



Devising Modern Fintech Solutions to Combat Global IUU Fishing and Protect Marine Ecosystems

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Abstract

Illegal, unreported, and unregulated (IUU) fishing extracts 180 million tons of fish annually, an unsustainable rate that, if continued, could threaten marine ecosystems and the livelihoods of 600 million people globally. Overfishing methods destroy critical habitats, including coral reefs and seagrass beds, and unbalances marine food chains. These consequences have already affected our ecosystem, driving many species such as Chinese Paddlefish to extinction. This paper proposes fintech-driven solutions to combat IUU fishing and promote sustainable marine practices. For example, taking advantage of blockchain, a secure and immutable ledger, fishing activities can be transparently tracked, ensuring compliance with environmental, social, and governance (ESG) standards. To incentivize fishermen and companies to comply with these sustainable practices, fintech platforms can reward compliant fishers with enhanced banking access and public funding. The impacts can provide greater impact in economically challenged coastal communities, where overfishing is frequent. Case studies, such as The Nature Conservancy's Blue Bonds program, demonstrate how financial applications can offer the key in restoring fish stocks and protecting marine biodiversity.

1 . Introduction

Each year, approximately 180 million tons of fish are extracted from the ocean—an unsustainable rate that threatens marine ecosystems, requiring a technological intervention.¹ 180 million tons is the same as 4.5 million fully loaded 18-wheeler trucks, and when placed in a line, is able to encircle the Earth's equator nearly three times. The harvesting at this unsustainable rate negatively affects not only the ocean environment, but also the fishing industry. When these fish stocks deteriorate, it threatens the food source of billions and livelihoods of up to 600 million people globally.² However, the fishing industry often prioritizes profit growth over the long-term health of marine populations.

The ocean comprises the majority of Earth, shrouding 70% of its total surface.³ Some of its many benefits include: seafood, medicines, and biofuels. The ocean also helps with removing waste, acting as a carbon sink, and shields villages and cities from potential damage from storms. However, removing key marine species influences the abundance of available food sources, leading to an overall decrease in the health of the ocean ecosystem.

Overfishing is one of the deadliest threats the ocean is currently facing, jeopardizing the existence of 34% of international fish stocks.⁴ Overfishing refers to extracting fish at a rate that prevents populations from replenishing, disrupting the natural balance of marine ecosystems.

This has led to the decline of numerous key species in the food chain. These figures help regulate the careful balance of the ratio between predator and prey. Humans often disrupt this balance by overharvesting either predators or prey, causing cascading effects across the ecosystem. For example, the overharvesting of cod in the North Atlantic has led to an explosion in small fish and invertebrates.⁵ Though this might seem beneficial, these prey will exact an increased toll on the environment around them as their food and shelter needs increase, which harms other species. For example, algal blooms have increased 13% from 2003 to 2020.⁶ This



is due to the overharvesting of marine algae predators and causing algae to multiply and explode in population. These blooms release toxins harmful to both humans and marine life, deplete oxygen levels, and block sunlight essential for aquatic vegetation. These areas are labeled dead zones, as marine life can no longer survive there.

Only about 150 years ago, the ocean was widely regarded as an inexhaustible resource. In 1883, renowned biologist and scientist Thomas Huxley argued at the International Fisheries Exhibition that certain fish stocks, such as cod, offered an infinite resource of food, stating, 'The cod fishery... and probably all the great sea fisheries, are inexhaustible; that is to say, that nothing we do seriously affects the number of the fish'.⁷ In the present, however, using improved scientific tools and measurements, this perception is false. However, many fishing businesses attempt to push this false narrative to the public, attempting to exchange ocean life for monetary gains. This once-common belief in the ocean's inexhaustibility has been overturned by clear evidence of overfishing and ecosystem degradation.

Modern methods like bottom trawling harm marine ecosystems by indiscriminately harvesting sea life and destroying critical habitats such as coral reefs and seagrass beds. Both of these marine habitats play important roles for a variety of ocean species. Coral is a hotspot for many, as it not only provides housing, but a perfect feeding ground for others. These corals often serve as a rare ideal shelter for many marine species, and accordingly, their survival must be ensured.

