ECONOMIC VALUATION ON CLIMATE CHANGE IN THE MARINE FISHERIES IN CILACAP, CENTRAL JAVA

PROJECT PAPER

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APPROVAL

It is hereby certified that we have read this project paper entitled ‘Economic Valuation on Climate Change in the Marine Fisheries in Cilacap, Central Java’ by Rizky Yulianisa, and in our opinion it is satisfactory in terms of the scope, quality, and presentation as a partial fulfillment of the requirements for undergraduate degree in Economics.

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CERTIFICATION OF EXAMINATION

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ABSTRACT

The objective of this study is to estimate the impact of climate change in the marine capture fisheries in Cilacap, Central Java. Also to formulate the adaptation and mitigation strategies on the impacts of climate change.

Data collection was done through multi-stages sampling. Samples of respondents were: 73 marine-fisher respondents, 43 collector respondents, and 100 consumer respondents, which were analyzed by descriptive statistics. In the aspect of production, there was a decrease in catch which caused severe losses in 26 respondents, an increase in length of trip which was vary from 1 day to 7 days, and changes in fishers spending, such as: change in cost of fuel, change in food & lodging cost, and change in productivity. Lack of production has led to a decrease in fish-stocks. Therefore availability and sustainability of fish-stock in the aspect of distribution became questionable, which influenced availability and affordability of fish in market (Aspect of consumption).

Thus, enhancing the performance of extension institution was needed to anticipate the impact of climate change in marine fisheries sector. An ideal extension institution was made to enhance the performance of extension institution was made in order to estimate transaction cost of the policy. The result has shown the amount of information cost, policing cost and operational & maintenance cost to establish a successful program.

Keywords: *climate change, marine-fisheries, Cilacap, direct use value, transaction cost, extension institution.*

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Semarang, June2011

Rizky Yulianisa

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CHAPTER I

INTRODUCTION

1.1 Background

Indonesia is located between 6° 08’ North latitude and 11° 15’ South latitude, and between 94° 45’ - 141° 05’ East longitude and equator line located at 0° latitude line. Indonesia covers an archipelagic area of 1,910,931.2 sq.km consists of 17,504 islands, with a total population of 231.4 million in 2009 (BPS – *Statistics of Indonesia*, 2009). It stretches about 5,000 km from West to East and about 2,000 km from North to South. Two-thirds of Indonesia territory is covered by sea, with the area of about 3.1 million sq.km, excluding 2.7 million sq.km areas of marine waters which is under the Exclusive Economic Zone (EEZ). Therefore, Indonesia has vast marine resources with various stocks of fish and other marine assets.

According to Bailey (1987), the geographic location of Indonesia, between Continent of Asia and Continent of Australia, and between Indian Oceans and Pacific Oceans, influences the condition of the current surface for Indonesian waters. The current surface condition is also affected by the winds of prevailing monsoons. North of the equator during November through March, the monsoons winds flow out of the Northeast. From June to September is dominated by the Southeast monsoons. During this period, the circulation of surface waters is through the Banda, Flores, Java, and Shout China Sea. But, during these last

decades this condition might change due to global warming and/ or climate change.

Climate change is defined as any substantial change in Earth's climate that lasts for an extended period of time. Global warming refers to climate change that causes an increase in the average temperature of the lower atmosphere (Kim, Granger, Puckett, Hasar, and Francel; 2006). Sea level rise, changing sea temperature, inland temperature changes, changes in precipitation and water availability, and also extreme weather, such as cyclone and inland flood, are caused by climate change.

Climate change and or global warming can cause an increase in sea temperature, which leads to a melting of ice and snow surface on earth. This causes sea water volume increase and sea level rise. Over the last decade, sea level has risen approximately 0.1 to 0.3 meters (Numberi, 2009). If this continues, mangrove forests and wetlands will reduce, causing a decrease in water productivity and disrupt the marine biota, which is associated with coastal ecosystems. Moreover, coral bleaching will increase, reducing nutrition and population of fish. This may threaten fisheries and aquacultures by shifting the distribution of fish stocks, especially in Indonesia.

The Role of Marine Fisheries in Indonesia

The coastline of Indonesia spans over 81.000 km (Marine and Fisheries Services, 2009) making Indonesia famous for its rich and diverse marine biota/life as one of the largest in the world. This diversity consists of coastal ecosystem,

including mangrove forests, sea grass, coral reef, and marine ecosystem, with large number of fish.

Table 1.1
Fish Production in Indonesia 2006 - 2009

Year		2005	2006	2007	2008	2009
Production (million tons)		**6,87**	**7,49**	**8,24**	**9,05**	**10,07**
Capture fisheries	Sub Total	4,71	4,81	5,04	5,20	5,29
	Marine Fisheries	**4,41**	**4,51**	**4,73**	**4,70**	**4,79**
	Inland Open water Fisheries	0,30	0,29	0,31	0,49	0,50
Culture fisheries	Sub Total	2,16	2,68	3,19	3,86	4,78
	Marine culture	**0,89**	**1,37**	**1,51**	**1,97**	**2,44**
	Brackish-water	0,64	0,63	0,93	0,96	1,18
	Freshwater	0,33	0,38	0,41	0,48	0,59
	Cage	0,07	0,06	0,06	0,08	0,09
	Paddy Field	0,12	0,11	0,09	0,11	0,14

Source: Ministry of Marine Affairs and Fisheries, 2010

Table 1.1 shows the trend in fisheries production in Indonesia from 2005 – 2009. In 2009, total fish production was about 10,07 million, with the marine and inland fisheries contributed 7,23 million tons (71,80 percent) and 2,84 million tons (28,20 percent) respectively, and contributed 3,14 percent of the total GDP and 3,40 of the GDP of non-Oil and Gas. This clearly indicates that predominance of the marine subsector in Indonesian fisheries.

The estimated potential production of marine fishery in Indonesian territory is about 8,36 million ton per year. Nonetheless, this potential seems to be

primary dominated by small-scale operations, which are typical of Indonesian fisheries, which are dictated by low technical inputs as well as productivity and income. However, the contribution of small-scale fisheries to the national fish production is substantial. Inevitably, the marine fishery occupies a very important place in Indonesian economy.

The Role of Marine Fisheries in Central Java

The island of Java plays an important role in the fisheries sector in Indonesia. The number of fishery households in Java consecutively in 2008 and 2009 were covers 44,71 percent and 41,79 percent of the total fishery households in Indonesia. Table 1.2 shows the largest number of fishery households was in Central Java, with the number of households in 2008 and 2009 were 271.003 and 221.979.

Table 1.2
Marine Fishery Households in Java 2008 and 2009

Province	2007	%	2008	%
DKI Jakarta	7.411	0,70	6.575	0,68
West Java	475.939	44,74	445.826	46,44
Banten	47.725	4,49	45.502	4,74
Central Java	**271.003**	**25,48**	**221.979**	**23,12**
D.I. Yogya	48.764	4,58	47.722	4,97
East Java	210.860	19,82	190.336	19,83
Total	1.063.708	100,00	959.947	100

Source: Statistics of Indonesia, 2010

Table 1.3 shows the volume and value of production in marine fisheries by region in Central Java in 2009. Total fish production was 195.635,7 ton with value of 902.423.272.000 rupiahs. The contribution of northern coast and southern coast of Central Java were 91,3 percent and 8,7 percent of the total volume of production. The northern and southern coast of Central Java contributed

871.888.051.000 rupiahs (96,6 percent) and 30.535.221.000 rupiahs (3,4 percent) of total value of production.

