Task Force 04
TRADE AND INVESTMENT FOR SUSTAINABLE AND
INCLUSIVE GROWTH

Blockchain for Food Security Restraining Illegal Fishing and Ensuring Sustainability

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Abstract

The lack of transparency in global fish supply chains leads to problems such as illegal fishing and seafood mislabeling. This undermines the sustainability of marine fisheries and erodes consumer trust. Billions of people depend on fish for nutrition and income, and their access to food and livelihoods is compromised by the current fragmented traceability systems. However, blockchain technology offers a comprehensive solution by creating an unchangeable digital record of supply chain transactions. This record is accessible to all participants in real-time across a distributed network. Studies show how blockchain enables transparency and accountability across the supply chain, from fisher to customer. Tracking catch details, certifications, processing, transport and labeling on a distributed ledger addresses traceability gaps. This benefits both supply chain members and customers. Members gain simpler compliance and operations while customers obtain food origin and handling transparency for informed decisions. Increased transparency from blockchain allows stakeholders to build trust from source to sale.

Challenges scaling and options include integrating diverse stakeholders, addressing technical scaling, and establishing legal recognition of digital records. This brief proposes the G20 support coordinated pilots to test applications, develop consensus standards and address barriers collaboratively. Driving interoperability and incentivizing compliance through trade can further promote adoption. With strategic action, blockchain could significantly improve global supply chain visibility, sustainability and trust by 2025 if barriers are overcome through cooperation.

Keywords: Blockchain, Fish, Supply Chains, Sustainability, Transparency, Traceability, Policy, Standards, Trade, Pilots, Technology

Diagnosis of the Issue

Global fish supply chains face significant sustainability and transparency challenges that undermine food security, livelihoods, and ocean health objectives encompassed by the UN Sustainable Development Goals. Illegal, unreported, and unregulated (IUU) fishing costs the global seafood industry as much as $26 billion to $50 billion annually (Oceana 2021). These lost catches represent not just financial losses, but also foregone nutrition for vulnerable coastal communities highly dependent on seafood.

Small-scale fishers comprise over 90% of Asia and Africa's fishing workforce (Mills et al. 2011), sustaining communities for generations. Operating from marginal areas with limited access, they remain vulnerable to economic shocks that can plunge regions into deeper poverty. Securing their sustainable participation in value chains is critical to achieving SDGs 1 and 2 of eradicating hunger and poverty, urgent as nearly 850 million face food insecurity (FAO 2023) impacting vulnerable groups. Achieving SDGs 13, 14 and 15 requires reducing pressures on vital marine ecosystems through accountable practices across all scales. Beyond environmental threats, weaknesses in fragmented global fish supply networks inhibit coordinated management and market access.

Traceability gaps enable 25-30% species substitutions/mislabeling in major importers like the US. This undermines sustainability claims and consumer trust. Such barriers constrain smaller export-reliant developing country producers, increasing vulnerability to trade protectionism conflicting with SDG 10 on inequality. Overcoming information asymmetries is key given fish market size. Coordinating via the G20 trade task force harnesses opportunities to simultaneously drive sustainability across environments, livelihoods and markets through collaborative problem solving like blockchain-based

traceability pilots and standards. This can build trust and resilience across scales transforming scattered fisheries governance.

By crystallizing blockchain into policy and pilots, the T20 task force can leverage the G20's position to drive norm-setting supporting the 2030 Agenda. As the premier global economic forum representing two-thirds of the world's people, G20 coordination of traceability pilots across sectors could seed multilateral collaboration models at scale. Formulating data standards, legal frameworks recognizing blockchain records, and trade incentives would strengthen industry uptake. Multi-partner testing could generate evidence to overcome adoption barriers like performance, energy use and small producer access constraints. Addressing fragmented fisheries governance through a coordinated blockchain lens exemplifies SDG 17 of leveraging trade mechanisms for sustainable development. The task force's convening power could catalyze local to global transformations to future-proof ocean livelihoods dependent on accountable, transparent value chains. Powerful G20 members are well positioned to exert market influence shaping global trade, investment and technology standards aligning with the 2030 Agenda.

