

Fishery supply chain traceability by using blockchain

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ABSTRACT

The risk to food safety has increased due to a rise in global food demand. The number of fish consumed has grown over time. Presently, aquaculture farms provide over half of the fish that people eat. Similar to other food goods, fish and fishery products must be traceable in order to either notify consumers about the fish's journey through the value chain or to recall fish lots in the event that there is a health risk to the public. The fishing sector boosts the country's economy and is very susceptible to trade due to its lengthy shipping times, short consumption windows, and seasonal fluctuations in trade volume. The increasing number of research demonstrates how the blockchain era's potential in the food sector is blossoming with application cases across many geographies. Together with smart contracts, blockchain ensures an unchangeable and transparent framework that enables creative business solutions. This article details the analytical stage of a project that intends to provide a platform for combining all the data regarding the fish's origin and every stage of its journey, including high-quality information, until it reaches the end user. A blockchain technology framework for the fishing sector is proposed in this paper. Additionally, this study will look into how blockchain technology can be integrated into the supply chain. In this work, we describe an Ethereum blockchain-based private system that may be used to manage fishing supply chain operations in a secure, confidential, transparent, decentralized, and reliable manner.

INTRODUCTION

The consumption of fish has increased significantly in the last few decades due to population growth and shifting consumer habits. In the human diet, fish has grown in importance as a source of protein. Gephart et al. claim that while fish consumption is rising annually, the seafood sector is likewise evolving. Half of the seafood produced worldwide is currently produced through aquaculture [1]. If non-food applications are taken out of the equation, aquaculture currently accounts for 53% of the consumption of fisheries products [2]. Since the late 1980s, the output of catch fisheries has been rather stagnant; therefore, aquaculture has had to adapt to the changing preferences of consumers. Food safety is now a crucial marketing concern in addition to a public health concern. Customers want to know exactly what they are purchasing or consuming. Governments, like the European Union, are putting out directives that mandate the registration of a product's origin [3], enhancing product traceability and expediting recalls when needed. The benefits of traceability in networks of fish supply are examined by the writers of [4].

The study determines and outlines the benefits that can be quantified, and it concludes that fish supply chains with traceability will:

- When necessary, lower the expenses associated with product recalls and expedite the recall process.
- Lower the risks, expenses, and negative effects of foodborne disease outbreaks, including missed work and medical expenses.
- Enhance the company's image and support preserving

the product's credibility with the market and customers.

In order to identify the information that must be gathered on a common platform to support the traceability of fish and fishery products from the sea or aquaculture farms to the plate, the main goal of this paper is to identify all stakeholders involved and understand the business processes involved in the value chain of fish products (capture and aquaculture). In order to accomplish two major goals, the project's analysis phase is being described in this article. The project's goal is to create a traceability platform.

- To provide the opportunity for end customers to become fully informed about the fish product they are purchasing. The buyer needs to be able to provide information about the fish's origins (where it was raised or captured), its creator or capturer, when it was captured, how it was stored, where it was transported, how it underwent transformation, and other details.
- If a product lot needs to be recalled due to food contamination or another harm to the public's health, to provide the authorities with the information regarding the fish. All fish that are raised or captured at a specific location on a given date, whether they are delivered by a specific vehicle or kept in a specific warehouse, etc., will be listed on the platform.

