The dynamics of the total output of the fishery sector: The case of Indonesia

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Abstract. The purpose of this study is to analyze the dynamics of the total output of the Indonesian fishery industry when the changes of the final demand occur. This study employs a demand-pull Input-Output (IO) quantity model, one of the calculation tools in the IO analysis, as an analysis instrument. Two conditions are noticed in calculations and analysis parts, namely (1) “whole sector change”, and (2) “pure change”. An initial period in this study is 2008. The results show that, in both conditions, the discussed sector has similar patterns, namely this industry receives the positive impacts from scenarios 1 and 3 while the negative impact is obtained from scenario 2. The results also explain that, in both conditions, the biggest positive impact for the analyzed sector is given by scenario 3, the change of households and non-profit private institutions consumptions.

1. Introduction

[1] explained the role of fisheries in the society through the following statements:

“Directly and indirectly, fisheries provide employment for hundreds of millions of people. The vast majority of these people are in developing countries where the sector often plays a key role in preventing and reducing poverty; it is likely that millions more people are involved in fishing activities than appear in official statistics.”

The following exposure, which was given by [2], confirms the role:

“Around 140 million tonnes of fish and seafood per year are used for human consumption. Set against the global production of cereals of around 2.2 billion tonnes, that figure is comparatively low. Owing to its unique combination of nutrients, fish makes a major contribution to a healthy diet. It supplies proteins, healthy fatty acids, vitamins and other elements essential for health such as iodine and selenium. Furthermore, in developing countries fish is often the only affordable and relatively easily available source of animal protein. In some regions on Earth fish can provide up to 50 per cent of the total animal protein in people’s diets. This is the case, for example, in Bangladesh, Cambodia and Ghana.”

On the other hand, [3] mentioned the importance of the fishery industry in the society through the following explanation:

“To those involved in fisheries, the importance of the industry to the economy is obvious: (i) exports of fish and fish products earn foreign exchange which helps provide the resources needed to pay for crucial imports; (ii) it provides employment for a substantial number of people; (iii) the catch of commercial and
 conduct the study in order to get a deeper understanding of the relationships between *octofasciatus* distribution and behavior. [12] did the comparison of the estimated life history parameters for deployed at the water surface, attached to the surface trawl headrope, in their study in monitoring fish two temperate reservoirs. They used a SIMRAD EK60 (38 kHz) split-beam echosounder with the transducer utilizing an underwater stereo camera. [11] addressed the fish behavior at the mouth of a midwater trawl in tested the impact of the three types of the underwater lighting on observable rockfish density and behavior by fishing in the major Italian fishing fleets, and (3) the catch per unit of the effort from 1950 to 2010. [10] imagination and wallet of the angler, they do not influence CPUE or hooking injury in bass but appear to use by stock assessment scientists and fishery managers in their works. They compared industry-generated reports of landed catch to independent observer estimates in their study. [6] explored the crisis involving the Europe Union (EU), Iceland, Norway, and the Faroe Islands regarding the relative allocation and size of Total Allowable Catches (TACs) in the mackerel fishery in the Northeast Atlantic. They employed simple non-cooperative and cooperative game theory in their study. [7] developed a method to objectively measure and characterize the location and size of the patterns of discoloration which are currently appeared in the fillets of commercially harvested yellowtail flounder (*Limanda ferruginea*) on the east coast of Canada. Further, they developed an image processing program to analyze the patterns of the fillet discoloration in order to achieve the goal of their study. [8] assessed the effects of lure color on catch-per-unit-effort (CPUE), size selectivity and hooking injury of largemouth bass, *Micropterus salmoides*, by employing artificial 12.7 cm unscented soft-plastic worms. Their study expressed that while different lure colors might capture the imagination and wallet of the angler, they do not influence CPUE or hooking injury in bass but appear to have a small effect on the size of the captured fish.

Meanwhile, [9] provided the estimations of (1) catches for all marine fishing sectors, (2) the effort of fishing in the major Italian fishing fleets, and (3) the catch per unit of the effort from 1950 to 2010. [10] tested the impact of the three types of the underwater lighting on observable rockfish density and behavior by utilizing an underwater stereo camera. [11] addressed the fish behavior at the mouth of a midwater trawl in two temperate reservoirs. They used a SIMRAD EK60 (38 kHz) split-beam echosounder with the transducer deployed at the water surface, attached to the surface trawl headrope, in their study in monitoring fish distribution and behavior. [12] did the comparison of the estimated life history parameters for *Hyporthodus octofasciatus* from the south-eastern Indian Ocean with the one from the western central Pacific Ocean. [13] conducted the study in order to get a deeper understanding of the relationships between *Doryteuthis gahi* immigrations and size distributions during the seasons of fishing, and related wind, temperature, and geostrophic current conditions. The focused area of their study was Falkland Islands.

