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To cite this article: S Fathoni *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **241** 012030

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Analysis determinant supply & demand fisheries

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Abstract. Gross Domestic Product (GDP) growth of fisheries sector in Indonesia is always above the National GDP growth, in Q3 2017, the fisheries sector grew to 6.79% with a GDP value of Rp. 169,513.10 billion while national GDP growth is only 5.03%, this shows a very large fishery potential. The government is increasingly focused on the fisheries sector because it is part of the national flagship sector in the Nawa Cita program, by issued many policies, one of them trawling bans in accordance with regulation 2 / PERMEN-KP / 2015. The aims of this study is to analysis the factors of fisherman production, the amount of financing/credit, trawling ban on fish production and Gemar Makan Ikan campaign against fish demand in the provinces of Java and Bali. This study used Two Stage Least Square (2SLS) method with panel data of provinces in Java and Bali islands from 2006-2017. In this approach, the assumption made is the amount of fish production is the same as the amount of fish demand on the island of Java and Bali. The result are number of fishermen and credits significantly positively to fish catching. Population is significantly positive for fish consumption. Ban trawl policy is still not felt by the impact. And Campaigns actually reduce fish consumption compared to without campaigns.

1. Introduction

Oceans can provide great resources, both for the economic side and basic human needs. Development in the fisheries sector has a large impact on the economy and has spatial integration to other industries, especially those directly related to marine resources [7].

The fisheries sector is one sector that has great potential in Indonesia. In terms of production, the Java region was the largest contributor to the sale of sea fish volume as well as the cause of the increase in fish sales volume in 2016 which reached 4 402 485 kw or around 77.85%, while outside Java only contributed 22.15% to the volume of fish sold amounting to 1 252 374 kw [5].

Until now, the consumption pattern of Indonesian people towards animal food sources in general is still low compared to plant foods. In 2017, animal protein consumption was 26.61% of total protein. Fish is one of the food ingredients which absorbs higher protein compared to other animal products such as beef and chicken, fish protein contribution to total animal protein reaches 47.23% or 12.57 grams / day while in meat is 8.75 grams / day and eggs of 5.29 grams / day. For calorie consumption in fish, it is still relatively low compared to calorie consumption in meat, which is 46.5 kcal / day in fish and 78.42 kcal / day. Consumption of calories from fish is consumed by provinces with many islands such as North Maluku (91.15 kcal), Southeast Sulawesi (90.87 kcal), and West Papua (87.20 kcal) while the lowest is DI Yogyakarta (16.11 kcal) and Central Java (27.68 kcal) [4].

This study aims to analyze the factors that influence the production/capture and demand/consumption of fish. Including looking at the effectiveness of policies with trawling bans in accordance



with regulation 2 / PERMEN-KP / 2015 and the GEMARIKAN campaign by the Ministry of Maritime Affairs and Fisheries since 2010 [12].

