მოწყობა, რათა ჩაერთოს აღნიშნულ დაცულ ტერიტორიების რიგებში (მაგალითად, კურორტი ლებარდე, კურორტი ზეკარი და ა.შ.).

რეგიონალური ტურიზმი მნიშვნელოვან როლს შეასრულებს არამარტო რეგიონალური ეკონომიკის, არამედ ქვეყნის სოფლის მეურნეობის განვითარებაში.

სოფლის მეურნეობის დარგში დასაქმებული სუბიექტებისათვის საჭიროა სამეცნიერო-საკონსულტაციო მომსახურების, პროფესიული ცოდნის დაუფლებისა და კვალიფიკაციის ამაღლების ხელშეწყობა, რათა განვითარდეს შიდა სასურსათო ბაზარი და დავიცვათ სასურსათო უსაფრთხოება. შესანიშნავი იქნება საკვების ფესტივლების მოწყობა, რომელიც იქნება ადგილობრივად მოყვანილი პროდუქციით და მოეწყობა ტრადიციული სამზარეულოს გამოფენა. კულტურული ღონისძიებების დაგეგმვა და აშ. რაც ხელს შეუწყობს ასევე რეგიონის და სოფლის განვითარებას.

Blockchain Technology – Breakthrough for Agri-food Industry
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Abstract. In the modern world, there is a growing interest in Blockchain Technology (BCT) both in the business world and among researchers. One of the potential areas where this technology is expected to be widely used is the agri-food supply chain. The purpose of this article is to highlight the needs for implementation of Blockchain Technology in agri-food supply chain and the benefits associated with the widespread use of this technology. To achieve this goal, the paper includes analysis of the world's leading studies, scientific articles and books. Research shows that the future potential of this technology and the advantages of its introduction.

Keywords: Agriculture, Supply Chain, Blockchain, Innovation.

1. **Introduction** Current population has a constantly growing tendency. Consequently, the issue of feeding the increased word population rises. It poses great

challenges to the agricultural sector to produce higher quantity of products with the acceptable quality and low costs, and simultaneously take care on environment (Fiore et al., 2018). Besides the usage of huge amount of clean water in agri-food production, there are other unpredictable factors such as climate change, the spread of new diseases and pests. Additionally, it is important to achieve maximum production not only by spending as few resources as possible but also by causing minimal damage to the environment, which poses additional challenges for farmers. This requires the understanding of the importance of modern technologies and systems in agriculture and of the fact that without modernization, for traditional farms alone will be difficult to meet the challenges in the field. Therefore, it is necessary for farmers to introduce innovative approaches to production process. Through modern technologies, the entrepreneur can optimize resources and increase profits with simple solutions.

2. The world evolves constantly and so the agriculture does. Due to the globalization, the international trade became a part of daily life. Agri-food supply chains got longer, more and more stakeholders are involved in the processes, the number of necessary paper-documents is increased (Adamashvili et al., 2018). Thus, the risk of fraud, contamination, mistakes, confusions, loss of information and other uncertainties increases. Information gets a crucial importance. It becomes a tool for consumers for getting known quality and provenience of products. The features of Blockchain Technology meet consumers' current requirements. Indeed, BCT supports registering all information during each phase of supply chain, making this information immutable, trustful and transparent (Gallo et al., 2019). Furthermore, it gives the ability to the interested party to trace and track the products along supply chain.

Insomuch, it is clear that the introduction of modern technologies is necessary. However, it should be noticed that this process requires solutions for many different challenges. Therefore, it can probably not be completed quickly and painlessly. Still, the agricultural sector has already adopted a lot of technological innovations. There are widely used Information and Communication Technologies (ICTs), Big Data Analytics (BDA), Internet of Things (IoT), Machine Learning (ML), Decision Support Systems (DSSs) and others (Adamashvili et al., 2020). Therefore, this field can be considered ready for further innovations.

The aim of this article is to analyze the impact of Blockchain Technology on agri-food industry. In order to reach the purpose, it consists of literature review. The topic related literature has been identified and studied from world's biggest databases such as Scopus, Web of Science (WoS) and Google Scholar. Cross-referencing have been used as well.

The next section of the article discusses the needs of emerging technologies in agri-food industry. It is followed by benefits of Blockchain Technology for agriculture. Lastly, the results and conclusion completes the paper.

2. Literature Review

2.1. Needs

Since 2000, combat malnutrition has become a global concern and one of the priorities worldwide (under SDG 2 - Sustainable Development Goals). However, it is still important issue. All over the world the issue of foodborne diseases is present to different extents. According to World Health Organization (WHO), an estimated 600 million (that is 1/10 of world population) fall ill because of eating contaminated food and 420,000 people die every year (WHO, 2020). Foodborne diseases are extremely costly in economic terms, and environmentally, in terms of wasted resources. The estimates of foodborne diseases in the US alone are roughly US$55 billion annually (Scharff 2015). Increasing importance is given to food safety and integrity that ensure handling, preparing and storing food in ways that prevent foodborne illnesses, as well as the fairness and authenticity of food in the value chains both materially and digitally. It is crucial for the global economic market and social well-being to have the food industry developing over time, where innovations define and create these improvements for the industry.

