



Quantifying the Association Between Aquaculture Production and Mangrove Deforestation Using a Global Fixed Effects Model

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Mangrove forests play an important role in global ecological stability. Despite this, the global mangrove coverage has been declining in recent decades. Alongside coastal urbanization and climate change, the expansion of the aquaculture industry has been identified as an important driver of mangrove deforestation due to the increase in demand and the lucrative nature of the seafood market. While there are qualitative studies that analyze this at local and regional levels, there is a gap when it comes to quantitative studies done on a global scale. This study aims to address this gap by quantifying the effect of Annual Aquaculture Production (AAP) on the Annual Percentage Change in Mangrove Area (APCIMA) across 35 countries from 2007 to 2020. Data was sourced from the Our World in Data (OWID) repository and the Food and Agriculture Organization (FAO). Countries were selected based on complete coastal data availability, and raw AAP data were log-transformed to address right-skewness and heteroskedasticity. A fixed effects model (FEM) was employed to control unobserved, time-invariant country-specific characteristics that could introduce omitted variable bias. The analysis reveals a highly significant negative relationship ($p < 0.001$) between log-transformed AAP and APCIMA. The model coefficient of -1.70 shows that increases in aquaculture yield are significantly associated with higher rates of mangrove deforestation. Furthermore, the overall FEM explains approximately 62.5% of the total variation in mangrove area changes, while roughly 6.2% of the variation in mangrove deforestation within individual countries is explained by fluctuations in domestic aquaculture production. As the demand for food grows with the population, it's not feasible to halt the aquaculture industry; instead, we recommend more sustainable practices. Specifically, we suggest directing funding toward research into how mangroves can be integrated into aquaculture farming and providing financial assistance to coastal families for preserving and expanding mangrove forests.

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