TRACEABILITY ARCHITECTURE TECHNOLOGY FOR SHORT COMMERCIAL EXCHANGE

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Abstract

The intense governmental effort to achieve Sustainable Development Goals (SDG), allowed project development accomplishment within this framework and, hand in hand with globalization, has connected Colombian territories with large cities by technological interfaces. The population and territorial view of the SDG has promoted trends that bring near consumers and territories of goods producers or consumer services; one of these trends are short commercial systems (SCS). This research has proved that Colombian SCS aid commercial exchange equity, promote sustainable and conscious consumption, produce new social and commercial links, contribute to reducing packaging use and solid waste production, product freshness, traditions and knowledge exchange, supply chain actors autonomy and integration of actors involved; this was also potentialized by the Covid-19 sanitary crisis. Evidence showed that SCS is performed by families or farming associations that lack technics to certify quality process and that effectively apply continuous improvement process, making uncompetitive operations faced to other commercial models; however, traceability as a quality strategy for perishable products has shown to adapt, allowing continuous quality improvement according to the supply chain actor requirements and the appropriate architecture that allows to model according to the requirements of each of the participant actors. The need to build a technological architecture that allows establishing the best commercialization and distribution model for each actor involved in the supply chain, ensuring guidelines for development and success of this technological answer is concluded from the four phases of this research. The architecture involved in this research allows adaptability in different rural families in the same economical sector, potentializing competitiveness, and clear information flow, minimizing risks, time, and allowing decision making facing possible risks.

Keywords

Short Commercial Systems; Traceability; Quality; E-Commerce; Fresh products; Model.

1. Introduction

Short Commercial Circuits (SCC) implementation in Colombia has generated the exchange of successful experiences in family associations in the commercialization of agricultural products. Based on SCC, it is possible for farmer networks to access markets and shorten distances with the final consumer especially in urban markets (UN, 2020). According to the above, the development of SCC fosters the growth of agricultural associations located in the region of Cundinamarca, since the main source of income is based on the agroindustrial sector. Hence, the development and implementation proposal for this project is generated.

This research was conceived in four phases, the first phase focuses on the application and beginning of the survey to elaborate the state of the art, theoretical framework and references of this research; the second phase analyses and describes the project; the third phase builts the improvement proposal, leading to the fourth phase of proposal verification and improvement of the SCC system validation. To come up to this proposal, an explorative methodology that consists of the search for information and identification of aspects that allow the development of the state of the art was applied, likewise, industry 4.0 is responsible for the efficient use of resources and the logistics of integration of the participants of the supply chain network, this generates projects carrying out a social integration in which 14 municipalities are located, integrating 330 families in the region of Cundinamarca, Colombia.

This research aims to appropriate and adapt other initiatives developed in Colombia such as "Red de Mercados Agroecológicos Campesinos del Valle del Cauca". According to the UN (2020), this organization has about 58 organizations and 300 families, which produce under the principles of agroecology, such as respect for natural cycles; use of coverage; soil conservation practices; ecological management of soil, fertilizers, and microorganisms; integration of the vegetable with the animal, use of forages; non-use of agrochemicals, among others.

The above confirms that the purpose of SCC is to reach families located in rural areas of the country, starting with those close to capital cities. In the region of Cundinamarca at least 1.445 families have been benefited, as well as farmers from other regions outside Cundinamarca, such as Boyacá, Meta, Tolima and rural Bogotá (Rodríguez, 2020). Through the collection of the research material, a proposal consisting in the creation of a technological tool to manage a communication channel between the producer and point of sale, to allow the optimization flow of information and materials. A traceability architecture is exposed to guarantee the control of the activities of actors and is used to validate the proposal.

1.1 Objetives

To develop a traceability architecture design focused on the exchange process of goods or Short Commercial Circuits (SCC) that affect directly rural areas in the Cundinamarca department, including small businesses, farmers families and final consumers, to maintain control and quality within the supply chain.

2. State of art of traceability in Short Commercial Circuits (SCC)

SCC combines strategies looking for direct commercialization with the final consumer avoiding intermediaries. To explain from a technical deepening the following quote is exposed:

- "*It refers to a set of initiatives that revolve around the production, distribution and food consumption, which are developed in most cases as alternatives to other more widespread forms of these activities*." González Calo, I., Haro Giménez, T., Ramos Real, E., & Renting, H. (2012).

2.1 Industry 4.0

According to Ynzunza (2017), globalization has promoted new forms of commercial exchanges making use of high-tech strategies, in which automation for information flows, technology, commercialization and production among others, stands out, in order to achieve greater optimization of time and efficient use of resources. This has allowed the industries of mass production of consumer goods in general, to adapt to the new paradigms of competitiveness, such as customization, allowing production to be flexible in relation to what is demanded following trends in the region and the world, stimulating the flexibility of the provision of services and the synergy of actors involved in value chains.

