The Relation of Environmental Quality and Fishery Sector in Indonesia

Shanty Oktavilia[1], Reikha Habibah Yusfi[2], Firmansyah[3], FX Sugiyanto[3]

[1]Faculty of Economics, Universitas Negeri Semarang and Doctoral Program in Economics, Diponegoro University
[2]Master of Economics Development, Diponegoro University
[3]Department of Economics, Diponegoro University

oktavilia@mail.unnes.ac.id

Abstract. The condition of fishery sector is currently stagnating, even tending to decline, which is indicated by the decrease of production in some areas in Indonesia. Environmental degradation in marine waters is due to global climate change and uncontrolled fish exploitation impact on the decline of marine fisheries production. While in aquaculture, the environmental quality is also indicated to influence the production. Nevertheless, the increase of production of both marine and terrestrial fisheries has an effect on the quality of the environment. This study aims to analyze the interrelationship between the influence of environmental quality on the production of fishery sub-sector and the influence of fishery subsector production on environmental quality. This research employs environmental quality data and output of fishery of 34 provinces in Indonesia during 2011-2015. The study finds that output of fishery sector affects the environmental quality, which proves the Environment Kuznets Curve in the fishery sector in Indonesia. Since a certain threshold is achieved, the increase in revenue followed by the increase in environmental quality. The study also finds that the environmental quality has a positive effect on the production of fishery. Implication of the study is the increase of income of fishery households can be encouraged the ability of the community to protect the environment and increases the willingness of households to sacrifice other goods to environmental protection.
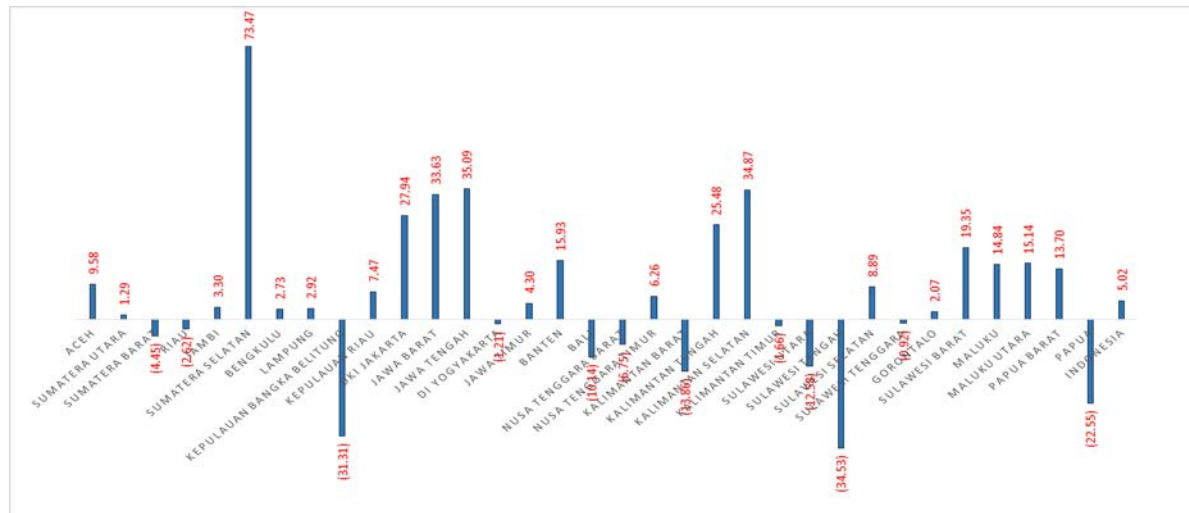
1. Introduction

Fish and fish products are the essential commodities required by humans in fulfilling their needs on food meterials. FAO predicts that in 2010, fish and seafood commodities may contribute 17 percent of the world's protein supplies. Fish products are essential commodities for the developing countries because they contribute 75 percent of their population's protein consumptions [1]. Fish Commodities have been captured and cultivated for thousands of years and remained becoming the essential food sources. Fish products contain micronutrients and omega-3 fatty acids which are essential for the mothers' and children's health throughout the world.

