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The Role of Blockchain Technology in Food supply Chains

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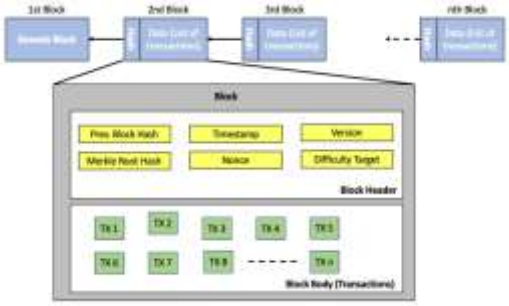
ABSTRACT: Blockchain is an emerging digital technology allowing ubiquitous financial transactions among distributed untrusted parties, without the need of intermediaries such as banks. This article examines the impact of blockchain technology in agriculture and food supply chain, presents existing ongoing projects and initiatives, and discusses overall implications, challenges and potential, with a critical view over the maturity of these projects. Our findings indicate that blockchain is a promising technology towards a transparent supply chain of food, with many ongoing initiatives in various food products and food-related issues, but many barriers and challenges still exist, which hinder its wider popularity among farmers and systems. These challenges involve technical aspects, education, policies and regulatory frameworks.

KEYWORDS: Blockchain Technology, Digital Agriculture, Food Supply Chain, Barriers, Benefits, Challenges.

I. INTRODUCTION:

In this paper, we get vivid picture of how a blockchain is a digital transaction ledger, maintained by a network of multiple computing machines that are not relying on a trusted thirdparty. Individual transaction data files (blocks) are managed through specific software platforms that allow the data to be transmitted, processed, stored, and represented in humanreadable form. In its original bitcoin configuration, each block contains a header with a time-stamp, transaction data and a link to the previous block. A hash gets generated for every block,based on its contents, and then becomes referred in the heading of the subsequent block.



[1].Every transaction is disseminated through the network of machines running the blockchain protocol, and needs to be validated by all computer nodes.

The problem of consensus has been extensively studied by researchers in the past, however its use in the domain of blockchain has given new stimuli and motivation, leading to novel proposals for design of blockchain systems. The most well-known, used in Bitcoin, is called “Proof of Work” (PoW) and it requires computer nodes, called miners in this case, to solve difficult computational tasks before validating transactions and be able to add them to the blockchain .

[2]. By introducing Blockchain in food supply chain, food companies can improve traceability of food product right from the farm till the table. An iOT powered Blockchain system gathers and records data pertaining to a product's journey right from their point of origin till the end-consumers.

[3]. Blockchain deals with the fragmented food supply chain by securing the entire process of food transportation in a way that every participant remains accountable for their responsibilities (as per the agreement) throughout the supply chain.This is widely helpful for the agricultural sector as well.

[4].This paper presents the design of blockchain and the implementation stages involved in the blockchain technology.where we can come to identify the advantages involved in following this process as blackmarketing is also eliminated in this kind of architecture and implementation.