Seagrass helps to soak and absorb carbon dioxide, slowing and decreasing the effect of greenhouse gases.

One main cause of overfishing is due to coastal communities. These countries often have underdeveloped economies, forcing many of their citizens to exceed sustainable limits and overharvest. These governments are often powerless to either aid or enforce sustainable limits on their ocean due to a lack of financial resources. In 2021, the Food and Agriculture Organization (FAO) reported that 46% of fish stocks in the Southeast Pacific, a region with many low-income coastal communities such as Peru and Ecuador, were harvested at biologically unsustainable levels.⁸ This is significantly higher than the global average of 34% of overfished stocks, highlighting intense overfishing pressure from small-scale fisheries in these underdeveloped economies reliant on fishing for livelihoods.

This paper argues that blockchain technology, when used with verified industry partners, can track annual fish harvests and curb illegal fishing that undermines regulated, sustainable practices. Furthermore, there is very little incentive for fishers and fishing companies to comply with regulations if they interfere with profits. Fintech companies, or companies that implement online programs and technology to provide financial services, could implement strict environmental, social, and governance (ESG) reporting standards with live tracking technologies to ensure that rules are being followed, with compliance rewarded with enhanced access to the banking system. Fintech companies could administer a financial reward system for companies complying with sustainable development objectives set by the UN, with public funding being doled out to compliant market actors who monitor and log their catches and activities through a blockchain-powered central ledger.

2. Overfishing Drives Species Extinction and Habitat Destruction:

Overfishing and unregulated fishing pose a lethal threat to marine ecosystems, driving species to extinction and jeopardizing the ocean's capacity to sustain life and livelihoods. The Chinese Paddlefish, a species that thrived for 200 million years and survived the dinosaur extinction, was declared extinct by 2022. The species is speculated to have vanished between 2005 and 2010 due to the relentless overfishing and habitat destruction. In the 1970s, humans harvested around 25 tons of this ancient fish annually, a rate that decimated its population.⁹ This tragic loss now serves to highlight the devastating consequences that overfishing can induce, but could have been easily prevented with sustainable fishing practices. According to the Food and Agriculture Organization (FAO), 35% of global fish stocks are overfished, while 57% are fished at their maximum sustainable levels, leaving little room for recovery.¹⁰ Though a large portion of marine life species are being threatened with a risk of extinction, there is still time to prevent the similar fate of the Chinese Paddlefish.

Modern advancements in the fishing industry, while boosting efficiency in seafood harvesting, serve as a double-edged sword, as they intensify the rate of overfishing. Bottom trawling, using a giant heavy net dragged across the seafloor to catch as many fish and crustaceans as possible, paired with sonar, a modern method to scan for fish, is highly efficient at harvesting seafood. Trawling leaves too few fish to repopulate the vast areas it reaps. Though this method can catch more than any other fishing method, it destroys marine habitats, as the trawling nets carve away the seabed, which can rip apart seagrass and coral reefs. These two are essential, as coral reefs provide homes for around 25% of all marine species, while seagrass helps absorb carbon dioxide, slowing the decay rate for harmful gases in the atmosphere.¹¹ In the modern age, fishing methods provide an easy method of sustenance, but in the process damage ocean environments.

Bottom trawling also results in bycatch—the unintended capture and killing of non-target species such as dolphins and sea turtles. These include endangered species, such as dolphins or sea turtles. This common occurrence eventually decimated the dolphin population, forcing companies to produce tuna safe stickers on tuna can stickers, claiming tuna cans are “dolphin-safe”. Bycatch accounts for up to 40% of global catches, highlighting the destructive capabilities bycatch has on the environment.¹²

The fishing industry has extracted fish at levels far exceeding sustainable limits. For example, the Pacific bluefin tuna has declined more than 80% since the 1970s.¹³ As it becomes harder and harder for fishermen to make a living out of these declining species, they take to unreported fishing. Unreported fishing is when fishermen do not report the true number of fish caught, thus ruining any sustainability and ESG regulations and plans to rebuild marine life fish stocks. Weak regulatory enforcement allows for this to happen, as many regions lack the resources necessary to enforce these regulations. It is now estimated that one-fifth of all wild-caught fish are caught illegally.