One of the primary sources of protein in the human diet is fish and fish products. Gephart et al. claim that while fish consumption is rising annually, the seafood sector is likewise evolving (5). Since the late 1980s, fisheries production has been almost stagnant worldwide, meaning that the majority of the increase in fish consumption has been attributed to aquaculture production (5), which currently accounts for half of the world's seafood supply. Simultaneously, buyers are growing pickier and expect to know not just the nutritional worth of the fish they purchase, but also where it comes from and how well it is preserved throughout the supply chain. To do this, it is essential to monitor every action taking place along the whole fish value chain, from aquaculture or capture to supermarket or plate. The origin (wild or aquaculture), as well as the who, what, when, and where of its capture (or raising), transportation, storage, transformation, and other details, must be known. Stated differently, the implementation of traceability is crucial throughout the entire value chain of fisheries. However, fish may go through multiple businesses during the manufacturing or catch process before reaching the final consumer. This implies that a single fish or fish lot may be used in the operations of multiple businesses. Therefore, in order to fully understand the history of the fish, it is imperative that the internal procedures of each organization participating in the value chain be integrated. The merging of these processes has been suggested in (6). In this paper, we propose to use blockchain technology to implement traceability in the fisheries value chain. This is primarily because blockchain technology is ideal for product traceability, allowing all chain activities to be registered in a distributed, transparent, secure, and reliable manner. These days, blockchain is thought to be among the technologies that best satisfies supply chain traceability requirements. (7) Permissioned public blockchains (hybrid blockchains), permissioned private blockchains (closed networks), and permissionless public blockchains are the three categories into which blockchains can be divided (7,8). Here, we make advantage of Ethereum, a public blockchain with no permissions. Many actors in the fishing industry are able to access and change data due to the lack of an open supply chain, which is clearly against accepted legal and ethical standards. The fishing sector is notorious for engaging in illegal, unreported, and unregulated

(IUU) activities include fraud, overfishing, and abuses of human rights [9]. To address this issue, fully traceable and transparent fisheries supply chains are necessary, and blockchain technology can help with that [9]. The scope of effective product traceability systems has increased due to the rising acceptance and popularity of digital technology across a range of industry sectors. Quick Response (QR), RFID, and Near Field Communication (NFC) codes are some of the most used methods for product tracking and tracing. Nevertheless, despite their simplicity of use and ease of implementation, these tools and strategies are ineffectual when dealing with fragmented data [10]. Because blockchain is impervious to tampering, it can add security, traceability, and reliability to any system. While current blockchain-based methods in the fishing sector preserve product information continuity in the pre- and post-processing phases, they are unable to track fish data when the fish undergo morphological changes throughout the fish processing phase. Additionally, these methods track and record product movement data using techniques based on RFID and QR codes. While combining blockchain technology with Internet of Things devices guarantees improved data management and integrity, it is unable to effectively manage the supply chain's traceability for aquaculture [11]-[12]. The absence of RFID tags and QR codes during fish processing could lead to supply chain gaps that could facilitate counterfeiting and species adulteration [13], [14]. Therefore, by substituting high-value species for low-value ones, con artists can take advantage of this opening to perpetrate food fraud. Therefore, once a fish species' skin is removed, fraudsters can easily alter the fish goods [15]. A programmable blockchain technology like Ethereum can be utilized to handle the conceivable difficulties and enhance the current fish tracing techniques. These apps can be run by users in the Ethereum Virtual Machine. Smart contracts are often protocols that enable the verification and execution of traceable and irreversible transactions without the need for a third party's involvement [16]. In this work, we present a blockchain-based fish traceability solution that can manage Ethereum smart contract operations in a decentralized, transparent, private, safe, and trustworthy manner for both wild-caught fish and farmed fisheries supply chains. An overview of the global fisheries supply chain mechanism that is being adopted is shown in Figure 1.

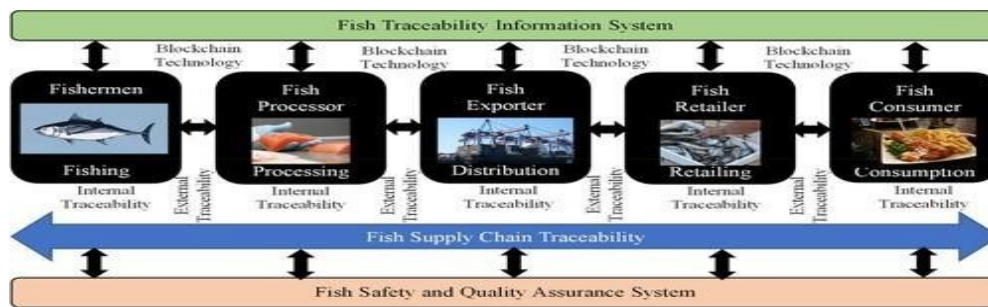


Fig. 1. Conceptual framework of fishery supply chain process

The worldwide fishing industry of today face a number of difficulties along their supply chains. Fish capture, overfishing, habitat degradation of important species, shifting global fuel prices, climate change, and so forth are some of the common challenges [17]. Fish harvesting and its supply chain must be closely monitored and managed in order to preserve sustainability in the fishing sector [18]. This technology could help the fishing industry by boosting supply-chain transparency, which could help prevent illicit activities, enhance operational effectiveness, enhance supply-chain coordination, enhance sustainability performance, and recognize market trends [19, 20].

