Blockchain Model in Industrial Pangasius Farming

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Abstract. Today, the problem of counterfeit goods, counterfeit goods, circulating goods, they have no origin, products such as seafood containing banned substances, toxic substances are negatively affecting consumers' health, the solution of the traceability of manufactured products acts as an essential quality management tool to ensure the safety of providing complete information for products. However, current solutions data is stored centrally on a group of servers, this information can be edited and deleted by the administrator and by hackers; leading to low reliability of the data. In this article, we propose a blockchain model in industrial pangasius farming, one of the current solutions is to switch to a distributed model, data will be distributed to different physical servers, they are not data can be added, removed, edited or deleted without the consent of the parties involved. The proposed solution focuses on controlling all interactions and transactions between all involved participants in the production process, all transactions are recorded and stored in the ledger (immutability) of the blockchain. The experimental results are the transactions, all transactions are recorded and stored in the ledger of the blockchain. In addition, the data can be retrieved as needed.

Keywords: Blockchain · Pangasius · Traceability · Smart Contracts · Supply Chain

1 Introduction

Pangasius in particular is a food that plays an important role in providing nutrition for the people in the world. However, the food hygiene and safety have caused businesses to suffer heavy financial and reputational losses. The main cause of the above situation is that the production stage is not satisfactory, the hatchery cannot trace the origin of the seed, such as: where did the broodfish come from? what year did the fish spawn? Where is the place to supply the food? how is it processed? how is it tranported?. Besides, the demand for safe and quality food is increasingly important. The market mixes the safe

C. V. Phan and T. D. Nguyen (Eds.): ICCASA 2022, LNICST 475, pp. 33–44, 2023.
https://doi.org/10.1007/978-3-031-28816-6_3

and unsafe foods, the clean and dirty foods, the real and fake foods. The consumers need information to check and to use food safely, to improve health, and to reduce disease.

In recent years, the traceability of the products, the fish foods, the seafoods has received much attention in the scientific research community in the country and on the world. Aly Farag El Sheikha et al. [1] presented a study on Traceability as a Key to Fisheries Safety using the DGGE PCR technique. However, this technique cannot clearly trace the history of fish and other aquatic products. Iñigo Cuiñas et al. [2] presented an RFID-based Traceability study. Ganjar Alfian et al. [3] presented the studies to improve the efficiency of RFID-based Traceability System, data is stored centrally in one or a group of servers. Thus, due to the centralized nature, and it dependents on people, so the current solutions have very low reliability and transparency.

One of the solutions today is to switch to a distributed model. Data will be distributed to different physical servers, it is not possible to add, edit or delete data without the consent of the participants. Essentially, a blockchain is an immutable and decentralized [11], the ledger is shared public to allow the participants, who can track the transactions. Each block is hashed and they are linked to the next block, which becomes a secure chain of immutable and tamper-proof records. In this article, we propose a blockchain model in industrial pangasius farming. The proposed solution focuses on controlling all interactions and transactions between all involved participants in the production process. All transactions are recorded and stored in the blockchain's immutable ledger. The purpose of this study is that it has contributed to the development of a supply chain [12] to ensure the safety, quality of the product and the reliability of the users.

The article layout is divided into six parts: Sect. 1 introduces the basics of traceability and proposes a blockchain model in industrial pangasius farming, Sect. 2 presents the blockchain concept and analyzes transactions in the block. Section 3 describes how to connect to Ethereum, Sect. 4 presents the process of raising pangasius on the farm and a blockchain-based pangasius farming model, Sect. 5 presents experimental results, and finally the conclusion, it presents a summary of the results obtained.

2 Blockchain and Transactions

2.1 Blockchain

Blockchain is a database system that allows the storage and transmission of blocks of information. They are linked together by encryption. Basically, each block contains the following key information: Data (The data in each block depends on the type of blockchain); Hash (to identify a block and the data in it). The hash is unique, any change in the block will change the hash; The matching hash (which is the hash of the previous block) will form the chain. With any change, one block will cause the next blocks to not fit and some other additional information like Index, Nonce, Timestamp.

Hashing alone is not enough to prevent tampering [4], as hashes can be quickly computed by computers. The Proof-of-Work (PoW) algorithm controls the difficulty of generating a new block. For blockchains like BitCoin or Ethereum, blocks are created (mined) by people called miners. When a new block must be generated, a computational difficulty is sent to the network. Miners will generate new blocks and be rewarded with cryptocurrency.

