

BLOCKCHAIN AS A MODEL FOR INNOVATION IN COFFEE EXPORTS

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Abstract: The intensification of new technologies from the 90's, allowed the optimization of time and money throughout the industry. As agriculture is an important sector in Brazil and new technologies are constantly being adopted, Blockchain emerges as a viable alternative to serve the entire export chain of the coffee sector. Considered the second largest commodity in the world, Brazil being the main producer and exporter of this culture. The coffee chain is simple yet complex and the adoption of Blockchain would facilitate the commercialization and existing database in the chain. In this way, with the introduction of new technologies that facilitate trade processes, traceability, logistics, food safety and access to information on each aspect of the coffee market, Blockchain could be an alternative that will contribute to the optimization of trade transactions in the sector. . The general objective of this research was to investigate Blockchain as a technological alternative to fill the gap in the coffee production chain, regarding information transparency and process agility. The emergence of blockchain as a tool for agribusiness promoting the search for information, traceability, with quality criteria and socio-environmental compliance that would be certified throughout the process, which, from the point of view of domestic and foreign consumer markets, could boost the adhesion of the Brazilian Identification System (BRASIL, 2017). The method used in this research was exploratory research, which, according to Gil (2008), has the main purpose of developing, clarifying and modifying concepts and ideas, with a view to formulating more precise problems or researchable hypotheses for further studies. It was observed that the payments of most taxes at origin have the producer as the weak link in the chain, reflecting on its profitability; there was a need to create a shareable and easily

accessible data platform, with the producer as the user of origin and the consumer as a supervisory agent, in this way, it is possible that it is an easy-to-use, accessible, safe, traceable and immutable and positive against fraud. It is concluded that the adoption of blockchain would facilitate the understanding of the sector, creating management, logistics and commercial strategies, in order to monetarily benefit everyone who is inserted in the chain. Clarity of information for the consumer is increasingly required, and tracking each step can be beneficial against fraud, health issues and information seeking. Its main advantage is the security of information and its characteristic of being immutable, an important factor so that falsifications and frauds do not occur during the course of the chain, thus guaranteeing a greater tax return for the public coffers, in addition to facilitating customs inspection in ports.

Keywords: External market, taxation, coffee chain, big date.

INTRODUCTION

From the 1990s onwards, the intensification of the opening of markets brought with it a business approach to agricultural activity as an economic segment called agribusiness. Agribusiness is based on the use of systematic ideas to build the basis for the production, processing, storage, distribution and commercial operation of agricultural inputs and products (CASTRO, 2001).

According to Lourenço (2008), agribusiness is modern, efficient and competitive, becoming a prosperous, safe and profitable activity. According to the Agribusiness Portal (2021), Brasil has a diversified climate, regular rainfall, abundant solar energy and almost 12% of all available fresh water on the planet, Brasil has 388 million hectares of fertile and high-quality

arable land. productivity, of which 90 million have not yet been exploited.

In terms of market value, coffee is currently the second largest commodity in the world, after oil (TALBOT, 2004). Among the current agricultural products, coffee is grown in 50 countries and consumed in dozens of others, being one of the oldest commodities in the world and one of the products that has contributed most to the expansion of the European world economy (TALBOT, 2004; WALLERSTEIN; Hopkins, 1986).

In 2016, the coffee park was estimated at 2.25 million hectares and there were approximately 287 thousand producers in 1900 municipalities. In addition, Brasil has become the largest consumer of coffee in the world, surpassing the United States, with an annual average of 839 cups of 40 ml being consumed per person, which represents more than 5 times the world average (ABIC, 2018).

With the advance in information and communication technologies (ICTs) the physical, political and cultural barriers between nations have been reduced. Globalization has facilitated access to raw materials, goods and services and given all people the power to influence the direction of technological development and the formatting of goods and services (EMBRAPA, 2014).

Armed with equipment and sensors, with no connection limits, the world population exercises its power of choice on a global scale, substantiating the *Big Data reality*, in which a large volume of data and information on trends and demands reflects, among others, manifestations of character cultural and psychosocial. It is essential that research and innovation organizations invest heavily in tools and processes to support the forecast of technological demand and future demand for goods and services, which is becoming increasingly fragmented and dynamic (EMBRAPA, 2014).

In the near future, the private sector will use the *Big Data tool more frequently* in order to multiply access to services and consumer goods. The public sector will use it to support the formulation, improvement and implementation of public policies in sensitive areas (such as medicine, public health, food production and the environment). In the agricultural field, the *Big Data Era* will still affect genetic improvement, climate prediction, precision agriculture and the understanding of market dynamics (EMBRAPA, 2014).

The emergence of *blockchain* as a tool for agribusiness can promote the adoption of so-called smart contracts (*Smart Contracts*), with quality and socio-environmental compliance criteria that would be certified throughout the process, which, from the point of view of domestic consumer markets and abroad, it can boost the adhesion of the Brazilian Identification System (BRASIL, 2017).

