 800,000	-	-	-	v	-	-	2	Rp 400,000	-	Rp 400,000	-
10	26	6	Rp80,000	Rp 480,000	No	-	-	v	-	-	1	Rp 480,000	-	Rp 480,000	-
11	33	6	Rp80,000	Rp 480,000	No	-	-	v	-	-	1	Rp 480,000	-	Rp 480,000	-
12	36	10	Rp80,000	Rp 800,000	No	-	-	v	-	-	2	Rp 400,000	-	Rp 400,000	-
13	42	8	Rp80,000	Rp 640,000	No	-	-	v	-	-	1,5	Rp 426,667	-	Rp 426,667	-
Ave				Rp 1,892,727			Rp 1,115,000	average of total cost/ha						Rp 466,667	Rp 1,954,333

No flooding hazard		Mild Flooding Hazard		Severe flooding hazard	
cost/ha	cost/year	cost/ha	cost/year	cost/ha	cost/year
Rp -	Rp -	Rp 466,667	Rp 298,666,667	Rp 1,954,333	Rp 1,250,773,333,33

Appendix 5.2 Damage and Precaution Costs of Flooding on Aquaculture Production (Crops)

No	G-1	D-1a1			E-1a			E-1b	Loss of revenue (IDR)/ha	Losses: 50%	Losses: 87%	Losses: 100%
		Pond production (yield)			E-1a1	E-1a2	E-1a3					
		D-1c1	D-1d1	D-1e1								
1	7	75%	-	Rp 4,500,000	v	-	-	2	Rp 2,250,000	Rp 2,669,301	Rp 4,644,583	Rp 5,338,602
2	8	100%	-	Rp 5,950,000	v	-	-	2	Rp 2,975,000			
3	12	100%	-	Rp 1,250,000	v	-	-	0.4	Rp 3,125,000			
4	13	100%	-	Rp 20,000,000	v	-	-	2.5	Rp 8,000,000			
5	15	70%	-	Rp 28,000,000	-	v	-	2	Rp 14,000,000			
6	20	100%	-	Rp 9,000,000	v	-	-	2	Rp 4,500,000			
7	22	60%	-	Rp 8,000,000	-	-	v	2.5	Rp 3,200,000			
8	24	100%	-	Rp 7,200,000	v	-	-	2	Rp 3,600,000			
9	26	81%	-	Rp 4,400,000	v	-	-	1	Rp 4,400,000			
10	33	100%	-	Rp 4,000,000	v	-	-	1	Rp 4,000,000			
11	36	75%	-	Rp 6,250,000	v	-	-	2	Rp 3,125,000			
12	42	80%	-	Rp 3,840,000	v	-	-	1.5	Rp 2,560,000			
Average		87%	-	Rp 8,532,500	Average loss of revenue/ha (E-1a1)				Rp 4,644,583			

No flooding hazard (0%)		Mild flooding hazard (50%)		Severe flooding hazard (100%)		Average flooding hazard (87%)	
Cost/ha	cost/year	Cost/ha	cost/year	Cost/ha	cost/year	Cost/ha	cost/year
Rp -	Rp -	Rp 2,669,301	Rp 1,708,352,490	Rp 5,338,602	Rp 3,416,704,981	Rp 4,644,583	Rp 2,972,533,333

Appendix 5.3 Damage and Precaution Costs of Flooding on the Settlement

No	G-1	D-1a2				house			Precaution costs /household	Damage costs /household	Precaution + damage (costs) / household
		House				D-2		D-3			
		D-1c2	D-1d2	D-1e2 (Accumulation)	damage/year						
1	1	-	-	-	-	Yes, raising yard	yard	Rp 1,800,000	Rp 1,757,143	Rp 1,920,000	Rp 3,677,143
2	10	-	-	-	-	Yes, raising yard	yard	Rp 1,500,000			
3	14	-	-	Rp 5,000,000	Rp 1,000,000	-	-	-			
4	24	-	-	-	-	yes, raising house	house	Rp 2,500,000			
5	25	-	-	-	-	Yes, raising yard	yard	Rp 2,000,000			
6	27	-	-	Rp 5,000,000	Rp 1,000,000	-	-	-			
7	28	-	-	Rp 20,000,000	Rp 4,000,000	No	-	-			
8	30	-	-	Rp 6,000,000	Rp 1,200,000	No	-	-			
9	32	-	-	-	-	Yes, raising yard	yard	Rp 2,000,000			
10	33	-	-	Rp 12,000,000	Rp 2,400,000	No	-	-			
11	42	-	-	-	-	Yes, raising yard	yard	Rp 1,500,000			
12	43	-	-	-	-	yes, raising yard	yard	Rp 1,000,000			
Average		-	-	Rp 9,600,000	Rp 1,920,000	Average		Rp 1,757,143			

No flooding hazard		Mild flooding hazard		Severe flooding hazard		Estimated Costs/ha (settlement)/year		
cost/household	cost/year	cost/ household	cost/year	cost/household	cost/year	No Flooding Hazard	Mild flooding hazard	Severe flooding hazard
Rp -	Rp -	Rp 1,757,143	Rp 1,273,928,571	Rp 3,677,143	Rp 2,665,928,571	Rp -	Rp 93,671,218	Rp 196,024,160

Appendix 6. Possible Damage Costs of the Erosion

Appendix 6.1 Possible Damage Costs of the Erosion on Settlement

No	G-1	G-5	A-2a	A-2c	A-2b1 (m2)	A-2d	No Erosion	Full Erosion
1	4	51	self-owned	concrete	72	Rp 100,000,000		
2	10	35	self-owned	concrete	72	Rp 80,000,000		
3	24	67	self-owned	concrete	130	Rp 120,000,000		
4	25	32	self-owned	concrete	84	Rp 100,000,000		
5	26	52	self-owned	concrete	63	Rp 150,000,000		
6	27	32	self-owned	mixed	60	Rp 70,000,000		
7	30	30	self-owned	mixed	60	Rp 75,000,000		
8	31	34	self-owned	concrete	80	Rp 100,000,000		
9	33	63	self-owned	mixed	72	Rp 80,000,000		
Average					77	Rp 97,222,222		
Value of asset (IDR/m2)						Rp 1,262,626		
Total accumulation of damage costs							Rp -	Rp 17,171,717,172
average of damage cost/year								Rp 1,717,171,717

Appendix 6.2 Possible Damage Costs of the Erosion on Aquaculture Production (Crops)

No	Variables	Profit/ha (pond)/cycle (IDR)	Profit/ha (pond)/year (IDR)	profit/ year (IDR)	Unit
1	Profit from Crops from traditional Monoculture Milkfish	Rp 2,523,537	Rp 5,047,075	Rp 3,230,127,744	IDR/ha/year
2	Profit Crops from improved (using MOL) Polyculture Milkfish and Tiger Shrimp	Rp 6,166,117	Rp 12,332,233	Rp 7,892,629,333	IDR/ha/year

Appendix 7. Environmental Cost Benefit Analysis (ECBA)

Appendix 7.1 CBA for Scenario 1 (BAU)

Appendix 7.1.1 BAU for the Worst Erosion Case Scenario

		2016	2017	2018	2019	2020	2021
Benefit of the presence of mangrove currently	**Brushwood (Silvofishery ponds)**	Rp 118.476.600	Rp 113.737.536	Rp 108.998.472	Rp 104.259.408	Rp 99.520.344	Rp 94.781.280
	Brushwood (Mangrove Patches)	Rp 106.400.000	Rp 102.144.000	Rp 97.888.000	Rp 93.632.000	Rp 89.376.000	Rp 85.120.000
	Aquatic Organisms	Rp 1.362.130.440	Rp 1.348.509.135	Rp 1.334.887.831	Rp 1.321.266.526	Rp 1.307.645.222	Rp 1.294.023.918
	Maintenance of fisheries	Rp 1.677.261.723	Rp 1.660.489.106	Rp 1.643.716.489	Rp 1.626.943.872	Rp 1.610.171.254	Rp 1.593.398.637
Potential losses due to no intervention (no mangrove restoration	**Erossion hazard (losses of assets: settlements)**	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
	Flooding hazard on settlement (damage costs and precaution cos	Rp 382.178.571	Rp 471.353.571	Rp 560.528.571	Rp 649.703.571	Rp 738.878.571	Rp 828.053.571
Traditional Monoculture Milkfish	Reconstruction (labour)	Rp 841.566.336	Rp 807.903.683	Rp 774.241.029	Rp 740.578.376	Rp 706.915.722	Rp 673.253.069
	Saponin (herbal medicine	Rp 46.286.148	Rp 44.434.703	Rp 42.583.257	Rp 40.731.811	Rp 38.880.365	Rp 37.028.919
	Kompos (manure fertiliser)	Rp 20.829.600	Rp 19.996.416	Rp 19.163.232	Rp 18.330.048	Rp 17.496.864	Rp 16.663.680
	Milkfish seed	Rp 631.200.000	Rp 605.952.000	Rp 580.704.000	Rp 555.456.000	Rp 530.208.000	Rp 504.960.000
	Water pump rent fee	Rp 189.360.000	Rp 181.785.600	Rp 174.211.200	Rp 166.636.800	Rp 159.062.400	Rp 151.488.000
	Fuel	Rp 46.276.428	Rp 44.425.371	Rp 42.574.314	Rp 40.723.257	Rp 38.872.200	Rp 37.021.142
	harvesting labour	Rp 151.488.000	Rp 145.428.480	Rp 139.368.960	Rp 133.309.440	Rp 127.249.920	Rp 121.190.400
	Operational Cost	Rp 1.927.006.512	Rp 1.849.926.252	Rp 1.772.845.991	Rp 1.695.765.731	Rp 1.618.685.470	Rp 1.541.605.210
	***Additional costs due to flooding (damage and precaution)**	Rp 88.368.000	Rp 113.111.040	Rp 108.398.080	Rp 129.606.400	Rp 123.715.200	Rp 216.510.016
	Milkfish Production	Rp 4.729.266.000	Rp 4.417.390.080	Rp 4.233.332.160	Rp 3.936.794.400	Rp 3.757.849.200	Rp 3.374.395.200
	Revenue	Rp 4.729.266.000	Rp 4.417.390.080	Rp 4.233.332.160	Rp 3.936.794.400	Rp 3.757.849.200	Rp 3.374.395.200
Cash Flow		Rp5.595.981.679	Rp5.207.878.994	Rp4.977.050.309	Rp4.607.820.503	Rp4.383.282.778	Rp3.855.550.237
Present Value (Discount Rate 5%)	**5%**	Rp5.595.981.679	Rp4.959.884.756	Rp4.514.331.346	Rp3.980.408.598	Rp3.606.137.589	Rp3.020.924.497
Present Value (Discount Rate 10%)	**10%**	Rp5.595.981.679	Rp4.734.435.449	Rp4.113.264.718	Rp3.461.923.744	Rp2.993.841.116	Rp2.393.993.354
Present Value (Discount Rate 15%)	**15%**	Rp5.595.981.679	Rp4.528.590.429	Rp3.763.365.073	Rp3.029.716.777	Rp2.506.156.155	Rp1.916.889.880

