EXPANDED ABSTRACT

Agri-food Supply Chain Traceability for Fruit and Vegetable Cooperatives Using Blockchain Technology

Objectives

Blockchain is considered today a disruptive technology that has the capacity to transform the agri-food industry, since it promises to solve many problems related to the lack of trust in the product that consumers acquire. However, the parties involved in the agrifood supply chain are numerous and physically dispersed, which makes data and information management difficult. As a result, the production process is not transparent and trust is difficult to build.

In the horticultural sector, technological innovation in traceability is crucial from a economical point of view. An increasing demand in society for greater information about food reflects the need for more transparency. At the same time, more and more fresh products are accompanied by a variety of certification schemes, with an increasing risk of fraud and adulteration. Within this context, cooperatives of fresh fruits and vegetables can gain additional benefits from the implementation of blockchain technology.

This paper seeks to make an initial contribution to the emerging public debate on this issue by providing an overview of blockchain and its application in agriculture, examining implications for food transparency and identifying some potential challenges for agri-food cooperatives.

Based on the above reasons, the main purpose of this article is to conceptualize, design and test a traceability system of the agri-food supply chain based on blockchain technology that helps agri-food cooperatives to improve transparency regarding the origin and the processes incorporated into the product.

Methodology

A new model that involves blockchain and a smart contract to coordinate the tracking of food in the agriculture supply chain is presented in this paper.

The food supply chain involves many different actors such as farmers, manufacturers, logistics, wholesalers, resellers, retailers and supermarkets. This system is currently inefficient and unreliable.

In the current situation, much of the data and information on compliance are recorded on paper or stored in a centralized database.

Through the development of a Proof of Concept (PoC) in the field of agri-food supply chain traceability, the possible implications of the blockchain are explored.

The PoC based on a case related to the berries of southern Spain is developed through the construction of a demonstrator that monitors the different nodes involved in the supply chain. The demonstrator is based on a previous analysis of the berries supply chain and the interactions between farmers, the cooperative, its certifiers, logistics providers, retailers and supermarkets, in order to allow a digital representation of a batch of berries to be associated with a unique and immutable digital certificate.

To prove the origin and the traceability of the berries production and to be able to customize the roles of each actor in the supply chain with blockchain, the PoC concept was developed in a Spanish farmers cooperative with a permissioned ledger (hyperledger) and a smart contract.

Results

At the moment, few would question the relevance of blockchain to agri-food. The main question of adopting blockchain technology in the traceability of goods in the agri-food supply chain, is related to the added value compared to existing ICT (Information and Communication Technologies) solutions. This PoC has shown that it is feasible to incorporate basic information from the field and manufacturing processes, packaging and shipping into a chain of blocks with an authorized general ledger and a smart contract. Compared to traditional situations with centralized databases, the PoC demonstrator shows how blockchain can be used to ensure that different agents share the same level of information about the validity and provenance of inviolable certificates.

This new supply chain architecture via blockchain can provide the relevant data to the participants, it can maintain confidentiality and can spread data effectively among the participants that use the blockchain technology. Therefore, the PoC pilot demonstrated that the blockchain technology could be used successfully in that context.

Furthermore, given the experimentation carried out, it was shown that a medium-sized server (eg VPS in cloud) could function properly as a node for the purposes of this type of use case. There was also no need for special hardware, and the software infrastructure (eg Hyperledger Fabric) is open source and for free.

During the development of the PoC, it was learned that it is important to maintain periodic dialogues between stakeholders in order to achieve a better understanding of the interests of each

one and to identify common bases for the application of blockchain. The experience in this project shows that the meetings, in which different stakeholders presented and debated different use cases, are a good mechanism for expanding the agri-food blockchain ecosystem.

Conclusions

The advantage of this model over the centralized models is that all the products are tracked with blockchain and with this traceability it is possible to give confidence to the final consumers about the origin of the products because all the data and transactions carried out in the chain are recorded in the blockchain and managed through a smart contract. The PoC shows that this system is efficient, safe, transparent and avoids intermediaries, which results in lower costs while generating greater confidence in retailers, supermarkets and consumers, which is particularly beneficial for small farmers and cooperatives

The research findings contribute to a better understanding of the blockchain technology for the various stakeholders in the fresh food chain, especially for cooperatives, being an opportunity for the improvement of reputation and competitiveness in a highly globalized economy.

Several limitations were found for the PoC demonstrator. First, the amount of data and information that is shared is very limited. As with most PoC pilots, the project has not yet been able to demonstrate how the system would work when handling a large number of transactions. In addition, our demonstrator focused on a single smart contract. In practice, however, multiple smart contracts would need to be implemented for the different contractual relationships and to keep the transaction data visible only to the relevant subset of participants. Mistakes in the smart contract design have also shown that testing, validation and rigorous semantics are essential to avoiding significant damage to business relationships.

Finally, to take full advantage of the power of blockchain, the adoption of this technology by several cooperatives is recommended. Most cooperatives are too small or have a lack of knowledge to invest in blockchain by themselves.

In summary, blockchain is a promising technology for the competitiveness of cooperatives. The near future will show if blockchain technology will become a reliable and transparent way to provide a differential value for agri-food cooperatives.

KEYWORDS: Blockchain, Food Traceability, Cooperatives, Smart Contract, Smart Agriculture, Trust-building, Agriculture Supply Chain, Proof of Concept.