Blockchain is a model based on the establishment of an *approved* consensus between all the “blocks” that make up the *blockchain* and is ensured by an algorithm that acts as a proof of work, *defining* the parameters for incorporation of data packets into the network. (KYPRIOTAKI & ZAMANI, 2015).

This way, with the introduction of new technologies that facilitate trade processes, traceability, logistics, food safety and access to information on each aspect of the coffee market, Blockchain could be an alternative that will contribute to the optimization of trade transactions in the sector.

RESEARCH PROBLEM AND OBJECTIVE

The general objective of this research was to investigate the *Blockchain* as a technological alternative to fill the *gap* in the coffee production chain, referring to information transparency and process agility. *Blockchain* as a model of innovation in the sector.

THEORETICAL FOUNDATION OVERVIEW OF COFFEE AND BLOCKCHAIN

Calculated by market value, coffee is now the second largest commodity in the world, behind oil (TALBOT, 2004). Among current agricultural products, coffee is grown in 50 countries and consumed in dozens of other countries, being one of the oldest commodities in the world and one of the products that most contributed to the expansion of the European world economy (TALBOT, 2004; WALLERSTEIN; Hopkins, 1986).

There are two main types of commercial coffee in the world: Arabica coffee, which accounts for about 70% of the world market, and Conilon, for the remaining 30%. Arabica coffee is a plant highly susceptible to climatic conditions (drought, hail and frost) and can only grow under certain tropical or subtropical climatic conditions with a temperature of 17° to 25°C. The altitude is between 800m and 2,000m, depending on the latitude, the rainfall is between 1,200 and 1,500 mm, and rainfall is concentrated in the period of flowering, fruiting and drought at harvest (ICO, 2012).

Currently, coffee is a commodity produced in more than 60 countries and is considered one of the commodities with the highest volume of commercialization in the world. In fact, the importance of coffee trading activities has spread to over 125 million people worldwide and is maintained through this trade (VAPSYS, 2019).

However, although Brasil is the largest producer and exporter of coffee, it still faces the difficulty of a more efficient commercialization. Since this activity needs to be adjusted, in addition to the packaging and use of the product description, it must also be introduced according to certain functions of the importing country, and the description must be done in the corresponding official

language (SIMÕES, 2000).

In addition to the difficulties caused by the lack of understanding of foreign markets, one of the main obstacles to the international competitiveness of Brazilian industrialized coffee is the lack of procedures, largely related to logistics. Notwithstanding the need to participate in international fairs, management and incentive to add value to the product to make industrialized coffee more competitive in the foreign market, logistics organizations still have their own requirements to complete the export trade of the coffee sector (SIMÕES, 2000).

With the constant technological evolution and digital economy, information and communication technologies have become fundamental for economic progress, and in addition, they have provided paths for the emergence of new payment methods, such as virtual currencies, among them, bitcoin, which since its creation has expanded borders, reaching a market value higher than the Brazilian Real (SWAN, 2015).

This currency is based on the blockchain, a decentralized database of records, called a public ledger, of all transactions or digital events that were executed and shared between participants. Each transaction requires the consent of the system participants in order to be verified, and once entered, the information will never be deleted. Furthermore, the *blockchain* contains a reliable record of all transitions performed, and its great success has attracted attention not only in the financial market, but also in academia and other sectors (SWAN, 2015).

However, away from these financial institutions, there is a problem in transactions, as nothing prevents a user from forwarding the same file that he transmitted to a particular individual, to another network user, which generates the expense of duplicating the same currency unit (ULRICH, 2014).

This obstacle was solved by *blockchain technology* that works as a digital ledger shared by all users of a P2P network, that is, it is nothing more than a structure that maintains information on transactions already carried out in the market of a certain virtual currency, and identical copies of this record are accessible to all network participants, and so when a user sends a monetary transaction equal to another one already performed to a user who is not the current sender, the *blockchain will* record two distinct transfers (FONSECA, 2016).

Therefore, the main properties of this technology that are beneficial to the development of applications and systems are the decentralization of applications, which are executed in a distributed way through the establishment of trust between the parties without the need for a reliable intermediary entity, the availability and integrity, since the entire set of data and transactions are replicated in different blocks, transparency and auditability (CHAGAS, 2019).

Since all transactions are contained in the public ledger and can be audited and verified at any time, the immutability and irrefutability of transactions, which once registered cannot be refuted and updates are possible through new transactions, privacy and anonymity, and for Finally, cooperation and encouragement (CHAGAS, 2019).

According to Swan (2015), the potential benefits of *blockchain application* go beyond the economic environment, and can be used in political, humanitarian, social and scientific domains, with great potential to revolutionize industry, commerce and drive economic change, due to transparency and security the exchange of values and information in both the public and private spheres (MATTLA, 2016).