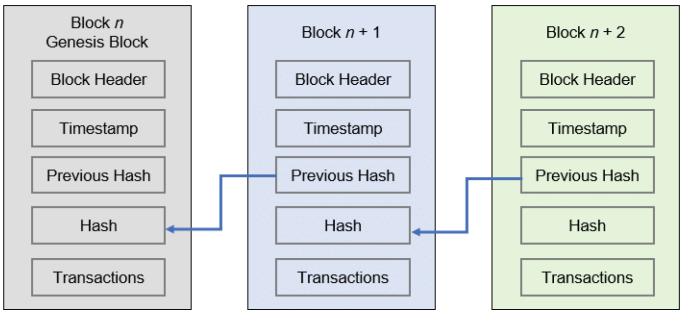

Fig. 1. Illustrated diagram of a chain of blocks linked together to form a blockchain.

In Fig. 1 illustrated a blockchain consisting of 3 blocks: block *n*, block $n + 1$, bolck $n + 2$ linked together to form a chain of blocks. The hash of block *n* is the previous hash of block $n + 1$, the hash of block $n + 1$ is the previous hash of block $n + 2$, the hash of block $n + 2$ continues to be the hash of the next block.

2.2 Transaction in Block

A transaction [5] represents an interaction between the parties. With cryptocurrencies, a transaction represents the transfer of coins between Blockchain users. For a business environment, a transaction can be a way of recording activities that occur on a digital or physical asset (Fig. 2).

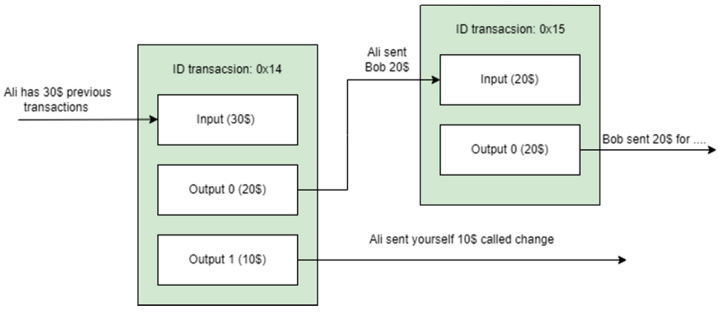

Fig. 2. Illustrated example of cryptocurrency trading.

Each block in the Blockchain may contain no transactions or it may contain multiple transactions. A user submits information to the Blockchain network. The information sent may include the person's address, the sender's public key, digital signatures, and transaction inputs and outputs.

The internal transaction [6] is the result of the smart contract [7, 13], the transaction is transmitted from the EOA to the smart contract. Smart contracts are one of the most important aspects of the Ethereum blockchain. They are digital contracts, it does business automation. In addition, Ethereum smart contracts are programs, they are

installed on the blockchain to manage Ether balance [14], and transactions. Smart contracts are open to the public on the blockchain. Smart contract transactions are tracked and sent through externally owned accounts (known as EOA). These transactions appear as internal transactions in the transaction history ETH and they are not displayed.

3 Connecting to the Ethereum Network

3.1 Local Node

To run a local node, we need to install Geth [8]. With Geth on the computer, it synchronizes with the network. The local node requires a machine with strong configuration, large storage capacity, takes a lot of time to create a local node. Use the Json RPC method to interact with the Ethereum network. By default, the Ethereum package will connect to port 8545 on localhost (Fig. 3).

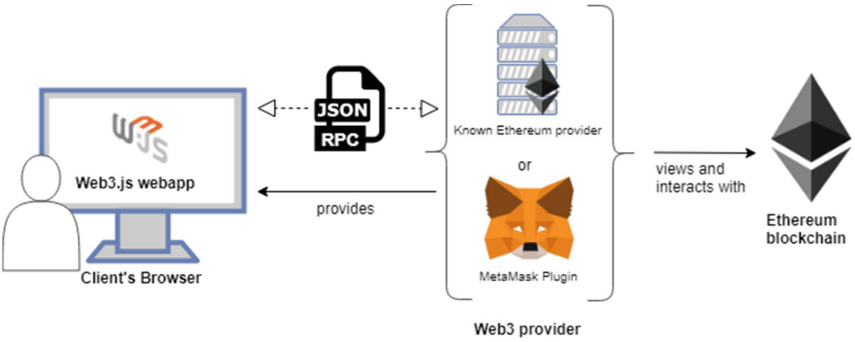

Fig. 3. The JSON RPC method connects to the Ethereum blockchain.

