Review

Traceability Information Model for Sustainability of Black Soybean Supply Chain: A Systematic Literature Review

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Abstract: Traceability information as a solution option becomes an important task for the industry in providing products, preparing sustainable raw materials, and ensuring adequate safety quality. The emergence of these demands makes the industry perform tracking in order to prepare product inventories ranging from raw materials to products that have been produced. Based on these reasons, the scope of this paper is to provide a systematic review of the literature on various aspects of implementing information traceability models and sustainability of supply chain on economic, social, environmental, technological, institutional, and infrastructural dimensions. For this purpose, we use the Scopus, Science Direct, EBSCO Host, and ProQuest databases. We used the PRISMA model to identify, filter, and test for the eligibility of articles to be included. We selected 52 articles contributed by this search engine. We found was that between 2018 to 2021 there was increasing interest in this research. The dominant traceability information model in the article uses blockchain, the rest use operations research (OR), Google Earth Engine (GEE), website-based, Unified Modeling Language (UML), Extensible Markup Language (XML), physical markup language (PML), logit, enterprise resource planning (ERP), soft independent modelling of class analogies (SIMCA), and Spatially Explicit Information on Production to Consumption Systems (SEI-PCS).

Keywords: traceability; information modelling; sustainability; supply chain; black soybean; PRISMA model

1. Introduction

As an agricultural product that is consumed globally, the soybean has long been one of the most important commodities in today's international market [1]. In the global market, soybeans are consumed in various forms such as whole soybeans, soybean oil, and foods made from soybeans [2]. However, only 6% of the total soybean production in the world is used in its whole form (seeds), and the remaining 94% is for the industrial use of soybean oil or producing food products [3] such as tempeh, tofu, soy sauce, tauco, oncom, yogurt, soy milk, soy burgers, and animal feed [4–6].

The challenges of globalization are combined with the complexity between production and consumption that continues to increase, such that traceability information from supply chain networks is needed accurately, effectively, and efficiently [7]. When Small and Medium Enterprises (SMEs) or industries that require soybean raw materials (such as Unilever, Hershey, Mars, Cargill, and Nestle), such as black soybeans for soy sauce making, they redesign strategies to utilize small-scale agriculture in developing countries [8,9]. Not to mention there are consumer concerns about food production, not wanting to buy food products from industries with genetically modified organism (GMO) soybean raw materials [10]. So, it is necessary to track soybean production and processing as well as

analyse the basic traceability framework to record information related to product quality and safety [11].

The main use of black soybeans as a raw material is for making soy sauce [12], with the reason that they are preferred because of the natural black color and a delicious and savoury taste [13]. In addition, the advantage of this black soybean is that it has a tannin content of four times that of the yellow soybean; the tannin content in yellow soybeans ranges from 0.63–0.70, while in black soybeans it ranges from 4.10–4.27 [14]. Since black soybeans are a raw material, companies must ensure a stable black soybean supply chain to meet production requirements in terms of quality and quantity [8,9]. The need for black soybeans has increased by 10%, and their availability must be maintained for the sustainability of the soy sauce industry [15].

Basically, this study aims to conduct a systematic literature review (SLR) on the traceability, sustainability, and supply chain of black soybeans. This review complements existing review articles related to supply chain traceability and sustainability information. Table 1 shows the differences between this review and the previous review articles. The review articles listed in Table 1 are classified based on: content analysis, time spent, traceability, supply chain, food/soy products, and sustainability with six dimensions, namely economic (eco), social (soc), environmental (env), technological (tech), institutional (inst), and infrastructural (infra). This traceability information for supply-chain sustainability can affect the economic, social, environmental, technological, institutional, and infrastructural dimensions [1,10,11,16–20]. The symbols Y and N, representing Yes and No, respectively, indicate whether a given article falls within the predefined classification.

Table 1. Differences between the relevant literature reviews and this review.

Source	Content Analysis? Y/N	Article Time Span (Year)	Traceability (Y/N)	Supply Chain? (Y/N)	Product		Sustainability					
					Food (Y/N)	Soy (Y/N)	Eco (Y/N)	Soc (Y/N)	Env (Y/N)	Tech (Y/N)	Inst (Y/N)	Infra (Y/N)
[16]	Y	2002–2020	Y	Y	Y	N	N	N	N	N	N	N
[17]	Y	1967–2020	Y	Y	Y	N	Y	Y	Y	Y	N	N
[18]	Y	2006–2022	Y	Y	Y	N	N	N	N	Y	N	N
[19]	Y	1998–2021	Y	Y	Y	N	Y	N	N	Y	N	N
[20]	Y	1992–2022	Y	Y	Y	N	Y	Y	Y	Y	N	N
This Article	Y	1998–2022	Y	Y	N	Y	Y	Y	Y	Y	Y	Y

Source: own elaboration.

The assumption of this research arises because the industry conducts searches in order to prepare product inventories, ranging from raw materials to products that have been produced. This traceability information is present as a solution option and becomes an important task for the industry in providing products by preparing sustainable raw materials and ensuring adequate safety quality [11,21–25]. The development of traceability research related to soybeans is about actor commitment, by analyzing the transparency and sustainability of soybean supply chains [26], and actor contracts, by demonstrating business transactions and soybean supply chain workflows [27]. Then, research on product traceability, process, quality, and transformation in the presentation of the soybean value chain from farmers, elevators, and processors [28], application of a non-GMO soybean certification traceability system [29,30], web-based information on traceability of organic soybean production supply [11], traceability of food products produced from soybeans [31], and traceability of production information by knowing the time of planting and harvesting soybeans as a decision maker [32].

We have a reason to focus on this research considering the importance of traceability information in the sustainable supply of product raw materials and the certainty of the quality of the product itself. In addition, traceability information is needed for actors, for

example transactions, activities, effectiveness, and social and environmental impacts, as well as policies and commitments [26]. The behavior of actors also needs to be known, for example, about the role, nature, relationships between actors (contracts, supplier relationships, and their implications), resource-use decisions, steps to overcome risks, buy/sell options, empowerment, and partnerships [26]. Other traceability information about product, process, and product quality was reviewed by three stakeholders of the soybean chain, namely farmers, elevators, and processors [28]. In addition to the three stakeholders above, it is also necessary to know information about seed companies, distributors, retailers, and consumers [27]. Timely and accurate information about the area where crops are grown is essential for estimating crop production, and mapping crops beforehand can benefit decision-making related to crop insurance, land leases, supply chain logistics, and markets [32].