Industry 4.0 is a catalyst, allowing companies to break the new paradigms of competitiveness, identifying opinions of actors involved in a value chain and their connection with the sociodemographic and psychological factors that influence decision-making. and behaviour in the purchase and use process (Roblek et al. 2016). In recent times, market fast changes have led organizations to develop new ways of developing logistics by adopting new models, which seek the integration of the supply chain network participants, and the coordination of all activities within the organization, in order to be able to face a globalized and highly competitive market.
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2.2 Intelligent strategies applied in the Colombian agricultural sector

According to Copete (2020), the agricultural sector in Colombia is not the exception in 4.0 technology implementation and has to do not only with cropping and soil use, since it only represents 8% in value composition. Widening the panorama and thinking in product integrity, like selection, benefit, cleaning, cut, packaging or product transformation, distribution, commercialization and marketing. In Colombia, and according to Copete (2020), the agricultural sector is experiencing two relevant changes. The first one is reshuffling food demand and technological transformation, which is explained by the deep relationship that food production has with human behaviour, changes and social movements, cultural transformation and economic dynamics. The second change derived as a cause of technologies convergence in agricultural chain value. For this, agriculture has focused on process digitalization, knowledge management and process optimization for intelligent decision making, based on real-time information supported on tools like Big Data, drones, remote sensing, AI, traceability, location services, cloud computing and environmental sensing (ETC, 2018). This has the potential to drive sustainability and resilience in agriculture and food systems (ACIEM, 2020). However, for this to be achieved, it is necessary to bridge gaps for the digital transformation in agriculture, such as connectivity, affordability, electronic literacy, information and communication technologies, digital education and policies and programs that favour the adoption of these technologies. It is important to acquire tools such as the internet, mobile phones, implement the use of social networks and support for agro-business and innovation culture (talent development and innovation programs and technology transfer, such as hackathons, incubators and start-up programs (FAO, 2019).

In Colombia, the adoption of smart strategies is beginning to make its way, and for this, the Ministry of Science, Technology and Innovation, the Agricultural Research Corporation - Corpoica and the Ministry of Agriculture and Rural Development built the Strategic Plan for Science, Technology and Innovation of the Colombian Agricultural Sector (PECTIA) for 2017 to 2027 came to life with the sanction of Law 187 and the National System of Agricultural Innovation - SNIA, which aims to generate Research+Development+Innovation necessary to improve competitiveness, knowledge management, training and sustainability of this economic sector in Colombia and thus break the barriers and gaps described above.

3. Research methods

Classification criteria for this research were developed from the following structure (Table 1)

Table 1. Methodology

Classification criteria	Research type		Description
Level	**Exploratory - projective**		The research is developed through two steps. The first step is the search for information to identify needed data for the construction of the manuscript. For this, a previous study of art was carried out, searching for information with emphasis on the research process on a specific rural area, Cundinamarca department, in this case. Based on evidence of the current problem, the second stage or projective stage is given, where solutions are proposed to a specific situation seeking to increase the implementation of Short Commercial Circuits within rural areas of the country, starting from inquiry, description and development process that encourages the economic reactivation of the agricultural sector.
Design	**Field**	**Mixed**	The development of a mixed method is justified under a research question, through the unification of quantitative and qualitative data, allowing to deepen and argue with facts the topics of the research.
Research external purpose	**Applied**	**Feasible project**	Research feasibility is concluded by verified structure and viability, consisting of development of a proposal for a viable operating model to solve problems derived from the current health emergency situation, to improve life quality of actors in the agricultural sector of the country.

Classification criteria for this research are focused on the previous description, allowing the construction of the proposal through numbers, data, and references. It can be emphasized that the external purpose of this document remains a feasible project prospect.

4. Characterization and results of technological architecture for commercial exchange.

There are currently 25 producer associations composed of nearly 800 farmers that commercialized their products in the marketplace of the municipalities of Facatativá, Zipaquirá and Cáqueza, where every day they release fresh products.This measurement is starting to be effective in most remarkable marketplaces of Bogotá located in the neighbourhoods Restrepo and 20 de Julio. This strategy has benefited more than 330 rural families in 14 municipalities of Cundinamarca, through the commercialization of agricultural products like avocado, tangerine, orange, onions, tomatoes, banana, plantain, cassava, coffee, panela, eggs, vegetables, among others.
At the end of 2020, around 183 tons of food had been sold in the different markets within the municipalities and Bogotá.

To date, the initiative has impacted five provinces: Alto Magdalena and Bajo Magdalena, Gualivá and Sabana Centro and Occidente, with agricultural products from Bojacá, Cajicá, Guayabal de Síquima, Nilo, Nocaima, Sasaima, La Vega, Vianí, Villeta, Bituima, Zipaquirá, Pacho and Cota. The products have been commercialized in marketplaces of the municipalities. Thus, with more than 95 transactions, a superior income of $200,000,000 COP was generated,

as well as transportation and sale of 180 tons of food. Most representative projects in Cundinamarca present the following information (Table 2).

Table 2. Projects in Cundinamarca - Data

City of origin	Project name	Description	Number of beneficiaries
Cundinamarca	Plan Padrino Para Semillero de Propietarios	Municipal administrations and families interested in accessing the program are monitored and guided through the registration process, assigning "godparents" in each of the municipalities.	Beneficiaries of this program are able to sign contracts with a purchase option for a period of 24 months. The national government offers a subsidy of $ 526,000 COP for rent fees of priority interest or social interest housing.
Madrid	Plan piloto en Madrid	This initiative anticipates no transportation costs for farmers. Transportation of products is assumed by government vehicles that pick-up products to market places. The purpose is to serve as a link between producers and buyers.	More than 330 farmer families in 14 municipalities

4.1 Short Commercial Circuits (SCC) research proposal

Research information collected was used to identify the needs of the agricultural sector required for process optimization and economic growth. In such ways, the following schemes are proposed for SCC optimization.

