

Financial Crimes and Environmental Sustainability: A Game Theory Model of Illegal Fishing and Its Financial Ecosystem

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Abstract

Illegal, unreported, and unregulated (IUU) fishing poses a substantial risk to marine ecosystems, biodiversity, and global economic stability, especially in areas reliant on fisheries. Intricate financial networks often enable the unlawful monetary transfers linked to illegal, unreported, and unregulated (IUU) fishing, while inadequately supervised banking institutions obscure the origins of the profits. This article examines the critical role of financial institutions and banks in addressing IUU fishing by detecting dubious transactions indicative of money laundering, corruption, and other financial offences. This research uses game theory to provide a mathematical framework that simulates the strategic interactions of primary parties, such as financial institutions, regulators, illicit fishing enterprises, and enforcement organisations. The results highlight the need of collaboration between financial institutions and regulatory agencies in overseeing, identifying, and mitigating financial crimes associated with environmental degradation. The use of game theory underscores the potential for improved financial regulation and collective accountability to markedly diminish illicit fishing practices and foster environmental sustainability.

Keywords: IUU fishing, environmental sustainability, cooperative strategies, money laundering, marine ecosystems.

JEL Classification: Q56; K42; C71

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Introduction

Illegal fishing is one of those environmental crimes that have recently gained much attention due to the fact that it causes extensive damage to marine ecosystems and biodiversity (Chen et al., 2023). It includes unauthorized, unreported fishing activities that are significantly depleting fish stocks, damaging marine habitats, and overfishing (Sumaila, & Tai, 2020) specially in developing countries (Du et al., 2021). The ecological balance gets disrupted by such activity, causing long-term damage to aquatic environments. According to the United Nations Environment Programme, environmental crime is unlawful conduct that involves illegal fishing, illegal logging, illegal wildlife trade, or the illegal pollution of the environment (Elliott, 2022). Though environmental crimes have been monitored for decades, it has only recently been linked with broader discussions on how banks and financial institutions can assist in preventing such illegal activities.

In fact, illegal fishing is a serious threat to marine ecosystems, biodiversity, and sustainable livelihoods. According to the estimate by Agnew et al. (2000) illegal, unreported and unregulated fishing (IUU) volume based on 11 and 26 million tons of fish from the oceans annually, representing about 15% of global fish catch, which adds to over-exploitation in fish stocks and the collapse in marine species. Furthermore, IUU fisheries causing the depleting of the stock contravenes the global initiatives on biodiversity conservation and sustainability (Pauly, 2013). Apart from the ecological impact, illegal fishing fuels a wide range of environmental crimes, such as habitat destruction (Aceves-Bueno et al., 2021). The practice of harmful fishing methods, like trawling or dynamite fishing, in an unselective manner results in damage to marine habitats, including coral reefs which further cause loss of biodiversity (Carneiro, & Martins, 2022). Similarly, illegal fishing threatens not only the marine environment but also undermines legitimate fishing industries, causing economic loss for coastal communities and governments dependent upon marine resources (Lindley, 2022).

On the other hand, financial institutions and banks are in a position to know most of the illegal financial activities that might include money laundering, corruption, and illicit financial transactions regarding IUU fishing (Yuliantiningsih et al., 2022). IUU fishing provides huge profits to illegal organizations that often use complicated financial systems in which lax supervision can be exploited. Banks, as guardians of financial flow, may observe large or suspicious transactions and can raise a red flag with regard to further scrutiny. Further, it is facilitated through the existence of anti-money laundering frameworks, such as know your customer (KYC) requirements and suspicious activity reporting.

In such a respect, IUU fishing integrated within a standard framework of AML may easily turn financial institutions into critical stakeholders in fighting not only money laundering but also environmental crimes. It is here that the monitoring of accounts related to fisheries and related transactions might provide added value, especially in coastal or high-risk regions, to a data base that significantly increases, when shared with regulators and enforcement agencies, the chances of identifying illicit activities. Such a penalty might also be imposed on financial institutions should they fail to report suspicious transactions, which would consequently increase vigilance in the monitoring of accounts involved with illegal fishing activities. Likewise, the banking and financial sector is increasingly being recognized as one of the major stakeholders in combating IUU fishing and wider environmental crimes (Rosello, 2020). It plays an active role in tracking and preventing money flows related to the crimes. As Mniwasa, (2022) endorse that in fact, financial institutions are better placed to identify suspect financial transactions and block attempts at money laundering linked to illegal fishing and other environmental crimes. The financial action task force (FATF) recommended enhanced due diligence on the part of banks for industries known to be linked with environmental crimes, including fisheries (Harris, 2024). This covers monitoring transactions which may be linked to the illegal fishing activities, identifying companies' ultimate beneficial owners operating within the fisheries' sector, and reporting suspicious activity to the financial regulators Oberle & OBERLE, 2022).