Several studies [2], [3], suggest that although statistically the number of global fish catches increase, the fish-catch growth actually has annually decreased since the 1990s. In Indonesia, the production of capture fisheries in some provinces shows a declining growth, although there are still many provinces showing a positive growth in the production of capture fisheries. The provinces showing a declining growth include West Sumatra, Riau, Bangka Belitung Islands, Special Region of

Yogyakarta, Bali, West Nusa Tenggara, West Kalimantan, East Kalimantan, North Sulawesi, Central Sulawesi, Southeast Sulawesi and Papua.

Source: [4], processed

Figure 1. Average Growth Rate in 2011-2015 on the production of capture fisheries based on Each Province (Percent)

The problem on the declining production of capture fisheries are due to several factors, inlcuding climate changes, offer fishing, and fish catches without paying attention to the environmental impacts. Climate changes are long-term impacts due to the humans' behaviours which pay no attention on the environment. Environmental pressures appear due to the increasing human activities. The increasing greenhouse concentrations and atmospheric ozone-depleting gases, climate changes, some species extinctions, energy source depletion and the declining number of natural resources which do not pay attention to their life cycles [5], [6]. Some ecological scientists and economists warn that there will be an environmental degradation due to the economic activities exceeding the Earth's ecological capacity to regenerate [7]. In the fishery sector, the relationship of environmental quality dimension with sustainable economic and social development becomes real because fishery sector is the driving force of human activities, processes and patterns since fishery sector is the nutrition sources, employment providers, entertainment centers, wealth sources, which also provides multiplier influences to the other economic sectors [8].

Non-environmentally friendly fish catches without paying any attention to the fish cycles are considered causing problems on the environmental quality. The declining environmental quality, especially the quality of marine ecosystems may eventually cause problems on fish availability in the future. This problem is also a universal occurence. In some studies, the impact of the declining capture fishery stocks due to the environmental degradation mainly occurs at the Atlantic waters of the Middle East and the Northeast Pacific, the Black Sea and Mediterranean [1]. The environmental degradation phenomena may also occur in Indonesia's marine waters. This research aims at analyzing the influence of capture fishery production and fishery sub-sector on the environmental quality and analyzing the environmental impacts on the production of capture fisheries in Indonesia.

2. Method

This research is conducted to analyze the influence of capture fishery production on the environmental quality in Indonesia and vice versa, to analyze the influence of environmental quality on the capture fishery production. The data used are the secondary data of 34 provinces in Indonesia in the period of 2009-2016. Then, the analytical model used is the econometric regression of data panel model intended to figure out the most efficient estimation result due to the increasing number of

observations which implications may improve the degree of freedom. The approaches used for data panel are both fixed effect model (FEM) and random effect model (REM) [9].

By entering the variables analyzed in this study, there are two empirical models with data panel regression equations as follows:

The first model analyzes the influence of capture fishery production (FISH) and revenues proxied with the regional domestic gross (GDRBF) fishery subsector on the environmental quality index (Z). This model may also prove whether the Environmental Kuznets Curve (EKC) hypothesis occurs on the fishery subsector in Indonesia.

$$Z_{it} = \beta_0 + \beta_1 LFISH_{it} + \beta_2 LGDRBF_{it} + \beta_3 (LGDRBFit)^2 + u_{it} \dots\dots\dots\dots\dots \quad (1)$$

The second model analyzes the influence of environmental quality (Z) and the capture fishery production (FISH) in Indonesia on the regional domestic gross (GDRBF) fishery subsector.

$$LGDRBF_{it} = \alpha_0 + \alpha_1 Z_{it} + \alpha_2 LFISH_{it} + e_{it} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (2)$$

In both models, (L) shows the natural logarithm, (u) and (e) are the error terms, (i) shows the observations based on provinces and (t) shows the observations based on the time series.

3. Result and Discussion

The analytical results both using FEM and REM model show that the first finds that individual capture fishery production variable significantly influences the environmental quality variable. However, the Hausman test (chi-square statistics = 14.1238) shows that REM model may be rejected that FEM model is used. Subsequently, the interpretation of results may only be analyzed based on FEM results.

