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What does digital transformation do in agriculture? A systematic literature review of Agri-food sector's digitalisation

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A B S T R A C T

Digitalisation supporting business processes will be increasingly important for the agrifood industry and the related supply chain. The primary goal of this research is to highlight research works investigating the agrifood sector with digitalisation, based on structured literature collection and using a nomenclature of an internationally recognised database, namely Eurostat. Systematic literature review was done in order to achieve the goal set using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology and the keywords of digitalisation and agri/agro-food. The meta-data of Scopus and Web of Science databases were used for this study. 92 articles were included in the qualitative analysis and results show that the topic on digitalisation with the agri-food industry and/or supply chain has been increasing year by year. Furthermore, the most important topic dealt by a high percentage of the articles is the e-business, in particular the level of the technological solutions for the integration with customers and suppliers. Moreover, the pandemic situation over the past few years has drawn the attention of the researchers to analyse the effects of COVID-19.

1. Introduction

In the field of agri-food sector the role of the digitalisation and at the same time the implementation of the new technologies in the agricultural sector, has been increasing in the past few years. This process makes the global food industry and its associated supply chains less exposed to unexpected events such as COVID-19 pandemic, the negative effects of which have an impact on the operators in the supply chain. The expansion of digital technologies provides opportunities for the stakeholders of the supply chains to access and share information. Therefore, different solutions like IoT (Internet of Things), BCT (Blockchain technology) and RFID (Radio Frequency Identification), have been implemented by farms allowing them to ensure information required by the whole food supply chains. Thus, food monitoring becomes simpler that brought F2F (Farm to Fork) strategy closer to the consumers, and besides, it helps to reduce the number of food safety incidents. According to one of the reports of the Food and Agricultural Organization of the United Nations (FAO, 2014), the introduction of new technologies has an increasing role in the agri-food industry as these solutions improve efficiency, the accuracy of information and the speed of information flow. Therefore, the aim of this study is to carry out a systematic categorisation the articles published on the topic of agri-food industry by PRISMA methodology, using the nomenclature of EUROSTAT as it is a widely known classification of statistical indicators. This summarising study can be the basis for future analysis and the findings also contain where the databases can be found.

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2. Materials and Methods

2.1 Data Collection

The collection and systematic review of the articles dealing with agri-food industry has been conducted in a structured way, using a combination of agri-food and digitalisation keywords. To achieve a wide range of articles in line with these keywords, the authors was conducted using only significant academic papers from the biggest online databases: Scopus and Web of Science. The structured literature collection was performed by the steps of PRISMA methodology (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Page et al., 2021). The original concept was published in 2009, however it is evolving year by year (Liberati et al., 2009). PRISMA is a concept which used to sum up the aims of the study was written, the methodology was used and what the authors found. The process, the stages of systematic search and the literature sorting can be seen on Figure 1.

