The Carbon Footprint of Consuming Fish Species in Japan

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Author: Hisashi Ito
Co-Authors: Taiga Shimotsuura, Tomomi SHODA, Shigemi KAGAWA

Global demand for fishery products is expanding due to population growth, the development of transportation system, and increasing health consciousness. Compared to agricultural and livestock products, fishery products have a smaller carbon footprint. Thus, in the context of a carbon neutrality, fisheries production is projected to expand. According to Robert et al. (2018), despite a minimal increase in global fisheries production from 1990 to 2011, greenhouse gas (GHG) emissions from fisheries have risen by 28%. Therefore, there is an urgent need to reduce GHG emissions from fisheries. However, GHG emissions from fisheries are still not clearly quantified, except for generalizations based on a limited number of case studies. To the best of our knowledge, this study is the first attempt to evaluate the embodied CO2 emissions induced by fisheries production in Japan, considering fishery types, fish species, and to suggest possible CO2 mitigation policies from the perspective of fishery types.

In this study, we quantify direct and indirect CO2 emissions from fisheries in Japan based on Embodied Energy and Emission Intensity Data for Japan Using Input-Output Table (3EID) using Environmental-extended Input-Output (EEIO) Analysis (Nansai, 2019). Fisheries production data published by the Ministry of Agriculture, Forestry, and Fisheries of Japan are utilized as final demand. We estimated direct and indirect CO2 emissions from fisheries production in Japan from 2011 to 2021 by fishery types, fish types, and fish species based on the data.

The empirical results show that annual CO2 emissions from fisheries production in Japan were approximately 6 Mt-CO2, accounting for about 0.5% of the total annual CO2 emissions in Japan. The annual CO2 emissions from fisheries production increased from 2011 to 2015 due to the rise in the value of fisheries production caused by an increase in export value. In contrast, there was a downward trend from 2016 to 2020, with a 10.5% decrease. The main reason for this decline is the reduced production value caused by a decrease in the return and migration rates of various fish species, driven by changes in the marine environment.

In terms of fishery type, marine fisheries, representing approximately 70% of the total CO2 emissions from the fisheries, contributed to the decrease in annual CO2 emissions from fisheries from 2016 to 2020. It should be noted that the carbon intensity of marine fisheries is higher than that of other fishery types. Therefore, reducing the proportion of marine fisheries and increasing the share of other fishery types has significant potentials to decrease total CO2 emissions from fisheries.

In terms of fish type, we found that fish was the largest contributor to CO2 emissions from marine fisheries, accounting for 67% of annual CO2 emissions from this sector. Additionally, shellfish, which represents the second-largest share after fish, can also be produced through marine aquaculture. In other words, a shift from marine fisheries to marine aquaculture, especially for fish and shellfish, has significant potential for reducing CO2 emissions.

In terms of fish species, we identified the top 10 species that contributed the most to the total annual CO2 emissions from production of fish, accounting for 79% of the total annual CO2 emissions from this sector. Based on the Family Income and Expenditure Survey, the consumption of tuna, salmon, trout, and yellowtail is especially high in Japan, contributing significantly to CO2 emissions due to their large production value (Statistics Bureau of Japan, 2020). Shifting from marine fisheries to

marine aquaculture for species in high demand, such as yellowtail, salmon, and horse mackerel can significantly reduce CO2 emissions. However, the number of fish species that can be produced by marine aquaculture is limited. In other words, the CO2 mitigation effect of shifting from marine fisheries to marine aquaculture is relatively small.

In conclusion, in a context where the production of fishery products in Japan will continue to heavily rely on marine fisheries, additional mitigation approaches, such as improving environmental efficiencies in the operation of fishing vessels, are needed.