The main contributions of this paper are as follows:

- To manage the operations of the fishing supply chain in a decentralized, traceable, responsible, transparent, private, secure, and reliable manner, we suggest a private Ethereum blockchain solution.
- We outline the system architecture used in the procedures of the fishing supply chain.
- We propose the use of smart contracts to operate and

validate the processes in the fisheries supply chain.

- We highlight the uniqueness and efficacy of our solution and provide the security analysis to demonstrate its safety and reliability.

This is how the remainder of the paper is structured. Related work is included in Section II. The proposed blockchain-based system is discussed with all system members in Section III including conceptual framework, model description and proposed smart contract implementation. In Section IV presents the result and discussion with the Details of the suggested solution's generalization aspect, comparative analysis, and security concerns. In Section V, we offer our closing observations.

I. Related Work

In order to prevent potential risks to public health posed by food products, authorities such as the European Union adopt regulations requiring the registration and control of the origin of specific items, improving product traceability, and permitting faster recalls, when necessary. As a result, numerous initiatives to introduce traceability throughout food value chains—including those involving fish products—have been undertaken. Next, we bring emphasis to the fish and fish product traceability platforms.

i) Fish Traceability platforms

The authors of (21) provide a method for tracing fish and fisheries products that they term TraSiPesc. The system's designers identified the factors—such as end users and consumers—that impact the fish and fishery products business sector's acceptance of traceability and took into account the general principles of traceability, the national legal framework, the European Union (EU), and the unique characteristics of the fishery industry. Yan et al. (22) suggests a platform for the aquatic foods supply chain that facilitates the traceability of aquatic product supply chains from production to sales, including distribution. This portal contains production-related data, such as water quality monitoring. The traceable platform's system-level and network structure aspects, as well as its general structure, are presented by the authors. The method is used using tilapia products in a case study conducted in China. A platform is proposed in (23), which aims to trace aquaculture products from the farm to the consumer. Web services, the foundation of the platform's implementation, are ready to accept data collected by RFID systems. Data gathered via Wireless Sensor Networks (WSN) technology is combined with this data. The benefits of introducing the developed platform are also analyzed in the study, with a focus on predetermined goals and KPI evaluation. The authors of (24) suggest a monitoring tool's structural layout to enhance the supply chain traceability for Romanian fisheries. The instrument is meant to keep an eye on the quality and safety of fish and fisheries products. A general plan for the traceability system is presented in the article. The writers of [25] examined the methods and strategies that seafood supply chain businesses now use. The location of fish species, production techniques, and other factors that are necessary to trace the origins of food fraud were identified in this study. The fishery supply chain lacks a trustworthy, dependable, and impenetrable data management system due to the shortcomings of all the previously described methods. Decentralized and distributed technologies, such as blockchain, can therefore help to resolve the problems. Examples of pertinent blockchain-based technologies for creating supply chain traceability in the fishing sector are given in the next section.

Blockchain based fishery traceability

Each stakeholder in a supply chain should be aware of the present status of the product flow; blockchain technology can assist in developing a platform that makes this data visible to all authorized parties. Additionally, since data transacted in the blockchain system is irreversibly stored in the ledger and cannot be altered, all parties involved in the fishery supply chain are held responsible for the information they provide during business transactions and are unable to retract their actions. Strong points of blockchain, according to Ruoti et al., include provenance tracing, shared governance and operations, resistance to data loss, and auditability (Ruoti et al., 2019). The fisheries value chain greatly depends on these points. Value creators do not have blind faith in one another, but they do desire to be a part of a system. Blockchain technology allows them to share operations and governance. The operators' agreement over the actions that the system will carry out is known as the consensus protocol. Additionally, each node—that is, each value chain operator—stores and replicates the data. That is, resistance to data loss. Conversely, a new block containing the transaction's details, including the timestamp, is added to the blockchain once a transaction is completed. The blockchain can be audited because this new block has been approved by the consensus process that has been approved by the value chain operators. As demonstrated by authors (26), (27) and others, a number of them chose to apply traceability in value chains through the use of blockchain technology.