This paper fills the gap in the literature by modelling strategic interactions among these key players using both cooperative and non-cooperative game theory perspective. The paper models the decisions of banks, regulators, and enforcement agencies in monitoring illegal financial flows related to IUU fishing and demonstrates how the potential cooperation between the different parties can increase the likelihood of detecting and disrupting the illegal fishing proceeds' financial flows such as money laundering. This study develops an integrated model that will align the incentives of

all stakeholders to be more effective in the fight against the financial crimes related to illegal fishing.

Methodology - Game Theory Analysis

Game theory has been advanced as a strategic framework that can foster cooperation between financial institutions, regulators, and enforcement agencies in combating environmental crimes, including illegal fishing. Indeed, Sun, Y., Sun, Z., Zhang, Y., & Qiao, Q. (2024) establish the way models of cooperative game theory can be used to review how financial institutions are able to align their interests with those of regulatory bodies and enforcement agencies in effectively monitoring and blocking the flows of money associated with the environmental crime of illegal fishing. A mathematical form of game theory to prevent illicit money flow through IUU fishing is done, focusing on the role of banks and data sharing, in a multi-agent, cooperative, and non-cooperative game. This Game theory model would involve main players like banks & financial institutions, regulatory bodies, fishing companies, and enforcement agencies that share data to monitor and prevent IFFs (see figure 1 the key player of the game)

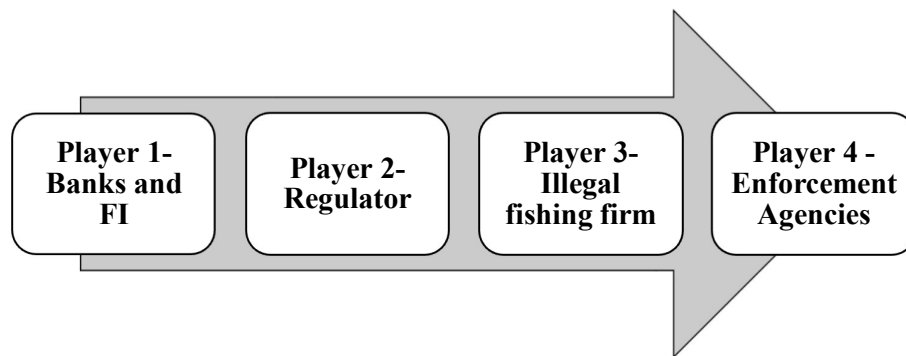


Figure 1 Key player

Source: Author own based on game theory concept

Discussion

The game is based on Nash Equilibrium with Cooperative Sub-games. Due to involvement of different players; the best strategy for every player is determined by the action of the rest. In this case, the cooperation between banks and regulators will enhance the effectiveness of halting illegal financial flows while illegal fishing firms may non-cooperate (see respective payoff's of the each player in figure 2)

