Applying Blockchain Technology in Seafood Supply Chain Management

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***Abstract*: Global markets, mainly in Europe and America, require traceability to control quality and seafood safety. For shrimp supply chain quality management, such as production and processing, blockchain technology has been used in some countries. At this moment (2020), shrimp produced in Vietnam often do not satisfy the expectations of Western consumers with respect to the desired quality, especially in traceability system for accuracy technology (Khoi, 2020). The scientific challenge with respect to the improvement of the quality traceability of seafood supply chains implies the structural incorporation of the important elements in the process of food production, which are based on current scientific research for quality-orientated product development. This paper investigated the legal issues, and evaluate the costs and benefits to companies and countries that use blockchain technology in shrimp supply chain management.**

***Key words*: shrimp supply chain, quality management, blockchain, traceability**

I. INTRODUCTION

Seafood safety has become a top priority for the public and the private sector in Europe (Luning et al., 2006). European food legislation has been shaped by a blend of scientific, societal, political and economic forces to establish and maintain a high level of protection of human health (FAO, 2002). This has to be accomplished in such a way that it does not arbitrarily or unjustifiably discriminate against any international trading partner (Van Plaggenhoef et al., 2003).

The development of both public and private food safety standards has been driven by numerous food scandals (Dioxin, BSE, Avian influenza…). Consumers have become concerned about the safety of the food they consume. Food safety regulations do not only provide health protection, but also protect other consumer interests through providing them with accurate information.

As a result, the EU food industry is challenged to increase food product quality, and consumer trust, eliminate food hazards, and increase traceability of food products throughout the production chain. EU governments are reacting by imposing tighter food safety requirements and the private sector is, increasingly, using food safety standards such as HACCP, SQF, EUREP-GAP, etc. as a competitive variable in commercial strategies (Willems et al., 2005).

In Vietnam, there is not much reliable traceability solution for domestic brands that offers consumers the opportunity to self-validate their purchase (A. Tan, P.T. Ngan. 2020).

The farm to table policy is based on the general food law (GFL). The presence of information asymmetries, unaligned incentives between chain actors, low contract enforcement tend to increase market failures. It is therefore highly relevant to examine the role that governance of the supply chain plays in structuring business relationships. This paper investigated the legal issues, and evaluate the costs and benefits to companies and countries that use blockchain in seafood supply chain management.

II. LITERATURE REVIEW

Traceability can be understood as "the capability of detecting the origin and following the trace of seafood product from which food or other substances can be produced and used in human or animal food products or even with a probability of being used in this way, throughout all the production, transformation or distribution phases". Blockchain technology is widely used for this purpose, especially on farms and within the retailing sector. With respect to the seafood supply chain, antibiotics control can be carried out using blockchain, as the aim of this technique is to trace products, from their origin to the consumer.

Blockchain is a series of immutable records of data where each of these blocks of data is secured and contains a cryptographic hash of the previous block. The technology follows a decentralized approach; everyone involved has to follow the set of rules.

In a shrimp supply chain, there are stakeholders involved (for e.g. in farming: a farmer, a trader, a processing/export firms and a consumer, etc.) with access to a shared set of data, about a common product that moves between them across its lifecycle. For making the supply chain process successful, every party that's concerned with the product must show their involvement such as a farmer sharing the information about the product's harvest, the distributor about the logistics, and the retailer about the price and consumer information.

Blockchain Technology is helping every industry in various ways. Blockchain facilitates trust through transparency and automated smart contracts while maintaining privacy and security across the supply chain.

For example, as a farmer, keeping track of important data or storing the crop information in a piece of paper or spreadsheet isn't relatively practical, and here's where Blockchain will help them by tracking every record of a crop from the moment it's planted till it reaches its consumers. All information about

the supply chain processes and events can be securely stored and accessible in real-time thus providing insights to all the actors in making the process efficient.