Besides, globalization has dramatically affected on how the people and companies interact with each other and do their businesses. Product and material flows are not as easy as before. Agriculture management is becoming more complex. A more frequent need for intermediaries causes the supply chains to get longer (Mylrea & Gourisetti, 2018). Hence, the documentation, along with copies for all other involved parties, increases the transaction processes that makes it challenging to understand the origin of products (Mei & Dinwoodie, 2005).

Moreover, due to the globalization, counterfeiting activities and fake products are growing in open market (Ting et al., 2015). This problem puts every day a strain on, not only the relationship of trust between business and consumer, but all the relationships that make up the supply chain. A numerous transparency and efficiency issues in agricultural supply chains ultimately put farmers and consumers at a disadvantage. Despite the fact that agri-food supply chains are already digitalized (cloud computing, artificial intelligence, internet of things), there are a lot of remarkable inefficiencies in the farming operations, distribution and selling.

Globally, the cost of food fraud is US$40 billion every year (PWC, 2017), the operational costs of supply chains are more than half of the total cost and 7% of the world trade costs are only the documentations (Niforos, 2017). Therefore, traceability becomes the crucial factor in agri-food supply chain, in terms of the ability to trace and follow the history of final product in the supply chain, and possessing necessary information on all stages of production process, warehousing, distribution and trade (Aung & Chang, 2014).

Additionally, consumers demand desired products in a shorter notice. Therefore, the companies need to meet consumers' needs, to perform efficiently and at the same time keep competitiveness and profit.

The innovations need to play a crucial part in the overall processes of food quality and human health improvement, nature protection, and biodiversity safety. In the modern world, the data has an effective impact on increasing the productivity of agriculture and farming, and even on maintaining a proper level of security and traceability for the products. Therefore, it has a crucial importance to get and manage the data accurately (Rabah, 2017; Ashutosh, 2012). The ability to keep the data accurate and make the documenting process efficient, encourages trustworthiness of products (Stich et. al, 2016). Since there is increased problem of information asymmetry and miscommunication among stakeholders caused by longer supply chains (Barratt, 2004), it is crucial to note that, the informational transparency of these processes is required in order to ensure trustworthiness of the products, as well as the effectiveness of all the elements that play part in the process (Hua et. al, 2018). Consequently, the low transparency state and not stably trustworthiness of the agricultural chains systems, poses a severe threat to safety, food quality and sustainability at times (Guo et. al, 2018; Saberi et. al, 2018).

The elements having the highest impact how the system works are strongly related to the information - data, its analysis, its exchange between actors, and in general, its availability in time as well as reliability. Agricultural data contains all kinds of information such as industrial data, storage, transportation, customer behaviors, etc. This data with emerged technologies can change the way companies do the businesses (Chen et al., 2019; You, 2019; Cayirci & Rong, 2018). By using resources in a more efficient manner, it has become a foundation for new business models that create new similar opportunities in making industries more transparent, time effective, traceable, trustful and sustainable. Subsequently, the need for third party involvement gets reduced, together with documentations, upscale internal operations of the companies and streamline business processes, that result higher profit and satisfaction of customers (Tripoli & Schmidhuber, 2018).

2.2. Benefits

A very promising way to solve these issues, would be using a technology that increases the notion of trust, improves the efficiency of agricultural development, and provides entirely transparent, secure and appropriate provision of data from farms, passing by agricultural technology providers, working staff, financial sectors, to the end of chain represented in processing and handling (Reyna et al., 2018). All these requirements can be found in blockchain technology (BCT) (Laurence, 2017). This is where blockchain technology can be of utmost importance and could potentially offer permanence of records and facilitation of shared data between diverse actors in food supply chain. Digitalization of the industries has already built new models of relationship between actors of supply chains. In this regard, blockchain is an emerging technology and it is already transforming the ways, stakeholders interact with each other (Queiroz & Wamba, 2019).

Blockchain technology can benefit all actors, by minimizing the food contamination risks, and giving them the ability to know accurately the origin of the products (Yoo & Won, 2018). Indeed, Blockchain technology through decentralization, trustworthiness and collective maintenance ensures a reliable register of well-systemized information (Karikari et al., 2019). It creates accurate fixed data that is locked in time, for all needs and purposes (Lyons & Kahn, 2018). Blockchain technology provides a transformative information and communications, and has the potential to organize the dynamic structure of the data. Moreover, its highly resilient architecture and distributed nature make it an effective platform to deliver more accurate, and appropriate data sets for more productive analysis on a real time basis (Niforos-IFC, 2017). When the transaction occurs across supply chain, all network members get informed instantly and they do not need to wait for relevant documentations or actual actions to arrive in a traditional way. The potential blockchain technologies hold is vast, as they would be able to shift the paradigm and offer a transparent and trustworthy food chain processes within the food integrity standards.