In agriculture, one of the possible applications of *blockchain technology* are

socio-environmental certifications, which can act as an enabler in the certification process of small rural producers, since the principles of the technology are similar to the pillars of the Participatory Guarantee System (SPG), a system that works from a network of producers with the objective of inspecting practices adopted by the other members of the group, respecting what is allowed for the production of organic products, that is, both are based on a system of transparency, security and socialization through the active participation of its members (FOSTER & CARDAMONE, 2018).

METHODOLOGY

This work will be conducted by using secondary data obtained through bibliographic reviews, encompassing books, academic works, websites of public and private institutions.

According to Gil (2008) the main purpose of exploratory research is to develop, clarify and modify concepts and ideas, with a view to formulating more precise problems or researchable hypotheses for further studies.

The same author also defines descriptive research as the description of the characteristics of a given population or phenomenon or the establishment of relationships between variables. There are countless studies that can be classified under this heading and one of its most significant characteristics is the use of standardized data collection techniques.

Triviños (1987) says that descriptive research requires the researcher to provide a series of information about what he wants to research. This type of study intends to describe the facts and phenomena of a certain reality.

Seabra (2002) clarifies that, unlike qualitative research, the results of quantitative research can be quantified. As the samples are usually large and considered representative

of the population, the results are taken as if they constituted a real portrait of the entire target population of the research. Quantitative research focuses on objectivity. Influenced by positivism, she believes that reality can only be understood based on the analysis of raw data, collected with the help of standardized and neutral instruments.

The analysis will be descriptive, operationalizing the data in graphs and tables in which a rereading of the source of origin (CECAFÉ) was carried out, in order to facilitate the understanding for comparisons and the research will be based on the theoretical field in an extensive and exploratory way using results which will be analyzed according to the information obtained through secondary data, characterizing the sector and seeking valid alternatives for innovation in the field of transparency.

ANALYSIS OF RESULTS

Coffee is the second most consumed beverage in Brasil, second only to water, and this reflects on our productivity, guaranteeing Brasil as the largest coffee producer in the world, with approximately 3,019,051 tons of production volume per year, which demonstrates the greatness of Brazilian agribusiness and its importance to the national economy. In terms of exports, according to data from the Council of Coffee Exporters of Brasil (CECAFÉ) in February 2020, Brasil exported 3.3 million bags of coffee (considering the sum of green, soluble and roasted & ground coffee). In terms of values, foreign exchange revenue was US\$ 423.7 million.

According to data from the Ministry of Agriculture, Livestock and Supply (MAPA, 2017), the national coffee park is estimated at 2.25 million hectares and comprises a universe of about 290,000 producers, most of them small, spread across approximately 1,900 municipalities.

Coffee plantations are present in 15 Brazilian states: Acre, Bahia, Ceará, Espírito Santo, Goiás, Federal District, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraná, Pernambuco, Rio de Janeiro, Rondônia and São Paulo (figure 1). Soil characteristics, altitude, temperature range and climate are crucial to guarantee the quality of the product.

The diversity of microclimates present in each Brazilian state allows the production of countless variations of coffee, each one with its particularity, whether in aroma or with a special flavor. The export of differentiated coffees is something that has been growing a lot and that countries like the United States, for example, are increasingly looking for, due to the taste that they like the most. According to CECAFÉ (2021), Brasil exported 1 (one) million bags of differentiated coffee (higher quality, special or with some type of certification) between January and February 2021, with a revenue that reached US\$ 173.7 million. The destination countries are USA, Belgium, Germany, Japan and Italy.

As a means of transporting Brazilian coffee production, the port of Santos is in the lead, with around 78% of shipments to destination countries. Next, we have the ports of Rio de Janeiro (RJ), Vitória (ES), Paranaguá (PR) and Salvador (BA), as shown in Figure 2 below.

Following the same trend of differentiated coffees, coffees that do not have any special features are mainly destined for the USA, Germany, Belgium, Italy and Japan. As shown in figure 3, it shows the countries that most export our coffee and Figure 4, by continent.

Arabica coffee is today the most widespread species in Brasil, and in terms of quality, it has greater prestige. As a characteristic, it is a high-altitude plant, and because of that its production is mostly concentrated in the states of São Paulo, Minas Gerais, Paraná, Bahia and



Figure 1 - Main producing states (MG, ES, SP, BA and RO).
Source: CECAFÉ (2021). Self elaboration.