In coastal regions like West Africa, dire economic conditions force local communities to overfish to secure enough income to feed their families. Fishing is a primary livelihood for many in these developing areas, yet poverty and limited economic opportunities push villagers to exploit marine wildlife beyond sustainable limits. In West Africa, an estimated 40% of fish caught are from illegal, unreported, or unregulated fishing, making it the largest source of such catches

globally.¹⁴ Coastal communities often are a major source of overfishing due to economic pressures, and should be considered when providing a technological solution.

3. United Nations High Seas Treaty to Protect Marine Biodiversity:

The critical potential threats that overfishing can pose has even attracted the attention of the United Nations, leading to the creation of Goal 14: to conserve and sustainably use oceans, seas, and marine resources for sustainable development. To address this, the UN, after 35 hours of intense debate, signed the High Seas Treaty, formally known as the Biodiversity Beyond National Jurisdiction (BBNJ) Agreement, on September 20, 2023. This treaty aims to protect 30% of global waters by 2030. They aim to do so by establishing marine protected areas (MPAs) in international waters, enforcing stricter environmental impact assessments for fishing activities, and sharing marine genetic resources.¹⁵ Through global cooperation, with many nations implementing monitoring systems, enforcing regulations, and investing in sustainable fisheries management to curb overfishing and habitat destruction, these goals can be achieved. The treaty's focus on protecting critical habitats like coral reefs is vital, as overfishing, especially bottom trawling, devastates these ecosystems, which, despite covering less than 1% of Earth's surface, support 25% of marine species, a biodiversity that sustains 500 million people globally. This destruction is projected to cost the US \$500 billion per year by 2100. Ocean habitats must be preserved as they are essential for marine life and serve as a financial asset for various nations.¹⁶

4. Fintech Innovations Foster Sustainable Fishing Practices:

Since the early 2010s, finance and fintech companies have aided in advancing ocean conservation, utilizing technologies to promote sustainable fishing practices and protect marine ecosystems. Fintech companies usually harness technology to deliver financial services like digital payments and investment platforms. Climate fintech companies, a specialized subset, prioritize environmental goals, such as reducing carbon footprints and supporting conservation.

For example, the climate fintechs Aspiration offers green digital banking, climate risk assessments, ESG (Environmental, Social, Governance) reporting, sustainable investment platforms, and blockchain-based systems to track carbon emissions and fishing activities.¹⁷

There is a growing demand from sustainability-conscious consumers and stricter global regulations mandating climate-related compliance, which helps attract significant investments to sustainable solutions. Another example includes The Nature Conservancy's Blue Bonds program, launched to aid economically challenged coastal and island nations, while also enforcing marine conservation. To any country vowing to protect 30% of their ocean areas by 2030, The Nature Conservancy provides a compelling proposition: refinance national debt for countries using credit enhancement and commercial capital to secure lower interest rates and extended repayment terms from investors, public funders, and international organizations. The organization prioritizes sustainable revenue streams, such as coral reef restoration to increase tourism, or improved fisheries management to combat overfishing. Its success is evident, as in Cabo Pulmo National Park, fish stocks surged by 400% a decade after the Blue Bonds intervention. In the Republic of Seychelles, starting in 2016, the program generated \$430,000 annually for conservation, protecting 86 million acres of ocean by 2020.¹⁸ These efforts prove how fintech-driven solutions can guide sustainable fishing and preserve marine biodiversity for future generations.