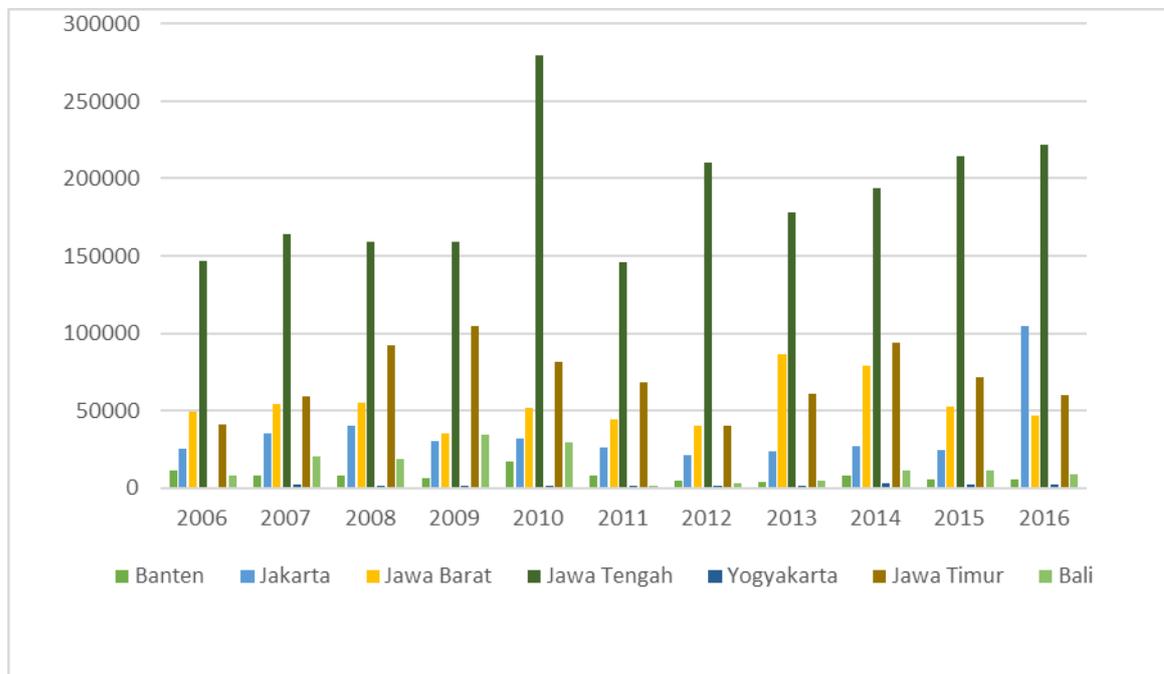


Figure 1. Value of fish production 2006-2016.

2. Literature Review

2.1. Supply-Demand Side of Fisheries [6]

Simple theory on the supply-demand side of fisheries is the relationship between supply side to output resulting in fishing effort related to production costs [6]. Copes argued that on the supply side, the proportion of technology was considered constant and there were no restrictions on entry in the fishery. Supply is considered static in a long-term balance in fishing effort. In the production factors, with a fixed technology assumption, the proportion of fixed factors and the diversity of small fishing units, the number of factors used will be proportional to fishing efforts. Costs are calculated here for all unit factors at the level of marginal opportunity costs, so cost costs have linear integration with the total output.

A point of at least theoretical interest is the possibility that a backward-bending supply curve offers for simultaneous existence of more than one point of stable long-run equilibrium (A and B in Figure 2) with given demand (D) and supply schedules. This possibility that a total cost curve of sigmoid shape converts to a price-output supply curve that is asymptotic in relation to the price axis and thus convex towards the origin in the upper part of its negatively sloped portion. Obviously, the equilibrium point with larger output and lower price (B) is socially preferable to the other (A). The former yields both a greater consumers' surplus and a lower cost. Assuming fluctuations in demand, however, it is likely that the less favourable equilibrium (A) will prevail. The increased demand could call for an equilibrium (at C) that would bypass A. That with an initial equilibrium at A, a (temporary) reduction in demand (D,) could lead to an equilibrium on the lower slope of the supply curve (E). A subsequent restoration of demand might then come to rest in equilibrium at B. The short-run mobility of manpower, both into and out of the fishing industry, is limited. But with a given labour force, fishing capacity may be increased through technological improvements. (B) These, however, are likely to be irreversible [6].

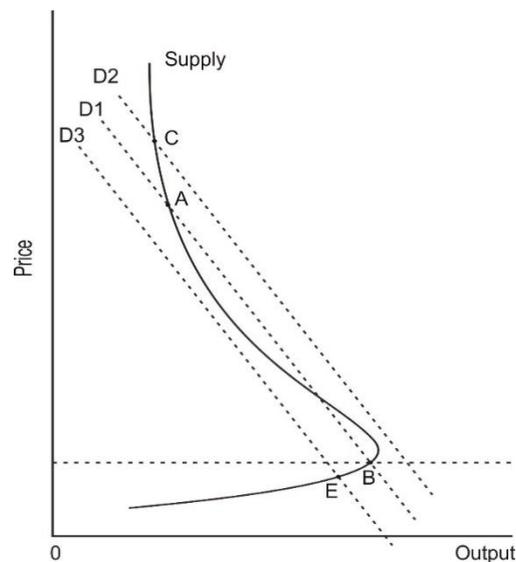


Figure 2. Equilibrium curve of fisheries [6].