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Rp 90.042.216	Rp 85.303.152	Rp 80.564.088	Rp 75.825.024	Rp 71.085.960	Rp 66.346.896	Rp 61.607.832	Rp 56.868.768	Rp 52.129.704	Rp 47.390.640
Rp 80.864.000	Rp 76.608.000	Rp 72.352.000	Rp 68.096.000	Rp 63.840.000	Rp 59.584.000	Rp 55.328.000	Rp 51.072.000	Rp 46.816.000	Rp 42.560.000
Rp 1.266.781.309	Rp 1.225.917.396	Rp 1.171.432.178	Rp 1.103.325.656	Rp 1.021.597.830	Rp 926.248.699	Rp 817.278.264	Rp 653.822.611	Rp 490.366.958	Rp 354.153.914
Rp 1.559.853.403	Rp 1.509.535.551	Rp 1.442.445.082	Rp 1.358.581.996	Rp 1.257.946.292	Rp 1.140.537.972	Rp 1.006.357.034	Rp 805.085.627	Rp 603.814.220	Rp 436.088.048
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp 17.171.717.172	Rp 17.171.717.172	Rp 17.171.717.172
Rp 1.014.668.571	Rp 1.201.283.571	Rp 1.387.898.571	Rp 1.574.513.571	Rp 1.761.128.571	Rp 1.858.568.571	Rp 1.956.008.571	Rp 1.848.103.714	Rp 1.720.710.857	Rp 1.573.830.000
Rp 639.590.415	Rp 605.927.762	Rp 572.265.108	Rp 538.602.455	Rp 504.939.802	Rp 471.277.148	Rp 437.614.495	Rp 403.951.841	Rp 370.289.188	Rp 336.626.534
Rp 35.177.473	Rp 33.326.027	Rp 31.474.581	Rp 29.623.135	Rp 27.771.689	Rp 25.920.243	Rp 24.068.797	Rp 22.217.351	Rp 20.365.905	Rp 18.514.459
Rp 15.830.496	Rp 14.997.312	Rp 14.164.128	Rp 13.330.944	Rp 12.497.760	Rp 11.664.576	Rp 10.831.392	Rp 9.998.208	Rp 9.165.024	Rp 8.331.840
Rp 479.712.000	Rp 454.464.000	Rp 429.216.000	Rp 403.968.000	Rp 378.720.000	Rp 353.472.000	Rp 328.224.000	Rp 302.976.000	Rp 277.728.000	Rp 252.480.000
Rp 143.913.600	Rp 136.339.200	Rp 128.764.800	Rp 121.190.400	Rp 113.616.000	Rp 106.041.600	Rp 98.467.200	Rp 90.892.800	Rp 83.318.400	Rp 75.744.000
Rp 35.170.085	Rp 33.319.028	Rp 31.467.971	Rp 29.616.914	Rp 27.765.857	Rp 25.914.800	Rp 24.063.743	Rp 22.212.685	Rp 20.361.628	Rp 18.510.571
Rp 115.130.880	Rp 109.071.360	Rp 103.011.840	Rp 96.952.320	Rp 90.892.800	Rp 84.833.280	Rp 78.773.760	Rp 72.714.240	Rp 66.654.720	Rp 60.595.200
Rp 1.464.524.949	**Rp 1.387.444.689**	**Rp 1.310.364.428**	**Rp 1.233.284.168**	**Rp 1.156.203.907**	**Rp 1.079.123.647**	**Rp 1.002.043.386**	**Rp 924.963.126**	**Rp 847.882.865**	**Rp 770.802.605**
Rp 205.684.515	**Rp 283.676.429**	**Rp 267.916.627**	**Rp 331.105.638**	**Rp 310.411.536**	**Rp 358.797.645**	**Rp 333.169.242**	**Rp 366.752.448**	**Rp 336.189.744**	**Rp 305.627.040**
Rp 3.205.675.440	Rp 2.852.897.760	Rp 2.694.403.440	Rp 2.372.302.080	Rp 2.224.033.200	Rp 1.932.608.160	Rp 1.794.564.720	Rp 1.533.816.000	Rp 1.405.998.000	Rp 1.278.180.000
Rp 3.205.675.440	**Rp 2.852.897.760**	**Rp 2.694.403.440**	**Rp 2.372.302.080**	**Rp 2.224.033.200**	**Rp 1.932.608.160**	**Rp 1.794.564.720**	**Rp 1.533.816.000**	**Rp 1.405.998.000**	**Rp 1.278.180.000**
Rp3.518.338.331	Rp2.877.857.169	Rp2.495.017.161	Rp1.839.227.378	Rp1.410.759.267	Rp828.835.863	Rp443.914.650	-Rp17.210.871.454	-Rp17.477.375.756	-Rp17.663.604.214
Rp2.625.438.233	Rp2.045.239.361	Rp1.688.725.823	Rp1.185.582.367	Rp866.083.812	Rp484.603.163	Rp247.188.288	-Rp9.127.292.595	-Rp8.827.262.397	-Rp8.496.495.641
Rp1.986.010.265	Rp1.476.795.770	Rp1.163.943.919	Rp780.011.951	Rp543.908.768	Rp290.501.914	Rp141.444.888	-Rp4.985.376.404	-Rp4.602.339.280	-Rp4.228.526.412
Rp1.521.074.752	Rp1.081.893.106	Rp815.625.536	Rp522.823.211	Rp348.718.115	Rp178.152.652	Rp82.970.822	-Rp2.797.247.770	-Rp2.470.054.061	-Rp2.170.759.547

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	Total Cash Flow & NPV
Rp 42.651.576	**Rp 37.912.512**	**Rp 33.173.448**	**Rp 28.434.384**	**Rp 23.695.320**	**Rp 18.956.256**	**Rp 14.217.192**	**Rp 9.478.128**	**Rp 4.739.064**	**Rp -**	
Rp 38.304.000	**Rp 34.048.000**	**Rp 29.792.000**	**Rp 25.536.000**	**Rp 21.280.000**	**Rp 17.024.000**	**Rp 12.768.000**	**Rp 8.512.000**	**Rp 4.256.000**	**Rp -**	
Rp 245.183.479	**Rp 149.834.348**	**Rp 108.970.435**	**Rp 81.727.826**	**Rp 68.106.522**	**Rp 54.485.218**	**Rp 40.863.913**	**Rp 27.242.609**	**Rp 13.621.304**	**Rp -**	
Rp 301.907.110	**Rp 184.498.790**	**Rp 134.180.938**	**Rp 100.635.703**	**Rp 83.863.086**	**Rp 67.090.469**	**Rp 50.317.852**	**Rp 33.545.234**	**Rp 16.772.617**	**Rp -**	
Rp 17.171.717.172	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp -**	**Rp -**	**Rp -**	
Rp 1.407.461.143	**Rp 1.221.604.286**	**Rp 1.016.259.429**	**Rp 791.426.571**	**Rp 533.185.714**	**Rp 266.592.857**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp 302.963.881	Rp 269.301.228	Rp 235.638.574	Rp 201.975.921	Rp 168.313.267	Rp 134.650.614	Rp 100.987.960	Rp 67.325.307	Rp 33.662.653	Rp -	
Rp 16.663.013	Rp 14.811.568	Rp 12.960.122	Rp 11.108.676	Rp 9.257.230	Rp 7.405.784	Rp 5.554.338	Rp 3.702.892	Rp 1.851.446	Rp -	
Rp 7.498.656	Rp 6.665.472	Rp 5.832.288	Rp 4.999.104	Rp 4.165.920	Rp 3.332.736	Rp 2.499.552	Rp 1.666.368	Rp 833.184	Rp -	
Rp 227.232.000	Rp 201.984.000	Rp 176.736.000	Rp 151.488.000	Rp 126.240.000	Rp 100.992.000	Rp 75.744.000	Rp 50.496.000	Rp 25.248.000	Rp -	
Rp 68.169.600	Rp 60.595.200	Rp 53.020.800	Rp 45.446.400	Rp 37.872.000	Rp 30.297.600	Rp 22.723.200	Rp 15.148.800	Rp 7.574.400	Rp -	
Rp 16.659.514	Rp 14.808.457	Rp 12.957.400	Rp 11.106.343	Rp 9.255.286	Rp 7.404.228	Rp 5.553.171	Rp 3.702.114	Rp 1.851.057	Rp -	
Rp 54.535.680	Rp 48.476.160	Rp 42.416.640	Rp 36.357.120	Rp 30.297.600	Rp 24.238.080	Rp 18.178.560	Rp 12.119.040	Rp 6.059.520	Rp -	
Rp 693.722.344	**Rp 616.642.084**	**Rp 539.561.823**	**Rp 462.481.563**	**Rp 385.401.302**	**Rp 308.321.042**	**Rp 231.240.781**	**Rp 154.160.521**	**Rp 77.080.260**	**Rp -**	
Rp 275.064.336	**Rp 274.550.118**	**Rp 240.231.354**	**Rp 228.448.954**	**Rp 190.374.128**	**Rp 167.323.546**	**Rp 125.492.659**	**Rp 91.173.894**	**Rp 45.586.947**	**Rp -**	
Rp 1.150.362.000	Rp 981.642.240	Rp 858.936.960	Rp 705.555.360	Rp 587.962.800	Rp 449.919.360	Rp 337.439.520	Rp 214.734.240	Rp 107.367.120	Rp -	
Rp 1.150.362.000	**Rp 981.642.240**	**Rp 858.936.960**	**Rp 705.555.360**	**Rp 587.962.800**	**Rp 449.919.360**	**Rp 337.439.520**	**Rp 214.734.240**	**Rp 107.367.120**	**Rp -**	
-Rp17.769.556.830	-Rp17.896.577.770	-Rp17.802.715.996	-Rp17.712.184.986	-Rp17.495.770.588	-Rp17.306.479.314	-Rp17.072.844.136	Rp48.177.796	Rp24.088.898	Rp0	**-Rp133.294.200.030**
-Rp8.140.438.724	-Rp7.808.217.601	-Rp7.397.396.209	-Rp7.009.313.052	-Rp6.593.971.930	-Rp6.212.028.609	-Rp5.836.349.567	Rp15.685.308	Rp7.469.194	Rp0	**-Rp40.605.082.309**
-Rp3.867.173.296	-Rp3.540.742.503	-Rp3.201.974.956	-Rp2.896.083.780	-Rp2.600.634.815	-Rp2.338.634.430	-Rp2.097.330.160	Rp5.380.407	Rp2.445.640	Rp0	**-Rp4.674.932.455**
-Rp1.898.939.599	-Rp1.663.055.359	-Rp1.438.550.583	-Rp1.244.552.360	-Rp1.068.996.463	-Rp919.504.968	-Rp788.775.455	Rp1.935.515	Rp841.528	Rp0	**Rp9.434.299.065**