Objectively, the purpose of this research is to provide an overview of the model/methodology of information on the supply of traceability of existing products to date and to review supply-chain sustainability in six dimensions. As a form of the originality of this research and the contribution to knowledge, we would like to provide an overview of other models/methodologies that have not been found on traceability information during this SLR search, in the Section 6 of this study. This paper used the preferred reporting items for this systematic review and meta-analysis (PRISMA) guidelines for this SLR. We identify articles from the target database. After that, we complete article screening. Articles, after duplicates are removed, are entered into the eligibility column and filtered according to the research theme. Duplicated articles go into the included column for preservation and use in the bibliography. We analyse backwards and forwards from the articles that were filtered according to the research theme, so that they were finally entered into the included column and retained for analysis. We use VOSviewer for bibliometric use.

Finally, this paper provides a new definition that expands on existing definitions of traceability information for supply-chain sustainability. In addition, this study also examines studies that focus on developing traceability as a potential strategy to respond to the quantity and quality of a product.

2. Theoretical Background

Sustainability of the supply chain means managing supply chain functions, which are in harmony with the social environment, and economic sustainability requirements of stakeholders, to reduce sustainability risks in the supply chain and improve market performance [33]. Another opinion [34] is that a sustainable supply chain not only generates profits while achieving its potential but also is one that is responsible to consumers, suppliers, society, and the environment with innovative strategies, tactics, and technology management. Actually, the supply chain itself is defined as an indispensable element in the global economy: it must be based on the efforts of various industrial stakeholders, such as government and non-governmental organizations [35], while being sustainable as a balance of the environmental, social, and business dimensions [36].

Sustainability of the supply chain means managing the flow of material, information, and capital as well as cooperation among companies along the supply chain, while taking aim at the three dimensions of sustainable development, namely economic, environmental, and social, which must be considered as derived from customer requirements and stakeholders [37]. Supply chain management tools coordinate the flow of material, information, and capital both within and between supply chain partners [38]. The supply chain ensures the production and distribution of products at the right time, keeping in view the needs of consumers, all at the lowest possible cost [39].

The soybean supply chain is a complex network that creates significant economic advantages in many countries but requires many supporting services such as infrastructure and processing [40]. The soybean supply chain refers to carrying out several physical economic activities of soybeans and relevant information from producers to consumers to meet consumer demands [11]. Soybean supply-chain sustainability requires engagement

with stakeholders to address environmental and social issues, so that it will improve the economy, where a facilitated mechanism is needed for better governance [1].

Information of traceability is a supply chain problem and is usually a feature of quality assurance schemes [41]. Traceability is a solution option and is an important task for the food industry in providing food products with adequate quality and safety assurance [24]. Thakur and Donnelly [28] define traceability as the ability to trace food, feed, animals, or food-producing substances to be consumed, through all stages of production, processing, and distribution. Traceability should maintain information about cultivation and processing, which can provide some information for quality issues and provide consumers with useful information [11].

Traceability is a systematic record of the supply chain linked to a food product item through the identification and documentation of how the ingredients of the food product are combined [7]. Traceability systems are implemented as a tool to assist in food safety and quality assurance and to achieve consumer trust [25]. Traceability information is needed to make decisions and find out the whereabouts of relevant actors and production volume [42]. The traceability information reports on the various actors involved in the supply chain (including production, transportation, and processing systems), such as the roles and relationships between actors (including contracts and supplier relationships and their power implications), and at the site of production [26].

3. Materials and Methods

One of the main problems in sustainability efforts here is the lack of traceability information in providing stable raw materials in quantity and quality to maintain the safety of the quality of the products they sell. Traceability is a registration system that documents the product path from suppliers through intermediary steps to consumers, where the product is subject to local quality and safety controls [31]. This literature search required a systematic bibliometric literature review to provide new insights and analyse the existing literature [43]. A literature review is a form of research that uses a rigorous research process to collect valid and reliable data to build knowledge [44]. Several strategies, standards, and guidelines can be adopted for developing and collaborating networks and themes in the literature review [45].

For this literature search we have adopted a stepwise approach, namely modelling, analysis, structuring, and writing. We used the Scopus, Science Direct, EBSCO Host, and ProQuest databases for this literature search. As an initial step in the literature search, we begin with determining the research theme, namely with the theme of traceability information, sustainability, supply chain, and soybeans. Then, the keywords A, B, and C were created related to traceability, sustainability, supply chain, and soybean information. After that, we created keyword D to combine keywords B and C as well as keyword E for A and D. Keyword searches (Table 2) were not limited to titles and abstracts but also included article content and articles published before July 2021.

Searching the literature in Table 2, we found articles in the Scopus database with 169 articles, Science Direct 1137 articles, EBSCO Host (Academic Search Ultimate) 1535 articles, and ProQuest (ABI/INFORM) 179 articles. We combined the search results to obtain 3020 articles using code E. The results of this literature search show that the document type is only in the form of articles and in English. We exclude conference papers, reviews, book chapters, books, conference reviews, notes, editorials, letters, and short surveys. After searching for keywords in the database, we approached using PRISMA (Figure 1), identified, filtered, and tested the feasibility of articles and included [46–51].

The articles identified in the search in the database, after we combined and used code E (Figure 1), yielded 3020 articles. We screened each article and filtered by research theme, namely traceability, sustainability, supply chain, and soybean information. We can still accept products other than soybeans, because it can add insight to the literature and new knowledge on traceability, sustainability, and supply chain theory. In total, 751 articles were reviewed for feasibility, with the latest issues of traceability information

models and the existence of sustainability issues in the supply chain, such as sustainability from the social, economic, environmental, technological, institutional, and infrastructural dimensions, and also including one or more actors in supply-chain sustainability. We also identify sustainability challenges, value chains, mechanisms, consequences, and potential barriers [1].