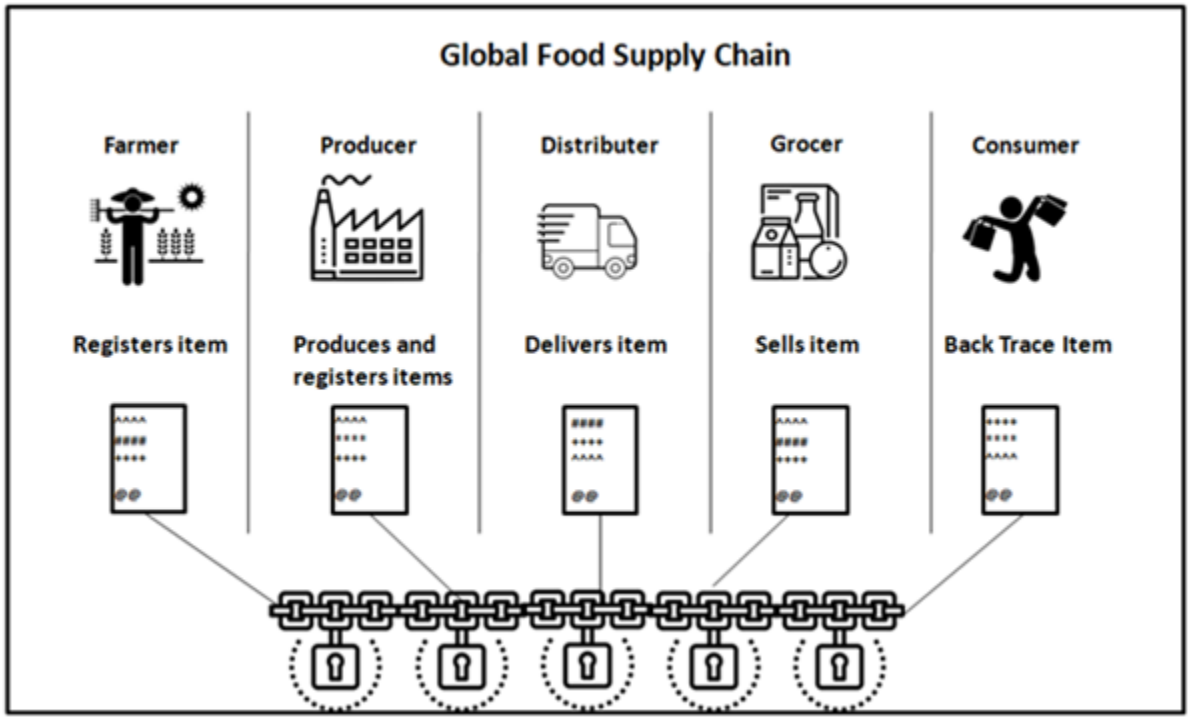

Figure 1. Overview of stakeholders using the global food supply chain

Yusr et al, (2020) stated that green supply chain management has a positive and significant impact on green innovation performance, where greening the chain that the company involved in leads to a better green innovation performance.

Tebaldi et al. (2018) inspected how innovation and sustainability are integrated into the wider context of the supply chains. As food frauds are rapidly increasing in European countries, these problems that Blockchain technology can solve. A supply chain application offers its consumer a complete understanding of the food which has been purchased by them. If there is any unethical activity, then the time and location of such events could be identified and stored in an immutable way in Blockchain to provide end to end traceability and audibility (the decentralized architecture and consensus mechanism built into blockchain makes it almost impossible for one actor in the supply chain to manipulate data).

To ensure food safety from farm to table, The European Union has implemented the Trade Control and Expert System for food traceability and risk management functions, which traces the food products through the supply chain process. Blockchain-based solutions increase efficiency and traceability across the production chain and transform the technique of how we connect, execute, and perform the business.

Seafood quality needs to take 'the voice of the consumer' into account as well as 'the voice of the product'. 'The voice of the consumer' requires an integrated approach to food science, technology, nutrition and consumer science. On the other hand, 'the voice of the product' is about how quality can be obtained via a food science and technology approach and demarcates what is possible with a certain product and what is not.

The consumers' appreciation of food is the result of the interaction between several things, namely the consumer himself (e.g., habits, culture, personality, mood and physiology), specific quality attributes of the food (clustered in sensory, health, production and convenience attributes), and the context or situation in which this interaction takes place (e.g., time, place, who with, how, what with).

Quality, as seen from the consumers' perspectives, is a multifaceted concept, based on quality expectations as perceived prior to consumption and quality experiences as perceived during and after consumption (Grunert, 2002). While quality experience is very much related to physical product properties, quality expectation is related to previous quality experience as well as information about the production methods, packaging and the appearance.

Since these characteristics are specific for the agri-food chain, an integrated approach of management and technology is required for the measurement of food quality systems.

In conclusion, quality is considered from a broad perspective by selecting a management and a production based description. However, these descriptions have to be made quantifiable in order to measure the effectiveness of food quality systems.

III. APPLYING BLOCKCHAIN TECHNOLOGY AS A SEAFOOD SUPPLY CHAIN TRACEABILITY SYSTEM

Traceability system must be quantifiable in order to measure the effectiveness of the production system. Therefore, besides the quality description, a traceability concept has to selected in order to measure the total quality performance. The primary objective of food quality management is to meet or exceed customer and consumer requirements on food quality (Luning, Marcelis, & Jongen, 2002). However, there is no unambiguous concept for food quality in literature (Da Cruz et al., 2006; Luning et al., 2007; Peri, 2006), so it is necessary to clarify a quality concept for our functions model. From a techno-managerial perspective, food quality should be perceived broader than just physical product quality. In this research, the following quality dimensions have been selected to evaluate the quality concepts:

- Product quality refers to intrinsic and extrinsic quality attributes of the food product. Intrinsic attributes are directly related to the physical product, like safety, health, sensory value, convenience, while extrinsic ones refer to other aspects like how it is produced (e.g. animal friendly) (Luning et al., 2002). A food product as such has no quality but consists of physical chemical properties. Quality attributes are the result of (various) product properties, which are noticeable by sensory observation or via communication, and in this way they contribute to quality perception and experience of consumers and customers (Steenkamp, 1990; Van Trijp & Steenkamp, 2005).