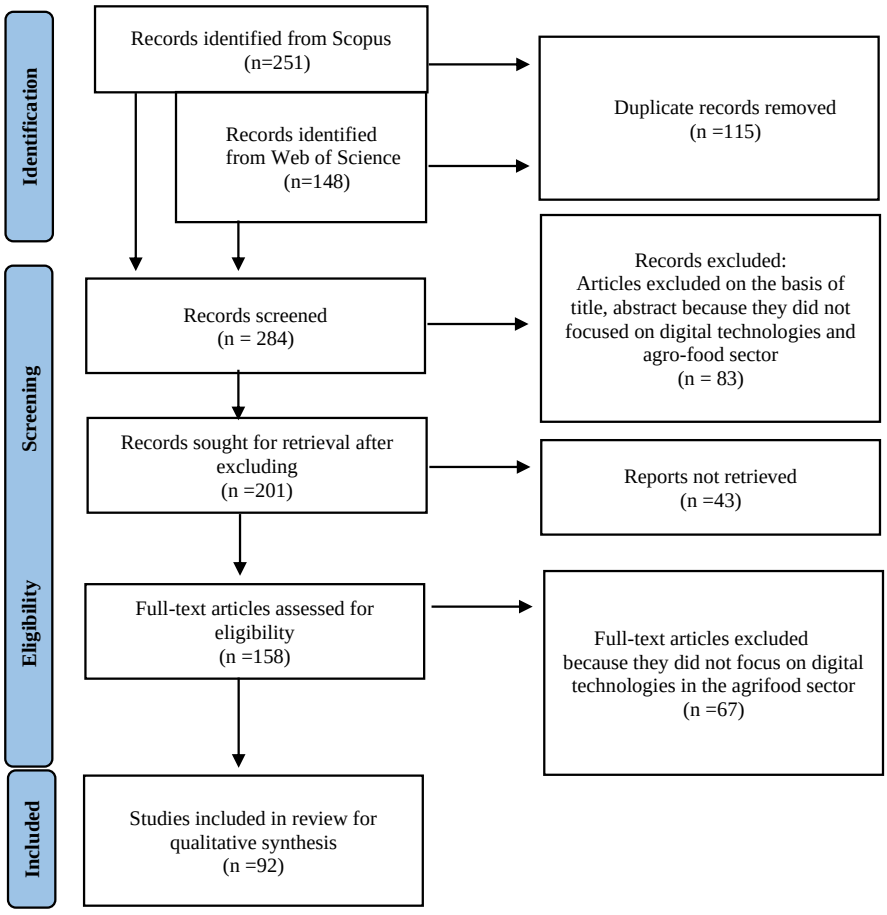

Figure 1. **The preferred reporting items for systematic review and meta-analyses (PRISMA) flow diagram process and outcomes**

Source: author's compilation, 2023

An article selection applying keyword filtering from the two databases Scopus and Web of Science was collected during the initial step. The keyword strings were used in a complex filtering process, the elements of them can be seen in the following table. The keyword search was carried out in the same content: title, keywords and abstract. The search interfaces, however, differ syntactically as presented in the table too. Data download was performed in April 2023.

Table 1. Description of the search string and respective database.

Database	Search String	n of Studies Identified
Scopus	TITLE-ABS-KEY: („agri-food" OR „agro-food" AND „foodsector" AND „digitalisation")	251
Web Of Science	TOPIC: („agri-food" OR „agro-food" AND „foodsector" AND „digitalisation")	148

Source: author's calculation, 2023

Keywords of agrifood and agrofood are used in the articles interchangeably thus synonyms were defined in the first step in the first stage in the search process. The „foodsector" and „digitalisation" were used as keywords to narrow down the number of literatures. Time interval was not used, all the published articles were taken into account.

The summarised keyword search had led to 251 search results on Scopus and 148 on Web of Science matching the criteria entered, thus, a total of 399 records were recruited for this study. Subsequently, manual elimination of duplicates was the next step and it had resulted 284 records, these were used in the first stage of the analysis. Keywords and abstract were used in the first stage of filtering to exclude articles that are not related to the topic in focus. Afterwards, a total of 201 articles left for the final stage of filtering, these articles were read and 67 of them were excluded from the further analysis as their main topic was not around the subject of agrifood industry with digitalisation. Articles not available for the authors were excluded in this stage too. Finally, 92 articles were included for current study. The topic is evolving dynamically, as the second figure shows: every year, more and more authors are discussing the relationship between digitalisation and the agri-food industry. The figure also illustrates that since the pandemic emerged, it has been a "hot topic", with a huge number of researchers starting to investigate the increased digitalisation.

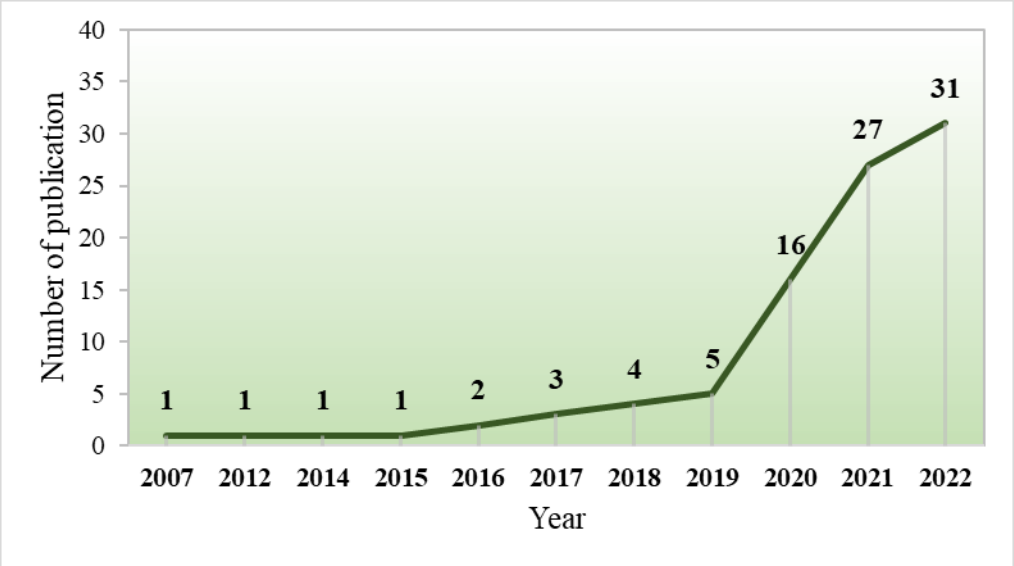

Figure 2. **Studies by year of publication *(the base of the study without duplications). N=92***