Table 2. Use of keywords in the database.

| Code	Keywords	Scopus	Science Direct	EBSCO Host (Academic Search Ultimate)	ProQuest (ABI/INFORM)	Total
A	Traceability or "information traceability" or "information model"	46.113	79.736	2.596	5.592	134.037
B	Sustainability and "supply chain" or "supply chains"	105.963	6.912	4.867	26.099	143.841
C	Soybean or "tropical soybean" or "local soybean" or "black soybean"	480.860	15.471	26.928	8.406	531.665
D	B and C	2.477	5.530	647	447	9.101
E	A and D	169	1.137	1.535	179	3.020

Source: own elaboration.
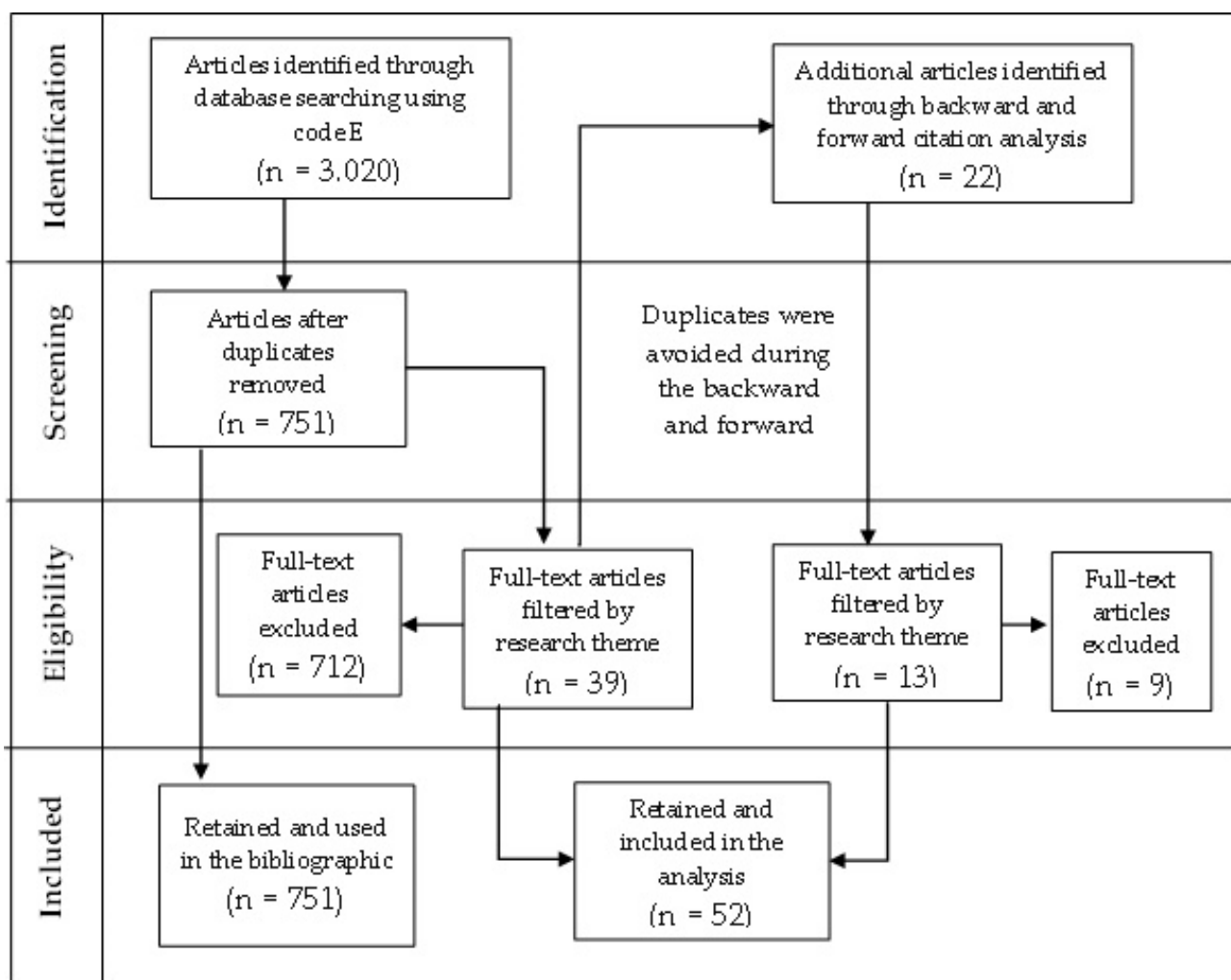
Figure 1. PRISMA model. Source: own elaboration.

As a result, we obtained 39 articles after the feasibility test was carried out. We published 712 articles because they were more related to health issues, DNA, molecular biology, fuel, biosensors, biodiesel, biochemistry, transgenics, compound content, animal nutrition, and forest conservation. For the 39 articles that have been reviewed for feasibility, we perform a backward and forward citation analysis of each article. Our aim is to add to the relevant articles in the literature and to find out the origins of traceability theory in the articles. For backward and forward citation analysis, we still use the same databases: Scopus, Science Direct, EBSCO Host, and ProQuest. During backward and forward citations, we also take care to avoid duplication of articles. We obtained 22 additional articles from backward and forward citation analysis. We did a feasibility study of the 22 articles, and we obtained an additional 13 articles; we excluded 9 articles because there is no traceability theory or no traceability model. Finally, we obtained 52 articles that we will analyse, and we also used 751 articles to visualize bibliometrics in VOSviewer.