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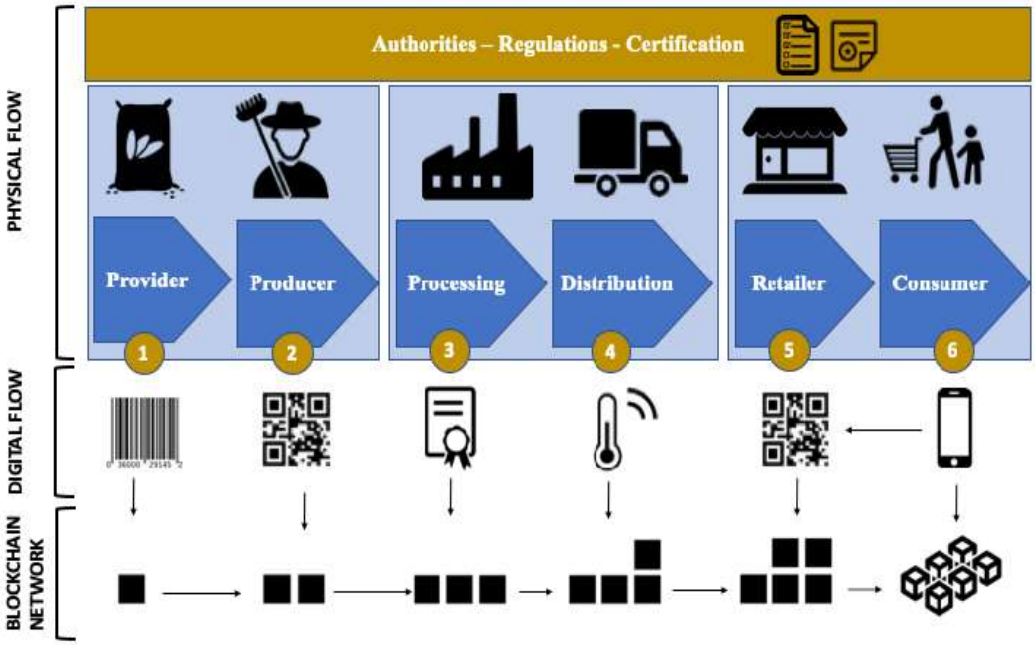
FOOD SUPPLY CHAIN



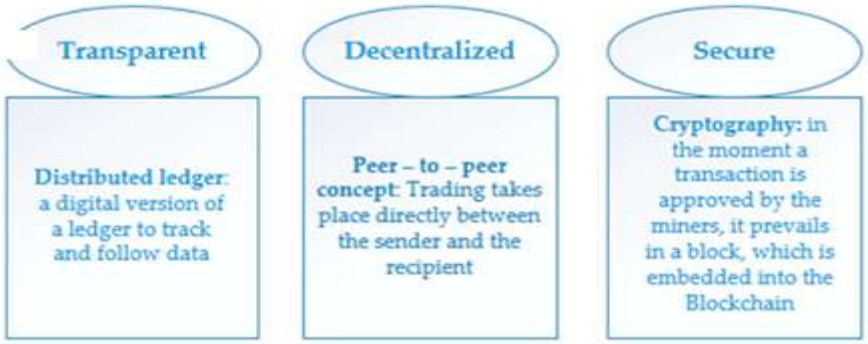
The food chain worldwide is highly multi-actor based and distributed, with numerous different actors involved, such as farmers, shipping companies, wholesalers and retailers, distributors, and groceries. The main phases characterizing a generic agri-food supply chain are described .

The various Stages include:

1. Production: The production phase represents all agricultural activities implemented within the farm. The farmer uses raw and organic material (fertilizers, seeds, animal breeds and feeds) to grow crops and livestock. Throughout the year, depending on the cultivations and/or animal production cycle, we can have one or more harvest/yield.

2. Processing: This phase concerns the transformation, total or partial, of a primary product into one or more other secondary products. Subsequently a packaging phase is expected, where each package might be uniquely identified through a production batch code containing information such as the production day and the list of raw materials used.

3. Distribution: Once packaged and label, the product is released for the distribution phase. Depending on the product, delivery time might be set within a certain range and there might be a product storage step (Storage).