Source: author's calculation, 2023

2.2 Data Analysis and Results

Selected articles were analysed by two researchers in order to avoid bias (1st and 2nd authors). The disputed articles were sorted out during group discussion. Eurostat database is used as the basis for grouping the selected articles in this study. The subcategories and indicators within „Digital economy and society" category were applied to specify the topic of digitalisation discussed together with the

agrifood industry. This attribution may support an easier search and access among articles addressed in this paper. Besides, our results may provide a basis for future examinations and the availability of Eurostat indicator set – serving as grouping factors – containing enterprise data, is also indicated.

Table 2. **Studies characteristics by Digital economy and society categories (EUROSTAT)**

Main Categories	Sub Category
E-commerce (isoc_ec)	E-commerce sales (isoc_ec_eseln2) Value of e-commerce sales (isoc_ec_evaln2) Obstacles for web sales (isoc_ec_wsobs_n2) E-commerce purchases (isoc_ec_ebuyn2) Connection to the internet (isoc_ci)
Internet access (isoc_ci_in_en2)	Use of computers and the internet by employees (isoc_ci_cm_pn2) Type of connections to the internet (isoc_ci_it_en2) Use of mobile connections to the internet (isoc_cimobe_use) Use of mobile connections to the internet by employees (isoc_cimobp_use)
E-business (isoc_eb)	Integration of internal processes (isoc_eb_iip) Integration with customers/suppliers, supply chain management (isoc_eb_ics) Cloud computing services (isoc_cicce_use) Big data analysis (isoc_eb_bd) 3D printing and robotics (isoc_eb_p3d) Internet of Things (isoc_eb_iot) Artificial intelligence (isoc_eb_ai)
Websites and use of social media (isoc_cism)	Websites and functionalities (isoc_ciweb) Social media use by type, internet advertising (isoc_cismt)
ICT security (isoc_cisc)	Security policy: measures, risks and staff awareness (isoc_cisce_ra) Security incidents and consequences (isoc_cisce_ic)
COVID-19 (isoc_e_cvd)	Covid-19 Impact on ICT usage (isoc_e_cvd)

Source: author's compilation based on EUROSTAT, 2023

3. Results and Discussion

3.1. The most commonly used keywords

Regarding keywords, the most commonly keywords were the following: Agrofood/agrifood, agriculture, agriculture 4.0, future agriculture, AI (Artificial Intelligence), ICT (Information and Communication Technologies), digitalisation, food supply chain, RFID, IoT, Big Data, e-commerce. The number of frequency of the least frequent keyword was 9 in this analysis.

3.2. Content analysis

Articles were sorted out by the main topics (Table 3), based on the objectives discussed. 5+1 categories were determined. The topic of „Digitalization for Sustainable Agri-Food" became the first category, containing papers discussing sustainability issues and analysing the role of digitalisation in sustainable future. This topic involves 11% of the analysed papers. The topic of „Agriculture 4.0" defined as the second category. Articles investigating the usage of technological solutions in the agriculture belong to this category that can be considered as the most diverse topic of agri-digitalization. Papers discussing the potential use of current technologies, such as Blockchain, IoT, Cloud solutions, AI, RFID, machine vision or robotics, were classified in this category and it involves

50% of the sample population. Authors created the „New challenges post COVID-19" as the third category for articles discussing the impact of the pandemic on agriculture. This topic is relatively new as studies have been publishing from 2019 onwards, however, it means 17% of the analysed articles.