4. Literature Analysis: Themes and Trends

We obtained 52 articles from 1998 to 2021 (Figure 2). The year 2021 is the year with the highest number of articles for the research themes we are looking for; articles with traceability began in 1998 and articles began to increase in 2018, so we can say that between 2018 and 2021 there is increasing interest in research on traceability information and supply-chain sustainability.
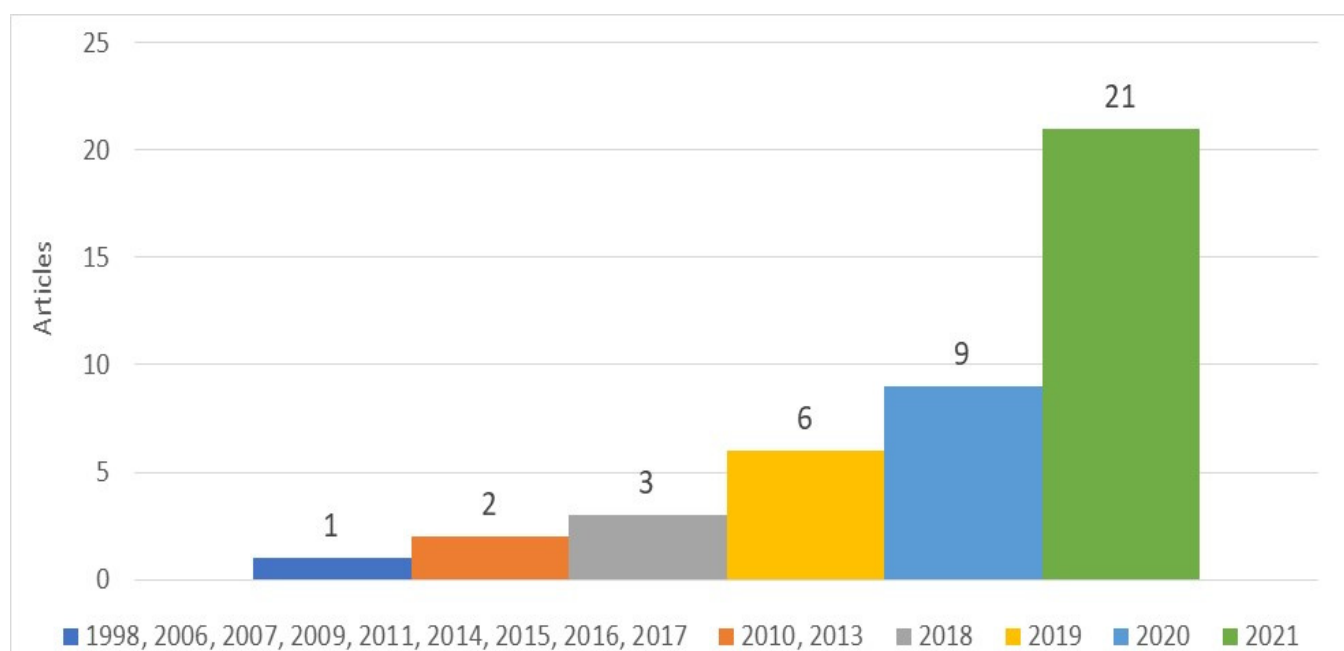

Figure 2. Articles by year. Source: own elaboration.

In Table 3, we use the Scimago Journal & Country Rank 2020 (SJR 2020) analysis, best quartiles, h-index, and number of published articles. The result of our analysis is that 40 articles have been published: 18 Q1, 12 Q2, 6 Q3, and 1 Q4. The study of published articles with the highest score of 2.96 (SJR 2020) produced Q1, h-index 138, and 1 article. Articles with the highest publication IEEE Access totalled five articles, Journal of Food Engineering three articles, Sustainability three articles, International Journal of Production Research two articles, Food Control two articles, Information Processing in Agriculture two articles, Applied Sciences two articles, and others one article each.

Table 3. SJR, best quartile, h-index, and articles.

Journal	SJR 2020	Best Quartile	H-Index	Articles
ISPRS Journal of Photogrammetry and Remote Sensing	2.96	Q1	138	1
Trends in Food Science & Technology	2.68	Q1	188	1
World Development	2.39	Q1	175	1
Journal of Cleaner Production	1.94	Q1	200	1
Ecological Economics	1.92	Q1	202	1
International Journal of Production Research	1.91	Q1	142	2
Plant Science	1.51	Q1	150	1
Food Control	1.37	Q1	125	2
Computers and Industrial Engineering	1.32	Q1	128	1
Journal of Food Engineering	1.29	Q1	179	3
Information Society	1.13	Q1	75	1
Annals of Operations Research	1.07	Q1	105	1
GM Crops & Food	1.06	Q1	27	1
PeerJ Computer Science	0.81	Q1	24	1
Information Processing in Agriculture	0.77	Q1	27	2
Sustainability Accounting, Management and Policy Journal	0.62	Q1	29	1
Sustainability	0.61	Q1	85	3
IEEE Access	0.59	Q1	127	5
Journal of Agricultural and Resource Economics	0.55	Q2	48	1
British Food Journal	0.51	Q2	80	1
Journal of Food Process Engineering	0.51	Q2	45	1
Journal of Chemometrics	0.47	Q2	92	1
International Food and Agribusiness Management Review	0.47	Q2	35	1
Journal of Advances in Management Research	0.46	Q2	20	1
Journal of Agribusiness in Developing and Emerging Economies	0.46	Q2	15	1
Security and Communication Networks	0.45	Q2	43	1
Applied Sciences	0.44	Q2	52	2
Logistics	0.4	Q2	21	1
Transactions on Emerging Telecommunications Technologies	0.37	Q2	47	1
Cluster Computing	0.34	Q3	50	1
International Journal on Food System Dynamics	0.34	Q2	8	1
Scientific Programming	0.27	Q3	36	1
Mathematical Problems in Engineering	0.26	Q3	62	1
Discrete Dynamics in Nature and Society	0.26	Q3	39	1
Turkish Journal of Computer and Mathematics Education	0.22	Q3	3	1
International Journal of Advanced Computer Science and Applications	0.19	Q3	18	1
International Journal of Services Operations and Informatics	0.15	Q4	13	1
International Federation for Information Processing	-	-	37	1
IOP Conference Series. Earth and Environmental Science	-	-	26	1
International Conference on Information Systems, Logistics and Supply Chain	-	-	5	1

Note: - data not available. Source: own elaboration.