To be precise, blockchain generally specifically addresses some of the most problematic aspects of the food system and offers beneficial solutions such as: transparency and accountability, origins and processing of food products, market access for small producers and international labor standards (Caro et. al, 2018; Neisse et. al, 2017; Klems et. al, 2017; Korneychuk, 2018). The ability to track food from its earliest stages, all the way to the shelves and be able to pinpoint all the participating firms as well as individuals in the process, earns customer confidence. Allowing the consumers to know where the food had been cultivated, how well it had been maintained and what the real current value is, promoted a more informed decision-making behaviors, encourages consumers to purchase the products safely and earns

a higher revenue to firms/individuals (Kshetri, 2018). So, a recall progress in BCT, that means to have the ability of tracing product ownership, also helps to define if along supply chain, there is passed and used the correct information about product. Before purchasing a product, consumers can be able to verify all the data and consult the certified documentation: not only the origin and provenance, but also the information about transportation conditions - if the frozen food was transported safely at the right temperature, for instance. Theoretically, those who have the access to the network, can track and trace all the relevant information regarding the product. That makes easier for manufacturers, on the one hand, to identify the weak points or causality of faulty; for regulators, on the other hand, to verify if the product meets the standards. Consequently, BCT is recognized as a significant tool to solve the problems related to faulty, fraud and adulteration (Ge et al., 2017). It is a digital distributed ledger that providing immutable permanent transactions and distributed data access, ensures opportunity to record, track, and monitor the assets in a reliable way (Niforos-IFC, 2017).

Blockchain technology makes it easier to trace contaminated products to their source quickly, allowing faulty items to be removed from stores to minimize both illness and financial losses. Blockchain is a digitally ledger containing a reliable and trustworthy information on the origin and provenance of food products. It improves the food standards through transparency and detailed information recorded in the system. This information includes the data about quality (freshness, safety, geographic indications), safety (health, risk management) and sustainability (organic, Fairtrade) of products (Tripoli & Schmidhuber, 2018). Due to the high efficiency potential that comes with the blockchain technology, the food industry workers are able to easily determine products that should be removed from shelves in a matter of minutes instead of the days, it would traditionally require for the same task. Thus, the economic advantage in addition to lower health risks for the customers and higher quality food presentation in stores. Therefore, BCT enables businesses and regulators to trace and pinpoint contaminated or fraudulent products quicker and less wastefully.

Blockchain technology (BCT) can substantially reduce the costs in supply chain and increase the efficiency of the operations especially if there is a need for contracts (Chen et al., 2018). The introduction of BCT would allow the sharing of agri-food information in a reliable and safe environment while guaranteeing its immutability. All the players in the supply chain would no longer need to use "paper documents" or rely on central entities or third parties to certify the various information and documents produced during the various supply chain passages. BCT also allows to create "smart contracts" and to have a unique system of records (Accenture, 2018). Smart contracts are a type of computer programs that allow users to create the

contract by posting a transaction to the blockchain and by building complex if-then statements; the contracts can self-verify if the conditions meet the agreements done by nodes (Laurence, 2017). The advantage compared to physical contracts, is that smart contracts do not depend on centralized authorities, they do not need to settle or clear the transactions manually that are time consuming, costly and contain high risk of error or fraud. So, smart contracts provide the real-time performance of the contractual obligations and, at the same time, huge savings in transaction fees and legal costs.

Last but not least, from the microeconomic point of view, innovations play an outstanding role for suppliers' success in this field. Consequently, according to the academic data reviewed above, the implementation of software innovations regarding consumer preferences and demands, are crucial and can assist in trustworthiness and transparency of food value chain processes. This could mean higher competitiveness on the market for the firms that have adopted the innovative software approach, while it would mean trustworthy and good quality end products for the customers.

3. Results and conclusion

The agriculture sector benefits from digital innovations. However, the study highlighted the issues of current agri-food supply chains. They still deal "paper documents". Tracking and tracing the product is still challenging. This reflect in the risk of counterfeiting or in the difficulty to recall the product from retail stores. This latter may cause the spread of illness in the population related to alimentation. The article also showed the features of BCT that can be a solution for identified problems along supply chains.

The benefits of BCT implementation is agri-food supply chain is obvious. This technology has the ability to register all the data immutably and securely transfer it. Moreover, it reduces the time to accumulate necessary information and provide with it the interested party. Therefore, it simplifies recall process as well and, consequently, minimizes the risk of fraud, illness and related costs.

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