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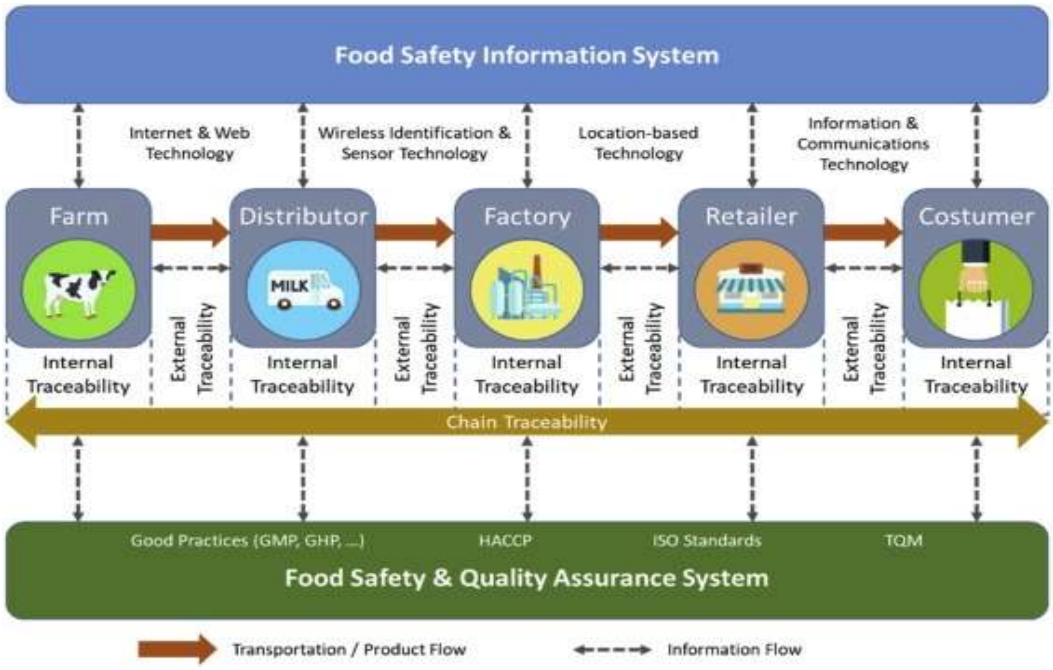
II. EXPERIMENTATION:

Our focus was on existing initiatives, projects and case studies, and not on the general potential of blockchain in the field. Based on this search, only 29 papers were identified. From these papers, just 23 were relevant, in terms of using blockchain technology in food supply chain. To increase bibliography, related work of the initial 29 papers was examined, together with a keyword-based search in popular search engines, increasing the number of relevant identified initiatives to 49.

Based on their purpose and overall target/goal, these 49 initiatives were divided into six main categories, as follows:

a) food security (2 projects/initiatives, 4%),
b) food safety (3 projects/initiatives, 6%),
c) food integrity (24 projects/initiatives, 49.5%),
d) support of small farmers (8 projects/initiatives, 16%),
e) waste reduction and environmental awareness (5 projects/initiatives, 10%), and
f) better supervision and management of the supply chain (7 projects/initiatives, 14.5%).



Food integrity is about reliable exchange of food in the supply chain. Each actor should deliver complete details about the origin of the goods. Examples of these details have been listed at the beginning of Section 3, and the process is described in Figure 2. This issue is of great concern in China, where the extremely fast growth has created serious transparency problems (Tian 2017), (Tse, et al. 2017). Food safety and integrity can be enhanced through higher traceability (Galvez, Mejuto and Simal-Gandara 2018), (Creydten Fischer 2019). By means of blockchain, food companies can mitigate food fraud

Recent research has predicted that the food traceability market will be worth $14 billion by 2019 (MarketsandMarkets Research 2016). There are numerous examples of companies, start-ups and initiatives aiming to improve food supply chain integrity through the blockchain technology. The most important on-going projects are listed below, based on their scale, their potential impact and the significance of the partners, organizations and/or actors involved. The agricultural conglomerate Cargill Inc. aims to harness blockchain to let shoppers trace their turkeys from the store to the farm that raised them (Bunge 2017). Turkeys and animal welfare are considered at a recent pilot involving blockchain (Hendrix Genetics 2018).

Food safety: is the condition of processing, managing and storing food in hygienic ways, in order to prevent illnesses from occurring to human population. Food safety and quality assurance have become increasingly difficult in times of growing global flows of goods (Creydten Fischer 2019). The Center for Disease Control and Prevention (CDC) claims that contamination because of food causes 48M Americans to become ill and 3,000 to die every year (CDC 2018), (Tripoli and Schmidhuber 2018).