Traceability is implemented in the tilapia supply chain by Abderahman Rejeb in Ghana, from producers to the ultimate consumers (27). In Ghana, tilapia is among the most popular fish species to eat. The author implemented fish aquaculture traceability using blockchain technology (27). A blockchain-based approach to implementing traceability in agri-food supply chains is presented by Caro et al. The authors compared and assessed the latency, CPU, and network consumption of the two blockchain implementations—Ethereum and Hyperledger Sawtooth—that they presented (26). The authors of (28) are tracking and calculating the carbon impact of businesses and items using blockchain technology. The authors are implementing a platform in the Ethereum permissionless public blockchain through the use of a Solidity smart contract. The article also describes a distributed application that gives customers access to blockchain-stored data on a company's or product's carbon footprint. In his discussion of blockchain's potential to boost customer trust in the fish value chain, Peter Howson provides an example of how the technology may be used to protect marine life (29). Researchers in [28] looked into how blockchain might be used to control the fish supply chain. The authors claim that combining NFC, RFID, and QR code approaches could aid in overcoming traceability issues. Nevertheless, these methods fall short of presenting a prototype and concentrate solely on the seafood supply chains rather than farmed fish. Adding state-of-the-art technologies can improve traceability even more. However, the seafood supply chain is not new to blockchain technology or the Internet of Things. In a review paper published in [30], researchers emphasized the advantages of implementing IoT in conjunction with Blockchain technology. This study also examines how blockchain technology might be used by IoT devices to store data for improved traceability management. The authors of [31] suggested a blockchain-based solution as part of the implementation, which would lessen the scalability issues related to blockchain-based techniques for the fishing supply chain. Hash functions are used to generate hash values, which are subsequently used to log data transactions in the blockchain. This method tracks and monitors events and environmental data using public and private Ethereum blockchain platforms with IoT devices. Nevertheless, the security and vulnerability elements of implementing blockchain in the fishing supply chain have not been covered by these approaches.

Traceability of fishery by blockchain: technical perspective Conceptual structure of a fish traceability system

There is currently no widely recognized conceptual framework or philosophy that supports the establishment and application of food supply chain traceability (32). Moreover, there are insufficient scientific investigations about the use of blockchain technology in supply networks generally and in the context of fish supply chains. (33) put up a cogent theoretical framework to enhance comprehension and facilitate the efficient application of food traceability systems. Four unified concepts comprised this framework: accessibility, data integration, data recording, and identification. outlines future directions for research on food supply chain digitization and offers a paradigm for supply chain integration in urban food systems, highlighting the use of digital technologies for interventions in (33-34). (35) provide a conceptual framework based on a public-private hybrid blockchain to handle the issues of certification, traceability, and transparency related to the export of prawns from Bangladesh. This study used a practical approach to propose a framework that aids in understanding the boundary conditions of supply chain blockchain technology, building on the frameworks that have been published. The framework primarily outlines the application of blockchain technology to fish traceability.

i) Blockchain based fishery traceability model

The model, which represents the current supply chain's growth and incorporates data for every entity, is an investment in the creation of traceability systems. Employing blockchain technology provides entities with security, transparency, and easy access. A conceptual representation of the blockchain supply chain for products originating from fisheries illustrates how every user of the system communicates with the blockchain network. Fishing has long been a source of food and a means of livelihood for a large number of people globally. As a solution to this technological

problem, we propose utilizing blockchain technology to encourage transparency in the fishing industry. Blockchain technology may be able to help with the traceability of sustainable fishing. Sustainable fishery management requires traceability. It is more difficult for authorities to track down the source of fish products in the absence of it, which may encourage unethical activities like illicit fishing and mislabeled goods. Stakeholders can effectively track and record the journey of fish products from the point of capture to the point of sale thanks to blockchain technology. The traceability platform's smart contract needs to be registered and deliver traceability data, such that the platform must provide the history of the entire product in addition to its current location or locations, taking into account the context of the lot number's

