

A Bioeconomic Evaluation of Distant Water Fishing Management Strategies in Liberia

Mara Booth | Taylor Cook | Dustin Duncan | Abigail Kirk | Madeleine Whitman
Faculty Advisor: Anastasia Quintana
Client: Conservation International

Background & Environmental Problem

As global demand for seafood intensifies, industrial distant water fishing (DWF) fleets are increasingly operating within the exclusive economic zones (EEZs) of developing countries, including Liberia. Liberia's coastal waters, rich in biodiversity, play a critical role in supporting food security and local communities' livelihoods. In addition, the fishery sector constitutes 10% of the country's gross domestic product. However, DWF fleets, including foreign industrial trawlers, are frequently fishing in the country's EEZ, creating challenges for sustainability, equity, and national resource governance. These fleets generate critical national revenue through access fees, based on the estimated market value of their landed catch. Yet, they often operate with limited oversight, raising concerns about overfishing, habitat degradation, and unfair competition with Liberia's small-scale fisheries, which are central to the country's food systems. Previous research has also found that over the past decade, despite new policy implementation, DWF trawling fleet catch has increased, while small-scale catch has decreased. In partnership with Conservation International, this project evaluates the trade-offs among ecological, economic, and social outcomes under alternative DWF management strategies for *Sardinella* spp. Using a custom-built bioeconomic model, non-market valuation, and qualitative analysis, we aim to inform a more balanced approach that supports both national revenue generation for the National Fisheries and Aquaculture Authority and long-term sustainability for Liberia's fisheries sector.

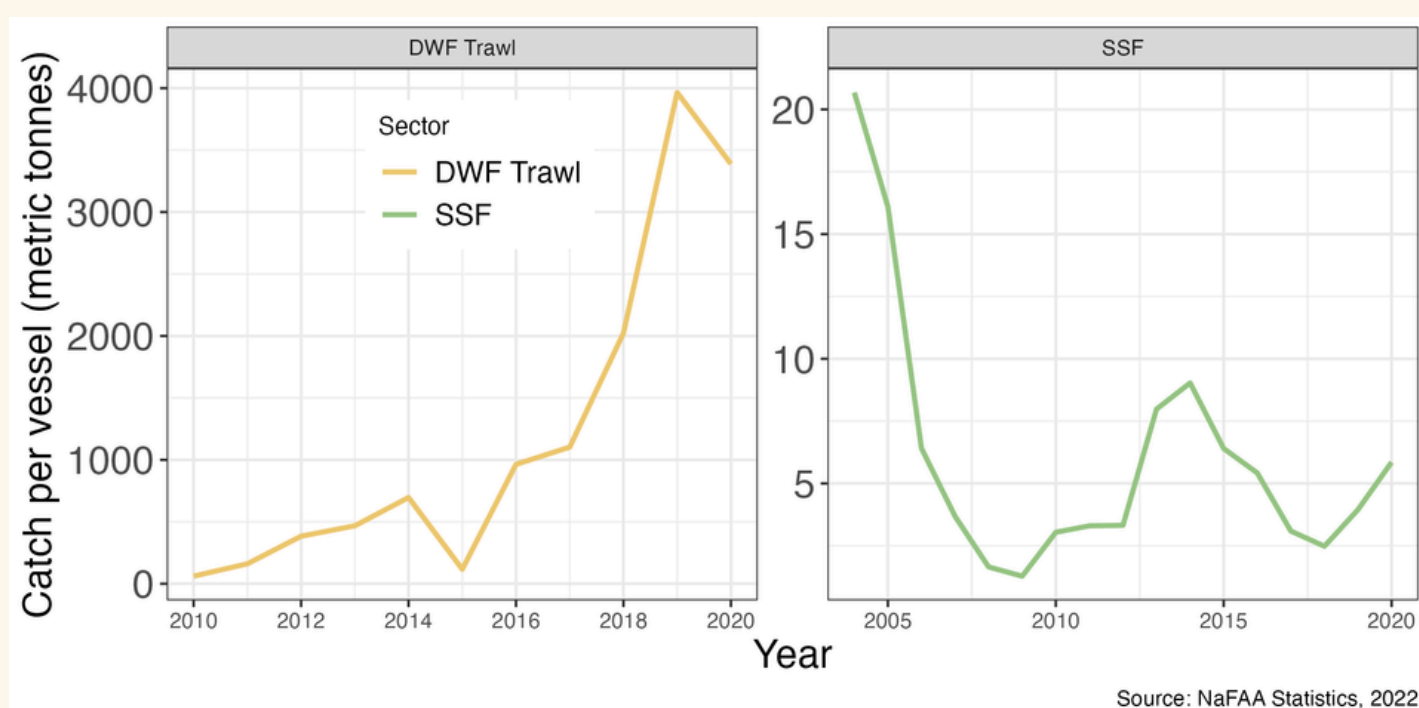


Figure 1: Catch per unit effort for the distant-water trawl fleet and the small-scale fleet
Source: Jueseh et. al [in review]