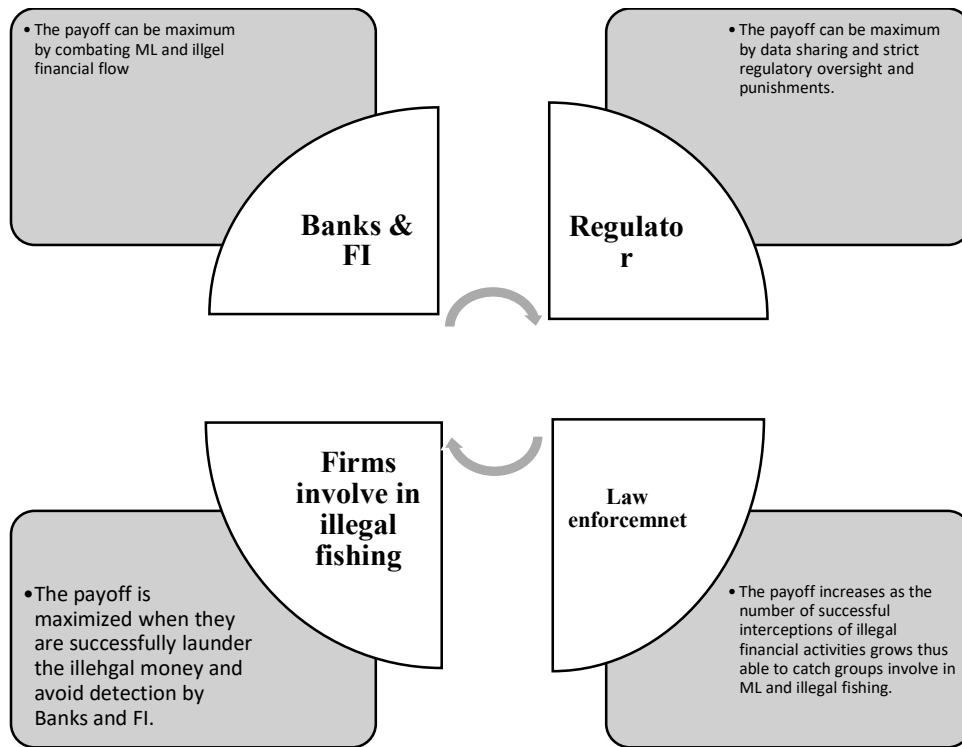


Figure 2. Payoffs of the player
 Source: Source: Author own based on game theory concept

A. Strategy 1- Game Nexus Between Banks And Illegal Fishing Firms

The firm which involve in illegal fishing choose their action strategy as x_a ; to attempt their proceed of crime from the financial institutions and banks. In respond to their strategy the financial institution and banks applied risk based approach and strict monitoring thus their respective strategy is, y_{BF} . Based on above nexus the utility function can written as follow,

$$U_{BF}(y_{BF}, x_a) = \text{Flow of illegal funds without trigger alert} - \text{Cost of strategies adopt by the bank}$$

$$U_{IFF}(x_a, y_{BF}) = \text{Amount of illegal money laundering proceed from illegal fishing} - \text{Probability of being caught by banks and financial intuitions.}$$

Based on the Nash equilibrium, neither player can improve their payoff by changing their strategy unilaterally,

$$y_{bf}, x_a \text{ such that } U_{BF}(y_{bf}, x_a) \geq U_{BF}(y_{BF}, x_a), \& U_{IFF}(x_a, y_{bf}) \geq U_{IFF}(x_a, y_{bf})$$

B. Strategy 2 - Cooperative Nexus Between Banks And Regulators

Banks and regulators could enter into a cooperative game by cooperating with each other thus by sharing the information of suspicious activity detected by the bank and financial institution with

regulator. This would therefore make them even more capable of detecting illegal activities and thus reducing the successful rate of money laundering from illicit fishing companies. The cooperative payoff between banks, financial institutions can be express in below utility form,

$$U_{B+R}(a_B, a_R) = \text{decreasing in illegal activities (i-e financial flow from proceed of illegal fishing)} + \text{data sharing cost between Banks, FI and Regulator)}$$

The cooperative game can be express in the form of Shapley value (α), which under the concept of game theory indicates fairly distributed gains and costs among actors in a coalition. Furthermore N is the set of all players, and $v(DS)$ is the value function that assigns the value of cooperation to the coalition of players such as bank and regulator.

$$\alpha_i(N, v) = \sum_{DS \subseteq N/\{i\}} \frac{|DS|! (|N| - |DS| - 1)!}{|N|!} [v(DS \cup \{i\}) - v(DS)]$$

C. Strategy 3 - Mixed Strategy Mechanism (I-E Banks , Fi And Regulator)

The successful outcome is based on strong monitoring of bank such as B_{PSTM} and R_{PF} is the probability of prosecution based on regulatory investigation on suspicious transaction based on banking and financial institution data sharing. Considering the fact the firm which involve in the money laundering thus the funds obtained from proceed of crime of illegal fishing ; their strategy is to avoid detection by choosing financial channels with minimal oversight thus absence of strong money (B_{PSTM}).

The firm expected utility can be written as follow,

$$FEU_{IFF} = \sum (1 - B_{PSTM} \times R_{PF}) \times \text{illegal financial flow} - P)$$

Thus, FEU; final expected utility of illegal fishing firm & P refer for the penalties imposed by regulator. The final expected utility can be reduced by strengthen the key attributes of all player involved, such as transaction monitory effectiveness (TME), relevant data sharing between the bank and regulator (RDS), trend algorithm for detection probabilities of activities (ADP) and strong prosecution of regulatory body and imposing of penalties (P).The bank effective produces also reduces the flow the illegal activities and proceeds of crimes (KYC).