Table 1.3
Volume and Value of Production of Marine Fisheries Based on Regency/City in Central Java 2009

Regency/City	Volume		Value of Production	
	Ton	Share (%)	Rupiah (thousand)	Share (%)
TOTAL	**195.635,7**	**100,0**	**902.423.272,0**	**100,0**
Northern Coast	**178.627,2**	**91,3**	**871.888.051,0**	**96,6**
Regency of Brebes	2.503,8	1,4	8.523.577,0	1,0
Regency of Tegal	588,1	0,3	6.678.750,0	0,8
City of Tegal	25.231,3	14,1	144.343.723,0	16,6
Regency of Pemalang	11.014,4	6,2	60.158.360,0	6,9
Regency of Pekalongan	1.764,1	1,0	7.539.614,0	0,9
City of Pekalongan	33.045,3	18,5	146.523.222,0	16,8
Regency of Batang	23.296,2	13,0	94.308.575,0	10,8
Regency of Kendal	1.530,8	0,9	8.953.392,0	1,0
City of Semarang	175,1	0,1	649.995,0	0,1
Regency of Demak	1.903,9	1,1	7.329.215,0	0,8
Regency of Jepara	5.992,6	3,4	31.226.511,0	3,6
Regency of Pati	31.132,5	17,4	150.191.819,0	17,2
Regency of Rembang	40.449,1	22,6	205.461.298,0	23,6
Southern Coast	**17.008,5**	**8,7**	**30.535.221,0**	**3,4**
Regency of Wonogiri	24,3	**0,1**	230.946,0	0,2
Regency of Purworejo	67,4	**0,4**	1.546.954,0	0,6
Regency of Kebumen	2.249,4	**13,2**	28.757.321,0	23,8
Regency of Cilacap	**14.667,4**	**86,2**	**201,291,942**	**75,4**

Source: Marine and Fisheries Services, Central Java, 2010.

Southern coast of Java is proven to be more vulnerable of disaster and climate change, because its direct adjacent to Indian Oceans and Australasian Plate (National Disaster Management Agency, 2010). Therefore, southern coast of Java is more relevant to be study-area than northern coast of Java. Table 1.3 shows that Regency of Cilacap is the leading area of fisheries sectors in southern

coast of central Java. It contributed 14.667,4 tons or 75,4 percent of the total production with the value of 201.291.942.000 rupiahs. Cilacap has a coastline of approximately 105 km and a fishing area of 5600 km2. Fishing in the coastal area is done within 12 miles from the coastal line and isobaths of 3-100m, or within the border line of Indonesian Maritime Territorial Area. Regency of Cilacap

The northern coast of Java has a different characteristic compares to southern part of Java. Unlike the southern coast, the northern coast of Java is characterized by the presence of broad deltaic plains built out into the relatively low-wave energy micro-tidal environment of the Java Sea by silt-laden rivers. These deltas are formed by mud, sand and other sediments resulting from siltation in the mouth of the rivers. While the southern coast of Java is characterized by relatively high-wave energy, this is because the coast directly adjacent to the open sea (Indian oceans). In theory, there are three factors which trigger waves, such as swell, local wind, and the plate shifting at the bottom of the ocean.

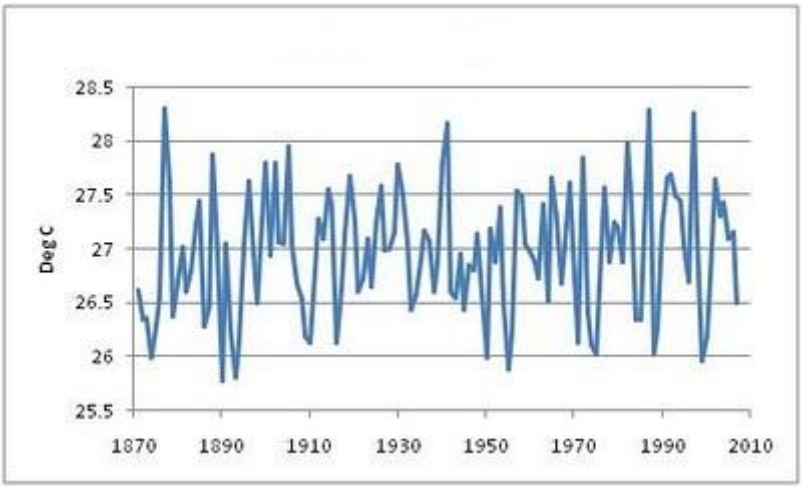
In certain places, the interference between the swell with the local wind waves – for example in Cimaja, Pelabuhanratu, or in Cilacap - can form waves as high as 3 – 4 meters. The southern coast of Java is also vulnerable to tsunami. Tsunami is triggered by the shifting of the plate at the bottom of the ocean. Interaction between the three types of waves (swell, local-wind waves, and tsunami) is believed to produce a massive-wave which will be able to sweep the coast.

Also, because of its direct adjacent to Indian Ocean, southern coast of Java, especially Cilacap, is vulnerable to sea surface temperature (SST) changing.

According to Bailey (1987), the role of SST is important, since it is the interface from the atmospheric to the oceanographic environment. SST changing (global warming) will cause harm to the fishers, because it is related to the temperature tolerance of microbial, plankton, larvae, and fish biomass.

Global climate change gives significant impact on the fisheries sector. A significant impact of climate change in terms of ecological and oceanography variables have been detected since the past 30 years. According to Intergovernmental Panel on Climate Change (2004), one of the strongest variables in measuring climate change is SST. The variability of global SST has shown a lot more significant changes since 1970 – present compared to decades before.

Figure 1.1
Variability of Global SST in year 1870 – 2010



Source : IPCC, 2010

Recent estimates also suggest that the impact on global temperatures will still be very large (Table 1.4). It is due to the increasing of greenhouse gases every year, which is highly contributed by carbon dioxide. In 2006, the concentration of greenhouse gases in the atmosphere was around 425 parts per million (ppm) of

carbon dioxide equivalent (380 CO2 only), and it has recently been increasing by over 2 ppm each year. Because many greenhouse gases, including CO2, stay in the atmosphere for more than a century and the effect of climate come through with a lag, SST and sea level rise will continue to rise during the twenty-second century. Most of damaging consequences of climate change are associated with water in some form, especially storm and sea level rise, which furthermore create enormous impact towards ocean habitats.

Table 1.4
Estimation of Increase in Global Temperature

CO2 equivalent	Temperature change by 2100		Temperature change at equilibrium	
	Temperature change (Based on IPCC 2001 climate models	Temperature change (Based on 2004 Hadley Centre ensembles)	Temperature change (Based on IPCC 2001 climate models	Temperature change (Based on 2004 Hadley Centre ensembles)
400 ppm	1,2 – 2,5°C	1,6 – 2,8°C	0,8 – 2,4°C	1,3 – 2,8°C
450 ppm	1,3 – 2,7°C	1,8 – 3,0°C	1,0 – 3,1°C	1,7 – 3,7°C
550 ppm	1,5 – 3,2°C	2,2 – 3,6°C	1,5 – 4,4°C	2,4 – 5,3°C

Source: IPCC, 2010

In measuring the level of climate change and its vulnerability to the fisheries sector, information on climate and weather is required. In Indonesia, the measurement of the change in climate and weather is provided by BMKG (*Badan Meteorologi, Klimatologi dan Geofisika*) or Meteorology, Climatology and Geophysics Agency.

This information is provided by the Station of meteorology BMKG. Station of meteorology is BMKG's unit which has main function in monitoring the weather and providing weather information. This information includes:

a. Weather information in general

b. Maritime weather information

c. Weather information for flights

d. Climate information

e. Earthquakes and tsunami information

Central Java has 4 cities with BMKG stations. Class I climatology station, class II meteorology station, and class I maritime meteorology station in Semarang, geophysics station in Banjarnegara, which provides earthquakes and tsunami information, and class III meteorology stations in Cilacap and Tegal, which provide weather information only in Cilacap and Tegal.

Provided information includes rainfall density, temperature, and wind flow that affects sea currents, weather forecast, and sea level rise. This information is useful for agriculture and fisheries sectors, especially marine fisheries sector. In the agriculture sector this information can help farmers to determine the best time to seed and cultivate their rice-fields, so that they obtain the best yields as possible. Whereas in the fisheries sector, especially marine fisheries, this information is used to seek the best time to capture fish.