We present a bibliometric study to investigate and identify indicators of the dynamics and evolution of scientific information (Figure 3). To review the bibliometric results, we use the scientific software VOSviewer 1.6.18. This aims to identify the keywords of this research, namely traceability information and supply-chain sustainability.
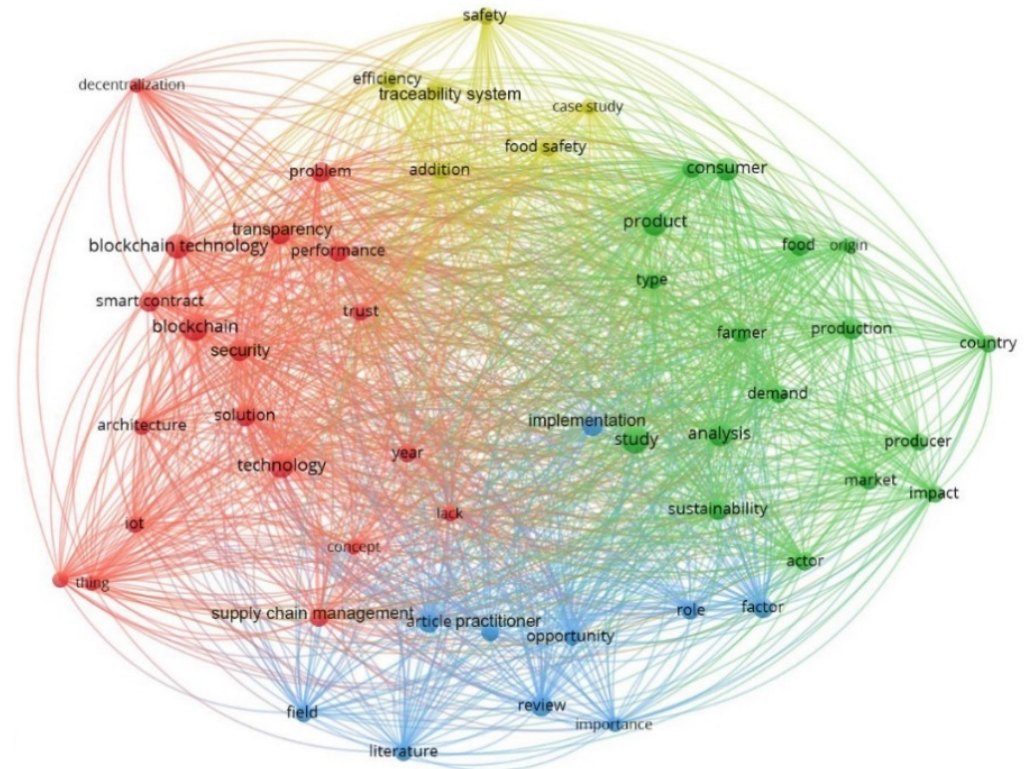

Figure 3. Network of all keywords. Source: own elaboration.

In Figure 3, we found from the results of VOSviewer that there were four clusters of 52 words items that appeared. The keyword traceability appears in cluster 4, sustainability in cluster 2, and supply chain in cluster 1. Cluster 1 (red) contain 19 words items such as blockchain, blockchain technology, concept, decentralization, internet, IoT, lack, performance, architecture, security, smart contract, solution, supply chain management, technology, thing, transparency, trust, and year. In cluster 2 (green) there are 17 items such as actor, analysis, consumer, country, demand, farmer, food, impact, market, origin, producer, product, production, study, sustainability, type, and use. Cluster 3 (blue) raises 10 items such as article, factor, field, implementation, importance, literature, opportunity, practitioner, review, and role. In cluster 4 (yellow) there are six words items such as addition, case study, efficiency, food safety, safety, and traceability system.

We further analyse the keywords that we have created, namely traceability and supply-chain sustainability (Figure 4). We haven't seen many articles using that keyword. If given a network of traceability, it can be seen that blockchain, technology, smart contracts, study, analysis, product, consumer, production, food safety, market, and trust are more often used. For our keywords shown in Figure 4, traceability is in yellow (cluster 4), sustainability is in green (cluster 2), and supply chain is in red (cluster 1). Overall, our keywords are related to all existing clusters.
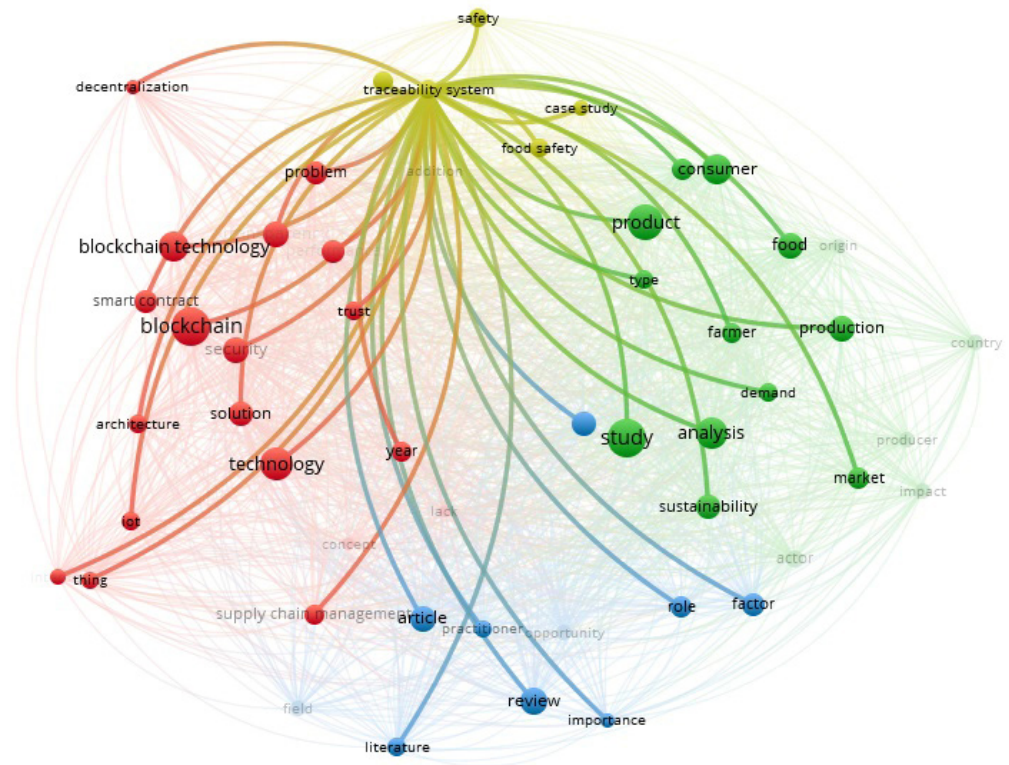
Figure 4. Network of keyword traceability, sustainability, and supply chain. Source: own elaboration.

