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Economic Contribution of Southern West Java Province Marine Fisheries

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ABSTRACT

Economic development has negative impacts on the environment and spurs an upward trend of environmental degradation and resource depletion. However, as incomes increase, the structure of the economy may change, shifting from a resource-intensive economy to a serviceand knowledge-based technology-intensive economy. Marine Fisheries development is one of the economic's sector that contribute on regional economic growth in west java province. This paper present the Input Output Analysis to show economic contribution of Marine fisheries of southern west java province. Total contribution (direct and indirect effect) of marine fisheries in the Southern West Java economy range from 12.7%, 13.1% to 14.6% in terms of value added, employment and production value. The direct economic contribution in 2017 for the first two measures is 5.5% and 7.3%. Recommendation as consequences of this finding are investment should be alocated to fish culture on high value fish species. Concerning investment on marine fisheries resources, it needs increasing financial institution supporting.

***Keyword*:** Economic, Marine, Fisheries, Input-Output, Southern West Java Province

1. INTRODUCTION

The impacts of economic development on resource abundance can be differentiated into three stages. The first stage is referred to as the scale effect, which is characterized by a

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persistent utilization of heavy machinery, indicating a structural change in an economy. At this stage, economic development has negative impacts on the environment and spurs an upward trend of environmental degradation and resource depletion. However, as incomes increase, the structure of the economy may change, shifting from a resource-intensive economy to a serviceand knowledge-based technology-intensive economy.

This stage is referred to as the composition effect, which is characterized by the development of cleaner industries and by more stringent environmental regulations that limit environmental pressures [1]. Show that better resource management practices are beneficial not only for reducing resource exhaustion but also for increasing production efficiency.

Finally, a wealthy nation is capable of allocating a higher share of R&D expenditures [2], leading to the invention of new technologies that will gradually replace obsolete technologies that tend to be dirtier and less efficient. This stage is referred to as the technical effect, which also contributes to improvements in environmental quality. The cumulative effects of these three different stages of economic development create an inverted U-shaped relationship between economic growth and resource abundance.

The fishery sector is an important contributor to the Southern West Java economy and an important sector in terms of its contribution to export, income and employment [3-7]. Estimates of the fishery sector's contribution can vary considerable depending on what is defined as "fisheries" and on what method that is applied in estimating the fisheries economic activities [5-7].

The aim of this paper is to discuss some methods for estimating the fisheries economic activity and by use of data from Southern West Java, calculate the marine fisheries contribution to the regional economy [7, 8]. Marine fisheries in this article includes aquaculture in marine areas and harvesting and processing of marine wild fish (captured fisheries) [9, 10].

A concept widely used to measure the size of a sector is the sale value or gross production value. This has the advantage of being relatively easy to measure at industry level and is also easy assessable in for example export and industrial statistics [11, 12]. The sale value does not give a precise measure of the contribution to an economy because of double-counting. For example, feed bought by the aquaculture industry is part of the sale from the feed producers but is also accounted for in the sale from the aquaculture industry.

Economists prefer the concept value added to compute a sector's contribution to an economy [11]. An industry's value added is defined as wage, depreciation, profit, capital income and indirect business taxes. The sum of the value added in all industries in an economy gives the gross regional product (GRP), a commonly accepted measure of the size of a regions economy. Employment is a third measure to compute for an industry contribution to an economy.

The weakness of the above-described measures is that they do not account for economic activity beyond the fisheries sectors. The activity in the fishing sector will have indirect effects on other sectors of the economy. The fourth method applied will therefore be an Input-Output (IO) model. This model can measure the linkages an industry has to the whole economy.

This paper discusses the contribution of the fisheries sectors to the Southern West Java economy by applying and comparing the three last methods described above; value added, employment and linkages. The first method mentioned (sale value) will not be applied due to the weakness described above [16-25].