Appendix 7.1.2 BAU for the Best Case Situation

		2016	2017	2018	2019	2020	2021
Benefit of the presence of mangrove currently	**Brushwood (Silvofishery ponds)**	**Rp 118.476.600**	**Rp 116.107.068**	**Rp 113.737.536**	**Rp 111.368.004**	**Rp 108.998.472**	**Rp 106.628.940**
	Brushwood (Mangrove Patches)	**Rp 106.400.000**	**Rp 104.272.000**	**Rp 102.144.000**	**Rp 100.016.000**	**Rp 97.888.000**	**Rp 95.760.000**
	Aquatic Organisms	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.355.319.787**	**Rp 1.348.509.135**	**Rp 1.341.698.483**	**Rp 1.334.887.831**
	Maintenance of fisheries	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.668.875.415**	**Rp 1.660.489.106**	**Rp 1.652.102.797**	**Rp 1.643.716.489**
Potential losses due to no intervention (no mangrove restoration)	**Erossion hazard (losses of assets: settlements)**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
	Flooding hazard on settlement (damage costs and precaution cos	**Rp 382.178.571**	**Rp 471.353.571**	**Rp 560.528.571**	**Rp 649.703.571**	**Rp 738.878.571**	**Rp 828.053.571**
Traditional Monoculture Milkfish	Reconstruction (labour)	Rp 841.566.336	Rp 824.735.009	Rp 807.903.683	Rp 791.072.356	Rp 774.241.029	Rp 757.409.702
	Saponin (herbal medicine	Rp 46.286.148	Rp 45.360.426	Rp 44.434.703	Rp 43.508.980	Rp 42.583.257	Rp 41.657.534
	Kompos (manure fertiliser)	Rp 20.829.600	Rp 20.413.008	Rp 19.996.416	Rp 19.579.824	Rp 19.163.232	Rp 18.746.640
	Milkfish seed	Rp 631.200.000	Rp 618.576.000	Rp 605.952.000	Rp 593.328.000	Rp 580.704.000	Rp 568.080.000
	Water pump rent fee	Rp 189.360.000	Rp 185.572.800	Rp 181.785.600	Rp 177.998.400	Rp 174.211.200	Rp 170.424.000
	Fuel	Rp 46.276.428	Rp 45.350.899	Rp 44.425.371	Rp 43.499.842	Rp 42.574.314	Rp 41.648.785
	harvesting labour	Rp 151.488.000	Rp 148.458.240	Rp 145.428.480	Rp 142.398.720	Rp 139.368.960	Rp 136.339.200
	Operational Cost	**Rp 1.927.006.512**	**Rp 1.888.466.382**	**Rp 1.849.926.252**	**Rp 1.811.386.122**	**Rp 1.772.845.991**	**Rp 1.734.305.861**
	***Additional costs due to flooding (damage and precaution)**	**Rp 88.368.000**	**Rp 115.467.520**	**Rp 113.111.040**	**Rp 138.443.200**	**Rp 135.497.600**	**Rp 243.573.768**
	Milkfish Production	Rp 4.729.266.000	Rp 4.509.419.040	Rp 4.417.390.080	Rp 4.205.212.200	Rp 4.115.739.600	Rp 3.796.194.600
	Revenue	**Rp 4.729.266.000**	**Rp 4.509.419.040**	**Rp 4.417.390.080**	**Rp 4.205.212.200**	**Rp 4.115.739.600**	**Rp 3.796.194.600**
Cash Flow		Rp5.595.981.679	Rp5.293.902.797	Rp5.133.900.955	Rp4.826.061.552	Rp4.669.205.189	Rp4.171.254.659
Present Value (Discount Rate 5%)	5%	Rp5.595.981.679	Rp5.041.812.188	Rp4.656.599.505	Rp4.168.933.421	Rp3.841.366.665	Rp3.268.287.172
Present Value (Discount Rate 10%)	10%	Rp5.595.981.679	Rp4.812.638.906	Rp4.242.893.351	Rp3.625.891.474	Rp3.189.129.970	Rp2.590.020.962
Present Value (Discount Rate 15%)	15%	Rp5.595.981.679	Rp4.603.393.737	Rp3.881.966.695	Rp3.173.213.809	Rp2.669.633.221	Rp2.073.850.773

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Brushwood (Silvofishery ponds)	**Rp 104.259.408**	**Rp 101.889.876**	**Rp 99.520.344**	**Rp 97.150.812**	**Rp 94.781.280**	**Rp 92.411.748**	**Rp 90.042.216**	**Rp 87.672.684**	**Rp 85.303.152**	**Rp 82.933.620**
Brushwood (Mangrove Patches)	**Rp 93.632.000**	**Rp 91.504.000**	**Rp 89.376.000**	**Rp 87.248.000**	**Rp 85.120.000**	**Rp 82.992.000**	**Rp 80.864.000**	**Rp 78.736.000**	**Rp 76.608.000**	**Rp 74.480.000**
Aquatic Organisms	**Rp 1.328.077.179**	**Rp 1.321.266.526**	**Rp 1.307.645.222**	**Rp 1.294.023.918**	**Rp 1.280.402.613**	**Rp 1.253.160.004**	**Rp 1.225.917.396**	**Rp 1.185.053.482**	**Rp 1.144.189.569**	**Rp 1.103.325.656**
Maintenance of fisheries	**Rp 1.635.330.180**	**Rp 1.626.943.872**	**Rp 1.610.171.254**	**Rp 1.593.398.637**	**Rp 1.576.626.020**	**Rp 1.543.080.785**	**Rp 1.509.535.551**	**Rp 1.459.217.699**	**Rp 1.408.899.847**	**Rp 1.358.581.996**
Erossion hazard	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
Flooding hazard on settlement	**Rp 1.014.668.571**	**Rp 1.201.283.571**	**Rp 1.387.898.571**	**Rp 1.574.513.571**	**Rp 1.761.128.571**	**Rp 1.858.568.571**	**Rp 1.956.008.571**	**Rp 2.053.448.571**	**Rp 2.150.888.571**	**Rp 2.248.328.571**
Reconstruction (labour)	Rp 740.578.376	Rp 723.747.049	Rp 706.915.722	Rp 690.084.396	Rp 673.253.069	Rp 656.421.742	Rp 639.590.415	Rp 622.759.089	Rp 605.927.762	Rp 589.096.435
Saponin (herbal medicine	Rp 40.731.811	Rp 39.806.088	Rp 38.880.365	Rp 37.954.642	Rp 37.028.919	Rp 36.103.196	Rp 35.177.473	Rp 34.251.750	Rp 33.326.027	Rp 32.400.304
Kompos (manure fertiliser)	Rp 18.330.048	Rp 17.913.456	Rp 17.496.864	Rp 17.080.272	Rp 16.663.680	Rp 16.247.088	Rp 15.830.496	Rp 15.413.904	Rp 14.997.312	Rp 14.580.720
Milkfish seed	Rp 555.456.000	Rp 542.832.000	Rp 530.208.000	Rp 517.584.000	Rp 504.960.000	Rp 492.336.000	Rp 479.712.000	Rp 467.088.000	Rp 454.464.000	Rp 441.840.000
Water pump rent fee	Rp 166.636.800	Rp 162.849.600	Rp 159.062.400	Rp 155.275.200	Rp 151.488.000	Rp 147.700.800	Rp 143.913.600	Rp 140.126.400	Rp 136.339.200	Rp 132.552.000
Fuel	Rp 40.723.257	Rp 39.797.728	Rp 38.872.200	Rp 37.946.671	Rp 37.021.142	Rp 36.095.614	Rp 35.170.085	Rp 34.244.557	Rp 33.319.028	Rp 32.393.500
harvesting labour	Rp 133.309.440	Rp 130.279.680	Rp 127.249.920	Rp 124.220.160	Rp 121.190.400	Rp 118.160.640	Rp 115.130.880	Rp 112.101.120	Rp 109.071.360	Rp 106.041.600
Operational Cost	**Rp 1.695.765.731**	**Rp 1.657.225.601**	**Rp 1.618.685.470**	**Rp 1.580.145.340**	**Rp 1.541.605.210**	**Rp 1.503.065.080**	**Rp 1.464.524.949**	**Rp 1.425.984.819**	**Rp 1.387.444.689**	**Rp 1.348.904.559**
*Additional costs due to flooding (damage and precaution)	**Rp 238.161.018**	**Rp 338.835.734**	**Rp 330.955.834**	**Rp 424.229.099**	**Rp 413.882.048**	**Rp 499.753.862**	**Rp 486.939.661**	**Rp 565.410.024**	**Rp 550.128.672**	**Rp 534.847.320**
Milkfish Production	Rp 3.711.834.720	Rp 3.407.627.880	Rp 3.328.380.720	Rp 3.039.512.040	Rp 2.965.377.600	Rp 2.691.847.080	Rp 2.622.825.360	Rp 2.364.633.000	Rp 2.300.724.000	Rp 2.236.815.000
Revenue	**Rp 3.711.834.720**	**Rp 3.407.627.880**	**Rp 3.328.380.720**	**Rp 3.039.512.040**	**Rp 2.965.377.600**	**Rp 2.691.847.080**	**Rp 2.622.825.360**	**Rp 2.364.633.000**	**Rp 2.300.724.000**	**Rp 2.236.815.000**
Cash Flow	Rp3.924.538.167	Rp3.351.887.247	Rp3.097.553.665	Rp2.532.445.396	Rp2.285.691.684	Rp1.802.104.104	Rp1.621.711.341	Rp1.130.469.451	Rp927.262.636	Rp724.055.822
Present Value (Discount Rate 5%)	Rp2.928.550.805	Rp2.382.123.687	Rp2.096.546.246	Rp1.632.436.882	Rp1.403.216.418	Rp1.053.652.946	Rp903.029.556	Rp599.512.086	Rp468.330.642	Rp348.283.230
Present Value (Discount Rate 10%)	Rp2.215.299.483	Rp1.720.048.152	Rp1.445.031.645	Rp1.074.004.061	Rp881.233.090	Rp631.626.495	Rp516.727.211	Rp327.456.732	Rp244.177.233	Rp173.333.207
Present Value (Discount Rate 15%)	Rp1.696.686.151	Rp1.260.098.570	Rp1.012.595.788	Rp719.879.037	Rp564.988.027	Rp387.350.064	Rp303.109.445	Rp183.732.890	Rp131.048.784	Rp88.982.467

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	Total Cash Flow & NPV
Rp 80.564.088	**Rp 78.194.556**	**Rp 75.825.024**	**Rp 73.455.492**	**Rp 71.085.960**	**Rp 68.716.428**	**Rp 66.346.896**	**Rp 63.977.364**	**Rp 61.607.832**	**Rp 59.238.300**	
Rp 72.352.000	**Rp 70.224.000**	**Rp 68.096.000**	**Rp 65.968.000**	**Rp 63.840.000**	**Rp 61.712.000**	**Rp 59.584.000**	**Rp 57.456.000**	**Rp 55.328.000**	**Rp 53.200.000**	
Rp 1.062.461.743	**Rp 1.021.597.830**	**Rp 980.733.916**	**Rp 939.870.003**	**Rp 899.006.090**	**Rp 858.142.177**	**Rp 817.278.264**	**Rp 776.414.351**	**Rp 721.929.133**	**Rp 681.065.220**	
Rp 1.308.264.144	**Rp 1.257.946.292**	**Rp 1.207.628.441**	**Rp 1.157.310.589**	**Rp 1.106.992.737**	**Rp 1.056.674.886**	**Rp 1.006.357.034**	**Rp 956.039.182**	**Rp 888.948.713**	**Rp 838.630.862**	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp 8.585.858.586**	**Rp 8.585.858.586**	
Rp 2.345.768.571	**Rp 2.443.208.571**	**Rp 2.540.648.571**	**Rp 2.638.088.571**	**Rp 2.665.928.571**	**Rp 2.665.928.571**	**Rp 2.665.928.571**	**Rp 2.665.928.571**	**Rp 2.532.632.143**	**Rp 2.399.335.714**	
Rp 572.265.108	Rp 555.433.782	Rp 538.602.455	Rp 521.771.128	Rp 504.939.802	Rp 488.108.475	Rp 471.277.148	Rp 454.445.821	Rp 437.614.495	Rp 420.783.168	
Rp 31.474.581	Rp 30.548.858	Rp 29.623.135	Rp 28.697.412	Rp 27.771.689	Rp 26.845.966	Rp 25.920.243	Rp 24.994.520	Rp 24.068.797	Rp 23.143.074	
Rp 14.164.128	Rp 13.747.536	Rp 13.330.944	Rp 12.914.352	Rp 12.497.760	Rp 12.081.168	Rp 11.664.576	Rp 11.247.984	Rp 10.831.392	Rp 10.414.800	
Rp 429.216.000	Rp 416.592.000	Rp 403.968.000	Rp 391.344.000	Rp 378.720.000	Rp 366.096.000	Rp 353.472.000	Rp 340.848.000	Rp 328.224.000	Rp 315.600.000	
Rp 128.764.800	Rp 124.977.600	Rp 121.190.400	Rp 117.403.200	Rp 113.616.000	Rp 109.828.800	Rp 106.041.600	Rp 102.254.400	Rp 98.467.200	Rp 94.680.000	
Rp 31.467.971	Rp 30.542.442	Rp 29.616.914	Rp 28.691.385	Rp 27.765.857	Rp 26.840.328	Rp 25.914.800	Rp 24.989.271	Rp 24.063.743	Rp 23.138.214	
Rp 103.011.840	Rp 99.982.080	Rp 96.952.320	Rp 93.922.560	Rp 90.892.800	Rp 87.863.040	Rp 84.833.280	Rp 81.803.520	Rp 78.773.760	Rp 75.744.000	
Rp 1.310.364.428	**Rp 1.271.824.298**	**Rp 1.233.284.168**	**Rp 1.194.744.038**	**Rp 1.156.203.907**	**Rp 1.117.663.777**	**Rp 1.079.123.647**	**Rp 1.040.583.517**	**Rp 1.002.043.386**	**Rp 963.503.256**	
Rp 519.565.968	**Rp 566.259.619**	**Rp 549.100.237**	**Rp 590.159.797**	**Rp 571.122.384**	**Rp 606.547.853**	**Rp 585.632.410**	**Rp 615.423.787**	**Rp 592.630.314**	**Rp 616.787.600**	
Rp 2.172.906.000	Rp 2.024.637.120	Rp 1.963.284.480	Rp 1.822.684.680	Rp 1.763.888.400	Rp 1.630.957.680	Rp 1.574.717.760	Rp 1.449.456.120	Rp 1.395.772.560	Rp 1.278.180.000	
Rp 2.172.906.000	**Rp 2.024.637.120**	**Rp 1.963.284.480**	**Rp 1.822.684.680**	**Rp 1.763.888.400**	**Rp 1.630.957.680**	**Rp 1.574.717.760**	**Rp 1.449.456.120**	**Rp 1.395.772.560**	**Rp 1.278.180.000**	
Rp520.849.007	Rp171.307.309	-Rp27.465.115	-Rp363.703.642	-Rp488.441.675	-Rp713.937.031	-Rp806.400.674	-Rp1.018.592.859	-Rp9.589.578.191	-Rp9.655.170.775	**Rp29.116.892.697**
Rp238.606.931	Rp74.740.812	-Rp11.412.323	-Rp143.929.881	-Rp184.088.530	-Rp256.262.246	-Rp275.667.967	-Rp331.624.607	-Rp2.973.420.470	-Rp2.851.198.691	**Rp33.674.406.157**
Rp113.351.919	Rp33.892.238	-Rp4.939.842	-Rp59.468.452	-Rp72.603.743	-Rp96.474.719	-Rp99.063.076	-Rp113.754.574	-Rp973.587.660	-Rp891.133.624	**Rp31.121.712.119**
Rp55.660.409	Rp15.918.884	-Rp2.219.322	-Rp25.555.753	-Rp29.843.923	-Rp37.931.958	-Rp37.256.186	-Rp40.921.383	-Rp335.005.036	-Rp293.301.275	**Rp27.616.055.594**