5. Technology Tracks Sustainable Seafood and Combats Overfishing:

The urgency of ocean conservation has inspired a growing number of companies to contribute to marine protection efforts. One of these companies is the Seafood Watch, implemented by the Monterey Bay Aquarium. This aims to create sustainable food harvesting systems and a healthy ocean environment by using ESG standards, or standards that measure how sustainable a company is. To do this, the Seafood Watch tracks and analyzes aquaculture, salmon fisheries, and fishing businesses to assess their impact on the environment. Within the fishing business, they rate each business, giving a recommendation based on the business's impacts on fish stocks, impacts on other species, management effectiveness, and impacts on habitats and ecosystems. This rating helps customers decide whether to choose or avoid purchasing their goods. The Global Fishing Watch also helps within the fishing industry, utilizing live tracking technologies to make sure fishing businesses or others are abiding by the sustainability laws put in place. Modern technology in the form of satellites and AI is being used to map and track the whole of the ocean. The Global Fishing Watch receives data from the satellites in space and uses AI to analyze the data. The Global Fishing Watch can examine various marine vessels, ranging from oil rigs, gas rigs, mining rigs, aquaculture pens, and even ocean wind farms.¹⁹

The IBM Food Blockchain Tracker addresses a unique challenge by enabling consumers to trace the entire journey of their purchased food, fostering trust through transparency. This blockchain, an immutable and secure ledger, ensures reliable records of a product's origin and production process, building confidence between customers and suppliers. Research indicates that over half of consumers value knowing the source of their food, with many Americans willing to pay up to a third more for sustainably and transparently sourced products, and nearly all expressing greater loyalty to brands offering full transparency.²⁰ By providing verifiable data on fishing practices, this technology supports efforts to combat overfishing, aligning with blockchain-based solutions to enforce sustainable catch limits to protect marine ecosystems.

6. Modern Inventions Aid Oceans:

Modern technologies are offering great opportunities to be utilized as tools, tackling individual problems facing the oceans. For example, blockchains can be used to help organize marine cleanups. Its nature creates a transparent record that cannot be changed. This is due to the network of computers it is based on, making it hard to manipulate that network. Each block contains a record of the transactions, which makes it a secure ledger. Blockchains can also be used as an incentive, offering rewards to individuals and organizations that aid in ocean cleanups. This can provide motivation and compensation for the labor required. One example of a success story using this method is the Plastic Bank Blockchain. The company addresses ocean plastic pollution by incentivizing community collection through blockchain-verified exchanges. They offer digital tokens, a currency on their Plastic Bank app that can be used for increased income, zero-interest loans, education, and social benefits. To get these tokens, members of the community collect plastics and exchange them, which are verified on their blockchain platform.²¹ The potential value of AI in the ocean conservation field is now being recognized.

7. Financial Incentives and Blockchain to Ensure Marine Sustainability:

There is very little surveillance and incentive for fishermen and fishing companies to comply with sustainable ESG regulations if they interfere with profits. To combat this, fintech companies can

implement ESG reporting standards with live tracking technologies to ensure that rules are being followed. Those who comply with the rules will be rewarded with enhanced access to the banking system. This means fintech companies would administer a financial reward system for companies who comply with these sustainable objectives set by the UN, with public funding being doled out to compliant market actors who monitor and log fishing businesses' catches and activities through a blockchain-powered ledger.

Blockchain Vulnerabilities and Mitigations: Though blockchains offer immutable records, the human actors who input the data are easily susceptible to corruption and error. One possible solution introduces weighing stations at ports, checking the weight of fish caught. However, it can be mitigated through transferring illegally caught fish to other boats who do not use ports or weighing stations. Installing low cost Vessel Monitoring Systems (VMS), including GPS trackers, accelerometers, and basic cameras, can deter desires of possible participation in IUU fishing. For example, with vessels above a certain size (>10 meters), it will be required to install such technology with data automatically fed into a blockchain-based ledger. For others in need of affordability, low cost and low maintenance systems can be subsidized by governments, Non-Governmental Organizations (NGO's), or international bodies, and have already been put into use. In Timor-Leste, a solar-powered monitoring system using basic GPS and digital tech was launched in 2019, providing near-real-time data at minimal cost to fishers, with funding from development partners like WorldFish²². This model relies on affordable components and community training, making it scalable for low-income areas. Prototype architectures using long-range, low-power wireless tech networks (LoRaWAN) have been developed to track small vessels at a fraction of traditional VMS costs, being energy-efficient and not requiring constant power, ideal for boats without reliable electricity²³.

