Analysis of Fisheries Support Estimate for Sustainable Blue Economy

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Abstract: The Blue Economy concept was firstly introduced after 2008 Mortgage Crisis, and gained importance in the United Nations Sustainability Conference held in Rio in 2012. In this study, the concept and the scope of the blue economy are given, and the fishing activity, which is one of the crucial blue economy components, is emphasized. According to the Food and Agriculture Organization (FAO) reports, fish stocks are decreasing due to overfishing in the world. It has been suggested that fisheries support is leading to overfishing and to the reduction of fish stocks. The purpose of this study is to analyze whether fisheries support causes overfishing and whether it is a problem for sustainable fish resources. In the Python program, a production model was estimated to analyze the relationship between fisheries production and fisheries support, the number of vessels and the number of fishermen in 37 countries between the years 2012 and 2017. According to the model, it was observed that fisheries support, the number of vessels and the number of fishermen increase fish production, but there is not a high correlation between the variables. In order to remove the overfishing pressure on fish production, it is important to shift the fisheries support to the support types which are indirectly related with the fish output.
1. Introduction

The term “Blue Economy” was firstly mentioned after 2008 Mortgage Crisis and was seen as a sea-based solution strategy for the global economic recession (Çoban, 2017). The concept of Blue Economy was introduced for the first time in the book “The Blue Economy” written by Gunter Pauli (2010) and emphasized that the Blue Economy creates richness in terms of sustainability and therefore a balance should be established between environmental and economic targets.

At the United Nations Conference on Sustainable Development (UNCSD) held in Rio de Janeiro on 20-22 June 2012, the main focus themes were “Sustainable Development and the advancement of the Green Economy”. But many coastal countries stated that the “Blue Economy” was more appropriate for their sustainable development approach than the Green Economy concept.

The blue economy concept aims to promote economic growth, the improvement of livelihood of those who earn their livelihood by sea, also aims to ensure environmental sustainability of oceans and coastal areas.

The definition of “ocean economy” has been also used by the countries which include ocean-related economic activities, but these activities vary for each country. As the oceans are seen as the source of growth and investment, the terms “blue economy” and “blue growth” emerged as part of the expression of the ocean economy (The Economist, 2015).

Blue economy covers many activities like fish production, coastal tourism, producing resources for medicine, also extracting renewable resources, marine transport, shipbuilding etc. This article focuses on only fish production which is an important component of blue economy for sustainable ocean and sea resources. The purpose of this study is to analyse the blue economy and the impact of the fisheries subsidies on overfishing, because it is suggested that fisheries support and overfishing are obstacles to sustainable blue economy.

2. Materials and Methods

The possible impacts of support level, number of vessels and employment in the fishing sector on the fish production level are examined in a panel of 37 countries covering 2012 through 2017 (Table 1). The impact of the number of vessels and the number of fishermen is also analyzed, but the main focus of the study is the relationship between the fisheries support and the fish output. The data are collected from the OECD.Stat, the Statistical Website of the OECD.

Panel data analysis is made in Phyton which is a multi-purpose programming language. Panel data results are obtained by writing Phyton code and running it in the program.

Table 1. The List of the Countries

| OECD Countries | 1 Australia | 15 Latvia | 28 Argentina |
|----------------|-------------|-----------|-------------|
| 2 Belgium      | 16 Lithuania| 29 Brazil |
| 3 Canada       | 17 Mexico   | 30 China (People's Republic of) |
| 4 Chile        | 18 Netherlands | 31 Colombia |
| 5 Denmark      | 19 New Zealand | 32 Costa Rica |
| 6 Estonia      | 20 Norway   | 33 Indonesia |
| 7 France       | 21 Portugal | 34 Malaysia |
| 8 Germany      | 22 Slovenia | 35 Peru |
| 9 Greece       | 23 Spain    | 36 Philippines |
| 10 Iceland     | 24 Sweden   | 37 Chinese Taipei |
| 11 Ireland     | 25 Turkey   |             |
| 12 Italy       | 26 United Kingdom |
| 13 Japan       | 27 United States |
| 14 Korea       |             |             |
2.1. Blue economy concept and blue economy growth in the world

Blue economy is suitable for all countries and can be applied in many ways. Oceans make up of 72% of the world’s surface and they provide a substantial portion of the global population with food and livelihoods and are the means of transport for 80% of global trade; also the seabed currently provides 32% of the global supply of hydrocarbons with exploration expanding (United Nations, 2014).