The Fish2Fork Research Project

The fish supply chain is a complex network that involves various stakeholders, including fishermen, aquaculture farmers, processors, distributors, retailers, and consumers. In recent years, ensuring transparency, traceability, and sustainability within this supply chain has become a significant concern due to issues such as illegal fishing, mislabeling, fraud, and environmental degradation (Howson 2020). To address these challenges, blockchain technology has emerged as a potential solution. Blockchain is a decentralized digital ledger technology that securely records transactions across multiple computers, ensuring transparency, traceability, and immutability. Numerous studies have highlighted the potential of blockchain in enhancing transparency and traceability, allowing consumers and regulators to verify the origin, quality, and sustainability of fish products. These attributes can effectively combat illegal fishing, prevent mislabeling, and ensure compliance with regulations (Tokkozhina, Martins, and Ferreira 2023).

The implementation of blockchain in fish supply chains can significantly enhance trust and consumer confidence. By providing access to accurate and reliable information about the fish's journey from catch to plate, blockchain empowers consumers to make informed choices and support sustainable fishing practices. Blockchain-based certification systems enable consumers to verify eco-labels and other sustainability claims, thereby fostering trust between producers and consumers (Tolentino-Zondervan, Ngoc, and Roskam 2023).

By capturing data on catch locations, fishing methods, and species, blockchain facilitates the identification of unsustainable practices and supports the implementation of targeted conservation measures. Immutable smart contracts in Blockchain-based can incentivize responsible fishing practices by rewarding fishermen who comply with sustainable fishing standards. Despite its potential, the adoption of blockchain in fish

supply chains faces several challenges. One major obstacle is the integration of diverse stakeholders, each with their own data systems and technological capabilities. Interoperability issues and the standardization of data formats need to be addressed to ensure seamless information sharing. It is important that concerns regarding data privacy, security, and the scalability of blockchain networks must be considered during the implementation process.

Several developed countries, such as Australia, Norway, and the USA, have already implemented blockchain in their fisheries and aquaculture sectors (Tolentino-Zondervan, Ngoc, and Roskam 2023). For instance, IBM has signed a letter of intent to use blockchain technology for companies in the seafood industry, with five of these companies located in Norway. According to the Norwegian Seafood Association, there has been a rapid growth in consumer demand for food products with known origins, and consumers are willing to pay for this information.

In a consumer survey conducted as part of the Fish2Fork project, which received European Economic Area (EEA) grant funding, the main objective was to assess consumer interest in blockchain-based information. The survey was conducted in two countries, Norway and Portugal. In Norway, there was a high level of interest among consumers in having general information about fish products, particularly regarding their origin, and consumers appreciated accurate and correct information, with females showing slightly more interest than males. This information also influenced their purchasing decisions. In Portugal, the results were similar, with no significant impact of factors such as age, gender, or education level on purchasing decisions for products with traceability information availability. However, the interest in knowing the origins of fish products positively influenced further purchasing decisions for such products (Ferreira et al. 2021).

Recommendations informed by Fish2Fork

Based on lessons learned from the Fish2Fork research project, several recommendations have emerged for strategically supporting the adoption of blockchain technology to enhance transparency and sustainability across global fish supply chains.

Pilot blockchain traceability systems

The G20 should encourage the launch of a global blockchain traceability pilot program to test solutions in diverse geographies and fisheries. An inter-agency task force would administer large- scale national pilot initiatives in member states with substantial seafood trade like China, India, Indonesia, Brazil, Japan, the EU and the USA.

Pilots would integrate stakeholders from fishing communities to processors to retailers, tracking a minimum of 10 priority supply chains per member state. Core tracked data should include catch location/depth, gear type, species/volumes, vessel identifiers, catch documentation, change of custody records, inputs/outputs at each stage, cold chain conditions and final certifications/labels.

Additional metrics like bycatch, environmental impacts and crew welfare could also be tested. Pilots should run for two years with ongoing refinement. An applied research program would develop toolkits, train stakeholders and evaluate technical, social and economic feasibility of scaling traceability applications to aid small producers. Regular multi-stakeholder workshops should analyze outcomes to establish baseline key performance indicators covering improved compliance, time/cost savings, resource sustainability, job creation and consumer trust. National agencies would submit comprehensive reports on pilot design, issues identified, solutions tested and ongoing resource needs.

An international advisory board consisting of exporters, fish workers, Indigenous groups and civil society would provide oversight and recommendations. Regular global summits would disseminate project progress, successful models and recommendations to inform future projects. Pilots would help establish reference architectures, technical specifications and traceability templates applicable worldwide.