JSON-RPC [9] is a stateless, light-weight remote procedure call (RPC) protocol. Primarily, this specification defines several data structures and the rules around their processing. It is transport agnostic in that the concepts can be used within the same process, over sockets, over http, or in many various message passing environments. It uses JSON (RFC 4627) as data format.

3.2 Public Node

To interact with the Ethereum network via a public node using the public RPC provided by Infura [9], it is the best choice.

Infura is a Web3-enabled service delivery project focused on Ethereum [10] Infura provides tools and infrastructure that allow developers to easily connect their applications to platform blockchains such as Ethereum. Essentially, Infura provides the necessary tools for any application to start developing anything on Ethereum right away, without having to run complex infrastructure yourself. Infura provides connectivity for all developers using the Ethereum blockchain. The highlight of the Infura infrastructure is the network hosted on Ethereum: Mainnet, Ropsten, Rinkeby, Kovan (See Fig. 4).

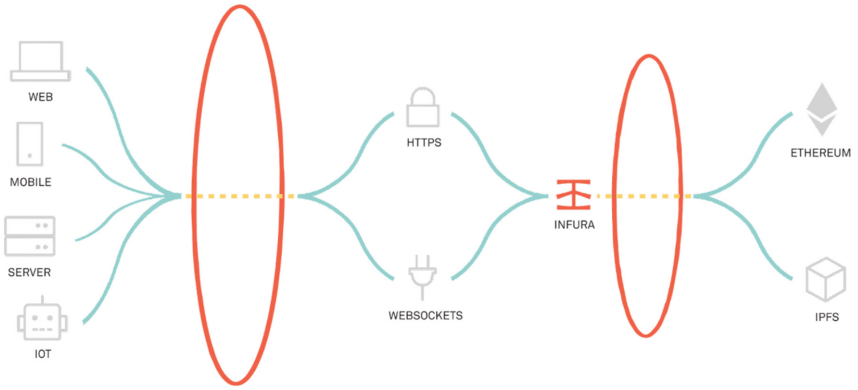

Fig. 4. RPC Infura model. Using the Infura's PROJECT ID KEYS to point the Ethereum packet to the Infura RPC interface.

4 The Process of Raising Pangasius

4.1 Processing of the Raising Pangasius at the Farm

Processing of the raising pangasius at a farm is carried out as follows:

- **Preparing the pond**

Before stocking fish, the pond must be renovated according to the technical process, such as: with an area of at least 500 m^2 or more, the pond edge is compacted firmly to avoid water leakage. Ponds should be near motorways or near rivers, canals and canals to transport food, seed, and commercial fish more conveniently. Ponds need to have separate supply and drainage drains; the size depends on the pond area. The location of the pond should be near a clean, unpolluted water source, so that it can actively supply water to the pond during the farming period.

- **Water supply**

All types of ponds must have a sewer system, and set up drains so that when pumping, the water falls into the pond to create a lot of foam to provide more oxygen for the fish. If possible, it is advisable to dig more ponds to store water and treat settling ponds before pumping into the pond, because it will make the pond to limit pathogens. It is necessary to build and install a large-diameter discharge culvert, which can discharge from 1/3 to 1/2 of the water in the pond in two hours to promptly prevent risks from occurring. The water must be taken from clean water sources that are less polluted, water is taken through a drain with a mesh filter to prevent harmful fish and predators. When the pond has been filled with water about 50–70 cm, then pausing for 3–5 days, then getting enough water.

- **Provide fingerlings**

On the market today, there are many types of pangasius of poor quality, so farmers must follow the technique of raising pangasius for export carefully from selecting and carefully checking the origin and situation. Disease…to ensure healthy fish, no scratches, uniform size from 10–12 cm/fish. Depending on the water quality as well as the area and depth of the pond along with the experience of raising fish, it is possible to stock different densities from 15–60 fish/m^2. When new fingerlings are purchased, fish should be released into the pond in the early morning or cool afternoon (mild weather), before releasing the fish should be bathed for 15–20 min with dilute salt water.

- **Provide fish food**

Homemade food: The downside of this type of food is that if you don't add minerals and vitamins, the fish will be slow to grow, so it takes a long time, about 6 months, for the fingerlings to have a size of 2.5 cm. However, if fed with enough nutrients, it only takes 4.5 months to harvest. Besides, the production of homemade food also pollutes the water very quickly, causing for fish to get sick.

