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Fair Label versus Blockchain Technology from the Consumer Perspective: Towards a Comprehensive Research Agenda

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Abstract

Many small farmers and workers on plantations in poorer countries constantly live on the poverty threshold. Those people suffer from rising commodity prices and trade structures that pass price pressure to the weakest link. Farmers are at the mercy of these structures and must comply as they have no other choice. On the consumers' side of the supply chain, it is often hard to recognize agricultural products' fairness and originality, especially in processed food. Many organizations – through food labelling - partially inform consumers about products' provenance and fairness. Whereas several studies confirm that food labels positively influence the consumers' intention to buy food, the vast number of organizations and labels are hard to evaluate and distinguish. A technology that could be a gamechanger in sustainable and fair global agriculture could be Blockchain Technology (BCT). With the help of BCT, the need for a central authority like a "fair label" agency may become obsolete, with the same or even better results. This conceptual article surveys subject matter literature and concludes that there is a noticeable research gap in the possibility of BCT replacing or enhancing fair food labels. Thus, the paper shows the potential of BCT to improve fairer agricultural supply chains and make them transparent for customers. By doing so, some research areas and research questions will be derived. Furthermore, specific directions for future research will be shown.

Keywords

Fair agriculture, blockchain, supply chain management, fairtrade, food labelling

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Introduction

There are many unsolved economic and ethical issues within the supply chain of agricultural products and food. Many small farmers and workers on plantations in poorer countries constantly live on the poverty threshold. Those people suffer from rising commodity prices and trade structures that pass price pressure to the weakest link. Farmers are at the mercy of these structures and must comply to make a living. Therefore, many organizations evolved to eliminate inequalities amongst global agricultural supply chains and diminish sustainability issues. For example, the Fairtrade Label guarantees smallholder farmers a minimum price for their product, intended to cover the average costs of sustainable production and improve their living conditions (Jefford, 2021).

Consequently, fair label organizations certify the fairness of products with labels visible on agricultural products and food. Further, also food consumers want the assurance that their food is safe and that the accompanying information is accurate (Rupprecht et al., 2020). It seems that those fair food label organizations excel in alleviating inequalities and are sustainable; however, the variety of organizations is hard to comprehend and distinguish for consumers. Consequently, consumers are faced with an increasing number of sustainable food labels, deprived of the possibility to prove which is the right one. According to Sirieix et al. (2013), these different labels add to the competition of product information in consumers' minds, even though it is not transparent for consumers if the whole product is traded fair or just parts of it.

Studies (Wang et al., 2020) found that the perceived quality of food labels positively influences the consumers' intention to buy food. That means food producers strive to put trusted labels on their products to increase sales. Also, "Made-in" labels are used by customers to judge a product's

quality ex-ante (Haucap et al., 1997). However, customers hold different levels of trust in different labels, which depend on the food certifying body. Consequently, consumers need to trust organizations or labels on products to know the provenance of agricultural products (Wang et al., 2020). For example, there is no real transparency between farmers' and government administrations' exchanged data, especially in poorer regions. Consequently, governments could alter information for their advantage, and the development of the agricultural industry will be hindered (Sowmya et al., 2020).

This issue imposes some room for improvement through new technologies. One technology that could be a gamechanger in sustainable and fair global agriculture is Blockchain Technology (BCT). With the help of BCT, the need for a central authority like a "fair label" agency may become obsolete, with the same or even better results. This technology is not just a significant improvement for customers, but it is also a gamechanger for farmers in poorer regions – as BCT can democratize the information in supply chains. In addition, the technology could inform farmers more about their products' journey and better manage customer relationships and risks (Fairtrade Foundation, 2019).

The agricultural supply chain

The recent supply chain issues, which span over many worldwide industries and products, do not stop at the agricultural industry. Ironically, the issue with agricultural supply chains is that there is a shortage of food on the one hand, and on the other, there is rotten food in containers around the world. The reasons for that are various: labour shortages due to COVID-19, shortages of raw materials to repair equipment and the lack of herbicides which make crops growing more expensive (Sönmez, 2021).