identity, and include all activities and events that have occurred. Since it is the owner's duty to gather and maintain information about the operation that they are carrying out, every participant takes part in the blockchain (represented by an owner entity) (such as processing, distributing, etc.) A notional blockchain supply chain model (Fig. 2) illustrating the interactions between each system member and the blockchain network is provided for items originating from fisheries. It ensures appropriate coordination among the many stakeholders and tracks every step a food lot takes from its point of origin to its destination—the consumer—in order to identify the essential tracking and tracing for each stage of the fishing supply chain.

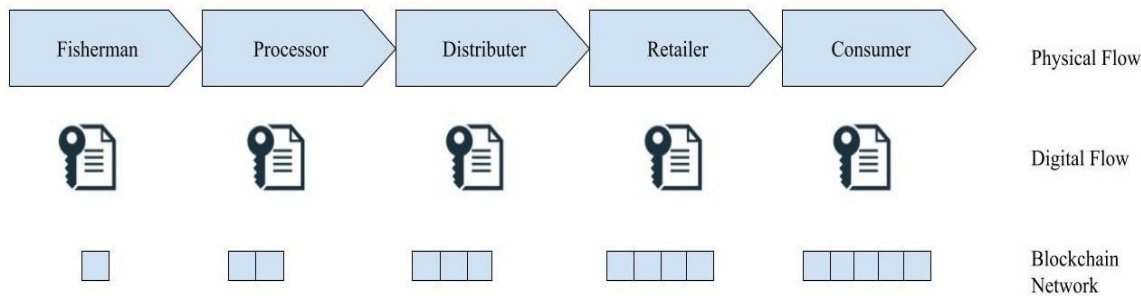


Fig.2. A blockchain-based information system processes the data from fishery products to consumers supply chain

The following roles are carried out by above mentioned entities in figure.,

Fisherman - This is where Processor will get fish lots to make further processing.

Processor - This person should adhere to a few rules.

Distributer - The fish lots are distributed to shops here.

Retailer - A typical consumer purchases from the retailer.

ii) Blockchain's technical characteristics that enable the tracking of fish from the source to the consumer

Fish tracking from the source to the customer can be supported by a number of technical characteristics found in blockchain technology. The technological features of blockchain that can be applied to seafood traceability include smart contracts, distributed consensus, transaction verification, a platform for smart contracts, value transfer between peers, security, immutability, and uniqueness. Smart contracts, or application logic, on blockchains should record traceability data in a conforming standard like GDST (29). A local or global ledger for traceable resource units (TRUs) that has distinct IDs and details on the changes the fish product experiences enroute from bait to

plate can also be found within smart contracts, which enable asset tokenization and data and metadata storage, are two of the most widely used blockchain features. On a blockchain, smart contracts are computer programs that can be executed. Their code and status are comprised of these agreements or programs. For instance, an Ethereum blockchain smart contract is a particular kind of account that has a balance and the capacity to transmit transactions via the blockchain network. These smart contracts can communicate with user wallets or accounts. Smart contracts are the core elements of decentralized ledger traceability solutions. Decentralized data storage of crucial data pieces related to a fish catch, for example, can be built using smart contracts that limit access to specified personnel and save the status of the fish caught in a contract.

iii) Blockchain-based fish traceability System: Smart Contract Implementation

The traceability platform's central smart contract needs to be registered and provide traceability data. The platform must supply the lot's current location (or locations), as well as its whole history, in order to provide a fish lot number. A solidity smart contract consists of the declaration of the pertinent input and a collection of functions, such as a constructor. This code can be found on the Ethereum blockchain at a particular address. The smart contract serves as the cornerstone of the entire application. It outlines the necessary data structures and support functions.