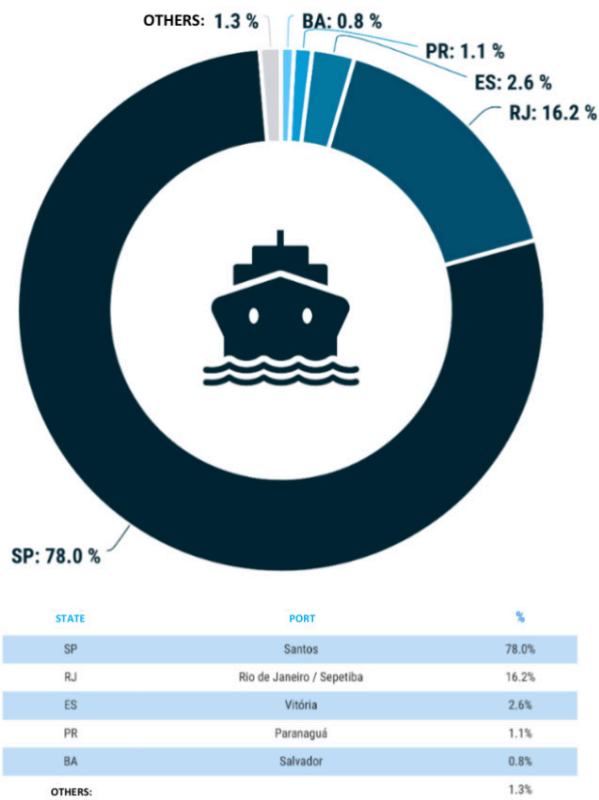


Figure 2 – Brazilian coffee exports by dispatch and shipment units in 2021.
Source: CECAFÉ (2021). Self elaboration.

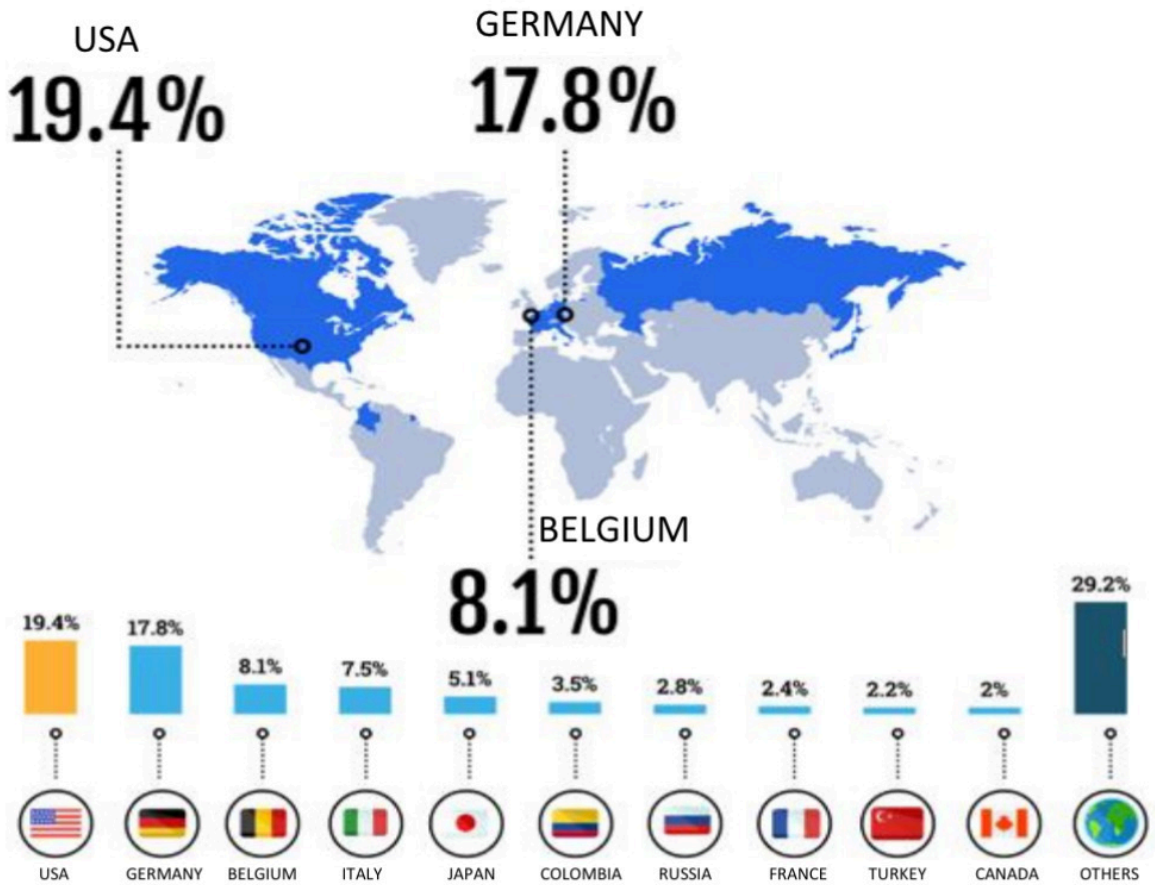
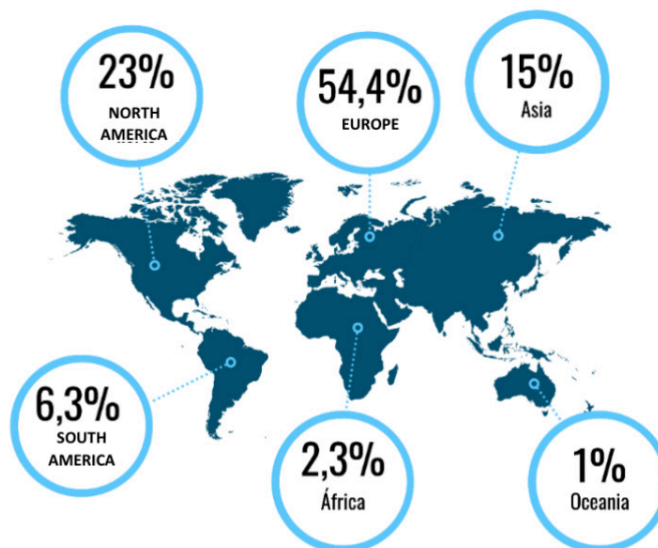