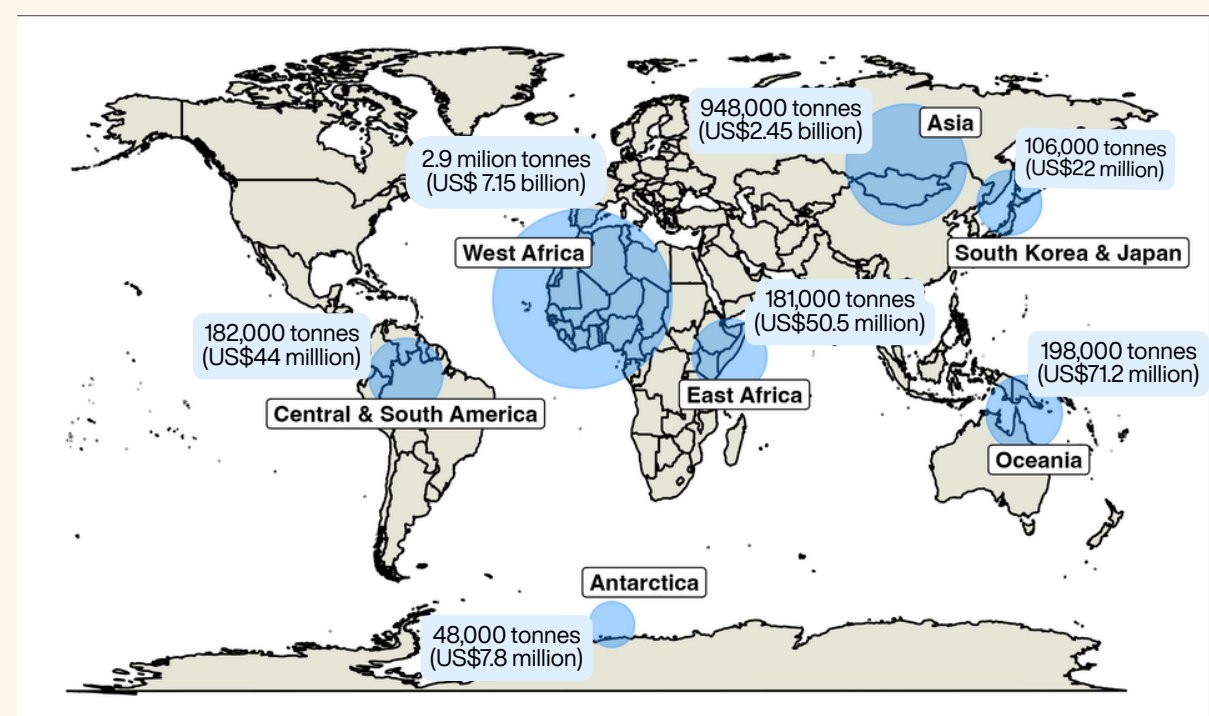


Figure 2: Estimates of China's Distant Water Fishing Fleet

Goals and Objectives

01

Evaluate the market and non-market impacts of distant water fishing trawlers, by exploring the following scenarios related to DWF trawler access in Liberia:

- Business-as-Usual (BAU): maintain current access fee of 10% of landed catch value.
- Fee increase: Increase access fee to 50% and 100% of landed catch value.
- Immediate Ban: Ban all DWF trawlers from the Liberian EEZ.

02

Provide a qualitative analysis for key non-quantifiable concerns to be used alongside scenario evaluation for decision-making. Topics include: *Illegal, unregulated, and unreported (IUU) fishing, Human rights violations, Fishing Risk, Fisher Income, Food Security, Fish Processor Health, Trophic Value of Sardines, and Shrimp trawling within the Inshore Exclusion Zone (IEZ).*

03

Evaluate the economic, social, and environmental implications based on each scenario's expected outcomes to identify key trade-offs for government and local communities to use for their decision-making.

Methods and Model Results

The Model: This model combines biological and economic components to simulate the decision-making behaviors of both DWF and small-scale fleets within the sardine fishery in Liberia. The model is manipulated through four different scenario inputs, under a ten-year horizon, to calculate the optimal access fee NaFAA should charge to DWF fleets to maximize the economic benefits to small-scale fleets and maintain the revenue gained from charging the access fee.

Non-Market Evaluation: Non-market (anything not related to or influenced by the exchange of goods and services through a market system) evaluations were estimated through a combination of literature review, data analysis, and calculations. Final estimations were determined by integrating outputs from our bioeconomic model.