Table 3. **The main aims of the studies** *(N=92)*

	Main aims/objects of the studies	n of Studies	References
1	Digitalisation for Sustainable Agri-Food	10(11%)	(Espelt Rodrigo, Pena-Lopez and Vega, 2017; Pearce *et al.*, 2018; Serbulova *et al.*, 2019; Bahn, Yehya and Zurayk, 2021; Jorge-Vázquez, Chivite-Cebolla and Salinas-Ramos, 2021; Kusumowardani, Tjahjono and Priadi, 2021; Rowan and Casey, 2021; Wang and Fan, 2021; Kukk, Põder and Viira, 2022; Wolfert and Isakhanyan, 2022)
2	Agriculture 4.0 (Blockchain, IoT, Cloud, AI, RFID, CV, etc.)	46(50%)	(Bernardi *et al.*, 2007; Herdon, Várallyai and Péntek, 2012; Paper *et al.*, 2013; Piramuthu and Zhou, 2016; Bronson and Knezevic, 2016; Marouni, 2017; Tudora, Alexandru and Eugenia, 2017; Caro *et al.*, 2018; Meidayanti, Arkeman and Sugiarto, 2019; Miranda *et al.*, 2019; Biradar *et al.*, 2019; Borrero, 2019; Fracarolli *et al.*, 2020; Barge *et al.*, 2020; Lopez-Morales, Skarmeta and Martinez, 2020; Mrdalj and El Bilali, 2020; Munz, Gindele and Doluschitz, 2020; Panetto *et al.*, 2020; Shahid *et al.*, 2020; Boniecki *et al.*, 2020; Baralla *et al.*, 2021; Chen *et al.*, 2021; Durrant *et al.*, 2021; García-Manso *et al.*, 2021; Junaid *et al.*, 2021; Kramer, Bitsch and Hanf, 2021; Liu *et al.*, 2021; Mateo-Fornés *et al.*, 2021; Menon and Jain, 2021; Oruma, Misra and Fernandez-Sanz, 2021; Osório *et al.*, 2021; Seymour *et al.*, 2021; Abbasi, Martinez and Ahmad, 2022; Cook *et al.*, 2022; Echegaray *et al.*, 2022; Hassoun *et al.*, 2022; Hilten and Wolfert, 2022; Kamariotou *et al.*, 2022; Krithika, 2022; Krstić *et al.*, 2022; Beluhova-uzunova and Dunchev, 2022; Rejeb *et al.*, 2022; Resce and Vaquero-piñeiro, 2022; Stoica, Giucă and Sterie, 2022; Talari *et al.*, 2022; Top *et al.*, 2022)
3	New challenges post COVID-19	16(17%)	(Butu *et al.*, 2020; Kumar, Padhee and Kumar, 2020; Senesi, Palau and Neves, 2021; Zielińska-Chmielewska, Mruk-Tomczak and Wielicka-Regulska, 2021; Chen and Yang, 2021; Constantin, Pătărlăgeanu, *et al.*, 2021; Priyadarshini and Abhilash, 2021; Čehić *et al.*, 2022; Rengarajan *et al.*, 2022; Sgroi, 2022; Sridhar *et al.*, 2022; Tseng *et al.*, 2022; Guo *et al.*, 2022; Li, Zhao and Han, 2022; Mastronardi, Cavallo and Romagnoli, 2022; Popescu and Popescu, 2022)
4	Food sector's innovations in SMEs	8(9%)	(Herdon, Várallyai and Péntek, 2012; Coghlan *et al.*, 2020; Cocco *et al.*, 2021; Aubry *et al.*, 2022; Conti, 2022; Csordás, Lengyel and Füzesi, 2022; Kamariotou *et al.*, 2022; Todorova and Zaharco, 2022)
5	Websites and social media platforms	12(13%)	(Scuderi and Sturiale, 2015; Calvet-Mir *et al.*, 2018; Kabbiri *et al.*, 2018; Fernandez *et al.*, 2019; Caiazza and Bigliardi, 2020; Cristobal-Fransi *et al.*, 2020; Sass *et al.*, 2020; Borrero and Zabalo, 2021; Sedek *et al.*, 2021; Constantin, Rădulescu, *et al.*, 2021; Oruma, Misra and Fernandez-Sanz, 2021; Ancín, Pindado and Mercedes, 2022)
6	Review articles	21	-

Source: author's compilation, 2023

The following fourth category involves papers dealing with the situation of small and medium-sized enterprises (SMEs) and the digital innovation used by this sector. It has a key importance, 9% of the selected papers deals with the different aspects of digitalisation, and in particular the topic of short supply chains in the SME sector. Fifth category is „Websites and social media platforms" that includes articles seeking to address the opportunities of web pages, social media platforms and their marketing potential of the different agricultural sectors and the web presence in general of the agri-food business operators. Not surprising, maybe, considering the accelerating trend of digitalisation processes in several sectors, such as education and health sector, caused by the pandemic situation. This category involves 13% of the papers. Finally, authors present those similar review papers that were included in the analysis as main topics, however these papers also partly or entirely can be viewed at review articles.