4.1.1 Short Commercial Circuits (SCC) traceability architecture proposal

Two marketing schemes are disclosed as follows (Figure 1, Figure 2)

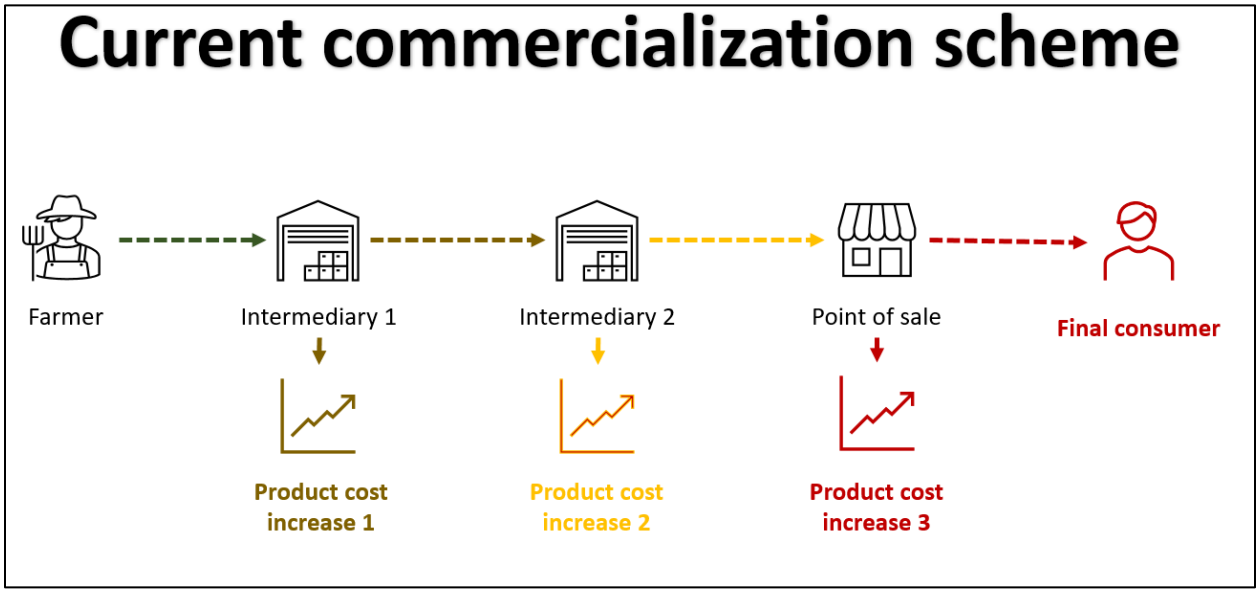

Figure 1. Current commercialization scheme

Figure 1 represents the current commercial scheme, where farmers need to sell products to intermediaries without adding value to the network. This is due to the fact that the farmer does not know the product marketing mechanisms and for each intermediary, the product is marketed its cost increases.

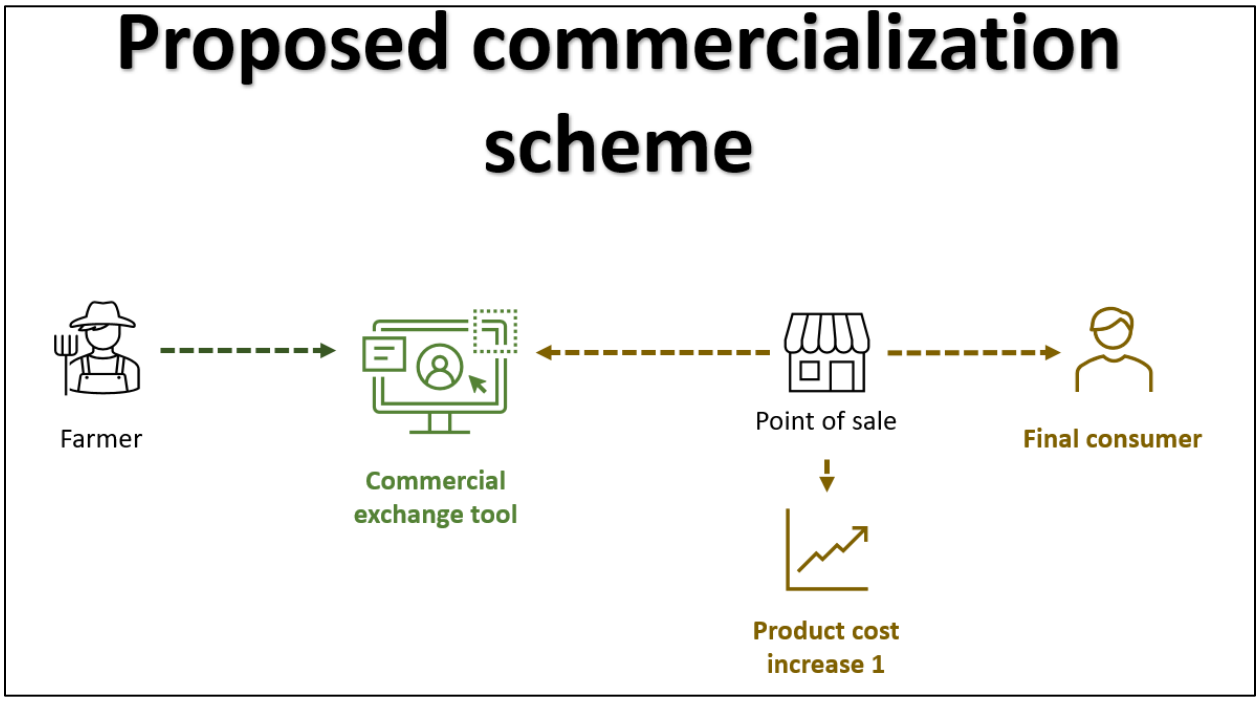

Figure 2. Proposed commercialization scheme

Figure 2 presents the commercialisation scheme proposal using a communication technology tool between farmer and marketplace, where product costs are lower and processes that do not add value to the supply network are eliminated.