The study analyzes the fishery sector of the specific Asian country, from above literatures, however, is still limited. On the other hand, the readers are presented the previous studies discussed the other industrial sectors of Asian countries. For example, [14] investigated the dynamics of Indonesian creative industries. More specifically, the purposes of his study were (1) to obtain the other perspective about the role of creative industry sectors in the Indonesian national economy, and (2) to inquire about the strategies to improve these industries. He employed the Input-Output (IO) analysis in order to achieve these goals. His study focused on the period between 1990 and 2005. Besides, [15] conducted a deeper analysis regarding the impacts of the changes of final demands on the total outputs of Japanese energy sectors. His study focused on two industries, namely (1) petroleum refinery products, and (2) non-ferrous metals.

Meanwhile, [16] forecasted the influences of the Information and Communication Technology (ICT) on the structural changes of the national economics of Japan. They employed IO and statistical approaches as analysis instruments. [17] analyzed the role of ICT sectors on the Japanese national economy using simple household income multiplier, one of the analysis tools in the IO analysis. The analysis period of his study was from 1995-2005. On the other hand, using this multiplier, [18] analyzed this role on the Indonesian national economy. The analysis period of his study was from 1990-2005. [19] investigated the influences of Gross Domestic Product (GDP) and ICT on the structural changes of Indonesian industrial sectors on the period between 1990 and 2005. They employed the statistical tool in analyzing these influences, namely the Constrained Multivariate Regression (CMR) model. [20] exposed the impacts of the modifications of final
demands on the total outputs of Indonesian ICT sectors by using the IO analysis as an analysis tool. [21] applied a simple output multipliers method in order to get the other perspective regarding the role of ICT sectors in the Indonesian national economy from 1990-2005. The study investigated the other perspective regarding this role for the Japanese case was conducted by [22]. His analysis focused on the period from 1995-2005. Besides, using the Structural Decomposition Analysis (SDA), [23] compared the role for the cases of Indonesia and Japan.

The study focuses on the analysis of the fishery sector of the specific Asian country is important because it will describe the characteristics of the sector. Further, this analysis can also open the opportunity in observing this sector from an economic point of view. This study is conducted in order to (1) fulfill the gap of the study in the fishery topic, (2) get the characteristics, and (3) open the opportunity.

The purpose of this study is to analyze the dynamics of the fishery industry of the specific Asian country. In other words, the following research question, “how to describe the dynamics of the fishery sector of the specific Asian country?”, is tried to be solved by this study. This study focuses on the case of Indonesia. This country is chosen because their ocean area is wide. Using the previous studies as references, this study employs the IO analysis as an analysis tool. The dynamics are represented by the amendments of the total output of the sector. The trigger of these amendments is the changes of the final demand of the sector.

2. Methodology

The methodology of this study refers to the previous study which was conducted by [24]. The methodology of this study is described as follows. The first step is to elaborate the data used. This study uses the IO table of Indonesia for 2008. This table consists of 66 industries. These industries are explained in Appendix.

The second step is to define the Indonesian fishery sector used. This sector is described in Table 1. The third step is to conduct the calculations in order to know the impacts of the changes of the final demand on the total output of the analyzed sector. A demand-pull IO quantity model, one of the calculation tools in the IO analysis, is used in the calculations. [25] described that the following equation is a representation of this model:

\[
x^1 = L^0 f^1
\]

where \(x\), \(L\), and \(f\) are the matrices of the total outputs of sectors, the Leontief inverse, and the final demands of sectors, respectively. 0 and 1 explain initial and future periods, respectively. An initial period in this study is 2008. Table 2 exposes the final demand modification scenarios used. These scenarios, compared with the previous ones, are slightly different. One of the differences can be seen on the name of the scenario 3. The name is changed from “The change of outside households consumption” to “Households and non-profit private institutions consumptions modification”.