Qualitative Analysis: For non-market evaluations where monetary estimates were difficult to determine due to complexity, data limitations, or time constraints, we conducted comprehensive literature reviews.

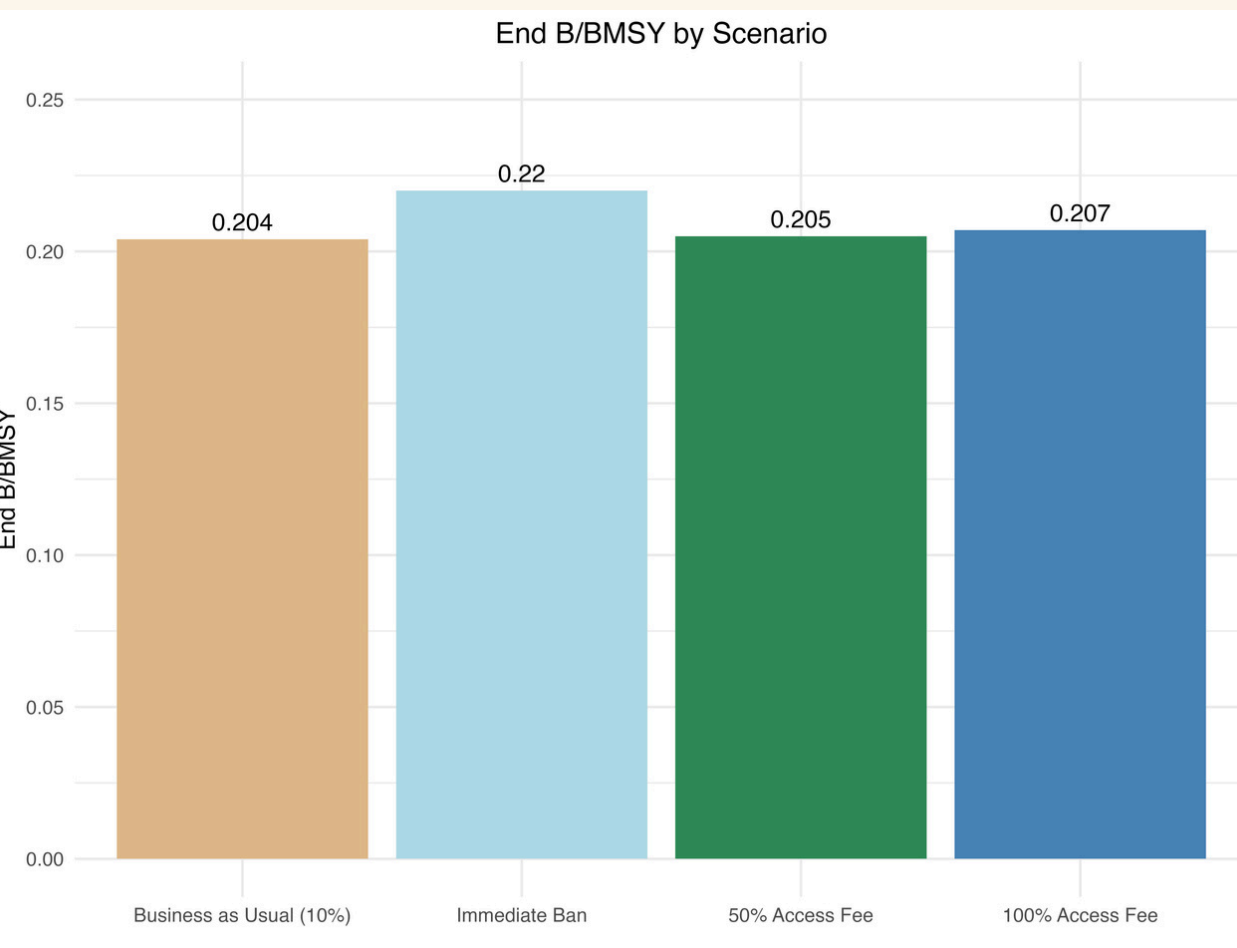


Figure 3: Model outputs for *Sardinella* biomass and harvest under four different policy scenarios