Generally, modern supply chains are a complex endeavour across different industries with multiple functions, potentially conflicting objectives, and numerous dependencies between material and information flows. The agricultural supply chain (ASC) is more complex, with many inbound and outbound networks (Denis et al., 2020). The complexity in the ASC is enhanced by the fact that most agricultural products are perishable. Therefore the opportunity to use inventory as a buffer against demand and transportation variability is limited (Ahumada and Villalobos, 2009). Moreover, ASC are more complex to manage than other supply chains, mainly due to the importance of factors like food safety and quality, limited shelf life, demand, and price variability. An efficient and fair agricultural supply chain results from stable networks and common relations between input suppliers, producers, processors, traders and retailers (Bhagat and Dhar, 2011). In addition, recent studies (Eluubek kyzy et al., 2021) found that current agricultural supply chains have a hard time helping impoverished farmers because agricultural supply chains focus mainly on the processes between farmers and consumers and omit smallholder farmers. That is because the agricultural industry prefers to work with large scale farmers that use modern technology, and small farmers do not have any possibility to negotiate from the same level. Hence agencies can bargain prices down. Summarized, the main issues of ASC are food loss, safety, insecurity, accessibility, increased demand, diminishing resources, and the global food crisis (Despoudi et al., 2021).

Blockchain technology

Since the ground-breaking invention of the peer to peer electronic cash system (Bitcoin) in 2008 (Nakamoto, 2008), Blockchain Technology (BCT) has seen an enormous rise in academic and practical significance for various applications. This interest might be fuelled by vast and valuable applications paired with the fairytale-like rise of Bitcoin and other cryptocurrencies (Coinmarketcap.com, 2021).

Initially, the BCT was used as a decentralized platform to validate transactions in financial applications without the need for any third party. Gradually, applications in non-financial industries are on the rise and impose many opportunities (Nofer et al., 2017). BCT is applicable for every business which relies on an intermediary between two parties. Therefore the BCT can challenge existing business models in almost every industry (Morkunas et al., 2019).

Without technical detail, a blockchain can be described as a distributed data database in encrypted so-called "blocks" (Rymarczik, 2020). These data blocks are cryptographically linked together and can be verified by all parties at any time (Antonucci et al., 2019; Nakamoto, 2008). To be able to do so, the data is stored with reference to the previous data block, forming an indefinite ever-growing chain of blocks. The blocks are created by parties who maintain the whole network and are called miners and get rewarded for their contribution (Chitchyan and Murkin, 2018).

By doing so, the data on the Blockchain is for everybody viewable and due to the connection of the blocks not amendable. This opens many possibilities for applications where trust is a crucial issue.

Blockchain technology in the agricultural supply chain

The agricultural sector is still one of the most minuscule digitalized industries, with many unused possibilities and inefficiencies (Gandhi et al., 2016). It brakes the development of modern business models based on IT tools implementation despite their steep spread in business activity (Hu et al., 2019; Roshchyk et al., 2022). Furthermore, the food supply chain has become a worldwide, multi-actor, distributed supply chain, where many stakeholders, like farmers, shipping companies, wholesalers, retailers, and end customers, are included (Kamilaris et al., 2019). Through BCT, there is a reliable approach for tracing all transactions and managing all stakeholders. This reduces the space for fraud and malfunctions along the supply chain and quicker detection of inefficiencies. Hence, BCT technology can provide solutions to food-quality and food-safety issues, which are concerns of both customers and governments (Xiong et al., 2020). Furthermore, considering the current backlogs and issues along global supply chains, a transparent supply chain optimizes operations, guarantees the quality of outputs and ensures the sustainability of processes (Montecchi et al., 2021; Křenková et al., 2021). These consequences are valuable due to increasing challenges for agriculture development in an international environment (Przekota et al., 2020).

Although the Blockchain had its primary usage in the financial industry and is also known mainly because of digital currencies like Bitcoin, Ether and many other financial usages, the Blockchain in agriculture has its justification. The fields of applications are vast but can be categorized mainly around the supply chain of food (Kamilaris et al., 2019). Like many other industries, supply chains in the agricultural industry have never undergone a digital transformation.

The main challenges that need to be tackled in the future are the rising food demand, changing consumer preferences, environmental issues and sustainability, costs, food safety, and fair trade (Schmidhuber, 2018). Lately, the BCT in agriculture has become a growing trend, and Blockchain led innovations in the agricultural market have been rapidly gaining traction (Jefford, 2021). As an example, BCT could improve food labelling: Studies show that BCT could be far superior to a food label organization, as customers must trust the organization in guaranteeing the quality of the product. However, BCT is not based on trust but on knowledge that cannot be manipulated (Uhlich and Lux, 2021).