The conditions of “whole sector change” and “pure change” are included in above calculations. The former situation explains the condition which the changes of the components of the final demand are addressed to all Indonesian industrial sectors while the latter one only focuses on the discussed sector. In this study, the former situation will be called “condition A” while the term of “condition B” is applied to explain the latter one. The analysis regarding above impacts is discussed on the next step. Conclusions of this study and suggestions for further researches are exposed on the final step.

| Table 1. Indonesian fishery sector used in this study. |
|--------------------------------------------------------|
| Sector Number | Sector Name |
|----------------|-------------|
| 23             | Fishery     |
Table 2. The final demand modification scenarios used in this study.

| The Component of the Final Demand | Scenario 1 | Scenario 2 | Scenario 3 |
|----------------------------------|-----------|-----------|-----------|
| Exports Modification             | Increase 30% | Constant | Constant |
| Imports Modification             | Constant | Increase 30% | Constant |
| Households and Non-profit Private Institutions Consumptions Modification | Constant | Constant | Increase 30% |

(Source: [26], with the slight modifications)

3. Results and analysis

Table 3 exposes the total output of the discussed sector for each scenario on condition A. Figure 1 explains in more details the dynamics of the total output of the sector on this condition. Based on the results, one can argue that, on the condition, the biggest positive impact on the total output of the analyzed sector is given by scenario 3, households and non-profit private institutions consumptions modification. Meanwhile, the negative impact is given by scenario 2, the change of imports.

On the other hand, Table 4 describes the total output of the analyzed sector for each scenario on condition B. Figure 2 exposes in more details the dynamics of the sector’s total output on this condition. Based on the results, one can say that, on the condition, the biggest positive impact on the total output of the discussed sector is given by scenario 3, households and non-profit private institutions consumptions change. On the contrary, the negative impact is delivered by scenario 2, the imports modification.

Above phenomena show that, in both conditions, the discussed sector has similar patterns, namely this industry receives the positive impacts from scenarios 1 and 3 while the opposite impact is obtained from scenario 2. Above phenomena also explain that, in both conditions, the biggest positive impact for the analyzed sector is given by scenario 3, the change of households and non-profit private institutions consumptions. Based on these results, one can argue that, the effective way to enhance the total output of the Indonesian fishery sector in the future are to increase the rate of households and non-profit private institutions in terms of consuming the products of the industry. Besides, to restrict import activities for these products also will be a good step.

The availability of the sector’s products in the especially domestic market is a key point in order to achieve above enhancement. Therefore, the obstacles of the goal should be eliminated. One of the serious obstacles is an illegal fishing activity. This activity can be omitted by executing the strict punishment for the perpetrators. On the other hand, this punishment can be smoothly executed if the law in terms of the activity is clear and enforced. The other essential point in order to achieve the goal is every party who has a relationship with the fishing should notice the importance of the marine ecosystem balance. This balance will ensure that the products are available for long periods of time.

Table 3. The total output of the discussed sector for each scenario on condition A (100 million Rupiah).

| Sector Number | Sector Name | X_t, t = 2008 | X_t+1, Scenario 1 | X_t+1, Scenario 2 | X_t+1, Scenario 3 |
|---------------|-------------|---------------|------------------|------------------|------------------|
| 23            | Fishery     | 1,837,672.86  | 1,878,964.00     | 1,807,693.94     | 2,384,981.80     |
Figure 1. The dynamics of the total output of the Indonesian fishery sector (condition A).

Table 4. The total output of the discussed sector for each scenario on condition B (100 million Rupiah).

| Sector Number | Sector Name | $X_t$, t = 2008 | $X_{t+1}$, Scenario 1 | $X_{t+1}$, Scenario 2 | $X_{t+1}$, Scenario 3 |
|---------------|-------------|-----------------|------------------------|------------------------|------------------------|
| 23            | Fishery     | 1,837,672.86    | 1,847,278.01           | 1,836,979.96           | 2,217,310.86           |

Figure 2. The dynamics of the total output of the Indonesian fishery sector (condition B).
4. Conclusions and further researches

This study investigated the dynamics of the total output of the Indonesian fishery industry when the changes of the final demand occurred. This study employed a demand-pull IO quantity model, one of the calculation tools in the IO analysis, as an analysis instrument. Two conditions were noticed in calculations and analysis parts, namely (1) “whole sector change”, and (2) “pure change”. An initial period in this study was 2008. One of the differences between current and previous studies could be seen on the name of the scenario 3, households and non-profit private institutions consumptions modification.