- **Supply of medicine**

This is an indispensable step in the catfish farming process. It is necessary to pay attention to the weather to have a suitable way to feed the fish, when it is too hot to feed the fish vitamin C and change the water regularly. If the fish is sick, use antibiotics at a dose of 0.1%. Antibiotics will work if the pond environment is clean. However, if antibiotics are abused, fish will slow down and reduce weight gain.

- **Harvest**

The most reasonable time to harvest is after 9–10 months of rearing, when the fish reaches 0.7–1.2 kg/fish. We can base on the market situation to harvest in the most efficient way, avoiding the case that the fish has not reached the size, reducing the selling price and waste food. After the harvest, the pond needs to be drained and the pond needs to be renovated to prepare for the next crop.

4.2 Blockchain Model in the Farming Process of the Pangasius

In the farming process chain of the pangasius, the participant is the farmer (FARMERS) including the following tasks: pond preparation, water supply, seed supply, food supply, medicine supply and harvesting (in Fig. 5). Each subject has its own task function. Subjects interacting with the farmer generate a transaction. Transactions are permanently stored on the blockchain. When needed, information can be retrieved at any time.

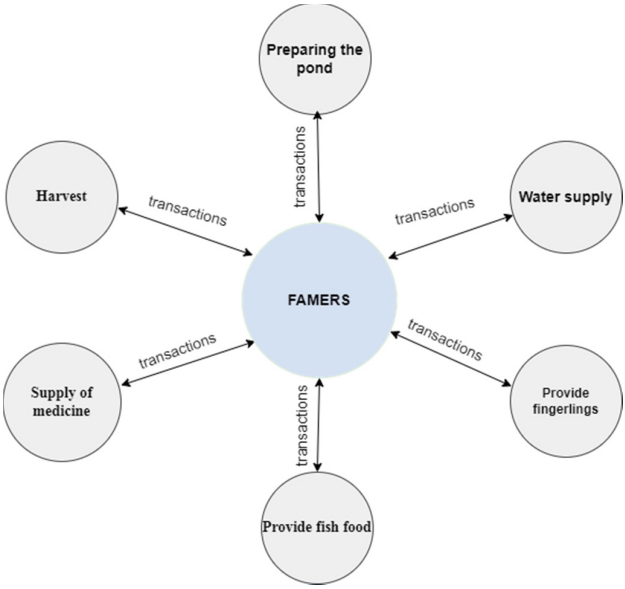

Fig. 5. Blockchain model in the process of raising pangasius at the farm.

5 Experiment

5.1 Assign Accounts to Subjects

Identifying the objects involved in the production process, then select the Address code and assign a management label in Table 1. In this experiment, the authors used Metamask (an add-on utility on Chrome browser, helping to manage accounts and interact with Blockchain).

Determining the data to be stored on the Blockchain, the data must be useful, clearly and accurately. In this article, we choose the Rinkeby Testnet (https://rinkeby.etherscan.io), where we can search for all recorded transactions for future tracing.

Table 1. List of accounts used to participate in the pangasius farming process.

Address	Name	Subjects
0xF8B86C3…c1d5	Account 2	Farmers
0xBe8B4ce…1802	Account 3	Preparing the pond
0xDE8B3c3…6206	Account 4	Water supply
0xDA8a137…CD3e	Account 5	Provide fingerlings
0x6eA0e74…7A30	Account 6	Provide fish food
0x5E0FA1E…c7B6	Account 7	Supply of medicine
0xD754425…9Ad3	Account 8	Harvest

5.2 The Scenarios

Case 1: Transaction between Farmer (0xF8B86C3…c1d5) and Preparing the pond (0xBe8B4ce…1802). Data is permanently stored at block 10933294 (See Fig. 6).