3.3. Related Reviews

As mentioned earlier, in the last few years, the topic of agri-food sector and digitalisation has been increased more and more. Most of the researcher related with at least one of the buzzwords, and more and more literature or bibliometrics analysis is being published in the research area. Although the most of the journal requirement's ask for the keyword "literature review" to be included in the title, some authors omit it, according to experience.

Table 4 **Top 5 review articles on topis related to digitalisation in the agri-food industry**

Article	Issues Reviewed	Methods	Key Findings
(Rocha, de Oliveira and Talamini, 2021)	Blockchain	PRISMA Bibliometric analyses	Its practical application in agribusiness supply chains, where most studies are concentrated in engineering and information technology, is considered less developed. Regionally, developments in this area are concentrated around the US and China. Its application in this area would bring a number of benefits such as: data immutability, traceability, smart contracts, reduction of intermediary costs, etc.
(Liu *et al.*, 2021)	IoT Robotics AI-BigData Blockchain	Thematic Literature Review	The article covers the usability and potential of the performance and tools expected from Agriculture 4.0 in many areas of agriculture. They discuss, among other things, the limitations in addition to the opportunities, and they also contrast the research challenges of implementing current technologies.
(Hilten and Wolfert, 2022)	IoT	Multiple case study research	5G technology in agriculture is still in its early stages. The authors highlight five key benefits for adopters of the technology. They also identify the concepts of the existing adopter sector, where research is concentrated on arable crops and livestock production, coupled with big data analysis, and highlight the potential for managing scarce resources.
(Stoica, Giucă and Sterie, 2022)	Digital agriculture	Bibliometric analyses	The authors took stock of articles from the last five years and found that two main clusters of keywords were grouped around the buzzwords digital agriculture and agriculture 4.0. Digitalisation as a general topic, and agriculture and big data, management and climate change are linked as second cluster.

(Abbasi, Martinez and Ahmad, 2022)	IoT and Cloud Robotics, UGVs, UAVs AI-ML-BigData	PRISMA	The study looked at articles from 2011 to 2021, where it took into account the ever-changing current trends. Among their findings was that most of these solutions are in their infancy in terms of agricultural use or are being tested as prototypes. The study details the added value of digital agriculture to the value chain, as well as the economic, technological and societal challenges.

Source: author's elaboration, 2023

As can be seen from the table above, systematic literature processing is also reflected in many areas of agricultural digitalisation like; IoT, AI, ML, Big Data Blockchain, Robotics, etc. These articles also differ in methodology, but it can be said that most of the research papers published in academic journals use some known methodology such as PRISMA or Bibliometric analyses or a combination of these. It can be found at that such high-level methods have become more prominent in recent years, providing a more comprehensive picture for further research and researchers.

3.4. Published studies by main EUROSTAT categories

Further analyses present the article characteristics by Eurostat categories, disbursed by year and topic. Classification was conducted using the methodology described in Table 2. Based on the Figure 3, it is remarkable that „ICT security" has not been dealt with in the selected papers.