Develop interoperability standards

The G20 task force should establish a Seafood Traceability Standards Organization (STSO) to facilitate open technical discussions and timely standards development. Governed by an independent multisector board, STSO's initial focus areas should include data schemas, ontologies, exchange protocols, connectivity guidelines, identifiers, security, privacy-protective solutions and certification procedures based on pilot outputs.STSO would work closely with regional fisheries bodies to issue living documents specifying interoperability guidelines through participatory comment periods and testing phases ensuring responsiveness and inclusiveness. A standing technical committee would monitor implementation addressing issues as technologies evolve, harmonizing global traceability interlinkages.

Incentivize sustainable fishing

The G20 could launch a Sustainable Seafood Incentive Facility to pilot results-based finance leveraging blockchain. Fisheries demonstrating strong coordinated management, traceability and environmental performance via digital records may access concessional trade financing, training, and purchase guarantees. Larger trade deals may condition preferential terms on partners upholding digitally verifiable legal/sustainability criteria agreed through stakeholder processes. This strengthens ecosystem-based practice

alignment across policy. An associated mechanism could reward small-scale fishery traceability integration through competitive/matching grants administered by a trust. Digital ID programs may facilitate access to microfinance and insurance. Over time, these incentive frameworks can help transition global seafood governance toward increased sustainability, equity and climate resilience.

Drive multi-stakeholder collaboration

Addressing complex barriers demands cooperation. The G20 should establish Cross-Sectoral Working Groups on traceability co-chaired by government and industry leaders. Working groups would include technical, trade, financial, certifying, producer and community representatives, advocates and organizations. Regular meetings and collaboration platforms would foster trust and understanding between diverse perspectives. Focus areas include benchmarking seafood systems against industrial standards; establishing legal pathways for blockchain records; designing privacy-protective monitoring; incentive structures; and interoperable open-source platforms. Working groups would conduct analyses, reviews and consensus exercises informing strategy. They would regularly report progress to the G20 and make recommendations to accelerate adoption focusing on constraints faced by small producers and women.

Empower consumers with transparency

The G20 could support national education initiatives on sustainable seafood and workers' rights leveraging traceability data. Digital product passports may inform choices via consumer apps, displays or QR codes revealing origins, handling and certifications. Targeted campaigns using open data could spread blockchain benefits, especially among youth and women influencing spending. Digital literacy workshops combining financial

and environmental modules would nurture responsible consumption supporting oceans and communities. Trust funds may reward civic participation through redeeming points for sustainable products or community investments traced via blockchain. Portals should make information universally accessible regardless of connectivity or literacy.

Provide targeted technical assistance

The G20 should launch technical assistance prioritizing small businesses and digitally lagging regions. This includes open-source training, toolkits and capacity building through local traceability cooperatives. Targeted subsidies could test solutions to access evolving technologies despite geographical limitations. Advisors embedded within fishing communities would custom-fit solutions through participatory research. Digital ID and onboarding schemes unlock broader participation. Oversight ensures equitable, inclusive aid distribution and addresses potential harms from digital transitions. Sharing expertise globally strengthens resilience for all stakeholders.

Leverage trade policy levers

The G20 could condition preferential trade terms on traceability compliance. Pilots may exempt sustainably imported seafood validated via interoperable digital ledgers from paperwork, duties or quotas. Over time, as confidence in systems grows, preferential designation or exclusions may require verifiable proof of legality, handling claims extending to partners' fisheries control. Trade policy thus drives uptake of transparency via consistent, rules-based incentives upholding sustainability and human rights. Close stakeholder consultation ensures trade levers recognize limitations and avoid disadvantages to vulnerable producers through technical assistance empowering global traceability integration.

Extension to the Fish2Fork Recommendations

Blockchain could further leverage Fish2Fork through tokenizing seafood assets and decentralized finance apps. Issuing tokens representing fish stock ownership pre-catch gives small producers novel financing options. Smart contracts could automate token trades for fiat on maturity, based on validated harvests. This provides producers liquidity when needed without lengthy loans, leveraging blockchain.

Opening the fractionalized token investment on exchanges will allow ordinary citizens to participate directly in funding sustainable ocean industries for financial returns. Token-gated supply chain data gives investors visibility into operations, incentivizing responsible stewardship that maximizes yields. The immutability of blockchain records also assures token holders their share is securely tracked throughout complex supply network paths. If structured appropriately to minimize risk, tokenization could self-finance the expansion of traceability infrastructure by democratizing investments previously limited only to large intermediaries. It gives financing autonomy back to coastal communities reliant on fisheries for livelihoods and food security. Overall, Fish2Fork's integration of DeFi protocols represents an innovative platform for building a more inclusive, transparent and resilient blue economy.