Table 1. Data Estimation Results of the Panel Model: Environmental Quality (Z) as the Dependent Variable

Variable	FEM		REM	
	Coefficient	t-Statistic	Coefficient	t-Statistic
C	38.00837	1.950840*	31.75860	1.648604**
LOG(FISH)	2.780590	2.861419*	2.052783	2.159718*
LOG(GDBRF)	1.713498	0.719993	1.492188	0.632936
LOG(GDBRF)^2	-0.162617	-1.720482**	-0.059349	-0.664534

Notes: *) significant at 5%; **) significant at 10%

The estimation result presented in table 1 shows the statistic value of t-test showing the fishery production variable has a significant and positive effect on environmental quality (t-statistic 2.8614). This means that the increase of capture fishery by 1 percent will increase the environmental quality index by 2.7 units. It means that the regeneration cycle of fishery commodity in Indonesia is still very good making fishing able to encaurage the the quality of ecosystem. Meanwhile the regional income variable of fishery sub-sector shows a significant positive relationship on GDRBF and significant negative relationship on (GDRBF) 2.

Such type of relationship suggests that the empirical model does not represent environmental Kuznet curve phenomenon on fishery subsector in Indonesia. It is proveny by the regional income of fishery subsector having positive relationship for environment. Even though it is found to be insignificant, the characteristics of fishery sub-sector in Indonesia tends to have positive effect on environment showed by the coefficient value $\beta_1 > 0$ and $\beta_2 < 0$. This environmental Kuznet curve of fishery subsector for this empirical model does not represent phenomenon of inverted U-curve because the variable used for proxy the environment is the environmental quality index instead of the negative variables such as pollution, emission, or other degrading indicators.

Table 2. Estimation Result of Panel Data Model:
Dependent Variable of Regional Income for Fishery Subsector (GDBRF)

	FEM		REM	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic
C	11.13801	8.418026*	11.15457	0.0000*
Z	-0.027825	-3.216833*	-0.027630	0.0017*
LOG(FISH)	0.279326	2.570663*	0.276862	0.0118*

Notes: *) significant at 1%

The estimation result using the second model aims to see the effect of environmental qulity and fishery production on the regional income of fishery subsector in Indonesia. It shows that the both independent variables have significant effect on degree of error of 1 percent with negative direction on the environmental quality variable and have positive on capture fishery production variable. The result of analysis either using FEM or REM Model shows that the environmental quality and capture fishery production individually has significant effect on regional income of fishery subsector. However, the Hausman test (chi-square statistic 9.3609) shows that the REM model is rejected to use over the FEM model. Then, the second model will be analyzed and intrepreted using FEM model.

The estimation result using FEM panel data shows that the average intercept value for the whole model is 11.13 (significant at alpha 1 percent). It means tat the FEM panel data are able to explain the different behaviour of regional income per capital on 34 provinces which are analyzed in the empirical model of dependent variable. Then, it is found that the environmental quality variable has negative and significant effect on regional income of fishery sector with t-statistics 8.4180. It means that a decrease of one unit for environmental quality index will improve the regional income of fishery subsector by 0.027 percent. This confirms that in developing countries like Indonesia, the increase of fishery production is influenced by bad behaviour on the environment. While the fishery production variable has positive effect on regional income of fishery subsector. An increase of one percent fishery production will improve regional income of fishery sub sector by 0.27 percent.

4. Conclusion

In this study, the ecological problem related to fishery production can be summarized in two points. First, how the effect of the capture fishery on environmental quality is and how the phenomenon of EKC of fishery subsector occurs in Indonesia. Second, the pressure on fish resources especially in coastal areas due to its quality of fishery resources. This pressure has caused the decline of fishery stock. The decline occurs likely because of the environmentally unfriendly human behaviour such as the use of fishing gear disrpting the ecosystem. Based on both models applied in this research, they confirm the result of the research in developing countries related to environmental quality and fishery subsector. The result of empirical model in Indonesia shows that fishery production variable positively affects the quality of environment. Then, the second model shows that the decrease of environmental quality index improves the fishery production in Indonesia. This research has some data limitations so that it does not represent all provinces. Besides, the research uses aggregate variables making it unable to give more detail relationship behaviour. Then, the next research of EKC model can be expanded and have more complex environmental indicators to see more detail other representing environmental components. This research can also show the relation of environmental quality with fishery commodity and other marine products per commodity.

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