Although BMKG has provided information about climate change, the marine-fishers have low capabilities in accepting this information. Therefore, decreasing in quantity and quality of production happens every year, especially in Cilacap as the leading fisheries sector in southern part of Central Java. Economic valuation on the impact of climate change is important, to estimate how much the impact of climate change in the marine fisheries sector in Cilacap and furthermore to formulate strategies in order to anticipate and mitigate the impact of climate

change in marine fisheries sector in Cilacap, not only because its vulnerability on climate change but also lack of previous research in study area.

1.2 Statement of the Research Problem

Fishermen are significantly dependent on the fisheries sector. Generally, they live in a minimum standard of living, not only economically limited, but also socially, politically, and they are limited to the access of education. Their livings cannot be categorized as a decent living or poor which is shown by their financial condition and living-facilities. Kirana (2008) stated that one of the most important things included in poverty was incapability. This incapability was strongly connected to the ownership, employment of simple technologies, and high dependency on the climate condition, especially when the climate affects the tidal which affects the number of fish captured. This shows that the coastal livelihood is still vulnerable to climate change.

Climate change has caused the coastal livelihoods, which consist of fishermen, fish farmers, and other households that depend their living on fisheries sector, become economically unstable.

Although BMKG has provided information to the Marine and Fisheries Services in the local areas, the coastal livelihoods still have a low acceptability to this information. This can be proven from the fisheries sector that are still dominated by small-scale fishermen, and that these fishermen still sail to the sea to capture fish when the storm happening which causes them to get minimal

results from fish capturing. It proves that the information from BMKG is important for the fishermen.

However, it is also proven that miss-match between BMKG information and what the fishermen belief as a culture or social behavior happen. Fishermen in central Java, especially in Cilacap regency, still have a tendency to use traditional technologies in predicting the climate change, such as: constellations, and local belief on the culture of catching in order to predict the location and time of capturing fish, and these fishermen are difficult to accept information that has been provided by BMKG, causing a decrease of productivity of marine fisheries.

Therefore an economical measurement of impact of climate change to determine the cost/benefit of the fishermen in these local areas is required.

Based on explanation above, some questions of the research can be concluded as follows:

1. Which area in the southern part of Central Java is the most vulnerable to climate change?
2. How much is the impact towards the production of marine fisheries in that particular vulnerable-area?
3. What is the total economic value of the impact of climate change in the marine fisheries sector in the study-area?
4. What strategies can be done by the stakeholders in anticipating the impacts of climate change?

1.3 Objectives and Contributions

1.3.1 Objectives of the Study

1. To identify the most vulnerable area of climate change on fisheries sector in central Java.
2. To explore on climate change impact towards the marine fisheries production in the prone-area.
3. To estimate economic valuation of the impact of climate change on fisheries sector in the study-area.
4. To formulate the adaptation and mitigation strategies on the impacts of climate change.

1.3.2 Contributions of the Study

1. As a consideration in determining the right policy, especially the adaptation and mitigation strategies on the impact of climate change on marine fisheries in Cilacap regency, central Java.
2. As a source of improvement in marine fisheries sector.
3. As a reference for the future research with similar problems and topics.

1.4 Organization of the Study

CHAPTER I

Introduction, this chapter presents the background of research, research questions, purpose and advantages of research, and systematic of writings.

CHAPTER II

Study of Literature, this chapter presents a brief view of theoretical literature and empirical studies related to the study, as well as previous research, critical framework, and hypothesis.

CHAPTER III

Methodological framework, this chapter presents the research variables, operational definition, sample, research source, methods of sample collection, and methods of analysis to answer the research questions.

CHAPTER IV

Result and discussion, this chapter presents the description of objects of research, data analysis which gives the estimation, discussion which gives the interpretation and research result comprehensively.

CHAPTER V

Closing, this chapter includes the conclusion of data analysis and discussion, as well as recommendation towards particular parties which are related to this research..

CHAPTER II

LITERATURE REVIEW

2.1 Theoretical Backgrounds

2.1.1 Climate Change

According to the World Climate Conference (1979), weather is defined as a condition of atmosphere in a certain period of time, including the changing and the disappearance of a phenomenon. Whereas Gibbs (1987) defines weather as a condition of atmosphere characterized by many parameters, including temperature, pressure, wind, humidity, and several rain phenomenon, in an area in a short period of time (minutes, hours, months, seasons, or years).

Climate is defined as a synthesis of events related to weather in a long period of time, which is statistically sufficient enough to show the difference between one period to another (BMKG). Gibbs (1987) defines climate as a statistical chance of a condition of atmosphere, including temperature, pressure, wind, humidity, which occur in an area in a long period of time.

Climate change is the change of conditions of earth's atmosphere, including temperature and rainfall density which heavily impacts on many aspects of human lives (Ministry of the Environment, 2001). These physical changes happen in a long period of time. National Institute of Aeronautics and Space(2002) defines climate change as the average change of one or more elements of weather in an area and global climate change is defined as the change of climate of the earth. IPCC (2001) stated that climate change refers to the average variations of an area's climate or to the variability which is statistically

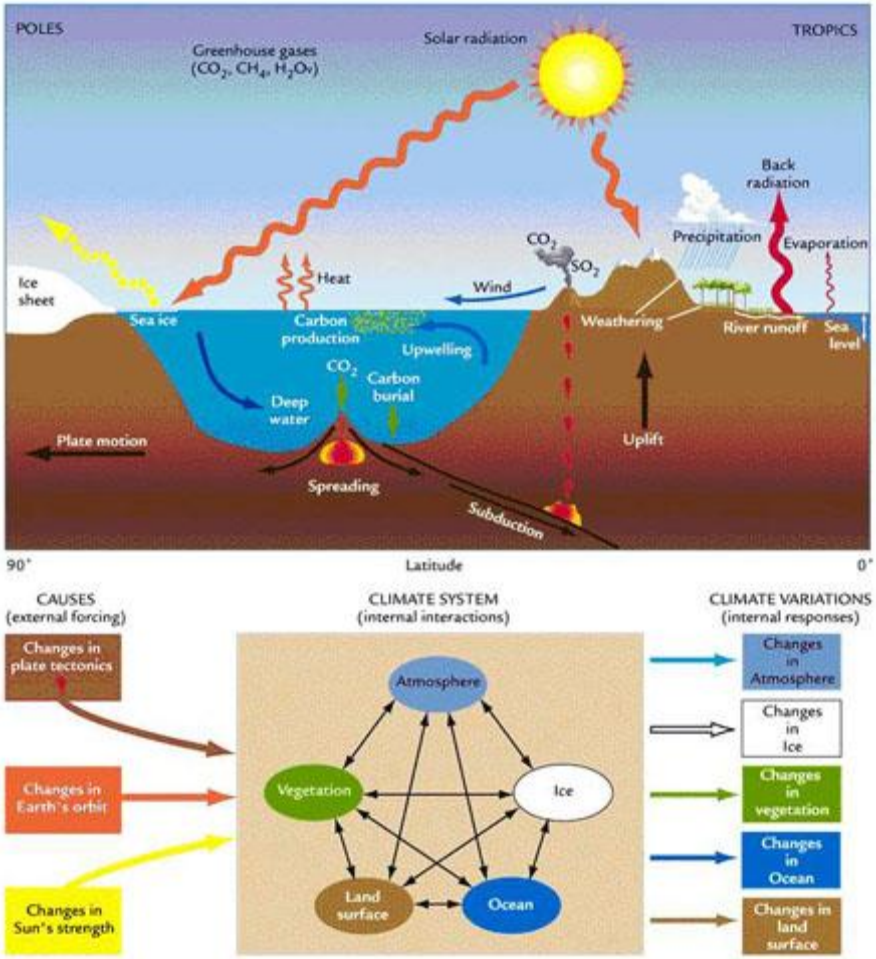
actual for a long period of time (usually decades or more). Further, it is also stated that climate change happens due to internal natural process, as well as external forces or continuous human activities change the atmosphere's composition and land use patterns.