AI models would analyze various data, including GPS trajectories, vessel speed, stop-and-go patterns, and power consumption, to predict fishing duration and predicted catches. Upon docking, reported catches, logged using automated scales or AI-estimated volumes, are cross-verified against predicted activity, with significant discrepancies triggering fines proportional to the violation, while compliance unlocks fintech incentives. Since coastal communities may not find the greatest value within enhanced banking access, as loans are not as favorable to them, other benefits could include: access to premium markets for sustainable seafood, and training in aquaculture systems. These would include training in options such as seaweed farms to reduce reliance on overfished stocks, not replacing fishing entirely.

A large portion of our fish today comes from illegal and unregulated fishing. Every time a fisherman violates a sustainable regulation, it brings the species one step closer to extinction. This would affect the livelihoods of 600 million people worldwide. A significant amount of overfishing stems from coastal villages. Many of their citizens depend on fishing not only for their livelihoods, but also for their economy. They can exploit their local fish stocks due to a lack of surveillance from their government, as well as a necessity to provide for themselves financially. To satisfy the needs of those in the fishing industry while simultaneously being able to strictly enforce these ESG regulations, the use of public funding becomes essential in this solution. Organizations such as the UN have various initiatives that focus on aiding and increasing sustainable development, often providing funding. For example, the UN established the Green Climate Fund in 2010, tackling the issue of increasing global temperatures. It has



now grown to aid countries around the world with a total accumulated value of 63 billion USD. The Fund helps developing countries to fight climate change by providing financial aid to various projects that help reduce greenhouse gases.²⁷ Governments can also utilize taxes or even create taxes on environmentally damaging activities, such as illegal fishing or carbon emissions to raise funding as well. Crowdfunding and donations would also be a viable option to raise money. Finally, if this solution does work in increasing the number of fish stocks in these targeted areas, tourism, especially marine tourism, could be the last step in unlocking these funds. By harnessing blockchain-powered fintech solutions to enforce transparent, sustainable fishing practices, we can halt IUU fishing and reverse the devastation to our oceans, securing the livelihoods of millions, and ensuring a thriving ocean for generations to come.