2.2. Related studies

Several studies discussing the determinants of fish catching. Inoni dan Oyaide [10] examined the effects of socio-economic factors on artisanal fish yield in the South Agro-ecological zone of Delta State, Nigeria. They found that household size, gender of fisher, fishing experience, season, fishing craft, labour, capital depreciation, and non-fishing income had statistically significant effects ($p < 0.05$) on fish catch.

Akanni [1] uses the probit model in determining the level of fish catch, the result are education, credit facilities and extension significant by 10%, fishing distance 5% and catch level 1%. Akanni (2010) found that in motorized fisheries, labor, fuel and credit were significantly positive for fishing by 0.7843%, 1.452% dan 0.277%.

Mfiangga (2014) analyzed the determinant of fish catching in the Bagamoyo District of Tanzania, which found a significant variable in fishing are Alternative income generating activities (AIGAs) Education level household head (X5) Organization participation (X4) Household size (X6) on 5% dan - (X1) Access to credit (X2) Land size owned (X3) on 1%.

Boesono et.al. [3] analyze many factors which influence weight total catch of mini purse seine and analyzed the productivities in Brebes. There is only variable number of trips (X5) which has significant influence with the elasticity of 1.061.

Tran et.al. [16] examines the seafood sector in Indonesia using the supply and demand model. In terms of demand, fish consumption is largely driven by rapid population growth, higher income, urbanization and consumer preferences for fish. Whereas from the supply side, slow growth or stagnation is caused by IUU fishing.

Munro & Sumaila [11] revealed that subsidies will increase the profitability of fisheries, but increasing subsidies tend to over-exploit, so that in open access fisheries, the addition of subsidies will weaken the sustainability of natural resources. In terms of policy in Indonesia : a moratorium on new fishing permit issuance, prohibition on transshipment and regulation 2/PERMEN-KP/2015 concerning the prohibition of trawling and trawling in Indonesian waters in January 2015 [8].

3. Material and Methods

This study aims to determine the factors that influence fish production and consumption, as well as the effectiveness of government policies in the fisheries sector. The object of research is the provinces in Java and Bali (Banten, West Java, Central Java, Yogyakarta, East Java and Bali) from 2006 to 2017. The analysis used is Regression 2SLS (Two Stage Least Square) with the endogenous variable is Production fish, fish consumption and fish prices.

3.1. Two Stage Least Square (2SLS)

Supply and Demand Fish Model:

$$\begin{aligned} \text{Supply : } QS &= \alpha_1 + b_{11}P_{it} + \tau_{11}K_{it} + \tau_{12}L_{it} + \tau_{13}Loan_{it} + \tau_{14}Sub_{it} + \tau_{15}UW_{it} + \tau_{16}Dtrawl_{it} + u_1 \\ \text{Demand : } QD &= \alpha_2 + b_{21}P_{it} + \tau_{21}Y_{it} + \tau_{22}PX_{it} + \tau_{23}Pop_{it} + \tau_{24}Dcamp_{it} + u_2 \end{aligned}$$

By applying the conditions of the conditions (order conditions) of identification, the equation for the supply of fish is underidentified while the equation for the demand for fish is overidentified. The use of Ordinary Least Square in the equation causes the correlation between P_{it} with u , so that it is not consistent. it requires a proxy called a variable instrument in the Two Stage Least Square (2SLS) [9].

3.2. Reduce Form 1

In the reduce form 1 it is assumed that the supply and demand for fish in the provinces of Java and Bali is the same, then obtained:

$$QS = QD$$

$$\begin{aligned} \alpha_1 + b_{11}P_{it} + \tau_{11}K_{it} + \tau_{12}L_{it} + \tau_{13}Loan_{it} + \tau_{14}Sub_{it} + \tau_{15}UW_{it} + \tau_{16}Dtrawl_{it} + u_1 &= \alpha_2 + \\ b_{21}P_{it} + \tau_{21}Y_{it} + \tau_{22}PX_{it} + \tau_{23}Pop_{it} + \tau_{24}Dcamp_{it} + u_2 & \\ P_{it} = \Pi_{10} + \Pi_{11}K_{it} + \Pi_{12}L_{it} + \Pi_{13}Loan_{it} + \Pi_{14}Sub_{it} + \Pi_{15}UW_{it} + \Pi_{16}Dtrawl_{it} + \Pi_{21}Y_{it} & \\ + \Pi_{22}PX_{it} + \Pi_{23}Pop_{it} + \Pi_{24}Dcamp_{it} + v_1 & \end{aligned}$$