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In 2016, Oceana performed a research on seafood fraud, showing that 20% of seafood is labelled incorrectly (Oceana 2013). Lee et al. commented that food supply chains are characterized by reduced trust, long shipment distances, high complexity, and large processing times (Lee, et al. 2017).

Blockchain could provide an efficient solution in the urgent need for an improved traceability of food regarding its safety and transparency. As Figure 2 shows, recording information about food products at every stage of the supply chain allows to ensure good hygienic conditions, identifying contaminated products, frauds and risks as early as possible. Walmart and Kroger are among the first companies to embrace blockchain and include the technology into their supply chains (CB Insights 2017), working initially on case studies that focus on Chinese pork and Mexican mangoes (Kamath 2018).

Potential benefits: Blockchain technology offers many benefits, as it can provide a secure, distributed way to perform transactions among different untrusted parties (Yuan, et al. 2019), (Pearson, et al. 2019), (Creydten Fischer 2019). This is a key element in agriculture and food supply chains, where numerous actors are involved from the raw production to the supermarket shelf (Lin, et al. 2017), (Tripoli and Schmidhubber 2018). To improve traceability in value chains, a decentralized ledger helps to connect inputs, suppliers, producers, buyers, regulators that are far apart, who are under different programs, different rules (policies) and/or using different applications (Lee, et al. 2017). Via smart contracts, manufacturers can develop scalable and flexible businesses at a lower cost, and the overall effectiveness of manufacturing services can be improved (Li, et al. 2018).

Blockchain has the potential to monitor social and environmental responsibility, improve provenance information, facilitate mobile payments, credits and financing, decrease transaction fees, and facilitate real-time management of supply chain transactions in a secure and trustworthy way (Lee, et al. 2017). In the case of an outbreak of an animal or plant disease, contaminated products could be traced more quickly (Tripoli and Schmidhubber 2018). Blockchain could even be used to make agricultural robotic swarm operations more secure, autonomous and flexible (Ferrer 2018).

In particular, blockchain seems very suitable to be used in the developing world, as we saw in the Section 3.4, in relation to small farmers' support. Other scenarios could involve finance and insurance of rural farmers (Chinaka 2016), as well as farmers outside.