Appendix 7.2 CBA for Scenario 2 (Polyculture Milkfish and Tiger Shrimp without Mangrove Restoration)

Appendix 7.2.1 Scenario 2 for the Worst Erosion Case Scenario

		2016	2017	2018	2019	2020	2021
Benefit of the presence of mangrove currently	**Brushwood (Silvofishery ponds)**	**Rp 118.476.600**	**Rp 113.737.536**	**Rp 108.998.472**	**Rp 104.259.408**	**Rp 99.520.344**	**Rp 94.781.280**
	Brushwood (Mangrove Patches)	**Rp 106.400.000**	**Rp 102.144.000**	**Rp 97.888.000**	**Rp 93.632.000**	**Rp 89.376.000**	**Rp 85.120.000**
	Aquatic Organisms	**Rp 1.362.130.440**	**Rp 1.348.509.135**	**Rp 1.334.887.831**	**Rp 1.321.266.526**	**Rp 1.307.645.222**	**Rp 1.294.023.918**
	Maintenance of fisheries	**Rp 1.677.261.723**	**Rp 1.660.489.106**	**Rp 1.643.716.489**	**Rp 1.626.943.872**	**Rp 1.610.171.254**	**Rp 1.593.398.637**
Potential losses due to no intervention (no mangrove restoration)	**Erosion hazard (losses of assets: settlements)**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
	Flooding hazard on settlement (damage costs and precaution costs)	**Rp 382.178.571**	**Rp 471.353.571**	**Rp 560.528.571**	**Rp 649.703.571**	**Rp 738.878.571**	**Rp 828.053.571**
Traditional plus Polyculture Milkfish & Shrimp	Reconstruction (Labour)	Rp 841.600.000	Rp 807.936.000	Rp 774.272.000	Rp 740.608.000	Rp 706.944.000	Rp 673.280.000
	Saponin (herbal medicine)	Rp 46.288.000	Rp 44.436.480	Rp 42.584.960	Rp 40.733.440	Rp 38.881.920	Rp 37.030.400
	MOL & manure	Rp 750.559.920	Rp 720.537.523	Rp 690.515.126	Rp 660.492.730	Rp 630.470.333	Rp 600.447.936
	Milkfish seed	Rp 420.800.000	Rp 403.968.000	Rp 387.136.000	Rp 370.304.000	Rp 353.472.000	Rp 336.640.000
	Tiger shrimp seed	Rp 210.400.000	Rp 201.984.000	Rp 193.568.000	Rp 185.152.000	Rp 176.736.000	Rp 168.320.000
	Water pump rent fee	Rp 189.360.000	Rp 181.785.600	Rp 174.211.200	Rp 166.636.800	Rp 159.062.400	Rp 151.488.000
	Fuel	Rp 46.288.000	Rp 44.436.480	Rp 42.584.960	Rp 40.733.440	Rp 38.881.920	Rp 37.030.400
	Harvesting labour	Rp 168.320.000	Rp 161.587.200	Rp 154.854.400	Rp 148.121.600	Rp 141.388.800	Rp 134.656.000
	Operational Cost	**Rp 2.673.615.920**	**Rp 2.566.671.283**	**Rp 2.459.726.646**	**Rp 2.352.782.010**	**Rp 2.245.837.373**	**Rp 2.138.892.736**
	***Additional damage costs due to flooding**	**Rp 88.368.000**	**Rp 113.111.040**	**Rp 108.398.080**	**Rp 129.606.400**	**Rp 123.715.200**	**Rp 216.510.016**
	Milkfish Production	Rp 5.002.512.480	Rp 4.672.617.062	Rp 4.477.924.685	Rp 4.164.253.632	Rp 3.974.969.376	Rp 3.569.360.256
	Shrimp Production	Rp 6.694.928.000	Rp 6.253.424.640	Rp 5.992.865.280	Rp 5.573.075.200	Rp 5.319.753.600	Rp 4.776.921.600
	Revenue	**Rp 11.697.440.480**	**Rp 10.926.041.702**	**Rp 10.470.789.965**	**Rp 9.737.328.832**	**Rp 9.294.722.976**	**Rp 8.346.281.856**
Cash Flow		**Rp11.994.282.751**	**Rp11.226.007.665**	**Rp10.744.423.618**	**Rp10.010.551.457**	**Rp9.540.435.052**	**Rp8.663.169.399**
Present Value (Discount Rate 5%)	**5%**	Rp11.994.282.751	Rp10.691.435.871	Rp9.745.508.951	Rp8.647.490.730	Rp7.848.939.528	Rp6.787.819.909
Present Value (Discount Rate 10%)	**10%**	Rp11.994.282.751	Rp10.205.461.514	Rp8.879.688.941	Rp7.521.075.475	Rp6.516.245.511	Rp5.379.146.605
Present Value (Discount Rate 15%)	**15%**	Rp11.994.282.751	Rp9.761.745.796	Rp8.124.327.878	Rp6.582.100.078	Rp5.454.774.705	Rp4.307.126.279

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Rp 90.042.216	**Rp 85.303.152**	**Rp 80.564.088**	**Rp 75.825.024**	**Rp 71.085.960**	**Rp 66.346.896**	**Rp 61.607.832**	**Rp 56.868.768**	**Rp 52.129.704**	**Rp 47.390.640**
Rp 80.864.000	**Rp 76.608.000**	**Rp 72.352.000**	**Rp 68.096.000**	**Rp 63.840.000**	**Rp 59.584.000**	**Rp 55.328.000**	**Rp 51.072.000**	**Rp 46.816.000**	**Rp 42.560.000**
Rp 1.266.781.309	**Rp 1.225.917.396**	**Rp 1.171.432.178**	**Rp 1.103.325.656**	**Rp 1.021.597.830**	**Rp 926.248.699**	**Rp 817.278.264**	**Rp 653.822.611**	**Rp 490.366.958**	**Rp 354.153.914**
Rp 1.559.853.403	**Rp 1.509.535.551**	**Rp 1.442.445.082**	**Rp 1.358.581.996**	**Rp 1.257.946.292**	**Rp 1.140.537.972**	**Rp 1.006.357.034**	**Rp 805.085.627**	**Rp 603.814.220**	**Rp 436.088.048**
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**
Rp 1.014.668.571	**Rp 1.201.283.571**	**Rp 1.387.898.571**	**Rp 1.574.513.571**	**Rp 1.761.128.571**	**Rp 1.858.568.571**	**Rp 1.956.008.571**	**Rp 1.848.103.714**	**Rp 1.720.710.857**	**Rp 1.573.830.000**
Rp 639.616.000	Rp 605.952.000	Rp 572.288.000	Rp 538.624.000	Rp 504.960.000	Rp 471.296.000	Rp 437.632.000	Rp 403.968.000	Rp 370.304.000	Rp 336.640.000
Rp 35.178.880	Rp 33.327.360	Rp 31.475.840	Rp 29.624.320	Rp 27.772.800	Rp 25.921.280	Rp 24.069.760	Rp 22.218.240	Rp 20.366.720	Rp 18.515.200
Rp 570.425.539	Rp 540.403.142	Rp 510.380.746	Rp 480.358.349	Rp 450.335.952	Rp 420.313.555	Rp 390.291.158	Rp 360.268.762	Rp 330.246.365	Rp 300.223.968
Rp 319.808.000	Rp 302.976.000	Rp 286.144.000	Rp 269.312.000	Rp 252.480.000	Rp 235.648.000	Rp 218.816.000	Rp 201.984.000	Rp 185.152.000	Rp 168.320.000
Rp 159.904.000	Rp 151.488.000	Rp 143.072.000	Rp 134.656.000	Rp 126.240.000	Rp 117.824.000	Rp 109.408.000	Rp 100.992.000	Rp 92.576.000	Rp 84.160.000
Rp 143.913.600	Rp 136.339.200	Rp 128.764.800	Rp 121.190.400	Rp 113.616.000	Rp 106.041.600	Rp 98.467.200	Rp 90.892.800	Rp 83.318.400	Rp 75.744.000
Rp 35.178.880	Rp 33.327.360	Rp 31.475.840	Rp 29.624.320	Rp 27.772.800	Rp 25.921.280	Rp 24.069.760	Rp 22.218.240	Rp 20.366.720	Rp 18.515.200
Rp 127.923.200	Rp 121.190.400	Rp 114.457.600	Rp 107.724.800	Rp 100.992.000	Rp 94.259.200	Rp 87.526.400	Rp 80.793.600	Rp 74.060.800	Rp 67.328.000
Rp 2.031.948.099	**Rp 1.925.003.462**	**Rp 1.818.058.826**	**Rp 1.711.114.189**	**Rp 1.604.169.552**	**Rp 1.497.224.915**	**Rp 1.390.280.278**	**Rp 1.283.335.642**	**Rp 1.176.391.005**	**Rp 1.069.446.368**
Rp 205.684.515	**Rp 283.676.429**	**Rp 267.916.627**	**Rp 331.105.638**	**Rp 310.411.536**	**Rp 358.797.645**	**Rp 333.169.242**	**Rp 366.752.448**	**Rp 336.189.744**	**Rp 305.627.040**
Rp 3.390.892.243	Rp 3.017.731.853	Rp 2.850.080.083	Rp 2.509.368.422	Rp 2.352.532.896	Rp 2.044.269.965	Rp 1.898.250.682	Rp 1.622.436.480	Rp 1.487.233.440	Rp 1.352.030.400
Rp 4.538.075.520	Rp 4.038.670.080	Rp 3.814.299.520	Rp 3.358.320.640	Rp 3.148.425.600	Rp 2.735.873.280	Rp 2.540.453.760	Rp 2.171.328.000	Rp 1.990.384.000	Rp 1.809.440.000
Rp 7.928.967.763	**Rp 7.056.401.933**	**Rp 6.664.379.603**	**Rp 5.867.689.062**	**Rp 5.500.958.496**	**Rp 4.780.143.245**	**Rp 4.438.704.442**	**Rp 3.793.764.480**	**Rp 3.477.617.440**	**Rp 3.161.470.400**
Rp8.085.576.535	**Rp7.111.155.426**	**Rp6.493.132.181**	**Rp5.518.995.616**	**Rp4.860.541.991**	**Rp3.975.864.970**	**Rp3.366.155.963**	**-Rp14.575.790.593**	**-Rp15.061.884.967**	**-Rp15.467.703.497**
Rp6.033.581.701	Rp5.053.765.397	Rp4.394.807.443	Rp3.557.593.783	Rp2.983.951.147	Rp2.324.605.904	Rp1.874.401.596	-Rp7.729.852.954	-Rp7.607.275.409	-Rp7.440.229.850
Rp4.564.097.164	Rp3.649.147.137	Rp3.029.094.083	Rp2.340.592.897	Rp1.873.949.347	Rp1.393.516.417	Rp1.072.561.027	-Rp4.222.087.341	-Rp3.966.265.061	-Rp3.702.845.239
Rp3.495.617.865	Rp2.673.346.721	Rp2.122.616.428	Rp1.568.843.006	Rp1.201.451.644	Rp854.585.230	Rp629.158.618	-Rp2.368.973.462	-Rp2.128.675.989	-Rp1.900.895.459