4.1.2 Traceability architecture

To make the architecture, it is necessary to first understand involved actor needs. Based on this information, the following diagram illustrates the traceability system architecture required to guarantee information and materials flow in the SCC (Figure 3).

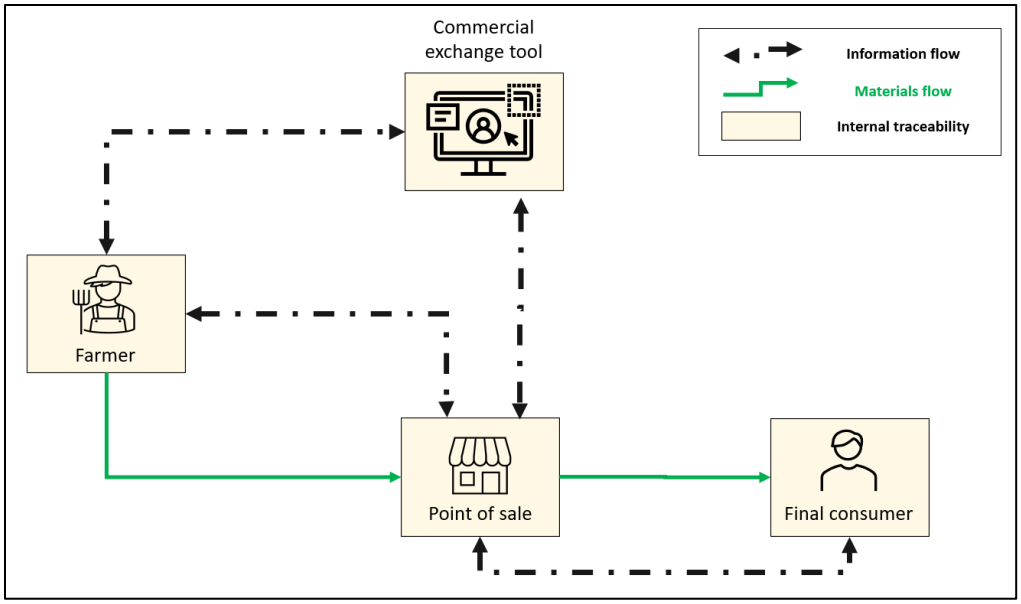

Figure 3. Traceability architecture SCC

Clarifying about this structured architecture, the following process flows are shared to detail the interaction of each actor.

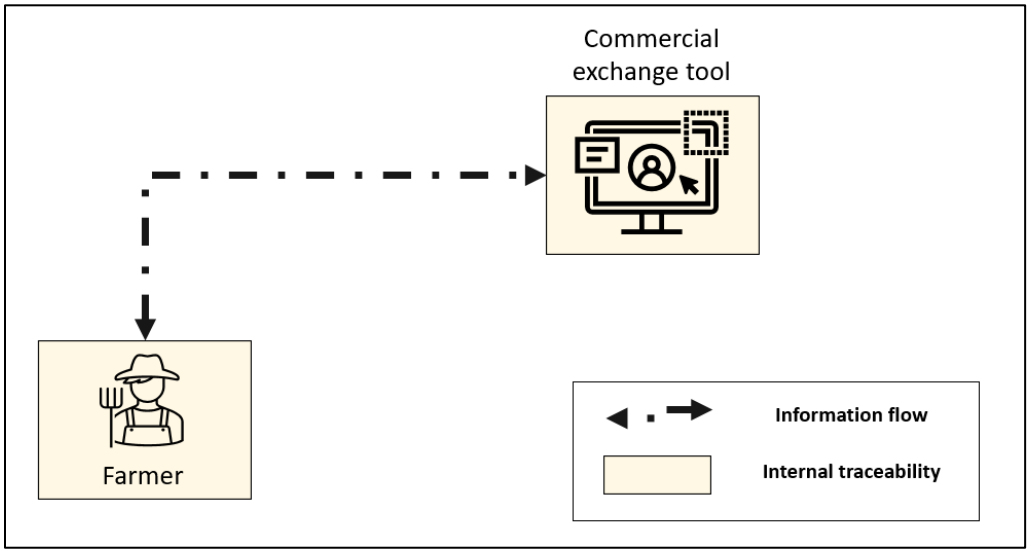

Figure 4. . Interaction process Farmer – Commercial exchange tool

Traceability of materials flow starts with the farmer from the crop, registering volume and weight, production date, product characteristics and commercialization value in the Commercial Exchange Tool (CET) (Figure 4)