Figure 3 – Main destinations of Brazilian coffee exports in 2021.

Source: CECAFÉ (2021). Self elaboration.



*Central America has a 0.1% share.

Figure 4 – Share in Brazilian Coffee Exports by Continent.

Source: CECAFÉ (2021). Self elaboration.

part of Espirito Santo. Robusta coffee, on the other hand, is mainly produced in the states of Espirito Santo and Rondônia, and is mostly used by the industry to make soluble coffee.

Table 1 below shows exports by type of coffee in the period from January to February of the last 5 years, in addition to the percentage share by quality of coffee in exports.

Foreign exchange revenue and volume in Brazilian exports in the last 5 years has been growing year after year, as can be seen in Figure 5. This shows how relevant the Brazilian product has been compared to the others, which creates a trend of choice priorities for consumers in destination countries, in which, due to the gustatory power, they prefer the Brazilian product.

According to data from the Ministry of Agriculture, Livestock and Supply (MAPA, 2018), Brazilian coffee production is one of the most demanding in the world, in relation to social and environmental issues, and there is a concern to ensure the production of sustainable coffee. The coffee activity is developed based on strict labor and environmental legislation.

According to a consultancy carried out by IDC (2018), Brasil is the 11th in the world in the use of blockchain, with prospects for high investments and a lot of innovation¹ in various sectors. Agribusiness, which has been undergoing a digital revolution, is increasingly adherent to the data storage era. The *blockchain* in agro can have several purposes, functioning as a network of linked blocks that always carry content.

Technology today is an ally of man, being responsible for simplifying information to the reader. In view of this gap in transparency between the destination of the post-gate product to the final consumer, highlighting food safety, there needs to be a traceability

system that is safe and immutable.

In addition, the producer must be aware of what he has and what he pays in tax to the government. A dual transparency portal using the *blockchain system* would solve these problems.

For the development of a transparency portal with the producer as a user, we highlight the concomitant help and cross-referencing of data from the Ministry of Agriculture, Livestock and Supply (MAPA) with the Secretariat of the farm of each state and federal revenue, facilitating transparency of data and access to information regarding the current situation of the property with its obligations (IPTU, IPVA, ICMS and the like).

Agriculture 4.0 can be accessible to everyone, in order to meet farm needs. Portraying in a single and safe system what can be applied, at the time of planting, at harvest and identifying which cooperative collected the production to process and commercialize for trading carrying out the export is something that will bring food security and product traceability and confidence in the product Brazilian market, making it even more competitive.

Figure 6 below shows how this would work for the producer. The main advantage would be the transparency of its obligations and would make it easier for the Tax Authorities to inspect what is exported and tax return to the public coffers, avoiding fraud, which is common in this sector. The “Expresso” operation can be cited as fraud, in which, according to the Money Times (2021), more than 1 billion reais in tax evasion in the sector is estimated.

According to Debona et. al (2019), the daily life of a producer assigns many functions on his property, and his responsibilities within a production system are of paramount importance to ensure productivity.

1. Innovation: Use of different tools, techniques and models in order to improve the creation of products and services. Most of the time, technology is used to implement the system.

Time course	Volume in bags					
	Green coffee			Industrialized coffee		
	Robust	Arabica	total coffee	roasted	ground	total coffee Industrialized
Jul-16 a Mai-17	258.517	27.178.633	27.437.150	28.435	3.433.401	3.461.836
Jul-17 a Mai-18	398.891	24.268.880	24.667.771	18.636	3.183.199	3.201.835
Jul-18 a Mai-19	3.230.569	31.408.046	34.638.615	20.190	3.664.724	3.684.914
Jul-19 a Mai-20	3.818.952	29.650.046	33.468.998	24.813	3.686.835	3.711.648
Jul-20 a Mai-21	4.316.881	34.515.335	38.832.216	25.860	3.641.709	3.667.569

Table 1 - Brazilian exports by type of coffee.