Climate change is often perceived as 'global warming'. However, global warming is only one part of climate change because temperature is one of the parameters of the climate. Other related parameters are precipitation, cloud, wind, and sunscreen radiation. Global warming is an average increase of atmosphere temperature near by the earth surface and troposphere which contributes to the global climate change pattern. Global warming occurs as the result of an increase of greenhouse effect on the atmosphere (NOAA). The increase of greenhouse effects is mainly caused the over flows absorbance of the sun's infrared ray by the atmosphere through the earth's reflection. This, causes global climate change (Budianto, 2000)

Although global warming is only one part of the climate change phenomenon, yet it is important to be observed. That is because the changes in temperature will affect significantly to human activities. These changes could change the condition of the environment which will affect to the places where people live. This means, global warming threatens the entire human lives.

The climate system on figure 2.1 explains that climate change causes changes in atmosphere, ice, vegetation, ocean, and land surface. This is caused by the changes in plate tectonics, earth's orbit, and sun's strength.

Figure 2.1
Climate System



Source :NOAA, 2008 (http://www.ncdc.noaa.gov/paleo/ctl/about1a.html)

Climate change causes changes in sea surface temperature. SST is important since it is the interface from the atmospheric to the oceanographic environment. The most important analysis on SST variability carried out from 1971 to 2000. Before 1980, the anomaly of SST was below normal, or cooler than its average value. After 1980, the SST anomaly has been above average. On the basis of small scale fishery resources point of view, SST anomaly of 0,5°C (positive or negative) before 1980 was still tolerable. But when SST anomaly

reaches 2°C, or above, it would be harmful for small scale fishery resources, and the extreme anomaly is regarded since 1980. (Susilowati, 2010)

2.1.2 Definition of Marine-Fishers

Fishermen are a group of people who depend their lives on marine products, both from fish catching and fish farming. Generally, fishermen live in the coastal area close to their activities area.

Charles (2001) divided groups of fishermen into several terminologies. Full fishermen are fishermen that depend all of their daily needs on capturing fish. Part-time fishermen are fishermen that depend some of their daily needs on capturing fish as well as doing other activities such as farming and labors. There are ship-owner fishermen who can afford to run a fisheries business such as ships, fishing nets, equipment and tools. Ship-crew is people that allocate their time to operate ships and nets and earn wages from the job. Individual fisherman is a fisherman who has his own ships, boats, and nets, and operates it individually. Besides those groups, fishing industry in this region involves individuals working in four major activities: fish-capturing, fish-farming, fish-processing, and sales of fish (Indah Susilowati, 2004).

Some fishermen in this country face many challenges, such as: lack of modern culture and knowledge. For example, they save money to repair the facilities they own. They are generally lack of knowledge to solve the problem of climate change. Poverty, slums, and marginalized community are the social phenomenon arouse in this coastal marine-fishers community.

2.1.3 The Vulnerability of Fisheries Sector Due to Climate Change

Most of marine fisheries in Indonesia are community fisheries and only few of marine fisheries are industrial ones. Community fisheries themselves are still traditional. This means, that these fisheries are not well-informed and equipped with modern technologies. They simply believe in the traditional information inherited intergenerational and use traditional equipment and tools.

According to the Intergovernmental Panel on Climate Change (2007), vulnerability is a state of which a system is vulnerable to, and the inability to overcome the impacts from climate change, including climate variability and extreme.

The two major considerations in measuring the level of vulnerability of fisheries sector are how far the impacts of climate change including other changes involving fisheries sectors would be and the vulnerability of that sector to the impacts of the change.

Vulnerability is affected by many factors, such as the local government policy regarding fisheries sector or the capability of related institutions, technology, and other aspects. For example, people depend their lives on fisheries sector are vulnerable because of their informal legal status, their poor livelihood (both physically and socially), and their subsistence production (self-sufficiency).

The core of the vulnerability of fisheries sector is the critical risk. Risk, in this context, is the disaster caused by climate change. Several indicators of disaster can be obtained from secondary data, for example meteorology data that shows the frequency of rainfall and the period of rainy season (BMKG). The risk

analysis will show how sensitive fisheries sector is to climate change and the capability of fisheries sector to adapt. This will make the formulation of policy, which overcomes the vulnerability of fisheries sector to climate change, become more effective and well-targeted.

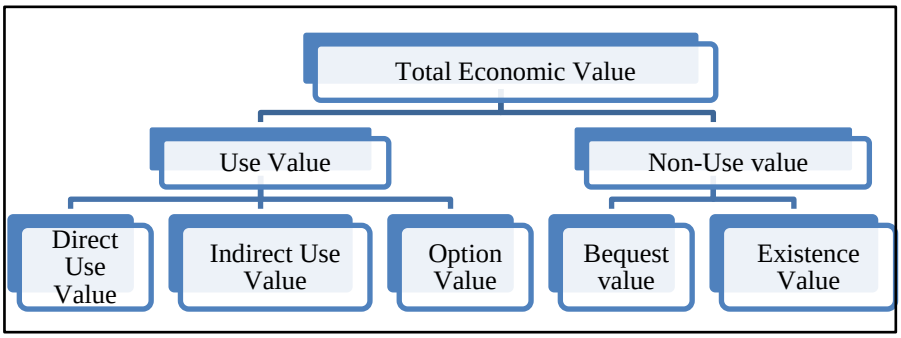
2.1.4 Economic Valuation

Economic valuation on ecosystem or environment is considered significant. This is because economic valuation offers at least five benefits according to NOAA. Firstly, it can be used to estimate the benefits offered by an ecosystem to the community. Secondly, it is useful to estimating the cost and benefit of various environmental systems, including conservations, ecotourism, and others. Thirdly, it helps the process of decision making. Fourthly, economic valuation also helps in estimating the cost that has to be spent by those using resources, such as tourists and fishermen, or taxes that have to be paid by individuals or companies which can cause negative effects to ecosystem. Last but not least, economic valuation can be used to help formulate policies that are efficient and suitable for the application and resource management.

2.1.4.1 Total Economic Value (TEV)

According to Freeman III (2002) TEV is a sum of economic value based on use value (UV) and economic value based on non-use value (NUV). UV consists of direct use value, indirect use value, and option value. While NUV consists of two components; bequest value and existence value. Typology of total economic value can be seen in figure 2.2.

Figure 2.2
Typology of Total Economic Value



Source: Freeman III, 2002

Barton (1994) explains several methodological approaches to valuate ecosystem/resource based on the typology above. Most of the approaches used are based on cost-approach. This is because benefit-approach is relatively unpredictable. Some popular methodologies are the effect of production (EOP) or production analysis and benefit-cost analysis, where benefit is described as production income. In its application in fishery, the widely used economic valuation was direct use value, with the analysis of production as the basis of its estimation.

Table 2.1 explains the values in total economic values (TEV) :

Table 2.1

Definitions and Examples of Compositions of Total Economic Values (TEV)

No	Values	Definition	Example
1	*Direct Use Value*	Value of economy obtained from direct use of resource/ ecosystem	Fishery use, mangrove wood use, etc
2	*Indirect Use Value*	Value of economy obtained from indirect use of resource/ ecosystem	Function of coral reefs ecosystem as spawning ground for coral-type fish, etc
3	*Option Value*	Value of economy obtained from potential direct use and indirect use of resource/ ecosystem	Benefit of biodiversity, new species, etc
4	*Bequest Value*	Value of economy obtained from the use of protection of resources/ ecosystem for future generation	Value of a traditional community system related to resources/ ecosystem; habitat, and biodiversity.
5	*Existence Value*	Value of economy obtained from a perception that a resource/ ecosystem exists regardless being used or not	Coral reefs that reach extinction, endemic species, etc

Source : Barton (1994)

2.1.4.2 Analysis of Production

Production is defined as the use of resources which completely transforms one commodity into another commodity, in terms of definition, place and time where these commodities are allocated, and how the consumers work on those commodities (Miller and Meiners, 2000). Production is not only limited to its producers, but also storage, distribution, shipping, and repacking.