References

1. "The State of Seafood," Seafood Watch, accessed June 14, 2025, <https://www.seafoodwatch.org/seafood-basics/the-state-of-seafood>.
2. "Oceans, Fisheries and Coastal Economies," The World Bank, accessed June 14, 2025, <https://www.worldbank.org/en/topic/oceans-fisheries-and-coastal-economies>.
3. "Where is All of the Earth's Water?," National Oceanic and Atmospheric Administration, accessed June 14, 2025, <https://oceanservice.noaa.gov/facts/oceanwater.html>.
4. "How Many Fisheries Are Overfished?," Sustainable Fisheries UW, accessed June 14, 2025, <https://sustainablefisheries-uw.org/how-many-fisheries-are-overfished/>.
5. Marine Biodiversity Hub. "Overfishing's Silent War on Marine Life: How Ocean Ecosystems Are Collapsing." *Marine Biodiversity Hub*, accessed June 14, 2025. <https://www.marinebiodiversity.ca/overfishings-silent-war-on-marine-life-how-ocean-ecosystems-are-collapsing/>.
6. Francisco Soto, "Large Increase in Harmful Algal Blooms Between 2003 and 2020," *Fish Farming Expert*, March 13, 2023, <https://www.fishfarmingexpert.com/harmful-algal-blooms/large-increase-in-harmful-algal-blooms-between-2003-and-2020/1499184>.
7. Charles Blinderman and David Joyce, eds., "Inaugural Address, Fisheries Exhibition, London (1883)," *The Huxley File*, Clark University, accessed June 14, 2025, <https://mathcs.clarku.edu/huxley/SM5/fish.html>.
8. Food and Agriculture Organization of the United Nations (FAO), "FAO Releases the Most Detailed Global Assessment of Marine Fish Stocks to Date," FAO Newsroom, June 11, 2025, [https://www.fao.org/newsroom/detail/fao-releases-the-most-detailed-global-assessment-of-marine-fish-stocks-to-date/en#:~:text=In%20the%20Southeast%20Pacific%20\(Area.species%20are%20doing%20as%20well](https://www.fao.org/newsroom/detail/fao-releases-the-most-detailed-global-assessment-of-marine-fish-stocks-to-date/en#:~:text=In%20the%20Southeast%20Pacific%20(Area.species%20are%20doing%20as%20well).
9. Lily Katzman, "The Chinese Paddlefish, Which Lived for 200 Million Years, Is Now Extinct," *Smithsonian Magazine*, January 10, 2020, <https://www.smithsonianmag.com/smart-news/chinese-paddlefish-which-lived-200-million-years-now-extinct-180973938/>.
10. Javier Parada and Ana Florina Pirlea, "Ending Overfishing: An Urgent Need to Protect Our Oceans," *World Bank Data Blog*, October 18, 2023, <https://blogs.worldbank.org/en/opendata/ending-overfishing-urgent-need-protect-our-oceans>.
11. Economist Impact, "The Ocean and the Sustainable Development Goals," accessed June 14, 2025, <https://impact.economist.com/ocean/ocean-sustainable-development-goals/>.
12. World Wildlife Fund (WWF), "Forty Percent of Global Fisheries Catch Wasted or Unmanaged," April 15, 2009, <https://www.wwfca.org/en/?162142/Forty-percent-of-global-fisheries-catch-wasted-or-unmanaged---WWF>.
13. World Wildlife Fund (WWF), "Bluefin Tuna," accessed June 14, 2025, <https://www.worldwildlife.org/species/bluefin-tuna>.
14. National Oceanic and Atmospheric Administration (NOAA) Fisheries, "Understanding Illegal, Unreported, and Unregulated Fishing," accessed June 14, 2025, <https://www.fisheries.noaa.gov/insight/understanding-illegal-unreported-and-unregulated-fishing>.
15. High Seas Alliance, "Treaty Negotiations," accessed June 14, 2025, <https://highseasalliance.org/treaty-negotiations/>.



16. International Union for Conservation of Nature (IUCN), "Coral Reefs and Climate Change," accessed June 14, 2025, <https://iucn.org/resources/issues-brief/coral-reefs-and-climate-change>.
17. GreenFi. "Introducing GreenFi." Accessed June 15, 2025.
<https://www.greenfi.com/resources/introducing-greenfi>.
18. The Nature Conservancy, "An Audacious Plan to Save the World's Oceans," last modified July 27, 2023,
<https://www.nature.org/en-us/what-we-do/our-insights/perspectives/an-audacious-plan-to-save-the-worlds-oceans/>.
19. Global Fishing Watch, "Open Ocean Project," accessed June 14, 2025,
<https://globalfishingwatch.org/open-ocean-project/>.
20. IBM, "IBM Food Trust," accessed June 14, 2025,
<https://www.ibm.com/products/supply-chain-intelligence-suite/food-trust>.
21. Plastic Bank, "Plastic Bank | The Global Bottle Deposit Program," accessed June 14, 2025,
<https://plasticbank.com>.
22. WorldFish. "Press Release: Timor-Leste Launches World-First Monitoring System for Small-Scale Fisheries." August 2, 2019.
<https://worldfishcenter.org/press-release/press-release-timor-leste-launches-world-first-monitoring-system-small-scale>.
23. Tasseti, Anna Nora, Alessandro Galdelli, Jacopo Pulcinella, Adriano Mancini, and Luca Bolognini. "Addressing Gaps in Small-Scale Fisheries: A Low-Cost Tracking System." Sensors (Basel, Switzerland) 22, no. 3 (January 22, 2022): 839. <https://doi.org/10.3390/s22030839>.
27. Green Climate Fund, "Homepage," accessed June 14, 2025,
<https://www.greenclimate.fund>.