Source: CECAFÉ (2021). Self elaboration.

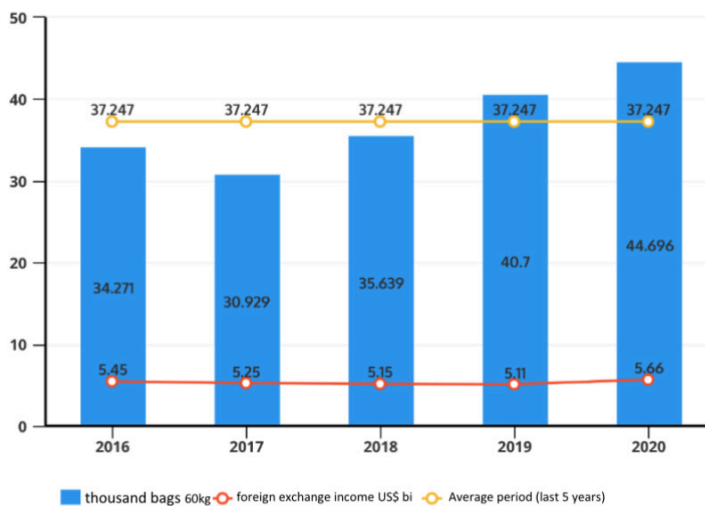


Figure 5 – Evolution of the volume and foreign exchange revenue of Brazilian coffee exports

Source: CECAFÉ (2021). Self elaboration.

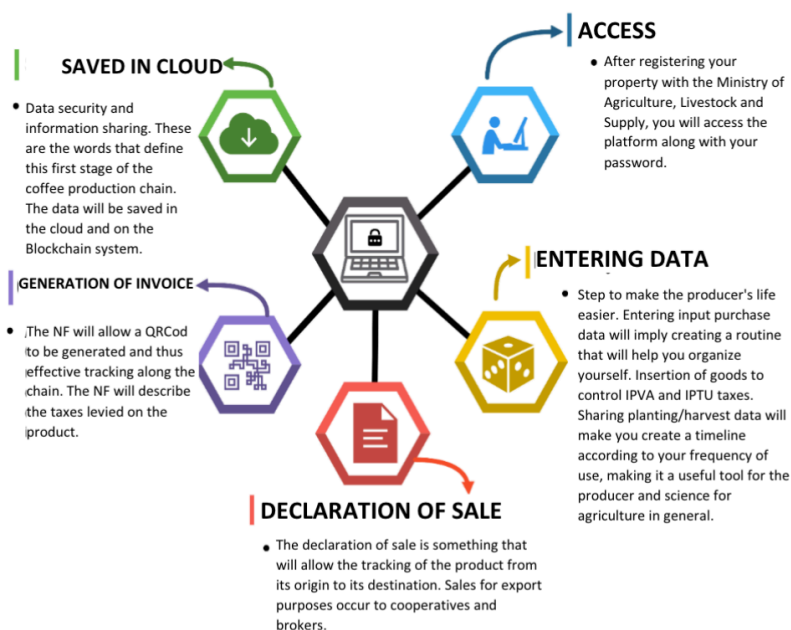


Figure 6 - Transparency system with the producer as a user.

Source: Own elaboration.

The difficulty with the handling of new information methods becomes an obstacle in the validation of the idea, which can be solved for those who do not have time or information for a business opportunity, from a company that has an agreement with MAPA, to carry out the visit and input of the producer's data on the platform, in addition to consulting, as an example in what happens with currency operations.

We can mention, for example, the company Licempre, which works for MAPA, offering services such as registration and/or alteration of the company in the system, adequacy, operating authorization, special authorization, audits and other services. As a *blockchain method* of traceability, we can mention Coplacana, which in partnership with EMBRAPA, has been carrying out tests to test the usability of the tool as a screening method in its sugarcane production.

The assertive use of the system will make it easy for the producer to have data on his property, such as the ideal timing for managing planting or harvesting, in addition to creating a timeline of his property and thus taking advantage of their own information in future harvests. For inspection bodies, the advantage will be the collection of information relevant to the growth of our agriculture (coffee sector).

The figure below shows what the step-by-step process would look like regarding the usability of the system integrating the cooperative and the trading company to carry out the conference and sale of the product for export.

For the transparency system to work, there must be inspection and mandatory use by cooperatives and trading, in which each one will feed the system creating a peer-to-peer (data sharing without the need for a central server). If an irregularity is detected somewhere in the food chain, the system can take it to the point of origin, which makes

investigations easier and more assertive, reducing the need for multiple checks.

The following figure 8, explaining the *blockchain system* as a traceable system of irregularities, having as a concept in terms of traceability, the efficiency worked out so that the posterior link contains information from the previous link.