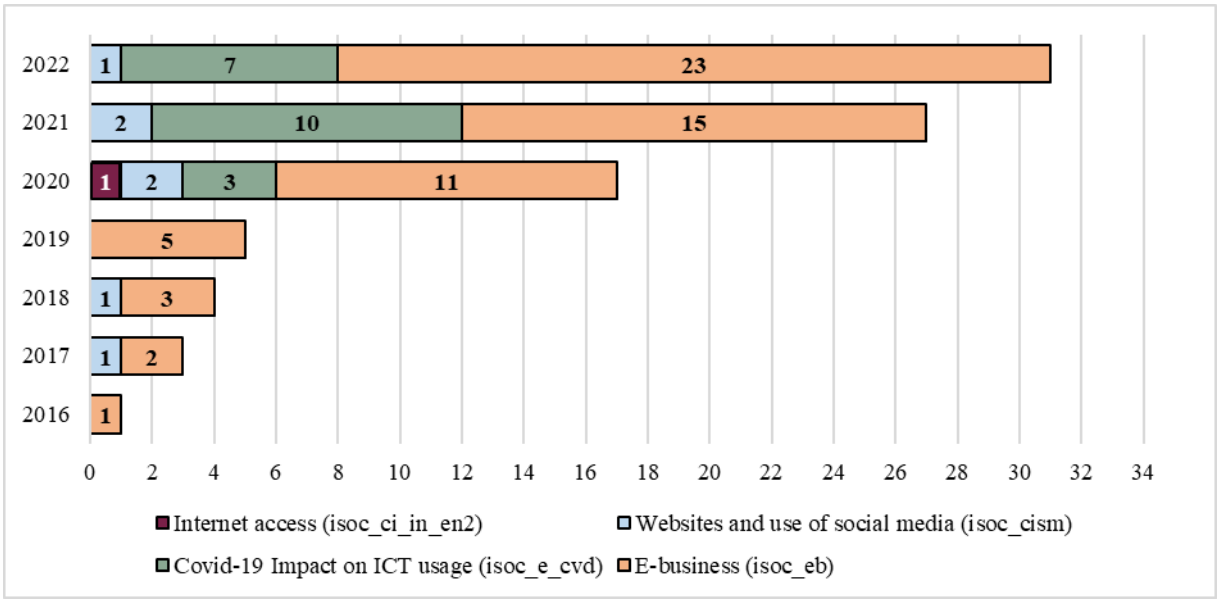

Figure 3. **Historical evolution of published studies by main categories** *(n=88 of studies)*
Source: author's compilation, 2023

Figure 3 demonstrates the number of the selected papers by years and by the defined categories, from 2016 to date. The upward trend in the number of publications from year to year clearly proves that the agri-food sector is a fundamental issue. It is also obvious that the category of „Internet access" appeared almost each year which match with Agriculture 4.0 topic in the previous Table 3. Thus, articles about the usage of different technological solutions were selected into this category. It is also apparent from the figure that since the outbreak of COVID-19, a growing number of studies have been published about the possible effects and challenges of the pandemic, while in the following year of 2020 an exceptionally high number of articles dealt with the aftereffects on the sector.

3.5. Published studies by EUROSTAT subcategories

On the following Figure 4 shows the number of articles by the chosen Eurostat main categories and subcategories. The colour of the columns means the main categories to which they belong. It is obvious from the figure, that during a three-year period the share of the publications investigating some aspects of COVID-19 with ICT usage is relatively high, however, this is the most recent among the categories. Most of the studies involved by this category deal with the relationship between the challenges of the pandemic and digitalisation, namely, what possibilities may be available in case of lockdowns or restrictions for farmers and further actors within the supply chain. In the conclusions, most of them highlighted that the appropriate information flow has an even more important role to play in the relationships of the actors within the supply chain which can be strengthened by digital development, upgrading, effective communication and trust between the actors, in order to continuous flow of products (Butu *et al.*, 2020; Desa and Jia, 2020; Kumar, Padhee and Kumar, 2020; Bahn, Yehya and Zurayk, 2021; Rowan and Casey, 2021; Senesi, Palau and Neves, 2021; Zielińska-Chmielewska, Mruk-Tomczak and Wielicka-Regulska, 2021; Constantin, Pătărlăgeanu, *et al.*, 2021; Oruma, Misra and Fernandez-Sanz, 2021; Osório *et al.*, 2021; Priyadarshini and Abhilash, 2021; Rengarajan *et al.*, 2022; Sridhar *et al.*, 2022; Tseng *et al.*, 2022; Guo *et al.*, 2022; Popescu and Popescu, 2022).

The next most popular research topic was the subcategory of „Integration with customers/suppliers, supply chain management". This category, following the indicators within this Eurostat category, includes the usage of digital solutions supporting enterprise/costumer communication, namely, the usage level of ERP (Enterprise Resource Planning) and CRM (Customer Relationship Management) technologies. Besides, studies dealing with Blockchain technology were also classified in this category (Herdon, Várallyai and Péntek, 2012; Caro *et al.*, 2018; Borrero, 2019; Fu *et al.*, 2020; Shahid *et al.*, 2020; Baralla *et al.*, 2021; Kramer, Bitsch and Hanf, 2021; Souza, Xavier and Filho, 2022) together with the research papers on short supply chains.