The basis of the global blue economy concept is to provide economic growth from the oceans while at the same time providing healthy oceans to serve the next generations. (Atakpa, 2018). As the oceans and the seas cover many activities, sustainable use of the oceans’ and seas’ resources are crucial for our future. The sustainability in oceans is not only crucial for the people who earn their livelihood from these resources, but also for all consumers, and for existence of biodiversity. An important aim of the blue economy comprises how the sectors related with the oceans and the seas will transition to more environmental-friendly activities.

Blue economy comprises many sectors like harvesting and trade of marine living resources, use of renewable natural forces, extraction of energy sources and minerals, commerce in and around the oceans like tourism, shipbuilding etc. (Table 2).

Table 2. Components of blue economy

| Type of Activity | Subcategory (related sector)                                                                 |
|------------------|---------------------------------------------------------------------------------------------|
| Harvesting and trade of marine living resources | Seafood harvesting (Fisheries-primary fish production)                                      |
|                  | Fisheries related activities (net and gear making, boat construction, ice production)       |
|                  | Trade of non-edible sea-products (for cosmetic, pet, and pharmaceutical products)           |
| Extraction and use of marine nonliving resources (non-renewable) | Extraction of minerals, energy sources (oil and gas)                                       |
|                  | Freshwater                                                                                |
| Use of renewable non-exhaustible natural forces (wind, wave, and tidal energy) | Generation of (off-shore) renewable energy                                                  |
| Commerce and trade in and around the oceans | Shipping and shipbuilding                                                                     |
|                  | maritime transport                                                                          |
|                  | costal urbanization                                                                         |
|                  | tourism                                                                                     |
| Indirect contribution to economic activities and environments | Carbon sequestration                                                                       |
|                  | Coastal Protection (habitat protection)                                                     |
|                  | Waste Disposal for land-based industry                                                     |
|                  | Existence of biodiversity (protection of species)                                           |

Source: World Bank, 2016: 1.

Seafood harvesting (fish production) is one of the main components of blue economy that is directly related with sustainability. The driver of the importance and growth in sea food harvesting is the demand for food, especially for protein. The sector also provides secondary activities related to marine fisheries like fish processing, packaging and marketing. In many places, employment enables young people to stay in their communities and have strengthened the economic viability of isolated areas, enhancing the status of women in developing countries (World Bank, 2017)

The biggest producer in seafood harvesting (fish production) in the world is China with 64 million tonnes. The fish production has been decreasing over the years especially in Belgium, France, Japan, Lithuania, Portugal, United States, Malaysia, Costa Rica, Philippines and Chinese Taipei (Table 3). Also, in other countries, there has not been a stability in world fish production over the years.

As seen in the Figure 1, the percentage of stocks fished at biologically unsustainable levels reached its maximum levels to 33% in 2008, then decreased to 28% in 2011, but later increased to 33% in 2015.
There are three main sources of overfishing: increased number of vessels (fleet), increased number of fishermen, and high fisheries subsidies. According to the Figure 2, global fleet has increased from 694,000 in 2004 reaching a total of more than 1,4 million vessels in 2011 (OECD). The number of
fishermen in the sector has also grown faster after 2004 and reached its maximum level about 6 million in 2011. As the number of vessels and the number of fishermen recorded their highest levels in 2011, the sustainability of oceans was put on the agenda in the Rio Conference in 2012.

![Figure 2. The number of vessels and number of fishermen (OECD, Fisheries database).](image)

But overall, fisheries support is suggested as the most important factor in overfishing rather than employment and the number of vessels.