5. Theoretical Perspectives

5.1. Traceability Information for Sustainability of Supply Chain

The lack of traceability information in supply-chain sustainability raises concerns among consumers and stakeholders about providing important credibility for food information, food quality, and food safety [52]. Traceability here of agricultural products such as low security, unreliability, and difficulty in gathering information [53]. Traceability also plays an important role in ensuring a secure, immutable, and transparent exchange of information between actors in the supply chain [54,55]. Products are tracked by building traceability to obtain information, size, and product safety [56] because traceability can identify and detail the entire process and production of a product's quality [57]. In addition to product traceability, the transparency of interactions between actors needs to be tracked for common approaches, beliefs, and performance issues [58]. There are three important characteristics for traceability, namely: (1) identification of units/batches of all materials and products, (2) information about when and where they are transferred and changed, and (3) systems that link the data [59]. Overall, good traceability helps minimize the production and distribution of unsafe or poor quality so that traceability is applied as a tool to assist in food safety and quality assurance to achieve consumer confidence [25].

Traceability for supply-chain sustainability can influence economic, social, environmental, technological, institutional, and infrastructural dimensions. For the economic dimension, traceability can reduce losses, increase income, and minimize risk [52,60] as well as be able to allocate resources efficiently [26,61]. Since, if not followed up, sustainability will have risks that can affect the economy, environment, or society [62]. Traceability is also able to maximize the expected profits of supply-chain participants and improve product quality, so that the higher the product quality is, the lower the returns [63–65]. So, it must be handled with quality reliability, availability, and risk of disruption [66]. For businesses, traceability can increase the value of business assets and increase profits through reducing costs and risks that will occur [8,16,30]. The product has the quality, and the proportion of contributions will have an effect on customer value [67].

Regarding sustainability for the social dimension, traceability can effectively reduce performance bottlenecks and improve supply-chain-participant communication [68]. However, there needs to be government support, consumer support, and vendor support with management, effective communication [60,64,69], and human resource training [70], so that it can bring about strong trust and transparency among supply chain actors [26,71] and influence the recognition and adoption of community activities [72]. For the environmental dimension, for example, waste management [60,73], pest and disease control [74,75], availability of fertilizers and pesticides [63,64,76,77], and sustainable water management [26,41,78,79].

Technology ensures sustainability under climate change by adopting plant-breeding seed technologies that will enable long-term genetic gain, so as to achieve high and sustainable productivity along with enhanced nutritional properties [74,80]. The use of seeds used in the field needs to be tracked [77] because seeds have a direct impact on production [81]. For the institutional dimension, stakeholders in supply-chain sustainability make internal governance arrangements for their own institutions as well as external stakeholders who seek to influence supply-chain activities [60]. Proactive development of various institutions and innovation regulations for supply-chain sustainability including eco-label, code of ethics, audit procedures, product information systems, procurement guidelines, and eco-branding [61,82]. Sustainability in the infrastructure dimension has increased, such as for roads, storage areas for product conditions, irrigation construction, and port repairs [60].

5.2. Traceability Information Model

The traceability model information from 52 selected articles gave rise to 12 traceability information models (Appendix A). Dominantly brought up was the blockchain model with as many as 22 articles, blockchain-operational research with (OR) 1 article, blockchain–IoT with 1 article, and blockchain–IPFS with 1 article. The rest are one article each, with traceability models such as decision-making evaluation and laboratory (DEMATEL), OR, soft independent modelling of class analogies (SIMCA), Google Earth Engine (GEE), logit, enterprise resource planning (ERP), Spatially Explicit Information on Production to Consumption Systems (SEI-PCS), Unified Modeling Language (UML), Extensible Markup Language (XML), physical markup language (PML), website-based, and website–UML.

Blockchain, as a created traceability information model, aims to provide evidence that new technologies and supply-chain sustainability practices are needed [52] and have the potential to ensure a secure, immutable, and transparent exchange of information between actors [54]. Blockchain as a traceability tool has become an important element in the supply chain, especially in matters sensitive to the safety of sectors such as food [59]. Investing in a blockchain system not only increases product reliability but also improves the performance of every major component of the fresh food supply chain [83]. The decentralized nature of blockchain, with distributed storage and modification of data, provides for fair exchange and secure sharing of data [53]. By using distributed software architectures and advanced computing, blockchain can change the way information is exchanged between actors and track product information [55]. The construction of the blockchain-based traceability system (BTS) found the level of damage to be freshly produced and traceability cost allocation [56]. Blockchain technology is revolutionizing any distributed-data-related application, by adding authentication and trust among stakeholders [84]. Integration of blockchain technology with supply chains can improve performance and maintain traceability, transparency, and product trust [58].

Blockchain as the backbone of Internet of Things (IoT) devices collects data from the field level, and smart contracts regulate interactions between all contributing parties [52,81], because traceability with blockchain–IoT is one of the most promising technologies, which has the advantage of being tamper-resistant and transparent and able to monitor of transactions [85]. IoT technologies, such as WSNs and RFIDs, can be utilized to monitor conditions in product-delivery scenarios [86]. Blockchain technology is combined with IPFS technology, which can ensure data security and effectively overcome data shortages in blockchain

capacity [57]. Blockchain-OR constructs a differential model under four modes to explore the interaction between sales mode choice and service strategy [87].