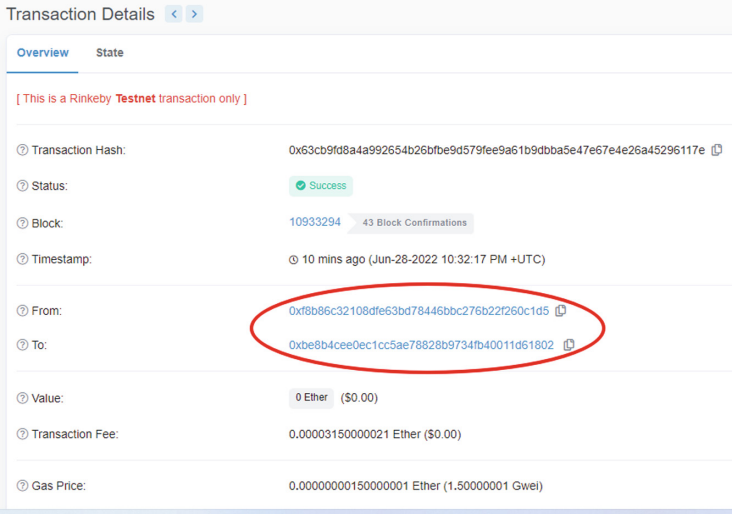

Fig. 6. Recording the results of transactions between farmer and preparing the pond.

Case 2: Transaction between Farmer (0xF8B86C3…c1d5) and Water Supply (0xDE8B3c3…6206). Data is permanently stored at block 10933297 (See Fig. 7).

Case 3: Transaction between Farmer (0xF8B86C3…c1d5) and Provide fingerlings (0xDA8a137…CD3e). Data is permanently stored at block 10933299 (See Fig. 8).

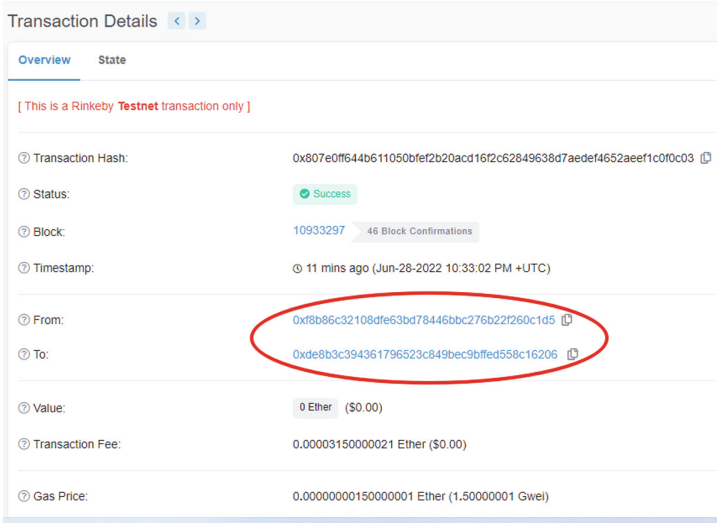

Fig. 7. Recording the results of transactions between farmer and water supply.

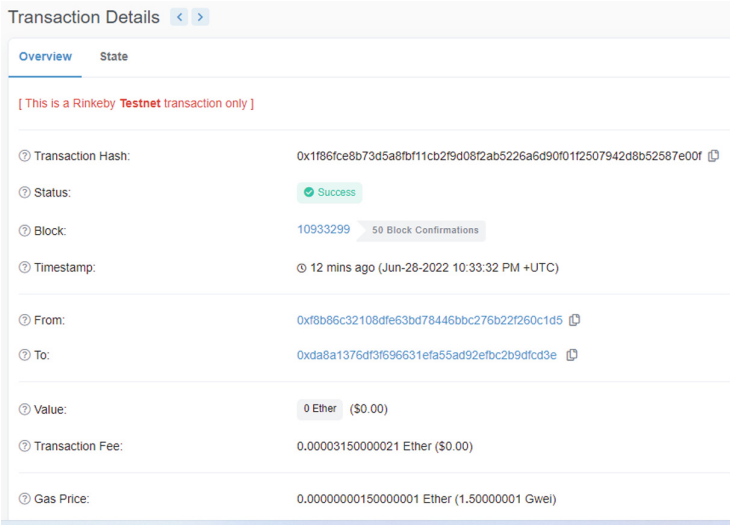

Fig. 8. Recording the results of the transaction between farmer and provide fingerlings.

Case 4: Make a transaction between Farmer (0xF8B86C3…c1d5) and Provide fish food (0x6eA0e74…7A30). Data is permanently stored at block 10933301 (See Fig. 9).