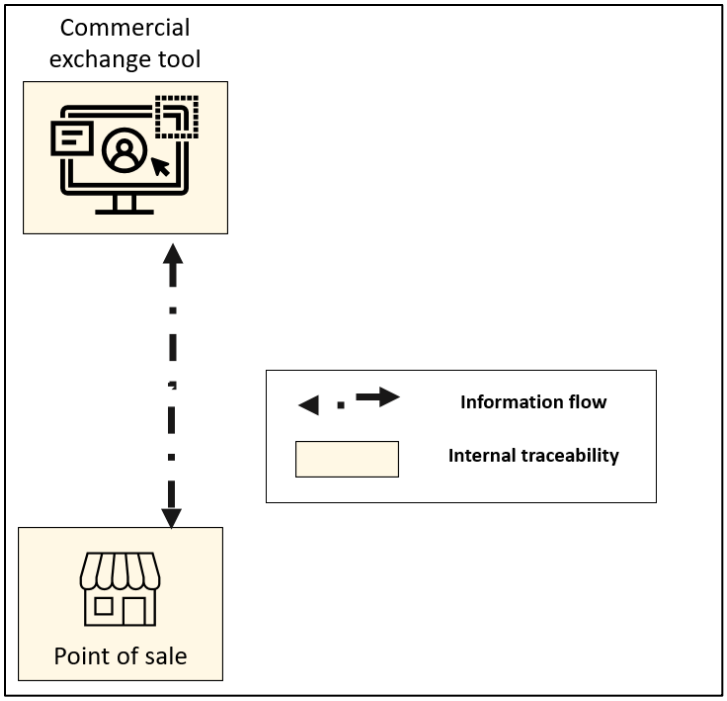

Figure 5. Interaction process Commercial exchange tool-Point of sale

When the farmer declares his production, the tool sends information to points of sale and displays focused on nearby sectors where the farmer is located. The points of sale also inform the inventory needs to commercialize (Figure 5)

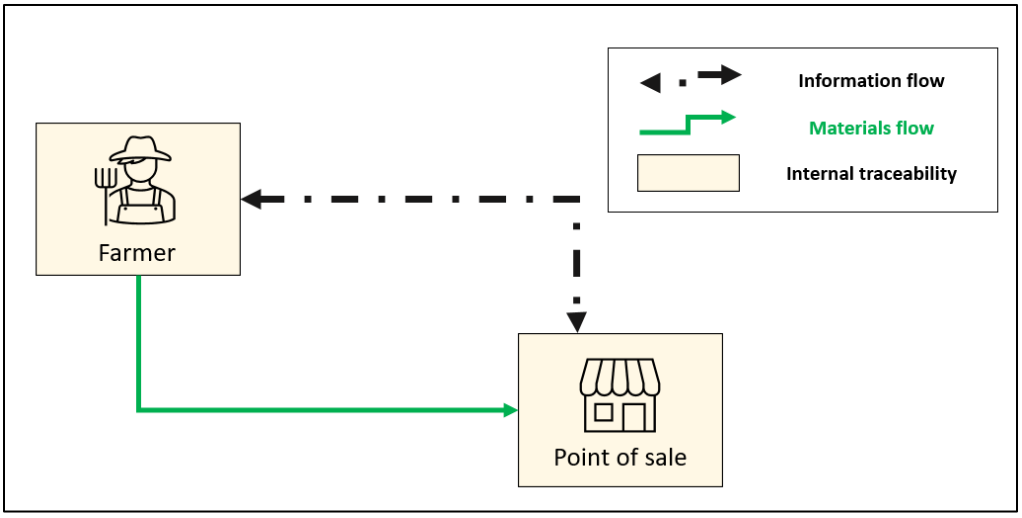

Figure 6. Point of sale-Famer

Point of sale validates the information provided by CET and enters into a marketing agreement with the farmer. It is the first flow of communication between the farmer and the points of sale. In this part, we begin to see the flow of information linked to the flow of materials (Figure 6).

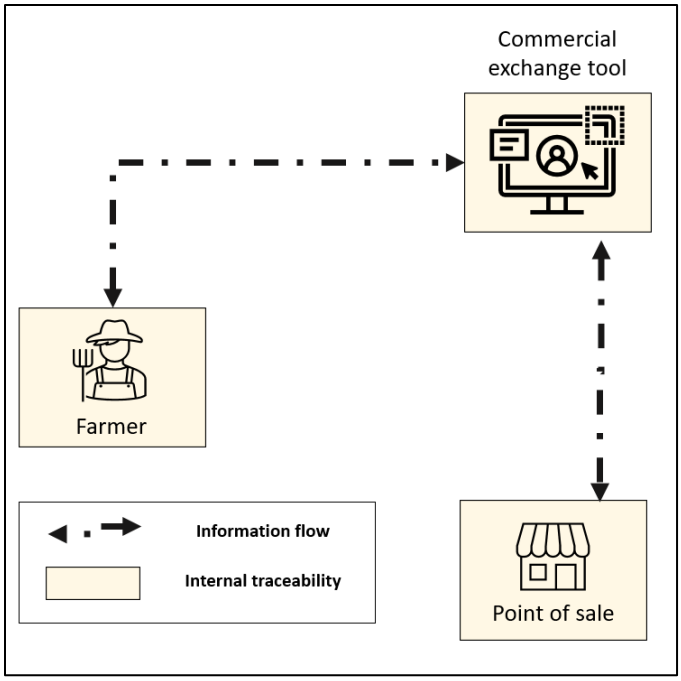

Figure 7. Point of sale-Farmer–Commercial exchange tool

After commercial agreements, information and material flow between farmers and points of sale. Also, information is emitted to CET to guarantee the profile quality of each part and to specify details of the commercial agreement (Figure 7)