With high-level political commitment from G20 leaders, the goals of interlinking key fisheries through blockchain could become reality within five years if adequately resourced.

Acceleration adoption scenario

An ambitious five-year action plan has been announced involving $500 million in initial funding for national pilots across member states. Digital infrastructure development   accelerates through public-private partnerships modernizing technologies for integrated traceability system rollouts.

Coordinated pilots launching in 10 fisheries per year help vet optimal technical architectures, governance models and data standards suited to diverse contexts. Annual global conferences enable cross-learning as a vibrant community of practice develops. Reference materials are openly accessible to all.

Within bilateral trade circles like BRICS, US-Canada and Japan-ASEAN, reciprocal traceability integration becomes a condition for preferential market terms by 2025. This spurs a "race to the top" as 90% of internationally traded volumes are validated on interoperable platforms by 2030 to maintain preferential quotas.

Clear standards combined with open-access platforms foster healthy competition as major seafood powers enhance sustainable fishing regulations year-on-year. Investments securing seamless trade bolster food security for all through resilient, equitable blue value chains.

Fragmented growth scenario

Despite proof that blockchain traceability improves governance and markets locally, entrenched geopolitical differences undermine multilateral cooperation.

Without a unified framework, every jurisdiction implements bespoke traceability systems in their image through 2025. Incompatible data formats, identifiers and standards fragment the global exchange of fishing records. Interoperability remains elusive.

Regional integration makes progress yet standards diverge. While data sharing increases within most of the domestic supply chains, exchange across borders remains inhibited. Traders skillfully reroute a small percentage of their catch from weak governance states through the lowest traceability jurisdictions, hampering monitoring. Illegal fishing declines only by a small percentage as compared to major decline with universal integration.

Stalled progress scenario

Initial pilots unexpectedly encounter obstacles like inadequate telecom infrastructure, high equipment costs, or complex community engagement needs. Without a coordinated effort to systematically address cross-border challenges, promising local models fail to flourish. As national initiatives stagnate, protectionist rhetoric grows regarding data sovereignty.

Traceability solutions remain isolated with niche examples benefiting industrial supply chains in partnership with early tech firms. Most small-scale producers will lack access, training or affordable solutions resulting in failure of cross-pollination of learnings, deterring greater participation. The potential for harnessing open platforms blockchain is lost which results in loss in the opportunity to strengthen sustainable management through frictionless participation across traditionally fragmented networks.

Unintended outcomes scenario

Early mover firms prioritize ownership of granular fisheries data captured through proprietary "end-to-end" traceability systems. While improving efficiency, designs focus narrowly on industrial supply chain optimization without regard for community rights frameworks. Detailed records of catch locations, seasonal patterns and processing methods enable extractive data practices. Corporate platforms claim intellectual property over aggregated and anonymized insights derived from Indigenous ecological knowledge systems developed over generations without consent.

Women fish processors in small-scale fisheries find access to markets, financing and industry decision-making conditioned upon usage of exclusive mobile apps and QR-code systems. However, designs disrupt customary leadership structures and resource governance arrangements led by women without stakeholder input.

References

FAO, UN. 2023. "Hunger and food insecurity." Food and Agricultural Organization. https://www.fao.org/hunger/en/.

Ferreira, Joao C, Ana Lucia Martins, Ulpan Tokkozhina, and Berit Irene Helgheim. 2021. "Fish control process and traceability for value creation using blockchain technology." International Conference on Innovations in Bio-Inspired Computing and Applications.

Howson, Peter. 2020. "Building trust and equity in marine conservation and fisheries supply chain management with blockchain." *Marine Policy* 115:103873.

Mills, David J, Lena Westlund, Gertjan de Graaf, Yumiko Kura, Rolf Willman, and Kieran Kelleher. 2011. "Under-reported and undervalued: small-scale fisheries in the developing world." *Small-scale fisheries management: Frameworks and approaches for the developing world* 1.

Oceana. 2021. Transparency and Traceability: Tools to Stop Illegal Fishing.

Tokkozhina, Ulpan, Ana Lucia Martins, and Joao C Ferreira. 2023. "Multi-tier supply chain behavior with Blockchain technology: Evidence from a frozen fish supply chain." *Operations Management Research* 16 (3):1562-1576.

Tolentino-Zondervan, Frazen, Pham Thi Anh Ngoc, and Jamal Luka Roskam. 2023. "Use cases and future prospects of blockchain applications in global fishery and aquaculture value chains." *Aquaculture* 565:739158.

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