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	Total Cash Flow & NPV
Rp 42.651.576	**Rp 37.912.512**	**Rp 33.173.448**	**Rp 28.434.384**	**Rp 23.695.320**	**Rp 18.956.256**	**Rp 14.217.192**	**Rp 9.478.128**	**Rp 4.739.064**	**Rp -**	
Rp 38.304.000	**Rp 34.048.000**	**Rp 29.792.000**	**Rp 25.536.000**	**Rp 21.280.000**	**Rp 17.024.000**	**Rp 12.768.000**	**Rp 8.512.000**	**Rp 4.256.000**	**Rp -**	
Rp 245.183.479	**Rp 149.834.348**	**Rp 108.970.435**	**Rp 81.727.826**	**Rp 68.106.522**	**Rp 54.485.218**	**Rp 40.863.913**	**Rp 27.242.609**	**Rp 13.621.304**	**Rp -**	
Rp 301.907.110	**Rp 184.498.790**	**Rp 134.180.938**	**Rp 100.635.703**	**Rp 83.863.086**	**Rp 67.090.469**	**Rp 50.317.852**	**Rp 33.545.234**	**Rp 16.772.617**	**Rp -**	
Rp 17.171.717.172	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp 17.171.717.172**	**Rp -**	**Rp -**	**Rp -**	
Rp 1.407.461.143	**Rp 1.221.604.286**	**Rp 1.016.259.429**	**Rp 791.426.571**	**Rp 533.185.714**	**Rp 266.592.857**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp 302.976.000	Rp 269.312.000	Rp 235.648.000	Rp 201.984.000	Rp 168.320.000	Rp 134.656.000	Rp 100.992.000	Rp 67.328.000	Rp 33.664.000	Rp -	
Rp 16.663.680	Rp 14.812.160	Rp 12.960.640	Rp 11.109.120	Rp 9.257.600	Rp 7.406.080	Rp 5.554.560	Rp 3.703.040	Rp 1.851.520	Rp -	
Rp 270.201.571	Rp 240.179.174	Rp 210.156.778	Rp 180.134.381	Rp 150.111.984	Rp 120.089.587	Rp 90.067.190	Rp 60.044.794	Rp 30.022.397	Rp -	
Rp 151.488.000	Rp 134.656.000	Rp 117.824.000	Rp 100.992.000	Rp 84.160.000	Rp 67.328.000	Rp 50.496.000	Rp 33.664.000	Rp 16.832.000	Rp -	
Rp 75.744.000	Rp 67.328.000	Rp 58.912.000	Rp 50.496.000	Rp 42.080.000	Rp 33.664.000	Rp 25.248.000	Rp 16.832.000	Rp 8.416.000	Rp -	
Rp 68.169.600	Rp 60.595.200	Rp 53.020.800	Rp 45.446.400	Rp 37.872.000	Rp 30.297.600	Rp 22.723.200	Rp 15.148.800	Rp 7.574.400	Rp -	
Rp 16.663.680	Rp 14.812.160	Rp 12.960.640	Rp 11.109.120	Rp 9.257.600	Rp 7.406.080	Rp 5.554.560	Rp 3.703.040	Rp 1.851.520	Rp -	
Rp 60.595.200	Rp 53.862.400	Rp 47.129.600	Rp 40.396.800	Rp 33.664.000	Rp 26.931.200	Rp 20.198.400	Rp 13.465.600	Rp 6.732.800	Rp -	
Rp 962.501.731	**Rp 855.557.094**	**Rp 748.612.458**	**Rp 641.667.821**	**Rp 534.723.184**	**Rp 427.778.547**	**Rp 320.833.910**	**Rp 213.889.274**	**Rp 106.944.637**	**Rp -**	
Rp 275.064.336	**Rp 274.550.118**	**Rp 240.231.354**	**Rp 228.448.954**	**Rp 190.374.128**	**Rp 167.323.546**	**Rp 125.492.659**	**Rp 91.173.894**	**Rp 45.586.947**	**Rp -**	
Rp 1.216.827.360	Rp 1.038.359.347	Rp 908.564.429	Rp 746.320.781	Rp 621.933.984	Rp 475.914.701	Rp 356.936.026	Rp 227.141.107	Rp 113.570.554	Rp -	
Rp 1.628.496.000	Rp 1.389.649.920	Rp 1.215.943.680	Rp 998.810.880	Rp 832.342.400	Rp 636.922.880	Rp 477.692.160	Rp 303.985.920	Rp 151.992.960	Rp -	
Rp 2.845.323.360	**Rp 2.428.009.267**	**Rp 2.124.508.109**	**Rp 1.745.131.661**	**Rp 1.454.276.384**	**Rp 1.112.837.581**	**Rp 834.628.186**	**Rp 531.127.027**	**Rp 265.563.514**	**Rp -**	
-Rp15.793.246.184	**-Rp16.140.025.516**	**-Rp16.265.732.774**	**-Rp16.394.897.036**	**-Rp16.398.030.630**	**-Rp16.428.371.507**	**-Rp16.414.263.280**	**Rp487.189.619**	**Rp243.594.810**	**Rp0**	**-Rp56.618.868.932**
-Rp7.235.068.047	-Rp7.041.839.671	-Rp6.758.747.934	-Rp6.488.017.479	-Rp6.180.245.284	-Rp5.896.838.516	-Rp5.611.213.786	Rp158.614.961	Rp75.530.934	Rp0	**Rp14.183.001.676**
-Rp3.437.070.518	-Rp3.193.218.004	-Rp2.925.535.014	-Rp2.680.696.674	-Rp2.437.462.765	-Rp2.219.975.221	-Rp2.016.426.153	Rp54.408.439	Rp24.731.109	Rp0	**Rp37.696.416.425**
-Rp1.687.741.617	-Rp1.499.826.183	-Rp1.314.354.471	-Rp1.151.992.699	-Rp1.001.924.246	-Rp872.850.506	-Rp758.348.631	Rp19.572.563	Rp8.509.810	Rp0	**Rp44.112.476.109**

Appendix 7.2.2 Scenario 2 for the Best Case Situation

		2016	2017	2018	2019	2020	2021
Benefit of the presence of mangrove currently	**Brushwood (Silvofishery ponds)**	**Rp 118.476.600**	**Rp 116.107.068**	**Rp 113.737.536**	**Rp 111.368.004**	**Rp 108.998.472**	**Rp 106.628.940**
	Brushwood (Mangrove Patches)	**Rp 106.400.000**	**Rp 104.272.000**	**Rp 102.144.000**	**Rp 100.016.000**	**Rp 97.888.000**	**Rp 95.760.000**
	Aquatic Organisms	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.355.319.787**	**Rp 1.348.509.135**	**Rp 1.341.698.483**	**Rp 1.334.887.831**
	Maintenance of fisheries	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.668.875.415**	**Rp 1.660.489.106**	**Rp 1.652.102.797**	**Rp 1.643.716.489**
Potential losses due to no intervention (no mangrove restoration)	**Erossion hazard (losses of assets: settlements)**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
	Flooding hazard on settlement (damage costs and precaution costs)	**Rp 382.178.571**	**Rp 471.353.571**	**Rp 560.528.571**	**Rp 649.703.571**	**Rp 738.878.571**	**Rp 828.053.571**
Traditional plus Polyculture Milkfish & Shrimp	Reconstruction (Labour)	Rp 841.600.000	Rp 824.768.000	Rp 807.936.000	Rp 791.104.000	Rp 774.272.000	Rp 757.440.000
	Saponin (herbal medicine)	Rp 46.288.000	Rp 45.362.240	Rp 44.436.480	Rp 43.510.720	Rp 42.584.960	Rp 41.659.200
	MOL & manure	Rp 750.559.920	Rp 735.548.722	Rp 720.537.523	Rp 705.526.325	Rp 690.515.126	Rp 675.503.928
	Milkfish seed	Rp 420.800.000	Rp 412.384.000	Rp 403.968.000	Rp 395.552.000	Rp 387.136.000	Rp 378.720.000
	Tiger shrimp seed	Rp 210.400.000	Rp 206.192.000	Rp 201.984.000	Rp 197.776.000	Rp 193.568.000	Rp 189.360.000
	Water pump rent fee	Rp 189.360.000	Rp 185.572.800	Rp 181.785.600	Rp 177.998.400	Rp 174.211.200	Rp 170.424.000
	Fuel	Rp 46.288.000	Rp 45.362.240	Rp 44.436.480	Rp 43.510.720	Rp 42.584.960	Rp 41.659.200
	Harvesting labour	Rp 168.320.000	Rp 164.953.600	Rp 161.587.200	Rp 158.220.800	Rp 154.854.400	Rp 151.488.000
	Operational Cost	**Rp 2.673.615.920**	**Rp 2.620.143.602**	**Rp 2.566.671.283**	**Rp 2.513.198.965**	**Rp 2.459.726.646**	**Rp 2.406.254.328**
	***Additional damage costs due to flooding**	**Rp 88.368.000**	**Rp 115.467.520**	**Rp 113.111.040**	**Rp 138.443.200**	**Rp 135.497.600**	**Rp 243.573.768**
	Milkfish Production	Rp 5.002.512.480	Rp 4.769.963.251	Rp 4.672.617.062	Rp 4.448.180.016	Rp 4.353.537.888	Rp 4.015.530.288
	Shrimp Production	Rp 6.694.928.000	Rp 6.383.704.320	Rp 6.253.424.640	Rp 5.953.057.600	Rp 5.826.396.800	Rp 5.374.036.800
	Revenue	**Rp 11.697.440.480**	**Rp 11.153.667.571**	**Rp 10.926.041.702**	**Rp 10.401.237.616**	**Rp 10.179.934.688**	**Rp 9.389.567.088**
Cash Flow		**Rp11.994.282.751**	**Rp11.437.409.149**	**Rp11.152.029.626**	**Rp10.597.160.525**	**Rp10.317.514.822**	**Rp9.579.826.216**
Present Value (Discount Rate 5%)	**5%**	Rp11.994.282.751	Rp10.892.770.618	Rp10.115.219.615	Rp9.154.225.699	Rp8.488.244.978	Rp7.506.044.511
Present Value (Discount Rate 10%)	**10%**	Rp11.994.282.751	Rp10.397.644.681	Rp9.216.553.410	Rp7.961.803.550	Rp7.047.001.450	Rp5.948.318.369
Present Value (Discount Rate 15%)	**15%**	Rp11.994.282.751	Rp9.945.573.173	Rp8.432.536.579	Rp6.967.805.063	Rp5.899.072.586	Rp4.762.866.723