### 2.2. Evaluation of fisheries support

Support policies in fisheries are intended to develop the fisheries sector and to reach some government’s goals like increasing production capacity, supporting fishermen and ensuring a stable supply of fish. The types of the fisheries subsidies vary from country to country. Some of the subsidies are related with the production level and can encourage production. These policies are production-distorting policies. Some of the subsidies are important for development of the fisheries sector, improvement of livelihood of the fishermen and supporting sustainability of ocean resources. These subsidies are non-production-distorting payments.

Basic fisheries subsidies that are related with the production level are:

- **Payments based on variable input use.** These payments are made on the basis of the costs of the fishing operation, such as purchase of gear, bait or ice, or the use of port services.
- **Payments based on output.** These transfers are made on the basis of the price of fish. They include tariffs, market interventions and consumer subsidies.
- **Payments based on fuel use.** These payments are in the form of fuel tax concessions or fuel subsidies. According to the FSE calculation, the amount of fuel that fishermen obtain from their own coasts is taken into account. The fuel they obtained from foreign countries is excluded from this calculation. Some countries are selling fuel for the vessels below the global average price (Martini and Innes 2018: 18). This is harmful for overfishing and this policy is both production-distorting and trade-distorting.

Payments that are indirectly related with the production (fishing) are:

- **Payments based on fishers’ income.** These are transfers that include employment insurance, disaster payments, wage subsidies, special income tax concessions.
- **Payments based on fishers’ own capital.** These transfers are based on investment in fishing operations or working capital for operations. This category includes, for example, concessional loans, special tax treatment on investment or returns on investment other than for capital in fishing vessels. Support that increases operators’ capacity to profit from the fishery, such as upskilling, marketing training and assistance would also fall in this category.
- **Payments based on vessels.** These transfers are made on the basis of the purchase, alteration, or scrapping of a fishing vessel. To remove over fishing pressure on the stocks, fishing vessel buyback program was launched in some countries. Some vessels were bought and removed from the fleet. In Turkey, fishing vessel buyback program was launched in 2012 and it has been continuing.

According to the OECD statistics, China provides the highest fisheries support among the countries with $ 3.83 billion in 2016 (Figure 3). In China, the support value was 6.97 billion dollars in 2012, it decreased to 5.06 billion dollars in 2014 and decreased again to 3.83 billion dollars in 2016.
China's fisheries support estimate alone is above the total Fisheries Support Estimate of all OECD countries of $3.80 billion. The countries that supported the fisheries sector the most after China were Japan with $1.22 billion, United States of America with $803 million and Canada with $675 million, respectively. Turkey has reduced the fisheries subsidies over the years; from 250 million dollars in 2013, to $149 million in 2017.

OECD categorized the fisheries subsidies according to their effect on production capacity (OECD, 2018): Variable inputs (such as for equipment, fuel or bait) and fixed inputs (vessels and other durable investments) are the most likely to increase fishing capacity. Transfers based on fishers’ income is relatively less likely to increase capacity. Support to general services (management, enforcement, infrastructure investments and R&D) is the least likely to increase capacity or fishing effort. China gives the highest input support to the fisheries sector among the countries (Figure 4). China is followed by Malaysia, Mexico, Indonesia, Brazil, Peru, France, Belgium and Chile.

Figure 3. Fisheries support estimate of OECD- and non-OECD countries, million Dollars (OECD, fisheries support estimate database).

Figure 4. Input subsidies in fisheries, million Dollars (OECD, Fisheries support estimate database).

Sustainable Development Goal 14— which concerns the ocean—calls on World Trade Organization members, “to prohibit certain forms of fisheries subsidies which contribute to overcapacity
and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies” by 2020. Prohibition of some fisheries subsidies that lead to overcapacity and overfishing have been considered in the WTO Doha Round in 2001; and at the WTO 11th Ministerial Conference in Buenos Aires in 2017 (WTO). But no agreement was reached.

Kituyi M. and Thomson, P. (2018) stated in the World Economic Forum that “90%” of fish stocks are used up due to the fisheries subsidies; especially fuel subsidies (type of input subsidies) are the crucial part of the fisheries support estimate. According to Kituyi and Thompson, harmful fisheries subsidies encourage overfishing and they benefit generally large-scale fleets. Nearly 85% of the fisheries subsidies are received by large fleets. However, 90% of the fisheries sector consists of small-scale fleets.