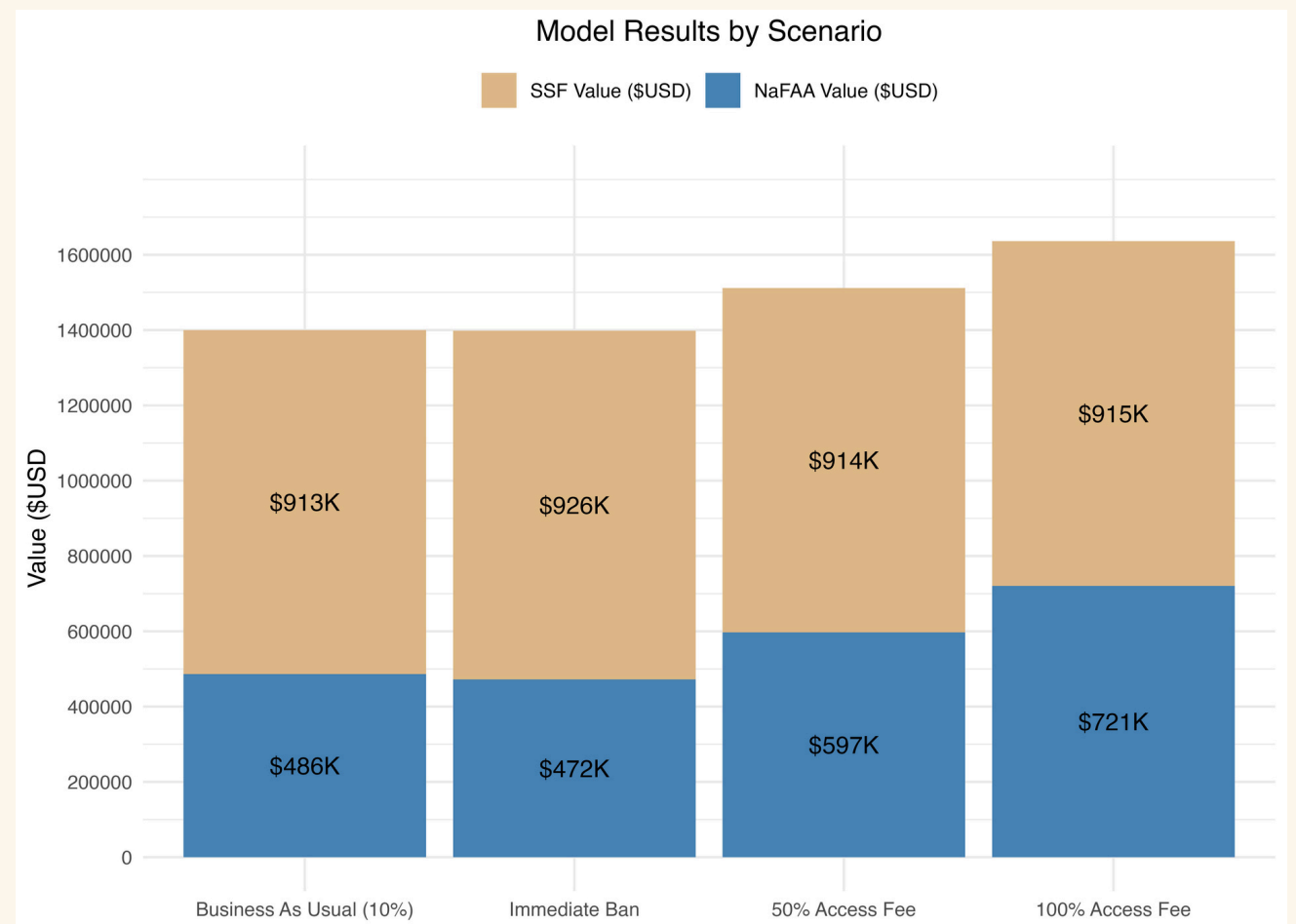


Figure 4: Final results illustrating model outputs under four different policy scenarios. All values are in 2023 USD.

Key Findings & Impact



Model results indicate that increasing the DWF access fee significantly raises the combined net present value of benefits, with a notable share attributed to small-scale fisheries and another portion to NaFAA, showing an improvement compared to the business-as-usual scenario.



Fish stock health, measured by the fish biomass ratio, improves from 0.204 (BAU) to 0.205 (50% fee), 0.207 (100% fee), and 0.220 (immediate ban). The results demonstrate that under all scenarios, the sardine stock remains overexploited, highlighting that a change in access fee is not enough to protect the fishery.



Non-market valuations and qualitative analysis highlight additional annual losses under BAU, including \$1.06 million in sardine biomass depletion and \$926.00 in social cost of carbon emissions.

Recommendations

- Reinvesting a portion of revenue into Liberia's small-scale fishery sector is critical for supporting broader sustainability, enhancing food security, strengthening local livelihoods, and promoting equitable, community-based management. The investment in small-scale fisheries to diversify their target species will also reduce the overexploitation of the sardine stock.

- The fee increase results indicate a financial case for slowly phasing out DWF trawlers.

- This research provides a foundational framework for policy evaluation to be used in future work. Future analyses should include additional ecologically and economically important species harvested in Liberia to better inform integrated management strategies.