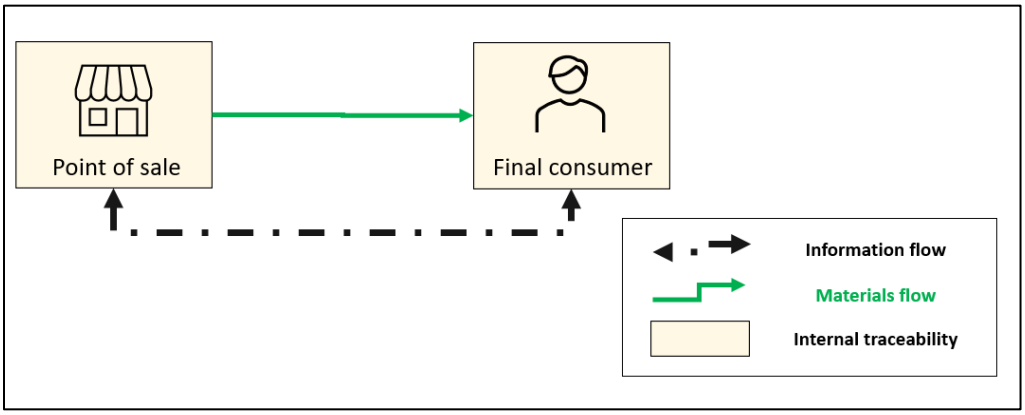

Figure 8. Point of sale-Client-Final consumer

The points of sale with its supplied inventory enters the traditional commercialization, promoting an optimal price margin and product quality for commercialization. Clients or final consumers provide feedback to the point of sale about any aspect of the product (Figure 8).

4.1.3 Associated technologies to fresh product traceability

Technologies over time have benefits and contributions that improve the productivity results of businesses. Results from this research proposal, generated added value to businesses, especially contributing to accomplishing quality requirements for all value networks involved actors, without increasing fixed and variable costs, and lessening the risk and uncertainty to products and information flow, allowing their competitiveness in local and regional markets.

This, it is ideal to associate such technology that is up to date and generates and contributes to the fresh products industry integrity among actors for product quality improvements and reliability in transactionality. The following table relates some details about performance and benefits (Table 3).

Table 3 Current traceability technology

Tecnología	Funciones	Beneficios
WMS (Warehouse Management System)	System used in department stores for detailed inventory information, management, compliance with the FIFO (First In First Out) rotation. This technology is covered by many ERP (Enterprise Resourcing Planning) due to its flexibility and adaptability to business logistics	• Operational process flow. • Inventory management optimization and precision. • Adaptability to operational and logistical processes of business. • Wide traceability margin on movements, transactions, product flow and control.
RFID (Radio frecuency Identification)	This technology is currently used in business for inventory management of high cost products. The technology assigns an intelligent label with information on location, batch, volume, etc.	• Real time information on managed inventory. • High inventory accuracy. • Detailed and real-time information on logistics process until the product reaches the customer
IOT (Internet Of Things)	Technology that associates the internet with the administration of products by offering information in real time, integrating devices, developing applications to improve quality standards.	• Market breadth to the seller of the product. • Avoidance of manual processes allows to focus on core business between buyer and seller. • Depending on its applicability, offers complete safety margins in the product transport process.

4.2 Short Commercial Circuits (SCC) proposal validation

Proposal validation aims to shield information and material flow between involved actors to achieve the objectives of the research.

4.2.1 Development with UML programming

Traceability software and ERP (Enterprise Resourcing Planning) are based on UML (Unified Modelling Language) programming. UML is a non-programming that bases the description of its iconic and abstract models on algorithms for the generation of reports, transaction schemas and ERP databases, whether they are servers such as SQL, Oracle, Java, etc. UML programming is a complement to the system that allows precise and key information extraction. In this case, traceability records must have breadth, detail and precision. To achieve the objective, the following class diagram is presented (Figure 9).

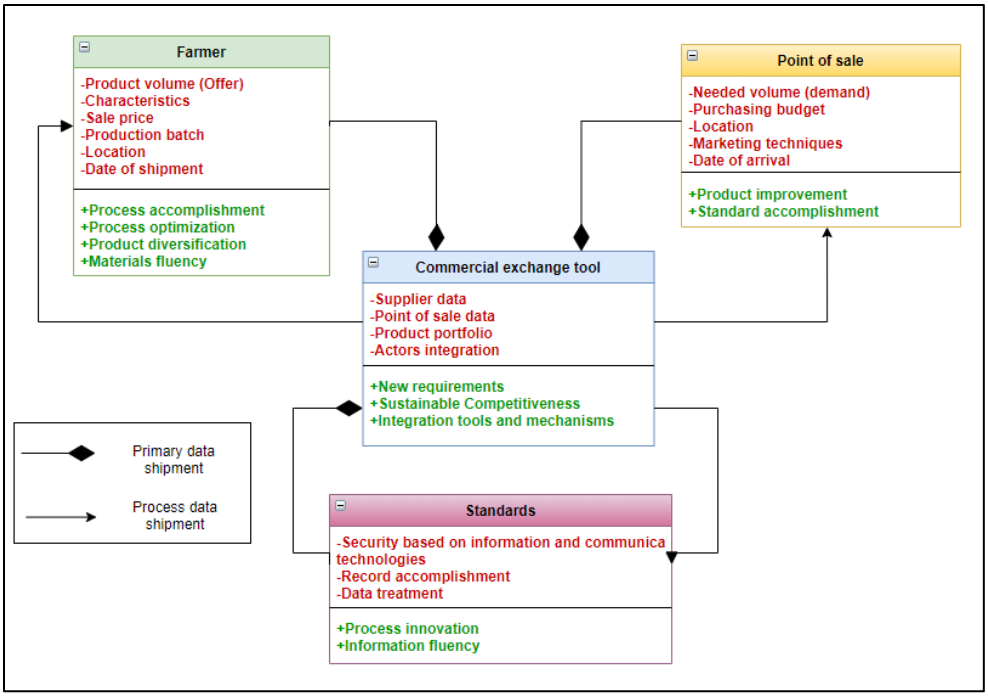

Figure 9. Class diagram for UML Programming

4.2.2 Architecture verification

It is convenient to talk about security. What current tools are available so that they can secure and shield the informational processes of Short Commercial Circuits (SCC)? For that, we relate the Blockchain methodology. Currently, it is related to the transactional, operational and financial security of cryptocurrencies. This methodology may contribute to the encryption process of the exercises, transactions and negotiation between sellers and buyers to guarantee reliability and prevent external persons from interrupting this flow of communication.