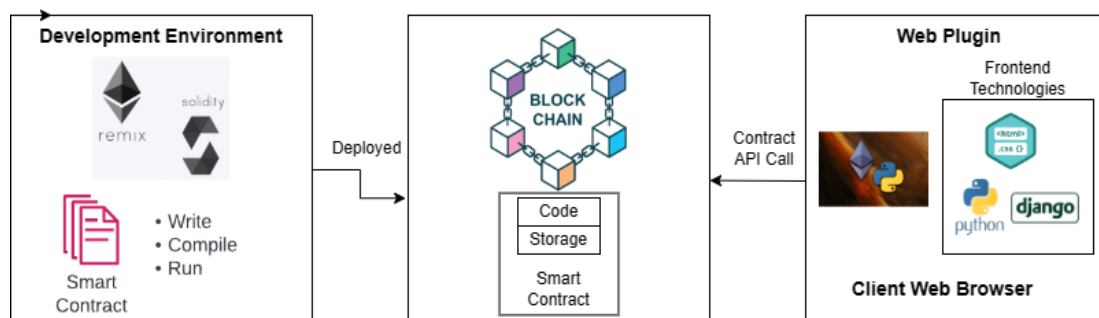


Fig.3. Architecture of traceability in fishery supply chain

The suggested supply chain traceability flow is depicted in Fig. 3. Solidity is used to write the smart contract, which is then compiled, moved, and deployed on the Ganache blockchain network using Remix IDE. The frontend communicates with the blockchain network and smart contract via Web3.py, HTML-CSS, and the Django framework, as well as through remixing. The

Ganache Network is connected to the Ethereum IDE, enabling transactions between all supply chain components.

The proposed smart contract will function as follows:

The smart contract's owner will be the one to implement it; only he has the power to approve various roles, like manufacturer, retailer, etc. Roles such as fisherman are compatible with smart

contracts; here, the processor will obtain fishlot details for additional processing. Distributor: This person transports the fishlot to stores; they are subject to several rules. & Retailer: Regular customers make purchases from a provider. We shall keep an eye on every fishlot the owner requests with the use of this. The blockchain will be used by smart contracts to store fishlot data. Additionally, the contract will save all the data about fishermen, processors, distributors, and retailers on the blockchain and verify that the data is still available there. Smart contracts with geotagged picture fields, which provide the precise

location and additional image details of a product lot, increase confidence and transparency. The owner has the ability to upload new fishlots to the blockchain and modify any role that is included in the contract. It is possible to add (save) and read data from the blockchain by implementing the `addFisherman()`, `addProcessor()`, `addDistributor()`, and `addRetailer()` functions. Taking everything into consideration, this smart contract offers a means of monitoring a fishery product's journey through the supply chain while maintaining transparency and responsibility.

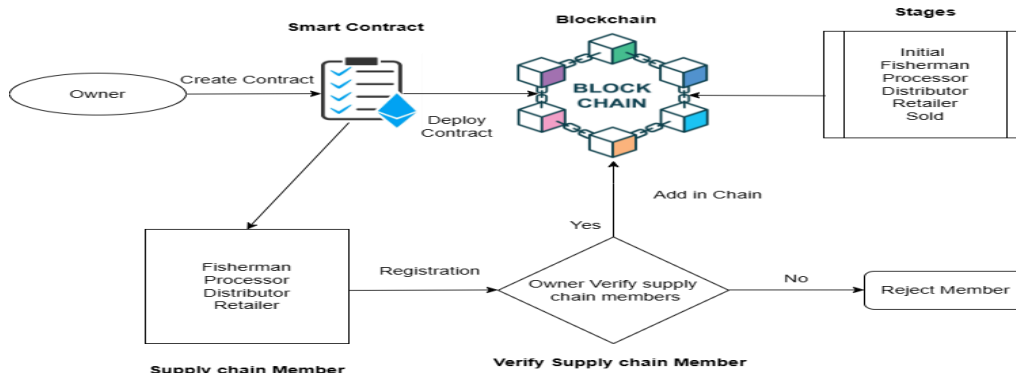


Fig.4. Workflow of smart contract for based on the blockchain supply chain traceability for fisheries.

All immutable objects created by the contract's activities and stored in the designated storage variables are stored on the blockchain. This suggests that the system is extremely robust and makes use of the blockchain's advantages (segregation, consistency, security, and transparency). A contract that has previously been published cannot be changed, unless it is republished. Every entity depicted the domain model is put into practice by the contract as a "struct" with the necessary characteristics

(<https://github.com/MadhuriJadhav1234/BlockProject.git>).