Furthermore, consumers are increasingly demanding high quality as well as safe food, paired with a wish for a smaller environmental footprint of agricultural products, which is also fostering the need for new innovative technology to trace food along the supply chain in an effective manner (Rana et al., 2021). In fact, farm-to-shelf traceability can be an essential factor in establishing a benchmark for food quality and safety ([x]cube LABS, 2020). Therefore, more and more companies are starting to use BCT along the supply chain: Coca Cola has been exploring multiple blockchain projects for years to tackle different issues. One latest project was created to find a secure registry for sugar cane workers to tackle forced labour worldwide (Chavez-Dreyfuss, 2018). Also, a Norwegian salmon producer made it possible to monitor every aspect of the salmon supply chain with the use of digital twins of the salmons on the Blockchain and make it, therefore, completely comprehensible (Ultsch, 2021). Nestle has been trying to ensure that its used palm oil is not linked to any deforestation of the rainforest. Therefore, with the help of BCT, Nestle can track the provenance and the correct shipment of palm fruits (Chandrasekhar, 2020). Most of the companies, both mentioned above and in general, are using BCT based on the IBM Food trust – a modular solution based on BCT that enables a more sustainable food ecosystem (IBM-Foodtrust, 2021). The IBM Food Trust Blockchain benefits are based on increased efficiency, fresher, safer food and sustainable food, less fraud, and reduced waste. Moreover, companies can build up a better reputation and can therefore increase the customer's confidence in the company's product. For example, IBM is working with start-ups on fairer conditions for coffee farmers. Customers can track the coffee beans back to the farmers and directly donate money to them (Stede, 2020).

Materials and methods

This article's main objective is to find research opportunities and define a research agenda for the possibility of BCT improving or replacing fair food labels. The research gap was identified

by literature research. A combination of the keywords "Fair Label" and "Blockchain" was chosen to evaluate the available research on this matter. For this article searches were performed over Emerald, Web of Sciences and Google Scholar. No restrictions concerning the date were selected. Although the vast amount of literature on BCT and ASC, there is an apparent lack of papers investigating the consumer perception of BCT and the possibility of the technology to improve or replace fair trade food labels or, in general, food labels. In fact, the author could not find any literature which is dedicating itself to the topic. Therefore, adequate research questions based on well-grounded theory must be formulated to create a comprehensive research agenda. Nevertheless, given the novelty of blockchain technology in the agricultural sector, there are many promising research possibilities for the future.

Results and discussion

BCT could transform the food industry in many ways: more food safety, less fraud and faster and fairer payments (Charlebois et al., 2017). According to Katsikouli et al. (2021), food fraud causes problems from several perspectives. Not only causes it the loss of trust from consumers in food products, but also can it lead to unfair competition and is a threat to brand reputation. This could have massive long term economic consequences for the affected company or even the country. Information of the foods supply chain as a whole and the environmental responsibility of each food producer are essential components of the consumer's trust (Sengupta and Kim, 2021). BCT could make supply chains more transparent and enables the agricultural industry to produce high-quality food with low social and environmental impacts (Rana et al., 2021).

Further, BCT could enable consumers to make more informed decisions about the products they are buying. According to Asioli et al. (2020), there is no denying that the agricultural production systems are facing unprecedented challenges and that due to sustainability concerns, there has been a proliferation of sustainable related food labels. However, the question remains: how could those sustainable related food labels be more informative so that consumers can distinguish those and grasp the value. Many of the advantages which a food label brings a consumer, like transparency, fairness, and information, could also be delivered by a transparent supply chain on a blockchain. Moreover, while using food labels, consumers need to trust companies or organizations responsible for the labels; there is no need by the use of BCT to trust any intermediating party. Due to the possible advantages of a BCT approach, the following research question can be derived:

RQ1: Blockchain technology improves the trust of consumers in fair agricultural products

It is almost impossible for consumers to understand the difference between various fair trade labels, and apart from some serious initiatives, it can be seen that the implementation of fair trade strategies is still very immature (Katsikouli et al., 2021). Consumers are bombarded with many claims on products on how the food is processed, produced and regulated, although consumers mainly cannot distinguish products just because of labelling and therefore are left confused (Abrams et al., 2010).

Almost all traditional food labels are intended to provide consumers with additional information. Studies like Banterle et al. (2013) state that with the use of sustainable food labels, the vertical coordination of supply chains increases and the product uncertainty is reduced. However, several studies indicate that consumers lack an understanding of their meaning (Hamilton and Raison, 2019). What is more, consumers could also struggle with trust in the source of the food label. Hence, Rupprecht et al. (2020) investigated the consumer's perception of five sources of label information: Producers, Governments, Producer Associations, Experts and Consumers. They found that, whereas labels of experts were the least legible, they were found to be the most trustworthy across all the examined countries and food types. So, the emergence of a widely used expert label, where scientific testing of food product is in the foreground as a trustworthy source of information, is proposed. They argue that this development aligns with the trend of greater supply chain transparency. However, what they are not even considering is a solution based on BCT.