For this, some security mechanisms exist, like fingerprints, to guarantee transactionality between parties or to confirm information during the execution of each process where they are interacting in the negotiation. Building a Customer to Manufacturer (C2M) negotiation model in Blockchain models will contribute to the improvement of electronic commerce of agricultural products according to the following steps:

- The farmer by means of his fingerprint confirms the shipping of products requested by the buyer and through digital signature confirms the execution.
- After the farmer confirms the shipping, this information is transmitted to each of the nodes to carry out the correct transport administration.
- An encrypted record of the process for each node is kept until the product reaches the customer.
- Sets of financial and legal control information that flows through Blockchain is protected.

Information with legal reliability is pursued since these schemes are not corruptible. In addition, it seeks to provide security to payment mechanisms using cryptocurrencies or electronic currencies and to have the reliability of the finances.

5. Conclusions

It is concluded that the proposal based on research of Short Commercial Circuits may obtain a technological advance that allows farmers to generate greater benefits from the products offered to the traditional market.
The proposal offers an opportunity to points of sale or marketing channels to broaden the vision of their small businesses by making agreements with producers that derive a strategic alliance between the actors and promote economic and sustainable development.

Traceability architecture proposal and its verification, complements actions between farmers and consumers, allowing to add value through detailed records for continuous processes improvement. The proposal also allows to locate new demands or improve decision-making relying on data and support information. Based on results obtained, there is evidence of an opportunity and development of government or national programs beginning to contribute to sustainable development within the logistics and value chains in the agricultural sector.

6. References

Lasprilla, D. M. (2011). Estado actual de fruticultura colombiana y perspectivas para su desarrollo. *Revista Brasileira de Fruticultura*, *33*, 199–205. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-29452011000500023&nrm=iso

Integración Regional (2020, 20 de noviembre). Sector agropecuario tiene un importante espacio en la Región Metropolitana

Semana.com Últimas Noticias de Colombia y el Mundo. 2021. *Los 'Circuitos cortos de comercialización', una alternativa de ventas campesinas*. https://www.semana.com/contenidos-editoriales/seguridad-alimentaria/articulo/los-circuitos-cortos-de-comercializacion-una-alternativa-de-ventas-campesinas/688665/>

Rodríguez, D (2020, 23 de junio). *Circuitos cortos de comercialización, una estrategia para reactivar la economía en el campo*. Las 2 orillas. https://www.las2orillas.co/circuitos-cortos-de-comercializacion-una-estrategia-para-reactivar-la-economia-en-el-campo/

Boletín Cepal-fao-iica (2014) Fomento de circuitos cortos como alternativa para la promoción de la agricultura familiar. https://repositorio.cepal.org/bitstream/handle/11362/37152/1/S1420696_es.pdf

Ynzunza, C. B., Izar, J. M., Bocarando, J.G., Aguilar, F. y Larios, M. (2017). *El Entorno de la Industria 4.0*: Implicaciones y Perspectivas Futuras. Conciencia Tecnológica, (54). 33- 45. https://www.redalyc.org/articulo.oa?id=944/94454631006

Roblek, V., Meško, M., & Krapež, A. (2016). A Complex View of Industry 4.0. *SAGE Open*, *6*(2), 2158244016653987. https://doi.org/10.1177/2158244016653987

Mosconi, F (2015) The New European Industrial Policy. Global competitiveness and the manufacturing renaissance (1era Edición). Routledge. https://doi.org/10.1430/84080

Lasi, H., Fettke, P., Kemper, H.-G., Feld, T., & Hoffmann, M. (2014). Industry 4.0. *Business & Information Systems Engineering*, *6*(4), 239–242. https://doi.org/10.1007/s12599-014-0334-4

Ricardo Cabrera, H., Rodríguez Pérez, B., León González, J. L., & Medina León, A. (2020). Ideas y conceptos básicos para la comprensión de las industrias 4.0. Revista Universidad y Sociedad, 12(4), 8-15. European Parliament (2016). Industry 4.0 – Study for the Itre Committee. Policy Departament Economics and scientific Policy. European Parliament.