2. METHOD AND THEORY FOUNDATION

In this paper we combine an OLG-model with a Leontief Production to develop a new growth model. To give the model a microeconomic foundation which is based on conflict theory. In principle we assume, that marginal production theory plays no role in determining the factor prices, instead of this technical explanation, we assume that the wage rates and interest rate are determined by a bargaining process between workers and capital owners. With the help we can show that both Harrod problems can disappear. Additionally we are able to analyze the transition path to an equilibrium.

The methodological approach in this paper is to use the input-output approach of analysis. This approach shows the relationship between the flows of the various sectors in the economy, whereby the relationship between the producers and the consumers as well as the interdependence among industries can be shown. It can also track the flow of commodity (goods and services) from one industry to another industry.

Harrod (1939) and Domar (1946) were the first who have formalized a theory on economic growth, where they implicitly made use of a Leontief-production function. Today, this theory is rarely used in mainstream economics. The most prominent models of today are the models of Solow (1956) and Romer (1986) and other endogenous growth models. The main critique against the Harrod-Domar approach is that it misses microeconomic foundations. Additionally, some neoclassical authors assume that capital is malleable, but this assumption can be doubted [13, 14].

The aim of this paper is to resolve the first problem. The neoclassical approach, makes use of technically determined factor prices. We instead assume that institutional arrangements are responsible for the factor prices and shares of labor and capital. The factor prices in neoclassical economics are determined by the marginal productivity theory. Since 50 years, the distribution of income is explained in mainstream economics by the theory of Clark (1899). His theory is based on the assumption that, the nowadays conventional neoclassical, production function is differentiable, linear-homogenous and that each factor has diminishing returns. Consequently, each factor of production is paid by its marginal product. This also holds for the wage rates: The marginal product of labor equals the wage rate in equilibrium. Although this model was severely attacked in the past by economists like J. Robinson, and others, this theory has survived. Its advantage is that the model is easier to handle from a mathematical view [13, 14].

All together this is maybe the reason, why the Leontief production function is not so prominent in economic theory like the Cobb-Douglas production function.

In reality, wage rates are often the result of a bargaining process between employers and employees, and not determined by marginal productivity. The reason is that it mostly impossible to determine the marginal product of labor or it would be too costly to determine them. Consequently, only the average productivity of labor will be taken into account as a proxy in the bargaining process.

In addition, we can doubt if production processes behaves like a neoclassical production function, which is still a black box. Furthermore it is questionable whether capital malleable? We have reasons to believe that this is not the case It makes no sense if two workers work with one computer, one desk and one chair. The marginal product of the second worker is obviously zero. The same argument holds for many other examples. In my view, the acceptance of the neoclassical production function is highly based on its mathematical practicability.

In this paper we want to show that it is possible to resolve the distribution problem of the Leontief production function with the help of a conflict success function, which was introduced by Tullock (1980). In determining the distribution between labor and capital, this means that both employees and employers must stake a part of their expected income to bargain about the distribution. These stakes are lost, if a labor dispute will arise. The amount of the stakes depends on institutional arrangements, especially on the labor laws (e.g. is allowed to found a union, who has to pay in the case of a labor strike, what are the obligations of employers etc.) The labor laws determine a part of the stakes [13, 14].

Let us assume that the production is given by a Leontief production function [14]:

$$Y = A\min\left[K, L\right], \tag{1}$$

where A is a positive constant parameter, representing the overall productivity, L is the quantity of labor force and K is the quantity of capital.

The question is how will output of production be distributed between labor force and capital? To resolve this, we assume that the employees are able to strike and that the employers are able to lock out the employees. Additionally, it is assumed that institutional rules for a labor dispute exist and how to use these possibilities in a legal way. Here we assume that the labor share of income depends on a conflict success function α, which has the following form [14]:

$$\alpha\left(g_L, g_C\right) = \frac{G_C + g_L}{G_C + G_L + g_C + g_L} \tag{2A}$$

and

$$1 - \alpha\left(g_L, g_C\right) = \frac{G_L + g_L}{G_C + G_L + g_C + g_L} \tag{2B}$$

where the function $1-\alpha\left(g_L, g_C\right)$ represents the labor share of the aggregate income. The variables G_L and G_C represent the power of employees and employers which stem from the institutional arrangements on labor disputes, especially labor laws.