Production process involves production factors consisting of workforce, land, capital, and entrepreneurship. In the economics theory, to analyze production, it is always assumed that three factors of production (land, capital, and entrepreneurship) are constant. The relations between factors of production used and the amount produced is called production function. Soekartawi (1990) explains that production function is the physical relation between dependent variable (Y) and independent variable (X). Explained variable is usually an input and dependent variable is usually an output.

2.1.4.3 Benefit and Cost Analysis

One of the means in economic valuation is by analyzing the cost and benefit resulted from a production. (Pearce*et. al*, 2006)

1. Production Cost

   Production cost is defined as all expenses of a producer to gain production factors and raw materials which will be used in a production. In Gilarso (2003), cost is all sacrifices in a production process, in the value of money, according to the market price.

   Sadono Sukirno stated that production cost can be divided into six categories, based on the relation between the natures of cost and the level of output:

   a) Total fixed cost (TFC), the total permanent cost that has to be paid regardless the level of output, for example: Ship or boat buying, equipment epreciation, and others.

b) Total variable cost (TVC), the total cost that changes according to the level of output, for example: fuel cost, workforce cost, and others.

c) Total cost, the sum of total fixed cost (TFC) and total variable cost (TVC)

$$TC = TFC + TVC \quad \text{.....(2.4)}$$

d) Average fixed cost (AVC), the permanent cost of each unit of output, where:

$$AFC = \frac{TFC}{Q} \quad \text{.....(2.5)}$$

TFC is the total fixed cost and Q is the total output.

e) Average Variable Cost (AVC), other cost besides AFC of each unit of output, where :

$$AVC = \frac{TVC}{Q} \quad \text{.....(2.6)}$$

TVC is the total variable cost and Q is the total output.

f) Average total cost (ATC), the production cost of each unit of output, where :

$$ATC = \frac{TC}{Q} \quad \text{.....(2.7)}$$

TC is the total cost and Q is the total output.

In production, including fishery production, cost usually reveives its primacy because it requires many considerations to make decision. These considerations are needed to fulfill the production cost which will lead to a successful production.

Production cost in fishery consists of two categories; actual cost and input cost. Actual cost consists of cash and non-cash. Cash costs in fishery businesses are, such as, fuel (solar, gasoline, and oil), preservatives(ice and salt), cost of food and drink supplies for crew members of ships, cost of ship/boat reparation, and cost of retribution. Non cash cost is, for example, the wages of crew members after the selling of production. Input costs are, for example, the depreciation value of boat/ship, machines, and fishing nets. This is because such cost is not fixed, but only a rough prediction (Mulyadi, 2005).

Wattanutchariya (1982), cost of fishery business is classified into three components:

a) Variable cost, the cost that is actually paid and changed according to number of fish produced, for example food supplies, fuel, wager, and medicine.
b) Fixed cost, the cost outside the production and operation, such as reduction of fishing nets and equipment.
c) Opportunity cost from input owners, both variable cost and fixed cost, such as wager for crew members from own family, the use of land and interests from capitals.

Fixed cost usually consists of depreciation cost of assets and the payment of interests used to buy those assets. Opportunity cost of capital ownership invested in fishery business is supposed to be fixed cost. Variable cost is defined as the total cost from all inputs when the fishery business operates, which includes

workforce cost, fuel cost, other input cost, and opportunity cost from workforce from own family.

Based on the result of pre survey on site, fixed cost includes value of ship depreciation, value of nets depreciation, and value of machine depreciation. Variable cost includes workforce cost, cost of raw material of fish, ice blocks, herbs for cooking (salt, etc), clean water, cost of equipment maintenance, retribution (security, license,etc), and other cost depends on the kinds of businesses.

2. Revenue

There are several important concepts of analyzing producer's behavior (Boediono, 1993):

a) Total Revenue (TR), the total revenue from the total output. In Fisheries sector, TR is the total revenue of fishermen or fish farmers. Total revenue is the multiplication of output/ number of fish produced (Q) and Fish price (P_Q), where :

$$TR = Q.P_Q \quad \text{.....(2.8)}$$

b) Average Revenue (AR), the revenue per unit of output sold. Where :

$$AR = \frac{TR}{Q} = \frac{Q.P_Q}{Q} = P_Q \quad \text{.....(2.9)}$$

Thus AR is price of output sold / fish per unit (P_Q)

c) Marginal Revenue (MR), the increase of total revenue (TR) caused by additional selling of one unit of output / fish. Where :

$$MR = \frac{\Delta TR}{\Delta Q} \quad \text{.....(2.10)}$$

3. Maximum Profit

Maximum profit (π) is a margin between total revenue (TR) and total cost (TC). The total of maximum profit is the furthest vertical distance between TR and TC curves (Sukirno, 2005).

2.1.5 Supply Chain of Marine Fisheries Sector

According to the Food and Agriculture Organization of the United Nations (2009), the supply chain includes all links from the point of production to the end-user or final consumer. The supply chain therefore contains a sub-set of markets or marketing systems.

A marketing system is defined as the chain of links between producers/suppliers and consumers/users, including all mechanisms, flow, interchanges, services and operators, and which determine the relationships between producer earnings and the supply of the physical product. Flows through a well-functioning marketing system include information on prices, market situation, trends, and consumer preferences as well as flows of physical product, and of money, credit and property rights.

Flows of physical product or distribution process, according to Dent (2008), is also a very important component of supply chain management. Distribution refers to the distribution of a good from one business to another. It can be from producers to supplier, supplier to retailer, or retailer to end customer. It is defined as a chain of intermediaries; each passing the product down the chain to the next organization, before it finally reaches the consumer or end-user. This process is known as the 'distribution chain' or the 'channel.' Each of the elements

in these chains will have their own specific needs, which the producer must take into account, along with those of the all-important end-user.

A number of alternate 'channels' of distribution may be available:

- Distributor, who sells to retailers, (also called as wholesaler)
- Supplier, who sells to wholesaler
- Retailer (also called dealer or reseller), who sells to end customers

Whereas in the distribution of fish as consumer goods, there are five alternatives of distribution channel:

1. Producers – Consumers
2. Producers – Retailer – Consumers
3. Producers – Wholesaler – Retailer – Consumers
4. Producers – Supplier – Wholesaler – Consumers
5. Producers – Supplier – Wholesaler – Retailer – Consumers

Traditionally, the distribution channels in most developing countries were characterized by a series of different levels such as importers, distributors, wholesalers and retailers as well as food brokers and agents, with each level performing a specific task. More recently, increased competition and improved logistics have shortened the chain in many markets in which imported products directly bought from source by the wholesaler or by the retail chain operator.

Wholesale markets play an important role in the distribution of fish and fishery products. They are generally divided into two categories; first hand wholesale markets that act as distribution centers for locally produced fish, and second hand wholesale markets that distribute products imported from other

regions or from abroad. The latter plays a significant role particularly in urban areas.

Wholesale markets offer economic efficiency gains as the clients, usually retailers and caterers, but also smaller local wholesalers can confront a large variety of products from different sources all located in one area. The large number of wholesalers present in the market guarantees a high level of competition with prices that immediately reflect changes in supply and demand. In many cities, the fish wholesale market is also integrated in a larger structure of food wholesale markets. City governments or municipal authorities own most wholesale markets. In order to ensure the competitiveness of the market in local fish distribution, it is vital that the concerns and interests of the main stakeholders; i.e. wholesalers and their clients, are taken into account and their role recognized and not only seen as a source of revenue for the municipal finances.