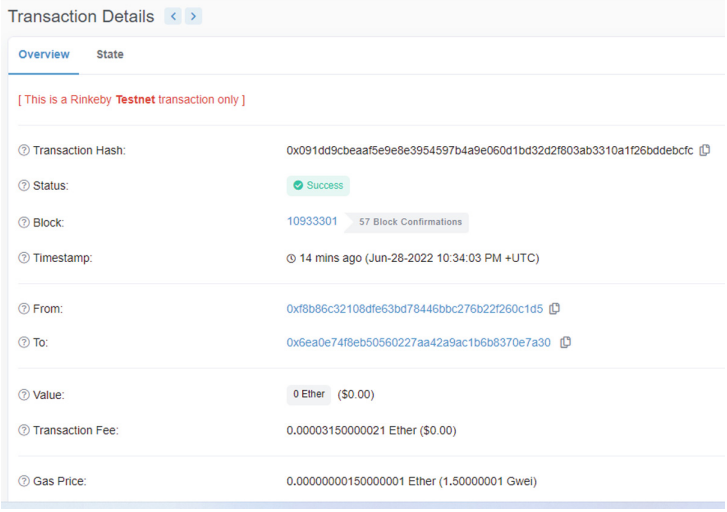

Fig. 9. Recording transaction performance between farmer and provide fish food.

Case 5: Making transaction between Farmer (0xF8B86C3…c1d5) and Supply of medicine (0x5E0FA1E…c7B6). Data is permanently stored at block 10933301 (See Fig. 10).

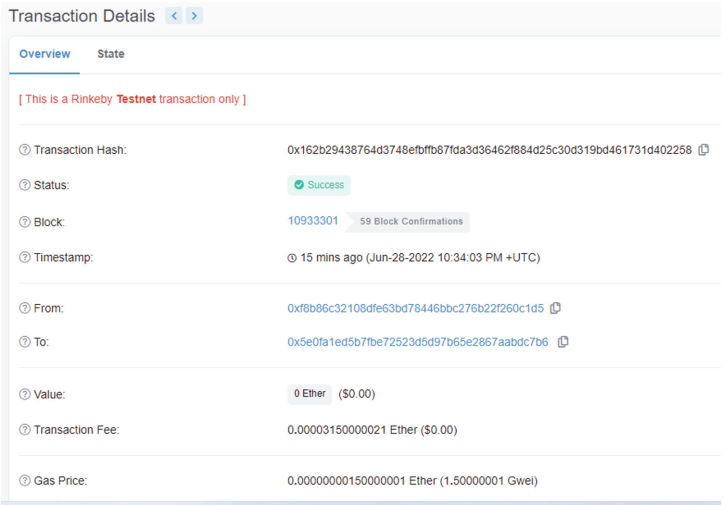

Fig. 10. Recording the results of transactions between farmer and supply of medicine.

Case 6: Make a transaction between Farmer (0xF8B86C3…c1d5) and Harvest (0xD754425…9Ad3). Data is permanently stored at block 10933303 (See Fig. 11).

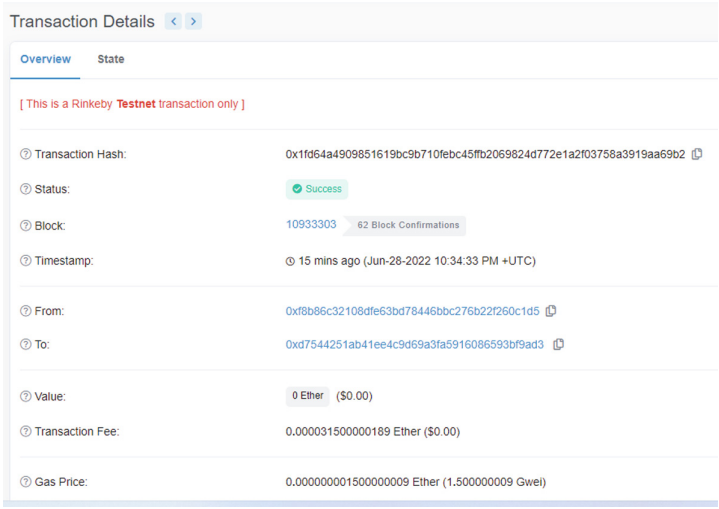

Fig. 11. Recording the results of transactions between farmer and harvest.

6 Conclusion

The blockchain technology has shown great potential, helping industries, agriculture, fisheries, all from the tradition of transformation to develop with Industry 4.0 and it has features such as: decentralization, immutability, decentralization, transparency. It is thanks to these characteristics that Blockchain-based frameworks are very interested and applied by the community in many fields such as finance and banking, economy, politics - society, health, education, etc. smart contract. In this article, we have used the advantages of Blockchain, specifically the Ethereum platform, to put into the industrial pangasius farming model.

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