Every type of event, including processing, distribution, selling, etc., needs a Fishlot ID in order to accomplish this. The event mappings consist of an event mapping that links the Fishlot ID to the corresponding structure for each sort of event, as well as an event mapping that lets the Fish lot ID be used to identify the kind of event. The function that makes it possible to see the stage of each occurrence is shown. The blockchain stores and prevents modification of any object created using the contract's functionalities and kept in the designated storage variables.

II. Result and Discussion: -

The outcome and discussion section centers on the outcome in the form of We propose a security analysis of our solution that provides total product traceability from the point of lot packaging to the point of delivery to the ultimate customer with the same lot number. In addition, we investigate the generalization problem and contrast our solution with the ones that already exist.

Result

On a decentralized, transparent, and secure platform made available by the program, each party involved in the fishing supply chain could record and keep track of all the data needed for each step in the chain. The application was designed to be user-friendly and easily accessible. The data used by the program could not be altered or deleted after they were saved on the blockchain since they were immutable. This ensured the legitimacy and integrity of the data; this is required to guarantee the food products' quality and safety. Taking everything into account, the practical application of the created application demonstrates how to use Blockchain technology to enhance and protect food supply chain analytics. Hence, by providing a decentralized, safe, and transparent platform, blockchain technology can raise consumer confidence in the food industry and enhance the safety and quality of food products. Traceability was previously achieved by researchers using a laborious, inefficient, and prone to error process. Because of this, there was a dearth of transparency, which made it difficult to pinpoint the exact reason for a problem in the case of a recall. Because they had to rely on the goodwill of middlemen, the producer also ran the risk of the items or their documentation being tampered with. On the other hand, the Ethereum network application that was created allowed the producer to efficiently and safely follow the fishlot's course from production to consumption. Lastly, the new traceability application has also improved customer satisfaction (Fig. 5). When customers can access thorough information about the origin, stages, and quality of the fish lot at the time of purchase, their faith (Fig.6) in the product and the producer is increased.

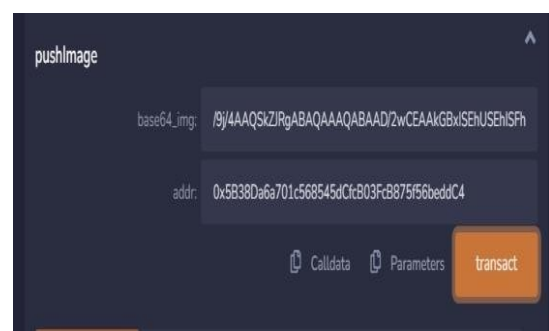
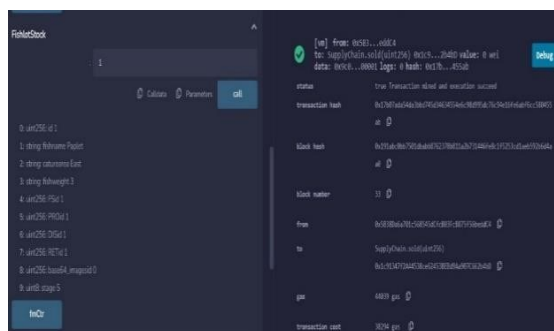


Fig.5. Result of the affected chain from the fishery **Fig.6.** Importing geotag image for consumer traceability system trust.

DISCUSSION

A. Security analysis: - Better security, robustness, and strength are provided by our solution. The key components and the

specifics of our suggestion are delineated below.

- **Data Integrity:** Data integrity is seriously compromised by data exploitation. The blockchain employs transaction

immutability and cryptography to protect data integrity.

- **Availability:** The distributed nature of blockchain technology is what has made it so popular. Every stakeholder in a decentralized system has access to the same data. Because of the Ethereum blockchain's basis for the system, there is virtually no chance of denial-of-service assaults.

- **Accountability:** Every participant's actions are identifiable and cannot be refuted, utilizing blockchain technology. Verifies the legitimacy of each transaction initiated by the participants in this agreement.