Retail chains are growing up faster than wholesale markets. Numerous international studies document the increasing power exercised in food distribution by the retail chains, such as: a marketing strategy for sea farmed products in Indonesia by Elsy, survey of value chain in Asia by Food & Agriculture Organization. Despite the negative competitive impact on suppliers and smaller retailers and fish mongers, the overall positive effects of modern retail channels includes lower prices to the consumer, improved accessibility and added convenience. It is also obvious that supermarket chains present important opportunities for volume sales for low-cost producers. In the European and North American markets for example, the chains have played an important role in

promotion and volume sales of aquaculture products such as salmon, bass, bream and catfish.

The successful formula of retail chains is a balanced mix of competitive pricing, large share of fresh produce and high quality standards obtained through narrow product specifications, modern logistics and stringent controls. In fact, one recurring result in consumer surveys is the trust placed by the consumer in the supermarket brand. That this phenomenon is not only confined to developed countries is evidenced by the proliferation of supermarket chains also in developing countries

In any market, the price formation mechanism is of fundamental importance. In order to guarantee economic efficiency and efficient allocation of scarce economic resources, available prices must reflect the actual costs of products and services but also the propensity of buyers to demand and of producers to produce and offer for sale. In order to achieve this, prices must be formed in a mechanism that gives voice to both the supply and the demand side.

In principle, a product can be sold in two ways: through private or direct sale or through public selling such as auctions. An auction is a regulated public sale in which goods are sold to the highest bidder. The seller will auction a product when he is expecting a higher price through public sale than through private sale.

2.2 Previous Studies

The previous studies are as follows:

1. **Indah Susilowati (2010)**

Indah Susilowati (2010) conducted a research entitled 'Developing Adaptation Strategies Due to The Vulnerable Small Scale Fisheries Sector in Central Java – Indonesia'. The main purpose of this research was framing adaptation strategies and mitigations for fisheries sector due to climate change. Data used in this research was primary and secondary data. Primary data was obtained from the fishermen in Central Java with adequate sample, discussions with key-persons and other competent people, whereas the secondary data was used to enrich the analysis of this research. This study used GIS maritime meteorology (Hartoko and Sulistya, 2009) and socio-economic approach (Susilowati et al., 2004; 2005; 2007; 2009) with modifications. Results of this research are: (1) the proof of the impacts of climate change on fishermen that are vulnerable in chosen areas; and (2) short term mitigation and adaptation strategies for small scale fisheries sector in order to survive the climate change.

2. **E. Baran, N. Schwartz, Y. Kura (2008)**

They conducted a research entitled 'Climate Change and Fisheries: Vulnerability and Adaptation in Cambodia'. The purpose of this research was to frame adaptation strategies for fishermen that were vulnerable to the impacts of climate change. This research stated that Cambodian fishers were very vulnerable to climate change. The hydrologic variations that happened in Mekong River were caused by climate change, causing changes of pattern of fishing, followed by the

extreme decrease of fishery production. This change of production made the people depend fully on fishery production. This in turn worsens poverty, marginalization, and the lack of other livelihood alternatives making them difficult to survive. Therefore, an adaptation plan that ensures irrigations and hydraulics projects being useful to the fisheries sustainability in Cambodia was needed. The adaptation strategy aroused from this research was the building of capacity of fishery community to promptly adapt to the climate change, with more diversification oflife dependency and more access to natural resources, which were side by side with the increase of long term capacity to adapt to climate change.

3. **Mayanggita Kirana (2008)**

The research entitled "Comparative analysis of empowerment level and Fish Processing between The Northern Coast and Southern Coast of Central Java in Supporting Food Security" has the objectives:

1 to identify the empowerment capability of fishermen and fish mongers in Rembang and Cilacap regencies from the economic and non-economic strength aspect.

2 to analyze their business strength in order to support the food stability for the surrounding community.

3 to frame the correct strategy to increase empowerment.

Data which were used in this research consist of primary and secondary data. Samples were collected using multistage sampling. Respondents taken as samples were fishers that used gillnets as fishing gears in Rembang and Cilacap

regencies, with each regency consists of 100 people. Respondents used as samples of fish mongers in Rembang and Cilacap regencies consist of respectively 133 and 129 people. And sample for consumers in Rembang and Cilacap regencies consists of 100 people for each regency. A method of analysis used in this research was descriptive analysis.

The result of the identification of the empowerment level of fishermen and fish mongers in Rembang and Cilacap Regencies generally showed a lack of power. However, if further compared, it was shown that fishermen and fish mongers in Cilacap regency were relatively more powerful compared to those in Rembang regency. This was caused by their lack of access to political power, economy, social and culture, which leads to the fragility in supporting the food stability. Therefore, strategy and alternatives are formed in order to increase the empowerment of fishermen and fish mongers in Rembang and Cilacap regencies using Analysis of Hierarchic Process (AHP).

The roles of stakeholders are needed through an activity of increasing the empowerment by establishing groups of coastal community where education, trainings, micro-credit loans according to their income cycle, and business assistance can be done. Furthermore, education for consumers to safely fill the needs of protein from fish also needs to be done. The food stability of an area can be increased through the strategy of community empowerment; therefore they have more roles in supporting the food stability.