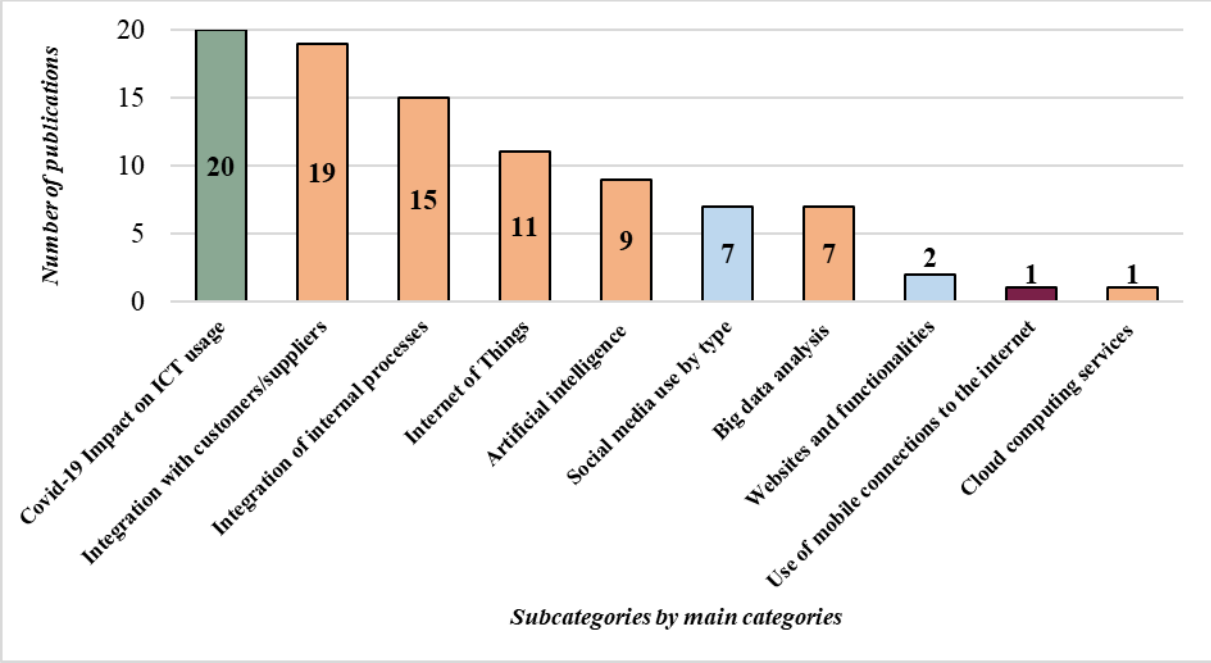

Figure 4. **Numbers of published studies by subcategories** *(n=92 of studies)*

Source: author's compilation, 2023

The category of „Integration of internal processes" includes technologies supporting internal enterprise communication and information flow such as the application of RFID (Radio Frequency IDentification) or NFC (Near Field Communication) (Bernardi *et al.*, 2007; Piramuthu and Zhou, 2016; Conti, 2022) along with articles related to topic of short supply chains.

The next subcategory is the „Internet of things" which is one of the hot topics nowadays since the beginning of the Industry 4.0 era. Basically those articles were sorted out in this category that deal with the cooperation and communication of different sensor networks, furthermore technologies, devices and systems in the food supply chain (Miranda *et al.*, 2019; Serbulova *et al.*, 2019; Mrdalj and El Bilali, 2020; Jorge-Vázquez, Chivite-Cebolla and Salinas-Ramos, 2021; Seymour *et al.*, 2021; Kamariotou *et al.*, 2022).

The next subcategory is the „Social media use by type, internet advertising" which includes 6 articles. Studies selected into this group are address the level of usage of different social media platforms and the main purposes of using them. It worth noting that half of these articles deal with a detailed analysis of consumer behaviour and the efficiency of commercials on social media platforms in the case of a given product. In the light of the content of these articles, the aims are mainly to determine the potential of own web sites, Twitter and Facebook(Scuderi and Sturiale, 2015; Espelt Rodrigo, Pena-Lopez and Vega, 2017; Caiazza and Bigliardi, 2020; Sass *et al.*, 2020; Borrero and Zabalo, 2021; Constantin, Rădulescu, *et al.*, 2021).

The next subcategory is „Big data" which involves articles with a relatively large variety of topics. Biradar et al. investigated its opportunities in areas affected by drought from the agri-ecological point of view (Biradar *et al.*, 2019) whereas in the study of Fracarolli et al., the potential applications of machine vision technology were explored. Their findings suggest that intelligence systems and Deep Learning technology may provide a wide avenue of possibilities in the area of harvesting, quality grading, classification of agro-industrial products and also in relation of injury assessment (Fracarolli *et al.*, 2020). Besides, further authors draw our attention to the different aspects of collecting and using agricultural data, while other researchers reached conclusions about the challenges and opportunities of this large body of data related to the topics of Agriculture 4.0 and Smart Agriculture (Bronson and Knezevic, 2016; Lopez-Morales, Skarmeta and Martinez, 2020; Liu *et al.*, 2021).