Smit, J., Kreutzer , S., Moeller, C., Carlberg, M,. Industry 4.0 (2016) https://www.europarl.europa.eu/RegData/etudes/STUD/2016/570007/IPOL_STU(2016)570007_EN.pdf

Organización de las Naciones Unidas para la Alimentación y la Agricultura (2019). Tecnologías Digitales En La Agricultura Y Las Zonas Rurales Documento De Orientación. FAO (CA4887ES/1/06.199). http://www.fao.org/3/ca4887es/ca4887es.pdf

Aciem (2020) Agricultura e Industria 4.0: oportunidad para la Ingeniería colombiana. ASOCIACIÓN COLOMBIANA DE INGENIEROS – ACIEM, 137. 8-11. http://www.capacitacion.aciem.org/Nacional/Revista/revista-aciem-edicion-no-137.pdf

Giraldo, A. F. (2020) Tan cerca y tan lejos de la agricultura 4.0 en Colombia. AGROTECH: Transformación, Mercado Y Producción – Revista *Universidad EAFIT*, 55 (175). 78 -85. https://publicaciones.eafit.edu.co/index.php/revista-universidad-eafit/article/view/6460/4926

Grupo ETC (2018) Blocking the chain - Industrial food chain concentration, Big Data platforms and food sovereignty solutions. Zoe Goldstein (Primera Edición). https://www.etcgroup.org/sites/www.etcgroup.org/files/files/la_insostenible_agricultura_4.0_web26oct.pdf

Lee, H. L., Padmanabhan, V., & Whang, S. (1997). Information distortion in a supply chain: The bullwhip effect. Management science, 43(4), 546-558.

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. Journal of cleaner production, 16(15), 1699-1710.

Srivastava, S. K. (2007). Green supply-chain management: a state-of-the-art literature review. International journal of management reviews, 9(1), 53-80.

Cachon, G. P. (2003). Supply chain coordination with contracts. Handbooks in operations research and management science, 11, 227-339.

Keating, B. A., Carberry, P. S., Hammer, G. L., Probert, M. E., Robertson, M. J., Holzworth, D., ... & McLean, G. (2003). *An overview of APSIM, a model designed for farming systems simulation. European journal of agronomy*, 18(3-4), 267-288.

Cachon, G. P., & Lariviere, M. A. (2005). Supply chain coordination with revenue-sharing contracts: strengths and limitations. Management science, 51(1), 30-44.

Lambert, D. M., & Cooper, M. C. (2000). *Issues in supply chain management. Industrial marketing management*, 29(1), 65-83.

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: moving toward new theory. International journal of physical distribution & logistics management, 38(5), 360-387.

Lee, H. L., So, K. C., & Tang, C. S. (2000). *The value of information sharing in a two-level supply chain. Management science*, 46(5), 626-643.

Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of operations management, 22(3), 265-289.

Unctad, X. (2015). Conferencia de las Naciones Unidas sobre Comercio y Desarrollo. http://www.exteriores.gob.es/RepresentacionesPermanentes/OficinadelasNacionesUnidas/es/quees2/Paginas/Otros%20Organismos%20y%20Fondos/UNCTAD.aspx

Departamento Administrativo Nacional de Estadística. (2016). Encuesta Nacional Agropecuaria ENA-2016. In Boletin tecnico comunicación informativa (DANE).

DNP. (2015). El Campo Colombiano: Un camino hacia el bienestar y la paz. Departamento Nacional de Planeación (DNP).

Doblas, N., & Socías Salvá, A. (2005). El comercio justo: implicaciones económicas y solidarias. CIRIEC - España. *Revista de Economía Pública, Social y Cooperativa.* https://www.redalyc.org/pdf/174/17405101.pdf

Bogard JR, Farook S, Marks GC, Waid J, Belton B, Ali M, et al. (2017) Higher fish but lower micronutrient intakes: Temporal changes in fish consumption from capture fisheries and aquaculture in Bangladesh. PLoS ONE 12(4): e0175098. https://doi.org/10.1371/journal.pone.0175098

IDEAS. (2017). El Comercio Justo y los Objetivos de Desarrollo Sostenible. Un camino en común. La voz de los pequeños productores 2017. IDEAS Comercio Justo.

López, D. (2011). Canales Cortos de Comercialización como elemento dinamizador de las agriculturas ecológicas urbana y periurbana. I Congreso Estatal de Agricultura Ecológica Urbana y Periurbana.

Renting, H., Marsden, T. K., & Banks, J. (2003). Understanding Alternative Food Networks: Exploring the Role of Short Food Supply Chains in Rural Development. *Environment and Planning A: Economy and Space*, *35*(3), 393–411. https://doi.org/10.1068/a3510

Sánchez-Mojica, K. Y., Herrera-Rubio, J. E., Martínez-Parada, M., & Pérez-Domínguez, L. A. (2018). Aplicación móvil como estrategia para la comercialización de productos agropecuarios. *Respuestas*, *23*(1), 52-59. https://doi.org/10.22463/0122820X.1335

Orjuela, J (2015) Sistema De Trazabilidad En La Cadena Frutícola Colombiana. https://repository.udistrital.edu.co/bitstream/handle/11349/3022/FonsecaRam%EFrezJohanEsteban2015.pdf;jsessionid=14DB1B4C8DCE07D8912FBCB86DE17DE1?sequence=1

Hurtado Gil, S. V. (2006). UML-based Scheme for Software Architecture Representations. Sistemas y Telemática. https://doi.org/10.18046/syt.v1i1.918

Zhan, H., Lv, X., & Xu, D. (2019). Research on Blockchain Technology in Promoting Environmental Protection Development of Agricultural Products E-commerce Model in Jilin Province. *IOP Conference Series: Materials Science and Engineering*. https://doi.org/10.1088/1757-899X/612/5/052037

Manosalva Barrera, Néstor Eliécer, & Cangrejo Aljure, Libia Denisse. (2018). Arquitectura tecnológica loT para la trazabilidad de productos frescos. *Revista Cubana de Ciencias Informáticas*, *12*(1), 28-42. Recuperado en 25 de marzo de 2021, de http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2227-18992018000100003&lng=es&tlng=es.