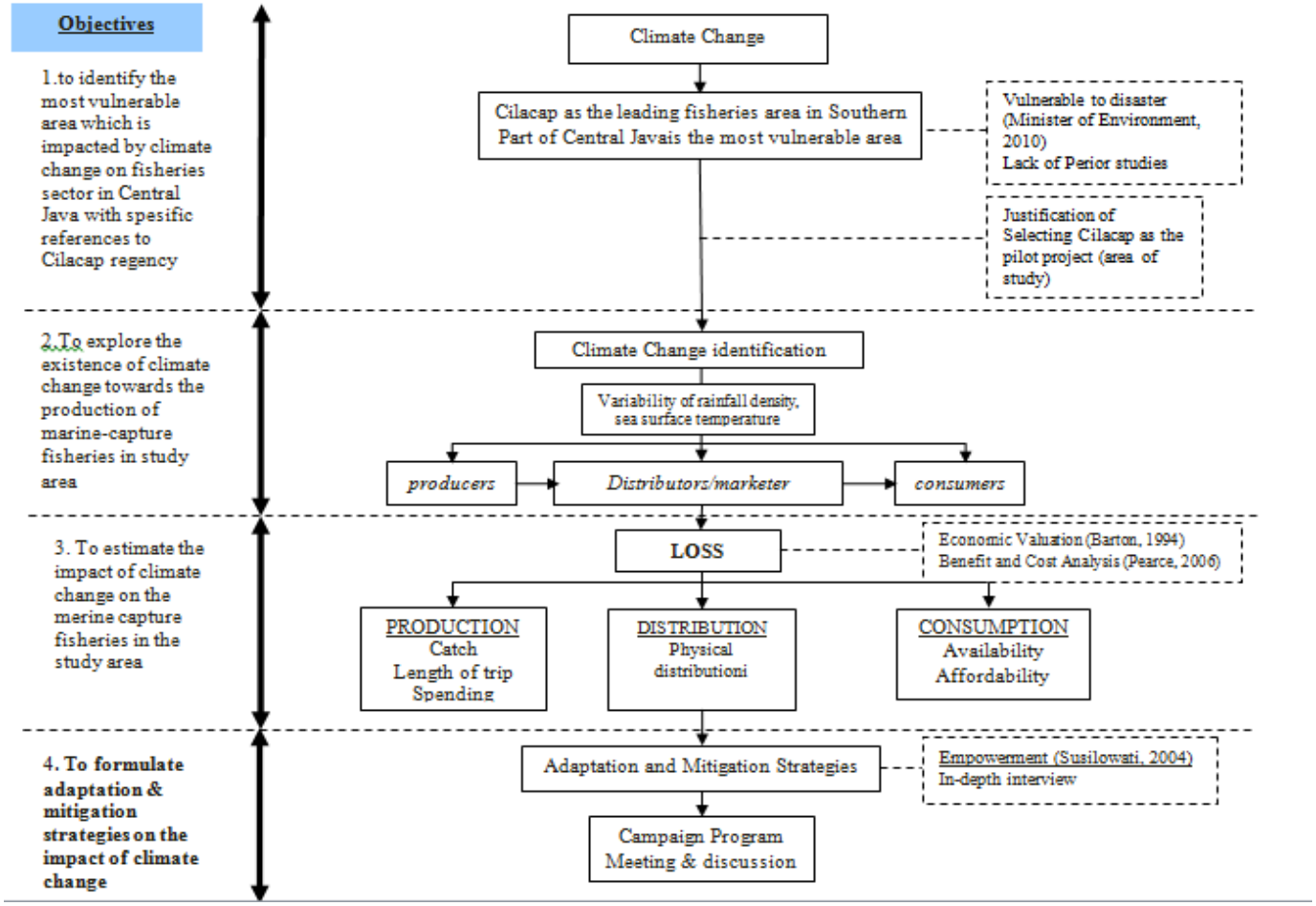
2.3 Conceptual Framework

The invulnerability of coastal livelihood to the impact of climate change has been the hope for all sectors including fisheries sector, fisheries business, government, and other relevant sectors. However, that hope is seemingly far-fetched, seeing the poverty in the research area. The poverty of this community is strongly related to the ownership and the use of simple technology and the high dependency of fisheries sector on climate (Indah Susilowati, 2004; Mayanggita Kirana, 2008)

The change of ecosystem caused by climate change affects the productivity of fisheries sector, mainly in the disaster prone areas where climate change, storms, and abrasions can be found. These fishermen are vulnerable because they still have a lack of understanding about climate and weather information which is provided by BMKG, and they still use traditional technique in predicting weather, making the output of production decrease. This causes their bidding level lower.

Therefore, economic valuation to frame adaptation and mitigation strategies is needed. It is expected that the income of the people working in small scale fisheries sector and the fulfillment of needs of the coastal livelihood will increase.

Figure 2.3
Roadmap of Research



2.4 Hypothesis

Based on the research of Indah Susilowati (2010) entitled 'Developing Adaptation Strategies Due To Climate Change: with Special Reference to The Vulnerable Small Scale Fisheries Sector in Central Java – Indonesia', small scale fisheries sector, which consists of fishers with 5 – 30 GT speed boat, was the most vulnerable sector to climate change in Java island. Their inability was caused by their unawareness of the indicators of fishery vulnerability. Therefore, there should be a continuous empowerment of stakeholder that was competent, such as academics/NGO, businessman, government, and community in general. Marine and Fisheries services, BMKG, local government, the department of industry, and should immediately work together in the efforts of the empowerment of coastal livelihood. This research also stated that the co-management approach is a promising approach in overcoming the impacts of climate change on fisheries sector.

E. Baran, N. Schwartz, Y. Kura (2008) also stated that most fisheries workers in Cambodia are very vulnerable to climate change. Adaptation and mitigation strategies offered by the research are increasing the adaptation capacity in fisheries community by building infrastructure such as hydropower dam, intensifying the fisheries sector, and building macroeconomics.

Based on prior research and studies, the hypotheses of this research are:

1. The level of vulnerability of people in fisheries sector due to climate change is still high. This is caused by the ignorance of the local fishermen

about the information given by BMKG and the traditional culture of fishing in study area.

2. The climate change shifts the best season for fishing. Thus, the fishermen would not be able to go fishing in the same season like they used to be which will decrease their productivity. Furthermore, climate change will cause an additional length of trip and additional costs/spending of fishermen.

CHAPTER III

METHODOLOGY

3.1 Variables and Operational Definition of Variables

The research variables and the operational definition of variables of this research can be seen in table 3.1

Table 3.1
Variables and Indicators of Variables

Variables	Indicators of Variables	Measurements
Analysis of Production	Analyzing cost and benefit resulted from a production	Benefit and Cost Analysis Estimating Revenue, Variable Cost, Fixed Cost, Total Cost Profit : Revenue > Total Cost Loss : Revenue < Total Cost
Economic valuation	1. Impact on Production	• Catch • Length of trip • Spending
	2. Impact on Distribution	Physical distribution
	3. Impact on Consumption	– Availability (local consumption in Cilacap) – Affordability
Transaction cost	1. Information Cost 2. Policing Cost 3. Operational & maintenance Cost	Estimation of cost through extension activities

Source: Abdullah et al, 1998, with modification

The definition of indicators of variables is as follows:

1. Impact on production is impact of climate change towards the production of marine fisheries. It can be measured by changes in volume of catch, length of trip, and spending or costs of fishermen. (FAO, 2010)

2. Impact on distribution is the impact of climate change towards the physical distribution of fisheries products (FAO, 2010). In this case is production of marine fishers.
3. Impact on consumption is the impact of climate change towards the consumption of fisheries products, which can be measured by availability and affordability (how many product can be consumed by fisheries which are relevant to their level of income).
4. Extension activity is the process of community learning and empowerment involving fishermen, businessmen and traders of fishery products to do "discovery learning" in order to obtain knowledge and technology to solve problems independently and interdependently.
5. Information cost is the cost of gathering information in managing a system to produce an efficient decision (Abdullah et al., 1998). The success of education program depends heavily on the amount of information available to policy makers, extension counselors, and extension targets (fishermen). Examples of information include: information on fisheries potential (quantity, quality, price, and location), and weather information by BMKG.
6. Policing cost is the cost incurred in making an agreement between stakeholders. Such costs include: coordination with communication provider, coordination with related agencies, and coordination between local and central government.

7. Operational cost is the cost used to implement and monitor education programs. Operational costs include: execution of programs, trainings, monitoring and evaluation, and institutional operational cost.

3.2 Sampling Methods and Sampling Size

To estimate the economic valuation on the impact of climate change towards marine-fisheries sector in Cilacap, three main aspects of fisheries are required, they are: production, distribution, and consumption. Production is represented by fishers as producers in marine-fisheries sector. Distribution is represented by collectors as distributors in fisheries sector. Consumption is represented by consumers which consume fisheries products.

Table 3.2
Recapitulation of Sample Size Based on Its Aspect

No.	Aspect	Name of Sample	Sample Size
1	Production	Fishers	73
2	Distribution	Collectors	43
3	Consumption	Consumers	100
	TOTAL		**216**

Source: Primary Data, modified.

Based on Table 3.2, the total sample in this study was 216 samples which consisted of fishers, collectors, and consumers. Production aspect was represented by 73 fishers, aspect of distribution was represented by 43 collectors, and aspect of consumption was represented by 100 consumers.

3.2.1 Sampling Methods and Sampling Size of Marine-Fishers

Population in this research was marine capture fishers located in Cilacap regency. As there were many limitations in conducting this research, samples representing the entire population was taken. The sampling method of fishers in Cilacap regency was multi-stages sampling, with several steps as follows:

Step 1

The first step is determining the region which would be used for the sampling areas. Based on the volume of production which was produced by the marine capture fisheries households (Table 3.2), the major area was located in Cilacap Selatan which later on became the location of sampling. The sampling location was determined based on the volume of production in those areas.

Table 3.3
Production of Marine-Capture Fisheries Based on its Region in Cilacap 2009

No.	Region	Volume of Production (ton)	Value of Production (billion rupiahs)
1.	District of Cilacap Utara	811	16,42
2.	District of Nusawungu	0,597	4,30
3.	**District of Cilacap Selatan**	**5.850**	**47,96**

Source: Marine and Fishery Offices, 2010

Step 2

The second step is determining the amount of sample. Sample was taken through quoted sampling, which was marine-fishers with ship category of 10-50 GT for production (n = 73) for the sample of fishermen in Cilacap Selatan. Due to limited time of research and the field condition, especially ships which operated for 4 – 7 days, 15 – 25 days, and even 3 – 6months, the obtained data were 73 marine-

fishers boats, considering production variations, value of production, limited-time of study and field condition. Data were collected from door to door. And the distribution of sample was as follows:

Table 3.4
Population and Sample of Marine-Fishers Based on Category of Boats in Cilacap Selatan

No	Category of Boats	Population (unit)	Sample
1.	5 – 10 GT	-	-
2.	**10 – 50 GT**	**202**	**73**
3.	50 – 200 GT	30	-

Source: Marine and Fishery Offices, 2010

Category of boats which was taken as sample was considering requirements of boat which can survive in wave above 3 meters high with built-in boat or not outboard motors. Because wave above 3 meters high is considered as one of the impact of climate change towards the currents of Indonesian waters (NOAA, 2009).