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Rp 104.259.408	**Rp 101.889.876**	**Rp 99.520.344**	**Rp 97.150.812**	**Rp 94.781.280**	**Rp 92.411.748**	**Rp 90.042.216**	**Rp 87.672.684**	**Rp 85.303.152**	**Rp 82.933.620**
Rp 93.632.000	**Rp 91.504.000**	**Rp 89.376.000**	**Rp 87.248.000**	**Rp 85.120.000**	**Rp 82.992.000**	**Rp 80.864.000**	**Rp 78.736.000**	**Rp 76.608.000**	**Rp 74.480.000**
Rp 1.328.077.179	**Rp 1.321.266.526**	**Rp 1.307.645.222**	**Rp 1.294.023.918**	**Rp 1.280.402.613**	**Rp 1.253.160.004**	**Rp 1.225.917.396**	**Rp 1.185.053.482**	**Rp 1.144.189.569**	**Rp 1.103.325.656**
Rp 1.635.330.180	**Rp 1.626.943.872**	**Rp 1.610.171.254**	**Rp 1.593.398.637**	**Rp 1.576.626.020**	**Rp 1.543.080.785**	**Rp 1.509.535.551**	**Rp 1.459.217.699**	**Rp 1.408.899.847**	**Rp 1.358.581.996**
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
Rp 1.014.668.571	**Rp 1.201.283.571**	**Rp 1.387.898.571**	**Rp 1.574.513.571**	**Rp 1.761.128.571**	**Rp 1.858.568.571**	**Rp 1.956.008.571**	**Rp 2.053.448.571**	**Rp 2.150.888.571**	**Rp 2.248.328.571**
Rp 740.608.000	Rp 723.776.000	Rp 706.944.000	Rp 690.112.000	Rp 673.280.000	Rp 656.448.000	Rp 639.616.000	Rp 622.784.000	Rp 605.952.000	Rp 589.120.000
Rp 40.733.440	Rp 39.807.680	Rp 38.881.920	Rp 37.956.160	Rp 37.030.400	Rp 36.104.640	Rp 35.178.880	Rp 34.253.120	Rp 33.327.360	Rp 32.401.600
Rp 660.492.730	Rp 645.481.531	Rp 630.470.333	Rp 615.459.134	Rp 600.447.936	Rp 585.436.738	Rp 570.425.539	Rp 555.414.341	Rp 540.403.142	Rp 525.391.944
Rp 370.304.000	Rp 361.888.000	Rp 353.472.000	Rp 345.056.000	Rp 336.640.000	Rp 328.224.000	Rp 319.808.000	Rp 311.392.000	Rp 302.976.000	Rp 294.560.000
Rp 185.152.000	Rp 180.944.000	Rp 176.736.000	Rp 172.528.000	Rp 168.320.000	Rp 164.112.000	Rp 159.904.000	Rp 155.696.000	Rp 151.488.000	Rp 147.280.000
Rp 166.636.800	Rp 162.849.600	Rp 159.062.400	Rp 155.275.200	Rp 151.488.000	Rp 147.700.800	Rp 143.913.600	Rp 140.126.400	Rp 136.339.200	Rp 132.552.000
Rp 40.733.440	Rp 39.807.680	Rp 38.881.920	Rp 37.956.160	Rp 37.030.400	Rp 36.104.640	Rp 35.178.880	Rp 34.253.120	Rp 33.327.360	Rp 32.401.600
Rp 148.121.600	Rp 144.755.200	Rp 141.388.800	Rp 138.022.400	Rp 134.656.000	Rp 131.289.600	Rp 127.923.200	Rp 124.556.800	Rp 121.190.400	Rp 117.824.000
Rp 2.352.782.010	**Rp 2.299.309.691**	**Rp 2.245.837.373**	**Rp 2.192.365.054**	**Rp 2.138.892.736**	**Rp 2.085.420.418**	**Rp 2.031.948.099**	**Rp 1.978.475.781**	**Rp 1.925.003.462**	**Rp 1.871.531.144**
Rp 238.161.018	**Rp 338.835.734**	**Rp 330.955.834**	**Rp 424.229.099**	**Rp 413.882.048**	**Rp 499.753.862**	**Rp 486.939.661**	**Rp 565.410.024**	**Rp 550.128.672**	**Rp 534.847.320**
Rp 3.926.296.282	Rp 3.604.513.046	Rp 3.520.687.162	Rp 3.215.128.291	Rp 3.136.710.528	Rp 2.847.376.022	Rp 2.774.366.381	Rp 2.501.256.240	Rp 2.433.654.720	Rp 2.366.053.200
Rp 5.254.613.760	Rp 4.823.967.040	Rp 4.711.781.760	Rp 4.302.848.320	Rp 4.197.900.800	Rp 3.810.680.640	Rp 3.712.970.880	Rp 3.347.464.000	Rp 3.256.992.000	Rp 3.166.520.000
Rp 9.180.910.042	**Rp 8.428.480.086**	**Rp 8.232.468.922**	**Rp 7.517.976.611**	**Rp 7.334.611.328**	**Rp 6.658.056.662**	**Rp 6.487.337.261**	**Rp 5.848.720.240**	**Rp 5.690.646.720**	**Rp 5.532.573.200**
Rp9.212.919.245	**Rp8.408.326.832**	**Rp8.036.401.631**	**Rp7.247.148.451**	**Rp6.885.401.982**	**Rp6.185.466.074**	**Rp5.892.679.413**	**Rp5.192.885.777**	**Rp4.879.883.927**	**Rp4.566.882.076**
Rp6.874.822.188	Rp5.975.640.897	Rp5.439.352.953	Rp4.671.576.509	Rp4.227.039.532	Rp3.616.513.907	Rp3.281.264.391	Rp2.753.898.199	Rp2.464.672.986	Rp2.196.748.364
Rp5.200.452.733	Rp4.314.801.175	Rp3.749.040.671	Rp3.073.498.398	Rp2.654.620.529	Rp2.167.968.124	Rp1.877.589.260	Rp1.504.194.038	Rp1.285.025.955	Rp1.093.275.259
Rp3.982.999.228	Rp3.161.001.500	Rp2.627.113.949	Rp2.060.091.899	Rp1.701.966.065	Rp1.329.524.012	Rp1.101.383.916	Rp843.989.115	Rp689.667.447	Rp561.244.622

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	Total Cash Flow & NPV
Rp 80.564.088	Rp 78.194.556	Rp 75.825.024	Rp 73.455.492	Rp 71.085.960	Rp 68.716.428	Rp 66.346.896	Rp 63.977.364	Rp 61.607.832	Rp 59.238.300	
Rp 72.352.000	Rp 70.224.000	Rp 68.096.000	Rp 65.968.000	Rp 63.840.000	Rp 61.712.000	Rp 59.584.000	Rp 57.456.000	Rp 55.328.000	Rp 53.200.000	
Rp 1.062.461.743	Rp 1.021.597.830	Rp 980.733.916	Rp 939.870.003	Rp 899.006.090	Rp 858.142.177	Rp 817.278.264	Rp 776.414.351	Rp 721.929.133	Rp 681.065.220	
Rp 1.308.264.144	Rp 1.257.946.292	Rp 1.207.628.441	Rp 1.157.310.589	Rp 1.106.992.737	Rp 1.056.674.886	Rp 1.006.357.034	Rp 956.039.182	Rp 888.948.713	Rp 838.630.862	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp 8.585.858.586	Rp 8.585.858.586	
Rp 2.345.768.571	Rp 2.443.208.571	Rp 2.540.648.571	Rp 2.638.088.571	Rp 2.665.928.571	Rp 2.665.928.571	Rp 2.665.928.571	Rp 2.665.928.571	Rp 2.532.632.143	Rp 2.399.335.714	
Rp 572.288.000	Rp 555.456.000	Rp 538.624.000	Rp 521.792.000	Rp 504.960.000	Rp 488.128.000	Rp 471.296.000	Rp 454.464.000	Rp 437.632.000	Rp 420.800.000	
Rp 31.475.840	Rp 30.550.080	Rp 29.624.320	Rp 28.698.560	Rp 27.772.800	Rp 26.847.040	Rp 25.921.280	Rp 24.995.520	Rp 24.069.760	Rp 23.144.000	
Rp 510.380.746	Rp 495.369.547	Rp 480.358.349	Rp 465.347.150	Rp 450.335.952	Rp 435.324.754	Rp 420.313.555	Rp 405.302.357	Rp 390.291.158	Rp 375.279.960	
Rp 286.144.000	Rp 277.728.000	Rp 269.312.000	Rp 260.896.000	Rp 252.480.000	Rp 244.064.000	Rp 235.648.000	Rp 227.232.000	Rp 218.816.000	Rp 210.400.000	
Rp 143.072.000	Rp 138.864.000	Rp 134.656.000	Rp 130.448.000	Rp 126.240.000	Rp 122.032.000	Rp 117.824.000	Rp 113.616.000	Rp 109.408.000	Rp 105.200.000	
Rp 128.764.800	Rp 124.977.600	Rp 121.190.400	Rp 117.403.200	Rp 113.616.000	Rp 109.828.800	Rp 106.041.600	Rp 102.254.400	Rp 98.467.200	Rp 94.680.000	
Rp 31.475.840	Rp 30.550.080	Rp 29.624.320	Rp 28.698.560	Rp 27.772.800	Rp 26.847.040	Rp 25.921.280	Rp 24.995.520	Rp 24.069.760	Rp 23.144.000	
Rp 114.457.600	Rp 111.091.200	Rp 107.724.800	Rp 104.358.400	Rp 100.992.000	Rp 97.625.600	Rp 94.259.200	Rp 90.892.800	Rp 87.526.400	Rp 84.160.000	
Rp 1.818.058.826	Rp 1.764.586.507	Rp 1.711.114.189	Rp 1.657.641.870	Rp 1.604.169.552	Rp 1.550.697.234	Rp 1.497.224.915	Rp 1.443.752.597	Rp 1.390.280.278	Rp 1.336.807.960	
Rp 519.565.968	Rp 566.259.619	Rp 549.100.237	Rp 590.159.797	Rp 571.122.384	Rp 606.547.853	Rp 585.632.410	Rp 615.423.787	Rp 592.630.314	Rp 616.787.600	
Rp 2.298.451.680	Rp 2.141.616.154	Rp 2.076.718.694	Rp 1.927.995.350	Rp 1.865.801.952	Rp 1.725.190.790	Rp 1.665.701.453	Rp 1.533.202.474	Rp 1.476.417.197	Rp 1.352.030.400	
Rp 3.076.048.000	Rp 2.866.152.960	Rp 2.779.299.840	Rp 2.580.261.440	Rp 2.497.027.200	Rp 2.308.845.440	Rp 2.229.230.080	Rp 2.051.904.960	Rp 1.975.908.480	Rp 1.809.440.000	
Rp 5.374.499.680	Rp 5.007.769.114	Rp 4.856.018.534	Rp 4.508.256.790	Rp 4.362.829.152	Rp 4.034.036.230	Rp 3.894.931.533	Rp 3.585.107.434	Rp 3.452.325.677	Rp 3.161.470.400	
Rp4.253.880.226	Rp3.794.196.332	Rp3.485.639.392	Rp3.039.290.230	Rp2.804.778.200	Rp2.469.203.769	Rp2.266.976.649	Rp1.944.736.949	-Rp6.736.001.338	-Rp6.911.609.879	Rp141.997.309.028
Rp1.948.751.545	Rp1.655.395.292	Rp1.448.355.163	Rp1.202.750.349	Rp1.057.091.405	Rp886.301.840	Rp774.965.675	Rp633.150.548	-Rp2.088.617.859	-Rp2.041.017.554	Rp105.129.444.502
Rp925.768.277	Rp750.661.517	Rp626.922.883	Rp496.948.239	Rp416.912.407	Rp333.664.915	Rp278.488.954	Rp217.184.640	-Rp683.876.564	-Rp637.913.933	Rp82.210.831.689
Rp454.589.931	Rp352.579.059	Rp281.657.506	Rp213.556.703	Rp171.372.730	Rp131.190.469	Rp104.735.656	Rp78.128.689	-Rp235.317.376	-Rp209.958.377	Rp67.403.653.617