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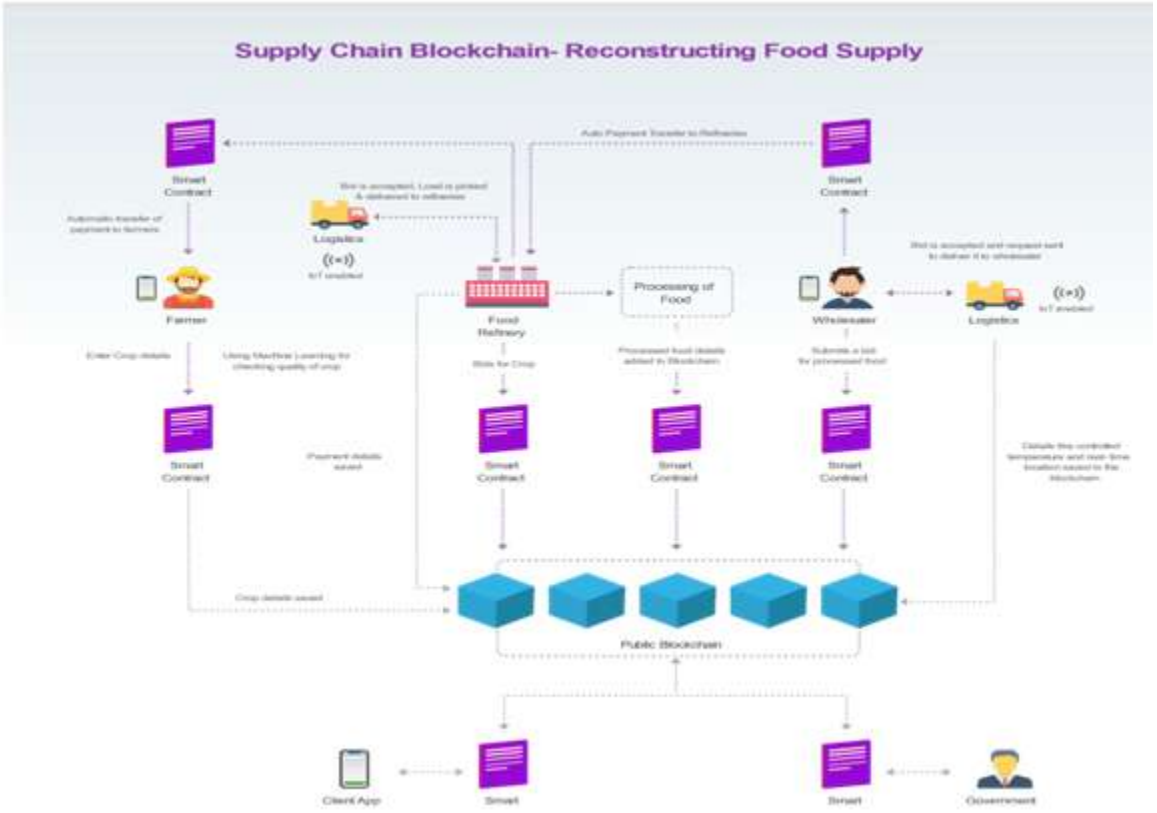
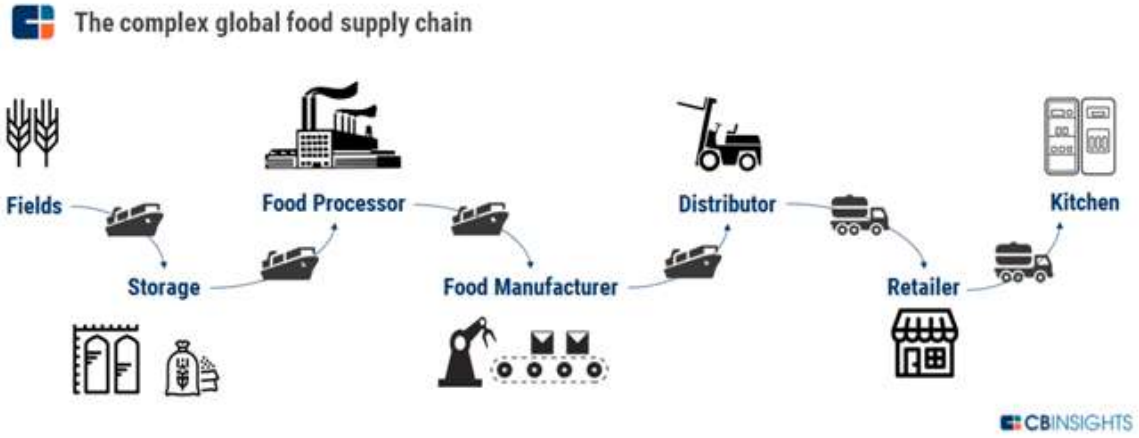
Diagrams:





III. CONCLUSION

Looking back on this project, the overall outcome of results to be observed. This can be evaluated by looking at how well our objectives were met. To reduce barriers of use, governments must lead by example and foster the digitalization of the public administration. They should also invest more in research and innovation, as well as in education and training, in order to produce and demonstrate evidence for the potential benefits of this technology. Even many governments are implementing this technology which is beneficial to the the consumers as well as the farmers.

From a policy perspective, various actions can be taken, such as encouraging the growth of blockchain-minded ecosystems in agri-food chains, supporting the technology as part of the general goals of optimizing the competitiveness and ensuring the sustainability of the agri-food supply chain, as well as designing a clear regulatory framework for blockchain implementations.

So, blockchain is has a huge impact on food supply chain in companies like Nestle,

Walmart , Dole, Golden State Foods, Unilever, and McLane Company, are also experimenting with the potential of blockchain in the food supply chain.
Supply chains are now in every organisation which leads to immutability, secure and efficient supply chain based on blockchain technology.

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