The Information traceability model based on the website produces information on organic soybean products [11] and subsidized fertilizers using the UML method [63]. The traceability model was analysed using Fuzzy, and the combination of these techniques helps in and identifies the application of agri-food supply chains [88]. SIMCA modelling showed the highest percentage in terms of predictive ability of cross-validation for soybean classification [31]. The GEE computational model can access and process a number of multi-sensor images to examine the earliest identifiable time (EIT) of rice, soybean, and maize products [32]. The logit model examines the impact of consumer preference factors on traceability [61]. The DEMATEL approach evaluates the relationship of drivers (main factors), with the effect of traceability system implementation [89]. ERP is a key factor for businesses, with the support of e-procurement as a tool in business relations, specifically for suppliers in soybean supply chain information systems [42]. The SEI-PCS model information relates production impacts to consumption, usually by tracking product origins and socio-environmental impacts [64]. OR investigates and compares two quality control methods, namely inspection control and traceability control, to optimize supply chain quality in the fashion and textile industry [65]. Trace Core XML contains recommendations for the traceability of food-ingredient identification and general standard procedures [7]. The traceability system in the XML implementation was identified and categorized in the first stage, and the second stage was transformed and incorporated into a five-element generic model using PML to track food products [22]. UML is presented for the soybean value chain and models product, quality, and transformation information captured by farmers, elevators, and processors [28].

6. Conclusions

From this literature review, we find that from 2018 to 2021, there was increasing interest in research on information traceability and supply-chain sustainability. The more dominant traceability model information in the article uses blockchain, the rest are OR, GEE, website, UML, XML, PML, logit, ERP, SIMCA, and SEI-PCS. Maybe, in the future, models/methodologies that do not exist on traceability, for example, agent-based modelling or dynamic systems, can be put into practice. This traceability for supply-chain sustainability can affect economic dimensions such as reducing losses, increasing revenues, and minimizing risks. It also affects social dimensions, such as reducing poor performance and improving communications between supply chain actors, as well as influencing the adoption of community activities. Then, for the environmental dimension, for example, sustainability needs better waste management, pest and disease control, availability of fertilizers and pesticides, and water management. For the technological dimension, such as the adoption of plant-nursery technology. For the institutional dimension, for example, stakeholders need to be making internal and external governance arrangements as well as proactive development and innovation arrangements. For the infrastructure dimension, includes road repairs, product storage areas, irrigation construction, and port repairs or product delivery.

The practical implication is that the enormous complexity of supply-chain agricultural products limits the development of efficient and global transparency and traceability solutions, so there is also a crossroads between blockchain technology, supply chain management, and sustainability. In addition, breaches in the supply chain have led to the need to mobilize all involved stakeholders to tackle counterfeiting challenges, and blockchain and IoT technologies are needed to ensure safe and sustainable supply chain operations; moreover, investment in the circular economy is increasing sharply, so that high quality data and methodologies are needed capable of improving, assessing, and documenting implementation processes and outcomes. A traceability system has been developed as a practical tool to increase supply chain (SC) transparency and visibility, especially in health- and safety-sensitive sectors such as food and pharmaceuticals.

The relevant limitations of the traceability system, the emerging technology literature classification level (ETLCL) framework, may not be the best guide when applied to established technologies and the impact of developing traceability models and traceability systems, where there is a relationship between traceability and economic circulars, since it only uses published peer reviewed journals, excluding book chapters or international peer review conferences. In addition, content analysis is too reductive and leads to an increase in abstractions and certain subjective interpretations. From the limitations of this research, future research efforts should focus on how to tackle and overcome. Moreover, researchers and developers should concentrate on how the blockchain can be made even safer and, in parallel, more efficient. Combined use of the framework (ETLCL) and grounded theory, along with 5W+1H, focuses on the detailed analysis of all aspects of specific product supply chains, as this can facilitate the more accurate and effective establishment of a traceability system. Then, there are future research and innovation opportunities related to the circular economy (CE), as circularity brings a new layer to this multi-disciplinary field and future research too, by developing and testing real-life traceability solutions, especially considering the feasibility of creating value-added subjects for aspects related to supply-chain costs.

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Appendix A

Table A1. Data synthesis (52 selected articles).

No.	Reference	Research Item	Traceability	Model	Supply Chain	Sustainability	Product
1	Anders et al. [80]	Breeding Technology	-	-	-	Technological	Agriculture
2	Medina & Thomé [60]	Soybean Supply Chain	-	-	√	Social, economic, environmental, infrastructural, institutional	Soybean
3	Nurgazina et al. [52]	Technology Applications in Food Supply Chains	√	Blockchain–IoT	√	Economic	Agri-food

Table A1. *Cont.*

No.	Reference	Research Item	Traceability	Model	Supply Chain	Sustainability	Product
4	Liu & Guo [83]	Supply Chain Decision Model Based on Blockchain	√	Blockchain	√	-	Food
5	Kang & Li [53]	Blockchain for Data Sharing Traceability System Based on Blockchain Smart Contract	√	Blockchain	-	-	Food
6	Aldrighetti, Canavari & Hingley [54]	Blockchain Application to Food Traceability	√	Blockchain	-	-	Food
7	Ronaghi [55]	Blockchain Model in Agricultural Supply Chain	√	Blockchain	√	-	Agriculture
8	Wu, Fan & Cao [56]	Blockchain Technology in Fresh Product Supply Chain	√	Blockchain	√	-	Agri-food
9	Patel et al. [84]	Blockchain for AFSC	√	Blockchain	√	-	Agri-food
10	Rana et al. [58]	Blockchain-Based-Model for Digital Supply Chain	√	Blockchain	√	-	Agri-food
11	Pranto et al. [81]	Blockchain–IoT Smart Agriculture	√	Blockchain	√	Technological	Agri-food
12	Zhang et al. [57]	Blockchain–IPFS for Agriculture Product	√	Blockchain–IPFS	√	-	Agri-food
13	Guo et al. [87]	Blockchain Anti-Counterfeit Traceability Service Strategy	√	Blockchain–OR	√	-	Food
14	Ekawati et al. [71]	Blockchain Tech for White Sugar Supply Chain	√	Blockchain	√	Social	Sugar
15	Kurniawan, Pramono & Amalia [63]	Website-Based Traceability Information System on Subsidized Fertilizer Supply Chain	√	Website–UML	√	Environmental, economic	Fertilizer
16	Srivastava & Dashora [88]	A Fuzzy ISM Approach for Modeling Electronic Traceability in AFSC	√	OR	√	-	Agri-food
17	Monteiro et al. [76]	Model for Pervasive Traceability of Agrochemicals	√	Blockchain	√	Environmental	Agrochemical
18	Hong et al. [72]	Application of Blockchain in Food Safety Management	√	Blockchain	√	Social	Agri-food