„Websites and functionalities" is the following subcategory. Calvet-Mir et al. analysed the contribution of Traditional Agroecological Knowledge (TAeK) based on civil society initiative in Spain, the title of the project is CONECT-E. Several farmers participated in the project, and using the digital platform they can share pictures, information and experience with each other and free of charge (Calvet-Mir *et al.*, 2018). Cristobal-Fansi et al. investigated agri-food cooperatives and the role of websites for communication, e-commerce and some supplementary functions is addressed among others. Their findings suggest that the olive oil and fruit sector perform better from web-consciousness point of view, a higher share of these organisations take advantage from Web 2.0 solutions compared to wine sector (Cristobal-Fransi *et al.*, 2020). And finally, regarding the last two categories, „Cloud computing services" and „Use of mobile connections to the internet", only one article is included in them.

4. Conclusions

One of the recent topics among the issues affecting the agricultural sector and concerning almost every people is food safety and food security. The parts closely related to this are the actors of the food supply chain and the processes between them throughout the whole product life cycle. These processes and the necessary supporting systems are increasingly assisted by high quality of digital technologies as its role has been more appreciated within the operators of the supply chain since the first appearance in 2019 of the pandemic. It is recognised that how can the information flow, trust and efficiency be supported by digital solutions. Data about the different aspects of digitalisation is also collected in Eurostat database in its folder of „Digital economy and society". These indicators were used by authors to establish the categories for own systemisation, completing it with a category on COVID-19 researches. Articles about agri-food with digitalisation are classified into them. Six main categories were determined which are the followings: e-commerce, internet access, e-business, websites and use of social media, ICT security and COVID-19. In the next step, two internationally recognised databases, WoS and Scopus were used to keyword queries, and then, PRISMA methodology was used to select papers needed for the analysis.

ICT security and e-commerce are two main categories which not including any articles. E-business, however, has been the most investigated topic, particularly the connection and integration of customers and suppliers, as well as the research works on IoT and Artificial Intelligence. These studies

deal with sensor networks, machine vision (e.g. automated methods for food classification), horticultural solutions and what-if analyses.
This result is in line with EU agricultural policy and many of its objectives to promote agriculture. The document identifies several digital opportunities, including digitising business processes and improving competitiveness (OECD, 2019). In addition, the Commission's "Digital Decade Policy Programme 2030" communication (ECLAC, 2022) also aims to support rural areas in the EU, including the agri-food sector, by creating a more substantial, more interconnected and digitally sustainable infrastructure with 4-5G network coverage and increased capacity to process large amounts of data.
The pandemic is an event initiated by global processes in 2019, determining daily lives; thus after its appearance, researchers are increasingly concerned with the effects and aftereffects of COVID-19 in different areas. However, the topic appeared in 2019, and the articles dealing with it constitute the most numerous subcategories, the number of items is 19 in it. Therefore, it can be considered as a hot topic for researchers. In fact, we should mention that the pandemic has accelerated the digitalisation of some sectors, including the agricultural and food-sector, because of the exposure and food security.
Further examinations were the studies and research on the topic of „websites and the use of social media". Most of the articles included in this category are related to analysing marketing campaigns on different social media platforms. Furthermore, the topics of 'Cloud computing' and 'Mobile connection to the internet' are also addressed in two studies. The authors found the following limitations:
Internal validity*:* First, it is essential to note that authors considered the articles from only two databases, further lists from other databases were not considered grey literature. On the other hand, most of the analysed studies were multidisciplinary, thus these would have been classified into more categories, however based on PRISMA methodology, authors categorised the articles using titles, keywords, and content.
External validity*:* The period for selecting publications was from 2007 to 2022. After selecting the articles, the articles that cannot be found and studies with specifically technical or medical thematic subjects were excluded.
Conclusion validity*:* Authors performed sorting and selection by the stages of PRISMA methodology. Two researchers analysed selected articles in two stages to avoid bias and the disputed articles were sorted out by mutual agreement. To provide consistency, data records were kept about procedures and publications.
Overall, it can be concluded that the authors can provide the basis for further research by applying the commonly used and widely recognised Eurostat database indicator categories for classifying research papers related to them. These selected, grouped, high-quality scientific works can also provide the literary basis for future research in a particular subject area. In addition, hot topics can be identified, and research gaps (R-gap) can be highlighted within the topics, such as the themes of the identified empty categories. Furthermore, the article also points out that other researcher's themes and EU objectives for the digitalisation of the agricultural sector and support system efficiency are in sync. This could also provide summarising feedback for policy makers and missing thematic areas could also indicate future funding opportunities.

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