These variables are exogenous determined The variables g_L and g_C represent the stakes of employers and employees in a labor dispute. E.g. g_L represents the loss of working time caused by a strike and/or the contributions to labor unions and g_C represents the loss of working hours caused by locking out the employees and/or the contributions to employer associations.

That means that the function $1-\alpha\left(g_L, g_C\right)$ represents the labor share of income and $\alpha\left(g_L, g_C\right)$ represents the capital share of income.

The production function per capita is given by [14, 15]:

$$y = A\min\left[k, 1\right] \; where \qquad k = \frac{K}{L} \tag{3}$$

Then the wage per capita is given by

$$w=(1-\alpha(g_L,g_C))A\min[k,1]-g_L=\frac{G_L+g_L}{G_C+G_L+g_C+g_L}y-g_L \tag{4}$$

The interest factor R is given by

(5) $$R=\alpha(g_L,g_C)\frac{A\min[K,L]}{K}-g_C=\frac{G_C+g_C}{G_C+G_L+g_C+g_L}\frac{y}{k}-g_C \tag{5}$$

Both the employers and the employees want to maximize their income shares. That means that the employees maximize (4) and the employers maximize (5), if both parties are risk-neutral. Here we assume that both parties behave like in a Cournot-Nash competition. That means that the workers maximize their stakes (4) given the optimal stakes of capital owners and the capital owner maximize their stakes (5) given the optimal stakes of the workers. After a little manipulation, we get the best response functions of both players, workers and capital owners [14, 15];

$$g_L=-g_C-G_L-G_C+\sqrt{(G_C+g_C)y}$$

and

$$g_C=-g_L-G_L-G_C+\sqrt{(G_L+g_L)y}$$

Equating the two best response functions leads to the optimal stakes for as well the workers as the capital owners.

$$g_L{}^*=\tfrac{1}{4}(y-4G_L) \tag{6}$$

and

$$g_C{}^*=\tfrac{1}{4}(y-4G_C) \tag{7}$$

This is the interior solution. Because we want to show the effect of institutional setting on income distribution, we assume that no interior solution exists. This can be done without loss of generality. So we apply the Kuhn-Tucker conditions, and we come to the result, that the stakes are zero, if $\min[G_L,G_C]>\tfrac{1}{4}y$. In this case the distribution of income is only determined by institutional rules. Here we analyze only this case.

The factor prices are then given by [14,15]:

$$w=(1-\alpha(g_L,g_C))A\min[k,1]=\frac{G_L}{G_C+G_L}y \tag{8}$$

and

$$R = \alpha(g_L, g_C)\frac{A\min[K, L]}{K} = \frac{G_C}{G_C + G_L}\frac{y}{k} \tag{9}$$

It should be noted, that the differences between (8) and (9) and equations (4) and (5) are a result of a corner solution. Now we have to analyze two different cases, one where $k \leq 1$ and the other, where $k > 1$.

3. RESULTS AND DISCUSSION

3. 1. Fisheries contribution to gross regional product (GRP)

As indicated above, value added for an industry is a precise indicator for this industry's contribution to the economy. To account for inflation, the data given in Table 1 is expressed in 2010 prices. Table 1 shows marine fisheries contribution to the Southern West Java GRP in the period 2014 – 2017. The marine fisheries are divided in three subsections; aquaculture, fish harvesting and fish processing. The development in each of these subsections will first be discussed, thereafter the development in marine fisheries as a total.

The most striking fact for the development of the aquaculture industry is the very strong annual increase in value added in the 4 years period; 23% annual growth compared to 3.5% in the economy as a whole. This strong increase is a result of the expansion in the period 2016 – 2017 when the annual growth in the value added was 40%. From the table we can also see that the aquaculture industry contribution to the total GRP was about 0.6% - 0.7% up to 2016, for thereafter to about double to 1.3% in 2017.