3.2.2 Sampling Methods and Sampling Size of Collectors

Population in this research was distributors or commonly named as *pengepul* or collectors which was located in Cilacap regency. Since there were many limitations in conducting this research, sample representing the entire population was taken. The sampling method of collectors in Cilacap regency was cluster sampling.

The number of collectors in Cilacap based on Profile of Marine and Fisheries in Cilacap (Marine and Fisheries Offices, 2010) was 99 collectors,

which consisted of 90 small scales collectors, 8 medium scale collectors, and 1 big scale collectors.

Step 1

The first step is determining the region which would be used for the sampling areas. Based on the data of marine and fisheries offices, the major area was located in *TPI Pelabuhan Perikanan Samudra Cilacap* (PPSC) which was taken as the location of sampling. The sampling location was determined based on Table 3.5

Table 3.5
Location and Population of Collectors

No	Name of TPI	Number of Collectors	Sample Size
1.	**TPI PPSC**	**71**	**43**
2.	TPI Sidakaya	4	-
3.	TPI Sentolokawat	6	-
4.	Mina Usaha Jetis	8	-

Source: Marine and Fishery Offices, 2010

Another 7 TPI in Cilacap, such as: Lengkong, Seleko, Pandanarang, Tegalkatilayu, Bateray, Kemiren, and RawaJarit, are considered active. But most of these TPI are selling inland-fisheries (Marine and Fishery Offices, 2010), which is irrelevant towards this study.

Step 2

The second step is determining the amount of sample. Roscoe (1975) recommends sample size which is ideally between 30 to 500 elements. Thus, the number of collectors which was taken was 43 persons in TPI PPSC.

3.2.3 Sampling Methods and Sampling Size of Consumers

Population in this study was consumers which were located in Cilacap Regency. Sampling method of consumer respondents was done by stratified cluster sampling. Consumers were classified into three clusters according to their monthly-income, which were low-income cluster, middle-income cluster, and high-income cluster. The clusters were classified as follows:

1. Low-income cluster: consumers whose income were less than 800.000,00 rupiahs per month
2. Middle-income cluster: consumers whose income were between 800.000,00 to 2.000.000,00 rupiahs per month
3. High-income cluster: consumers whose income were above than 2.000.000,00 rupiahs per month

Income level, which was used to determine the cluster, was based on *Upah Minimum Regional (UMR)* or regional minimum wage of labor in Cilacap regency. According to Central Bureau of Statistic of Central Java (2010), UMR of labor in Cilacap was 760.000,00 to 790.000,00 rupiah per month. Thus, criteria for low-income cluster was 800.000,00 rupiah, middle-income cluster was 2.000.000,00 rupiah, and high-income cluster was above 2.000.000,00 or 3 times bigger than 800.000,00 (Mason *et* al., 1999).

In determining the sample size, quoted sampling was taken. Quotably, the distribution of sample in each cluster can be seen in Table 3.6. Most samples were in middle-income level or between 800.000,00 to 2.000.000,00. Therefore, the most distribution was in the middle-income cluster.

Table 3.6
Sample of Consumers

Criteria	Sub-sample
1. Low-income cluster	30
2. Middle income cluster	40
3. High-income cluster	30
TOTAL	**100**

Source: Primary Data, modified

3.3 Data Collection

The source of data is the subject from which the data is obtained (Mason et al., 1999). The type and source of data employed in this research is primary and secondary data.

a. Primary data are the data obtained directly from the source or the object of research. The primary data in this research are collected from direct interviews with respondents (fishermen) using series of questions from 'Economic Valuation of Climate Change in Marine Fisheries in Cilacap, Central Java'

b. Secondary data are the data published before or already used in previous research or studies. Secondary data support this research which were collected from the following institutions:

   1) Central Java in Numbers 2009, BPS Central Java

   2) Data of Fishery Production 2006-2009, Marine and Fishery Offices Central Java

3) Data of Fishery Production 2006-2009, Marine and Fishery Offices in Cilacap
4) Meteorology, Climatology, and Geophysics Services in Cilacap

Data collection in this study was gained by several methods, they are:

1. Interview, done by direct questioning to respondents through questionnaire.
2. Observation, direct observation on respondents on site, that was the fishermen around Cilacap. According to Arikunto (2006), observation is observing and recording which is done at the location of object or phenomenon of the study, along with the object studied, to get the real picture of the study.
3. Documentations in this research are obtained from relevant literatures, newspapers, and magazines, also written materials from related institutions and the internet relevant to the study.
4. In-Depth Interview

   In-depth interviewing is a qualitative research technique that involves conducting intensive individual interviews with small number of respondents to explore their perspectives on a particular idea, program, and situation. In this case, in-depth interview was employed to obtain perspective of stakeholders towards the impact of climate change towards marine-capture fisheries in Cilacap.

3.4 Methods of Analysis

The method of analysis in this study was a descriptive statistics to determine the impact on climate change to the stakeholders, and economic valuation of benefit and cost which were obtained by the stakeholders because of climate change.

3.4.1 Descriptive Statistics

The method of analysis in this study was a descriptive statistics. Descriptive statistics is used to solve the problem of quantity measurements. This approach departs from the processed data into valuable information for decision making process (Mason *et* al., 1999)

It is used to calculate socio-economic profile of respondents, revenue and cost patterns of respondents, and other related indicators.

3.4.2 Economic Valuation

Economic valuation in the context of environment is the measurement of people's preferences on environment (which is less important). According to Pearce (2006), economic valuation is mainly the process of value determination of goods and services of the environment.

The approach of the model of economic valuation analysis used in this research is Total Economic Value (TEV). TEV was employed to estimate the risk caused by the climate change on marine-fisheries, especially the marine- fisheries in Cilacap.

The risk encountered by the fishermen of marine-capture fisheries was the loss caused by the decrease of the number of fish captured. Loss is defined as loss

in production (catch), additional length of trip, and increased spending. These costs were estimated through the analysis of benefit and cost.

3.4.3 Transaction Cost

Transaction cost analysis was chosen to determine the amount of cost used to establish a model of adaptation and mitigation strategies on the impact of climate change which adopted the model of transaction cost. This model had been engineered by Abdullah et al., (1998).

Transaction cost of an exchange is a characteristic inherent in a particular institution. Transaction costs consist of information cost, policing cost, and operational cost. Information cost is the cost of gathering information in managing a system to produce an efficient decision (Abdullah *et* al., 1998), this includes: creating new database, information on technology, weather and climate information, etc. Policing cost is the cost incurred in making an agreement between stakeholders. Such costs include: program planning, coordination with related institution/agencies, and fishers-group. Operational and maintenance cost is the cost used to implement and monitor extension education programs. Operational costs include: Execution of programs, trainings, monitoring and evaluation, and institutional operational cost. The category of transaction cost can be seen on the Table 3.7 below:

Table 3.7
Category of Transaction Cost

No.		Activity	Rupiah
1.	Information Cost	• Creating new database of fisheries potential in Cilacap	

		• Information on fisheries technology in the area • Climate and weather information • Information on capital
2.	Policing Cost	• Program Planning ○ Design of program ○ Feasibility studies ○ Meetings ○ Socialization of program • Coordination with related institution • Coordination with fishers-group
3.	Operational& Maintenance Cost	• Transportation cost • Field trip • Post-program assistance • Documentation • Maintenance of infrastructure • Maintenance of supporting facility • Maintenance of database • Evaluation and monitoring of program
	TOTAL	

Source: Abdullah *et* al., 1998