Another interesting point is the increasing demand for products that contain added value, either through certification or, according to SEBRAE (2020), it allows small farmers to more easily incorporate into the differentiated coffee market or some other aspect. Brasil is one of the leaders in specialty coffee exports and this shows us how this range of options has become attractive to consumers.

An interesting point to introduce would be the database, knowing where it came from, property information, where it went, until it reaches the final consumer, so that it is simple and accessible.

In the age of technologies and innovations, information from an entire chain can be displayed in Qrcode on the packaging of exported coffees. In addition to entertaining the consumer with information, this technology may be useful to the tax authorities of the country of origin, in the detection of any existing comorbidity or health alert, preventing its distribution in the local country. Below we have a flowchart that shows the operation of this technology from the producer to the tax authorities of the country of origin and consequently the consumer.

The purpose of using *blockchain* in the agricultural production chain ensures trust and security between all participants in the chain, where one information validates the other, optimizing inspection time, financial return, responsibility and transparency.

Its advantages are related to the distribution of records, where when

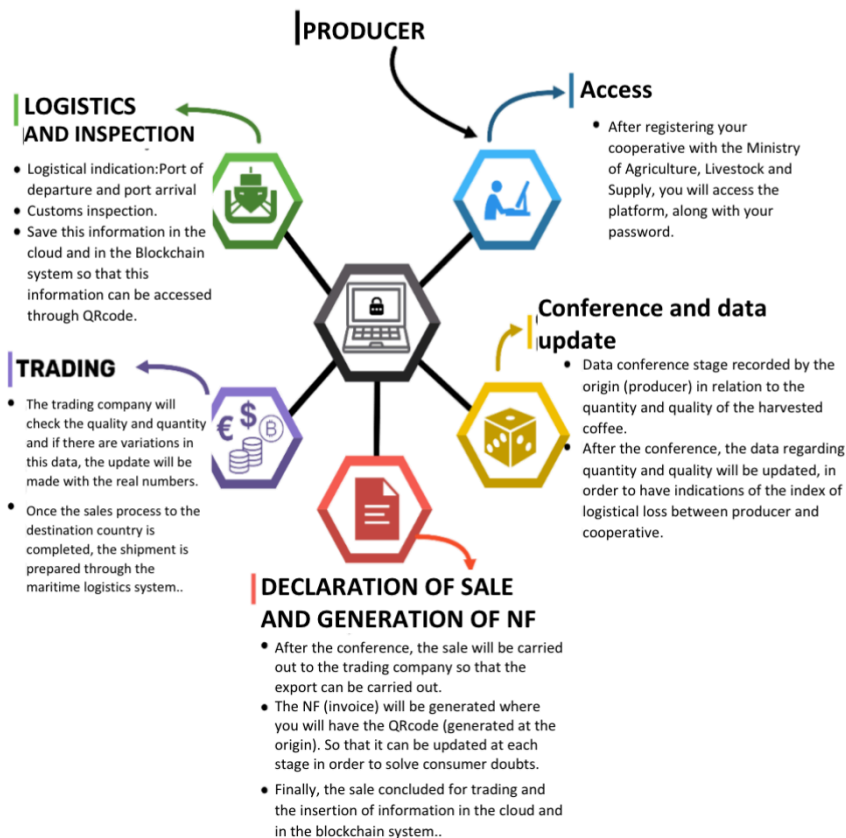


Figure 7 - Transparency system with the cooperative and trading as a user for export

Source: Own elaboration.

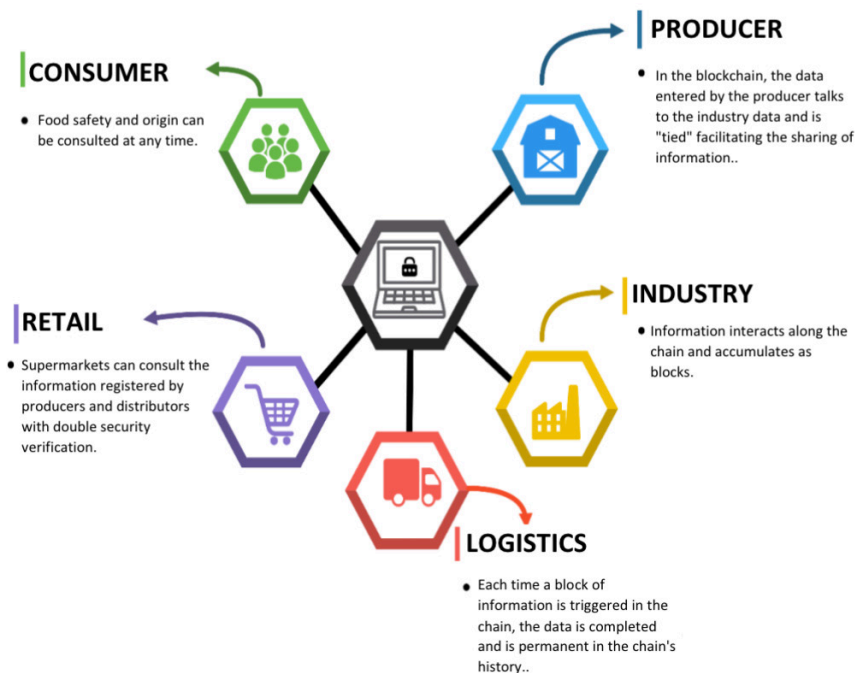


Figure 8 - Blockchain as a transaction tool, information; traceability and against irregularities.