The results showed that, in both conditions, the discussed sector had similar patterns, namely this industry received the positive impacts from scenarios 1 and 3 while the negative impact was obtained from scenario 2. The results also explained that, in both conditions, the biggest positive impact for the analyzed sector was given by scenario 3, the change of households and non-profit private institutions consumptions. Based on the results, the suggestions from this study regarding the effective ways to enhance the total output of the fishery sector of Indonesia in the future were to increase the rate of households and non-profit private institutions in terms of consuming the products of the industry, and to restrict import activities for these outputs.

The dynamics of the total output of the Indonesian fishery sector could be investigated from this study. This study, however, did not conduct the deep analysis about how to effectively increase the output in the future. This analysis is needed in order to concretely map out the strategies for achieving the goal. Therefore, as a further research, this study proposes the analysis.

This study also did not conduct the investigations in order to know the dynamics of the total outputs of other Indonesian sectors. The results of these investigations will be good insights especially in order to know the characteristics of these sectors. Hence, this study also suggests the investigations as a further research.

The role of the fishery industry on the Indonesian economy, however, could not be observed from this study. The information about this role is needed in order to sharpen the strategies for increasing the total output of this industry in the future. Based on this reason, this study suggests the exploration in order to know the role as one of the future researches. This exploration will be more interesting if the other data are also included.

The other suggested future research from this study is to conduct the international comparison on the current discussion. This comparison will describe the characteristics of the fishery industries of analyzed countries when the changes of final demands occur. One of the examples is to compare developed and developing countries.
### Appendix. Indonesian Industrial Sectors (66 Sectors)

| No. | Sector Name                                      |
|-----|-------------------------------------------------|
| 1   | Paddy                                           |
| 2   | Beans                                           |
| 3   | Maize                                           |
| 4   | Root crops                                      |
| 5   | Vegetables and fruits                           |
| 6   | Other food crops                                |
| 7   | Rubber                                          |
| 8   | Sugarcane                                       |
| 9   | Coconut                                         |
| 10  | Oil palm                                        |
| 11  | Tobacco                                         |
| 12  | Coffee                                          |
| 13  | Tea                                             |
| 14  | Clove                                           |
| 15  | Fiber crops                                     |
| 16  | Other estate crops                              |
| 17  | Other crops                                     |
| 18  | Livestock                                       |
| 19  | Slaughtering                                    |
| 20  | Poultry and its products                        |
| 21  | Wood                                            |
| 22  | Other forest products                           |
| 23  | Fishery                                         |
| 24  | Coal and metal ore mining                       |
| 25  | Crude oil, natural gas, and geothermal mining   |
| 26  | Other mining and quarrying                      |
| 27  | Industry of food processing and preservation    |
| 28  | Industry of oil and fat                         |
| 29  | Industry of rice milling                        |
| 30  | Industry of all kinds of flour                  |
| 31  | Industry of sugar                               |
| 32  | Industry of other food products                 |
| 33  | Industry of beverages                           |
| 34  | Industry of cigarettes                          |
| 35  | Industry of yarn spinning                       |
| 36  | Industry of textile, wearing apparel, and leather|
| 37  | Industry of bamboo, wood, and rattan            |
| 38  | Industry of paper and the products of cardboard  |
| 39  | Industry of fertilizer and pesticide            |
| 40  | Industry of chemicals                           |
| 41  | Petroleum refinery                              |
| 42  | Industry of rubber products and plastic         |
| 43  | Industry of non-metallic mineral products       |
| 44  | Industry of cement                              |
| 45  | Industry of basic iron and steel                |
| 46  | Industry of non-ferrous basic metal             |
|   | Description                                      |
|---|-------------------------------------------------|
| 47 | Industry of fabricated metal products           |
| 48 | Industry of machine, electrical apparatus, and  |
|     | equipment of electric                           |
| 49 | Industry of transportation equipment and its    |
|     | repairment                                      |
| 50 | Industry of other products                      |
| 51 | Electricity, gas, and water supply              |
| 52 | Construction                                    |
| 53 | Trade                                           |
| 54 | Restaurant and hotel                            |
| 55 | Railway transport                               |
| 56 | Road transport                                  |
| 57 | Water transport                                 |
| 58 | Air transport                                   |
| 59 | Services for supporting the transports          |
| 60 | Communication                                   |
| 61 | Financial institutions                          |
| 62 | Real estate and services of offices             |
| 63 | General government and defense institutions     |
| 64 | Social and community services                   |
| 65 | Other services                                  |
| 66 | Activities not elsewhere classified             |

(Source: [27], with the slight modifications)
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