Reducing overfishing would allow overexploited fish stocks to recover over time and sustainable fishing activities would bring higher economic returns in time (World Bank Group, 2017). However, to reach that equilibrium, reforms are necessary like shifting harmful subsidies to less production distorting subsidies. The subsidies can be applied to invest in sustainable fisheries, aquaculture and coastal community livelihoods, reducing the pressure on fish stocks (Kituyi and Thomson, 2018).

In the context of the fisheries subsidies, The Blue Growth Initiative of the Food and Agriculture Organization of the United Nations (FAO) assist countries in developing and implementing blue economy by eliminating harmful fishing practices and overfishing and instead incentivizing approaches that promote growth, improve conservation, build sustainable fisheries, and end illegal, unreported, and unregulated fishing (World Bank, 2017).

3. Results

For estimating the fish production level; support level, number of vessels and employment in the fishing sector are selected as explanatory variables. LogPL is the production level (in US Dollars) and denotes the dependent variable. LogSL is the total value of Fisheries Support Estimate in US Dollars which can encourage over fishing. LogV shows the fishing fleet (number of vessels) that can also increase catching operations. LogF indicates the number of fishermen (employment) in the fishing sector.

In order to examine whether the support level (SL) in the fisheries sector, the number of vessels (V) and the number of fishermen (F) affect the over fishing; production level model (PL) is estimated for the related countries between 2012 and 2017.

Ho: There is a positive correlation between production level and fisheries support level

H1: There is no relation between the variables

The following equation expresses the regression model:

\[ \log PL_i = \alpha + \beta \log SL_i + \beta \log V_i + \beta \log F_i + \varepsilon_i \] (1)

The coefficients of the parameters are statistically significant. The best fitted model is presented below:

\[ \log PL_i = -4.0340 + 0.4350 \log SL_i + 0.4336 \log V_i + 0.4094 \log F_i \] (2)

Support level and the number of vessels have a positive correlation with the production level. Ho; Hypothesis of whether the support level affects the production level in the related countries is accepted.

(Ceteris paribus), a 1% rise in the fisheries support estimate causes an increase in the production level by 0.43%; a 1% rise in the number of vessels causes an increase in in the production level by 0.43%; a 1% rise in the number of fishermen causes an increase in in the production level by 0.41%.
To sum up, according to the estimations, it has been observed that the fish production level has been affected by the increased number of fishermen and vessels. Also, high fisheries subsidies in the countries have affected the production levels in the countries causing an increase in fish harvesting.

4. Discussion and Conclusion

Fish harvesting is one of the main sources of human livelihood in many countries. As stated before, there are three main sources of overfishing: increased number of fishermen, rise in fleets and high fisheries subsidies.

As the number of fishermen and vessels rise in the countries, fish harvesting increases too. If there is a risk of overfishing due to the fleet capacity, countries can apply vessels buyback programme in order to minimize fishing pressure.

Generally, governments pursue high subsidies in the fisheries sector in order to ensure a stability in the fish production and to support earnings of fishermen. However, production-related subsidies like input subsidies (fuel tax exemptions) cause an increase in production level. So, these subsidies lead to overfishing and so depletion of fish stocks in the world.

The results in this study suggest that an increase in the fisheries support leads to over fishing. Although in the model, the coefficient of the support value is not so high, anyway it has been observed that the fisheries subsidies affect the production level. Also, the increase in the number of vessels and in the number of fishermen causes an increase in the fishing effort, too.

These findings highlight the importance of the types of fisheries subsidies. Generally, the main critics about the subsidies are whether the support is related with the output and whether it is in the form of input subsidies like fuel subsidies. This kind of policies is production-distorting causing over production. Decreasing the level of support has been discussed in GATT/WTO Rounds and the main idea in the Rounds were shifting the output and input support to non-production-distorting policies which gives importance to environmental-friendly production, animal welfare, income insurance and safety net programmes.
Blue economy must be supported for sustainable ocean and sea resources. The subsidies which can lead to overfishing must be changed and the countries can shift these harmful policies to non-production distorting policies.

For further researches, it is recommended to examine other components of the blue economy.

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