Table A1. *Cont.*

No.	Reference	Research Item	Traceability	Model	Supply Chain	Sustainability	Product
19	Kaur, Kalra & Attri [86]	Secure Product Traceability in Food Supply Chain Based on Blockchain	√	Blockchain	√	-	Food
20	Zhang et al. [85]	Blockchain–IoT-Based Traceability System for Frozen Aquatic Product	√	Blockchain–IoT	√	-	Frozen Aquatic
21	Ng & Ker [74]	On the Changing Nature of Canadian Crop Yield Distributions	-	-	-	Technological, environmental	Soybean
22	Latif et al. [90]	Blockchain for Product Supply Chain	√	Blockchain	√	-	Food
23	Shahid et al. [91]	Blockchain-Based Agri-Food Supply Chain	√	Blockchain	√	-	Agri-food
24	Demestichas et al. [16]	Blockchain in Agriculture Traceability Systems	√	Blockchain	√	Economic	Agriculture
25	Ding et al. [68]	Blockchain-Based Double-Layer for Product Traceability System	√	Blockchain	√	Social	Agriculture
26	Sunny, Undralla & Pillai [92]	Supply Chain Transparency through Blockchain-Based Traceability	√	Blockchain	√	-	Agriculture
27	Casino et al. [59]	Blockchain-Based Food Supply Chain Traceability	√	Blockchain	√	-	Agriculture
28	Hidalgo et al. [31]	Traceability of Soybeans Produced in Argentina Based	√	SIMCA	-	-	Soybean
29	You & Dong [32]	Examining Earliest Identifiable Timing of Crops Using All Available Sentinel $\frac{1}{2}$ Imagery and Google Earth Engine	√	GEE	-	-	Rice, Soybean, Corn
30	Zhang et al. [61]	Consumer Perception, Mandatory Labeling, and Traceability of GM Soybean Oil	√	Logit	-	Economic, institutional	Soybean
31	Hinkes & Peter [30]	Traceability for Deforestation-Free Supply Chains Applied to Soy Certification	√	-	√	Economic	Soybean

Table A1. *Cont.*

No.	Reference	Research Item	Traceability	Model	Supply Chain	Sustainability	Product
32	Jose & Shanmugam [93]	Supply Chain Issues in SME Food Sector	√	-	√	-	Agriculture
33	Creydt & Fischer [77]	Blockchain Algorithm Driven Food Traceability	√	Blockchain	√	Environmental, technological	Food
34	Haleem et al. [89]	Traceability in Food Supply Chain: A Grey-DEMATEL Spproach	√	DEMATEL	√	Social	Food
35	Salah et al. [27]	Blockchain-Based Soybean Traceability in Agricultural Supply Chain	√	Blockchain	√	-	Soybean
36	Wang et al. [94]	Smart Contract-based Product Traceability System in the Supply Chain Scenario	√	Blockchain	√	-	Agriculture
37	Gardner et al. [26]	Transparency and Sustainability in Global Commodity Supply Chains	√	-	√	Social, economic, environmental	Soybean
38	Sjauw-Koen-Fa et al. [9]	Exploring the Integration of Business and CSR Perspectives in Smallholder Souring	-	-	√	Social, economic	Black soybean
39	Mao et al. [79]	Innovative Blockchain-Based for Sustainable	√	Blockchain	√	Environmental	Food
40	Duan et al. [69]	Implementation of Food Traceability Systems	√	-	√	Social	Food
41	Morales et al. [42]	Information Systems in the Soybean Brazilian Supply Chain	√	ERP	√	-	Soybean
42	Godar et al. [64]	Tracing Fine-Scale Socio-Environmental Impacts of Production to Consumption	√	SEI-PCS	√	Social, economic, environmental	Soybean
43	Aung & Chang [25]	Traceability in a Food Supply Chain: Safety and Quality Perspectives	√	-	√	-	Food
44	Cheng et al. [65]	Optimal Product Quality of Supply Chain Based on Information Traceability in Fashion and Textiles Industry	√	OR	√	Economic	Textile

Table A1. *Cont.*

No.	Reference	Research Item	Traceability	Model	Supply Chain	Sustainability	Product
45	Storøy, Thakur & Olsen [7]	The TraceFood Framework for Implementing Traceability in Food Value Chains	√	XML	√	-	Food
46	Wang et al. [11]	Study for Organic Soybean Production Information Traceability System Based on Web	√	Website-based	-	-	Soybean
47	Thakur dan Donnelly [28]	Modeling Traceability Information in Soybean Value Chains	√	UML	√	-	Soybean
48	Pelaez et al. [29]	Implementation of a Traceability and Certification System for Non-Genetically Modified Soybeans	√	-	-	-	Soybean
49	Wang et al. [24]	Adding Value of Food Traceability to the Business: A Supply Chain Management Approach	√	-	√	-	Food
50	Regattieri, Gamberi & Manzini [23]	Traceability of Food Products	√	-	-	-	Food
51	Folinas, Manikas & Manos [22]	Traceability Data Management for Food Chains	√	XML, PML	-	-	Food
52	Moe [21]	Perspectives on Traceability in Food Manufacture	√	-	-	-	Food

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