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Navigating Consumption Dynamics through Consequential Life Cycle Assessment of Fish Products

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1. Introduction

Globally, wild fish stocks constitute an important source of food and demand for this product is high and expected to increase. In fact, half the global fish supply of proteins come from wild fisheries [1]. Although generally considered as a relatively climate-friendly way to produce food from animal sources, fishing activities result in emissions - primarily related to fuel used – that provide a non-negligible contribution to climate change. Carbon footprint studies can help understand the environmental impact of different fish products and fishing practices.

While traditional studies employ an attributional approach [2], which quantifies emissions retrospectively looking at how the production process took place, consequential LCA takes a consumption perspective aiming to estimate how changes in demand affect overall emissions [3]. In this case, marine capture fisheries are considered constrained activities, even though consumption of fish per capita kept increasing [1]. If supply of wild caught fish is constrained, a key issue is then to determine which suppliers can meet the increased demand [4]. Other industries have employed consequential LCA and current research explores methods to identify these suppliers for different products in sectors such as agriculture and energy [5-6]. However, the application of consequential LCA in the fishing sector remains relatively unexplored. Simultaneously, the sector faces constraints on increasing production due to its reliance on a finite natural resource. This circumstance poses challenges in identifying the marginal suppliers and discerning the products that will undergo shifts in consumption.

Therefore, the primary goal of this research is to identify the marginal mixes necessary to conduct a consequential LCA to assess the carbon footprint of the fish products. This study aims to address the research gap and provide insights into how changes in demand of fish products for fish can affect carbon emissions. Ultimately, the research seeks to inform policies and consumption practices to reduce the environmental impact of consuming fish products.

2. Methods

The hypothesis we investigate in this study is that only unconstrained suppliers will respond to increases in demand for fish. Should no fishery be able to meet the demand, a displacement or substitution effect may occur, where functionally equivalent products can be chosen by consumers. However, such substitutions can occur through various mechanisms. We attempt here to determine if marginal suppliers can be specific fisheries and determine different marginal mix using different functionality criteria.

Danish national landings and quota data are utilised to assess the potential for increased production in marine capture fisheries. For fish products without unconstrained suppliers, distinct criteria are used to define the marginal mixes, categorised by nutritional values, price, and cultural function. These factors represent different considerations influencing consumer choices, such as meeting specific dietary requirements, perceived value and affordability, or the role of specific fish products within the food chain, which reflects broader preferences. From these marginal mixes based on the three criteria, carbon emission results are calculated through Life Cycle Impact Assessment (LCIA) to determine the potential impact based on consumers' choices.

3. Results and discussion

Preliminary results highlight the constrained nature of marine capture fish. None of the major commercial species in Denmark can sustain an increase in demand, given the declining trend observed in historical data (Figure 1). The other expected result of this study is a consequential model that allows for a better analysis of the market dynamics for the fish supply. The identification of substitution choices has the potential to identify the specific sectors that, by supplying the extra demand, bear the carbon emissions. This allows to quantify the potential impact caused by different shifts in demand.

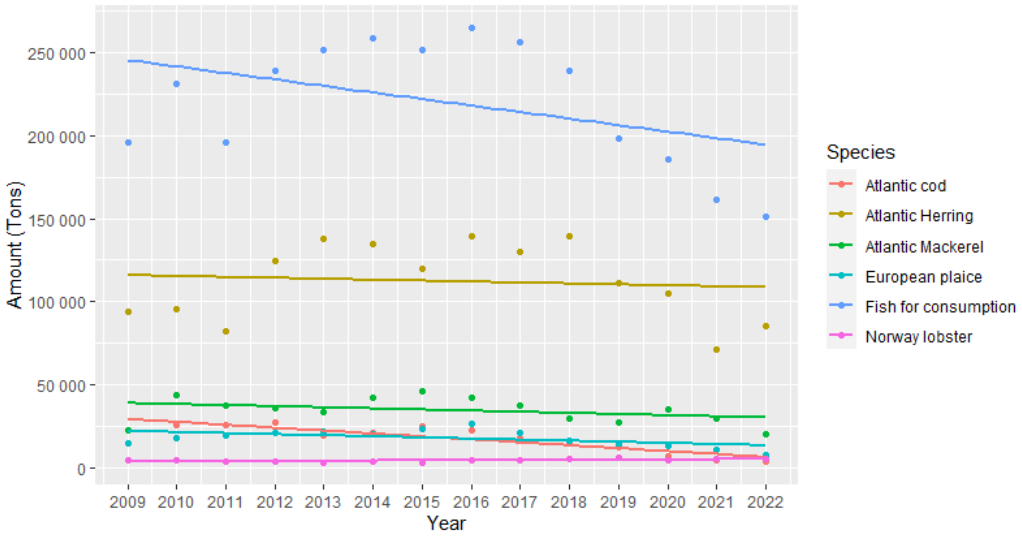

Figure 1: Trends in fish landing for main commercial species in Denmark.

The modelling process is still ongoing, but the expected outcome is a comprehensive model representing a diversified market mix of suppliers capable of meeting the increased demand for fish. This mix can include a range of sources such as fish products from aquaculture if the substitution occurs on nutritional content. Alternatively, a mix of protein sources, including both animal and vegetable options, can be considered if the substitution mechanism is driven by similarities in price or cultural functionality. These market mixes can be directly applicable in consequential LCAs of fish products.

The analysis offers insights into the real impact of increasing demand and identify which sectors are influenced by this displaced demand. Unlike current attributional LCAs that focus on past production, our consequential approach emphasises the future consequences of consumption. This can be useful in guiding consumers towards the best options in terms of carbon footprint and towards more sustainable consumption choices Policymakers can use the results to develop dietary guidelines that prioritize environmentally friendly food sources, ensuring that recommendations promote both health and environmental sustainability.

5. References

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