where:

$$v_1 = \frac{u_2 - u_1}{b_{11} - b_{21}}$$

3.3. Reduce Form 2

$$LnP = LnP$$

$$\begin{aligned} Q_t = \Pi_{30} + \Pi_{31}K_{it} + \Pi_{32}L_{it} + \Pi_{33}Loan_{it} + \Pi_{34}Sub_{it} + \Pi_{35}UW_{it} + \Pi_{36}Dtrawl_{it} + \Pi_{41}Y_{it} & \\ + \Pi_{42}PX_{it} + \Pi_{43}Pop_{it} + \Pi_{44}Dcamp_{it} + v_2 & \end{aligned}$$

where :

$$v_2 = \frac{u_1 \cdot b_{21} + u_2 b_{11}}{b_{21} - b_{11}}$$

Step 1. Regress the equation of reduce form.

$$\begin{aligned} P_{it} = \Pi_{10} + \Pi_{11}K_{it} + \Pi_{12}L_{it} + \Pi_{13}Loan_{it} + \Pi_{14}Sub_{it} + \Pi_{15}UW_{it} + \Pi_{16}Dtrawl_{it} + \Pi_{21}Y_{it} & \\ + \Pi_{22}PX_{it} + \Pi_{23}Pop_{it} + \Pi_{24}Dcamp_{it} + v_1 & \end{aligned}$$

v_1 is OLS residual. Then obtained:

$$\begin{aligned} \widehat{P}_{it} = \widehat{\Pi}_{10} + \widehat{\Pi}_{11}K_{it} + \widehat{\Pi}_{12}L_{it} + \widehat{\Pi}_{13}Loan_{it} + \widehat{\Pi}_{14}Sub_{it} + \widehat{\Pi}_{15}UW_{it} + \widehat{\Pi}_{16}Dtrawl_{it} + \widehat{\Pi}_{21}Y_{it} & \\ + \widehat{\Pi}_{22}PX_{it} + \widehat{\Pi}_{23}Pop_{it} + \widehat{\Pi}_{24}Dcamp_{it} & \\ P_{it} = \widehat{P}_{it} + v_1 & \end{aligned}$$

Step 2. \widehat{P}_{it} substituted into the fish supply and demand equation :

$$\begin{aligned} \text{Supply : } QS &= \alpha_1 + b_{11}\widehat{P}_{it} + \tau_{11}K_{it} + \tau_{12}L_{it} + \tau_{13}Loan_{it} + \tau_{14}Sub_{it} + \tau_{15}UW_{it} + \tau_{16}Dtrawl_{it} \\ &+ u_1 \\ \text{Demand : } QD &= \alpha_2 + b_{21}\widehat{P}_{it} + \tau_{21}Y_{it} + \tau_{22}PX_{it} + \tau_{23}Pop_{it} + \tau_{24}Dcamp_{it} + u_2 \end{aligned}$$

4. Result and Discussion

4.1. Supply of Fish

The function of fish supply is as follows:

$$\text{Supply} : QS = \alpha_1 + b_{11}\widehat{P}_{it} + \tau_{11}K_{it} + \tau_{12}L_{it} + \tau_{13}Loan_{it} + \tau_{14}Sub_{it} + \tau_{15}UW_{it} + \tau_{16}Dtrawl_{it} + u_1$$

Table 2 is the result of 2SLS data panel regression using Fixed Effect

Table 1. Regressi 2SLS supply/catching of fish.