Conclusion

Application of game theory to illegal fishing evidences that the main role of financial institutions involves a combination of cooperation between financial institutions, regulatory bodies, and enforcement agencies. The probability of detecting and disrupting illegal fishing activities using cooperative strategies, such as information sharing, joint surveillance, and algorithmic tracking of suspect financial flows, will be increased for reducing the illegal flow in financial sector. This mathematical framework makes a point that cooperative and non-cooperative approaches go hand in hand when it comes to developing an appropriate response to combat illegal fishing. Illegal fishing firms will always be developing new ways of evading detection, but the implication is clear that collective actions by banks, regulators, and enforcement agencies can greatly curtail the financial wherewithal that sustains such operations.

A key determinant of success in this fight would be the close collaboration among financial institutions and regulatory agencies to tackle such crimes. Thus, applying game theory as a strategic tool for combating illegal fishing crime and its potential illegal financial flows can be reduced easily.

References

Aceves-Bueno, E., Read, A. J., & Cisneros-Mata, M. A. (2021). Illegal fisheries, environmental crime, and the conservation of marine resources. *Conservation Biology*, 35(4), 1120-1129.

Agnew, J. (2000). From the political economy of regions to regional political economy. *Progress in Human Geography*, 24(1), 101-110.

Bennett, N. J., Alava, J. J., Ferguson, C. E., Blythe, J., Morgera, E., Boyd, D., & Côté, I. M. (2022). Environmental Justice in the Ocean. *Institute for the Oceans and Fisheries, University of British Columbia*, 39.

Carneiro, M., & Martins, R. (2022). Destructive fishing practices and their impact on the marine ecosystem. In *Life Below Water* (pp. 295-304). Cham: Springer International Publishing.

Chen, X., Xu, Q., & Li, L. (2023). Illegal, unreported, and unregulated fishing governance in disputed maritime areas: Reflections on the international legal obligations of states. *Fishes*, 8(1), 36.

Du, Y., Sun, J., & Zhang, G. (2021, October). The impact of overfishing on environmental resources and the evaluation of current policies and future guideline. In *2021 International Conference on Public Relations and Social Sciences (ICPRSS 2021)* (pp. 1120-1124). Atlantis Press.

Elliott, L. (2022). Transnational environmental crime and development. In *The Routledge Handbook of Global Development* (pp. 233-244). Routledge.

Harris, H. (2024). Financing Environmental Crime: Financial Sector Complicity in Global Deforestation and Opportunities for Regulatory Intervention. In *Financial Crime and the Law: Identifying and Mitigating Risks* (pp. 43-69). Cham: Springer Nature Switzerland.

Lindley, J. (2022). Food security amidst crime: harm of illegal fishing and fish fraud on sustainable oceans. In *The Palgrave handbook of climate resilient societies* (pp. 733-751). Cham: Springer International Publishing.

Mniwasa, E. E. (2022). Institutionalizing the fight against money laundering in Tanzania: the potential, limitations and challenges. *Journal of Money Laundering Control*, 25(4), 792-832.

Oberle, C. S., & OBERLE, C. S. (2022). Greening White-Collar Crime: Transforming Anti-Money Laundering Enforcement into an Instrument Against Environmental Crime.

Pauly, D. (2013). Beyond duplicity and ignorance in global fisheries. *WIT Transactions on State-of-the-art in Science and Engineering*, 64.

Rosello, M. (2020). Illegal, unreported and unregulated (IUU) fishing as a maritime security concern. *Global Challenges in Maritime Security: An Introduction*, 33-47.

Sumaila, U. R., & Tai, T. C. (2020). End overfishing and increase the resilience of the ocean to climate change. *Frontiers in Marine Science*, 7, 523.

Sun, Y., Sun, Z., Zhang, Y., & Qiao, Q. (2024). How can governments and fishermen collaborate to participate in a fishing ban for ecological restoration?. *Journal of Environmental Management*, 360, 120958.

Yuliantiningsih, A., Hartiwiningsih, Suherman, A. M., & Latifah, E. (2022). From illegal, unreported and unregulated fishing to transnational organised crime in fishery from an Indonesian perspective. *ASEAN International Law*, 481-502.