Table 1. Marine fisheries contribution to the Southern West Java gross regional product (GRP) 2014 – 2017

VALUE ADDED (mill 2010 kr)	2014	2015	2016	2017
Total Southern West Java	69,666	77,092	81,131	84,479
Aquaculture	444	560	586	1,053
Fish harvesting	1,642	1,963	2,234	2,108
Fish processing	1,312	1,336	1,536	1,480
Total marine fisheries	3,398	3,859	4,356	4,641
PERCENT OF TOTAL GRP				
Aquaculture	0.6%	0.7%	0.7%	1.3%
Fish harvesting	2.4%	2.6%	2.8%	2.5%

Fish processing	1.9%	1.7%	1.9%	1.7%
Total marine fisheries	4.9%	5.0%	5.4%	5.5%
AVERAGE ANNUAL GROWTH (%)	2014-15	2015-16	2016-17	2014-17
Total value added in N.N.	5.3%	2.6%	2.5%	3.5%
Aquaculture	13.1%	2.3%	40%	23%
Fish harvesting	9.8%	6.9%	- 2.8%	4.7%
Fish processing	0.9%	7.5%	- 1.8%	2.1%
Total marine fisheries	6.8%	6.4%	3.3%	6.1%

Sources: Fisheries Agency of West Java Province 2014, 2015, 2016, 2017;
Statistics West Java Province, 2017.

The development in fish harvesting, on the other hand, follows closer the development in the economy as a whole. Fish harvesting contribution to GRP varies from 2.4% to 2.8% in the period 2014-17. The annual growth rate in fish harvesting in the same period has been 4.7%, which is 1.2% higher than the average in the regional economy.

Fish processing shows a weaker development than fish harvesting. The annual growth has on average been 2.1% in the 4 years period compared to 3.5% in the GRP. Fish processing contribution to GRP has been between 1.7% - 1.9% in the period.

Total marine fisheries have increased its contribution to GRP from 4.9% in 2014 to 5.5% in 2017. This increase is due to the strong growth in aquaculture. The captured fisheries (harvesting and processing) have had a growth very close to the economy as a whole.

3. 2. Fisheries contribution to the Southern West Java employment

From Table 2 we can see that the annual growth in the employment in Southern West Java has been 1.4% in the 4 years period, from 208,000 employed in 2014 to 224,000 in 2017. The employment in the aquaculture industry has however been reduced by an annual rate of 1.8%.

In 2014 the aquaculture industry contribution was 0.6 % of the total employment in Southern West Java, while the contribution was reduced to 0.5% in 2017. The fact that the production has increased substantially shows that there has been a strong reduction in the number employed per output produced.

Fish harvesting has also reduced the percentage of total employment from 6 in 2014 to 4.8 in 2017. This implies a yearly reduction of 2.7% in the industry. This is not a new development. There has been a steady decline in the number of fishers in the post war period.

Fish processing has had a more stable development, counting for 2.2% of total employment in 2014 which was reduced to 2% in 2017. The absolute number shows small changes over the six-year period and the annual growth has consequently only been 0.3%.

Table 2. Marine fisheries contribution to the Southern West Java employment 2014 – 2017

EMPLOYMENT (number employed)	2014	2015	2016	2017
Total employment in Southern West Java	208,000	215,000	226,000	224,000
Aquaculture	1,271	1,380	1,074	1,131
Fish harvesting	12,534	11,782	11,461	10,467
Fish processing	4,505	4,490	4,724	4,578
Total marine fisheries	18,310	17,652	17,259	16,176
PERCENT OF TOTAL EMPLOYMENT				
Aquaculture	0.6%	0.6%	0.5%	0.5%
Fish harvesting	6.0%	5.5%	5.1%	4.8%
Fish processing	2.2%	2.1%	2.1%	2.0%
Total marine fisheries	8.8%	8.2%	7.7%	7.3%
AVERAGE ANNUAL GROWTH (%)	2014-15	2015-16	2016-17	2014-17
Total employment in Southern West Java	1.3%	2.6%	-0.4%	1.4%
Aquaculture	4.3%	-11.1%	2.7%	-1.8%
Fish harvesting	- 3.0%	- 1.4%	- 4.3%	- 2.7%
Fish processing	- 0.2%	2.6%	- 1.5%	0,3%
Total marine fisheries	- 1.8%	- 1.1%	- 3.1%	- 1.9%

Sources: Fisheries Agency of West Java Province 2014, 2015, 2016, 2017; Statistics West Java Province, 2017.