Variable	Coef	2SLS	
		Std. Error	t-Stat
Intersep	11559.15	15095.45	0.766
\widehat{P}	-94.787	108.313	-0.875
K	-0.887	0.717	-1.236
L	0.4635	0.148	3.128***
LOAN	17.526	5.838	3.002***
SUB	3.671	3.255	1.128
UW	-0.489	0.262	-1.863*
DTraw	-7456.136	8962.269	-0.832
R-squared	0.927		
F-statistic	68.377		

*) significant by 10% **) significant by 5% ***) significant by 1%

The parameter of fish supply function in table 2 shows number of fishermen significant positive on fish production with a coefficient of 0.4635. This means that every increase in one number of fishermen will increase fish catch by 0.4635 tons a year. This is in line with Akanni [2] which found that labor / fishermen were significant towards fishing in motorized fisheries with a parameter of 0.7843%. Inoni and Oyaide's [10] research found that the percentage increase in labor / fishermen caused an increase of 0.82% in fish catches.

The credit variable in the fish supply function is significantly positive with a coefficient of 17,526. In line with research of Akanni [2] in motorized fisheries, additional credit has a significant effect on fish catches of 0.277%.

Variable area of upwelling is significantly negative at the level of 10% of fish production of -0.489. this is a paradox, against the initial hypothesis that should be the greater upwelling area is an indicator of the amount of chlorophyll [14], the potential for more fish causes more fish catches. The price of fish, the number of ships, the price of fuel and the prohibition of trawling are not significant to the fish supply function. This shows that trawling tires are still not effective since the issuance of regulation 2 / PERMEN-KP / 2015 concerning the prohibition of trawls and trawls such as gear operations in Indonesian waters in January 2015.

4.2. Demand of fish

The function of fish demand is as follows:

$$\text{Demand} : QD = \alpha_2 + b_{21}\widehat{P}_{it} + \tau_{21}Y_{it} + \tau_{22}PX_{it} + \tau_{23}Pop_{it} + \tau_{24}Dcamp_{it} + u_2$$

The Table 3 is the result of 2SLS regression panel data using the Random Effect.

Table 2. Regression 2SLS demand/consumption of fish.

2SLS			
Variable	Coef	Std. Error	t-Stat
Intersep	-31980.85	29795.73	-1.073337
\hat{P}	-236.4453	162.6004	-1.454150
Y	0.002647	0.003525	0.750913
PX	512.3772	198.4987	2.581262**
POP	0.002422	0.001069	2.265267**
DCAMP	-22675.55	7400.922	-3.063881***
R-squared	0.201677		
F-statistic	3.940958		

*) significant by 10%, **) significant by 5% ***) significant by 1%

The fish demand function parameter in table 3 shows that the population is significantly positive for fish consumption with a coefficient of 0.002. this means that every increase in the population of 1 soul will increase fish consumption by 0.002 tons in one year. In line with Sugiawan et.al., [13] in his research modeling fish catches that are affected one of them is the level of population density. Tran et.al., [16] revealed that the increase in fish consumption was largely driven by rapid population growth.

Meat prices in the fish demand function are significantly positive with a coefficient of 512.37. This shows that the position of meat against fish is complementary. While fish prices and income are not significant to fish demand. The price of fish is not as significant as in Cameroon, where the price of fish is cheaper than chicken but consumers prefer chicken to fish [15]. Bellman et.al., (2016) shows that increased consumption of meat and fish together may be due to changes in diet, increased income and urbanization. Campaign “Gemar Makan Ikan” actually reduces fish consumption by -22675.55 compared to without campaign, this is due to the limitations of research that ignores the demand factor for fish production in wild cultivation and the assumption of research in the region that ignores the existence of exports and imports between regions.

5. Conclusion

The conclusion of the fisheries supply and demand function approach in Java Bali is:

- In the fish supply function, the variable number of fishermen and credits that are distributed affect fish production / fishing significantly positively.
- In the function of the demand, population is significantly positive for fish consumption.
- The impact of the 2015 ban trawl policy is still not felt by the impact, it can be seen from the insignificant results, perhaps because the impact has only been felt for the long term.
- Campaigns actually reduce fish consumption compared to without campaigns, this is due to the limitations of research that ignores the demand factor for fish production in wild cultivation and the assumption of research in the region that ignores the existence of exports and imports.

Acknowledgements

This research was supported by the Karimunjawa National Park Office (BTNKJ) and the Wildlife Conservation Society (WCS). We would like to thank all the staff of BTNKJ and WCS who have provided input, direction and assistance to secondary data and to fellow correspondents who have helped the research process.

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