On the contrary, Garaus and Treiblmaier (2021) found that blockchain traceability systems positively impact the retailer choices of customers. They argue that with the use of product labels, it can be shown that a traceable and immutable database has been used, which is increasing consumers' trust. Also, others like Behnke and Janssen (2020) describe BCT as a possible technological solution for a food traceability framework – amongst some boundaries which needed to be solved first. In addition, Uhlich and Lux (2021) state that consumers should demand documentation of supply chains via Blockchain, as they argue that BCT is

far superior to any sustainable food label. By doing so, companies would be forced to implement the technology and give it a preference over classical food labels (Upadhyay et al., 2021).

Hence, future studies could test whether BCT excels in using food labels. Based on that, a survey design similar to the survey conducted by Rupprecht et al. (2020) is proposed; however, extended with the sources of label information for each food type with a solution using BCT (Table 1).

Researchers could investigate and let BCT compete with the other label information sources. This leads to RQ2:

RQ2: Blockchain Technology is superior to fair labels in the perception of consumers

The issue with fair and sustainable food is linked to many sustainable development goals of the UN. Based on the arguments stated in the previous chapters, the author reckons that a BCT based fair label could improve many issues which are currently not or just partially solved. A way to show that foods provenance could be tracked in a tamper-proof manner would be a gamechanger for the customers and the industry. This can be achieved by a transparent blockchain delivered by BCT. By doing so, small farmers could see amongst others for how much their products will be sold, and big food companies could organize better business calculations by having more accurate and unalerted information on the provenance of its raw materials. BCT could also help companies to reach their Environmental Social Governance (ESG) goals, as BCT could allow for a credible sustainability assessment (Joseph, 2022). Finally, also consumers could profit, as they would undeniably see from where the product is from and whether farmers were treated fair.

This article aimed to show a research possibility about improving fair food labels using blockchain technology. Although most of the investigated articles were about classic food labels, describing the contents of the food, the author assumes that fair food labels can be seen analogously to food labels, as both are basically requiring the same trust for the issuing institution. It is immanent that ASCs are complex for many reasons (Ahumada and Villalobos, 2009; Denis et al., 2020; Kamilaris et al., 2019). So, it is not easy for the customer to understand and track food contents. Using a BCT fair food label, the customer could easily track food components back to the farmer and confirm theproduct'ss sustainability and fairness. The author suggests that the research questions could be answered by a survey similarly to Rupprecht et al. (2020) but extended with a BCT based information source. Research should pay attention to the fact that customers might not be able to grasp the technology initially and therefore might not see the advantages it could bring. Therefore, the survey authors may need to distinguish between people who are aware of the technology and people who are not. Another possibility would be to inform the respondents about the technology before taking the survey; however, this could result in a biased result. Furthermore, with BCT, some issues may remain; for instance, who assures that the data entered on the Blockchain is accurate (Jiang, 2019)? Consequently, someone could argue that BCT does not bring any value to supply chain tracking. However, some companies like Circularise evolved to develop solutions for these issues.

One limitation of this research agenda is that solely the customers' perspective is reviewed. However, the producers' and suppliers' perspective also bear interesting research possibilities that future research could also investigate. Another promising possibility would be to look at the perspective of fair food label organizations. For example, BCT might be a competitive product of fair food labels: A potential customer could make sure whether the product was traded fairly or not by having a completely transparent supply chain. Hence, there is no need for a fair label organization anymore. Contrary to that, someone could argue that a BCT

Label information source	Description of label information source
Blockchain based trust model	Crop to finished food trackability solution
Producers	People who produce the food
Governments	Departments in governments responsible for food
Experts	Independent, neutral researchers
Consumers	Customers who evaluate the food

Source: Rupprecht et al. (2020)

Table 1: Six types of sources of label information and their definition.

fair food label could also be a complimentary product to food labels organizations where the fair food label organization certifies that all data on the Blockchain is valid. Nonetheless, it needs to be researched if such an approach improves the current business-standard.

Conclusion

In this article, the possibility of BCT to improve and or replace classic fair food labelling is discussed. After a description of the ASC and BCT itself, research questions for further research on this topic are derived based on current literature. The question remains: Who is responsible for making the ASC more transparent and, therefore, fairer. What are current barriers to the adoption, and who, with which means, can implement the technology? According to the literature, industry leaders should embrace the technology and make it business-standard. By doing so, the entire food industry could be enhanced (Charlebois et al., 2017). Also, currently, governments are playing an essential role in ensuring that information provided on food is accurately and understood by consumers (Sengupta and Kim, 2021). Studies are also reasoning that the customers should start to demand more transparent ASC (Uhlich and Lux, 2021), which would ultimately lead to a fairer and probably more sustainable ASC. Future studies could also look at companies dedicated to changing current systems by implementing BCT and investigating the adoption. Future research can work on those thoughts, extend or refine them and adapt the stated research questions or answer them.

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