Marine fisheries as a whole has reduced its percentage of total employment substantially in the six year period, from 8.8% in 2014 to 7.3% of total employment in 2017. But still, marine fisheries has a much higher portion of total employment than of total GRP, 7.3% compared to 5.5%. This is due to the captured fisheries, which in 2017 contributed to 6.8% of total employment while the value added only was 4.2% of the total GRP.

3. 3. The multiplier effect of marine fisheries in the Southern West Java economy

In this part the multiplier effect of marine fisheries will be discussed and we will demonstrate how Input-Output (IO) analyses can be applied for this purpose. Both the value added and employment methods discussed above measure the direct impact of marine fisheries on the economy. They do not fully account for marine fisheries linkages with other industries and the resulting economic activities generated.

Marine fisheries have two types of economic effects on other sectors in the economy [4, 10]. First, a change in the output in the fisheries sectors means there will be a change in deliveries from other sectors whose products are used as inputs in marine fisheries production. This is referred to as the backward linkages. Second, a change in fishery output means there will be a change in the amounts of fishery output that are available to be used as inputs to other sectors using fish in their production. This is referred to as forward linkages. IO models provide a comprehensive approach in estimating these economic linkages and hence the total economic contribution of the fishery sector to an economy in terms of sales, employment and value added. There is a wide variation in the measurement procedures used for estimating the industry's contribution using the IO approach.

Broadly speaking, this procedure can be grouped into three approaches.

- final demand-based,
- hypothetical extraction of a sector or more than one sector,
- output based approach.

In the literature the final demand-based method is preferred because the double-counting problem is omitted [11-15]. By final demand we mean the final use of goods and services as consumption, investment and/or export. By the final demand-based approach we mean that it is consumption, investment and export that is the driving force in the economy.

3. 4. The Input-Output model

The I-O model is based on an I-O table of Southern West Java [4, 13-15] that can be defined in the terms of the following:

$$\sum_{j=1}^{n} X_{ij} + Y_i = X_i \quad (i = 1, 2, \ldots, n) \tag{10}$$

where X_{ij} is the sales from regional industry *i* to regional industry *j*, Y_i is the sales from regional industry *i* to final demand, X_i is the total sales from industry *i* and n gives the dimension of the I-O table. In the condensed table for Southern West Java used in this article n = 7.

By assuming constant I-O coefficients, the above equation system can be transformed to an operational impact model. In matrix algebra, the model is

$$AX + Y = X \tag{11}$$

where A is the matrix of I-O coefficients.

From equation (11) follows:

$$X = (I - A)^{-1} Y \tag{12}$$

where I is the identity matrix and $(I-A)^{-1}$ is the Leontief inverse of the total requirement matrix.

Let's define

$$B = (I - A)^{-1} \tag{13}$$

where B is an n by n Leontief inverse. For a given vector of industry exogenous final demand, the vector of industry outputs can be derived using the Leontief inverse matrix as

$$X = BY \tag{14}$$

In order to empirically estimate the value of output generated by aquaculture and fisheries sectors to support the input requirements of final demand of other sectors and the value of output by other sectors to support final demand of fishery products, the last equation can be partition as [14, 15]:

$$\begin{bmatrix} X_f \\ X_m \\ X_o \end{bmatrix} = \begin{bmatrix} b_{ff} & b_{fm} & b_{fo} \\ b_{mf} & b_{mm} & b_{mo} \\ b_{of} & b_{om} & b_{oo} \end{bmatrix} \begin{bmatrix} & Y_f & \\ Y_{mf} + & Y_{mm} + Y_{mo} & \\ & Y_o & \end{bmatrix} \tag{15}$$

where f represents fishery sectors, m trade and distribution sectors, o other sectors and f + m + o = n. Y_f and Y_{mf} are respectively, the final demand for fish products and trade and distribution services involved in the delivery of fish products to final consumers.