Source: Own elaboration.

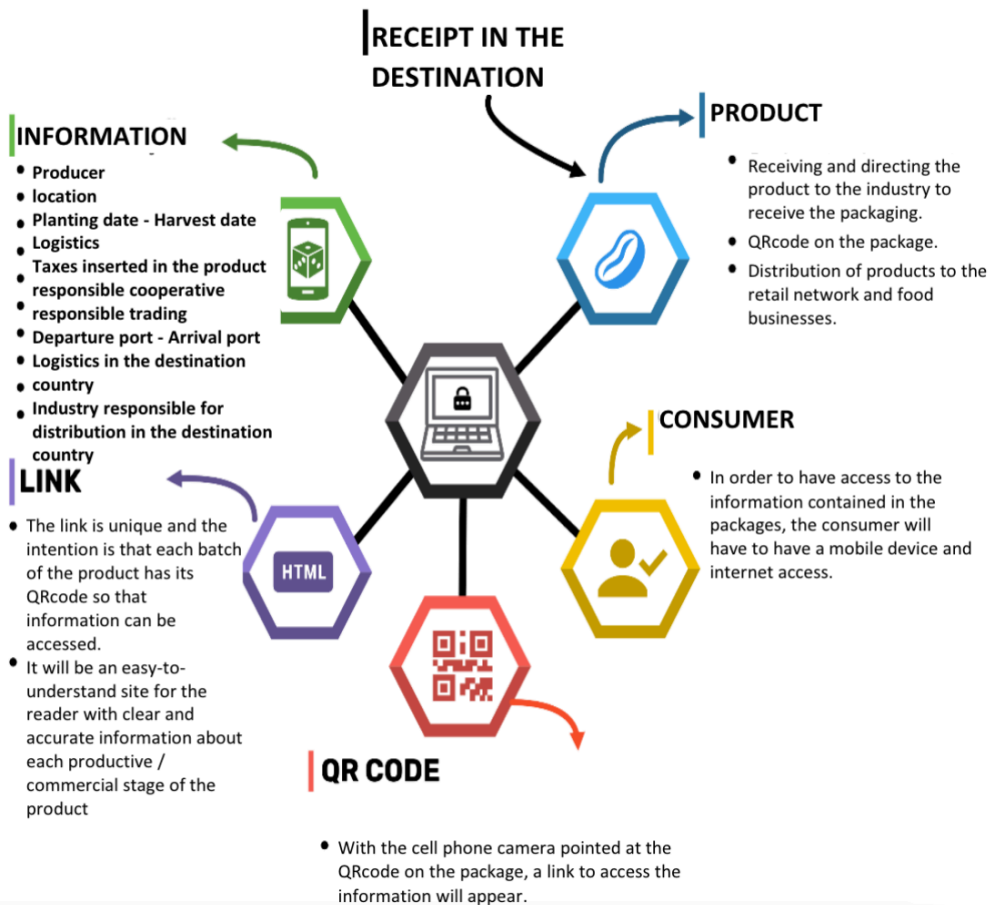


Figure 9 - Transparency system with the Consumer as a user

Source: Own elaboration.

registered an operation will be visible to everyone; privacy, where each operation can be verified and validated in the next block and the most important of all advantages, information security, being an immutable system and against fraud.

CONCLUSION

It is concluded that through the data presented, the importance of coffee activity in Brasil, since the sector stands out on the world stage with its product, having the position of the largest exporter in the world. There is also a large scale of production, which supplies internal and external consumption, which is due to the climate, altitudes and types of soil that favor the type of planting and thus diversify the product.

The producer, in turn, is responsible for a large part of the existing taxation in the chain, a problem that is not much explored in the academic field and that generates a gap in information and transparency for the

producer and society.

Another point was, possible frauds that occur in the chain in relation to tax evasion, a problem that would be solved with the assertive use of technology in your favor.

Being the producer the part that pays the most tax proportionally in the chain, noting that the difficulties are great in relation to the high and complex tax burden levied on the commercialization of the goods, as well as the various ancillary obligations. This point interferes with the final price of the product and, consequently, its commercialization, impairing an even better sales performance of the product.

Its main advantage is the security of information and its characteristic of being immutable, an important factor so that falsifications and frauds do not occur during the course of the chain, thus guaranteeing a greater tax return for the public coffers, in addition to facilitating customs inspection in ports.

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