- **Vulnerability study of smart contracts:** Defective and vulnerable smart contracts may affect the blockchain system. In order to make sure the smart contract codes are secure, we have used the Oyente and SmartCheck tools to do a security study on them.

B. Comparative Study

Our approach, in contrast to the previously mentioned research, is integrated; it integrates fishing supply networks with a working prototype solution. The report also recommends using blockchain

technology and smart contracts to enhance the fishing supply chain's operations. We created and tested our suggested framework using Remix IDE, and We accomplished the required research to validate our solution's viability and its roles in the fisheries supply chain, bringing the system into compliance with other industries. Our technology enables the application of the fish industry's present product traceability management system on many blockchain platforms, thereby optimizing its current features. Our technology can therefore be used by the fish industry as a first step towards bettering its present procedures.

C. Generalization

Proposed Ethereum platform system is designed, tested, and validated to satisfy the security, traceability, and transparency needs of the fisheries supply chain. Also proposed approach offers a secure and practical way to document since blockchain systems can efficiently encrypt data (Fig.7) business dealings. The proposed method may potentially be used by several industries that deal with product traceability, including the pharmaceutical, automotive, and logistics sectors. All the elements and activities of the suggested fishing supply chain can be effectively tracked and traced thanks to the suggested methodology.

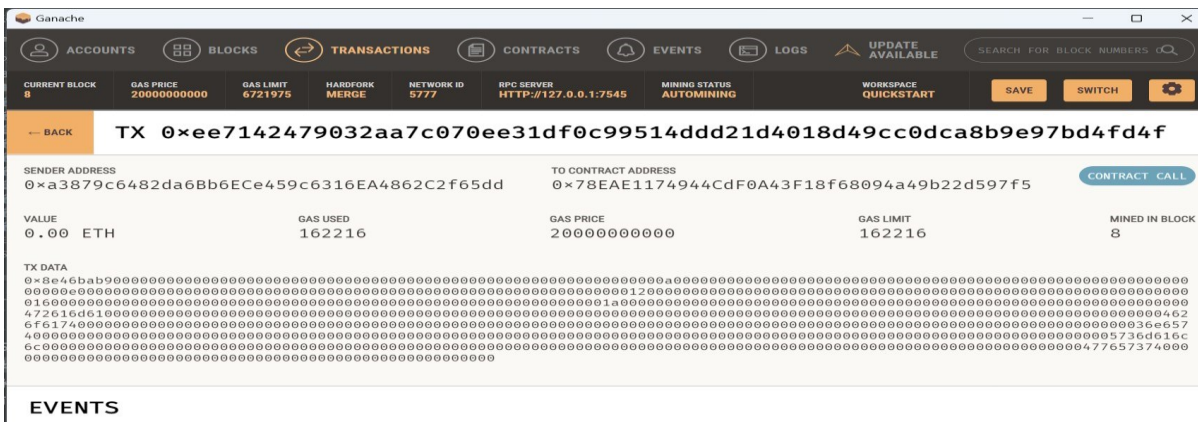


Fig.7. Blockchain platforms for recorded transactions, as they are effective at encrypting data.

CONCLUSION

The proposed blockchain-based approach to monitor and trace fish product lots in the fishing supply chain is transparent, accountable, secure, protected, and dependable. Suggested method of action guarantees candid communication between stakeholders, averting fish fraud and malpractice of all kinds. The workflow of a smart contract for traceability in the fishery supply chain using blockchain, including implementation procedures, testing, and validation features, has been established to identify events and automate activities in the supply chain for fishing. The solution's appropriate resilience against security threats and attacks must be demonstrated in the security analysis document. Give the fish supply chain access to a decentralised traceability system in your paper so they can monitor the traceability chain and get aggregated data about fisheries goods. The suggested approach's distinctiveness, effectiveness, and generalisability to cover a variety of supply chain functions are demonstrated by comparing it to existing blockchain and non-blockchain-based alternatives. In the future, plan to install and test our solution on the actual Ethereum network in addition to developing DApps for other stakeholders. In the fishing industry, a proposed platform for supply chain management traceability refers to the ability to track and monitor the movement of goods and services at every stage of the process. It involves employing state-of-the-art technology to track and record the transit of items from the supplier to the client.

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