The aim of using the I-O model is to calculate the total economy's output generated by the fisheries sector's final demand and the final demand of fishing trade and distribution services. The total impact can be found by a two step calculation.

First, we have:

$$Q_f = b_{ff} \cdot Y_f + b_{mf} \cdot Y_f + b_{of} \cdot Y_f \tag{16}$$

where Q_f is the total economy's output generated by fishery final demand.

Equation (17) can be simplified by introduction the output multiplier concept (P_j)

$$P_j = \sum_{i=1}^{n} b_{ij} \tag{17}$$

where b_{ij} are the elements of the Leontief inverse matrix (B). b_{ij} expresses the direct and indirect effect in industry *i* of a change in final demand from industry *j* by 1.

Recalling equation (17), $b_{ff} + b_{mf} + b_{mm} + b_{of} = P_f$

Equation (18) can therefore be rewritten as

$$Q_f = P_j \cdot Y_f \tag{18}$$

Eq. 18 states that the economy's output generated by the fisheries final demand is found by multiplier the fisheries output multiplier by the fisheries final demand [14, 15].

Correspondingly, we have

$$Q_{mf} = b_{fm} \cdot Y_{mf} + b_{mm} \cdot Y_{mf} + b_{om} \cdot Y_{mf} = P_m \cdot Y_{mf} \tag{19}$$

where Q_{mf} is the total economy's output generated by trade and distribution sectors final demand involved in the delivery of fishery products and services to final consumers and P_m is the output multiplier for the trade and distribution sector.

The total impact (TI) on the Southern West Java economy is found by adding eqs (19) and (20):

$$TI = Q_{mf}\cdot + Q_{nf} \tag{20}$$

Regional value added and employment impact will be estimated in the same manner as output except that the total requirement coefficients B are converted to total value added and employment coefficients.

Table 3 gives the marine fisheries percentage contribution to the Southern West Java economy. We have data for the total marine fisheries only for 2007. For aquaculture data has also been collected for 2017.

Table 3. Total contribution to the Southern West Java economy (In %)

Measure	Aquaculture		Captured Fisheries		Total
	2007	2017	2007	2017	2007
Production value	1.2%	5.5%	13.4%	n.a.	14.6%
Value added	1.5%	n.a.	11.2%	n.a.	12.7%
Employment	1.5%	n.a.	11.6%	n.a.	13.1%

In 2007 the marine fisheries total contribution (direct and indirect effect) varied from 12.7% to 14.6% depending on what measure used. The value added impact was 12.7% and the employment impact was 13.1%. This again indicates the region's strong dependency on marine fisheries.

4. CONCLUSIONS

The development of the aquaculture industry is of interest to examine closer. As seen from Table 3, the total contribution to the Southern West Java economy in 2017 was more than four times higher than in 2007. There are two reasons for the increased impact. Firstly, a substantial increases in the production value in the 12 years period. Secondly, the aquaculture industry has become a more integrated into the Southern West Java economy, particularly through locally produced feed and smolt. The increased integration of aquaculture into the Southern West Java economy is reflected in the output multipliers that has increased from 1.6 in 2007 to 1.9 in 2017.

Although similar estimates for the captured fisheries are not available for 2017, it is safe to assume that the employment impact of the captured fisheries in the regional economy has declined as reflected in the declining trends in direct employment in the captured fisheries.

For 2007, estimates of the total contribution (direct and indirect effect) of marine fisheries in the Southern West Java economy range from 12.7%, 13.1% to 14.6% in terms of value added, employment and production value. The direct contribution in 2017 for the first two measures is 5.5% and 7.3%. Recommendation as consequences of this finding are investment should be alocated to fish culture on high value fish species. Concerning investment on marine and fishery resources, it needs increasing financial institution supporting.

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