Appendix 7.3 Scenario 3 within the Worst and the Best Erosion Case Scenario

		2016	2017	2018	2019	2020	2021
Costs of Mangrove Rehabilitation	Preparation	Rp 24.000.000	Rp -	Rp -	Rp -	Rp -	Rp -
	Supply Material(s)	Rp 2.594.495.078	Rp 2.594.495.078	Rp 2.594.495.078	Rp 2.594.495.078	Rp 2.594.495.078	Rp 2.594.495.078
	Installation of the Permeable Dam	Rp 1.086.567.054	Rp 1.086.567.054	Rp 1.086.567.054	Rp 1.086.567.054	Rp 1.086.567.054	Rp 1.086.567.054
	(Re)Building Semipermeable dam	**Rp 3.705.062.132**	**Rp 3.681.062.132**	**Rp 3.681.062.132**	**Rp 3.681.062.132**	**Rp 3.681.062.132**	Rp 3.681.062.132
	Mangrove Seed (propagul)	Rp -	Rp 102.304.000	Rp -	Rp -	Rp -	Rp -
	Ajir (bamboo)	Rp -	Rp 127.880.000	Rp -	Rp -	Rp -	Rp -
	Rafia (Rope)	Rp -	Rp 3.682.944	Rp -	Rp -	Rp -	Rp -
	Labour	Rp -	Rp 971.888.000	Rp -	Rp -	Rp -	Rp -
	Boat (water trasportation) + fuel	Rp -	Rp 15.345.600	Rp -	Rp -	Rp -	Rp -
	Planting Cost (Investments)	Rp -	**Rp 1.221.100.544**	Rp -	Rp -	Rp -	Rp -
	Mangrove Seed (propagul)	Rp -	Rp -	Rp 10.230.400	Rp 10.230.400	Rp 10.230.400	Rp 10.230.400
	Ajir (bamboo)	Rp -	Rp -	Rp 12.788.000	Rp 12.788.000	Rp 12.788.000	Rp 12.788.000
	Rafia (Rope)	Rp -	Rp -	Rp 368.294	Rp 368.294	Rp 368.294	Rp 368.294
	Labour	Rp -	Rp -	Rp 97.188.800	Rp 97.188.800	Rp 97.188.800	Rp 97.188.800
	Boat (water trasportation) + fuel	Rp -	Rp -	Rp 1.534.560	Rp 1.534.560	Rp 1.534.560	Rp 1.534.560
	Replanting Cost (Fixed Cost)	**Rp -**	**Rp -**	**Rp 122.110.054**	**Rp 122.110.054**	**Rp 122.110.054**	**Rp 122.110.054**
Forgone Assets due to Mangrove (Re)Plantation	**loss of aquaculture Assets (Ponds) due to restoration**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**
Potential losses due to no intervention (no mangrove restoration) (Declining)	**Flooding hazard on settlement (damage costs and precaution costs)**	**Rp 382.178.571**	**Rp 382.178.571**	**Rp 382.178.571**	**Rp 382.178.571**	**Rp 382.178.571**	**Rp 382.178.571**
Benefit of Mangrove Rehabilitation	**Brushwood (Silvofishery ponds)**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**
	Brushwood (Mangrove Patches)	**Rp 106.400.000**	**Rp 106.400.000**	**Rp 106.400.000**	**Rp 106.400.000**	**Rp 106.400.000**	**Rp 106.400.000**
	Aquatic Organisms	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.362.130.440**
	Maintenance of fisheries	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.677.261.723**
Traditional Monoculture Milkfish	Reconstruction cost	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336
	Saponin (herbal medicine)	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148
	Kompos (fertiliser manure) – man made	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600
	Water Pump Rent Fee	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000
	Fuel	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000
	Milkfish seeds	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428
	harvesting labour	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000
	Total Operational Costs	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**
	***Additional costs due to flooding (damage and precaution)**	**Rp 88.368.000**	**Rp 88.368.000**	**Rp 88.368.000**	**Rp 88.368.000**	**Rp 88.368.000**	**Rp 88.368.000**
	Milkfish Production	Rp 4.729.266.000	Rp 4.729.266.000	Rp 4.729.266.000	Rp 4.729.266.000	Rp 4.729.266.000	Rp 4.729.266.000
	Revenue	**Rp 4.729.266.000**	**Rp 4.729.266.000**	**Rp 4.729.266.000**	**Rp 4.729.266.000**	**Rp 4.729.266.000**	**Rp 4.729.266.000**
Cash Flow		**Rp1.706.445.221**	**Rp509.344.677**	**Rp1.608.335.167**	**Rp1.608.335.167**	**Rp1.608.335.167**	**Rp1.608.335.167**
Present Value (Discount Rate 5%)	**5%**	Rp1.706.445.221	Rp485.090.169	Rp1.458.807.407	Rp1.389.340.388	Rp1.323.181.322	Rp1.260.172.688
Present Value (Discount Rate 10%)	**10%**	Rp1.706.445.221	Rp463.040.616	Rp1.329.202.617	Rp1.208.366.016	Rp1.098.514.560	Rp998.649.600
Present Value (Discount Rate 15%)	**15%**	Rp1.706.445.221	Rp442.908.415	Rp1.216.132.451	Rp1.057.506.479	Rp919.570.852	Rp799.626.827

2022	**2023**	2024	2025	2026	2027	2028	2029	2030	2031
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
Rp 180.224.480	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**
Rp 343.960.714	**Rp 305.742.857**	**Rp 267.525.000**	**Rp 229.307.143**	**Rp 191.089.286**	**Rp 152.871.429**	**Rp 114.653.571**	**Rp 76.435.714**	**Rp 38.217.857**	**Rp -**
Rp 114.226.754	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**
Rp 126.860.800	**Rp 147.321.600**	**Rp 167.782.400**	**Rp 188.243.200**	**Rp 208.704.000**	**Rp 229.164.800**	**Rp 249.625.600**	**Rp 270.086.400**	**Rp 290.547.200**	**Rp 311.008.000**
Rp 1.414.518.181	**Rp 1.571.681.406**	**Rp 1.781.232.372**	**Rp 2.069.364.950**	**Rp 2.488.466.883**	**Rp 3.064.732.040**	**Rp 3.510.027.843**	**Rp 3.771.966.550**	**Rp 3.929.129.775**	**Rp 3.981.517.516**
Rp 1.741.769.461	**Rp 1.935.292.676**	**Rp 2.193.323.628**	**Rp 2.548.116.187**	**Rp 3.064.178.092**	**Rp 3.773.763.211**	**Rp 4.322.078.985**	**Rp 4.644.617.676**	**Rp 4.838.140.890**	**Rp 4.902.648.628**
Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336
Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148
Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600
Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000
Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000
Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428
Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000
Rp 1.927.006.512	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**
Rp 79.531.200	**Rp 70.694.400**	**Rp 61.857.600**	**Rp 53.020.800**	**Rp 44.184.000**	**Rp 35.347.200**	**Rp 26.510.400**	**Rp 17.673.600**	**Rp 8.836.800**	**Rp -**
Rp 4.767.611.400	Rp 4.805.956.800	Rp 4.844.302.200	Rp 4.882.647.600	Rp 4.920.993.000	Rp 4.959.338.400	Rp 4.997.683.800	Rp 5.036.029.200	Rp 5.074.374.600	Rp 5.112.720.000
Rp 4.767.611.400	**Rp 4.805.956.800**	**Rp 4.844.302.200**	**Rp 4.882.647.600**	**Rp 4.920.993.000**	**Rp 4.959.338.400**	**Rp 4.997.683.800**	**Rp 5.036.029.200**	**Rp 5.074.374.600**	**Rp 5.112.720.000**
Rp5.634.263.690	**Rp6.090.810.986**	**Rp6.664.253.762**	**Rp7.413.039.757**	**Rp8.454.064.451**	**Rp9.845.775.584**	**Rp10.945.248.018**	**Rp11.635.586.273**	**Rp12.092.133.569**	**Rp12.314.889.906**
Rp4.204.374.314	Rp4.328.625.653	Rp4.510.629.264	Rp4.778.511.523	Rp5.190.062.213	Rp5.756.621.069	Rp6.094.723.648	Rp6.170.599.828	Rp6.107.349.149	Rp5.923.672.606
Rp3.180.394.968	Rp3.125.549.104	Rp3.108.923.563	Rp3.143.852.506	Rp3.259.407.817	Rp3.450.884.278	Rp3.487.493.326	Rp3.370.414.881	Rp3.184.236.700	Rp2.948.086.732
Rp2.435.847.676	Rp2.289.761.453	Rp2.178.556.376	Rp2.107.248.562	Rp2.089.715.437	Rp2.116.282.734	Rp2.045.745.115	Rp1.891.108.062	Rp1.708.965.010	Rp1.513.432.055

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	To
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
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Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
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Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
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Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp 180.224.480	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp 114.226.754	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	
Rp 311.008.000	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	
Rp 3.981.517.516	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	
Rp 4.902.648.628	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	
Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	Rp 841.566.336	
Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	Rp 46.286.148	
Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	Rp 20.829.600	
Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	Rp 631.200.000	
Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	
Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	Rp 46.276.428	
Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	Rp 151.488.000	
Rp 1.927.006.512	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	**Rp 1.927.006.512**	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp 5.112.720.000	Rp 5.112.720.000	Rp 5.112.720.000	Rp 5.112.720.000	Rp 5.112.720.000	Rp 5.112.720.000	Rp 5.112.720.000	Rp 5.112.720.000	Rp 5.112.720.000	Rp 5.112.720.000	
Rp 5.112.720.000	**Rp 5.112.720.000**	**Rp 5.112.720.000**	**Rp 5.112.720.000**	**Rp 5.112.720.000**	**Rp 5.112.720.000**	**Rp 5.112.720.000**	**Rp 5.112.720.000**	**Rp 5.112.720.000**	**Rp 5.112.720.000**	
Rp12.314.889.906	**Rp12.314.889.906**	**Rp12.314.889.906**	**Rp12.314.889.906**	**Rp12.314.889.906**	**Rp12.314.889.906**	**Rp12.314.889.906**	**Rp12.314.889.906**	**Rp12.314.889.906**	**Rp12.314.889.906**	**Rp222.888.095.622**
Rp5.641.592.958	Rp5.372.945.674	Rp5.117.091.118	Rp4.873.420.113	Rp4.641.352.488	Rp4.420.335.703	Rp4.209.843.527	Rp4.009.374.787	Rp3.818.452.179	Rp3.636.621.122	**Rp106.429.236.133**
Rp2.680.078.848	Rp2.436.435.316	Rp2.214.941.196	Rp2.013.582.906	Rp1.830.529.914	Rp1.664.118.104	Rp1.512.834.640	Rp1.375.304.218	Rp1.250.276.562	Rp1.136.615.056	**Rp57.178.179.265**
Rp1.316.027.874	Rp1.144.372.065	Rp995.106.143	Rp865.309.690	Rp752.443.208	Rp654.298.442	Rp568.955.167	Rp494.743.623	Rp430.211.847	Rp374.097.258	**Rp34.114.418.042**