- Costs incurred during the primary process including input purchasing, production and sales. It is the basis for quality/price perception

- Reliability refers to the ability of the organization to continuously meet requirements on quality, such as food safety level and other agreements, so providing confidence to customers and consumers.

Applying blockchain technology as a seafood supply chain traceability systems is effective management tools to achieve and ensure production and supply of safe seafoods. Nowadays, consumers have clear demands about other quality characteristics of their food such as flavour, taste, texture, appearance, shelf life, nutritional value, health value, convenience, etc. Yet, relatively little attention has been paid to the development of methodologies or systems for assessing and assuring consumer-orientated quality characteristics, a discrepancy that is particularly apparent in international seafood supply chain management. Blockchain technology is used in the management of supply chains to trace the movement of goods throughout the world and also for inventory control. In retail, blockchain makes it possible to relate seafood products with personal consumer information, making it easy to trace and check. If this kind of information could be related to credit cards, mobile phones or banking details, it would be possible to have a complete profile of the consumers' buying habits, personal preferences, banking operations and personal expenses.

IV. CONCLUSION

Application of the blockchain technology for seafood quality traceability system could be useful to facilitate the transformation of products, or even whole supply chains. Blockchain technology is the tool for seafood quality traceability system philosophy needs to be incorporated throughout the entire food supply chain 'from table to farm' and should include the understanding as well as the assurance of quality as perceived by consumers. It can be concluded that blockchain technology still entails country, industry, legal and consumer issues which need further research. These themes are very rich, clearly demanding balanced and constructive analysis to determine not if, but how and to what extent blockchain is going to be used to serve various stakeholders.

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REFERENCES

[1] Folinas, D.; Manikas, I.; Manos, B. (2006) Traceability data management for food chains. British Food Journal, Vol. 108, No.8, pp.622-633.

[2] Laha, F. & Katafono, K. 2020. *Blockchain application in seafood value chains*. FAO Fisheries and Aquaculture Circular No. 1207. Rome, FAO. https://doi.org/10.4060/ca8751en

[3] Linnemann, A.R., Benner, M., Verkerk, R. and M.A.J.S. van Boekel (2006). Consumer-driven food product development. *Trends in Food Science & Technology* 17, 184-190.

[4] Luning, P.A., W.J. Marcelis and W.M.F. Jongen (2002) Food quality management: a techno-managerial approach. Wageningen Pers, Wageningen, 323p.

[5] Khoi, L.N.D (2020), Constructing a tool for Seafood Quality Traceability, International Journal of Research and Scientific Innovation (IJRSI) | Volume VII, Issue VI, June 2020, 142-145

[6] Ropkins, K. and A.J. Beck (2003) Using HACCP to control organic chemical hazards in food wholesale, distribution, storage and retail. *Trends in Food Science & Technology* 14, 374-389.

[7] Sijtsema, S., Linnemann, A., Gaasbeek van T., Dagevos, H., & W.M.F. Jongen (2002). Variables influencing food perception reviewed for consumer-oriented product

[8] Trienekens, J.H. (1999) Management of processes in chains: a research framework. PhD thesis. Wageningen University, Wageningen, 173p.

[9] Yusr, M.M., Salimon, M. G., Mokhtar, S.S.M., Shaari, H., Abaid, W.M.A.W., Perumal, S., Saoula, O. (2020). Green innovation performance! How to be achieved? A study applied on Malaysianmanufacturing sector. Sustainable Futures, (2), 1-10.

[10] Yusr, M. M., Mokhtar, S. S. M., & Othman, A. R. (2017). Does interaction between TQM Practices and Knowledge Management Processes Enhance the Innovation Performance?. International Journal of Quality & Reliability Management. 34(7). 955-974.

[11] L. Tebaldi, B. Bigliardi, E. Bottani. (2018). Sustainable supply chain and innovation: a review of the recent literature. Sustainability, 10 (11)
[12] Tan, P.T. Ngan. 2020. A proposed framework model for dairy supply chain traceability, Sustainability
[13] Van der Vorst, J.G.A.J. (2000) Effective food supply chains. Generating, modelling and evaluating supply chain scenarios. PhD thesis, Wageningen University, Wageningen, 305p.