Appendix 7.4 Scenario 4 within the Worst and the Best Erosion Case Scenario

		2016	2017	2018	2019	2020	2021
Costs of Mangrove Rehabilitation	Preparation	Rp 24.000.000					
	Supply Material(s)	Rp 2.594.495.078	Rp 2.594.495.078	Rp 2.594.495.078	Rp 2.594.495.078	Rp 2.594.495.078	Rp 2.594.495.078
	Installation of the Permeable Dam	Rp 1.086.567.054	Rp 1.086.567.054	Rp 1.086.567.054	Rp 1.086.567.054	Rp 1.086.567.054	Rp 1.086.567.054
	(Re)Building semipermeable dam	**Rp 3.705.062.132**	**Rp 3.681.062.132**	**Rp 3.681.062.132**	**Rp 3.681.062.132**	**Rp 3.681.062.132**	**Rp 3.681.062.132**
	Mangrove Seed (propagul)	Rp -	Rp 102.304.000	Rp -	Rp -	Rp -	Rp -
	Ajir (bamboo)	Rp -	Rp 127.880.000	Rp -	Rp -	Rp -	Rp -
	Rafia (Rope)	Rp -	Rp 3.682.944	Rp -	Rp -	Rp -	Rp -
	Labour	Rp -	Rp 971.888.000	Rp -	Rp -	Rp -	Rp -
	Boat (water trasportation) + fuel	Rp -	Rp 15.345.600	Rp -	Rp -	Rp -	Rp -
	Planting Cost (Investments)	**Rp -**	**Rp 1.221.100.544**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
	Mangrove Seed (propagul)	Rp -	Rp -	Rp 10.230.400	Rp 10.230.400	Rp 10.230.400	Rp 10.230.400
	Ajir (bamboo)	Rp -	Rp -	Rp 12.788.000	Rp 12.788.000	Rp 12.788.000	Rp 12.788.000
	Rafia (Rope)	Rp -	Rp -	Rp 368.294	Rp 368.294	Rp 368.294	Rp 368.294
	Labour	Rp -	Rp -	Rp 97.188.800	Rp 97.188.800	Rp 97.188.800	Rp 97.188.800
	Boat (water trasportation) + fuel	Rp -	Rp -	Rp 1.534.560	Rp 1.534.560	Rp 1.534.560	Rp 1.534.560
	Replanting Cost (Fixed Cost)	**Rp -**	**Rp -**	**Rp 122.110.054**	**Rp 122.110.054**	**Rp 122.110.054**	**Rp 122.110.054**
Forgone Assets due to Mangrove (Re)Plantation	**loss of aquaculture Assets (Ponds) due to restoration**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**
Potential losses due to no intervention (no mangrove restoration) (Declining)	**Flooding hazard on settlement (damage costs and precaution costs)**	**Rp 382.178.571**	**Rp 382.178.571**	**Rp 382.178.571**	**Rp 382.178.571**	**Rp 382.178.571**	**Rp 382.178.571**
Benefit of Mangrove Rehabilitation	**Brushwood (Silvofishery ponds)**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**
	Brushwood (Mangrove Patches)	**Rp 106.400.000**	**Rp 106.400.000**	**Rp 106.400.000**	**Rp 106.400.000**	**Rp 106.400.000**	**Rp 106.400.000**
	Aquatic Organisms	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.362.130.440**	**Rp 1.362.130.440**
	Maintenance of fisheries	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.677.261.723**	**Rp 1.677.261.723**
Traditional plus Polyculture Milkfish & Shrimp	Reconstruction Cost	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000
	Saponin (herbal medicine)	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000
	MOL & manure	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920
	Milkfish seed	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000
	Tiger shrimp seed	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000
	Water pump rent fee	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000
	Fuel	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000
	harvesting labour	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000
	Operational Cost	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**
	***Additional costs due to flooding (damage and precaution)**	**Rp 88.368.000**	**Rp 88.368.000**	**Rp 88.368.000**	**Rp 88.368.000**	**Rp 88.368.000**	**Rp 88.368.000**
	Milkfish Production	Rp 5.002.512.480	Rp 5.002.512.480	Rp 5.002.512.480	Rp 5.002.512.480	Rp 5.002.512.480	Rp 5.002.512.480
	Shrimp Production	Rp 6.694.928.000	Rp 6.694.928.000	Rp 6.694.928.000	Rp 6.694.928.000	Rp 6.694.928.000	Rp 6.694.928.000
	Revenue	**Rp 11.697.440.480**	**Rp 11.697.440.480**	**Rp 11.697.440.480**	**Rp 11.697.440.480**	**Rp 11.697.440.480**	**Rp 11.697.440.480**
Cash Flow		**Rp7.928.010.294**	**Rp6.730.909.750**	**Rp7.829.900.239**	**Rp7.829.900.239**	**Rp7.829.900.239**	**Rp7.829.900.239**
Present Value (Discount Rate 5%)	**5%**	Rp7.928.010.294	Rp6.410.390.238	Rp7.101.950.330	Rp6.763.762.219	Rp6.441.678.304	Rp6.134.931.718
Present Value (Discount Rate 10%)	**10%**	Rp7.928.010.294	Rp6.119.008.863	Rp6.470.991.933	Rp5.882.719.939	Rp5.347.927.218	Rp4.861.752.016
Present Value (Discount Rate 15%)	**15%**	Rp7.928.010.294	Rp5.852.965.000	Rp5.920.529.481	Rp5.148.286.506	Rp4.476.770.874	Rp3.892.844.239

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
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Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**
Rp 180.224.480	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**
Rp 343.960.714	**Rp 305.742.857**	**Rp 267.525.000**	**Rp 229.307.143**	**Rp 191.089.286**	**Rp 152.871.429**	**Rp 114.653.571**	**Rp 76.435.714**	**Rp 38.217.857**	**Rp -**
Rp 114.226.754	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**
Rp 126.860.800	**Rp 147.321.600**	**Rp 167.782.400**	**Rp 188.243.200**	**Rp 208.704.000**	**Rp 229.164.800**	**Rp 249.625.600**	**Rp 270.086.400**	**Rp 290.547.200**	**Rp 311.008.000**
Rp 1.414.518.181	**Rp 1.571.681.406**	**Rp 1.781.232.372**	**Rp 2.069.364.950**	**Rp 2.488.466.883**	**Rp 3.064.732.040**	**Rp 3.510.027.843**	**Rp 3.771.966.550**	**Rp 3.929.129.775**	**Rp 3.981.517.516**
Rp 1.741.769.461	**Rp 1.935.292.676**	**Rp 2.193.323.628**	**Rp 2.548.116.187**	**Rp 3.064.178.092**	**Rp 3.773.763.211**	**Rp 4.322.078.985**	**Rp 4.644.617.676**	**Rp 4.838.140.890**	**Rp 4.902.648.628**
Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000
Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000
Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920
Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000
Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000
Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000
Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000
Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000
Rp 2.673.615.920	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**
Rp 79.531.200	**Rp 70.694.400**	**Rp 61.857.600**	**Rp 53.020.800**	**Rp 44.184.000**	**Rp 35.347.200**	**Rp 26.510.400**	**Rp 17.673.600**	**Rp 8.836.800**	**Rp -**
Rp 5.043.073.392	Rp 5.083.634.304	Rp 5.124.195.216	Rp 5.164.756.128	Rp 5.205.317.040	Rp 5.245.877.952	Rp 5.286.438.864	Rp 5.326.999.776	Rp 5.367.560.688	Rp 5.408.121.600
Rp 6.749.211.200	Rp 6.803.494.400	Rp 6.857.777.600	Rp 6.912.060.800	Rp 6.966.344.000	Rp 7.020.627.200	Rp 7.074.910.400	Rp 7.129.193.600	Rp 7.183.476.800	Rp 7.237.760.000
Rp 11.792.284.592	**Rp 11.887.128.704**	**Rp 11.981.972.816**	**Rp 12.076.816.928**	**Rp 12.171.661.040**	**Rp 12.266.505.152**	**Rp 12.361.349.264**	**Rp 12.456.193.376**	**Rp 12.551.037.488**	**Rp 12.645.881.600**
Rp11.912.327.474	**Rp12.425.373.482**	**Rp13.055.314.970**	**Rp13.860.599.677**	**Rp14.958.123.083**	**Rp16.406.332.928**	**Rp17.562.304.074**	**Rp18.309.141.042**	**Rp18.822.187.050**	**Rp19.101.442.099**
Rp8.889.162.171	Rp8.830.480.954	Rp8.836.351.055	Rp8.934.666.136	Rp9.182.990.009	Rp9.592.443.073	Rp9.779.348.058	Rp9.709.728.406	Rp9.506.483.484	Rp9.188.120.248
Rp6.724.198.306	Rp6.376.181.275	Rp6.090.400.785	Rp5.878.247.312	Rp5.767.003.977	Rp5.750.319.604	Rp5.595.891.308	Rp5.303.505.983	Rp4.956.470.125	Rp4.572.733.370
Rp5.150.027.899	Rp4.671.158.127	Rp4.267.805.622	Rp3.940.047.497	Rp3.697.419.258	Rp3.526.430.073	Rp3.282.520.205	Rp2.975.747.282	Rp2.660.114.436	Rp2.347.461.893

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	Total Cash Flow & NPV
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	Rp -	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp 180.224.480	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	**Rp 180.224.480**	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp 114.226.754	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	**Rp 114.226.754**	
Rp 311.008.000	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	**Rp 311.008.000**	
Rp 3.981.517.516	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	**Rp 3.981.517.516**	
Rp 4.902.648.628	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	**Rp 4.902.648.628**	
Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	Rp 841.600.000	
Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	
Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	Rp 750.559.920	
Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	Rp 420.800.000	
Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	Rp 210.400.000	
Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	Rp 189.360.000	
Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	Rp 46.288.000	
Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	Rp 168.320.000	
Rp 2.673.615.920	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	**Rp 2.673.615.920**	
Rp -	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	**Rp -**	
Rp 5.408.121.600	Rp 5.408.121.600	Rp 5.408.121.600	Rp 5.408.121.600	Rp 5.408.121.600	Rp 5.408.121.600	Rp 5.408.121.600	Rp 5.408.121.600	Rp 5.408.121.600	Rp 5.408.121.600	
Rp 7.237.760.000	Rp 7.237.760.000	Rp 7.237.760.000	Rp 7.237.760.000	Rp 7.237.760.000	Rp 7.237.760.000	Rp 7.237.760.000	Rp 7.237.760.000	Rp 7.237.760.000	Rp 7.237.760.000	
Rp 12.645.881.600	**Rp 12.645.881.600**	**Rp 12.645.881.600**	**Rp 12.645.881.600**	**Rp 12.645.881.600**	**Rp 12.645.881.600**	**Rp 12.645.881.600**	**Rp 12.645.881.600**	**Rp 12.645.881.600**	**Rp 12.645.881.600**	
Rp19.101.442.099	**Rp19.101.442.099**	**Rp19.101.442.099**	**Rp19.101.442.099**	**Rp19.101.442.099**	**Rp19.101.442.099**	**Rp19.101.442.099**	**Rp19.101.442.099**	**Rp19.101.442.099**	**Rp19.101.442.099**	**Rp393.406.087.866**
Rp8.750.590.712	Rp8.333.895.916	Rp7.937.043.730	Rp7.559.089.266	Rp7.199.132.635	Rp6.856.316.795	Rp6.529.825.519	Rp6.218.881.447	Rp5.922.744.235	Rp5.640.708.795	**Rp204.178.725.748**
Rp4.157.030.336	Rp3.779.118.488	Rp3.435.562.261	Rp3.123.238.419	Rp2.839.307.654	Rp2.581.188.776	Rp2.346.535.251	Rp2.133.213.865	Rp1.939.285.332	Rp1.762.986.665	**Rp121.722.829.355**
Rp2.041.271.212	Rp1.775.018.445	Rp1.543.494.300	Rp1.342.168.956	Rp1.167.103.440	Rp1.014.872.557	Rp882.497.876	Rp767.389.457	Rp667.295.180	Rp580.256.678	**Rp81.519.506.786**